MARINE PROPULSION UNITS

Installation & Service Manual

Jet Unit:	HJ-391
Part Number:	82096
Amendment 27	30/11/06

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

AMENDMENT RECORD

Part No: 82096
Jet Model: HJ-391
Manual: Installation & Servicing

Amdt	Incorporated By	Date
1.	C.W.F. Hamilton & Co Ltd	1/10/96
2.	C.W.F. Hamilton & Co Ltd	10/10/97
3.	C.W.F. Hamilton & Co Ltd	13/10/97
4.	C.W.F. Hamilton & Co Ltd	07/12/97
5.	C.W.F. Hamilton & Co Ltd	19/12/97
6.	C.W.F. Hamilton & Co Ltd	24/06/98
7.	C.W.F. Hamilton & Co Ltd	04/11/98
8.	C.W.F. Hamilton & Co Ltd	18/03/99
9.	C.W.F. Hamilton & Co Ltd	27/04/99
10.	C.W.F. Hamilton & Co Ltd	16/08/99
11.	C.W.F. Hamilton & Co Ltd	01/09/99
12.	C.W.F. Hamilton & Co Ltd	02/12/99
13.	[signature]	22/2/00
14.	K Brown	27-4-00
15.	[signature]	12/7/00
16.	K Brown	11-9-00
17.	K Brown	8-1-01
18.	[signature]	8/5/01
19.	K Brown	22-8-01
20.	[signature]	9/10/01
21.	[signature]	25/10/01
22.	[signature]	28/12/01
23.	K Brown	7-3-02
24.	[signature]	05/06/02
25.	[signature]	11/9/02
26.	[signature]	14/11/02
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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, mis-application, 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 ....

EQUIPMENT MODIFICATION LIST

Amendment No	Jet Serial No	Description Of Changes
Amdt 14	# 113 Onwards.	New Eagle Water Seal (Part No 61524) fitted to HJ-391 Jets from Serial No 113 onwards but excluding Ser No's, 139 and 140, which will be fitted with the old Water Seal (Part No 61419-SY). **Product Bulletin DSM 5/23/00-1 refers.**
Amdt 17	# 170 Onwards.	New Tailpipe Internal Anodes (Part No 111644) and attachment Studs (Part No JCQHXAH) fitted to the HJ-391 Jet Unit from Jet Serial No 170 onwards.

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.

2.11.

WARNING:

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

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

2.18. 3.14.

WARNING:

DO NOT HOIST THE JET UNIT USING A 2 LEGGED SLING ATTACHED AROUND THE TAILPIPE AND BEARING HOUSING AS THIS SLING WILL FOUL ON THE TRANSOM PLATE. TWO SEPARATE SLINGS AND HOISTING EQUIPMENT SHOULD BE USED TO HOIST THE COMPLETE JET UNIT.

3.8.

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.

4.1.

WARNING:

FAILURE TO CHECK COOLING WATER HOSES MAY RESULT IN FLOODING OF THE VESSEL.

4-3.

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.

6.6.

WARNING:

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

6.8. 7.5. 9.46. 9.47.

WARNING:

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

6.9.

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.

9.26.

WARNING:

EXERCISE EXTREME CARE AT ALL TIMES WHEN THIS OPERATION IS CARRIED OUT AS WATER MAY ENTER THE VESSEL THROUGH THE OPENING IN THE INTAKE.

9.27.

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 2.

CAUTION:

Not all Hull shapes are suitable for Waterjet Propulsion.

2.7.

SECTION 3.

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.

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.

3.1.

CAUTION:

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

3.2.

CAUTION:

If the original Transom is less than 95° deg, the area formed at 95° deg. may have to be increased to ensure sufficient room for the Jet Steering Controls inside the Transom.

3.5. 3.6.

CAUTION:

In multi Jet Unit installations, each Jet Unit is specifically assembled for Port, Starboard or Centre mounting. Ensure that each Jet Unit is fitted onto the correct Intake Block.

3.8.

CAUTION:

FOR STEEL HULLS:

The Jet Unit must be totally electrically insulated from the Hull. Insulating hardware is supplied with the Jet Unit. The insulation should be checked before finally bolting the Jet Unit and Transom Seal Assembly in place and again on completion.

3.8.

CAUTION:

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

3.12.

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.

3.13.

SECTION 4.

CAUTION:

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

4.1.

CAUTION:

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

4.4.

SECTION 5.

Nil.

SECTION 6.

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.

6.1.

CAUTION:

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

6.6. 6.7.

CAUTION:

If in a 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.

6.6.

CAUTION:

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

6.7.

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.

6.9.

SECTION 7.

CAUTION:

The Jet Unit cannot be run out of the water.

7.2.

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.

7.2.

CAUTION:

Do not block the drain holes in the underside of the Bearing Housing as this may cause water to mix with the oil, causing corrosion and eventual failure of the Thrust Bearing.

7.5.

CAUTION:

ANTI FOULING PAINTS:

Do not use copper- based anti-fouling paints. Tin base antifouling 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.

7.8.

CAUTION:

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

7.10.

SECTION 8.

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.

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.

8.1.

CAUTION:

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

8.2.

CAUTION:

ANTI FOULING PAINTS

Do not use copper oxide based anti-fouling paints. Leave all stainless steel parts polished and unpainted. Do not paint over the Anodes.

8.4.

CAUTION:

ANTI FOULING PAINTS

Do not use Anti Seize Compounds which are based on Graphite, Nickel or Copper Flakes - these will cause corrosion. Anti Seize Compounds, usually containing Zinc Flakes are available for Aluminium.

8.5.

CAUTION:

For Steel Hulls, the Jet Unit must be totally electrically insulated from the Hull.

8.6.

SECTION 9.

CAUTION:

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

9.2.

CAUTION:

The Steering Assembly can be re-assembled in several ways. It is important to follow the relevant drawings contained in this Manual, to prevent damage to the Steering Assembly.

9.21. 9.24.

CAUTION:

The Water Seal needs only to be replaced if it is leaking or it is suspect of leaking, or if there is insufficient material left on the Seal to last to the next inspection. Refer to Section 7. Maintenance – General, for details of the maintenance required.

9.28

CAUTION:

Do Not Attempt To Dismantle The Water Seal Cartridge.

9.28.

CAUTION:

The Water Seal Cartridge must remain clean and free of grease and oil.

9.31.

CAUTION:

Ensure that the Water Seal Cartridge is not pushed rearwards past the lip on the Mainshaft as this may damage the O Ring [5], which will cause failure of the Water Seal.

9.31.

CAUTION:

Avoid using excessive heating during welding.

9.38.

CAUTION:

When fitting a new Impeller into a Jet Unit the Impeller taper must be lapped to the shaft taper in accordance with British Standard MA 74.

9.40.

CAUTION:

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

9.40.

CONTENTS LIST

HJ 391 Drawings Package

List of Drawings contained within this Drawings Package.

Drawing Number	Amdt Status	Up-Issued
HJ 391 30 001	D	28/07/00
HJ 391 01 001 3 Shts	C	22/04/02
HJ 391 02 001	B	20/01/98
HJ 391 03 001	C	23/09/98
HJ 391 05 001	B	18/07/95
HJ 391 06 004	O	15/05/95
HJ 391 06 005 5 Shts	I	18/08/02
HJ 391 07 001 3 Shts	L	22/04/02
HJ 391 07 002	O	08/02/96
HJ 391 08 001 2 Shts	E	22/04/02
HJ 391 08 002 2 Shts	F	22/04/02
HJ 391 08 003 2 Shts	G	22/04/02
HJ 391 11 000	A	29/02/96
HJ 391 09 001	O	09/05/95
HJ 391 09 002	A	21/06/95
HJ 391 10 001	O	12/04/95
HJ 391 13 001	C	06/08/01
HJ 391 13 002	A	29/11/00
61524	J	28/01/02
85018	J	14/10/02
85080	B	24/09/96
85113	C	21/10/02
85114	B	23/11/99
85148 2 Shts	B	03/09/01

Position of Marker Tabs

Jet Drawings

Basic Jet

Couplings

Impeller & Inserts

Dipsticks

Steering

Reverse

Installation

Tools

Other

2. Design Basics

2.1. INTRODUCTION AND PRODUCT DESCRIPTION

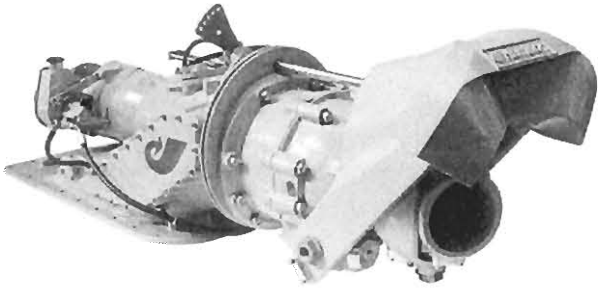
THE HAMILTON WATER JET SYSTEM

Introduction:

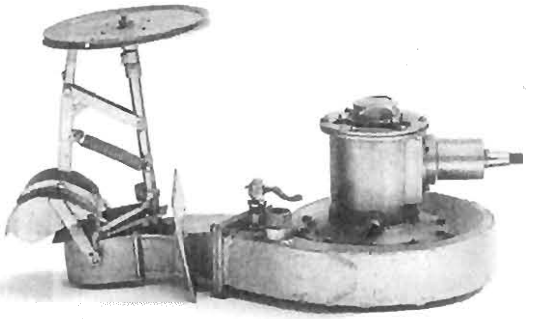
In the modern world, waterjets have rapidly gained acceptance as the leading means of propulsion for all types of high speed marine craft including ferries, work boats, patrol craft and pleasure boats. Recent advances in waterjet technology have put them ahead of conventional propeller systems in both 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 30,000 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.



Modern Hamilton Jet circa 2000



Hamilton Quinnat Jet circa 1953

Equipment Description:

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

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

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

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

2.1.1. 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-391 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.

2.2. PROPULSION SYSTEM DESIGN

NOTE:

Additional information on suitable hull shapes, estimating performance and engine matching may be found in the "HJ-391 DESIGNER'S MANUAL".

2.2.1. Jet Unit Selection

Jet Unit selection is a complex task and C.W.F. Hamilton should be consulted for advice in all cases.

2.2.2. Hull Loads

All loads produced by the Jet Unit result from the difference in momentum of the incoming and outgoing water. An exception is the torque load on the stator vanes as they remove the angular momentum of the waterjet which was input by the impeller.

The following four cases must be considered when calculating maximum loads:

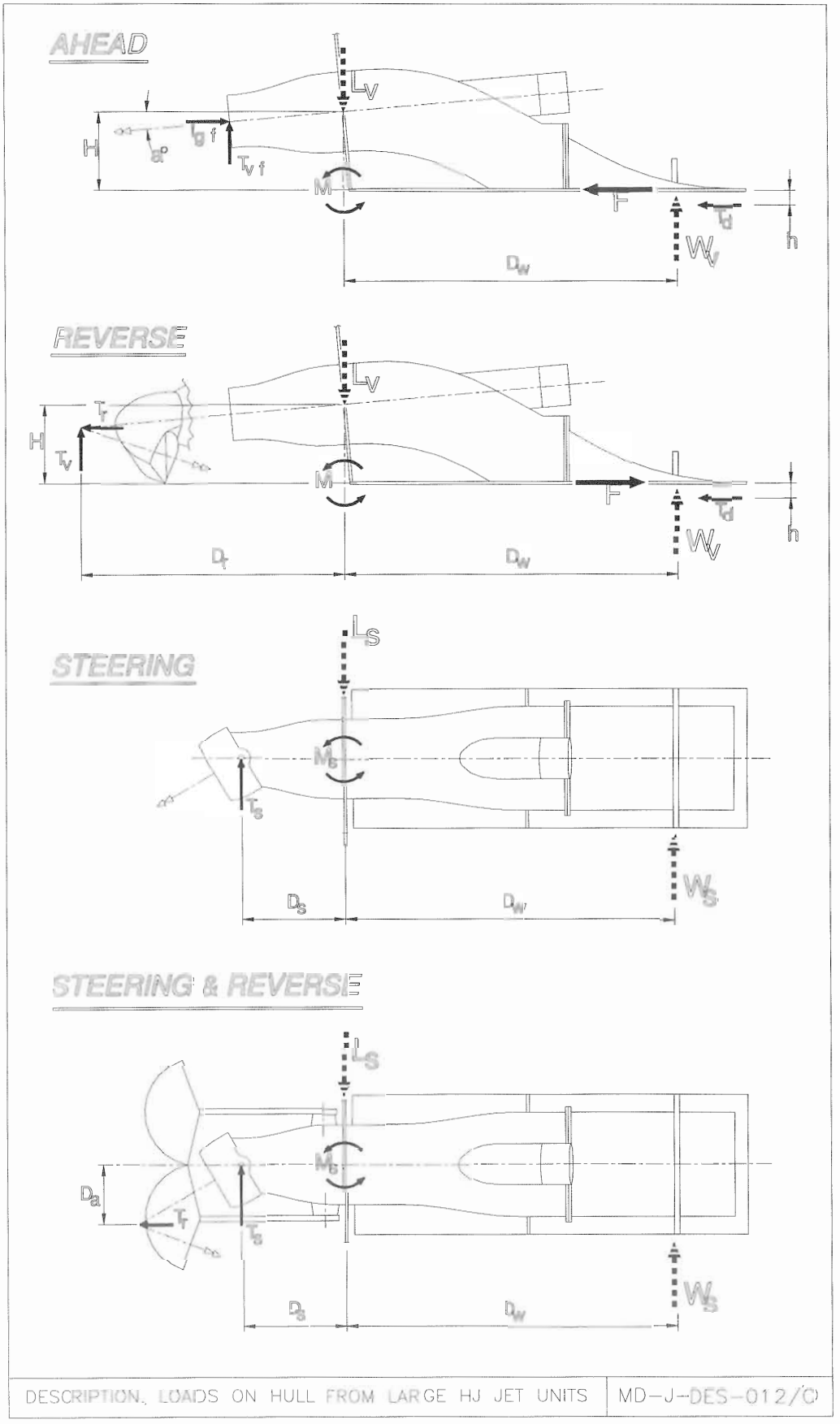
- Full Ahead.
- Full Reverse.
- Full Steering.
- Full Reverse & Full Steering.

The load situations are described by the diagram overleaf.

While the Jet Unit loads can be readily calculated, the hull reaction loads are statically indeterminate being dependent on the stiffness and rigidity of both the Jet Unit and the hull structure.

These loads have been estimated based on the assumptions that the Jet Unit is restrained:

- Radially at the transom (loads L_v and L_s).
- Axially and sideways at the base of the Transition Duct (loads F and W_s).
- Vertically at the transition webs (load W_v).



DESCRIPTION: LOADS ON HULL FROM LARGE HJ JET UNITS	MD–J–DES–012/C

The following tables give all relevant data for this Jet Unit.

DIMENSIONS			
Description	**Symbol**	**Units**	**Value**
waterjet angle	a	degrees	5.00
centre line height	H	m	0.362
mean inlet depth	h	m	0.10
transom to steering	D_s	m	0.5630
transom to reverse	D_r	m	1.15
transom to base centre	D_w	m	1.56
centre to reverse arm	D_a	m	0.29

MAXIMUM JET UNIT FORCES (And Supporting Data)						
Description	**Symbol**	**Units**	**LOAD CASE**			
			Ahead	**Reverse**	**Steering**	**Reverse & Steering**
design power	P	kW	850	850	850	850
vessel speed	V	knots	40	25	40	25
gross thrust	T_{gf}	kN	49.2	49.2	49.2	49.2
momentum drag	T_d	kN	25.9	25.9	25.9	25.9
reverse thrust	T_r	kN	23.3	-	-	-
steering thrust	T_s	kN	-	-	21.0	21.0
lift component	T_v	kN	4.3	13.9	-	13.2
horizontal moment	M_s	kN.m	0.0	-	21.0	32.2
vertical moment	M	kN.m	20.5	7.8	-	10.2
static power	P_s	Kw	400	-	-	-
static thrust	T_{gs}	kN	25.5	-	-	-

MAXIMUM HULL REACTION FORCES						
Description	**Symbol**	**Units**	**LOAD CASE**			
			Ahead	**Reverse**	**Steering**	**Reverse & Steering**
Axial load in bottom	F	kN	25.5	55.6	10.3	46.8
Side load on bottom	W_s	kN	0.0	0.0	7.6	20.7
Vertical load in webs	W_v	kN	13.0	5.0	10.1	6.6
Side load in Transom	L_s	Kw	0.0	0.0	28.6	41.6
Vertical load in Transom	L_v	kN	17.4	18.9	13.3	19.8

ADJUSTMENT OF LISTED HULL REACTION FORCES TO SUIT LOWER DESIGN POWERS

For lower "design power" values, the Hull Reaction Forces can be adjusted by using the following approximate equation:

"Your force" = K_{pr} x "Listed Force".

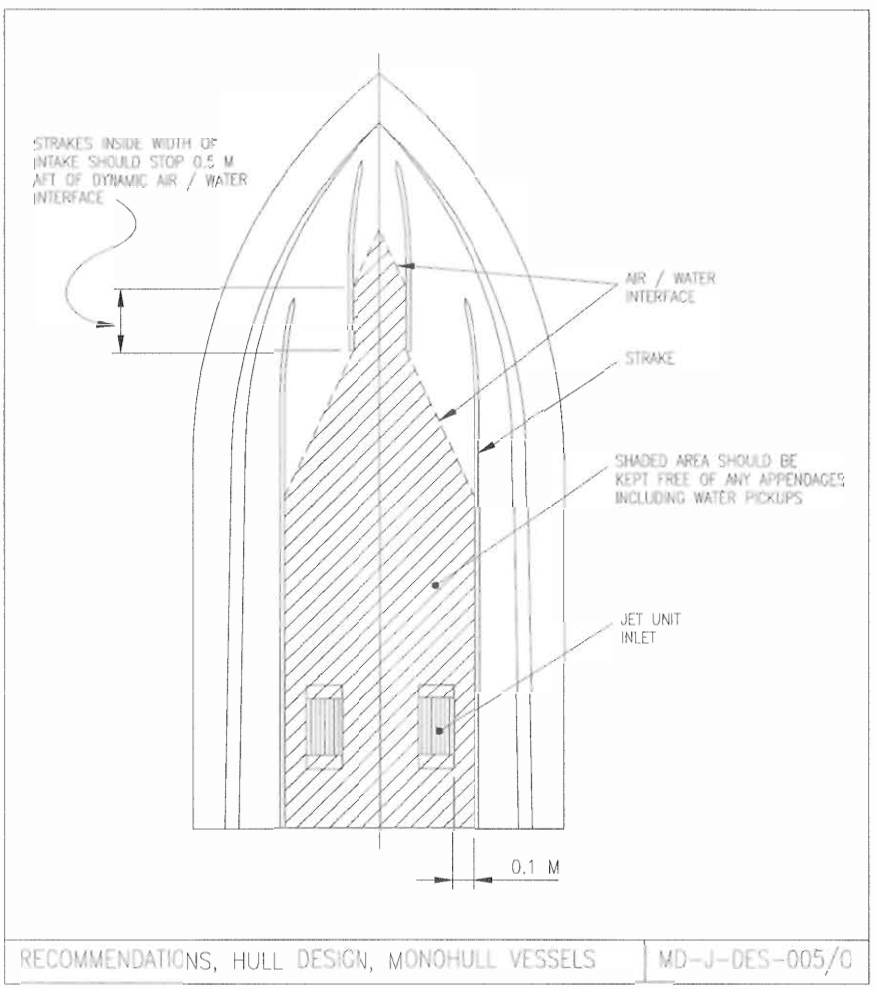
"Where: K_{pr} = (Your Design Power / Listed Design Power)$^{2/3}$rds.

2.3. HULL DESIGN

CAUTION:

Not all hull shapes are suitable for Waterjet Propulsion.

2.3.1.Mono Hulled Craft



1. Aerated water generated by the vessel's bow wave must not pass directly aft to the Jet Unit intake(s).
   - A vee'd bow stem in conjunction with 10º minimum deadrise angle is recommended.
   - Mount multiple Jet Units as close to the keel line as possible. ("staggered" engines are recommended).
   - Planing strakes, keelsons, "plank keels" and any other appendage that may create turbulent flow into the Jet Unit(s) must be removed from the hull bottom in front of and adjacent to the Jet Unit Intakes. Recommended strakes are as in Diagram MD-J-DES-005/0.

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 "bilge keels" are normally sufficient and these do not increase draft or interfere with waterflow into the jet intake.

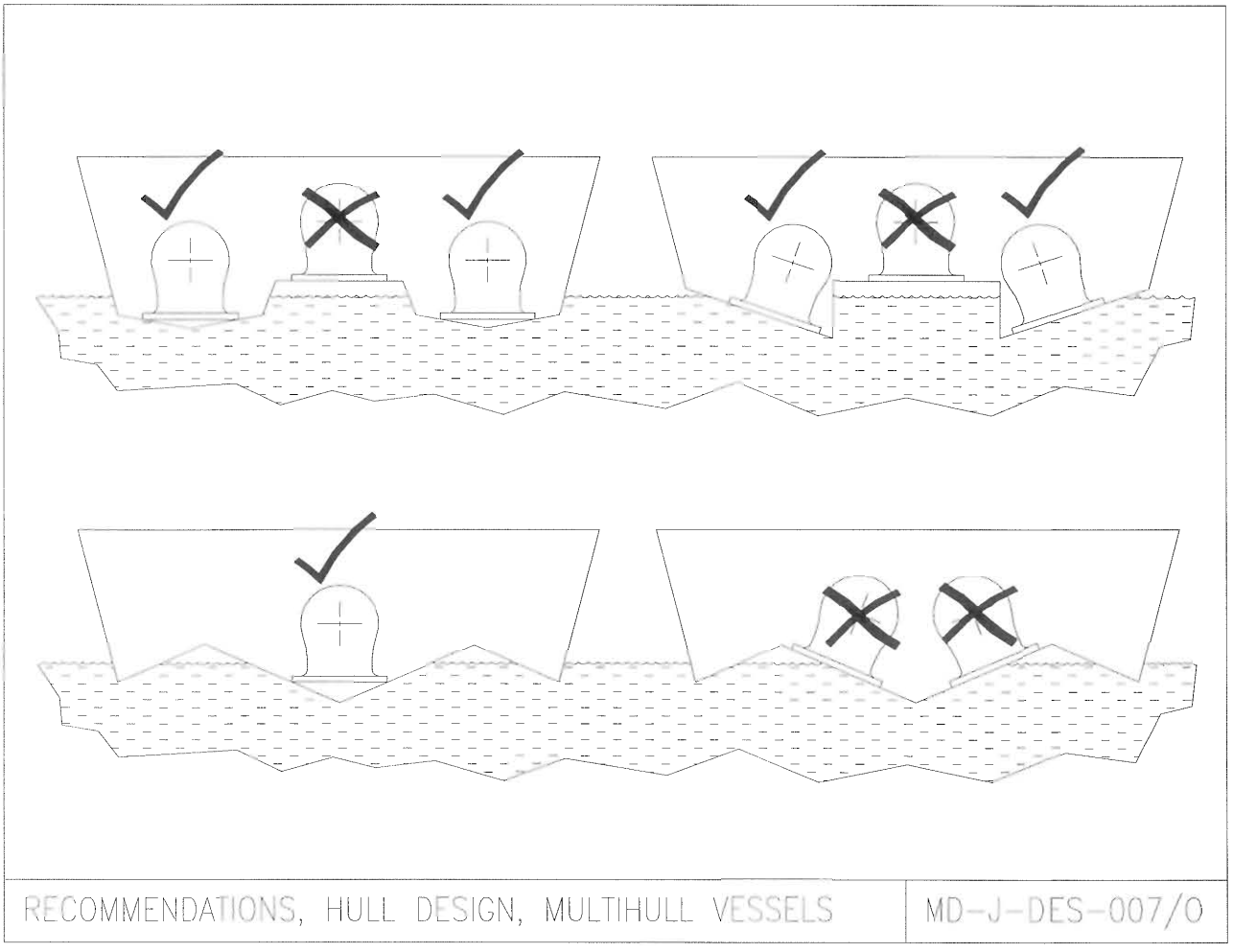
4. Immersion. The Jet Unit must be immersed with the water line at least up to the underside of the Mainshaft (at the Impeller) in order to prime the unit when the engine is started.

Refer to Twin Jet and Triple Jet Installation diagrams shown in the Jet Installation Details Drawings HJ-391-08-001 / 002 / 003 in the drawings package.

2.3.2. Multi Hulled Craft

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

Consult with C.W.F. Hamilton in all cases if Jet Units are proposed in these types of hull.

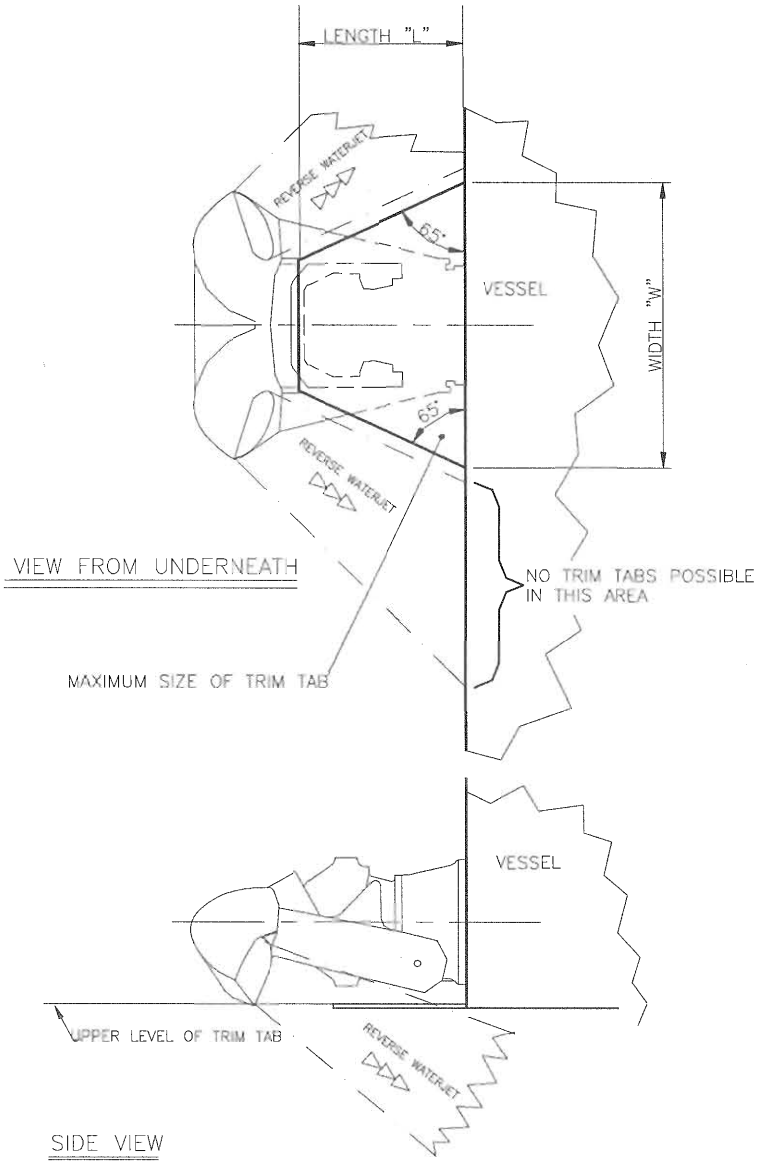


2.3.3. Trim Tabs

Trim tabs cannot be mounted directly alongside the Jet Unit as when moving astern, the reverse jet stream will hit them and reduce reverse thrust.

It is possible to mount trim tabs under the Jet Unit with any control equipment mounted on either side of the Jet Unit. The diagram below serves as a guide to the maximum size of trim tab that may be located under the Jet Unit. Contact Hamilton Jet if further details are required.

The diagram shows the area within which the Trim Tab must lie. From the maximum width "W" at the Transom, the area tapers inwards at 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-322	1030	740
HJ-321	1030	740
HJ-292	950	640
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

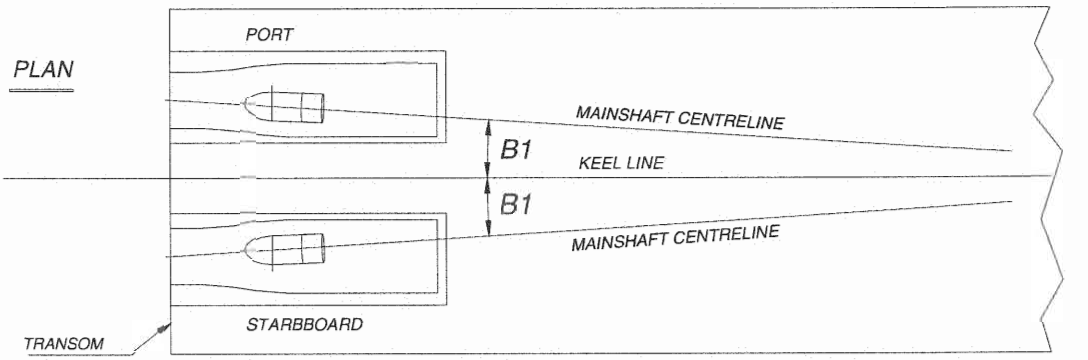
2.3.4. Engine Exhausts

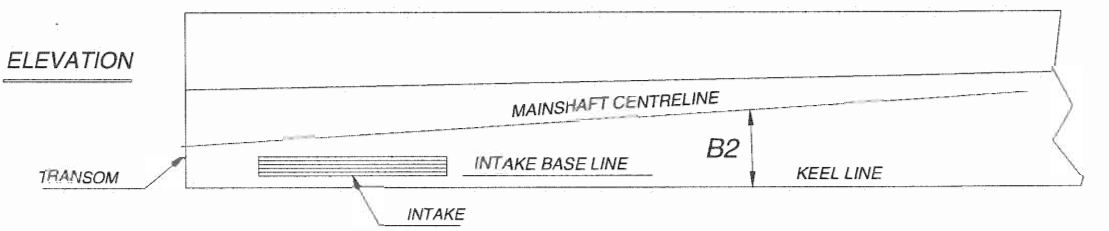
Engine exhausts should not be located below the waterline near the Jet Units.

If engine exhausts are located below the waterline near the Jet Units, the Jet Unit when moving astern can ingest water containing exhaust gases. This can cause loss of thrust and control of the Jet Unit.

2.4. JET MAINSHAFT ALIGNMENT (PORT AND STARBOARD JETS ONLY)

The Jet Unit Mainshaft is inclined at an angle of 5° to the intake base. When port and starboard Jets Units are mounted at the hull deadrise angle, the Jet Unit Mainshafts are no longer parallel to the keel line in plan. This is shown in the following diagram.





HULL DEADRISE ANGLE	MAINSHAFT ANGLE RELATIVE TO KEEL	
	B1	B2
0°	0.0°	5.0°
5°	0.4°	5.0°
10°	0.9°	4.9°
15°	1.3°	4.8°
20°	1.7°	4.7°
25°	2.1°	4.5°
30°	2.5°	4.3°

NOTE:

THIS DIAGRAM APPLIES TO JET UNITS WHERE THE MAINSHAFT IS INCLINED AT 5° TO THE INTAKE BASE

The above table lists the angle deviation of the Jet unit Mainshaft when the Jet Unit base is mounted parallel to the keel line:

2.5. DRIVELINES

WARNING:

THE JET UNIT THRUST BEARING MUST NOT BE SUBJECTED TO EXCESSIVE RADIAL LOADS CAUSED BY:
1. **ADAPTORS AND BELT PULLEYS OVERHANGING THE JET UNIT COUPLING FLANGE.**
2. **RIGID DRIVELINES WHICH DO NOT ACCOMODATE MISALIGNMENT CAUSED BY GEARBOX MOVEMENT.**
3. **DRIVESHAFT WEIGHT.**

2.5.1. Requirements of Driveline

1. It must accommodate parallel and angular misalignment plus allow axial movement.
2. It 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. 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.

2.5.2. Engineering Checks Required

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

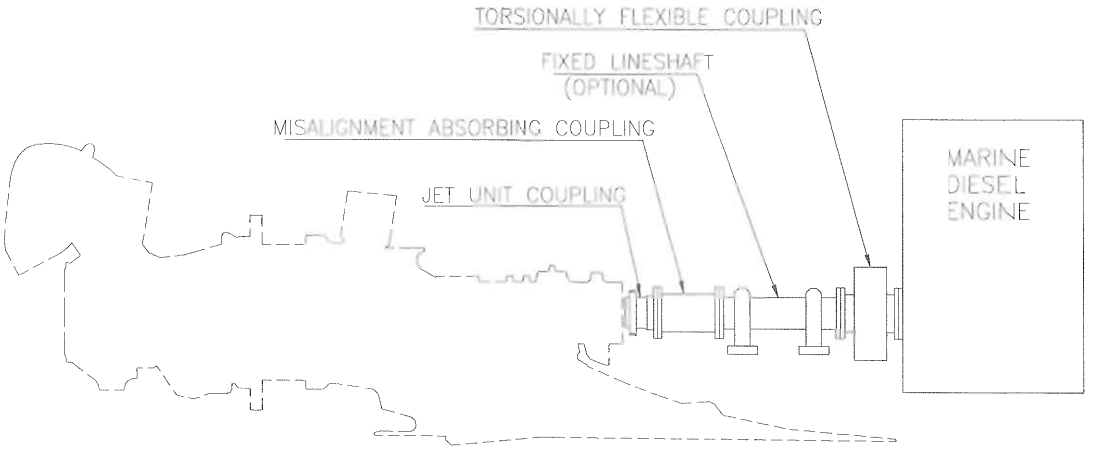
Checks must include:
1. Critical speed check for whirling of the Mainshaft: consult C.W.F. Hamilton & Co. Ltd.
2. Critical speed check for whirling of the driveshaft: consult driveline supplier.
3. Engine to jet alignment: consult C.W.F. Hamilton & Co. Ltd.
4. Torsional Vibration Analysis: consult engine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

NOTE:

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

2.5.3. Driveline Options

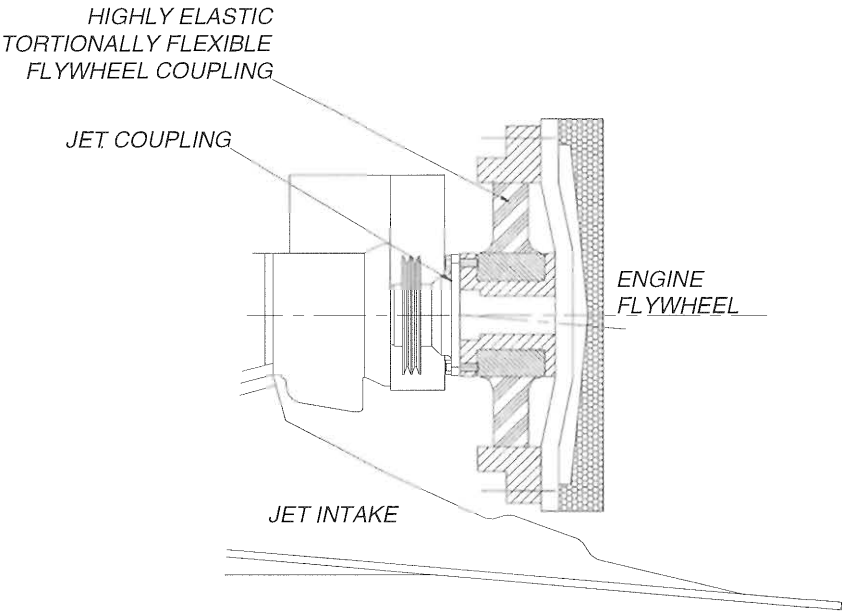
The following diagram shows the main types of driveline components and the different ways they can be used. This diagram is a guide only. ***Always contact Hamilton Jet before designing the Driveline.***



A. SINGLE ELEMENT HIGHLY FLEXIBLE COUPLINGS- 100-150mm LONG.

Very few couplings are torsionally flexible enough to be suitable for this arrangement. "Vulcan", "Centa" & "Kusel" are suitable couplings. These bolt directly to the engine flywheel (or gearbox flange if used) and the jet coupling flange via adaptor plates. The engine must remain in-line with the water jet mainshaft and rigid engine mounts are recommended.

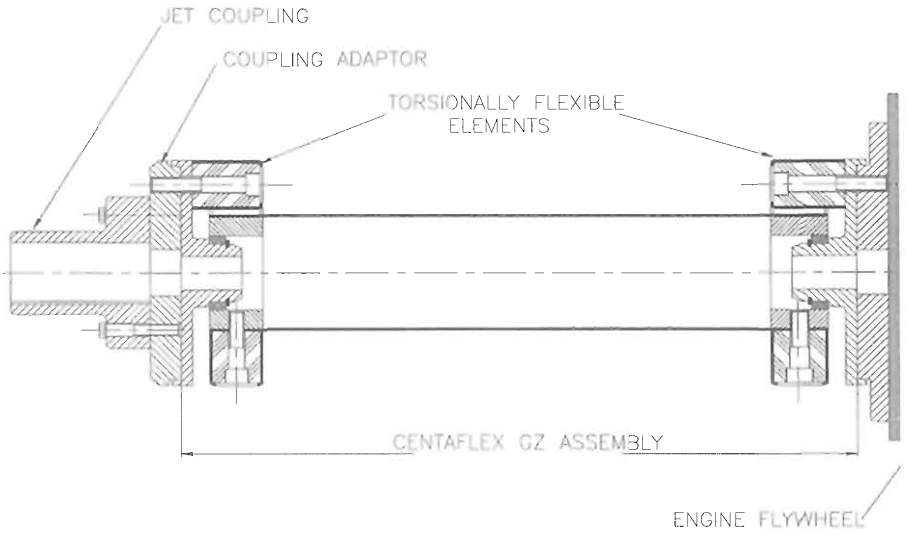
In all cases, when using this system, supply full details of proposed coupling to C.W.F. Hamilton and Co Ltd.



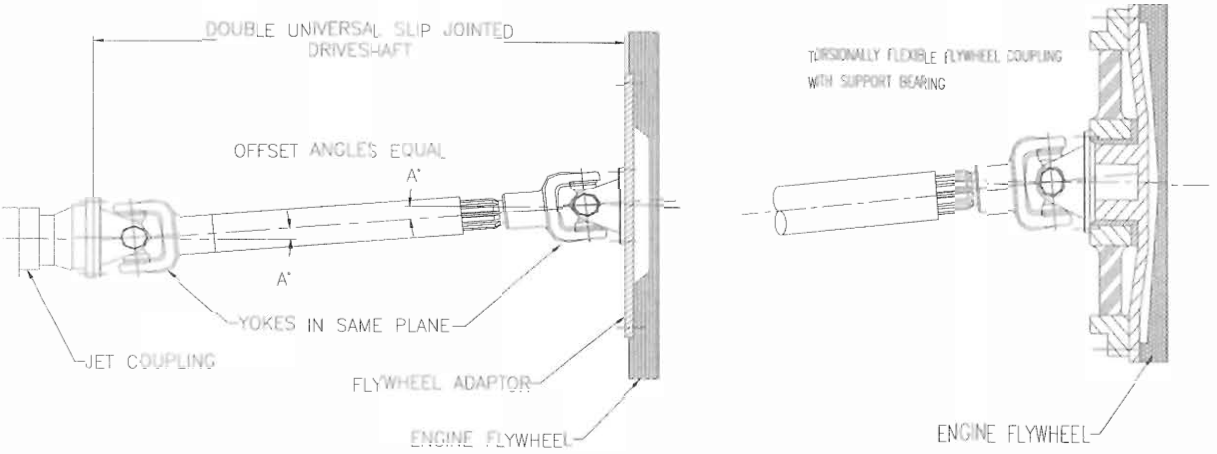
B. DOUBLE ELEMENT TORSIONALLY FLEXIBLE DRIVESHAFT- 300mm LONG OR OVER.

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 and can be flexibly mounted with this type of coupling.

Length of the driveshaft- from approximately 200mm (8") upwards but limited by the weight which can be allowed at the Jet Coupling **(refer to Section 2.5.6 "Critical Speed of Mainshaft").**



C. DOUBLE UNIVERSAL SLIP-JOINTED DRIVESHAFT 600mm UP TO APPROX 2000mm LONG



The most common method of coupling the engine to the Jet Unit is with the use of the double universal slip- jointed driveshaft (Cardan Shaft). This bolts directly to the Jet coupling flange. An adaptor plate or alternatively a suitable Torsionally Flexible Flywheel Coupling (TFFC) can be used between the universal driveshaft and the engine flywheel. The TFFC must be of the type with a support bearing to support the universal driveshaft. "Vulkan", "Centa" and "Kusel" have suitable couplings for use with universal driveshafts. Use of a TFFC is more appropriate for diesel engines and may be recommended by some manufacturers.

- **Length - from approximately 600mm up to 2000mm but limited by the weight which can be allowed at the coupling (refer to Section 2.5.6. "Critical Speed of Mainshaft").**

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 adaptor 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 always be installed at the engine and not the Jet interface.**
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 (A°)at each end. (see diagram below) Cavitation of jet and machinery damage can result due to the drive motion to the Jet not being constant velocity.**

Jet coupling flanges are available to directly match the following driveshafts which are suitable, subject to the engineering checks listed in Section 2.5.2. "Engineering Checks Required".

G.W.B. 587-.50 Series with 225mm or 250mm Flange Diameter.**8xM16** bolt flange. ELBE 0.122 Series with 225mm or 250mm **8xm16** bolt flange. **Also refer to Drawing HM-422-02-001 contained in this Manual.**

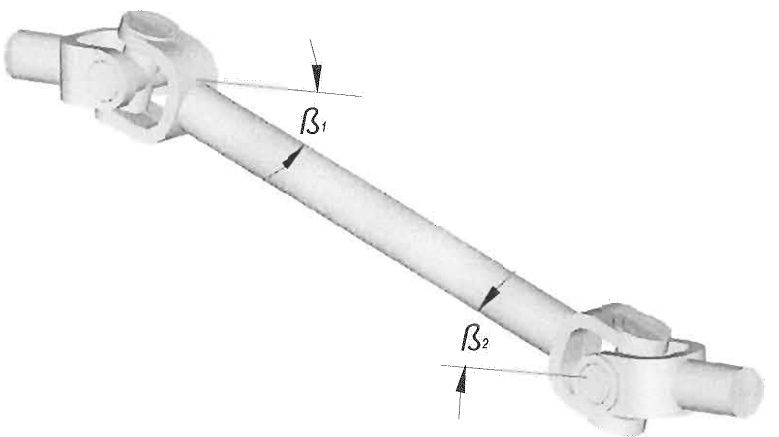
Torsionally Flexible Coupling (TFC)

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

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

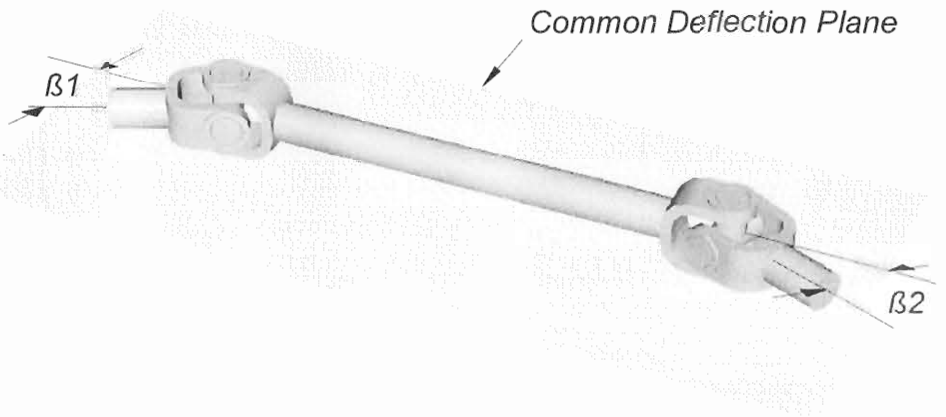
NOTE:

1. **There are only two allowable configurations for location of centrelines for the Jet Unit and Gearbox. These are the "Z" and "W" configurations shown. If these requirements are not met, then cavitation of the Jet Unit and machinery damage can result because the drive speed to the Jet Unit is not constant.**
2. **The universal Driveshafts must be assembled with the yokes (forks) in the same plane.**
3. **Correct running length of the shaft is with the shaft extended to half the total spline extension length.**
4. **The splined end of the driveshaft is heavier and should be installed at the gearbox end of the Driveline.**



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

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



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

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

NOTE:

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

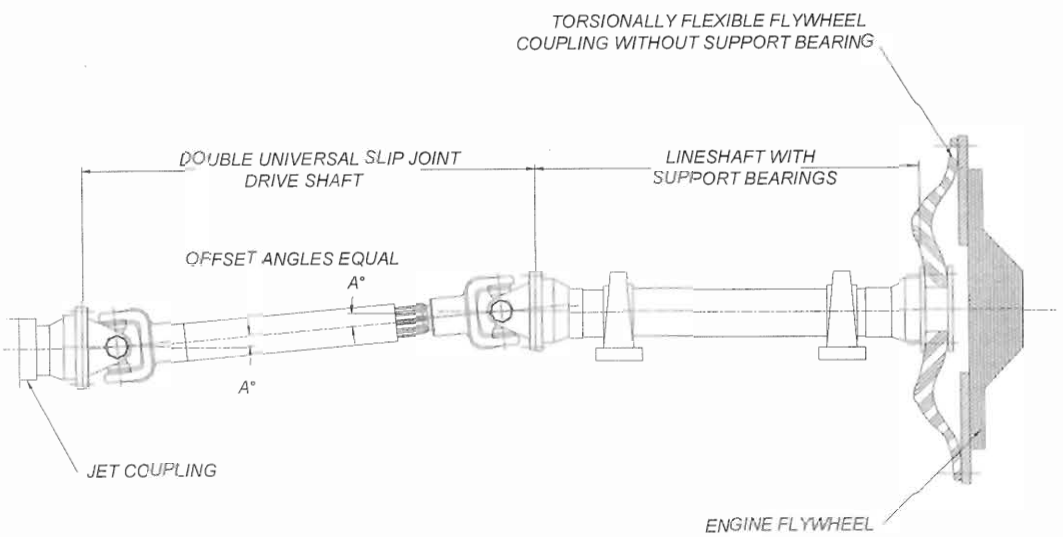
2. **When the TFC couples directly to a Lineshaft supported on bearings, a support bearing is not required.**

D. LONG DRIVESHAFTS:-OVER 2000mm LONG

Where the distance between the engine flywheel and jet coupling flange exceeds 2000mm, a fixed lineshaft supported in pedestal bearings should be used in conjunction with either universal driveshafts or torsionally flexible couplings between both the jet and lineshaft and the lineshaft and engine flywheel.

NOTE:

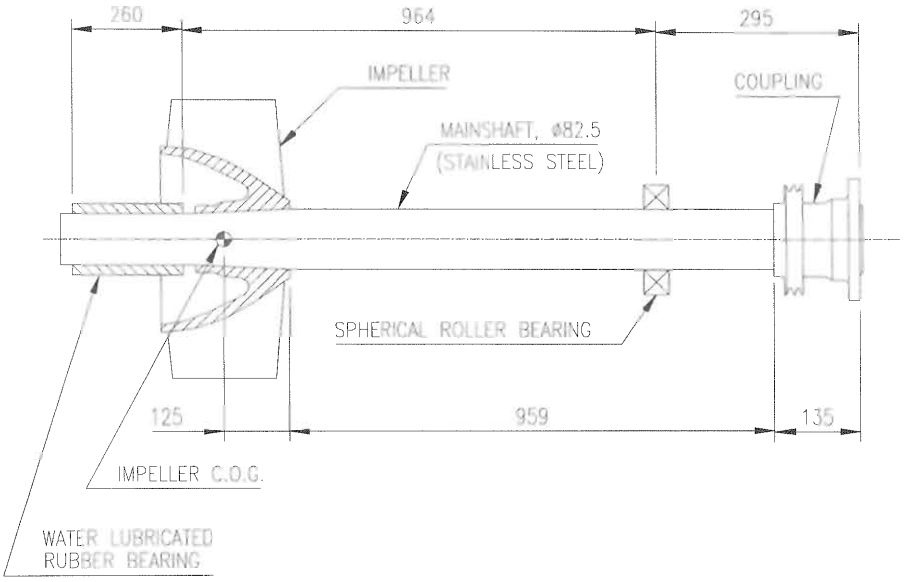
If a TFC is not required between the gearbox and the Lineshaft, then the Lineshaft can be directly attached to the gearbox flange using normal propeller shafting criteria. The gearbox should be mounted rigidly to avoid misalignment.



2.5.4. Jet Coupling Flange Details

Refer to Drawing HJ-391-02-001 Couplings and V Belts for HJ-391 Jets, for all relevant Coupling details.

2.5.5. Driveline Inertia Data



ITEM	TYPE	MASS (kg)	I_p (kg.m^2)
MAINSHAFT	ø82.5	65.5	0.06
COUPLING	ø225	9.4	0.05
	–	–	–
IMPELLER (DRY)	42–53	35	0.49
	57–70	38.5	0.54
	75–90	40	0.56

2.5.6. Critical Speed of Mainshaft

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

NOTE:

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

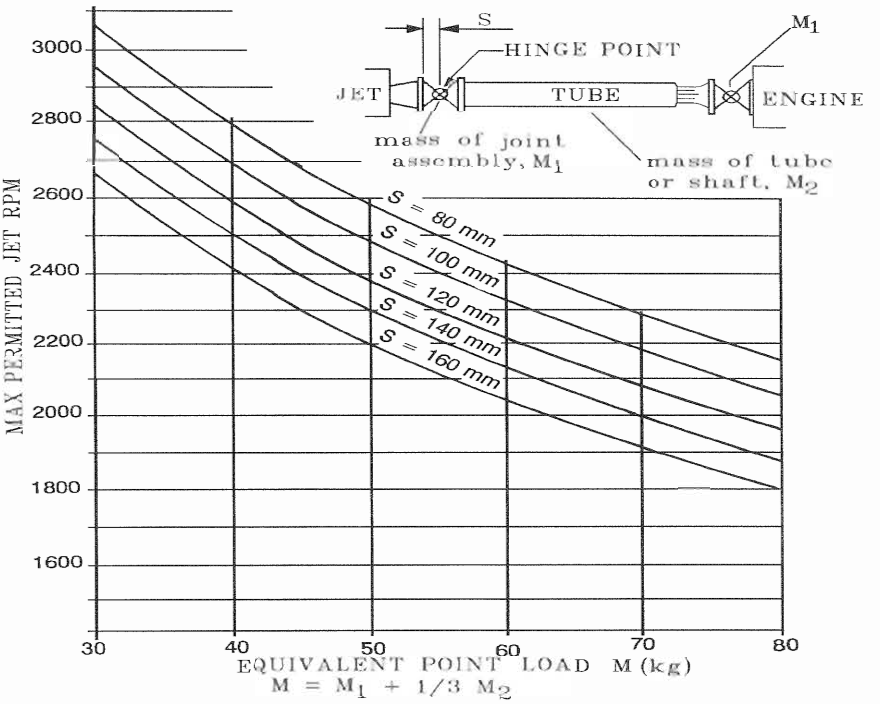
B. The heavier splined end of the Universal Driveshaft should be located towards the engine.

To use the following Figure:

1. Calculate or measure the equivalent point load M.
   a) **To calculate:-** $M = M_1 + 1/3\ M_2$ (Kg).
   b) **To measure:-** Suspend the shaft at the two universal cross joints, measuring the weight at the Jet end cross joint. Weight (in Kg's) = M.

2. Determine the distance from the Jet coupling to the hinge point on the joint assembly, = The distance S,
3. Draw a vertical line on the graph, the position being determined by the calculation made at Para 1a) (To calculate M).

4. At the intersection of the vertical Line "M" and the RPM Curve line as measured at Para 2, draw a horizontal line.
5. This will give the maximum permitted RPM for the Jet using the chosen driveline.
6. **If the high idle or no load maximum engine speed is above or near this value then consult Hamilton Jet for a more detailed analysis.**



2.5.7. Engine Location & Mounting

GENERAL

The engine(s) should be located in a position that will give the craft the most suitable fore and aft trim for the proposed boat speed. For semi-planing and moderate planing speed craft it is likely that the engine should be positioned well forward towards amidships for best trim and thus speed. For very high speed vessels 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.

MOUNTING

Mount the engine via mounting feet fixed to the engine bearers. The feet and bearers do not have to withstand the propulsion thrust load as this is transmitted from the Jet Unit 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 unit Coupling as the engine moves.
For steel hulls, ensure the driveline electrically insulates the engine from the Jet Unit.

COOLING

The Jet unit incorporates a 1¼" BSP Water Offtake Point on the top of the Impeller Race outside the vessel. This is fitted with a plug. A 1¼" BSP to 1¼" BSP hosetail can be fitted in place of the plug. This provides water at pressure as follows:-

Typical Minimum Pressure:- 10 kPa (1.5 psi) at 600 RPM.

Typical Maximum Pressure:-240 kPa (35 psi at 600 kW (800 hp) input power.

The Water Offtake may be used as a supplementary water supply (e.g. for a deck wash). **If it is used as part of the engine cooling circuit, the designer / builder must satisfy themselves that the available flow is sufficient for the cooling requirements and the engine can withstand the full pressure from the water offtake.**

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

ENGINE SYSTEMS

Engine wiring, instrumentation and throttle systems are all conventional. Follow the manufacturers recommendations.
With Steel hulls ensure the controls do not electrically connect the Jet Unit to the hull.

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.

2.5.8. Spare "V" Belts

WARNING:

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

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

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

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

3. Installation

NOTE:
The Installation Section of the Controls Manual contains additional information.

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.

3.1 BASIC INSTALLATION METHOD & DRAWING REFERENCES

FOR G.R.P. OR WOODEN HULLS:
Refer to Installation Drawings: HJ-391-08-001

An aluminium "Intake Block" (Part No. 108206) is supplied with the Intake Block Installation Kit (Part No 108083) 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-391-08-002

An aluminium "Intake Block" (Part No. 107926) 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-391-08-003

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

An aluminium "Intake Block" (Part No. 108206) is supplied with the Intake Block Installation Kit - Steel Hull (Part No 108083), to weld into a prepared opening in the Hull bottom. Insulation components are also supplied to totally insulate the Jet Unit from the Hull.

3.2 HULL PREPARATION

CAUTION:

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

3.2.1 Fixing the Intake Block To the Hull

The aluminium Intake Block is supplied with the installation kit for fiberglassing into fiberglass and wooden hulls, welding into aluminium hulls and bolting into the steel hulls.

The crossmember at the forward end of the Intake Block requires strong points in the hull to attach to.

G.R.P. AND WOODEN HULLS:

Drawings HJ-391-08-001 refer.

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

After moulding, drill 44 x diameter holes from underneath the hull up through the Intake Block Flange and hull. Use the machined dimples to locate the drill. Countersink these holes to suit the countersunk Screws [15]. Fit the countersunk Screws [15], Flat Washer [21] and Spring Washer [20] using RTV Silicon Sealant [33] provided, secure with Nuts [25] and tighten to the recommended torque.

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

ALUMINIUM HULLS:

Drawings HJ-391-08-002 refer.

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

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

STEEL HULLS:

Drawings HJ-391-08-003 refer.

Electrical Isolation
The Intake Block, Jet Unit and the Transom Plate must be completely electrically isolated from the rest of the Hull. This is achieved by the use of gaskets, bushes and seals, as shown on the Hull Installation 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:
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 [30].
2. With the Intake Block in place, drill through from below, the 44 countersunk points on the Intake Block with a 10mm dia Drill. After piercing the Intake Block make a small marking cut in the steel hull with the drill.
3. Remove the Intake Block and clean off all burrs.
4. Drill out the marked positions in the steel edges of the prepared opening to 16mm to accept the Nylon Insulating Bushes [28]. Remove all burrs.
5. Liberally smear both sides of the Intake Block Gasket [30] with RTV Sealant [33] 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 [33] on top of the Gasket [30] and run a bead of RTV Sealant around the internal corner of the prepared recess.
7. Ensure that all the Screws [15] are liberally smeared with RTV Sealant prior to fitting.
8. Install the Intake Block and secure in 3 positions with Screws [15], Nylon Insulating Bushes [28], Flat Washers [21], Spring Washers [20] and Nuts [25]. Hand tighten.
9. Check for electrical isolation between the Intake Block and the vessel hull before fitting the remaining screws.
10. Fit the remaining Screws [15], Nylon Insulating Bushes [28], Flat Washers [21], Spring Washers [20], Nuts [25] and secure using Loctite 262 [34].
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.

3.2.2 Transom Preparation

An area of the transom large enough for the Jet Unit Transom Plate [8] has to be carefully prepared at 95° to the Intake Block base. A hole large enough for the body of the Jet unit to pass through is cut in this prepared transom area. During assembly, the assembled Jet Unit is fed in through this transom hole forward onto the Intake Block to which it bolts. The Transom Seal which incorporates a solid rubber type seal then fits around the Jet Unit and bolts to the Transom. The Transom does not carry propulsive thrust loads but must resist a vertical force generated when the Reverse Duct is in the astern position. **Refer to Section 2.2.2 "Hull Loads" for details.**

FOR GRP AND WOODEN HULLS:

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

The following points should be noted:

1. The Intake Block centre line is marked fore and aft with an indication of the way round it should go.
2. If the original transom angle is less than 95° the area formed at 95° for the Jet Unit may have to be increased to allow sufficient room for the jet steering controls inside the transom.
3. The transom thickness should be a minimum of 20mm in the area prepared for the jet at 95.
4. If the hull bottom is warped consult C.W.F. Hamilton & Co with details.
5. For centrally mounted Jet Units only, the triangular shaped area fairing the Intake Block to the Hull Keel should slope down at no more than 5° to the Intake Block base.
6. The joint area should be prepared with wet GRP for the Intake Block to bed into and the fixing bolts fitted to secure it in place.
7. It is especially important that there is no step at the forward end of the Intake Block. Contours from the Hull to the Intake Block should be smooth with no steps greater than +/- 1mm.
8. The cross member should be attached to the nearest longitudinal frame. These transfer Jet Unit loads to the Hull.
9. Do not drill any holes for the Transom Seal Plate until the Jet Unit assembly is finally fitted to the Transition. The Transom Seal assembly should then be correctly located to use as a jig for the bolt hole centres.
10. **It is the responsibility of the Boat Builders to ensure that the following Jet Unit to Hull connections are strong enough to carry the load generated by the Jet Unit:**

    - **The Intake Block and the cross member attachments to Hull.**
    - **The Transom Plate attachment to the Transom.**

11. **Refer to Section 2.2.2 Hull Loads for further information.**

FOR METAL HULLS:

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

Aluminium Hulls:

The Intake Block is supplied 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 and Co.

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

NOTE:

It is the boat builders responsibility to ensure that the Intake Block does not distort during welding into the boat. It is recommended that the Intake Block should be clamped or bolted to a strongback and a welding procedure chosen which will not cause distortion.

The Transom preparation can be formed either:
By constructing the whole Transom at the required angle. (For multiple Jets, curving the Transom in plan view can provide greater accuracy with the Transom angle, noting that the Jet is mounted at the Hull Deadrise angle).

OR

By cutting the required area out of the Transom, repositioning at the required 95± 1° and then re-welding, with suitably shaped packing plates, back to the Transom.

The following points should be noted:

1. The Intake Block centre lines are marked fore and aft as well as the position of the aft face of the Transom.
2. The Transom plate thickness between frames adjacent to the Jet should be at least 10mm and in addition this plate must be 95° ± 1° to the Intake Block Base.

CAUTION:

If the original Transom is less than 95° deg, the area formed at 95° deg may have to be increased to ensure sufficient room for the Jet Steering Controls inside the Transom.

3. The vertical flange of the Intake Extension may be reduced in width if desired.
4. The hole cut out of the bottom plating must match the base flange shape with minimal clearance.
5. The 15mm Intake Block base is butt welded flush with the underside of the Hull bottom using a double Vee weld preparation and a full penetration weld. The protruding weld bead on the underside must be as small as possible, especially at the forward end.
6. It is especially important that there is no step at the forward end of the Intake Block. Plates must be flush and weld beads should not protrude more than 1mm.
7. If the jet is centrally mounted the area ahead of the intake Block must be faired in gently, back to the Hull. Normally a triangular shaped plate is used running forward at a slope of no more than 5° to the base as shown on the Hull Preparation Drawings.
8. A transverse cross member is to be welded across the top of the forward part of the Intake Block, to bolt or weld to the longitudinal frames. This is detailed in the Hull Preparation Drawings.
9. The Transom hole may now be cut out. Also a 16mm Backing Ring should be made as shown and welded to the inside of the Transom for the attachment bolts to be attached through. **Do not drill any holes until after the Jet Unit is fitted.**
10. **It is the responsibility of the Boat Builders to ensure that the following Jet Unit to Hull connections are strong enough to carry the load generated by the Jet Unit:**
    - **The Intake Block and the cross member attachments to Hull.**
    - **The Transom Plate attachment to the Transom.**
11. **Refer to Section 2.2.2 "Hull Loads" for further information.**

Steel Hulls:

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

The Transom Preparation can be formed either:
By constructing the whole Transom at the required angle. (For multiple Jets, curving the Transom in plan view can provide greater accuracy with the Transom angle, noting that the Jet is mounted at the Hull Deadrise Angle).
OR
By cutting the required area out of the Transom, repositioning at the required 95 ±1° and then re-welding, with suitably shaped packing plates, back to the Transom.

The following points should be noted:
1. The Intake Block centre lines are marked fore and aft.
2. The Transom Plate thickness between frames adjacent to the Jet should be at least 8mm and in addition this plate must be 95° ± 1° to the Intake Block Base.

CAUTION:

If the original Transom is less than 95° deg, the area formed at 95° deg may have to be increased to ensure sufficient room for the Jet Steering Controls inside the Transom.

3. The prepared recess must be a good match to the Intake Block to ensure good load transfer and sealing.
4. If the jet is centrally mounted the area ahead of the intake Block must be faired in gently, back to the Hull. Normally a triangular shaped plate is used running forward at a slope of no more than 5° to the base as shown on the Hull Preparation Drawings.
5. A transverse cross member must be welded across the top of the forward part of the prepared recess, to bolt or weld to the longitudinal frames.
6. A bolted detail of the attachment of the Transom Plate to the Transom is shown on the Hull Preparation Drawing. Some Certification Authorities may not allow holes to be made in the Transom. In this case a 25mm Transom Ring may be made up and welded to the inside of the Transom for the Studs to be tapped into. **Do not drill the holes until after the Jet Unit is fitted.**
7. **It is the responsibility of the Boat Builders to ensure that the following Jet Unit to Hull connections are strong enough to carry the load generated by the Jet Unit:**
   - **The Intake Block and the cross member attachments to Hull.**
   - **The Transom Plate attachment to the Transom.**
8. **Refer to Section 2.2.2 Hull Loads for further information.**

3.3 EQUIPMENT PREPARATION

Do not unpack the Jet Unit 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.

3.3.1 Steering Components

Drawing HJ-391-06-001 refers.

The Jet Unit is shipped complete with the steering components attached. It may be necessary to remove the steering components prior to installation of the Jet Unit into the vessel.

However, if problems with installation occur, *refer to Section 9.3. "Steering Assembly Removal and Overhaul"* and *Section 9.4. "Steering Assembly Refitting and Adjusting"* for removal and refitting instructions.

3.3.2 Reverse Components

Drawing HJ-391-07-001 refers.

The Jet Unit is shipped complete with the Reverse Cylinders and Reverse Duct attached. The Reverse Duct should be removed from the Jet Unit prior to fitting the Jet Unit to the Intake Block which will be already fitted to the Hull. *Refer to Section. 9.2. "Reverse Assembly Removal and Overhaul"*, in this Manual for the removal and refitting procedure.

1. Remove any Position Sensors and Linkages attached to the inboard end of the Reverse Cylinders.
2. Take care to label all electrical terminals for correct re-assembly.
3. Make every effort to remove Sensors in such a way that they can be replaced with minimum disturbance to their original position. **Refer to the *Controls* Manual supplied with this Jet Unit for further information.**

3.3.3 Remove Other Parts

The Jet Unit is shipped with the CT4 / HYRC Controls System fitted. Should it be necessary to remove the HYRC Controls System, refer to the CT4 / HYRC Controls Manual supplied with the Jet Unit, for details.

The following parts must be removed to allow the Jet Unit to be inserted from inside the Hull through the hole in the Transom and to avoid damage to delicate equipment.

REMOVE OVERFLOW PREVENTER (IF FITTED).

Drawings HJ-391-10-001 refers.

REMOVE THE 2 LARGE ANODES BOLTED TO THE BASE OF THE TAILPIPE.

Refer to Section 9.6. "Overhaul of the Tailpipe Area" and Drawing HJ-391-01-001

REMOVE THE TRANSOM SEAL ASSEMBLY

Refer to Drawings HJ-391-08-001 / 002 and 003 and Section 9.7. "Transom Plate Assembly Overhaul".

3.4 INSTALLING THE JET UNIT

Refer to Drawings:-

HJ-391-08-001 GRP Hulls.
HJ-391-08-002 Aluminium Hulls.
HJ-391-08-003 Steel Hulls.

CAUTION:

In multi Jet Unit installations, each Jet Unit is specifically assembled for Port, Starboard or Centre mounting. Ensure that each Jet Unit is fitted onto the correct Intake Block.

CAUTION:

FOR STEEL HULLS:

The Jet Unit must be totally electrically insulated from the Hull. Insulating hardware is supplied with the Jet Unit. The insulation should be checked before finally bolting the Jet Unit and Transom Seal Assembly in place and again on completion.

1. Loosen but do not remove the Nuts holding the Rear Header Ring in place against the Transom Seal. **Refer to Section 9.7.1. "Transom Plate Removal" for details.**
2. Slide the complete Transom Seal Assembly rearwards off the Jet Unit.

3.4.1 Preparation for Installation of the Jet Unit

ALL HULLS

Refer to Drawings HJ-391-08-001 / 002 and 003 refer.

Insert Attachment Studs into the Intake Block:
Apply Loctite 262 [34] to the threads of the 36 Studs [9] and screw 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 a spanner can be engaged on the nuts to tighten the stud into the hole.

Trial Assembly to Check Correct Fit:
1. Lift the Jet Unit in accordance with the current Lifting and Hoisting Regulations using a lifting sling attached around the Tailpipe and a separate sling attached around the Bearing Housing.

WARNING:

DO NOT HOIST THE JET UNIT USING A 2 LEGGED SLING ATTACHED AROUND THE TAILPIPE AND BEARING HOUSING AS THIS SLING WILL FOUL ON THE TRANSOM PLATE. TWO SEPARATE SLINGS AND HOISTING EQUIPMENT SHOULD BE USED TO HOIST THE COMPLETE JET UNIT.

2. In addition a sling should be placed around the Intake body near the centre of gravity to give additional support.
3. Ensure that the lifting slings are not fouling on the Reverse or Steering Cylinders which could be damaged. Ensure that the Sling attached to the Tailpipe does not foul on the Transom Plate during hoisting operations.
4. Lift the Jet Unit (complete with the Intake Screen fitted) into the Hull and position the Jet Unit so that the Tailpipe passes out through the Transom opening and the Intake with the Screen fitted, fits centrally in the rectangular hole in the Intake Block.
5. Check that the Jet Unit is correctly located in relation to the transom opening.
6. Check that the contours between hull and the water inlet, at front and rear, are smooth to within 1 mm. There should be no steps.
7. Remove the Jet Unit and rectify any problems as necessary.

Final Assembly:

8. Liberally apply RTV Silicone Sealant [33] to the top of the Intake Block and the underside of the Jet Unit flange.
9. Carefully position the Jet Unit flange over the Studs [9] fitted to the Intake Block and lower the Jet Unit onto the Intake Block.
10. Fit Flat Washers [19], Spring Washers [18] and Nuts [24] to Studs [9] and tighten evenly. Torque load to the recommended torque.
11. Remove excess sealant from inside and outside the Jet Unit.

Steel Hulls Only:

12. **Check the insulation between the Jet Unit and the Hull. (The resistance should be 1000 ohms or greater. If the reading is below 1000 ohms, the fault should be investigated and rectified before continuing).**
13. Remove the lifting equipment and slings from around the Jet Unit and remove from inside the vessel.

3.4.2 Fitting the Transom Seal Assembly

NOTE:

The Steering Shaft must be installed before proceeding with this Section.

1. Remove the protective tape from around the Transom Seal [5]. Slide the Transom Plate [2] up to the Transom face.
2. Fit the Transom Seal with the front and rear Header Rings to centre the Transom Plate on the Impeller Race.
3. Use the Transom Plate as a template to mark the attachment holes in the Transom Face.
   a) **For GRP, Wooden and Steel Hulls**, drill 22 holes 12.5mm dia through.
   b) **For Aluminium Hulls,** drill 22 holes 13mm dia through.

3. Refer to **Section 9.7.2. "Transom Plate Refitting"** for details on fitting the Transom Plate.
4. Refit the Tailpipe Anodes. Refer to ***Section 9.6. "Overhaul of Tailpipe Area".*** For details. Replace the Water Offtake Plug [76] **(Drawing HJ-391-01-001 refers).**

3.5 REFITTING THE REVERSE COMPONENTS

Drawings HJ-391-07-001 refer.

1. Reverse Cylinders. **Refer to *Section 9.2 "Reverse Assembly Removal and Overhaul"*, for refitting details.**
2. Reverse Duct. **Refer to *Section 9.2. "Reverse Assembly Removal and Overhaul"*, for refitting details.**

3.6 REFITTING THE STEERING COMPONENTS

Drawings HJ-391-06-005 refer.

1. Re-install the Steering Shaft Support Bracket onto the Jet Unit. **Refer to Section 9 4.4. "Steering Bracket Re-Fitting to the Jet Unit" and Drawing CT-SJK-01-007 / 009 / 010 and 011 in the Controls Manual.**
2. Refit the Steering Shaft [18], Tiller [17] and Steering Crank [16], taking care that the Cotters [12] are installed the correct orientation. **Refer to Section 9.4.7. "Steering Assembly Re-Fitting" and Drawings HJ-391-06-005 in the Jet Drawings Package.**
3. Ensure that the Steering Shaft Seal Assembly [19] is centered on the Steering Shaft[18].
4. Steering Cylinder. **Refer to *Section 9.4.6. "Steering Cylinder - Refit to the Jet Unit (Hamilton and Wagner Cylinder)"*,** for refitting details.
5. Refit any Sensors attached to the Tiller. **Refer to the Overhaul Section of the Controls Manual for details.**

3.6.1 Attaching the Steering Tie Rods

NOTE:

This Section only applies to Multi Jet Installations.

In Multi Jet Installations, the Steering Tie Rod is attached between the Steering Cranks of all Jet Units. This ensures that all Steering Nozzles are synchronized. The length of the Steering Tie Rods an be adjusted to suit the actual distance between Jet Units. The adjustment is made by cutting one end of the Rod to length and then welding on the end fitting.

INSTALLATION PROCEDURE:

Refer to HJ-391-06-005 "Steering Assembly Drawings" contained in the Drawings Package.

1. Ensure all Steering Nozzles are set to the CENTRE HELM position. The Steering Nozzles can be moved by opening the Steering Bypass Valve and using the emergency tiller to rotate the Steering Cranks.
2. Temporarily mount the complete Tie Rod assembly on the Steering Cranks. The Rod Ends locate in the aft hole on the Steering Crank. This allows the correct length of the Tie Rod to be determined.
3. Cut the Tie Rod to length and then weld on the Tube End.
4. Bolt one end of the now complete Tie Rod onto one Steering Crank.
5. Bolt the other end of the Tie Rod onto the other Steering Crank. Adjust the overall length by rotating the Ends in the Tie Rod.
6. Ensure all Rod End Locknuts and Attachment Nuts are finally tightened to recommended torque's.
7. Check that all Steering Cylinders reach their travel limits at the same time. This ensures that the Tie Rod is not overloaded.
8. Re-adjust the length of the Tie Rods as necessary.
9. Close all By-pass Valves.

3.6.2 Assembling the Jet Steering Tillers

Drawings HJ-391-06-005 refers.

SINGLE JET INSTALLATIONS

Cotter (taper) Pin in the Steering Tiller assembles from the opposite direction to the one in the Steering Crank. **Refer to HJ-391-06-005. Sheet 3 of 5.**

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 16°:**
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 HJ-391-06-005. Sheet 3 of 5, for "Single Jet Installations".**

b) **For Deadrise Angles at 16° or More:**
For both Jets - fit the Cotter (taper) Pins for the Tiller and Crank both from port to starboard. **Refer to Drawing HJ-391-06-005 Sheet 4 of 5 as for "Twin Jets, Port and Starboard Jets over 16° Installations".**

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 16°:**
For all three Jets, Cotter (taper) Pins in the Steering Tiller are assembled from opposite directions to those in the Steering Crank. **Refer to Drawing HJ-391-06-005 Sheet 3 of 5 as for "Centre Jet or Port Jet up to 16° Installations".**

b) **For Deadrise Angles of 16° or More:**
For the center Jet only, Cotter (taper) Pin in the Tiller assembles fits from the opposite direction to the one in the Steering Crank. **Refer to Drawing HJ-391-06-005 Sheet 3 of 5 as for "Centre Jet or Port Jet up to 16° Installations".**

For the port and starboard Jets only, Cotter (taper) Pins in the Steering Tiller are assembled from opposite directions to those in the Steering Crank. **Refer to Drawing HJ-391-06-005 Sheet 5 of 5 as for "Port and Starboard Jets over 16° Installations".**

TIGHTENING COTTER (TAPER) PIN NUTS:-

Ensure that 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 as shown in the Drawings HJ-391-06-005. Torque load all nuts to the recommended torque. **Refer to Drawing 85113.**

3.6.3 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.

3.6.4 Refitting the Overflow Preventer (If Required)

Drawing HJ-391-10-001 refers.

1. Refit the Overflow Preventer to the Jet Unit using Screw [2] and Washer [3].
2. Refit the Inspection Cover [70] and O Ring [71] and secure to Studs [72] with Spring Washers [81] and Nuts [58]. Torque load to the correct torque. **Drawing HJ-391-01-001 refers.**

3.6.5 Dipstick and Thrust Bearing Oil

Drawings HJ-391-05-001 refer.

1. Use the drawing as a guide to installing the Dipsticks.
2. For Vessels with multiple Jet Units, ensure that the Dipsticks are clearly identifiable and are not fitted to the wrong Jet Unit.
3. Fill the Bearing Housing Reservoir up to the Dipstick MAX level with the recommended oil.

3.6.6 Refitting the Hydraulic Power Unit (JHPU)

Refer to the Overhaul Section of the Controls Manual for details.

3.7 DRIVELINE AND ENGINE INSTALLATION

GENERAL

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

3.7.1 Mounting the Engine

Mount the engine via mounting feet fixed to the engine bearers. The feet and bearers do not have to withstand the propulsion thrust load which is transmitted from the jet directly to the hull. Flexible engine mounts will reduce vibration and noise but these must be used in conjunction with a driveshaft system, which does not cause a radial, or side load at the jet coupling as the engine moves. Refer to Section "Design Basics", sub Sections "Jet Mainshaft Alignment" and "Drivelines" for recommended driveshaft and engine installation angles.

3.7.2 Engine Cooling

1. The engine may be cooled conventionally or by making use of the 1¼" BSP outboard water offtake from the Jet. To ensure correct flow for engine cooling, a conventional water pick up and the engine raw water pump should be used.

CAUTION:

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

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

3.7.3 Governor Settings

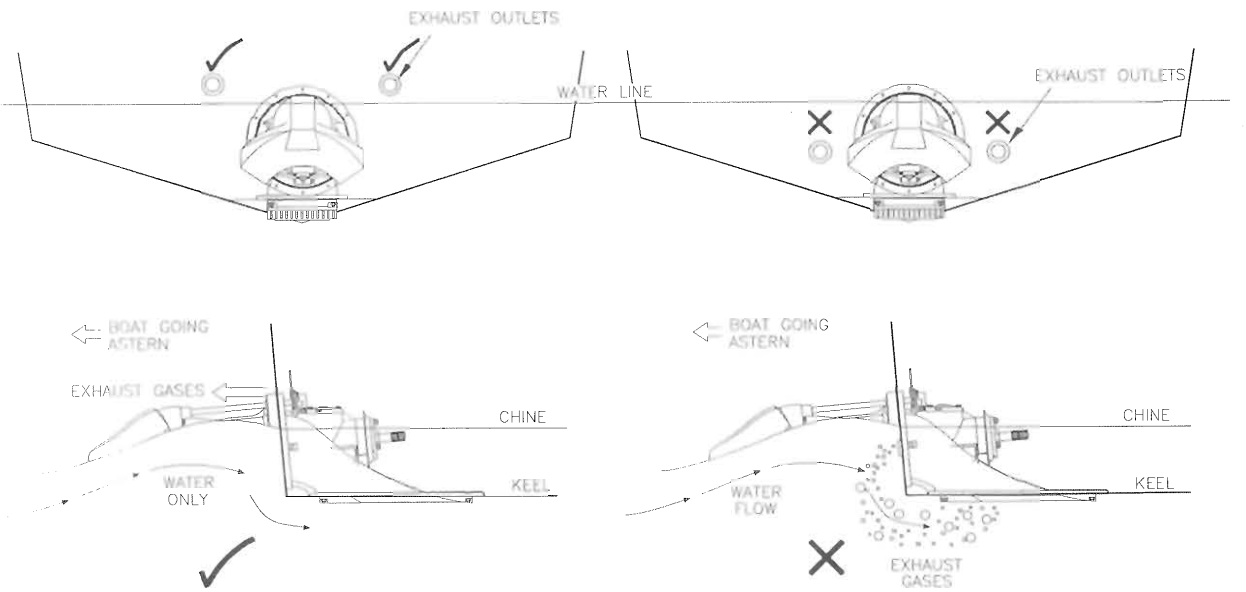
The "No Load" governor setting ("High Idle") on diesel engines should be set well clear of the full throttle R.P.M. achieved when driving the Jet Unit so that there is no chance of the governor reducing power (and performance) at full throttle. To check, select neutral if clutch or gearbox fitted but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

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

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

3.7.4 Exhaust Systems.

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



3.7.5 Spare "V" Belts

WARNING:

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

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

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

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

4. Commissioning

This information is intended for use by CWF Hamilton representatives. Refer to the Controls System Manual for details of commissioning checks specific to the Controls System.

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.

4.1 PRE-LAUNCH CHECKS

Check the following items:

4.1.1 Hull / Installation

Drawing HJ-391-01-001 refers.

1. Intake Block is smoothly faired to hull fore and aft.
2. The Hull is smooth and clear aft of the intake.
3. No flow obstruction forward of the Jet Unit intake.
4. The Intake and Transom sealing joints are correctly tightened. (do not overtighten) and the Transom Seal as been fitted correctly.
5. All gaskets and seals are firmly attached.
6. Exhaust outlets are correctly positioned.
7. Trim tabs or other obstructions do not interfere with reverse waterjet flow.

4.1.2 Jet Unit

Drawings HJ-391-01-001, HJ-391-03-001, HJ-391-05-001 and 85113 refer.

1. Correct Impeller and Nozzle are fitted.
2. Anodes in place, and are clean and unpainted.
3. Check that all hydraulic shafts for damage and check that they are free from contamination (Weld splatter, grinding dust, fiberglass resin, etc).
4. All Inspection Covers on all Jet Units are securely attached.
5. Dipsticks are correctly located.
6. Add the correct grade of oil to the Bearing Housing, using the Dipstick to determine the correct level. ***Refer to Section 7.5 Recommended Oils & Lubricants for details.***
7. Bearing Housing oil is the correct type and at the correct level on the dipstick.
8. Jet Mainshaft can be turned. **(NOTE: Do not run the Jet Unit out of the water).**

CAUTION:

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

4.1.3 Steering Assembly.

Drawing HJ-391 06-005 refers.

1. Steering Nozzle pivot pins are lubricated and locking bolts are correctly fitted and secure.
2. Cotter pins have been installed correctly and properly secured.
3. Steering Shaft bushes have been lubricated.
4. The Inboard Tiller moves freely over the full range of movement without sticking or binding.
5. The Steering Wheel moves freely, giving full steering lock to lock.

4.1.4 Drive Shafts and Couplings

Drawing HJ-391-02-001 refers.

Confirm that driveline details have been approved by C.W.F.Hamilton & Co. Ltd.

Universal Drive Shafts:

- Yoke disposition correct and lubricated.
- Spline engagement correct and lubricated.
- Joint angles correct as shown in **Section 2.4. "Drivelines".**
- Are correctly aligned at the the engine flywheel.
- All drive shaft bolts are correctly tightened.
- All flywheel bolts are correctly tightened as specified by the Driveshaft or Engine manufacturers.

Line Shafts:

- Square and aligned at engine flywheel.
- Aligned plummer blocks.
- Outer bearings close to end couplings.
- fore and aft positioning.

Torsional Couplings:

- Square at flywheel.
- Coupling bolting secure.
- Flywheel bolting secure.

4.1.5 Corrosion Prevention

1. Two wire electrical wiring system fitted (no earth return system fitted).
2. Fully connected earth bonding strip installed.
3. Effective leakage monitoring system installed.

4.2 POST LAUNCH CHECKS

Perform the following procedures before the engines are started.

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

1. 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.
2. Ensure that the vessel is securely moored fore and aft and located in deep clean water.
3. Check that the correct dipstick is fitted and that the oil level in all Bearing Housings are correct. Add or remove oil as necessary so that oil level is between the maximum and minimum levels. **Refer to Section *7.7. "Recommended Lubricants"* for details.**
4. Check the JHPU oil levels are correct.

4.2.1 Engine Running Checks (Vessel Moored)

1. The Water Bearing (Cutless Bearing) must operate wet. Do not operate the Jet Unit with the vessel out of the water, or with the vessel ballasted such that the Jet Unit does not prime (pump water properly) when the engine is started.
2. Ensure the vessel is securely moored fore and aft and in deep water.
3. With the Reverse Levers set to "Zero Speed", the engine(s) may be started and the engine suppliers representatives can carry out their engine checks.
4. If the engine cooling water is taken from the Jet water offtake, confirm that water is coming out of the engine exhaust outlets where possible. Periodically check that the engine is running at the correct operating temperature. Check that the cooling water hoses are secure.

WARNING:

FAILURE TO CHECK COOLING WATER HOSES MAY RESULT IN FLOODING OF THE VESSEL.

5. Check for water leaks around the Jet Unit whilst the engine is running particularly under the Bearing Housing (Mainshaft Water Seal).
6. Check that the Jet Unit and drive shaft is running smoothly (no vibration).
7. Periodically check the Bearing Housing temperature. Temperature should not exceed 80°C.
8. Check that the Reverse Controls are working by monitoring the Steering Nozzle position whilst moving the helm (check that port helm gives port nozzle deflection and that all nozzles are steering in the same direction).
9. Check that all steering travel is limited by the hydraulic cylinder and not the linkage.
10. After stopping the engine(s), check oil levels and replenish if required.

4.3 VESSEL SPEED AND HANDLING TRIALS

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".

4.3.1 Before Leaving the Mooring:

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

4.3.2 During Trials:

ADJUST THE ZERO SPEED POSITION:

1. Run the engine at approximately 1500 RPM and experiment to find the Reverse Control Lever position at which the vessel does not move ahead or astern. Ensure that steering is in the ahead position.
2. Check that the Reverse Detent indicates the "Zero Speed Position". Adjust as required.
3. **When proceeding away to open water for trials check for the following:**
   - Check that the steering is working correctly when going forward, at zero speed and when going astern.
   - Observe the Waterjet emerging from the Steering Nozzles when the vessel is going dead ahead at speed. The Waterjet should be a relatively clean and even shape.
   - If water is splashing back from the Nozzles then realignment of the Steering Nozzles may be required.

1. Periodically check the Bearing Housing surface temperature and record the temperature once it reaches a steady value. Due to friction caused by the seals within the Bearing Housing, the Bearing Housing is likely to be hot. The Bearing Housing operating temperature is satisfactory if the Bearing Housing casing maintains a temperature 70°C ± 5° **but should not exceed 80°C.**
2. A faulty Bearing will be heard and felt as a vibration through the Bearing Housing and is likely to cause significant heat build up and could even discolour the paint on the Bearing Housing.
3. If practical, check the coupling joint temperatures (if fitted). Increased joint temperature may indicate drive shaft misalignment.
4. Periodically check hydraulic oil temperature at the JHPU oil reservoir. Record the temperature reading after a sustained run at cruising speed and after a period of boat manoeuvering.
5. Record the maximum speed (using GPS) and engine revolutions. (Strong currents will result in inaccurate speed readings since the GPS provides speed over ground). At maximum speed the jet revolutions should be verified with a hand held tachometer at the Jet Unit Coupling.
6. Record vessel speed at varying engine revolutions if possible.
7. Record observations on vessel trim and loading, etc.

4.3.3 After Initial Trials (Engine Shut-Down)

1. ***Refer to Section 7.3. "Servicing Intervals"*** for any servicing required after completion of trials.
2. Ensure that all important information recorded during the trials is stored for future reference.
3. Check for water leaks around the Jet Unit especially at the Transom Plate and under the Bearing Housing (water seal leaks).
4. Check the Bearing Housing and JHPU oil levels and replenish if required. ***Refer to Section 7.7. "Recommended Lubricants" for details.***
5. **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 4.3.2. "Checking the Insulation" for further details.***

5. Faultfinding

HOW TO USE THIS FAULT FINDING TABLE:

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

5.1. JET UNIT SYSTEM FAULTS

Figure 5-1 Fault Finding Table.

SYMPTOM			
No.	**POSSIBLE CAUSE**	**SOLUTION**	**REFER:**
1	**Engine RPM increases suddenly.**		
	There is some blockage of the Jet Unit.	Remove the blockage.	**Sect 6.9.**
	Faulty engine tachometer.	Repair tachometer.	---
2	**Engine RPM increases suddenly, noise from Jet Unit and an aerated waterjet.**		
	Intake Screen blocked.	Remove the blockage.	**Sect 6.9.**
	Rope jammed on Intake Screen or wrapped around the Mainshaft.	Remove the blockage.	
	Object jammed on Stators and / or Impeller.	Remove the blockage.	
3	**Engine RPM increases gradually.**		
	Worn or blunt Impellers.	Inspect and repair Impeller.	**Sect 9.6.5.**
	Excessive Impeller Tip clearance.	Inspect and repair Impeller.	
4	**Engine RPM decreases.**		
	There is some problem with the engine.	Investigate engine operation.	Refer to the engine manufacturers manual.
5	**Thrust reduces (vessel speed drops).**		
	There is some blockage of the Jet Unit.	Remove the blockage.	**Sect 6.9.**
6	**Vibration suddenly increases the from Jet Unit.**		
	Debris stuck on the Impeller.	Remove the blockage.	**Sect 6.9.**
7	**Vibration gradually increases from the Jet Unit.**		
	Worn Driveshaft Universal joints.	Inspect and repair as necessary.	Refer to the driveshaft manufacturers manual.
	Worn Marine Bearing.	Inspect and repair Marine Bearing.	**Sect 9.6.7.**
8	**Loud high pitched rattling whine comes from the Jet Unit.**		
	Faulty Thrust Bearing.	Check the Bearing Housing oil temperature, if excessive, inspect and repair the Thrust Bearing.	**Sect 9.5.**
9	**Bad vibrations, gradually increasing.**		
	Worn Marine Bearing possibly caused by the Marine Bearing water drain hole blocked.	Inspect and repair Marine Bearing. Un-block the water drain hole.	**Sect 9.6.7.**
	Worn Driveshaft Universal joints.	Inspect and repair the driveshaft as per manufacturer's recommendations.	Refer to the driveshaft manufacturers manual.

SYMPTOM			
No.	**POSSIBLE CAUSE**	**SOLUTION**	**REFER:**
10	**Low engine R.P.M.**		
	Problem with engine.	Investigate the engine operation.	Refer to the engine manufacturers manual.
	Incorrect Impeller selection.	Check Impeller rating. Contact CWF Hamilton for a check to be made.	Incorrect Impeller selection, refer to **Dwgs HJ-391-03-001.**
11	**Water leaking from under the Bearing Housing.**		
	Faulty Water Seal.	Inspect and replace or repair the Water Seal.	**Sect 9.5.2. to 9.5.7.**
12	**Bearing Housing excessively hot.**		
	Thrust Bearing or Water Seal failure.	Overhaul the Bearing Housing and Water Seal.	**Sect 9.5.**
13	**Rapid Anode depletion.**		
	Water Pollution. (Anodes will be consumed at a quicker rate than normal).	Inspect Anodes at more regular intervals.	**Sect 7.4.**
	Check for stray currents (e.g. Through shore power connections).	Use an Isolation Transformer or Galvanic Isolator to the vessel electrical system.	**Sect 8.1.1. Sect 8.1.2.**
	Insufficient hull anodes.	Fit extra anodes to the vessel hull.	**Sect 8.1.5.**

5.2. REVERSE SYSTEM FAULTS

Figure 5-2 Reverse System Faults Table

SYMPTOM			
No.	**POSSIBLE CAUSE**	**SOLUTION**	**REFER:**
1	**Reverse Duct creeping down from the Up position.**		
	Reverse Cylinder. Reverse Cylinder Seal failure. Suspect Seals are:- Seal [34]. Seal [35].	Overhaul the Reverse Cylinder.	**Sect 9.2. Drawing HJ-391-07-001 refers.**
2	**Reverse Cylinder; Oil leaking from the Cylinder Mainshaft.**		
	Reverse Cylinder Seal failure. Suspect Seals are:- Seals [34]. Wear Rings [35]. Wiper Seals [36].	Overhaul the Reverse Cylinder.	**Sect 9.2. Drawing HJ-391-07-001 refers.**
3	**Reverse Cylinder; Oil leaking from the Cylinder around the Backhead and End Cap.**		
	Reverse Cylinder Seal failure. Suspect Seals are:- O-Ring [38].	Overhaul the Reverse Cylinder.	**Sect 9.2.3. Drawing HJ-391-07-001 refers.**
4	**Reverse Cylinder; Oil leaking from the Cylinder around the Nipple [40].**		
	Reverse Cylinder Seal failure. Suspect Seals are:- Bonded Seal [41].	Overhaul the Reverse Cylinder.	**Sect 9.2.3. Drawing HJ-391-07-001 refers.**
	Hose connections to the Nipple [40] faulty.	Check hose connections.	**Drawing HJ-391-07-001 refers.**

SYMPTOM			
No.	**POSSIBLE CAUSE**	**SOLUTION**	**REFER:**
5	**Reverse Mechanism stiff to operate.**		
	Reverse Cylinder Mainshaft bent or damaged.	Check Reverse Cylinder Mainshaft and replace if bent or damaged. Check the operation of the Reverse Cylinder.	**Sect 9.2.3 Sect 9.2.4. Drawing HJ-391-07-001.**
	Corrosion build-up around the Reverse Cylinder Mainshaft Clevis.	Clean the Reverse Cylinder Mainshaft. Remove the Clevis and clean out and refit.	**Sect 9.2. Drawing HJ-391-07-001 refers.**
6	**Water Leaking in from around the Hose Tail Tube [25].**		
	Hose Tail Tube loose.	Remove and check the Hose Tail Tube. Refit using Loctite 680.	**Sect 9.2.5. Drawing HJ-391-07-001 refers.**
7	**Poor Reverse Thrust.**		
	Reverse Duct water flow is being ingested into the Intake.	Determine the reason for flow ingestion into Intake and correct.	**Refer to Design Basics Section.**
	Reverse flow hitting the Trim Tabs.	Check the dimensions of the Trim Tabs and reposition if required.	**Sect 2.3.3.**
	Engine exhaust is being ingested into the Intake.	Reposition the engine exhausts to exit the vessel above the waterline.	**Sect 2.3.4.** and **Sect 3.7.4.**
8	**Poor Forward Thrust.**		
	Reverse Duct not travelling to the "fully up" position.	Determine the reason for the limited travel and correct.	**Sect 9.2.** Also refer to the Controls Manual.

5.3. STEERING SYSTEM FAULTS

Figure 5-3 Steering System Faults Table

SYMPTOM			
No.	**POSSIBLE CAUSE**	**SOLUTION**	**REFER:**
1	**Steering stiff at the Helm.**		
	Grit jamming the Nozzle.	Move the Nozzle from side to side to release the grit. Flush out the Nozzle. Remove the Pivot Pins and remove the Nozzle from the Nozzle Housing, Remove and check the Spacing Washers [33] to [35]. Check for wear and binding. Check the Lip Seal [39] for wear and damage. Replace with new parts as required.	**Sect 9.3. and Drawing HJ-391-06-005 refers.**
	Helm Wheel stiff.	Check, rectify and lubricate as necessary.	Refer to the Controls Manual.
	Steering Shaft stiff during operation.	Check movement of the Steering Shaft and clearance on Steering Bushes and Rod Ends, rectify to a loose running fit. Check for bent Steering Shaft, rectify or replace. Check the Shaft Seal Housing [19] for security.	**Sect 9.3 and Sect 9.4. Drawing HJ-391-06-005 refers.**
2	**Steering jamming.**		
	Grit / debris jamming the Nozzle.	Move the Nozzle from side to side to release the grit. Remove any debris and flush out the Nozzle. Remove the Pivot Pins and remove the Nozzle from the Nozzle Housing, remove the Spacing Washers [33] to [35]. Check for wear and binding. Check the Lip Seal [39] for wear and damage. Replace with new parts as required.	**Sect 9.3. Drawing HJ-391-06-005 refers.**
	Steering Nozzle Pivot Pins [2] loose or bent.	Remove, check and replace the Nozzle Pivot Pins [2], Flanged Bushes [26] and Nozzle Bushes [3].	**Sect 9.3 and Sect 9.4. Drawing HJ-391-06-005 refers.**
	Steering Nozzle or Steering Housing deformed by impact.	Remove, rebuild or replace as necessary.	**Sect 9.3 10. and Sect 9.3.11. Drawing HJ-391-06-005 refers.**
3	**Shaft Seal Housing leaking water.**		
	Shaft Seal Housing [19] leaking water around the Steering Shaft [18]. Suspect Seals are:- Seals [21]. Scraper Seal [20]. Wiper Seals [30]. Shaft Seal Gasket [22].	Remove the Shaft Seal Housing, replace seals and Shaft Seal Gasket. Check for for wear and damage. Replace with new parts as required.	**Sect 9.3 13. and Sect 9.4.5. Drawing HJ-391-06-005 refers.**

6. Operation

6.1. STARTING UP

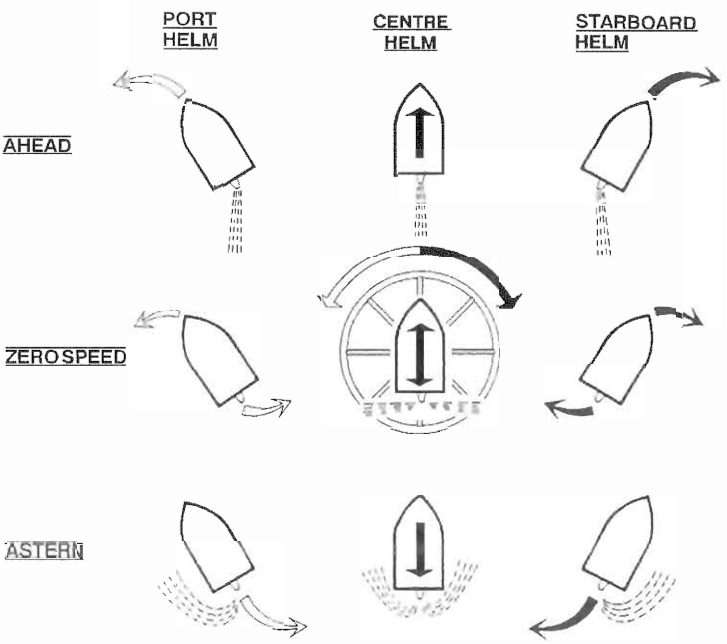
CAUTION:

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

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

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

6.2. STEERING



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

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

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

6.2.1. Total Hydraulic Failure

EMERGENCY STEERING

In the case of a failure of the Helm Wheel or the cable parts of the Steering System, the Jet may be steered by manually moving the Jet Tiller:
Disconnect the cable from the Steering Arm **(Drawing HJ-391 06 005 refers).**
Move the Steering Arm by hand as required to move the Steering Nozzle. Steering may only be possible at low RPM, unless an emergency Steering Arm Extension (Not included in CWF Hamilton standard supply) is used.

EMERGENCY MANUAL REVERSE DUCT CONTROL

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

To raise the Reverse Duct:

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

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

EMERGENCY MANOEUVERING AND DOCKING

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

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

6.3. MANOEUVERING AND DOCKING

6.3.1. Low Speed Manoeuvering and Docking

The vessel is best manoeuvred as follows:-

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

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

NOTE:

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

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

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

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

6.3.2.Moving Sideways

WITH TWIN JETS:

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

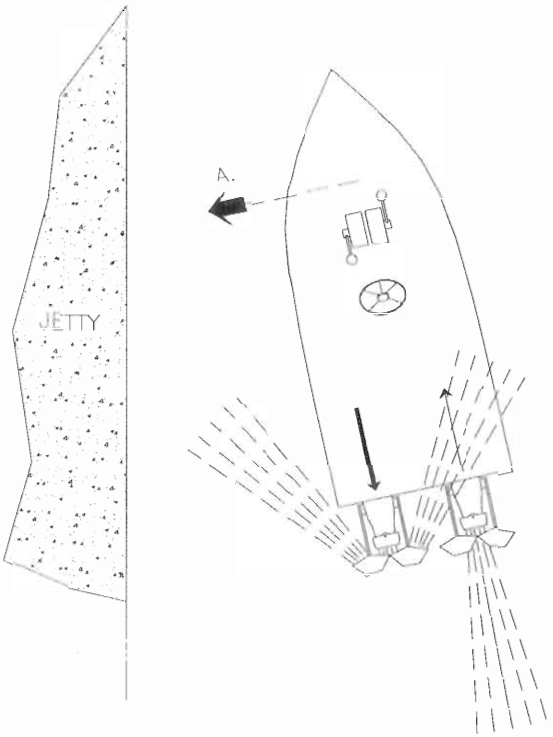
MOVING TO PORT

A

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

B

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

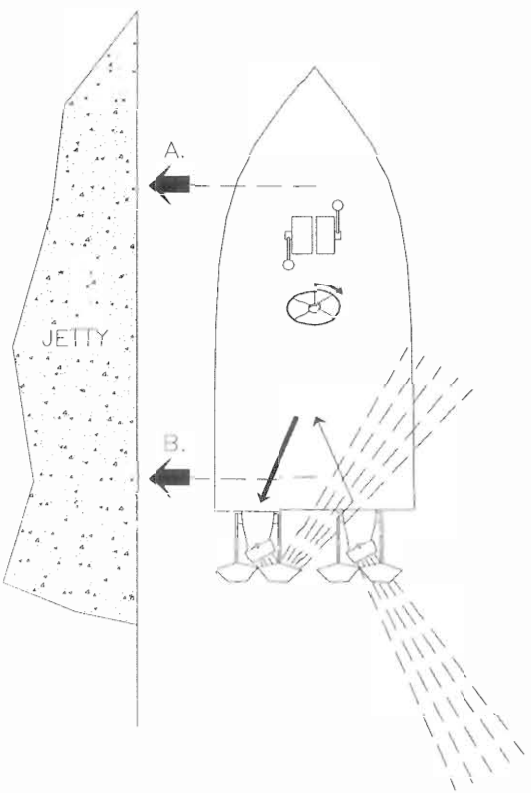


MOVING TO STARBOARD

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

DOCKING.

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



NOTE:

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

WITH TRIPLE JETS:

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

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

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

MOVING TO STARBOARD

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

TO STOP SIDEWAYS MOVEMENT

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

Steering:- Dead Ahead.
Throttle:- Idle.
Reverse:- Zero Speed.

6.4. CRUISING

CAUTION:

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

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

1. Running at speed with a partially blocked Inlet Grill or debris on the Impeller will result in cavitation damage to the Jet Unit. Before accelerating to full speed, all Jet Units should be cleared of debris. **Refer to Section 6.9. "Blockages (Debris In The Jet Unit)".**
2. Acceleration should be carried out gradually. Full power cannot be used at low vessel speeds such as when operating on one engine only.
3. If there is any blockage of the Jet Unit, the engine will run at higher than normal RPM and the vessel will accelerate slowly, and best speed will be reduced. If such symptoms are noticed, immediately slow the vessel and clear the blockage. **Section 6.9. "Blockages (Debris In The Jet Unit)" refers.**
4. In conditions of severe weather or overload, the engine speed should be reduced accordingly.

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

WARNING:

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

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

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

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

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

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

"CRASH" OR "EMERGENCY STOP"

This Procedure Should Only Be Used In An Emergency.

CAUTION:

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

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

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

6.6. SHALLOW WATER OPERATION

CAUTION:

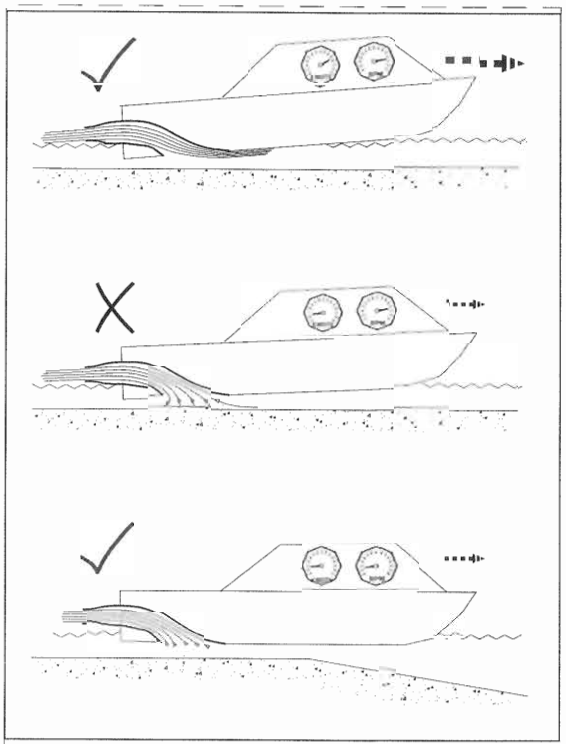
Do not run the Jet if the vessel has run aground. Damage may occur to Impellers.

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

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

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

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



SHALLOW WATER OPERATION M114-0

6.7. ACCELERATION TO HIGH SPEED

If leaving an area of shallows, or with debris in the water, ensure Jets are clear of debris before accelerating to high speed. **Refer to Section 6.9.3. "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 6.9.2. "Detecting Blockages".**

Daily, prior to commencing operations, the Inspection Cover should be removed and any debris removed from around the Impeller or Intake Screen. **Refer to Section. 6.9.3. "Clearing Blockages" and Section. 7.3. "Jet Unit Servicing Details", Item 1.**

CAUTION:

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

CAUTION:

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

6.8. AERATED WATER

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

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

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

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

6.9. BLOCKAGES (Debris In The Jet Unit)

6.9.1. Avoiding Blockages

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

6.9.2. Detecting Blockages

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

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

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

6.9.3. Clearing Blockages

WARNING:

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

The following methods can be used.

a) Slow or stop the engine driving the blocked Jet Unit. The blockage will often clear itself. This operation works best if the vessel is moving forwards.
b) Remove the Inspection Cover on the Intake Housing and manually clear the obstruction. **Refer to Section 6.10. "USING THE INSPECTION COVER".**
c) Send a diver overboard to clear the Intake Screen.

NOTE:

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

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

3. **Alternatively, an optional extra Hatch Extension can be fitted to the inspection point to allow inspection of the Intake Housing at higher water levels. (Drawing HJ-391-10-001 refers).**

6.10.USING THE INSPECTION COVER

WARNING:

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

CAUTION:

Before removing the Inspection Cover:-

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

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

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

6.11.USING THE SCREEN RAKE

The Screen Rake is actuated by pressing on the Screen Rake lever with your foot. This "rakes" any debris off the Intake Screen. Use the following guidelines.

1. The Jet Unit being cleared must be stopped.
2. The Vessel does not have to be stopped, but should not be moving at high speed.
3. A single full stroke of the lever is usually sufficient to clear any debris from the Intake Screen.

6.12.OVERFLOW PREVENTER

Drawing HJ-391-10-001 refers.

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

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

Refer to Section 9.8. "Overflow Preventer (Optional Extra)" for detailed instructions on the fitting and removal of the Overflow Preventer.

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

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

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

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

USE OF ENGINE TO STOP MAINSHAFT ROTATION

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

NOTE:

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

7. Maintenance: General

JET UNIT

The Jet Unit has been designed to require a minimum of maintenance. However, it is recommended that the Jet Unit is regularly overhauled and inspected for wear on bearings, seals etc.

MAINTENANCE - GENERAL

This Section is a general section covering aspects of maintenance that apply to the Jet Unit and associated equipment.
This Section and **Section 9 Overhaul,** cover maintenance work in more detail, as described below:

- Use this Section to organize 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

- The **"Overhaul"** 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 the loss of oil to surrounding areas by the liberal use of oil absorbent cloth.
2. If disconnecting a hydraulic connection to a part which is not being serviced, immediately plug the connection to prevent loss of oil and the entry of foreign particles.

7.1 PRESERVATION: PRE INSTALLATION

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

1. Storage temperature must be maintained between 10º and 40º and above the "dew point" (i.e. no condensation is allowed to form).
2. Loads on the Marine Bearing must be removed to prevent permanent distortion of the Marine Bearing in the load bearing area. The Loads on the Marine Bearing can be minimised by attaching and adjusting the ***"Mainshaft Support Tool"*** as shown in **Drawing HJ-391-11-000** onto the Mainshaft to unload the Marine Bearing.
3. It is desirable to keep the Bearing Housing components coated with oil. There are two ways that this can be achieved:
   a) Turn the Mainshaft 180º once every month.
      or
   b) Fully fill the Bearing Housing with the recommended lubricating oil to the filler neck to keep the bearings submerged. (This is more important in cold climates where rusting due to condensation could occur). **Refer to Section *7.7. "Recommended Lubricants".***
4. All exposed steel (except for stainless steel) parts should be protected from corrosion. To do this, coat these parts with a thin layer of rust preventative oil.

PREPARATION FOR USE

To ready the Jet Unit for use:

1. If the Bearing Housing has been completely filled with oil, drain out and refill with new oil. **Refer to Section *7.7. "Recommended Lubricants" and Drawing 85018. "Recommendations for Lubricants & Oils".***
2. Remove the ***"Mainshaft Support Tool"*** and refit the Inspection Cover. **Drawing HJ-391-11-000 refers.**

7.2 PRESERVATION: (Post Installation)

CAUTION:

The Jet Unit cannot be run out of the water.

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

If the Jet Unit is to be Laid-Up, carry out the following:-

1. Clean down the whole Jet Unit and wash inside and out with fresh water.
2. Hose the inside of the jet through the Intake Grill and the Nozzle. Allow to dry completely.
3. Spray with a suitable corrosion protection oil such as Shell Ensis.
4. Oil and lubricate all moving parts.

Carry out the following on a monthly basis:-

1. If the engine cannot be run, turn the Mainshaft by 180º. This can be done manually.
2. Stroke the Reverse Duct fully six times and leave in the raised position.
3. Operate the Steering from lock to lock fully six times.

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

1. Actively prevent marine growth through the following procedures:
   a) Paint the inside and outside of the Jet Unit with antifouling compound
   b) Keep light away from the Jet Unit. Moor the vessel in deep water rather than shallow water.
   c) Place an opaque bag over the Steering Nozzle to prevent light entering the inside of the Jet Unit. In shallow water a similar cover should be tied over the Intake Screen.

CAUTION:

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

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

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

7.3 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 servicing intervals may be varied to suit actual operating conditions.
   - Carry out a complete Jet Unit inspection every 5000 hours **(Refer to Section 7.4 / 14).**
   - Carry out Bearing Housing oil replacement every 1000 hours **(Refer to Section 7.4 / 3).**

SERVICING INTERVALS											
ITEM	WHAT TO DO	REFER TO	FIRST 5 HOURS	1 DAY	100 HOURS	500 HOURS	1 MONTH	3 MONTHS	1000 HOURS	FIRST 2000 HOURS	5,000 HOURS
INTERNAL WATER PATH	CLEAR BLOCKAGES	7.4/1		•							
BEARING HOUSING	CHANGE OIL	7.4/3	•						•		
BEARING HOUSING	CHECK OIL	7.4/2		•							
WATER SEAL	CHECK FOR LEAKS	7.4/4		•							
EXTERNAL ANODES	CHECK CONDITION	7.4/5						•			
REVERSE CYLINDERS & HOSES	CHECK FOR LEAKS, DAMAGE OR CORROSION	7.4/6	•				•				
REVERSE PUSH ROD	LUBRICATE	7.4/7			•		•				
STEERING CYLINDERS & HOSES	CHECK FOR LEAKS, DAMAGE OR CORROSION	7.4/8	•				•				
STEERING COTTER PINS	CHECK INTEGRITY	7.4/9		•							
STEERING CRANK	LUBRICATE	7.4/10			•		•				
STEERING SHAFT BUSHES	LUBRICATE	7.4/11			•		•				
SCREEN RAKE BEARINGS	LUBRICATE	7.4/12			•		•				
DRIVE SHAFT	LUBRICATE	7.4/13				•					
COMPLETE JET UNIT	EXAMINE / REPAIR	7.4/14								•	•

7.3.1 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	Check via Intake Inspection Hatch that they are clear of debris. **Ensure that water level is below Hatch or Overflow Preventer before opening Jet Inspection Covers.**
Reverse hydraulic oil lines.	Check for oil leaks especially if oil has been added to a system.
Steering hydraulic oil lines.	Check for oil leaks especially if oil has been added to a 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 oil causing corrosion and failure of the Thrust Bearings.
Thrust Bearing Oil	Check Thrust Bearing oil level and condition: **a)** A small loss of oil is not critical, Seals and Sleeves should be changed when the boat is next docked for overhaul. **b)** If the oil is a milky white colour, water has contaminated the oil, probably caused by a faulty Water Seal. Drain oil, flush Housing and refill with new oil and bleed the system.
Steering Cotter Pins	Check that the Steering Cotter Pins and Retaining Nuts are secure.

7.4 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 6.9. "Blockages (Debris in the Jet Unit)".**
2	Bearing Housing Oil - Checking.	**Check the oil level and condition daily.** The following conditions may be found during oil checks:- a) Oil level low. Check for faulty oil Seals. b) Oil has turned a milky white colour. Water has contaminated the oil. Check Water Seal. **Refer to Section 8.5. "Bearing Housing Area Removal and Overhaul".** I. Drain Bearing Housing oil. II. Flush out the Bearing Housing. III. Refill with new oil.
3	Bearing Housing Oil Changing.	**Change the Bearing Housing oil after the first 5 hours of running and then every 1000 hrs. (This period may be adjusted to ensure oil is changed before it deteriorates and to suit the operating conditions).** a) Place a container large enough to hold all the Bearing Housing oil, under the Bearing Housing Drain Plug. b) Remove the Dipstick. c) Remove the Drain Plug and allow all the oil to drain out. d) Inspect condition of the oil. e) Refit the Drain Plug. f) Refill the Bearing Housing with the correct oil as recommended in **Drawing 85018.**

CAUTION:

Do not block the drain holes in the underside of the Bearing Housing, as this may cause the water to mix with the oil, causing corrosion and eventual failure of the Thrust Bearing.

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. **Refer to Section 9.5.2. "Water Seal Removal".**
5	External Anodes	Check the condition of the Anodes every 3 months. Refer to Drawing HJ-391-13-002 for Anode location details.

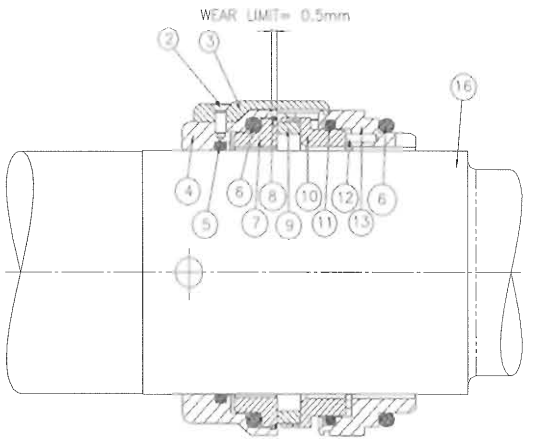
NOTE:

The rate at which Anodes erode away will vary considerably depending on the nature of the water. The inspection interval for Anodes can be increased after the actual erosion rate is determined from experience.

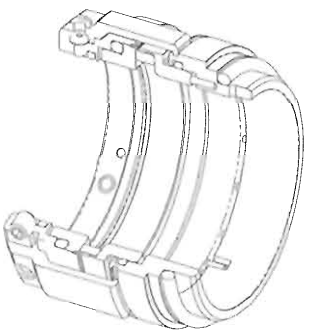
a) Inspect all external Anodes.
b) Replace any Anode which is less than half its original size.
c) Ensure that mating surfaces are scraped clean for good electrical contact.

Item No	Item	Operation
		d) Ensure that the Anodes are not painted over (especially when applying Antifouling paint). e) Scrub down with a wire brush if a coating has built up on the Anode. f) Retighten attachment fasteners to the recommended torque. g) Ensure that all fasteners are correctly tightened when fitting new Anodes.
6	**Reverse Hydraulic Cylinder and Hoses**	**Check after the first 5 hours and then monthly.** Check for leaks, damage or corrosion. Methodically check the Reverse Cylinder and attached hoses for any signs of oil leaks, damage or corrosion of the fittings. Repair as necessary. Refer to the Controls Manual supplied with this Jet Unit for information on Hose replacement.
7	**Reverse Push Rod**	**Lubricate every 100 hrs or Monthly whichever soonest.** Apply a light smear of marine grease to the Reverse Push Rods. **Refer to Drawings HJ-391-07-001.**
8	**Steering Hydraulic Cylinder and Hoses**	**Check after the first 5 hours and then monthly.** Check for leaks, damage or corrosion. Methodically check the Steering 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.
	NOTE: **The HJ-391 Steerable (JT) Nozzle System has been designed with minimum clearances between the Nozzle and Nozzle Housing. This allows optimum steering thrust at any lock with the minimum of loss of steering thrust. It is important to keep the Pivot Pins and Bushes in good condition to maintain clearances.** **Heavy impacts on the Nozzle Housing may deform it and cause the steering to jam.**	
9	**Steering Cotter Pins**	**Check integrity daily.** Check that the Cotter Pins are secure and that the retaining nuts are secure.
10	**Steering Crank**	**Lubricate every 100 hrs or Monthly whichever soonest.** Apply lubricating oil to the top of the Steering Crank and allow the oil to flow down into the joint.
11	**Steering Shaft**	**Lubricate every 100 hrs or Monthly whichever soonest.** Apply Marine Grease to the Steering Shaft. **Refer to Drawings HJ-391-06-005.**
12	**Screen Rake (If fitted)**	**Check and lubricate the Screen Rake Bearings every 100 hrs or Monthly whichever soonest.** a) Check for free operation. Stiffness or binding may be caused by debris caught in the Screen Rake or seized Screen Rake Bearings. Rectify as necessary. b) Apply grease to grease nipple on each side of the Screen Rake assembly.
13	**Driveshaft**	**Lubricate every 500 hrs or to suit the manufacturers recommendations.** Follow the manufacturers recommendations for type of Driveshaft used.

Item No	Item	Operation
14	Jet Unit	**Carry out an 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:-



ITEM NO.	DESCRIPTION
2	FLAT HEAD SCREW (C'SUNK)
3	SETTING CLIP
4	MATING RING HOLDER
5	O RING
6	O RING
7	MATING RING (WIRE RETAINED)
8	MATING RING RETAINING WIRE
9	BLK SEAL RING INSERT
10	SEAL RING SHELL
11	O RING
12	SPRING
13	STATIONARY ADAPTOR
14	PIN (Not Shown)
15	PIN (Not Shown)
16	MAINSHAFT



a) Water Seal - Check

Check for water dripping from beneath the Bearing Housing. If water is present, the Water Seal is defective and requires replacing as soon as possible. **Refer to Section 9.5.2. "Water Seal Removal".**

Check the Water Seal **"Max Wear Limit = 0.5mm"** has not been exceeded. Replace if the Water Seal will not reach the next maintenance period before it reaches its Max Wear Limit.

b) 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).

Impeller Clearance Specification:

Maximum recommended worn clearance between the Impeller and the Wear Ring:-

1.5 mm (0.060 inches) per side.

New clearance:- Approx. 0.6 mm (0.024inches).

c) Impeller and Wear Ring.-.Check for Wear and Damage

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

Item No	Item	Operation
14 (contd)	Jet Unit (contd)	**d) Reverse Duct - Remove** These items are to be removed in accordance with **Section 9.2.1. "Reverse Duct Removal"** in this Manual. **e) Steering Equipment. - Check for Wear** 1. Check all bushes of the Steering Equipment. These are: a) Steering Nozzle Pivot Pin Bushes [3]. b) The Steering Crank Bush [27]. c) The Steering Shaft Bushes [11] that guide and support the Steering Shaft. 2. These bushes should not be corroded, and should have free play less than about 0.4 mm (0.016 inches). 3. Check the Shaft Seal Housing [19] Seals for wear and damage and distortion. **Replace as shown in Section 9.3.13. "Shaft Housing Seal Assembly - Removal and Overhaul".** 4. Check the Lip Seals [39] attached to the rear face of the Nozzle. **Refer to Section 9.3.10. "Nozzle Overhaul".** **f) Steering Linkages - Disconnect** These items are to be disconnected and removed in accordance with **Section 9.3. "Steering Assembly Removal and Overhaul"** in this Manual. **g) Tailpipe, Nozzle & Nozzle Housing - Removal** When removing these items, refer to **Section 9.6. "Overhaul of the Tailpipe Area"** and **Section 9.3.9. "Steering Nozzle / Nozzle Housing Removal".** **h) Marine Bearing - Inspect** Push the Mainshaft hard from side to side to measure sideways movement of the Mainshaft. Measure movement at the Impeller blade tips. ***Maximum allowable total movement is 0.6 mm (0.024 inches)***. This indicates the amount of wear in the Marine Bearing and Bearing Sleeve. **i) Check all Castings, and other parts for Integrity** Check for the following possible problems: • Cracks. • Loose studs or nuts. • Corrosion. • Any other general wear.

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.

Item No	Item	Operation
14 (contd)	Jet Unit (contd)	**j) Jet Unit Paintwork.** The main body of the Jet Unit is constructed from Silicon-Aluminium alloy (LM6) which is resistant to salt water corrosion. The castings are finished in a polyurethane paint. Periodic cleaning down, wire-brushing and repainting may be required depending on water conditions 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. **k) Refit Components.** Refit components in accordance with the Overhaul Section of this Manual. Follow the recommendations on **Drawing 85113 "Recommendations, Fastener Locking, Torque and Thread Lubrication"**, for thread tightening torques, joint lubrication, thread and joint locking, Bearing Housing lubricants and hydraulic fluids. **l) Insulation Checks (Steel Hulls and Carbon Fibre Reinforced GRP Hulls Only).** Carry out Insulation Checks on a monthly basis, refer to **Section 8.3.2. "Checking the Insulation".**

If excessive wear or damage has been found, then undertake appropriate overhaul procedures as described in **Section 9. *Overhaul***. Schedule the next maintenance period to suit the conditions found during this inspection, using the following guidelines:

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

7.5 TOOLS

7.5.1 General Tools

The following tools are required for normal maintenance activities:

1. 1" drive torque wrench with capacity to 1100 Nm. This is for Impeller nut and Coupling nut.
2. 1/2" drive ratchet, torque bar and short extension with minimum of 13 mm, 17 mm, 19 mm, 24 mm, 30 mm, 38 mm, 70 mm.
3. 1 x 9 mm, 1 x 10 mm , 2 x 17 mm and 1 x 24 mm A/F spanners.
4. 6 mm, Allen key.
5. Long nose pliers.
6. Rubber mallet.
7. 150 and 300 mm Adjustable Wrench.
8. Small and large Straight Screwdrivers.
9. Grease Gun.
10. 38 and 70 mm sockets. 1" drive.

7.5.2 Special Tools

Special tools supplied with the Jet Unit are shown on Drawing HJ-391-11-000.

7.6 THREADED FASTENERS

Drawing 85113. "Recommendations for Fastener Locking, Torque's & Thread Lubrication".

CAUTION:

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

TIGHTENING TORQUE'S FOR THREADED FASTENERS

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

1. **Special Fasteners -HJ-391 Jet.**

Item	Torque	
Impeller Nut	1100 Nm	800 lbs/ft
Impeller Nut Securing Screws	8 Nm	6 lbs/ft
Coupling Nut	600 Nm	450 lbs/ft
Bearing Retaining Nut	840 Nm	620 lbs/ft
Bearing Locknut Securing Screws	18 Nm	14 lbs/ft

2. **Standard Fasteners**

All torque loadings for standard fasteners are shown on **Drawing 85018** which is included in the Jet Drawings Package.

THREAD LOCKING AGENTS

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

7.7 RECOMMENDED LUBRICANTS

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

ANTI-SEIZE COMPOUNDS:

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

THREAD LOCKING AGENTS

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

7.8 ANTI-SEIZE COMPOUNDS

Do not use graphite based anti-seize compounds as they cause corrosion problems.

8. Precautions Against Corrosion

8.1 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.

8.1.1 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.

8.1.2 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.

8.1.3 Corrosion Monitor

Refer to Drawing 85148.

It is recommended that a corrosion monitor be fitted.

a) 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.

b) 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.

c) 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.

8.1.4 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".

8.1.5 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

Refer to Drawing HJ-391-13-002 for Anode location details.

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 Nozzle, 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.**

8.1.6 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.

8.1.7 Anti Fouling Paint

CAUTION:

ANTI FOULING PAINTS

Do not use copper oxide based anti-fouling paints. Leave all stainless steel parts polished and unpainted. Do not paint over the anodes.

8.1.8 Anti Seize Compound

CAUTION:

ANTI SEIZE COMPOUNDS

Do not use Anti-Seize Compounds which are based on Graphite, Nickel or Copper Flakes - these will cause corrosion. Anti-Seize Compounds, usually containing Zinc Flakes are available for Aluminium.

8.1.9 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.

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

8.2.1 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.

8.3 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.

8.3.1 Earth Bonding System (Not Normally Current Conducting)

Refer to Drawing 85114 for details on 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.

8.3.2 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 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.

REPLACING THE REVERSE DUCT PIVOT BUSHES [6]

If the Reverse Duct Pivot Bushes [6] fitted to the Reverse Duct Arms are worn, these should be replaced. To replace, carry out the following actions:-

1. Drift out the old Bush [6] using a suitable size drift. If the Bushes are hard to remove, it may be necessary to apply light heat to the Reverse Duct Arms in the area of the bush to break the seal.
2. Clean out the bores of the Reverse Duct Arms, ensuring that all old primer and activator is removed.

NOTE:

The bore is NOT to be repainted.

3. Apply Loctite Activator 7075 to the outside of the Bush [6] and allow to dry.

NOTE:

The Loctite Activator 7075 must be used to refit the Reverse Duct Pivot Bushes [6] otherwise the Loctite 325 will not cure and retain the Reverse Duct Pivot Bushes [6] in position.

4. Apply Loctite 325 to the whole surface of the bore.

NOTE:

There are to be NO dry areas between the bush and the bore once the Reverse Duct Pivot Bush is fully fitted.

5. Press the Bushes [6] into the bores in the Reverse Duct Arms.

NOTE:

Ensure that the Bushes [6] are pushed fully home and sit flush with the sides of the Reverse Duct Arms.

6. Wipe off any excess Loctite from around the Bushes [6].

REPLACING THE REVERSE DUCT ARM CLEVIS PIN BUSHES [23]

If the Reverse Duct Arm Clevis Pin Bushes [23] are worn, these should be replaced. To replace, carry out the following actions:-

1. Drift out the old Clevis Pin Bush [23] using a suitable size drift. If the Bushes are hard to remove, it may be necessary to apply light heat to the Reverse Duct in the area of the Bush to break the seal.
2. Clean out the bore in the Reverse Duct, ensuring that all old primer and activator is removed.

NOTE:

The bore is NOT to be repainted.

3. Apply Loctite Activator 7075 to the outside of the Bush [23] and allow to dry.

NOTE:

The Loctite Activator 7075 must be used to refit the Clevis Pin Bush [23] otherwise the Loctite 325 will not cure and retain the Clevis Pin Bush [23] in position.

4. Apply Loctite 325 to the whole surface of the bore.

NOTE:

There are to be NO dry areas between the bush and the bore once the Clevis Pin Bush is fitted.

5. Press the Clevis Pin Bush [23] into the bore in the Reverse Duct Arm.

NOTE:

Ensure that the Clevis Pin Bush [23] is pushed fully home and sits flush with the sides of the Reverse Duct Arm.

6. Wipe off any excess Loctite from around the Clevis Pin Bush [23].

REPLACING THE REVERSE DUCT ANODES [2]

Refer to Drawing HJ-391-13-002 for location of Anodes.
Check the Anodes [2] and clean with a wire brush. Replace the Anodes if they are more than half consumed.

To replace the Anodes on the Reverse Duct carry out the following:
1. Unscrew and remove the Nuts [5], Spring Washers [4] and Bolts [3], attaching the Anode [2] to the Reverse Duct [1].
2. Remove the Anode [2].
3. Clean up and repair any loose paint or corrosion around the Anode location.
4. Fit a new Anode [2] and secure with Bolts [3], Spring Washers [4] and Nuts [5].
5. Torque load to the recommended torque.
6. Carry out Items a) to e) for the second Anode.

9.2.2 Reverse Cylinders Removal

Drawing HJ-391-07-001 refers.

The Reverse Cylinders only need to be dismantled if they are suspected of seal failure or are leaking excessively. Typical symptoms of seal failure are:
- ***Piston Seal [34]:*** Reverse Duct not staying in up position. **Note that this can also be caused by faults in the Control System.**
- ***Shaft Seals [35]:*** Oil leaking from the Fronthead [31] or Backhead [30].

To remove the Reverse Cylinders carry out the following actions:-
1. Disconnect and blank off all hydraulic hoses and Sender linkages. **Refer to Overhaul Section in the Controls Manual.**
2. Remove the Split Pin [19] and Clevis Pin retaining the Reverse Duct if not already removed for overhaul. **(Refer to Section 9.2.1. "Reverse Duct Removal").**
3. Mark the Clevis [20] position on the Shaft [27] before unscrewing and removing the Anode [21].
4. Remove the 4 Bolts [14] and Spring Washers [15] from the two Pillow Blocks [12].
5. Loosen the Hose Clips [24] at the Transom and pull the Cylinder forward until the Hose [26] is free from the Hose Tail Tube [25].
6. Lift the Pillow Blocks [12] up off the Dowels [16] and withdraw the Cylinder Assembly from the Jet Unit.
7. Repeat Items 1 to 6 to remove the second Reverse Cylinder.

9.2.3 Reverse Cylinder Dismantling

1. Remove the Mount Plate [42] from the Reverse Cylinder by removing the Pillow Blocks [12]. Inspect the Bushes [13] in the Pillow Block for wear. Replace if worn.
2. Remove the Nipples [40] and Bonded Seals [41] at both ends of the Cylinder.
3. Unscrew and remove the End Cap [33].
4. Remove the Backhead [30] from the Cylinder [32].
5. Remove the Mainshaft [26] complete with Piston [29] and Compensator Shaft [28] from the Cylinder.

NOTE:

Do not remove the Mainshaft [26] and the Compensator Shaft [28] from the Piston [29] unless they are worn or damaged and require replacement.

6. Unscrew Fronthead [31] from the Cylinder Barrel [32] using a Strap Wrench. Apply minimal heat if required to break the thread locking agent. Take care not to distort the Cylinder Barrel.
7. Remove all seals from the Piston [29], Backhead [30] and Fronthead [31].
8. Check the Cylinder [32] bore and Shaft [27] outside diameter for scoring and wear.
9. Remove all traces of the old thread locking agent from the Fronthead and Cylinder Barrel and thoroughly clean all parts..
10. Repeat Items 1 to 9 for the second Reverse Cylinder.
11. The following components should be examined for wear, score marks on the sliding surfaces or damage to the components. Replace any components showing signs of wear or damage.
    a) **Cylinder Barrel [32].**
    b) **Mainshaft [27].**
    c) **Compensator Shaft [28].**
    d) **Piston [29].**
    e) **Front Head [31].**
    f) **Back Head [30].**
    g) **Seals [34]. [35]. [36].**
    h) **Wear Rings [37].**
    i) **O Rings [38].**
    j) **Reverse Cylinder Anodes [21].**

REPLACEMENT OF THE REVERSE CYLINDER ANODE [21].

Refer to Drawing HJ-391-13-002 for location of Anodes.

1. Check that the Anodes [21] fitted to the outboard end of both the Reverse Cylinder Mainshaft [27]. If they are less than $^{2}/_{3}$rds of their original size, the Anodes should be replaced.
2. To replace the Reverse Cylinder Anodes [21] carry out the following actions:
    a) Unscrew the Thin Locknut [22] securing the Anode to the rear of Clevis [20].
    b) Mark the position of the Clevis [20] in relation to the Mainshaft, 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 Reverse Cylinder Mainshaft [27], unscrew the Clevis [20] from the end of the Reverse Cylinder Mainshaft and remove complete with Anode [21].
    d) Ensure that the Anode to Clevis contact surface is clean. Any loose paint or corrosion in the area is to be cleaned off and the paint surface repaired.
    e) Ensure that the Thin Locknut [36] is screwed fully onto the threaded end of the Reverse Cylinder Mainshaft [27].
    f) Refit a new Anode [21] onto the Reverse Cylinder Mainshaft.
    g) Screw the Clevis [20] onto the Reverse Cylinder Mainshaft [27] to the position marked at 2b) above.
    h) Push the Anode [21] up to the rear face of the Clevis and tighten the Thin Locknut [22] to secure the Anode [20] in position.
    i) To replace the second Reverse Cylinder Anode, carry out the actions a) to h).

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

9.2.4 Reverse Cylinder Re-Assembly

NOTE:

A. The Cylinder [32] and Mainshaft [27] must be replaced as a matched pair.

B. A Cylinder Overhaul Kit is available. This includes all Seals and a container of thread lock fluid 'Loctite 262'.

1. If the Mainshaft and Compensator Shaft have been separated from the Piston during overhaul, re-assemble the into the Piston using Loctite 262 on the screw threads to secure the Mainshaft and Compensator Shaft to the Piston and tighten to 80 ft/lbs (110 Nm.).
2. Fit new Seals to Piston [29], Backhead [30] and Fronthead [31].
3. Apply Loctite 569 or equivalent to the Cylinder threads engaging the Fronthead [31] and tighten Fronthead using a Strap Wrench.
4. Oil the Mainshaft and Piston Assembly and insert into the Cylinder. Care should be taken not to damage or displace the Seals.
5. Replace "O" Ring [38] in the Backhead and re-fit the Backhead to the Cylinder. Fit and tighten the Endcap [33].
6. If possible workshop test the Reverse Cylinder to its test pressure as shown on **Drawing HJ-391-07-001. Sheet 1.**

9.2.5 Reverse Cylinder Re-Fitting

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

1. Re-assemble the Hose [26] onto the Reverse Cylinder Fronthead [31] and secure with Hose Clip [24].
2. Fit the Hose Tail Tube [25] from inside the vessel, to the Transom using Loctite 680 and screw into the Transom using a soft jawed tool to grip the outside of the tube.
3. Ensure that the Anode [21] has been removed from the Mainshaft [27].
4. Loosely fit the second Hose Clip [24] over the Hose [26] fitted to the Reverse Cylinder Fronthead.
5. From inside the vessel, slide the Reverse Cylinder Mainshaft through the Hose Tail Tube [25] fitted to the Transom.
6. For the first mounting, assemble the Pillow Blocks [12] on the Reverse Cylinder [32] and guide the Pillow Blocks [12] towards the Dowels [16] fitted to the Impeller Race. Take note of how much further movement is required for the mounting holes to line up with the Dowels. This length must be trimmed from the Hose [26].
7. Move the Reverse Cylinder rearwards, guiding the Hose [26] over the Transom mounted Hose Tail Tube [25], until the Hose [26] fits completely over the Hose Tail Tube [25].
8. Position and tighten the second Hose Clip [24] around the rear of the Hose [26] to secure the Reverse Cylinder to the Transom.
9. Refit the Pillow Blocks [12] over the Dowels [16] fitted in the Impeller Race. Fit Bolts [14] and Spring Washers [15]. Tighten the bolts to the recommended torque. **(Drawing HJ-391-07-001 refers).**
10. Screw the thin Nut [22], Anode [21] and Clevis [20] onto the Reverse Cylinder Mainshaft end. Tighten the thin Nut [22] up against the Anode. Ensure that the Clevis is screwed back to the original mark made on removal of the Clevis.
11. Carry out Items 1 to 8 above to refit the second Reverse Cylinder.

9.2.6 Reverse Duct Re-Fitting

1. Ensure that all the Bushes [6] and [23] in the Reverse Duct are in good condition.
2. Apply marine grease to all sliding parts.
3. Using Lifting Gear, position the Reverse Duct so that the two Lower Pivot Bushes [6], line up with the threaded Pivot Pin Inserts [9] in the Tailpipe.
4. Insert the two Pivot Pins [7] and the Thrust Washers [8] through the Pivot Bushes and into the Tailpipe.
5. Fit and tighten the 4 Bolts [10] and Spring Washers [11] to the recommended torque.

NOTE:

The Pivot Pin uses a special torque. Refer to Drawing HJ-391-07-001 Reverse Assembly for HJ-391 Jet for torque figures.

6. With the Reverse Duct refitted to the Tailpipe, using lifting gear, raise the Reverse Duct and align the 2 Reverse Cylinder Clevis with the attachment points on the Reverse Duct.
7. Fit Spacer Washers [17] on either side of the Reverse Duct Attachment Points between the Clevis and the Reverse Duct. **(Drawing HJ-391-07-001 Section Z-Z refers)**.
8. Fit the Clevis Pin [18] to both Reverse Cylinders, ensuring that the Spacer Washers [18] remain in position.
9. Secure the two Clevis Pins [18] with Split Pins [19], ensuring that the legs of the Split pins are spread.
10. Reconnect hydraulic hoses.
11. Reconnect linkage to any sensors attached to the end of the cylinders.
12. Remove any lifting gear used for the raising of the Reverse Duct.

9.2.7 Adjustment of the Reverse Duct Position

Should the marked Clevis position of the Reverse Cylinders be lost, re-adjust the Clevis position as follows:

1. Lower the Reverse Duct fully, until the cylinders are at the end of their stroke.
2. Place a straight edge, square to the face of the Steering Nozzle, from the bottom of the Steering Nozzle opening, across to the Reverse Duct.
3. The base of the Reverse Duct opening should line up with the straight edge, ensuring that all the water jet is collected by the Reverse Duct.
4. If the Reverse Duct is too high or too low, adjust this position by adjusting the Clevis [20] either in or out on the Reverse Cylinder Main Shaft [27]. The second Reverse Cylinder must also be adjusted accordingly.
5. Once adjustments are completed, tighten the Slim Nuts [22] firmly on both Reverse Cylinders to secure the Clevis [20] at the correct position.
6. Reconnect any Control equipment attached to the Reverse Cylinders. **Refer to the *Overhaul* Section of the Controls Manual for further information.**

9.3 STEERING ASSEMBLY REMOVAL AND OVERHAUL

The Steering System oil should be changed annually or immediately if contaminated in any way. If the oil has been contaminated, all components must be dismantled, cleaned thoroughly and hydraulic lines flushed clean with Kerosene, Varsol or Diesel Oil

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.

NOTE:

This Jet Unit can be fitted with either a "Wagner" or a "Hamilton" Steering Cylinder. Please ensure that, prior to commencing Overhaul of the Steering Cylinder, the correct information is referred to in this Section.

A Cylinder Seal Kit is available from C.W.F. Hamilton and Co Ltd. Please ensure that the Type of Cylinder (i.e. Wagner / Hamilton, 120 or 190) is stated when ordering Cylinder Seal Kits.

Refill the hydraulic system with approved oil and bleed as per instructions in the Installation Section of the Controls Manual.

9.3.1 Steering Cylinder Removal (Hamilton Cylinder)

Drawings HJ-391-06-005, CT-SJK-01-011 and CT-SJK-03-003 in the Controls Manual refer.

1. Disconnect any Sensors attached to the Tiller [17]. Refer to the **Overhaul Section of the Controls Manual.**
2. Disconnect the Steering Cylinder Rod End from the Tiller [17] by removing Bolt [9] and two Thin Nuts [10] connecting Steering Cylinder Rod End to the Tiller.
3. Disconnect Steering Cylinder Hose connections as described in the **Overhaul Section of the Controls Manual,** ensuring that all connections are fitted with blanks to prevent ingress of moisture and dirt and the leaking of hydraulic oil.
4. Remove the 4 Nuts [12] and Spring Washers [13] retaining the Steering Cylinder to the Cylinder Mounting Bracket and remove the Steering Cylinder.
5. Check the Steering Shaft and linkage for:
   a) Free axial movement.
   b) Undue wear in the Steering Shaft Seals and sideways movement of rod].
   c) Undue wear in the Piston Wear Ring.
   d) Undue wear in the Piston Rod Assembly.
   e) Wear in the spherical rod end joints of the Steering Cylinder.

A Cylinder Seal Kit is available from C.W.F.Hamilton and Co Ltd.

9.3.2 Steering Cylinder Overhaul (Hamilton Cylinder)

Refer to Drawing CT-SJK-03-003 for HJ-391Jet Unit, in the Controls Manual.

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.

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

1. Unlock the M16 Thin Nut [18] from the Rod End [19] and unscrew the Rod End from the Shaft Assembly [10].

2. Unscrew and remove both ¼" BSPP Nipples [20] complete with Seal Washer [21] and Nitrile Seal [22] from Front Head [8] and the Back Head [6].
3. Whilst securely retaining the Cylinder [7] unscrew the Front End Cap [9] using a suitable "C" Spanner.
4. Remove the Front End Cap [9] and Front Head [8] complete from the Cylinder [7] and withdraw from the Cylinder Shaft [10]. Remove "O" Ring [17] and discard.
5. Withdraw the Shaft Assembly [10] fully from the Cylinder Barrel [7].
6. Unscrew the Cylinder [7] from the Backhead [6].]. Remove "O" Ring [16] and discard.
7. Remove all Seals "O" Rings and Wear Strips from the Shaft Assembly [10] , Front Head [8], and Backhead [6] and discard.

NOTE:

There is an "O" Ring fitted between the Piston and the Shaft Assembly [10]. This seal should not be disturbed as it should never require replacement. Should the Shaft Assembly or Piston require replacement, this seal will be already fitted as part of the Shaft Assembly [10].

8. Examine the Shaft Assembly [10] for excessive wear, and damage. Replace if excessive.
9. Check the Cylinder Mount [1] and Backhead [6] for damage and wear.
10. **There should be no requirement to dismantle the End Cap [2] from the Cylinder Mount [1] unless specifically replacing worn or damaged components.** Should the movement between the Cylinder Mount and Backhead be excessive, this movement can be reduced by tightening the End Cap [2] using a suitable Peg Spanner. **Do not overtighten the End Cap [2].**
11. Clean all parts thoroughly.
12. Check the Cylinder Bore and Piston Rod Assembly Shaft outside diameter. Replace if obviously worn or scored.

9.3.3 Steering Cylinder Re-Assembly (Hamilton Cylinder)

Refer to Drawing CT-SJK-03-003 for HJ-391 Jet Unit, in the Controls Manual.

NOTE:

To assist in the refitting of the Shaft Seals [11] and Wiper Seals [12] in the Front Head [8] and Back Head [6], the seals can be softened in warm water (hand warm - 55°C).

1. Replace the Shaft Seals [11] and Wiper Seals [12] in the Front Head [8] and Back Head [6],
2. Replace the Shaft Wear Strips [13] in the Backhead [6] and in the Fronthead [8].

NOTE:

A. The Shaft Wear Strips are supplied in Pre-Cut lengths and should be bent into a "C" shape to fit into their respective locations.

B. Two Shaft Wear Strips are fitted side by side in each location.

3. Replace the Piston Seal [14]on the Piston Shaft Assembly [10]. Fit the square rubber seal into the piston groove first ensuring that the seal is not twisted. Fit the Outer Ring (Red Coloured) on top of the Piston Seal [14].
4. Fit the Piston Wear Strip [15] to the Piston Shaft Assembly [10].
5. Apply a light smear of an approved oil or grease to the seals on the Front End Cap [9] and refit the Front End Cap over the Front Head [8].
6. Replace "O" Ring [17] on the front end of the Cylinder [7] and smear lightly with an approved oil or seal grease.
7. Loosely screw the Front End Cap [9] complete with the Front Head [8] onto the Cylinder [7]. **Do Not Tighten.**

8. Apply a light smear of an approved oil or grease to the seals on the Piston Shaft Assembly [10] and slowly feed the threaded end of the Piston Shaft Assembly through the Cylinder and the Front Head [8], taking care not to damage or displace the Shaft Wear Strips [13], Shaft Seal [11] and Shaft Wiper [12]. Push the Piston Shaft assembly home until the piston seals are completely inside the Cylinder.
9. Replace "O" Ring [16] on the lower end of the Cylinder [7] and smear lightly with an approved oil or seal grease.
10. Fit the Back Head [6] complete with Cylinder Mount [1] over the unthreaded end of the Piston Shaft Assembly [10], taking care not to damage or displace the Shaft Wear Strip [13], Shaft Seal [11] and Shaft Wiper [12] and Loosely screw into position
11. Tighten up the Front End Cap [9] and the Back Head [6], ensuring that the Nipple apertures remain in alignment fore and aft.
12. Refit the two Nipples [20] with Seal Washers [21] and Nitrile Seals [22] and tighten.
13. Refit the Rod End [19] and tighten up the pinch Nut 18].

NOTE:

A. It is advisable to workshop test the Steering Cylinder prior to refitting to the vessel.

B. The Test Pressure for the Steering Cylinder is 2250 lbs/psi.

9.3.4 Steering Cylinder - Refit to the Jet Unit (Hamilton Cylinder)

Drawing HJ-391-06-005 and Drawings CT-SJK-01-011 (Bracket) and CT-SJK-03-003 in the Controls Manual Drawing Package refer.

The refitting of the Steering Cylinder to the Cylinder Mounting Bracket should be carried out in consultation with the Steering Drawings contained in the Controls Manual Drawings Package.

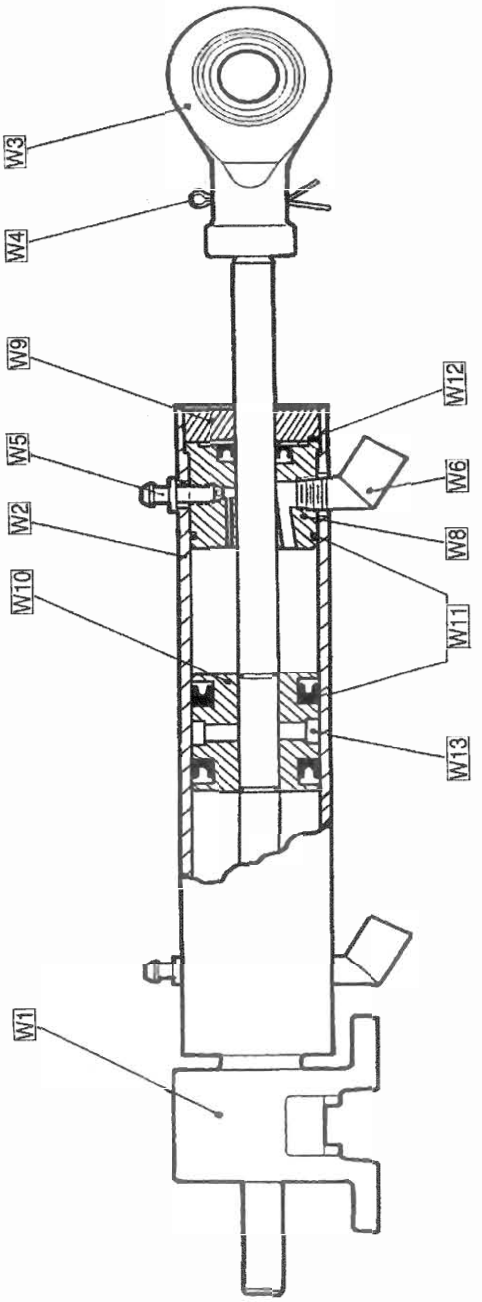
1. Mount the Steering Cylinder [7] onto the Studs [11] on the Bracket [3] with Nuts [12] and Spring Washers [13].
2. Connect the Steering Cylinder to the Tiller with Bolt [9] and 2 Thin Nuts [10].
3. Reconnect the Cylinder Hose connections to the Steering Cylinder. **Refer to the Controls Manual Drawing Package for correct Hose Connection information.**
4. Connect any Sensors attached to the Steering Crank. Refer to the **Overhaul Section of the Controls Manual.**
5. Refill the system with approved oil and bleed in accordance with instructions in the Controls Manual **Section 2. "Filling and Bleeding the Steering System".**

NOTE:

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

9.3.5 Steering Cylinder Removal (Wagner Cylinder)

Drawings HJ-391-06-005 and drawings CT-SJK-01-011 and CT-SJK-03-003 in the Controls Manual Drawing Package refer.



1. Disconnect any Sensors attached to the Tiller [17]. Refer to the **Overhaul Section of the Controls Manual.**
2. Disconnect the Steering Cylinder Rod End from the Tiller [17] by removing Bolt [9] and two Thin Nuts [10] connecting Steering Cylinder Rod End to the Tiller.
3. Disconnect Steering Cylinder Hose connections as described in the **Overhaul Section of the Controls Manual,** ensuring that all connections are fitted with blanks to prevent ingress of moisture and dirt and the leaking of hydraulic oil.
4. Remove the 4 Nuts [12] and Spring Washers [13] retaining the Steering Cylinder to the Cylinder Mounting Bracket and remove the Steering Cylinder.
5. Check the Steering Shaft and linkage for:
   a) Free axial movement.
   b) Undue wear in the Steering Shaft Seals and sideways movement of rod].
   c) Undue wear in the Piston Wear Ring.
   d) Undue wear in the Piston Rod Assembly.
   e) Wear in the spherical rod end joints of the Steering Cylinder.

A Cylinder Seal Kit is available from C.W.F. Hamilton and Co Ltd.

Refill the system with approved oil and bleed in accordance with instructions in the **Controls Manual Section, "Filling and Bleeding the Steering System".**

9.3.6 Wagner Steering Cylinder Information.

STEERING CYLINDER ASSEMBLY (WAGNER N40-120) PARTS LIST (HJ-391 / HM 422 / 461Jets)			
Item	Part No	Qty Reqd	Description
W1	710-0002	1	Trunnion Assembly
W2	720-0006	1	Cylinder Barrel
W3	710-0003	1	Rod End Assembly
W4	51-182005	1	Cotter (Split) Pin
W5	720-0014	2	Bleed Fittings
W6	41-332038	2	45° Street Elbow
W7	41007025	2	Hose
W8	720-0005	1	Cylinder End
W9	720-0003	1	Retainer
W10	710-0001	1	Piston Rod Assembly
W11	119-0082	1	Seal Kit (Includes all Seals)
W12	91-992001	1	Washer
W13	720-0052	1	Piston Wear Ring
W14	41-007025	2	Cylinder Hose (not illustrated)

9.3.7 Steering Cylinder Overhaul (Wagner Cylinder)

Diagram at Section 9.3.5. "Steering Cylinder Removal (Wagner Cylinder)" refers.

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

1. Unscrew and remove both 45° Street Elbow fittings [W6] from the Cylinder Barrel [W2].
2. Unscrew and remove both Bleed Fittings [W5] from the Cylinder Barrel [W2].
3. Unscrew and remove both Hex Headed Allen Screws [Not Shown] from the Retainer [W9].
4. Unscrew the Retainer [W9] fully from the Cylinder Barrel. The Retainer and Washer [W12] cannot be removed until the Rod End Assembly [W3] is removed.
5. Withdraw Piston Rod Assembly [W10] complete with Cylinder End [W8], the Retainer [W9] and Washer [W12] from the Cylinder Barrel [W2].
6. Remove Cotter Pin [W4] from the Rod End Assembly [W3] and unscrew the Rod End Assembly from the Piston Rod Assembly [W10].
7. Slide the Retainer [W9], Washer [W12] and the Cylinder End [W8], off the Rod Assembly. Noting the orientation of the large and small seals of the Cylinder End in relationship to the Cylinder Barrel. (Small Seal facing towards outer end of Cylinder Barrel. Large seals towards the centre of the cylinder).
8. Examine the Rod End Assembly [W3] for excessive wear, stiffness and damage to the joint. Replace if excessive.
9. By placing a suitable length of ½" dia round bar through the hole in the Trunnion Ball to restrain the rotation of the Trunnion Ball End within the Trunnion Assembly [W1], unscrew the Cylinder Barrel from the Trunnion Ball, taking care not to lose the Washer [W12] and damage or drop the lower Cylinder End [W8] whilst removing the Trunnion Assembly.
10. Remove Washer [W12] and remove the lower Cylinder End [W8] from the Cylinder Barrel. Note the orientation of the large and small seals of the Cylinder End in relationship to the Cylinder Barrel. (Small Seal facing towards outer end of Cylinder Barrel).
11. Check the Trunnion Assembly [W1] and Trunnion Bearings for wear[not shown]. Should the wear be excessive, dismantle and replace the Trunnion Bearings.
12. Remove all seals from the Piston Rod Assembly and both Cylinder Ends and discard.

13. Clean all parts thoroughly. Ensure all Threadlock fluid is removed from threads.
14. Check Cylinder Bore and Piston Rod Assembly Shaft outside diameter. Replace if obviously worn or scored.

NOTE:

The Cylinder Bore and Piston Rod Assembly must be replaced as a matched pair.

9.3.8 Steering Cylinder Re-Assembly (Wagner Cylinder)

Diagram at Section 9.3.5. "Steering Cylinder Removal (Wagner Cylinder)" refers.

1. Fit new seals from Seal Kit [W11], ensuring correct orientation of all seals.
2. Oil the Piston Rod Assembly [W10] with an approved oil (See Section 8, Approved Oils) and insert into the Cylinder Barrel [W2] until the Piston Rod protrudes equal length from either end of the Cylinder Barrel. Taking care not to damage the seals.
3. Oil one Cylinder End [W8] and slide over the threaded end of Piston Rod Assembly, ensure that the small inner seal is on the outer face of the Cylinder End.
4. Ensure correct orientation of the tapped large and small holes in the Cylinder End with the large and small holes in the Cylinder Barrel
5. Take care not to damage the outer seal on the Cylinder End, carefully push the Cylinder End firmly home until the base of the Cylinder End abuts against the shoulder in the cylinder barrel. Ensure the tapped large and small holes in the Cylinder End are aligned with the large and small holes in the Cylinder Barrel.
6. Apply Threadlock fluid to the male threads of the 45° Street Elbow fitting [W6] and refit to the large hole, ensuring that the elbow correctly locates through the Cylinder Barrel and into the Cylinder End. Hand tighten the elbow.
7. Refit the Bleed Fitting [W5] to the small hole at the same end of the Cylinder Barrel and hand tighten.
8. Refit Washer [W12] over the threaded end of the Piston Rod].
9. Apply Threadlock fluid to the threads of the Retainer [W9] and refit over the threaded end of the Piston Rod]. Screw Retainer fully home.
10. Apply Threadlock fluid to the threads of the two M8 Hex Headed Allen Screws [Not Shown] Screw into tapped holes in Retainer and tighten.
11. Refit Rod End Assembly [W3] ensuring that the drilled hole in the Rod End aligns with the hole in the threaded end of the Piston Rod.
12. Fit Cotter Pin [W4] and splay legs to retain, ensuring that the cotter pin legs are splayed back against the Rod End Assembly to prevent fouling.
13. Oil the second Cylinder End [W8] and fit over unthreaded end of the Piston Rod Assembly, check that the small inner seal is on the outer face of the Cylinder End.
14. Ensure correct orientation of the tapped large and small holes in the Cylinder End with the large and small holes in the Cylinder Barrel
15. Take care not to damage the outer seal on the Cylinder End, carefully push the Cylinder End firmly home until the base of the Cylinder End sits against the shoulder in the cylinder barrel. Ensure that the tapped large and small holes in the Cylinder End are aligned with the large and small holes in the Cylinder Barrel.
16. Apply Loctite to the male threads of the 45° Street Elbow fitting [W6] and refit to the large hole, ensuring that the elbow correctly locates through the Cylinder Barrel and into the Cylinder End. Hand tighten the elbow.
17. Refit the Bleed Fitting [W5] to the small hole at the same end of the Cylinder Barrel and hand tighten.
18. Refit Washer [W12] onto the unthreaded end of the Piston Rod.
19. Apply Loctite to the Trunnion Assembly [W1] threads and screw fully home. Place a suitable length of ½" dia round bar through the hole in the Trunnion Ball to restrain the rotation of the Trunnion Ball End within the Trunnion Assembly, screw the Cylinder Barrel fully home onto the Trunnion Assembly. Tighten hand tight.

NOTE:

It is advisable to workshop test the cylinder prior to fitting to the vessel.

9.3.9 Steering Nozzle / Nozzle Housing Removal

Drawing HJ-391-06-005 refers.

Prior to removing the Nozzle / Nozzle Housing from the Tailpipe, carry out the following inspection.

INSPECTING THE STEERING SHAFT AND BUSHES:

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

a) Free axial movement.
b) Excessive wear in the rear Steering Shaft Bush [11] and sideways movement of the Steering Shaft Rod [18].
c) Excessive wear in the Shaft Housing [19], Seals [20], [21], [22] and Rod Wiper Seal [30].
d) Wear in the spherical Rod End joints of the Steering Cylinder (Inboard).
e) Excessive wear in the Rod End Bushes outboard (These are normally a loose fit).

NOZZLE / NOZZLE HOUSING REMOVAL:

1. Disconnect any Sensors attached to the Steering Crank. **Refer to the Overhaul Section of the Controls Manual.**
2. If not already carried out in the previous Sections, disconnect the Steering Cylinder from the Tiller [17] as described in the Steering Cylinder Removal Section.
3. Disconnect the Steering Shaft [18] from the Crank [16] by removing the Nut [15] Spring Washer [14] Special Washer [13] and Cotter [12] from the from the Steering Nozzle end of the Steering Shaft.
4. Push the Steering Shaft forward into the vessel to clear the Steering Shaft Bush [11] and allow the Crank to be removed from the end of the Steering Shaft.
5. Remove the Steering Crank [16] from the Crank Bush [27] fitted in the Nozzle.

NOTE:

The Nozzle / Nozzle Housing can be removed from the Tailpipe / Nozzle Insert as a complete assembly. To remove, carry out the following actions:-

6. To remove the Nozzle / Nozzle Housing complete, carry out the following actions:-
   a) Remove Nuts [15] and Spring Washers [14] from Studs [37] securing the Nozzle Housing to the Nozzle Insert.
   b) Hit the Nozzle Housing sideways with a soft hammer and remove the Nozzle / Nozzle Housing off the Nozzle Insert.

REMOVING THE NOZZLE FROM THE NOZZLE HOUSING:

To remove the Nozzle from the Nozzle Housing, carry out the following actions:-

1. With the Nozzle / Nozzle Housing removed from the Tailpipe and before removing the Nozzle from the Nozzle Housing, loosen the JT Steering Lip Seals [39] as shown in Section 9.3.11. "Nozzle Housing Overhaul.
2. Remove Nuts [45] and Washers Special [46] from Studs [44] securing the Steering Arm [44] to the Nozzle [1].
3. Remove the Steering Arm off the Nozzle / Nozzle Housing.
4. Remove Bolts [4] and Nuts [6] securing the Nozzle Pivot Pins [2] in position.
5. Withdraw the Pivot Pins [2] fitted at the top and bottom of the Nozzle Housing.
6. Remove the Spacing Washer [33], [34] or [35] fitted between the Nozzle and the Nozzle Housing, at the top and bottom Pivot Pin locations.
7. Rotate the Nozzle and withdraw the Nozzle from the Nozzle Housing.
8. Remove and clean all components thoroughly.
9. Inspect all components for wear or damage. Repair or replace components as necessary.

INSPECTING STEERING NOZZLE [1] AND NOZZLE HOUSING [32]:

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

- **Nozzle Pivot Pin Bushes [3].**
- **Nozzle Housing Flanged Bush [26].**
- **Spacer Washers [33], [34], [35].**
- **Pivot Pins [2].**
- **Nozzle Crank Bush [27].**
- **Crank [16].**
- **Cotter [8].**
- **JT Steering Lip Seals [39].**
- **Nozzle Anode [7].**
- **Nozzle Housing Anode [36].**
- **Steering Shaft Bush [11].**
- **Steering Arm [43].**

REPLACING THE FORWARD STEERING SHAFT BUSH [11]. (Fitted to the Steering Bracket). Refer to Drawings CT-SJK-09-01-009 {Rotated Steering} or CT-SJK-01-010 {Non Rotated Steering} in the Controls Manual Drawings Package).

1. Examine the Steering Shaft Bush [11] located in the Steering Bracket attached to the Impeller Race.
2. If the Bush is found to be worn, and requires replacement, drift out the Bush [11] and clean out the bore of old Loctite and any corrosion.
3. Apply a thin coat of Loctite 747 or Primer 'T' to the mating surfaces of the Bush and the bore of the Steering Bracket and allow to dry.
4. Coat the primed surface of Bush [11] and Steering Bracket bore with Loctite 262.
5. Fit the Bush into the bore and rotate twice to distribute the Loctite.
6. Wipe off any excess Loctite from around the bush and Steering Bracket boss.

9.3.10 Nozzle Overhaul

Refer to Drawings HJ-391-06-005.

With the Nozzle and Nozzle Housing removed from the Jet Unit, carry out the following actions:-

REPLACING THE JT STEERING LIP SEALS [39].

NOTE:

The JT Steering Lip Seals can be replaced without separating the Nozzle from the Nozzle Housing. To replace the JT Steering Lip Seals [39], carry out the following actions:-

1. With the JT Steering Nozzle [1] and the Nozzle Housing [32] removed complete from the Jet Unit Tailpipe and placed face down on a workbench, unscrew and remove the Cap Screws [42] and Spring Washers [41] securing the 2 JT Steering Lip Seals [39] to the rear face of the Nozzle.
2. Carefully remove the 2 JT Steering Lip Seals [39] through the rear of the Nozzle Housing and discard.
3. Replace with 2 new JT Steering Lip Seals, ensuring that the JT Steering Lip Seals [39] are fitted with the overhang of the Seal facing towards the front of the Jet Unit when the Seal is fitted to the JT Steering Nozzle.
4. Thoroughly clean the threads of the Cap Screws [42] and apply Loctite 222 to the threads.
5. Refit the 2 new JT Steering Lip Seals [39] in position and adjust the Lip Seals [39] to just contact the spherical inner surface of the Nozzle Housing [32].

NOTE:

There is some movement in the Lip Seals [39] when loosely secured with Cap Screws [42], this is to allow the Lip Seals to be adjusted to fit the inside curvature of the Nozzle Housing.

6. Secure the 2 JT Steering Lip Seals [39] using Cap Screws [42], Flat Washers [40] and Spring Washers [41]. Tighten to the recommended torque.
7. Refit the JT Steering Nozzle [1] complete with the Nozzle Housing to the Tailpipe as shown in **Section 9.4.3. "Refit the Nozzle / Nozzle Housing to the Jet Unit".**

STEERING NOZZLE CRANK BUSH [27].

To replace the Steering Nozzle Crank Bush [27], carry out the following operation:-

1. With the Steering Nozzle removed from the Nozzle Housing and taken to a workshop facility. Ensure that the Steering Arm has been removed from the Nozzle as shown in **Section 9.3.9. "Steering Nozzle / Nozzle Housing Removal".**
2. Using a suitable Drift. Tap out the old Crank Bush [27] from beneath. It may be necessary to apply heat locally around the Bush to break the Loctite seal.
3. Clean out the Nozzle Bore of old loctite and ensure that the bore is **NOT PAINTED.**
4. Apply a thin coat of Activator 7471 to the outside surface of the Bush [27] and allow to dry before fitting. **Do not apply Activator to the bore of the Steering Arm boss.**

NOTE:

The Loctite Activator 7471 must be used to refit the Nozzle Crank Bush [27] otherwise the Loctite 680 will not cure and retain the Bush in position.

5. Apply Loctite 680 to the bore of the Steering Arm boss.

NOTE:

There are to be NO dry areas between the Steering Nozzle Crank Bush and the bore of the Steering Arm boss once the Steering Nozzle Crank Bush is fitted.

6. From the upper side of the Steering Arm Bracket, carefully press the new Crank Bush [27] fully home into the Steering Arm boss, until the bush is firmly pressed against the lip at the bottom of the bore.
7. **Ensue that the Bush is pressed in evenly and does not protrude above the sides of the Steering Arm boss.**
8. Clean off any surplus Loctite from around the replacement bush.

STEERING NOZZLE PIVOT PIN BUSHES [3].

The JT Steering Nozzle [1] is fitted with two Bushes [3] to accommodate the Steering Nozzle Pivot Pins [2] and a Steering Crank Bush [27] to locate the Steering Crank. If these Bushes should become worn, they should be replaced.

To replace the Steering Nozzle Pivot Pin Bush [3], carry out the following operation:-

1. With the Steering Nozzle removed from the Nozzle Housing, and taken to a workshop facility. Using a suitable Press, push out the old Nozzle Pivot Bushes [3]. It may be necessary to apply light heat to the Nozzle in the area of the Bush to break the loctite seal.
2. Clean out the bush bore of old loctite and loctite activator.
3. Remove all evidence of paint from inside the bore.

NOTE:

The bore is not to be repainted.

4. Apply Loctite Activator 7075 to the outside of the Bush [3] and allow to dry.

NOTE:

Loctite Activator 7075 must be used to refit the Steering Nozzle Pivot Pin Bush [3] otherwise the Loctite 325 will not cure and retain the Steering Nozzle Pivot Pin Bush in position.

5. Apply Loctite 325 evenly to the Nozzle bore.

NOTE:

There are to be NO dry areas between the Bush [3] and the Nozzle bore once the bush is fitted.

6. Carefully press the new Pivot Bushes [3] fully home into the Nozzle, ensuring that the Bushes are pressed in evenly and do not protrude above the sides of the Nozzle.

NOTE:

A. The Bushes [3] must be pressed into the Nozzle within 15 minutes before the loctite hardens off.

B. Ensure that the Bushes [3] do not protrude into the Spacer Washer recess.

7. Clean off any surplus loctite from around the replacement Bushes [3].

PIVOT PINS [2].

Examine the Nozzle attachment Pivot Pins [2]. Replace if signs of wear or damage are found.

STEERING NOZZLE ANODE [7].

Refer to Drawing HJ-391-13-002 for location of Anodes.

1. Ensure that the Steering Nozzle Anode [7] is not painted over.
2. Scrub down with a wire brush if a coating has built up on the Anode.
3. Visually check the Anode [7] attached to the Nozzle. If this Anode is more than half its original size, it should be replaced.
4. To replace the Steering Nozzle Anode carry out the following actions:-
   a) Remove Nut [10] and Spring Washer [9] securing the Anode to the Nozzle.
   b) Remove the Anode [7].
   c) Clean up and repair any loose paint or corrosion in the area where the Anode is located.
   d) Fit a new Anode [7] to the Studs [8] fitted to the underside of the Steering Nozzle and secure with Nut [10] and Spring Washer [9].
   e) Torque load to the recommended torque.

SPACER WASHERS [33], [34] AND [35].

Examine the Spacer Washers for any signs of wear or damage. Replace as required.

9.3.11 Nozzle Housing Overhaul

Refer to Drawings HJ-391-06-005.

NOZZLE HOUSING FLANGED BUSHES [26].

Inspect the two Flanged Bushes [26] fitted in the Nozzle Housing. These should be replaced if any signs of wear or damage are found.

To replace the Flanged Bushes [26] carry out the following actions. (Drawings HJ-391-06-005 refer).

1. With the Nozzle removed from the Nozzle Housing, drift out the Bush [26]. It may be necessary to apply light heat to the Nozzle in the area of the Bush to break the loctite seal.
2. Clean out the bores in the Nozzle Housing of old loctite and ensuring that the bores are **NOT PAINTED**.
3. Apply a thin coat of Loctite 7471 to the outer surface of the bush and allow to dry. **Do not apply Activator to the bore of the Nozzle Housing.**

NOTE:

Loctite Activator 7471 must be used to refit the Nozzle Housing Flanged Bush otherwise the Loctite 680 will not cure and retain the bush in position.

4. Apply Loctite 680 to the bore of the Nozzle Housing boss.

NOTE:

There are to be NO dry areas between the Nozzle Housing Flanged Bush and the bore of the Nozzle Housing once the Nozzle Housing Flanged Bush is fitted.

5. From inside the Housing, carefully press the Bushes [26] into the Nozzle Housing and rotate to distribute the loctite evenly over the surfaces. Wipe off excess loctite from around the bushes.

NOTE:

When pressing the Pivot Bushes into the Nozzle Housing, ensure that the securing bolt holes are aligned with the matching holes in the Nozzle Housing top and bottom Pivot Bosses.

REPLACING THE REAR STEERING SHAFT BUSH [11] AND STEERING SHAFT BUSH SLEEVE [47]. (Fitted to the Nozzle Housing).

1. Examine the Steering Shaft Bush [11] and the Steering Shaft Bush Sleeve [47] located on the top of the Nozzle Housing.
2. **The Steering Shaft Bush Sleeve [47] should not require replacement, should it be necessary to replace the Steering Shaft Bush Sleeve [47], the Steering Shaft should be removed as shown in Section 9.3.9. "Steering Nozzle / Nozzle Housing Removal", sub paragraph "Nozzle / Nozzle Housing Removal".**
3. If the Steering Shaft Bush [11] is found to be worn and requires replacement, drift out the Bush [11] from inside the Steering Shaft Bush Sleeve [47].
4. Press out the Steering Shaft Bush Sleeve [47] from the boss on the Nozzle Housing.
5. Clean out the bore of old loctite and any corrosion. **Ensure that the bore is NOT painted.**
6. Apply a thin coat of Loctite Activator 7471 to the outside surface of the Steering Shaft Bush Sleeve [47] and allow to dry. **Do not apply Activator to the bore in the Nozzle Housing.**

NOTE:

Loctite Activator 7471 must be used to refit the Steering Shaft Bush Sleeve otherwise the Loctite 680 will not cure and retain the bush in position.

7. Apply Loctite 680 to the bore of the Nozzle Housing boss.

NOTE:

There are to be NO dry areas between the Steering Shaft Bush Sleeve [47] and the bore of the Nozzle Housing once the Steering Shaft Bush Sleeve is fitted.

8. From the front of the Nozzle Housing, carefully press the Steering Shaft Bush Sleeve [47] into the boss on the top of the Nozzle Housing and rotate to distribute the loctite evenly over the surfaces.
9. Wipe off any excess Loctite from around the Bush Sleeve and the Nozzle Housing bosses.
10. Press fit a new Steering Shaft Bush [11] into the Steering Shaft bush Sleeve [47].

STEERING NOZZLE HOUSING ANODE [36].

Refer to Drawing HJ-391-13-002 for location of Anodes.

1. Ensure that the Steering Nozzle Anode [36] is not painted over.
2. Scrub down with a wire brush if a coating has built up on the Anode.
3. Visually check the Anode [36] attached to the underside of the Nozzle Housing. If this Anode is more than half its original size, it should be replaced.
4. To replace the Nozzle Housing Anode carry out the following actions:-
   a) Remove Nut [10] and Spring Washer [9] from Stud [8] securing the Anode to the Nozzle Housing.
   b) Remove the Anode [36] from Stud [8].
   c) Clean up and repair any loose paint or corrosion in the area where the Anode is located.
   d) Fit a new Anode [36] to the Stud [8] fitted to the underside of the Steering Nozzle and secure with Nut [10] and Spring Washer [9].
   e) Torque load to the recommended torque.

9.3.12 Nozzle Insert Removal

1. Remove the Nuts [15] and Spring Washers [14] from the Studs [37] securing the Nozzle Insert to the Tailpipe.
2. Examine the Nozzle Housing and Nozzle Insert for wear and damage, repair or replace as necessary.
3. Clean all parts thoroughly.

9.3.13 Shaft Housing Seal Assembly - Removal and Overhaul

Drawing HJ-391-06-005 refers.

The Shaft Seal Housing [19] is only to be dismantled if the Seals [20], [21], and [30] are suspected of being worn or are leaking.

To dismantle the Shaft Seal Housing Assembly, carry out the following actions:-

1. With the Steering Shaft [18] disconnected from the Crank [16] and the Tiller [17].
2. Slide the Steering Shaft rearwards out of the Shaft Seal Housing Assembly [19] and out of the Vessel.
3. Remove the 2 Nuts [10] and Flat Washers [24] from the Studs [23] securing the Shaft Seal Housing [19] to the Transom Plate.
4. Remove the Shaft Seal Gasket [22] from between the Shaft Seal Housing and the Transom Plate.
5. Replace Scraper [20], Rod Wiper [30] and Seal [21].

REPLACING THE SCRAPER SEAL [20], SEAL [21] AND ROD WIPER SEAL [30].

If the Scraper Seal [20], Seal [21] or the Rod Wiper Seal [30] are worn or damaged, new Seals should be fitted to the Shaft Seal Housing Assembly. To carry out this operation:-

1. Ensure that the Steering Shaft [18] has been withdrawn from the Shaft Seal Housing Assembly.
2. Remove the Scraper Seal [20] and take note of the way the Seal is fitted. **(With the Scraper Seal facing aft).**
3. Remove the Oil Seal [21] and take note of the way the Seal is fitted. **(With the Seal lip facing aft).**
4. Remove the Rod Wiper Seal [30] and take note of the way the Seal is fitted. **(With the Seal lip facing aft).**
5. Clean out the bore of the Shaft Seal Housing Assembly [19].
6. Smear a new Oil Seal [21] with grease ensuring that the inner face of the Seal is packed with grease.
7. Fit the Oil Seal [21] into the Shaft Seal Housing **ensuring that the seal lip faces aft.**
8. Smear a new Rod Wiper Seal [30] with grease ensuring that the inner face of the Seal is smeared with grease.
9. Fit the Rod Wiper Seal [30] into the Shaft Seal Housing ensuring that the seal fits correctly into the seal groove **with the seal lip facing aft.**
10. Smear a new Scraper Seal [20] with grease and fit the seal into the recess in the Steering Shaft Housing, ensuring that the Scraper Seal is fitted correctly **with the seal lip facing aft.**

NOTE:

Ensure that the Scraper Seal [20], Oil Seal [21] and the Rod Wiper Seal [30] are fitted as shown in Drawing HM-422-06-005 Sheet 1 of 5, with the seal lip facing aft.

9.4 STEERING ASSEMBLY REFITTING AND ADJUSTING

Drawing HJ-391-06-005 refers unless otherwise shown.

CAUTION:

The Steering Assembly can be re-assembled in several ways. It is important to follow the relevant drawings contained in this Manual, to prevent damage to the Steering Assembly.

9.4.1 Nozzle Insert Refitting

NOTE:

The small Spigot located at the top of the Nozzle Insert must be aligned with the Steering Shaft when refitting the Nozzle Insert onto Studs [37] located on the rear of the Tailpipe.

1. Re-fit the Nozzle Insert [31] onto Studs [37] located on the end face of the Tailpipe and secure with Spring Washers [14] and Nuts [15].
2. Torque load to the recommended torque.

9.4.2 Nozzle Refit to the Nozzle Housing

Prior to refitting the Nozzle Assembly to the Jet Unit, the Nozzle must be assembled to the Nozzle Housing and the Lip Seals [39] adjusted.

NOZZLE / NOZZLE HOUSING SPACER WASHER ADJUSTMENT.

NOTE:

The Nozzle has to be dry fitted to the Nozzle Housing to ascertain the correct thickness of Spacer Washer required to position the Nozzle centrally around the Nozzle Insert.

1. Trial assemble the JT Steering Nozzle [1] to the Nozzle Housing [32], ensuring that the Lip Seal attachment Screws [42] have been slackened off.
2. With the nose of the Nozzle turned either to the left or right of centreline, feed the Nozzle into the Nozzle Housing.
3. Rotate the Nozzle to align the upper and lower Bushes [3] with the upper and lower attachment spigot openings in the Nozzle Housing.
4. Fit the lower Spacing Washers [33], [34] or [35] as required to hold the Nozzle central over the end of the Nozzle Insert.
5. Fit the upper Spacing Washers [33], [34] or [35] as required to maintain the Nozzle central over the end of the Nozzle Insert.

NOTE:

The Spacer Washers [33], [34] and [35] are available in different thickness's, these should be selected to hold the Nozzle centrally over the conical end of the Nozzle Insert. Maximum vertical movement in the Nozzle should be limited to 1 mm Maximum.

6. Temporarily fit the upper and lower Pivot Pins [2] and loosely secure with Bolts [4] and Nuts [6].
7. Move the Nozzle through its full arc of travel and ensure that it does not come into contact with the nozzle Insert or the Nozzle Housing.
8. Should the Nozzle become stiff to operate through any of the movement or be outside the **Vertical Clearance limit of 1 mm Max,** adjust the Spacer Washers until the correct clearance is achieved.
9. Once the correct clearance has been achieved, remove the Nozzle from the Nozzle Housing.

10. Washers chosen to give the correct clearance for the Nozzle should then be glued in position on the outer faces of the Nozzle attachment bosses as follows:-

NOTE:

Loctite Activator 7075 must be used to refit the Spacing Washers [33], [34] and [35] otherwise the Loctite 325 will not cure. Do not apply loctite Activator 7075 to the Spacing Washer recess.

a) Apply Loctite Activator 7075 to one side of the chosen Spacing Washer and allow to dry.
b) Apply Loctite 325 evenly to the Spacing Washer recess in the Nozzle where the Spacing Washer will sit.
c) Press the Spacing Washer into position with the activator side to the loctite applied to the recess. Apply pressure to the Spacing Washer for approximately 15 minutes until the bond is formed.
d) Remove any excess loctite from around the Spacing Washer, ensuring that there is no loctite or activator on the Pivot Bush [3].
e) Carry out this operation for both Spacing Washers.

STEERING LIP SEAL ADJUSTMENT.

1. Smear the Pivot Pins [2] with Energrease MM EP2.
2. Refit the Nozzle to the Nozzle Housing and secure in position with the upper and lower Pivot Pins [2] and secure with Bolts [4] and Nuts [6]. Torque load to the recommended torque.
3. Refit the Steering Arm [43] over the rear Steering Shaft Bush and onto the Studs [44] located on the upper surface of the Nozzle [1] and secure in position with Special Washers [46] and Nuts [45]. Torque load to the recommended torque.
4. Rotate the Nozzle through its full arc of travel to ensure that there is no stiffness or binding of the Nozzle.

NOTE:

If the JT Steering Lip Seals [39] have been removed, they should be refitted at this point. Refer Section 9.3.10. "Nozzle Overhaul".

5. Place the Nozzle / Nozzle Housing with the Nozzle facing downwards on a workbench.
6. Adjust the Lip Seals [39] outwards to just contact the spherical inner surface of the Nozzle Housing [32].
7. Secure the 2 JT Steering Lip Seals in position with Spring Washers [41] and Capscrews [42]. Tighten to the recommended torque.

9.4.3 Refit the Nozzle / Nozzle Housing to the Jet Unit

NOTE:

Ensure that the Nozzle Assembly is fitted in the correct orientation to suit the application. Refer to Drawings HJ-391-06-005, sheets 3 of 5 to 5 of 5.

1. With the Crank Bush boss uppermost, locate the Nozzle Housing complete with Nozzle onto the flange of the Nozzle Insert and secure to Studs [37] with Spring Washers [14] and Nuts [15].
2. Torque load to the recommended torque.

9.4.4 Steering Bracket Re-Fitting to the Jet Unit

The following Drawings refer: -

CT-SJK-01-007 Steering Cylinder Powered Helm Kit.
CT-SJK-01-009 Steering Bracket (Rotated Helm).
CT-SJK-01-010 Steering Bracket (Non Rotated Helm).
CT-SJK-01-011 Steering Cylinder Manual Helm Kit.

If the Steering Bracket has been removed, refit the Steering Bracket to the Jet Unit. Ensuring that the Bracket is correctly orientated for the Jet steering arrangement. **Refer to the Controls Manual, Steering Assembly General Arrangement Drawings shown above.**

STEERING BRACKET (For Jets Fitted With Tie Rod Connections):

Drawings CT-SJK-01-009 Steering Bracket (Rotated Helm) and CT-SJK-01-010 Steering Bracket (Non Rotated Helm) refer.

Secure the Steering Bracket to the Studs [5] with Spring Washers [4] and Nuts [3]. Torque load to the recommended torque.

STEERING CYLINDER MOUNTING BRACKET (For Jets Fitted With Steering Cylinders):

Drawings CT-SJK-01-007 (Powered Helm) and CT-SJK-01-011 (Manual Helm) refer.

Secure the Steering Cylinder Mounting Bracket [3] to the Studs [7a] or [7b] fitted to the Jet Unit Impeller Race with Spring Washers [6] and Nuts [5]. Torque load to the recommended torque.

9.4.5 Shaft Housing Seal Assembly Refit

Drawing HJ-391-06-005 refers.

To reassemble the Shaft Seal Housing Assembly, carry out the following actions:-

1. Fit new Scraper [20], Rod Wiper [30] and Seal [21] to the Shaft Seal Housing [19], ensuring that the Seals are correctly fitted as shown in **Drawing HJ-391-06-005.**
2. Fit Gasket [22] onto the two Studs [23] on the Transom Plate.
3. Refit the Shaft Seal Housing Assembly [19] to the Studs [23] on the Transom Plate and secure loosely with 2 Nuts [10] and Flat Washers [24]. **Do not tighten Nuts [10]. These Nuts are tightened once the Steering Shaft has been refitted. Refer to Section 9.4.7. "Steering Assembly Re-Fitting". Item 8.**

9.4.6 Steering Cylinder - Refit to the Jet Unit (Hamilton and Wagner Cylinder)

The refitting of the Steering Cylinder to the appropriate Cylinder Mounting Bracket should be carried out in consultation with the Steering Drawings contained in the Controls Manual Drawings Package. **(Drawings CT-SJK-01-007 "Powered Helm" or CT-SJK-01-011 "Manual Helm" in the Controls Manual refers).**

1. Mount the Steering Cylinder [1] onto the Studs [11] on the Bracket [3] and secure in position with Nuts [12] and Spring Washers [13].
2. Connect the Steering Cylinder to the Tiller with Bolt [9] and 2 Thin Nuts [10].
3. Reconnect the Cylinder Hose connections to the Steering Cylinder. **Refer to the Controls Manual Drawing Package for Hose Connection information.**
4. Connect any Sensors attached to the Steering Crank. Refer to the **Overhaul Section of the Controls Manual.**

5. Refill the Steering System with approved oil and bleed the system. **Refer to the Controls Manual for information on how to fill and bleed the Steering System.**

NOTE:

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

9.4.7 Steering Assembly Re-Fitting

Drawing HJ-391-06-005 refers.

CAUTION:

The Steering Assembly can be re-assembled in several ways. It is important to follow the relevant drawings contained in this Manual, to prevent damage to the Steering Assembly.

1. If the Steering Bracket has been removed, refit the Steering Bracket to the Jet Unit, ensuring that the bracket is correctly orientated for the Jet steering arrangement **(Refer to Section 9.4.4. "Steering Bracket Re-Fitting to the Jet Unit" and to the "Steering Assembly Configuration Arrangement Drawings" contained in this Manual).**
2. Smear the Steering Crank [16] ball with grease and refit to the Nozzle Bush [27].
3. If the Steering Shaft has been removed to replace the Steering Shaft Bush [11] or the Shaft Housing [19], Seals, [20],[21], [22] and Rod Wiper Seal [30], lightly grease the Steering Shaft and slide the Steering Shaft rearwards through the forward Steering Shaft Bush [11] and the Shaft Seal Housing [19].

NOTE:

Extra care should be taken when fitting the Steering Shaft as the Scraper [20] and Rod Wiper [30] fitted in the Shaft Seal Housing can easily be dislodged. The Steering Shaft should be slowly rotated whilst it is being fed through the Shaft Seal Housing Assembly as the cutout in the Steering Shaft for the Cotter [11] may dislodge or damage the Scraper [20] and Rod Wiper [30] if the Steering Shaft is pushed straight through the Shaft Seal Housing Assembly.

4. Pass the Steering Shaft [18] through the Crank [16] and through the rear Steering Shaft Bush [11] until the Crank is correctly located over the cutaway in the steering shaft.
5. Secure the Crank in position with Cotter [12], Special Washer [13], Spring Washer [14] and Nut [15] ensuring that the Cotter is fitted correctly. **(Refer to the "Steering Assembly Drawings in this Manual).** Tighten to the recommended torque.
6. If the Tiller [17 has been removed from the forward end of the Steering Shaft [18], refit the Tiller to the Steering Shaft and secure with Cotter [12], Special Washer [13], Spring Washer [14] and Nut [15], ensuring that the Cotter is fitted correctly. **(Refer to the Controls Manual, Steering Assembly General Arrangement Drawings).** Tighten to the recommended torque.
7. Tighten Nuts [10], securing the Shaft Seal Housing Assembly [19] to the Transom Plate and torque load to the recommended torque.

NOTE:

Ensure that the Cotters fitted to the Steering Crank and the Tiller are fitted correctly. Refer to Drawing HJ-391-06-005 sheets 3-5 to 5-5 for the various steering options available.

8. Operate the Tiller to ensure that the Nozzle does not bind when moving.

NOTE:

FOR MULTI JET APPLICATIONS ONLY. If the Steering Tie Rods have been removed or replaced, refer to *Section 3.6.1. "Attaching the Steering Tie Rods"*, in the Installation Section of the Manual for information on installation of the Tie Rods for Multi Jet applications.

9.5 BEARING HOUSING AREA REMOVAL AND OVERHAUL

Drawings HJ-391-01-001 refer.

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.

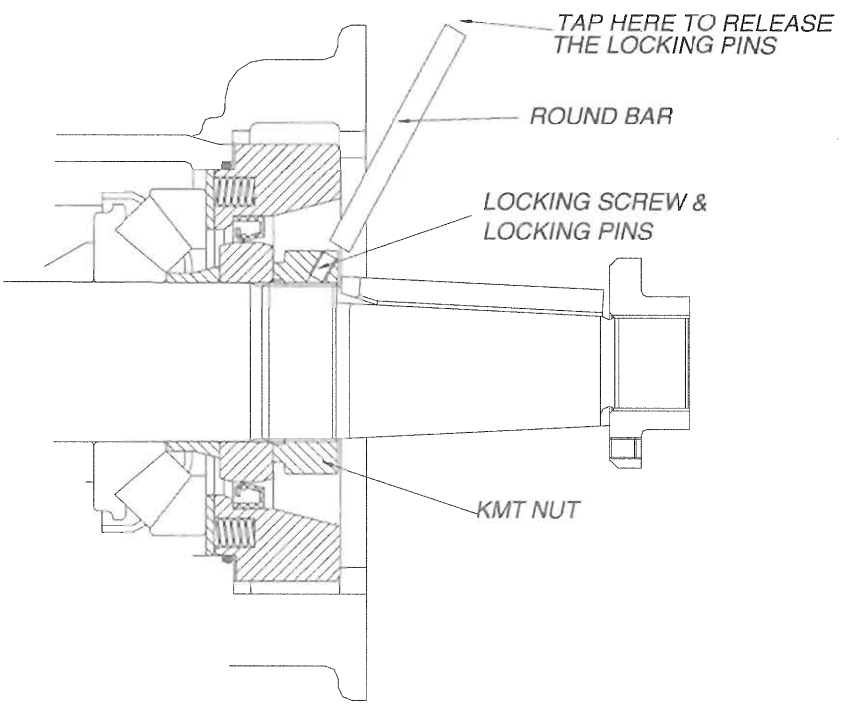
NOTE:

A. The Bearing Housing has been enlarged on Drawing: HJ-391-01-001Basic Jet Assembly, HJ-391.

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

9.5.1 Bearing Housing Removal

1. Remove the JHPU from its mount on the Bearing Housing.
2. Uncouple the driveshaft from the Jet Unit. Remove Plug [40] to drain the Bearing Housing oil.
3. Fit the ***"Reaction Arm Tool"*** to the Coupling and using the ***"Coupling Nut Spanner Tool"*** with an extension pipe, unscrew the Coupling Nut [33] **two turns only**.
4. Fit the ***"Coupling Puller Tool"*** to the Coupling Flange and tighten the Puller bolt firmly. Strike the Puller bolt firmly with a hammer to free the Coupling Flange off the taper. Unscrew and remove the Coupling Nut and the Coupling Flange from the Shaft.



REMOVING THE KMT BEARING RETAINING LOCK NUT

(Appendix 2 at the rear of this Manual includes further details on the KMT Nut).

1. To remove the KMT Nut, partially withdraw the 3 Locking Screws (part of Item 30) located around the circumference of the Nut.
2. 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.
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 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).**
4. Fit the ***"Bearing Retaining Nut Spanner"*** and slide the ***"Dummy Flange Tool"*** in behind to support it. The ***"Reaction Arm Tool"***is then bolted to the ***"Dummy Flange Tool"*** to prevent the shaft from turning whilst the Bearing Nut [30] is undone. Remove the Key Coupling Flange [32] and the Bearing Nut [33] from the Mainshaft [3].
5. If the Waterseal Assembly [17] **IS NOT BEING REPLACED**, remove the Inspection Cover [70] and fit the ***"Shaft Support Tool"*** (To prevent the Waterseal rotary parts from moving against the Counterface when the Bearing Housing is removed).

WARNING:

EXERCISE EXTREME CARE AT ALL TIMES WHEN THIS OPERATION IS CARRIED OUT AS WATER MAY ENTER THE VESSEL THROUGH THE OPENING IN THE INTAKE.

6. Remove the 6 x M20 Nuts [36] and Spring Washers [35] and remove the Bearing Housing complete.
7. Remove the rearmost Oil Seal Sleeve [23] from the Main Shaft after removing the small round Key [29].
8. Remove the two small M8 Nuts [9] and Spring Washers [10] retaining the Bearing Retainer Plate [16]. Taking care not to lose the 12 compressed Preload Springs [31] as the Bearing Retaining Plate is removed.
9. Remove and retain the Shims from between the Bearing Retainer Plate and Bearing Housing.
10. Remove the Distance Sleeve [28] and Oil Seal Sleeve [23].
11. Withdraw Bearing [26], Bearing Carrier [27] and Main Bearing [25} from the Bearing Housing [15].

NOTE:

The Main Bearing [25]. can be heated to assist the removal from the Bearing Carrier.

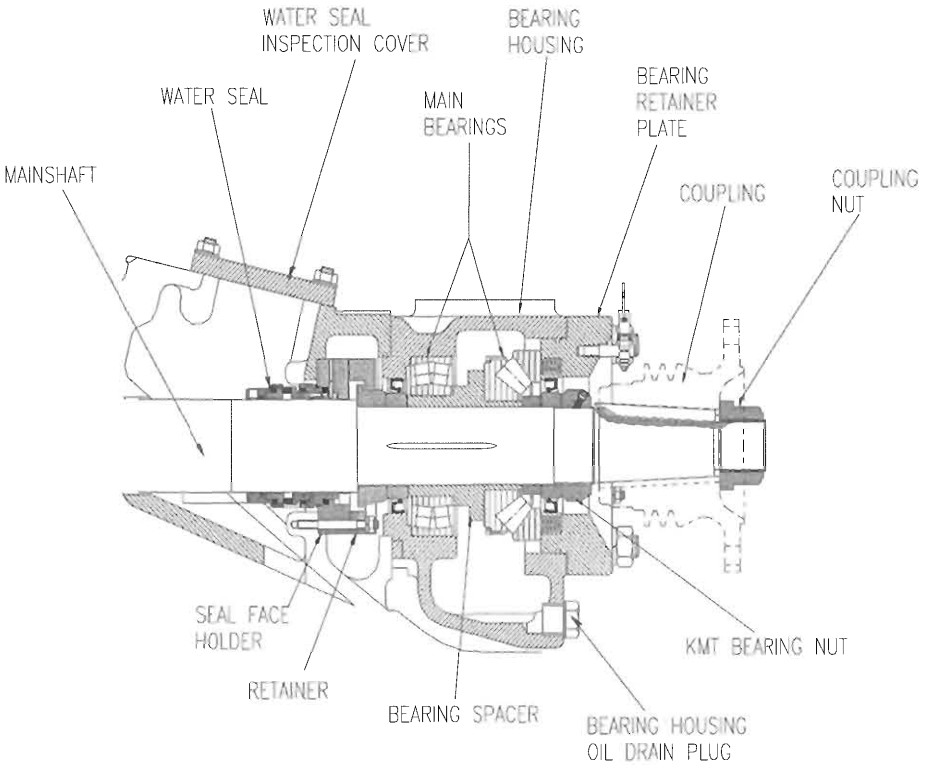
9.5.2 Water Seal Removal

Refer to Drawings HJ-391-01-001 and Drawing 61524.

CAUTION:

The Water Seal needs only to be replaced if it is leaking or it is suspect of leaking, or if there is insufficient material left on the Seal to last to the next inspection. Refer to Section 7. Maintenance – General, for details of the maintenance required.

The following diagram shows the major parts of the Bearing Housing Assembly.



CAUTION:

Do Not Attempt To Dismantle The Water Seal Cartridge.

NOTES:

A. The Eagle Mechanical Water Seal [17] must be removed from the Jet Unit Mainshaft as a complete item. The Red Setting Clips [3] must be fitted in position before removing the Water Seal to prevent accidental damage to the water seal faces.

B. These Water Seals can be returned to the manufacturer for reconditioning and repair, in the packaging used for the replacement Water Seal.

C. This Water Seal can be removed from the Jet Unit and re-installed as required. Always ensure that the Grub Screws [1] are replaced when refitting the Water Seal.

The Waterseal must be replaced if:

- It has worn and will not reach the next overhaul without failure.

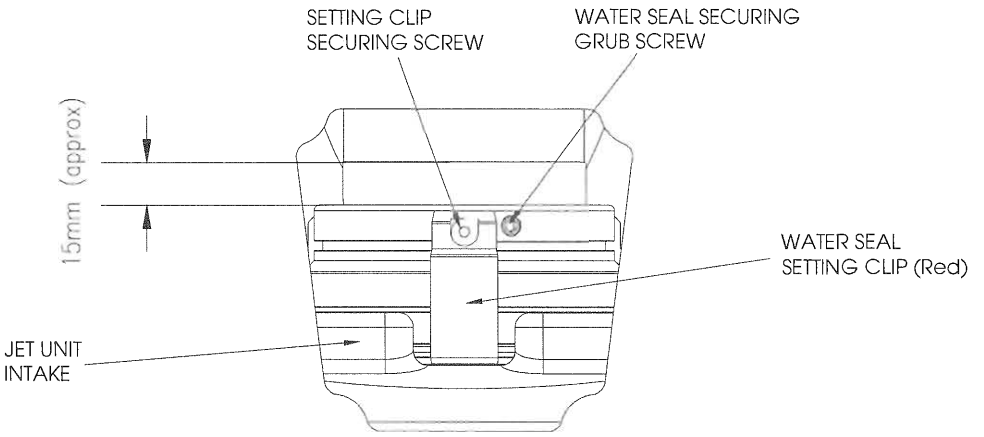
Max Worn Limit = 0.5 mm.

New Water Seal = 1.5 mm (approx).

- There have been signs of water leaking from underneath the Bearing Housing.

REMOVAL:
Drawings HJ-391-01-001 refer unless otherwise stated.

1. Remove the 4 Nuts [54] and Spring Washers [63] from Studs [65] securing the Rotary Seal Inspection Cover [68] to the Jet Unit Intake.
2. Remove the Inspection Cover and Gasket [69].
3. Rotate the Mainshaft to align the attachment position for the Seal Setting Clips (Red) [3] and secure the Seal Setting Clip in position with Screw [2]. **(Drawing 61524 refers).**
4. Repeat Item 3 above to fit the 2 remaining Seal Setting Clips.



HJ-391 WATER SEAL 'DETAIL C'

NOTE:

Ensure that the Seal Setting Clips are secured to the correct attachment points as the Water Seal securing Screws [1] are located adjacent to the Seal Setting Clip attachment points. Refer to "HJ-391 Water Seal Detail C" below.

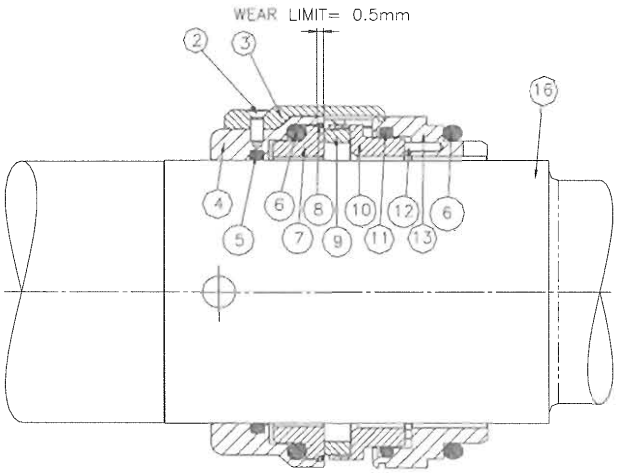
5. Loosen off the 3 Grub Screws securing the Water Seal to the Mainshaft.
6. Ensure that the Shaft Support Tool [5] **(Drawing HJ-391-11-000 refers)** has been fitted through the Main Inspection Cover opening to support the Mainshaft.
7. Ensure that the Bearing Housing [15] has been removed as shown in **Section 9.5.1. "Bearing Housing Removal".**
8. Unscrew and remove the Seal Face Retainer Nuts [9] and Spring Washers [10] on Studs [20] and withdraw the Retainer [21] and Slinger [22].
9. Screw two M8 bolts into the tapped holes in the Seal Face Holder [19] to remove complete with the Water Seal cartridge. **(Drawing 61524 refers).**

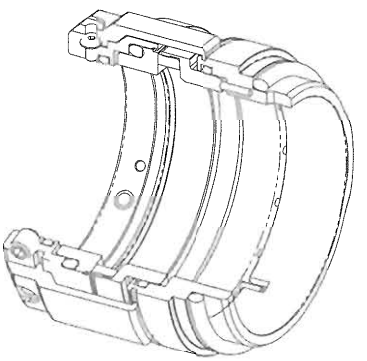
NOTE:

If the Water Seal Cartridge has come away from the Seal Face Holder [19], remove the Seal Face Holder from the Mainshaft and then gently push the Water Seal forwards out of the Water Seal cavity and remove from the Mainshaft.

9.5.3 Checking for Wear

ITEM NO.	DESCRIPTION
2	FLAT HEAD SCREW (C'SUNK)
3	SETTING CLIP
4	MATING RING HOLDER
5	O RING
6	O RING
7	MATING RING (WIRE RETAINED)
8	MATING RING RETAINING WIRE
9	BLX SEAL RING INSERT
10	SEAL RING SHELL
11	O RING
12	SPRING
13	STATIONARY ADAPTOR
14	PIN (Not Shown)
15	PIN (Not Shown)
16	MAINSHAFT





HJ-391 WATER SEAL (Part No 61524)

Check the following parts for damage or wear and replace where necessary:

a) **Oil Seals [24] and Sleeves [23].** (Sleeves may be turned end for end instead of replacing if they are in reasonable condition. Seals should be replaced at every Overhaul).
b) **Bearings [25] and [26].**
c) **Rotary Water Seal Cartridge [17].** Check that the Max Wear Limit of 0.5mm has not been exceeded. Replace if the Water Seal will not reach the next overhaul period before the Max Wear Limit of the Water Seal is reached. Check for visual signs of wear or damage to the Seal Body. **DO NOT DISMANTLE THE WATER SEAL CARTRIDGE.**
d) **Mating faces on the Bearing Spacer / Carrier [27].**
e) **Preload Springs [31].**
f) **"O" Rings.** Check for cuts, deformation, cracking or perishing.
g) **Check the Bore of Bearing Housing where Journal Bearing locates.** The Bearing should be a sliding fit. If the Housing Bore is scored or worn and the Bearing is loose, replace the Bearing Housing.
h) Thoroughly clean all parts.

9.5.4 Water Seal Re-Fitting

Refer to Drawings HJ-391-01-001 and Drawing 61524.

NOTE:

A. The Eagle Mechanical Water Seal must be fitted to the Jet Unit Mainshaft as a complete item with the Red Seal Setting Clips [3] remaining fitted until the Water Seal is fitted to the Mainshaft, to prevent accidental damage to the water seal faces. Do not remove the Red Seal Setting Clips until the Water Seal is in it's final operating position. *Refer to Section 9.5.7. "Final Assembly of the Water Seal".*

B. If the Water Seal is being re-fitted after removal, ensure that new Grub Screws [1] are used when refitting the Water Seal.

1. Ensure that the Jet Unit Mainshaft is clean and free from scratches, burrs or O Ring fretting. These can be polished out with a fine emery paper.
2. With the Seal Inspection Cover [68] removed, wet the forward part of the Mainshaft with a 20 to 1 water to household detergent mix.
3. Wet the O Ring [6] on the outer face of the Stationary Adaptor [13] and O Ring [5] on the inner face of the Mating Ring Holder [4]. with a 20 to 1 water to household detergent mix. **(Drawing 61524 refers).**
4. Ensuring that the Drive Pin cut out in the Stationary Adaptor [13] **(Drawing 61524 refers)** aligns with the Drive Pin [18] fitted to the Seal Face Holder [19]. Firmly press the Water Seal cartridge into Seal Face Holder [19].
5. Ensure that the Mainshaft is supported through the Main Inspection Cover opening by the Mainshaft Support Tool.
6. Smear the Seal Face Holder Gasket [44] with marine grease and fit over Studs [20] fitted to the outer face of the Water Seal cavity in the Intake.
7. Smear the Seal Face Holder [19] to Intake contact faces with marine grease, ensuring that the Water Seal Cartridge remains free of grease.

CAUTION:

The Water Seal Cartridge must remain clean and free of grease and oil.

8. Fit the Rotary Seal Fitting Sleeve [10] **(Drawing HJ-391 11-000 refers)** up against the shoulder on the Mainshaft.
9. Carefully slide the Seal Face Holder [19] and Water Seal cartridge complete, along the Mainshaft and over Studs [20].

CAUTION:

Ensure that the Water Seal Cartridge is not pushed rearwards past the lip on the Mainshaft as this may damage the O Ring [5], which will cause failure of the Water Seal.

10. Remove the Rotary Seal Fitting Sleeve [10] **(Drawing HJ-391 11-000 refers)** from the shoulder on the Mainshaft.
11. Fit the Slinger [22] to the Mainshaft and slide up against the shoulder on the Mainshaft directly behind the Seal Face Holder.
12. Slide the Retainer up the Mainshaft, over the Slinger and onto Studs [20].
13. Secure the Seal Face Holder [19], Gasket [44], Slinger [22] and Retainer [21] to the 8 Studs [20] with Nuts [9] and Spring Washers [10]. Torque load to the correct torque. **(Drawing 85113 refers).**

NOTE:

Do not tighten the Water Seal securing Grub Screws [1]. The Final Assembly of the Bearing Housing must now be completed before securing the Water Seal in its final operating position.

9.5.5 Bearing Housing Re-Fitting

Refer to Drawing HJ-391-01-001.

NOTE:

A. Bearings can be warmed in oil to not more than 120°C to aid fitting to the Bearing Carrier.

B. The Bearing Housing can be heated to assist the fitting of the Main Bearing [25].

1. Fit Aft Oil Seal [24] with lip inwards, to aft position in the Bearing Housing [15].
2. Take the Bearing Carrier [27] and fit Spherical Roller Bearing [25] and Inner Race of the Thrust Bearing [26] on to their respective landings. Warm Bearings in Oil to not exceeding 120°C to aid fitting to Bearing Spacer / Carrier [27].
3. Allow Bearing Assembly to cool down before fitting to the Bearing Housing.
4. Slide Seal Sleeve [23] up to Slinger Collar [22].
5. Fit the Round Key [29] into the Main Shaft Recess.
6. Fit the Bearing Housing Assembly onto the 6 Studs [34].
7. Slide the Bearing Spacer / Carrier Assembly [27] into the Bearing Housing [15], with the Journal Bearing [25] first, taking care to keep its outer race square until it correctly engages inside the Housing.
8. Continue to push home the Bearing Carrier as far as possible (Approximately 22mm). The Outer race being a slide fit in the Bearing Housing.
9. Ensure that the Round Key [29] remains in its recess in the Shaft and the cutout in the Bearing Spacer / Carrier engages correctly with the Round Key [29].
10. Fit the Outer Race of the Thrust Bearing [26] in place.
11. Fit the Front Oil Seal [24] with lip inwards, into the recess in the Bearing Retainer Plate [16].
12. Fit "O" Ring [41] to Bearing Retainer Plate [16].
13. Fit Bearing Retainer Plate [16] with Springs [31] using a smear of grease to hold them in position.
14. Initially refit Shims [37] [38] and [39] of the same total thickness as was previously used, (Items removed at Section 9.4.1/11). over the six Studs [34] and slide up to the Bearing Housing [15].
15. Fit 2 x M8 Nuts [9] and Spring Washers [10] onto Studs [20] and torque load to recommended torque as shown in **Drawing 85113**.

9.5.6 Final Assembly of the Bearing Housing

1. Slide the Distance Sleeve [28] and the second Seal Sleeve [23] fully onto the Shaft up to the Thrust Bearing [26].

NOTE:

Do not press directly onto the Seal but onto a circular flat surface which contacts the full outside diameter of the Seal.

2. Prior to refitting the KMT Bearing Retaining Nut [30]. Ensure that the 3 Locking Screws in the Bearing Retaining Nut are withdrawn and do not protrude into the thread path.
3. Lubricate the KMT Bearing Retaining Nut and fit onto the Mainshaft. ***Tighten hand tight only.***
4. Fit, Key Coupling Flange [32].
5. Fit Spanner (Bearing Nut) [7] and Special Tool "Reaction Arm - Dummy Flange" [9] to the Mainshaft using Coupling Nut [33] to retain. **Drawing HJ391-11-000 refers.**
6. Torque the Bearing Retaining Nut [30] to the recommended torque. **(Refer to Drawing HJ-391-01-001). Do not tighten the 3 KMT Bearing Retaining Nut Locking Screws.**

NOTE:

Bearing Clearance adjustment should be carried out at this point.

7. Check the Mainshaft axial clearance (or "End Float") is correct. ***Using a Dial Gauge on the Mainshaft, move fore and aft and check that 0.13 to 0.18 mm (0.005" to 0.007") movement is present.***
8. Alter the shims between the Bearing Retainer Plate [16] and the Bearing Housing [15] to achieve the correct End Float.

NOTE:

A. Shims of 0.05, 0.13 and 0.25 mm (0.002, 0.005 and 0.010 inches) are available.

B. It is necessary to use a lever to force the Mainshaft in both directions to measure total axial clearance.

9. On completion of Bearing End Float Check, remove the Coupling Nut [33], Spanner (Bearing Nut) [7] and Special Tool "Reaction Arm - Dummy Flange" [9].
10. Ensure that the 2 x Nuts [9] and Spring Washers [10} on Studs [20] on the Bearing Retainer Plate are correctly fitted and torque loaded to the recommended torque as shown in **Drawing 85113.**
11. Refit the 6 x Nuts [36] and Spring Washers [35] and torque load to the recommended torque as shown in Drawing 85018.
12. **Tighten the 3 Locking Screws in the KMT Bearing Retaining Nut to 20 Nm Max. Refer to Section 7.6. "Threaded Fasteners".**
13. Fit the Coupling ensuring that the Coupling Key [32] is still in place.
14. Fit the Special Tool *"Reaction Arm"* [1] to prevent the Coupling [77] from turning and tighten the Coupling Nut [79] to the recommended torque. **Refer to the 'Torque Chart' shown on Drawing HJ-391-01-001 for special tightening torque's.**

9.5.7 Final Assembly of the Water Seal

NOTE:

The Final Assembly of the Bearing Housing must be completed before securing the Water Seal in its final operating position.

To complete the fitting of the Water Seal, carry out the following operations:-

1. Remove the Shaft Support Tool from the Main Inspection Cover opening in the Intake and refit the Main Inspection Cover [70] and O Ring [71].
2. **Check that the Water Seal Cartridge [17] is still firmly fitted to the rear of the Seal Face Holder [19].** This can be carried out by using either a locally manufactured forked tool or two long bladed screwdrivers and levering the Water Seal Cartridge forwards into the recess in the rear of the Seal Face Holder.
3. **The front of the Red Setting Clip should be in line with the rear face of the Intake when viewed through the Rotary Seal Inspection Cover.**
   A measurement from the rear face of the Water Seal rearwards to the step in the Mainshaft should measure 15mm (0.59") approx. Refer to Section 9.5.2. "Water Seal Removal",. Image "HJ-391 Water Seal Detail C".
4. Rotate the Mating Ring Holder [4] on the Mainshaft until one of the Setting Clips [3] is at top dead centre. **(Refer to Drawing 61524. Detail C).**
   a) ***If the Water Seal has been replaced with a new Water Seal,*** back off the Grub Screw until a few threads are visible, apply a few drops of Loctite 222 to the thread and tighten the Grub Screw [1] hand tight onto the Mainshaft. **(Refer to Drawing 61524).**
   b) ***If the old Water Seal is being re-fitted,*** discard the old Grub Screw. Coat the threads of the new Grub Screw with a few drops of Loctite 222 and fit to the Mating Ring Holder [4]. Tighten the Grub Screw [1] onto the Mainshaft. **(Refer to Drawing 61524).**

5. Remove the Screw [2] securing the red Setting Clip [3]. Remove the Clip and Screw from the Water Seal.
6. Repeat Items 4a) or 4b) and Item 5, to tighten the 2 remaining Grub Screws [1] and to remove the 2 remaining red Setting Clips [3] and Screws [2] from the Water Seal.

NOTE:

Ensure that the Red Water Seal Setting Clips [3] are retained for fitting to the Water Seal when the Water Seal is either removed or replaced.

7. Refit the Gasket [69] and Seal Inspection Cover [68] and refit Spring Washer [63] and Nut [54] and torque to recommended torque.
8. Using the Reaction Arm Sockets and Wrench as a handle, check the Mainshaft Assembly will rotate.
9. Fill the Bearing Housing [15] with oil until the Dipstick oil level reaches the full mark. **Do not overfill.** Use oil as recommended in ***Drawing 85018. Recommendations, Fasteners, Lubricants & Oils.***

9.6 OVERHAUL OF THE TAILPIPE AREA

The vessel must be dry docked to carry out this overhaul.

9.6.1 Checking for Impeller Wear

Before dismantling the Tailpipe and Impeller Race end of the Jet Unit, remove the Inspection Cover [70] (or Intake Screen [5] if in dry dock) and carry out the following checks:

1. Using feeler gauges, check clearance between the tips of the Impeller Blades and Wear Ring [67] **at each side** of the Impeller **(not top and bottom).** ***Maximum recommended worn clearance is 1.5 mm. New clearance is approx 0.6 mm.***
2. Push the Mainshaft [3] hard from side to side. Check total sideways movement at Blade tips. ***Maximum recommended worn total movement is 0.6 mm (0.024").*** This indicates the amount of wear in the Water Bearing [48] and Water Bearing Sleeve [47].

9.6.2 Removal and Inspection of Impeller

1. Fit the Special Tools *"Shaft Support Tool"* so that the Water Seal [17] does not move against its Counterface when the Tailpipe Assembly [13] and Impeller are removed.
2. Remove 12 Tailpipe Attachment Nuts [58] and Washers Special [57].
3. Hit Tailpipe sideways with a rubber or wooden mallet to free the joint and remove the Tailpipe from the Jet Unit, (The Steering Crank [16] must be taken off the Steering Shaft [18] at the same time **(Drawing HJ-391-06-005 refers)**).
4. Remove Set Screw Special [51] from the Impeller Nut [50] **(Drawing HJ-391-01-001 Basic Jet Assembly refers).**
5. Lock the Coupling Flange with Special Tool *"Reaction Arm"* so that it cannot rotate.
6. Unscrew and remove the Impeller Nut [33] using Special Tool *"Shaft Nut Socket Spanner"*.
7. Withdraw Water Bearing Sleeve [47].
8. Screw Special Tool *"Impeller Puller"* on to Impeller Hub and tighten the Puller Bolt firmly. Free the Impeller from the Mainshaft by applying a sharp blow with a hammer to the Puller Bolt. Withdraw and remove the Impeller and Puller.
9. Remove Key [46] being careful not to lose the Locating Dowel [45].

9.6.3 Removing the Impeller Race

The Impeller Race need not be removed unless it is badly worn or corroded. Minor corrosion damage such as pitting may be repaired by welding. Grind the welded surface flush with the original surface. If the surface wear is more than 1mm deep, a new Impeller Race should be fitted.

NOTE:

The Impeller Race may be removed to a workshop facility for the replacement of the Wear Ring and Insulator (Refer to *Section 9.5.5. "Replacing the Wear Ring and Insulator"* for details).

To remove the Impeller Race proceed as follows:-

1. Ensure that the Reverse and Steering Assemblies have been removed. **Refer to Sections 9.2. "Reverse Assembly Removal and Overhaul" and Section 9.3. "Steering Assembly Removal and Overhaul" for removal details.**
2. Ensure that the Transom Assembly has been removed. **Refer to Sections 9.7. "Transom Plate Assembly Overhaul" for removal details.**
3. Remove Nuts [58] and Washer Flat [57] from Studs [56] securing the Impeller Race [4] to the Intake.

4. Remove Nuts [36] and Washer Flat [59] from Studs [60] securing the Impeller Race [4] to the Intake in 4 positions.
5. Hit the Impeller Race sideways with a rubber or wooden mallet to free the joint and remove the Impeller Race off the Intake and withdraw off the Mainshaft.
6. Watch for the large O-Ring [80]. Remove and discard this O Ring.

9.6.4 Replacing the Wear Ring and Insulator

NOTE:

The Wear Ring [67] need only be replaced if it shows obvious signs of wear, corrosion or bulging inwards. It should be replaced along with the Insulator [66].

REMOVAL OF OLD WEAR RING AND INSULATOR STRIP

STEP 1:

a) Find the joint in the Wear Ring [67] and force a long fine screw driver between the Wear Ring and the Insulator [66] adjacent to the joint.
b) Drive the screwdriver in the same direction as the Mainshaft. Keep pushing the screwdriver until one end of the Wear Ring pops inward.

STEP 2:

a) Pull the free end of the Wear Ring inwards and then remove the Wear Ring from the Impeller Race.
b) Remove the Insulating Strip and thoroughly clean and degrease the Impeller Race bore.

PREPARING A NEW WEAR RING FOR FITTING

Before fitting a new Wear Ring, it should be trial fitted into the Impeller Race with ***no Insulator fitted***. There should be a gap of approximately 1mm between the mating ends of the Wear Ring with the Wear Ring completely fitted into the Impeller Race bore.
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 FROM THE WEAR RING*** as the Wear Ring must be a tight fit in the Impeller Race once the Insulator is fitted. This ensures that the Wear Ring remains in the correct position during operation.

FITTING A NEW INSULATOR

1. Paint the Impeller Race bore with a thin layer of two pot vinyl etch primer (suitable for aluminium) and allow to dry.
2. Apply a thin coat of zinc phosphate epoxy primer (such as International Paints Intercure 200 HS) and allow to dry.
3. Apply a second coat of zinc phosphate epoxy primer. **While the primer is still wet**, fit a new Insulator [66] to the Impeller Race, ensuring that the Insulator is in contact with the primer over the whole surface of the Impeller Race.
4. Smear the complete inner surface of the Insulator with grease or hydraulic oil.

FITTING A NEW WEAR RING

STEP 1:

a) Take a new Wear Ring and with the chamfered end leading, butt the strip at the chamfers by twisting slightly, (this reduces the lead-in diameter) and gradually feed the Wear Ring from the forward face of the Impeller Race, inside the Insulator, into the Impeller Race. as shown on the diagram. **(See Insertion 1).**
b) Tilt the Wear Ring slightly so the end opposite the chamfer just enters the hole inside the Insulator Strip. **(See Insertion 2).**

STEP 2:

c) Push the chamfered ends of the Wear Ring joint together and pull the other end of the join outwards, as shown. This allows one end of the Wear Ring to completely enter the hole inside the Insulator Strip.
d) Carefully push the Wear Ring down into the Impeller Race until the Wear Ring butts fully. **(See Insertion 3).**
e) Push the Wear Ring into the Impeller Race, evenly as far as possible by hand.

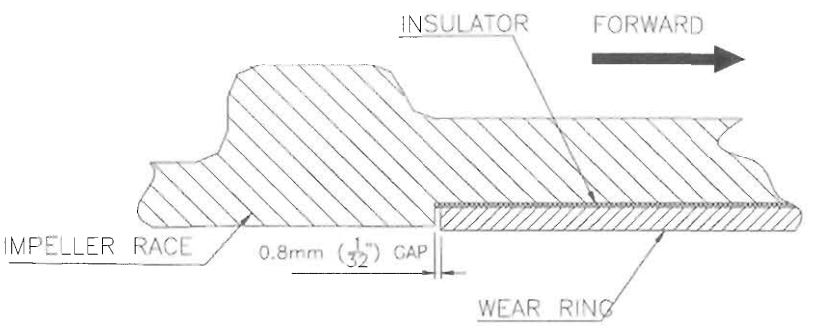
STEP 3:

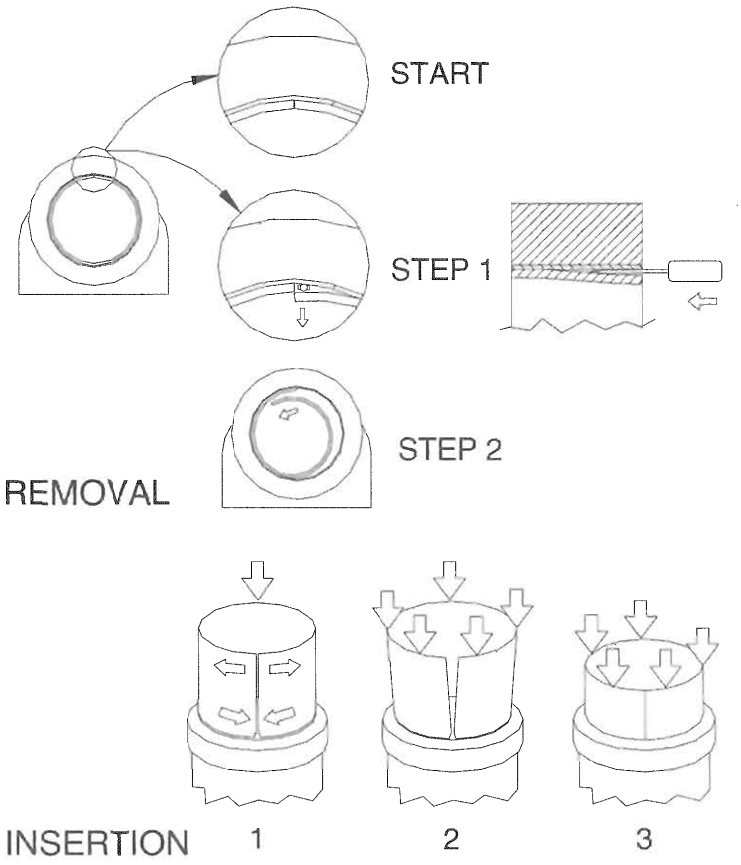
f) Place a flat heavy steel plate over the end of the Wear Ring (The Plate is used to prevent damage to the end of the Wear Ring and should cover the whole diameter of the Wear Ring).
g) Drive the Wear Ring evenly into the Impeller Race by hitting the steel plate with a large hammer, until the Wear Ring sits approximately 0.8 mm ($^1/_{32}$") from the end of the recess at the forward end of the Impeller Race
h) Check that the Insulator Strip is not being damaged as the Wear Ring moves inward.
i) The Wear Ring must not contact any part of the Jet Unit except for the Insulating Strip. Check this with an electrical resistance meter.

NOTE:

The Wear Ring is correctly fitted when the Wear Ring sits approximately 0.8 mm ($^1/_{32}$") from the end of the recess at the rear end of the Impeller Race and the forward end of the Wear Ring is flush with the forward edge of the Impeller Race spigot. . (Refer to the diagram showing the "Wear Ring Fitting Position").

j) On completion of the fitting of the Wear Ring, electrical insulation between the Wear Ring and the Impeller Race should be checked, using a Multi Meter. The resistance reading should be over 1000 ohms.





9.6.5 Impeller Overhaul

Impeller Specifications:	
Outside Diameter (OD):	**399.6 to 399.2 mm.**
Maximum out of balance:	**220 gm cm (11 grams at the OD).**

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.

Welding
Impellers are stainless steel type CF8M 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.

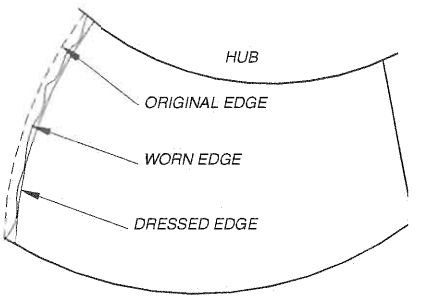
CAUTION:

Avoid using excessive heat during welding.

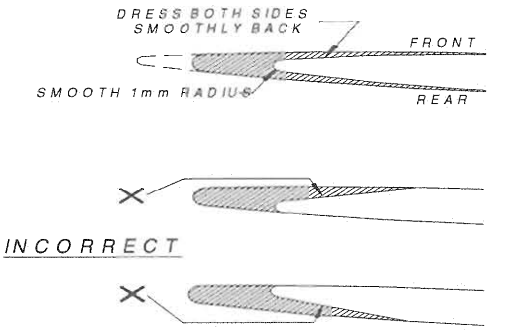
Bent Blades
The outer corners of a blade may be bent if the Impeller has been dropped or mishandled. Bent or dented blades may be straightened using a large adjustable spanner or other suitable tools. Bring the blade back to it's original smooth profile checking against undamaged blades.

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 leading edges as shown on the drawing. Blunt impellers cause loss of performance and sometimes cavitation. Bent or dented trailing edges should be straightened.



FRONT VIEW OF IMPELLER BLADE



Blade Sharpening Procedure

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

1. Dress the edge back to a smooth curve removing the minimum amount of metal.
2. Dress both faces of the blade taking slightly more metal off the rear side until the leading edge is 2 mm 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.
5. Grind or file a smooth 1 mm radius along the leading edge.

Impeller OD Modifications

1. If the Impeller OD 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 les 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.

9.6.6 Refitting the Impeller and Impeller Race

Drawings HJ-391-01-001 refer.

IMPELLER RE-ASSEMBLY

1. Clean all parts thoroughly.
2. Smear a light coating of grease over complete Mainshaft from in front of Impeller Seal [49] position including Impeller taper and aft including Impeller Nut thread.
3. Check O-Ring Intake / Impeller Race [80] for damage. . Replace if necessary. Refit to Intake / Impeller end of Impeller Race.
4. Refit Impeller Race [4] onto the Intake [1], through the Transom, taking care not to pinch O Ring [80]. Refit the 16 x M16 Nuts [58] and Special Washers [57] onto Studs [56] at Impeller Race / Intake and Torque load to recommended torque.
5. Remount the Transom Seal Assembly. **Refer to Section 9.7.2. "Transom Plate Refitting".**
6. Check the Impeller Seal [49] for damage. Replace if necessary. Fit Impeller Seal [49] onto the Mainshaft just ahead of the impeller taper on the Mainshaft.
7. Insert Impeller Key [46] locating it with Dowel [45]. (Dowel is to be fitted using Loctite 262 between the Dowel and the Impeller Key.
8. Slide Impeller onto the Main Shaft followed by the Bearing Sleeve [47].

CAUTION

When fitting a new Impeller into a Jet Unit the Impeller taper must be lapped to the shaft taper in accordance with British Standard MA 74.

9. Prevent the Shaft from rotating by fitting Special Tool *"Reaction Arm"* onto the Coupling Flange.
10. Fit the Impeller Nut [50] and tighten to the recommended torque shown on **Drawing HJ-391-01-001.**
11. If necessary re-drill the recess hole for the Grub Screw [51] in Mainshaft then fit Grub Screw [50] with Loctite 222 (or equivalent) thread locking fluid and tighten to recommended torque shown on **Drawing HJ-391-01-001.**
12. Working through the Main Inspection Cover, remove the surplus grease from the Impeller Seal recess (at front of Impeller). Then slide the Impeller Seal [49] back into the recess whilst rotating the Mainshaft and Impeller by hand.

IMPELLER RACE REFITTING

1. Smear the contact faces of the Impeller Race [4] and the Intake [1] with grease.
2. Smear O-Ring [60] with grease and fit over the flange on the forward end of the Impeller Race [4].
3. Fit the Impeller Race to the Intake ensuring that the larger diameter holes in the Impeller Race line up with Studs [60] on either side if the Intake.
4. Secure the Impeller Race to the Intake with Washer Flat [59] and Nuts [36].
5. Fit Washers Flat [57] and Nuts [58] to Studs [56] to secure the Impeller Race [4] to the Intake.

9.6.7 Tailpipe Overhaul

Drawings HJ-391-01-001 refer.

TAILPIPE

1. Check the fit of the Water Bearing Sleeve [47] in the Water Bearing [48]. **A diametrical clearance of 0.11 to 0.26 mm is normal and 0.6 mm max worn clearance.** If the Water Bearing Sleeve is scored or worn, it should be replaced
2. The Water Bearing Sleeve [47] and Water Bearing [48] should both be replaced if the Impeller has just been overhauled and the Wear Ring [67] replaced.
3. To replace the Water Bearing [48], press out the Fairing [14] first, followed by the Water Bearing [48].

CAUTION:

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

4. Clean out the bore and repaint with two part etch primer. Grease the Tailpipe bore before pressing in the new bearing.
5. Refit the Fairing [14] using Loctite 680 or equivalent. **DO NOT** paint the mating surfaces but ensure the Loctite is spread evenly over the whole of the mating surfaces to keep water out.

INTERNAL TAILPIPE ANODES [88].

Refer to Drawing HJ-391-13-002 for location of Anodes.

1. Check the 2 x Internal Tailpipe Anodes [88] attached to the Anode Mount Plate [89] fitted to the forward face of the Tailpipe, **(Drawing HJ-391-01-001 refers).**
2. Should these be less than $^{2}/_{3}$rds their original size, they should be replaced.
3. To replace the Internal Tailpipe Anodes [88], carry out the following operation:-
   a) With the Tailpipe removed from the Impeller Race, remove the 4 Nyloc Nuts [91] and Spring Washers [10] attaching the Anode Mount Plate [89] to the Studs [90] fitted to the Tailpipe.
   b) Remove the Nyloc Nut [91] and Spring Washer [10] attaching each Anode to the Anode Mount Plate [89].
   c) Remove the 6 x Internal Tailpipe Anodes [88].
   d) Clean up and repair any loose paint or corrosion in the area where the Anode is located.
   e) Fit new Internal Tailpipe Anodes [88].
   f) Attach with Nyloc Nut [91] and Spring Washer [10]. Torque load to the recommended torque.
   g) Refit the Anode Mount Plate [89] to the Tailpipe and attach with the 4 Nyloc Nuts [91] and Spring Washers [10]. Torque load to the recommended torque.
4. If the Anodes are still in good condition, ensure that the Anodes have not been painted over.
5. Scrub the Anodes with a wire brush if a coating of corrosion has built up on the Anodes.

EXTERNAL ANODES [61]

Refer to Drawing HJ-391-13-002 for location of Anodes.

1. Check the external Anodes [61] 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 Anode fitted to the underside of the Nozzle, carry out the following operation:-
   a) Remove the 2 x Nuts [54] and Spring Washers [63] from Stud [62].
   b) Remove the External Anodes [61].
   c) Clean up and repair any loose paint or corrosion in the area where the Anode is located.
   d) Fit a new External Anodes [61].
   e) Attach with 2 x Nuts [54] and Spring Washers [63]. Torque load to the recommended torque.
3. If the Anodes are still in good condition and do not require replacing, ensure that they have not been painted over.
4. Scrub down with a wire brush if a coating has built up on the Anodes.

PIVOT PIN INSERTS [9] (Drawing HJ-391-07-001 refers).

1. The Tailpipe is fitted with two Stainless Steel Inserts [9] for the Reverse Duct Pivot Pins [7] to thread into. If the Inserts [9] are worn, these should be unscrewed out of the Tailpipe and replaced with new Inserts.
2. To replace the Inserts [9] carry out the following actions.
   a) With the Reverse Duct removed from the Nozzle, unscrew the Insert from the Tailpipe. It may be necessary to apply light heat to the Tailpipe in the area of the Insert, to break the Loctite Seal.
   b) Clean out the Insert bores in the Tailpipe, ensuring that all old Loctite is removed from the threads.
   c) Apply a thin coat of Loctite 680 to the threads of the Insert and allow to dry.
   d) Screw the Inserts into the Tailpipe until it bottoms out then tighten firmly.
   e) Wipe off any excess Loctite.

9.6.8 Re-Fitting the Tailpipe

TAILPIPE RE-ASSEMBLY

1. Wipe the Water Bearing Sleeve [47] clean to ensure that the Water Bearing [48] remains free of grease.
2. Dust the inside of the Water Bearing [48] with Talc or French Chalk.
3. Clean and grease the Tailpipe to Impeller Race contact faces.
4. Check O-Ring [55] for damage. Replace if required. Smear O Ring with grease to retain in position and refit to Tailpipe /Impeller Race end of Tailpipe.
5. Refit Tailpipe, taking care not to pinch O Ring [55], at the same time refit Steering Crank [16] onto Steering Shaft [18]. **(Drawing HJ-391-06-005 refers).**
6. Fit Nuts [58] and Special Washers [57] onto Studs [56] at the Impeller Race / Tailpipe interface. Grease the Stud threads and tighten nuts to the recommended torque.
7. Using the Special Tool Reaction Arm, fitted to the Coupling Flange, as a handle and turn the Mainshaft to ensure the Assembly rotates freely.

9.7 TRANSOM PLATE ASSEMBLY OVERHAUL

NOTE:

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

Should it be necessary to remove the Transom Seal Assembly for repair or replacement of the following components, carry out the following procedures shown below.

To replace the Front Header Ring [3], Rear Header Ring [4], the Transom Seal [5] or the Transom Plate [2], the Reverse Duct must be removed to allow access.

9.7.1 Transom Plate Removal

ALL HULL TYPES:

Drawings HJ-391-08-001. "GRP Hulls".
Drawings HJ-391-08-002. "Aluminium Hulls".
Drawings HJ-391-08-003. "Steel Hulls".

To remove the Rear Header Ring [4] and replace the Transom Seal [5], carry out the following operation:-

1. Remove the Reverse Duct as shown in **Section 9.2.1. "Reverse Duct Removal".**
2. Ensure that the Steering Cylinder Main Shaft has been disconnected from the Steering Crank and the Shaft Housing Seal Assembly has been removed from the Transom Plate. **Refer to Section 9.3.13. "Shaft Housing Seal Assembly Removal and Overhaul".**
3. Slacken and remove the Header Ring attachment Nuts [25] and Spring Washers [20] from Studs [10].
4. Remove the Rear Header Ring [4] and the Transom Seal [5] and withdraw them off over the Reverse Cylinders.
5. From inside the vessel, undo and remove Nuts [25] and Spring Washers [20] from Studs [11] securing the Keeper Plates [6] to the forward face of the Front Header Ring [3] in two positions.

Should the Transom Plate require repair or replacement continue as below:-

6. Slacken and remove Bolts [14] and Nuts [24] and remove complete with Flat Washers [19] and Spring Washers [18].
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 [33]. Some effort may be required to separate the Transom Plate from the Transom.

8. Separate the Transom Plate from the Transom and remove from the vessel.
9. Remove the Transom Gasket [23] from the Transom **(Steel Hulls Only).**
10. Remove the Insulating Bushes [29] from the Transom Plate **(Steel Hulls Only).**
11. 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.
12. Clean and examine the Front Header Ring [3] and Rear Header Ring [4] for damage, distortion and corrosion. Replace as required.
13. Clean and examine the Transom Seal [5] for damage cuts or perishing. Replace as required.

9.7.2 Transom Plate Re-Fitting

ALL HULL TYPES:

Drawings HJ-391-08-001. "GRP Hulls".
Drawings HJ-391-08-002. "Aluminium Hulls".
Drawings HJ-391-08-003. "Steel Hulls".

NOTE:

For Steel Hulls Only: The Transom Seal Assembly must be totally insulated from the Hull by a Transom Gasket [31] and Flanged Insulating Bushes [29] fitted around the Transom Plate attachment Bolts [14].

1. Smear the Transom to Transom Plate attachment holes with RTV Sealant [33].
2. Smear the Transom Plate interface around the Transom to Transom Plate attachment holes with RTV Sealant [33].
3. Fit Flat Washer [19] to the Bolts [14] prior to fitting the Bolts to the Transom Plate.
4. Ensure that the holes in the Transom Plate and the Transom are liberally coated with RTV Sealant [33] before fitting the Bolts [14].
5. **(Steel Hulls Only).** Liberally coat the Transom Gasket [31] with RTV Sealant [33] and place in position against the Transom, ensuring that the bolt holes in the gasket are aligned with the bolt holes in the Transom.
6. **(Steel Hulls Only).** Liberally coat the Insulating Bushes with RTV Sealant [33] and fit to the Transom Plate, ensuring that the lip of the Insulating Bushes is fitted on the outside of the Transom Plate.
7. From the Tailpipe end of the Jet Unit, slide the Transom Plate up the Jet Unit and over the Reverse Cylinders.

NOTE:

Ensure that the bolt heads of the Bolts [17] securing the Transom Plate [8] to the Transom are located on the outside of the Transom Plate.

8. **(Steel Hulls Only).** Attach the Transom Plate to the Transom in 3 positions with Bolts [19], Nuts [4] and Spring Washers [3]. ***Hand tight only,*** ensuring that the Bolt heads are positioned on the outside of the Transom.
9. **(Steel Hulls Only).** Check the insulation between the Jet Unit and the Transom. (The resistance should be 1000 Ohms or greater. If the reading is below 1000 Ohms, the fault should be investigated and rectified before continuing).
10. **(Steel Hulls Only).** Fit the remaining Bolts [19], Nuts [4] and Spring Washers [3] and torque load to the recommended torque.
11. **(Steel Hulls Only).** Check the insulation between the Jet Unit and the Transom. (The resistance should be 1000 Ohms or greater. If the reading is below 1000 Ohms, the fault should be investigated and rectified before continuing).
12. Attach the Transom Plate to the Transom with Bolts [14], Nuts [24] and Spring Washers [18].ensuring that the Flat Washers [19] are fitted to the outside faces of both the Transom Plate and the Transom.
13. Ensure that the Transom Plate is correctly located over the Impeller Race.
14. Tighten to the recommended torque.
15. Refit the Front Header Ring [3] to the Transom Plate / Jet Unit interface ensuring that the Studs [10] that secure the Keeper Plate [6] are located at the same height on the port and starboard side of the Jet Unit and are facing forward. **(Refer to the Drawings shown above).**
16. Attach the two Keeper Plates [6] to the Studs [11] fitted to the forward face of the Front Header Ring [3] with Spring Washers [20] and Nuts [25]. Torque load to the recommended torque.
17. Refit the Transom Seal [5] onto the Studs [10] fitted to the Front Header Ring [3] located in the channel between Transom Plate and the Jet Unit.
18. Fit the Rear Header Ring [4] onto Studs [10] and secure to the Transom Plate using Spring Washers [20] and Nuts [25]. Tighten to the recommended torque. **(Drawing 85113 refers).**

19. Refit the Shaft Housing Seal Assembly to the Transom Plate and refit the Steering Cylinder Main Shaft through the Shaft Housing Seal Assembly as shown in **Section 9.4.5. "Shaft Housing Seal Assembly Refit".**
20. Connect the Reverse Cylinders to the Reverse Duct as shown in **Section 9.2.6. "Reverse Duct Re-Fitting".**

9.8 OVERFLOW PREVENTER (OPTIONAL EXTRA).

Refer to Drawing "HJ-391-10-001 "Overflow Preventer Option HJ-391".

C.W.F. Hamilton & Co Ltd can supply an Overflow Preventer as an optional extra. This item enables work to be carried out on the Jet Unit where normally, by removing the Inspection Cover, this may allow water to enter the vessel. The Overflow Preventer raises the height of the Inspection Cover by approximately 150mm.

9.8.1 Overflow Preventer Fitting.

Drawings HJ-391 01-001 and HJ-391-10-001 refer.

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 LEVELS.

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.
2. Ballast the bow end of the vessel to ensure that water does not enter the vessel through the Inspection opening when the Inspection Cover is removed.
3. Remove Nuts [58] and Spring Washers [81] from the three Studs [72] retaining the Main Inspection Cover [70] onto the Jet Intake.
4. Remove the Main Inspection Cover [70] and O Ring [71].
5. Smear the underside of the Overflow Preventer [1] with RTV Silicone Sealant [8].
6. Fit the Overflow Preventer over the Inspection Cover opening and secure in position with Washers [3] and Screws [2] and tighten to the recommended torque.
7. Remove any excess RTV Sealant.
8. With the Overflow Preventer securely fitted in position, ensure that the Drain Bung [7] is securely closed.
9. Check the O Ring [71] fitted to the Inspection Cover [70] for wear or damage and replace as required.
10. Smear the O Ring [71] with marine grease and refit to the seal groove on the underside of the Main Inspection Cover.
11. Refit the Main Inspection Cover [70] to the three Studs [72] fitted around the Inspection Cover opening and secure in position with Nuts [58] and Spring Washers [81].
12. To drain any surplus water from inside the Overflow Preventer, slacken the Drain Bung [7] fitted to the base of the Overflow Preventer.
13. A ½" ID hose may be fitted to the Drain Connection [4] to carry water to the vessel bilge.
14. Ensure that the Overflow Preventer is not leaking water from around the base and from the Drain Connection [4].

9.8.2 Overflow Preventer Removal.

Drawings HJ-391 01-001 and HJ-391-10-001 refer.

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 LEVELS.

To remove the Overflow Preventer [1] carry out the following operations:-

1. Ensure that the water level is below the level of the Main Inspection Cover [58].
2. Ballast the bow end of the vessel to ensure that water does not enter the vessel through the Inspection Cover opening when the Inspection Cover is removed.
3. Remove Nuts [58] and Spring Washers [81] from the three Studs [72] retaining the Main Inspection Cover [70] to the top of the Intake.
4. Remove the Main Inspection Cover [70] and O Ring [71].
5. Ensure that the O Ring [71] fitted to the Main Inspection Cover, is not perished or damaged, replace if required.
6. Smear O Ring [71] with grease and refit to the O Ring groove in the Main Inspection Cover [70].
7. Remove the attaching Screws [2] and Washers [3] securing the Overflow Preventer to the Main Inspection Cover Intake opening and remove the Overflow Preventer.

NOTE:

The Overflow Preventer has been attached using RTV Silicone Sealant and may require some effort to remove.

8. Clean off any excess Silicone Sealant from around the Main Inspection Cover.
9. Refit the Main Inspection Cover [70] to the Inspection opening in the top of the Intake and secure onto Studs [72] with Spring Washers [81] and Nuts [58]. Tighten to the recommended torque.
10. 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 = 0.5396 knots
1 knot = 1.8532 kilometres per hour

1 mile per hour = 1.609 kilometres per hour
1 kilometre per hour = 0.621 miles per hour
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.

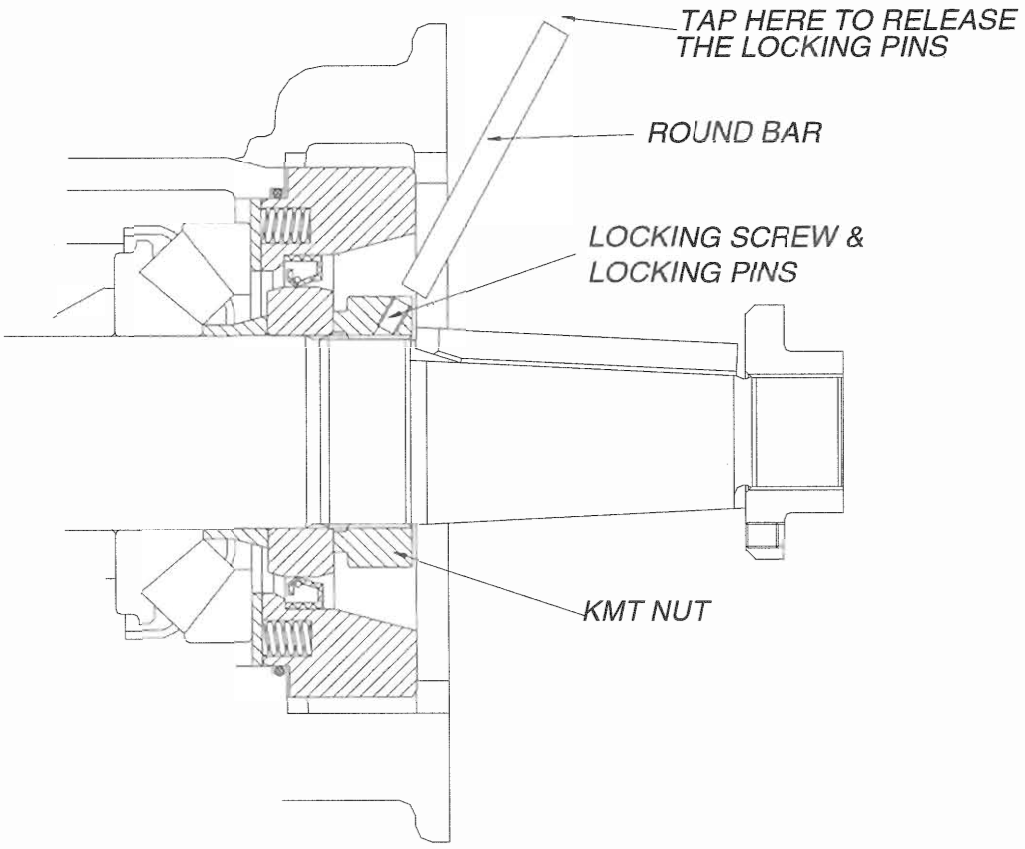
To secure the KMT Nut in position once torque loaded, the Locking Screws are tightened to the recommended torque, using a Socket / Allen Key or a Torque Wrench.

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.

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 slightly heavier blows. Unscrew the KMT Nut and remove from the Shaft.


TAP HERE TO RELEASE
THE LOCKING PINS
ROUND BAR
LOCKING SCREW &
LOCKING PINS
KMT NUT

LOCTITE APPLICATION GUIDE CHART – ALL JETS

WARNINGS

NO SMOKING IN THE PRESENCE OF PRIMER, ACTIVATOR OR ACCELERATOR.

PRIMER 7471, ACTIVATOR 7075 AND ACCELERATOR 7649, ARE ALL HIGHLY FLAMMABLE.

NEVER MIX PRIMER OR ACTIVATOR AND ADHESIVE DIRECTLY AS LIQUIDS.

FOR ADDITIONAL SAFE HANDLING PROCEDURES REFER TO THE PRODUCT DESCRIPTION SHEETS.

EQUIVALENTS:

638 LOCTITE IS THE EQUIVALENT OF 680 AND IS USED WITH 7471 PRIMER.

317 LOCTITE IS THE EQUIVALENT OF 325 AND IS USED WITH 736 ACTIVATOR.

LOCTITE APPLICATION: GENERAL PRACTICE

1. All parts must be free from oil and or grease.
   DO NOT USE PAINT THINNERS for cleaning.
   Use solvents such as Methylated Spirits, Trichlorethylene or Acetone.

2. Primers, Activators or Accelerators should not be applied to 'Active Surfaces', such as Bronzes and Steel.

3. Primers, Activators or Accelerators are not to be applied to any painted surface.

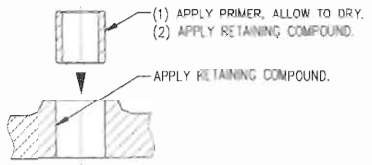
4. Allow sufficient time for Primers, Activators or Accelerators, where applied, to dry.

5. All painted Bores must be fully cured before the application of Loctite.

6. Fixing and full cure times for all Loctite will be increased at reduced temperatures.

7. Refer to relevant Product Data Sheets or Guidelines for safe use and Practice of all Loctite Products.

(1) UNPAINTED BORES/STAINLESS STEEL BUSHES



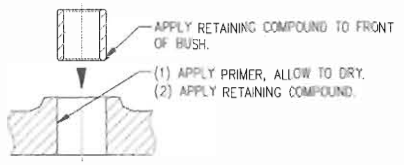
LOCTITE GRADE: 680 LOCTITE

COLOUR: GREEN

PRIMER/ACTIVATOR/ACCELERATOR		LOCTITE CURE SPEED	
TYPE	DRYING TIME	WITH PRIMER/ACTIVATOR/ACCELERATOR	
		PARTIAL	FULL
PRIMER 7471	30-70 SECONDS	5 MINUTES	4-6 HOURS

Bushes, Sleeves, Composite Bush Assemblies (Extra High Strength Retaining)
Primer will be used in all retaining applications.
Apply Primer to whole surface of Bush and allow to dry before fitting.
Apply Loctite to whole surface of Bore and front of Bush before fitting.
There are to be no dry areas between the Bush and the Bore.
Rotate Bush when fitting to distribute the Loctite evenly.
For press fitted Bushes, coat the entire Bush and Bore before pressing in the Bush.

(2) UNPAINTED BORES/LG2 BUSHES



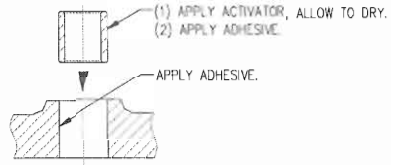
LOCTITE GRADE: 680 LOCTITE

COLOUR: GREEN

PRIMER/ACTIVATOR/ACCELERATOR		LOCTITE CURE SPEED	
TYPE	DRYING TIME	WITH PRIMER/ACTIVATOR/ACCELERATOR	
		PARTIAL	FULL
PRIMER 7471	30-70 SECONDS	5 MINUTES	4-6 HOURS

Bushes, Sleeves, Composite Bush Assemblies (Extra High Strength Retaining)
Primer will be used in all retaining applications.
DO NOT Apply Primer to LG2 Bush
Apply Primer to whole surface of Bore and allow to dry before fitting.
Apply Loctite to whole surface of Bore and front of Bush before fitting.
There are to be no dry areas between the Bush and the Bore.
Rotate Bush when fitting to distribute the Loctite evenly.
For press fitted Bushes, coat the entire Bush and Bore before pressing in the Bush.

(3) PAINTED INTERCURE BORES/STAINLESS STEEL BUSHES



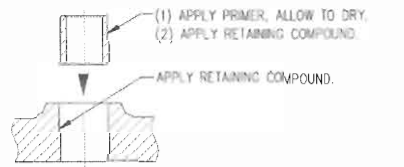
LOCTITE GRADE: 325 LOCTITE

COLOUR: AMBER

PRIMER/ACTIVATOR/ACCELERATOR		LOCTITE CURE SPEED	
TYPE	DRYING TIME	WITH PRIMER/ACTIVATOR/ACCELERATOR	
		PARTIAL	FULL
ACTIVATOR 7075	1-3 MINUTES	5 MINUTES	24 HOURS

Bushes, Sleeves, Composite Bush Assemblies (High Strength Adhesive)
Activator will be used in all retaining applications.
325 Loctite will not cure without the Activator.
DO NOT apply Activator to painted Bore.
Apply Activator to outside of Bush and allow to dry.
Apply Loctite to whole surface of Bore and OD of Bush before fitting Bush.
There are to be no dry areas between Bush and Bore.
Rotate Bush when fitting to distribute the Loctite evenly.

(4) PAINTED GLOSS BORES/STAINLESS STEEL BUSHES



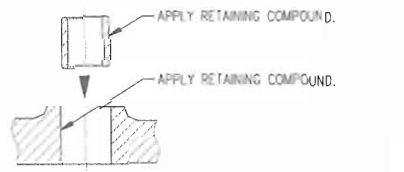
LOCTITE GRADE: 680 LOCTITE

COLOUR: GREEN

PRIMER/ACTIVATOR/ACCELERATOR		LOCTITE CURE SPEED	
TYPE	DRYING TIME	WITH PRIMER/ACTIVATOR/ACCELERATOR	
		PARTIAL	FULL
PRIMER 7471	30-70 SECONDS	5 MINUTES	4-6 HOURS

Bushes, Sleeves, Composite Bush Assemblies (Extra High Strength Retaining)
Primer will be used in all retaining applications.
DO NOT APPLY Primer to painted Bore.
Apply Primer to outside of Bush and allow to dry.
Apply Loctite to whole surface of Bore and OD of Bush before fitting Bush.
There are to be no dry areas between Bush and Bore.
Rotate Bush when fitting to distribute the Loctite evenly.

(5) PAINTED GLOSS BORES/LG2 BUSHES



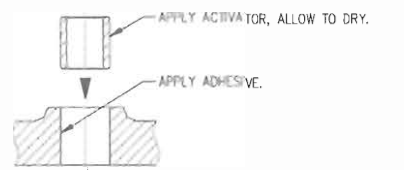
LOCTITE GRADE: 680 LOCTITE

COLOUR: GREEN

PRIMER/ACTIVATOR/ACCELERATOR		LOCTITE CURE SPEED	
TYPE	DRYING TIME	WITHOUT PRIMER/ACTIVATOR/ACCELERATOR	
		PARTIAL	FULL
N/A	N/A	30 MINUTES	4-6 HOURS

Bushes, Sleeves, Composite Bush Assemblies (Extra High Strength Retaining)
Apply Loctite to whole surface of Bore and OD of Bush before fitting Bush.
There are to be no dry areas between Bush and Bore.
Rotate Bush when fitting to distribute the loctite evenly.

(6) UNPAINTED BORES/D-GLIDE BUSHES



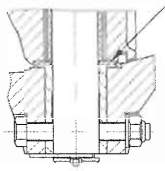
LOCTITE GRADE: 325 LOCTITE

COLOUR: AMBER

PRIMER/ACTIVATOR/ACCELERATOR		LOCTITE CURE SPEED	
TYPE	DRYING TIME	WITH PRIMER/ACTIVATOR/ACCELERATOR	
		PARTIAL	FULL
ACTIVATOR 7075	1-3 MINUTES	5 MINUTES	24 HOURS

D-Glide Bush Retention (High Strength Adhesive)
Activator will be used in all retaining applications.
325 Loctite will not cure without the Activator.
Apply Activator to outside of Bush and allow to dry.
Apply Adhesive to whole surface of Bore.
There are to be no dry areas between Bush and Bore.
Press Bush into Bore within 15 minutes.

(7) D-GLIDE THRUST WASHERS



LOCTITE GRADE: 325 LOCTITE

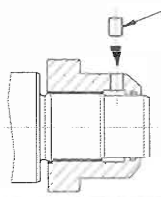
COLOUR: AMBER

PRIMER/ACTIVATOR/ACCELERATOR	
TYPE	DRYING TIME
ACTIVATOR 7075	1-3 MINUTES

LOCTITE CURE SPEED WITH PRIMER/ACTIVATOR/ACCELERATOR	
PARTIAL	FULL
5 MINUTES	24 HOURS

D-Glide Thrust Washer Retention (High Strength Adhesive)
Activator will be used in all retaining applications.
325 Loctite will not cure without the Activator.
Apply Activator to one side of Thrust Washer and allow to dry.
Apply Loctite evenly to Housing recess.
Press Thrust Washer into recess, Activator side to Adhesive.
Remove any excess Loctite from the Bush Bore.
Hold the Washer in place, for approx 15 minutes, until the bond is firm.

(8) MACHINE SCREWS, SET SCREWS, GRUB SCREWS



LOCTITE GRADE: 222 LOCTITE, 243 LOCTITE

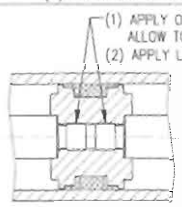
COLOUR: 243 BLUE; 222 PURPLE

PRIMER/ACTIVATOR/ACCELERATOR			
TYPE	DRYING TIME	LOCTITE CURE SPEED	PARTIAL / FULL
PRIMER 7471 (OPTIONAL)	30-70 SECONDS	WITH PRIMER	10 MINUTES / 2 HOURS
	N/A	WITHOUT PRIMER	20 MINUTES / 6 HOURS

PRIMER/ACTIVATOR/ACCELERATOR			
TYPE	DRYING TIME	LOCTITE CURE SPEED	PARTIAL / FULL
PRIMER 7471 (OPTIONAL)	30-70 SECONDS	WITH PRIMER	10 MINUTES / 2 HOURS
	N/A	WITHOUT PRIMER	20 MINUTES / 6 HOURS

Machine Screws, Set Screws, Grub Screws (Low Strength Thread Locking)
Primer is used to shorten the cure time when the temperature is below 15°.
Apply optional Primer to the thread of the Screw and allow to dry.
Apply Loctite to the thread engagement area of the Screw in sufficient quantity to fill all engaged threads.
Assemble the Screw to the Drawing Torque Specifications.

(9) CYLINDER SHAFTS, COMPENSATOR SHAFTS



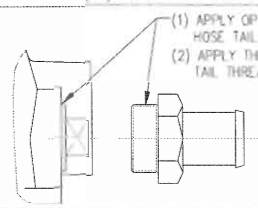
LOCTITE GRADE: 262 LOCTITE

COLOUR: RED

PRIMER/ACTIVATOR/ACCELERATOR			
TYPE	DRYING TIME	LOCTITE CURE SPEED	PARTIAL / FULL
PRIMER 7471 (OPTIONAL)	30-70 SECONDS	WITH PRIMER	10 MINUTES / 2 HOURS
	N/A	WITHOUT PRIMER	20 MINUTES / 6 HOURS

Cylinder Shafts, Compensator Shafts (Hydraulic, Pneumatic Thread Sealant)
Primer is used to shorten the cure time when the temperature is below 15°.
Apply optional Primer to the threads of the shafts and allow to dry.
Apply Loctite to the female threads in the Piston and to the threads on the Shafts in sufficient quantity to fill all the threads.
Assemble the Shafts and Piston as per the drawing specifications.

(10) WATER OFFTAKE BUNGS & HOSE TAILS



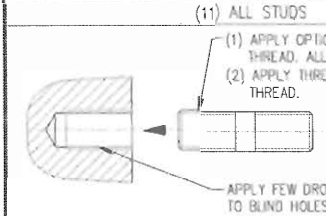
LOCTITE GRADE: 567 LOCTITE

COLOUR: WHITE

PRIMER/ACTIVATOR/ACCELERATOR			
TYPE	DRYING TIME	LOCTITE CURE SPEED	PARTIAL / FULL
ACCELERATOR 7649 (OPT)	30-70 SECONDS	WITH PRIMER	2 HOURS / 6 HOURS
	N/A	WITHOUT PRIMER	12 HOURS / 24 HOURS

Water Offtake Bungs & Hose Tails (Thread Sealant)
Accelerator is used where cure speed is unacceptably long.
Apply optional Accelerator to thread of Plug or Hose Tail and allow to dry.
DO NOT apply Accelerator to Brass Hose Tails.
Apply Loctite to thread engagement area of the Plug or Hose Tail leaving the first thread Loctite free.
Screw Plug or Hose Tail into Tailpipe until Plug or Hose Tail Bottoms, and tighten firmly.

(11) ALL STUDS



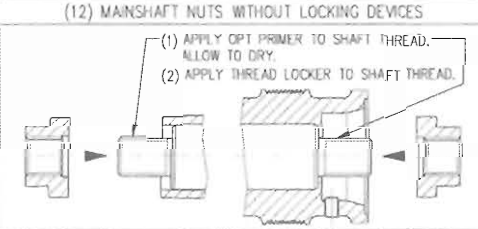
LOCTITE GRADE: 262 LOCTITE

COLOUR: RED

PRIMER/ACTIVATOR/ACCELERATOR			
TYPE	DRYING TIME	LOCTITE CURE SPEED	PARTIAL / FULL
PRIMER 7471 (OPTIONAL)	30-70 SECONDS	WITH PRIMER	10 MINUTES / 2 HOURS
	N/A	WITHOUT PRIMER	20 MINUTES / 6 HOURS

Studs (High Strength Locking)
Primer is used to shorten the cure time when the temperature is below 15°.
Apply optional Primer to the thread of the Stud and allow to dry.
For Blind Holes apply a few drops of Thread Locker into the hole.
Apply Loctite to the thread engagement area of the Stud in sufficient quantity to fill all engaged threads.
Assemble the Stud to specifications.

(12) MAINSHAFT NUTS WITHOUT LOCKING DEVICES



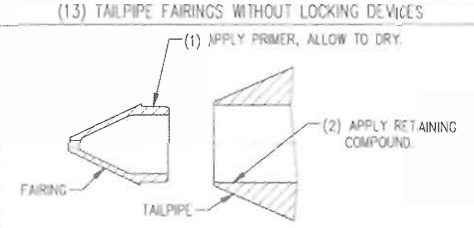
LOCTITE GRADE: 243 LOCTITE

COLOUR: BLUE

PRIMER/ACTIVATOR/ACCELERATOR			
TYPE	DRYING TIME	LOCTITE CURE SPEED	PARTIAL / FULL
PRIMER 7471 (OPTIONAL)	30-70 SECONDS	WITH PRIMER	10 MINUTES / 2 HOURS
	N/A	WITHOUT PRIMER	20 MINUTES / 6 HOURS

Mainshaft Nuts (Medium Strength Thread Locking)
Primer is used to shorten the cure time when the temperature is below 15°.
Apply optional Primer to the threads on the Mainshaft and allow to dry.
Apply Loctite to the thread engagement areas of the Mainshaft in sufficient quantity to fill all engaged threads.
Assemble Nuts to 'Jet Specific' torque specifications.

(13) TAILPIPE FAIRINGS WITHOUT LOCKING DEVICES



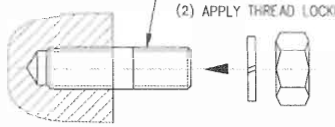
LOCTITE GRADE: 680 LOCTITE

COLOUR: GREEN

PRIMER/ACTIVATOR/ACCELERATOR			
TYPE	DRYING TIME	LOCTITE CURE SPEED WITH PRIMER/ACTIVATOR/ACCELERATOR	PARTIAL / FULL
PRIMER 7471	30-70 SECONDS	PARTIAL	FULL
		5 MINUTES	4-6 HOURS

Tailpipe Fairings without Locking Devices (Extra High Strength Retaining)
Apply Primer to Spigot of Fairing and allow to dry.
Apply Loctite to Spigot Bore of Tailpipe.
Fit using normal methods.

(14) NUTS ON STUDS AND BOLTS (WHERE SPECIFIED)



LOCTITE GRADE: 222 LOCTITE, 243 LOCTITE

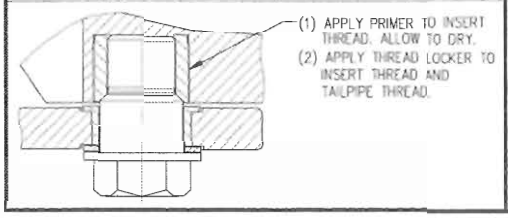
COLOUR: 243 BLUE, 222 PURPLE

PRIMER/ACTIVATOR/ACCELERATOR		LOCTITE CURE SPEED		
TYPE	DRYING TIME		PARTIAL	FULL
PRIMER 7471 (OPTIONAL)	30–70 SECONDS	WITH PRIMER	10 MINUTES	2 HOURS
	N/A	WITHOUT PRIMER	20 MINUTES	6 HOURS

PRIMER/ACTIVATOR/ACCELERATOR		LOCTITE CURE SPEED		
TYPE	DRYING TIME		PARTIAL	FULL
PRIMER 7471 (OPTIONAL)	30–70 SECONDS	WITH PRIMER	10 MINUTES	2 HOURS
	N/A	WITHOUT PRIMER	20 MINUTES	6 HOURS

Nuts (Low Strength Thread Locking)
Primer is used to shorten the cure time when the temperature is below 15°.
Apply optional Primer to the thread of the Stud or Bolt and allow to dry.
Apply Loctite to the thread engagement area of the Stud or Bolt in sufficient quantity to fill all engaged threads.
Assemble the Nut to Torque Specifications in Drawing No. 85113.

(15) TAILPIPE INSERTS (WHERE SPECIFIED)



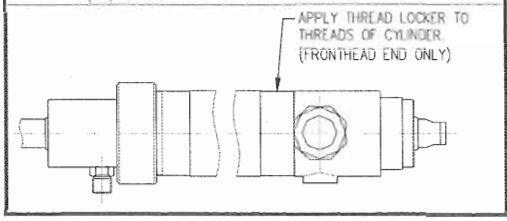
LOCTITE GRADE: 262 LOCTITE

COLOUR: RED

PRIMER/ACTIVATOR/ACCELERATOR		LOCTITE CURE SPEED		
TYPE	DRYING TIME		PARTIAL	FULL
PRIMER 7471 (OPTIONAL)	30–70 SECONDS	WITH PRIMER	10 MINUTES	2 HOURS
	N/A	WITHOUT PRIMER	20 MINUTES	6 HOURS

Tailpipe Inserts (High Strength Thread Locking)
Primer is used in all retaining applications.
Apply Primer to the thread of the insert and allow to dry.
Apply Loctite to the female threads in the Tailpipe and the threads of the Insert in sufficient quantity to fill all the engaged threads.
There are to be no dry areas between Insert and Tailpipe threads.
Screw Insert into the Tailpipe until it bottoms. Tighten firmly.

(16) STEEL CYLINDERS AND AB2 FRONTHEADS



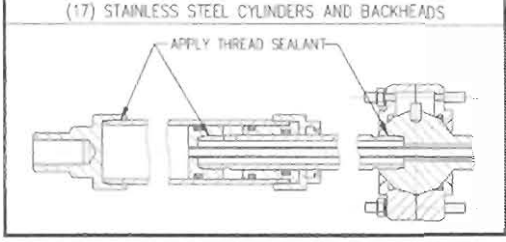
LOCTITE GRADE: 569 LOCTITE

COLOUR: BROWN

PRIMER/ACTIVATOR/ACCELERATOR		LOCTITE CURE SPEED	
TYPE	DRYING TIME	WITHOUT PRIMER/ACTIVATOR/ACCELERATOR	
N/A	N/A	PARTIAL	FULL
		45 MINUTES	24 HOURS

Steel Cylinders and AB2 Frontheads (Low Strength hydraulic Thread Sealant)
Leave the first thread free of Sealant.
Force the Sealand into the threads to thoroughly fill all threads.
Apply Loctite to the leading threads of the Cylinder (Frontnead end).
Assemble the Frontnead to the Cylinder and tighten firmly.

(17) STAINLESS STEEL CYLINDERS AND BACKHEADS



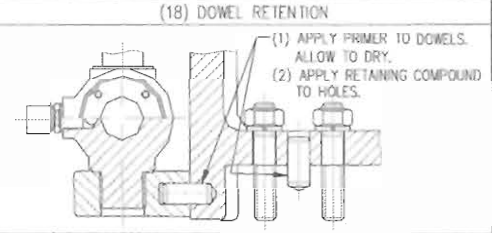
LOCTITE GRADE: 569 LOCTITE

COLOUR: BROWN

PRIMER/ACTIVATOR/ACCELERATOR		LOCTITE CURE SPEED	
TYPE	DRYING TIME	WITHOUT PRIMER/ACTIVATOR/ACCELERATOR	
N/A	N/A	PARTIAL	FULL
		45 MINUTES	24 HOURS

Stainless Steel Cyl's & Backheads (Low Strength Hydraulic Thread Sealant)
Leave the first thread free of Sealant.
Force the Sealant into the threads to thoroughly fill all threads.
Apply Loctite to the Shaft Threads (Piston End).
Apply Loctite to the Leading threads of the Cylinder (Backhead End).
Apply Loctite to the Shaft Thread (Connector End).
Assemble and align. Firmly tighten the Shaft into the Piston and Connector.
Tighten the Backhead to the Assembly Drawing Torque Specifications.

(18) DOWEL RETENTION



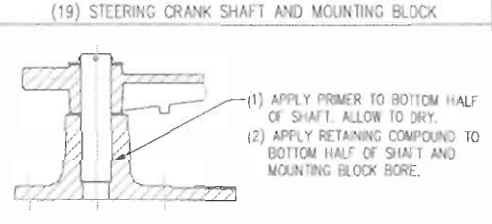
LOCTITE GRADE: 680 LOCTITE

COLOUR: GREEN

PRIMER/ACTIVATOR/ACCELERATOR		LOCTITE CURE SPEED	
TYPE	DRYING TIME	WITH PRIMER/ACTIVATOR/ACCELERATOR	
PRIMER 7471	30–70 SECONDS	PARTIAL	FULL
		5 MINUTES	4–6 HOURS

Dowel Retention (Extra High Strength Retaining)
Dowels are to be retained at one end only.
Apply Primer to one end of Dowel and allow to dry.
Apply Loctite to Dowel Hole in either Casting or Mounting Plate, Not Both.
Fit the end of the Dowel with the Primer into hole which has the Loctite.
Remove excess Loctite from the Dowel, before fitting the Mounting Plate over the Dowel.

(19) STEERING CRANK SHAFT AND MOUNTING BLOCK



LOCTITE GRADE: 680 LOCTITE

COLOUR: GREEN

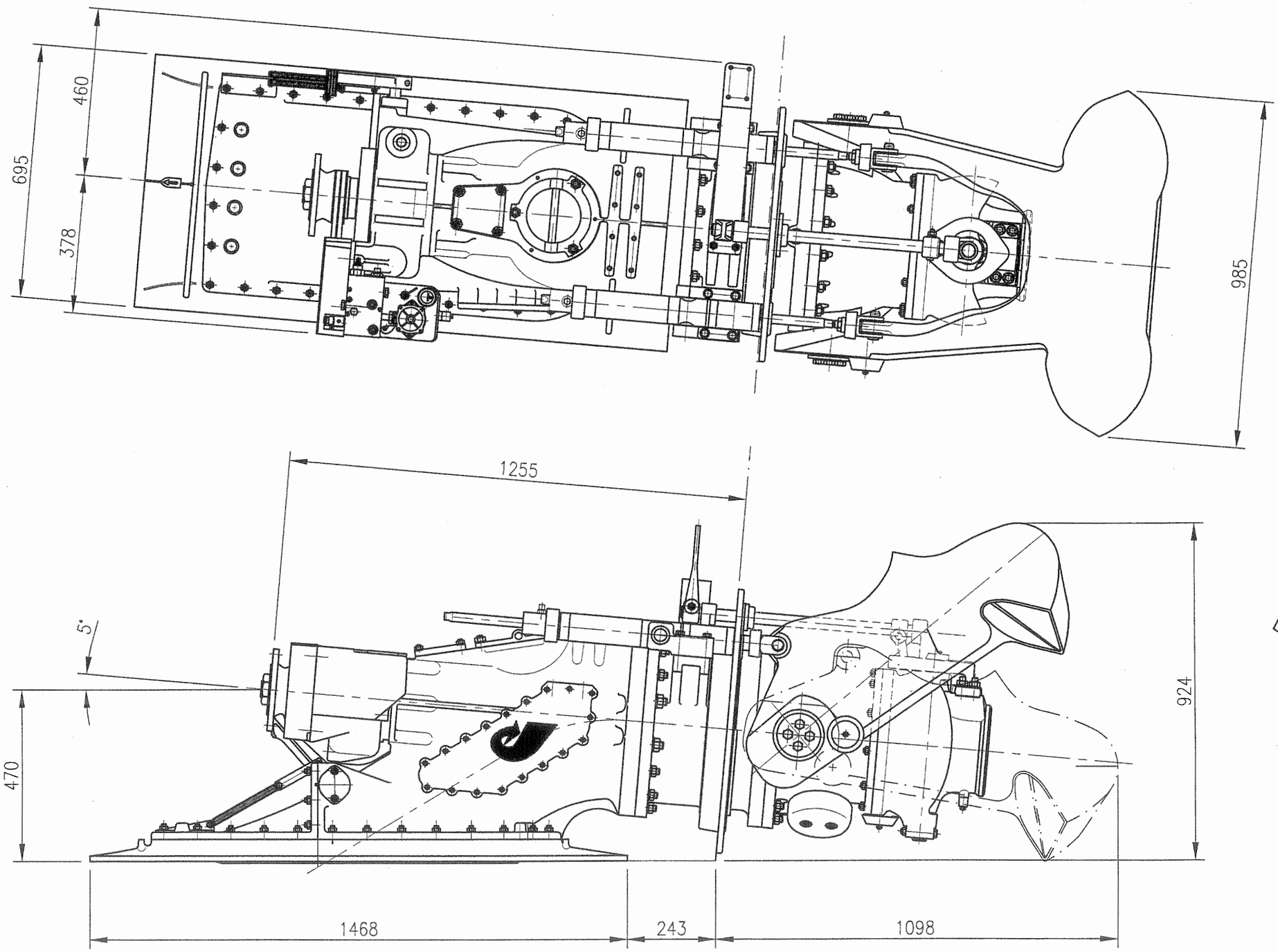
PRIMER/ACTIVATOR/ACCELERATOR		LOCTITE CURE SPEED	
TYPE	DRYING TIME	WITH PRIMER/ACTIVATOR/ACCELERATOR	
PRIMER 7471	30–70 SECONDS	PARTIAL	FULL
		5 MINUTES	4–6 HOURS

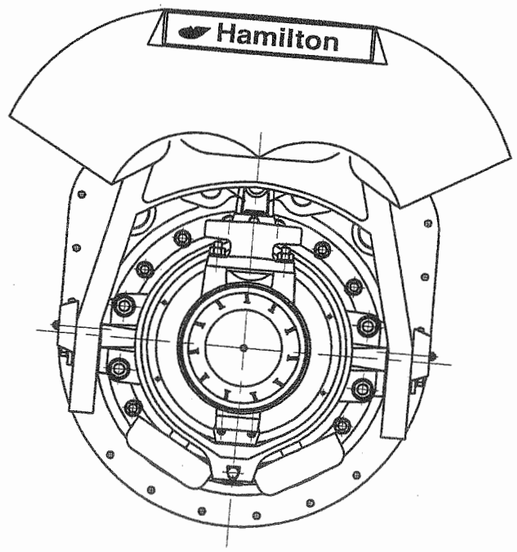
Steering Crank Shaft to Mountin Block (Extra High Strength Retaining)
Apply Primer to bottom half of Shaft and allow to dry.
Apply Loctite to the Bore of the Mounting Block and the bottom half of the Shaft.
Heat the Mounting Block if required.
Press the Shaft into the Mounting Block.
Remove excess Loctite from the Top half of the Shaft.

'T SCALE THIS DRAWING

PROJECTION

ALL DIMENSIONS IN mm. UNLESS OTHERWISE SHOWN.





HJ391 30 001 D

CL 150	D	P.M.W.	28.7.00	JT STEERING UPDATED
CL107	C	R.J.L	1.09.99	T3 STEERING REMOVED & JT STEERING ADDED.
CL087	B	P.S.	22/3/99	SHAFT LINE WAS HORIZONTAL.
CL86	A	P.S.	17/3/99	INTAKE BLOCK WIDTH WAS 680. SCREEN RAKE ARM ADDED.
CL3721	0	R.J.L	30/9/95	ISSUED FOR INFORMATION.
REF	NO.	BY	DATE.	AMENDMENTS

JET 391

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

MATERIAL

√ = N9 EXCEPT AS STATED

UNLIMITED DIMENSIONS TO BE ±

MAT'L CERT

DESIGNED DATE

DRAWN P.A.S 10-02-95

CHECKED

APPROVED

NAME

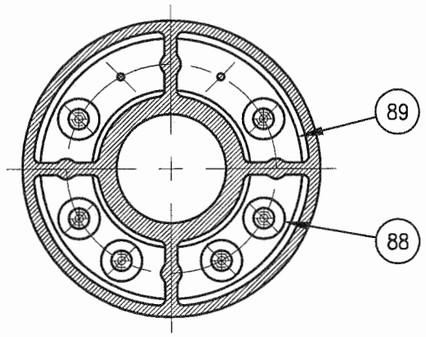
GENERAL ASSEMBLY FOR HJ391 JET

SCALE 1:8

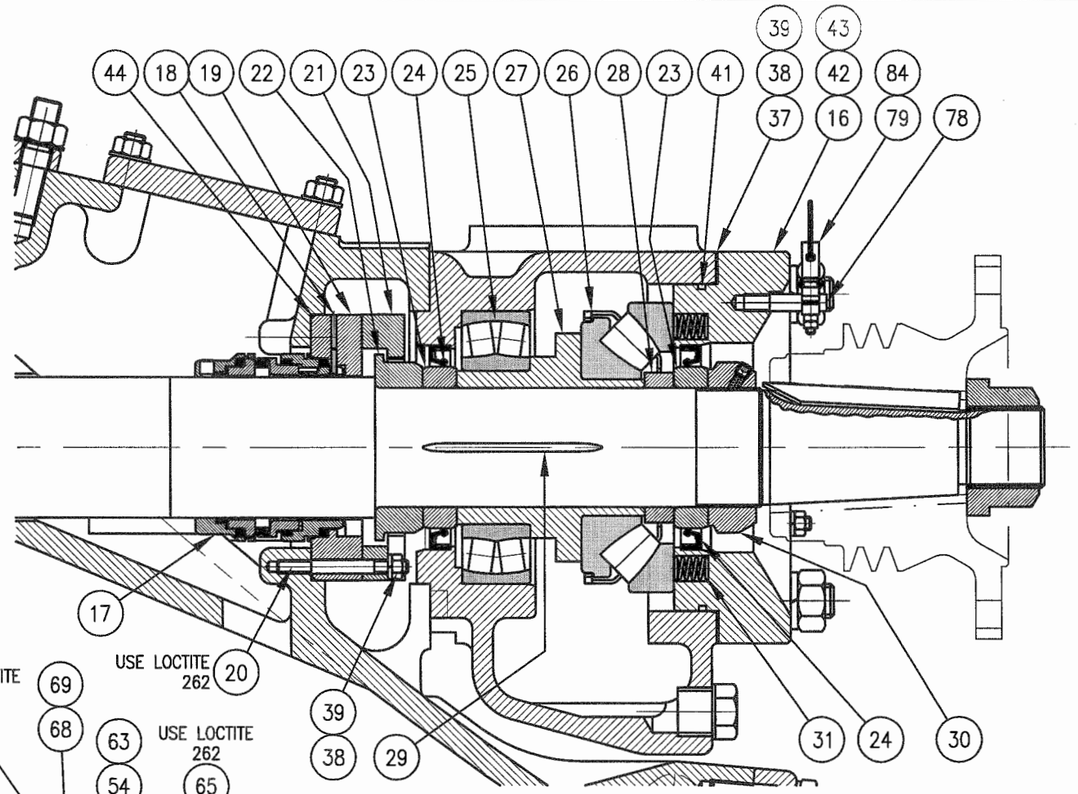
No. A1-HJ391 30 001 D

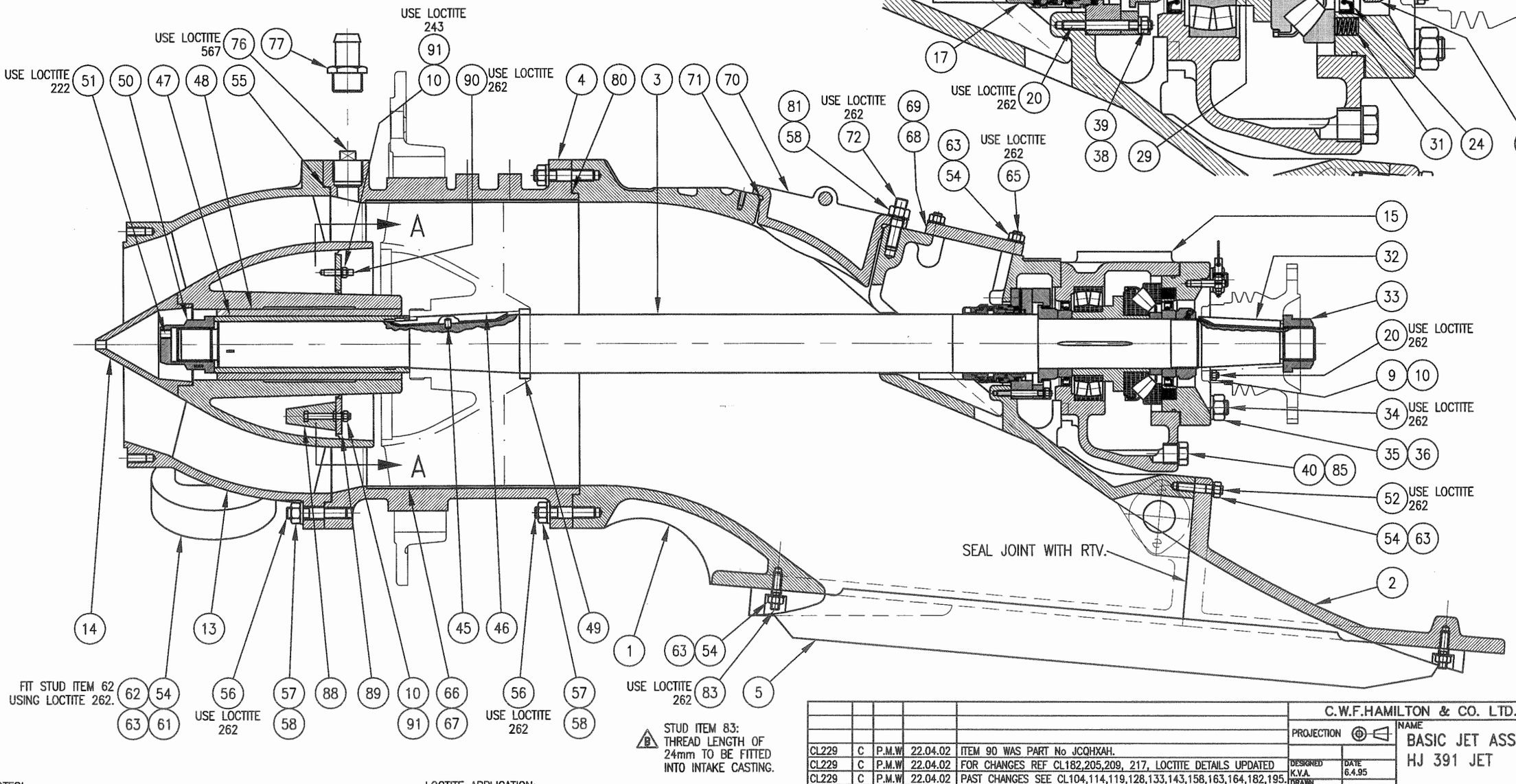
TORQUE CHART	Nm	ft.lb.
IMPELLER NUT (50)	1100	800
COUPLING NUT (33)	600	450
BEARING LOCKNUT (30)	840	620
BEARING LOCKNUT SET SCREW	18	14
IMPELLER NUT SET SCREW (51)	8	6
WATER SEAL SET SCREW	8	6
ALL OTHER NUTS AS PER DRAWING 85018		

LUBRICATION CHART – SEE DRAWING 85018



SECTION A–A





PAINTING NOTES!
1. STANDARD GLOSS FINISH: REFER TO DRAWING 85135 FOR PAINTING OF JET PARTS.
2. OPTIONAL ANTIFOUL FINISH: REFER TO DRAWING 85134 FOR PAINTING OF JET PARTS.
3. REFER TO DRAWING 111178 FOR PAINT SPECIFICATION AND APPLICATION.

LOCTITE APPLICATION:
REFER TO DRAWING No: 85144 FOR THE CORRECT APPLICATION INSTRUCTIONS FOR LOCTITE 222, 243, 262 & 567.

REF	NO.	BY	DATE	AMENDMENTS
CL229	C	P.M.W	22.04.02	ITEM 90 WAS PART No JCQHXAH.
CL229	C	P.M.W	22.04.02	FOR CHANGES REF CL182,205,209, 217, LOCTITE DETAILS UPDATED
CL229	C	P.M.W	22.04.02	PAST CHANGES SEE CL104,114,119,128,133,143,158,163,164,182,195.

JET 391

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

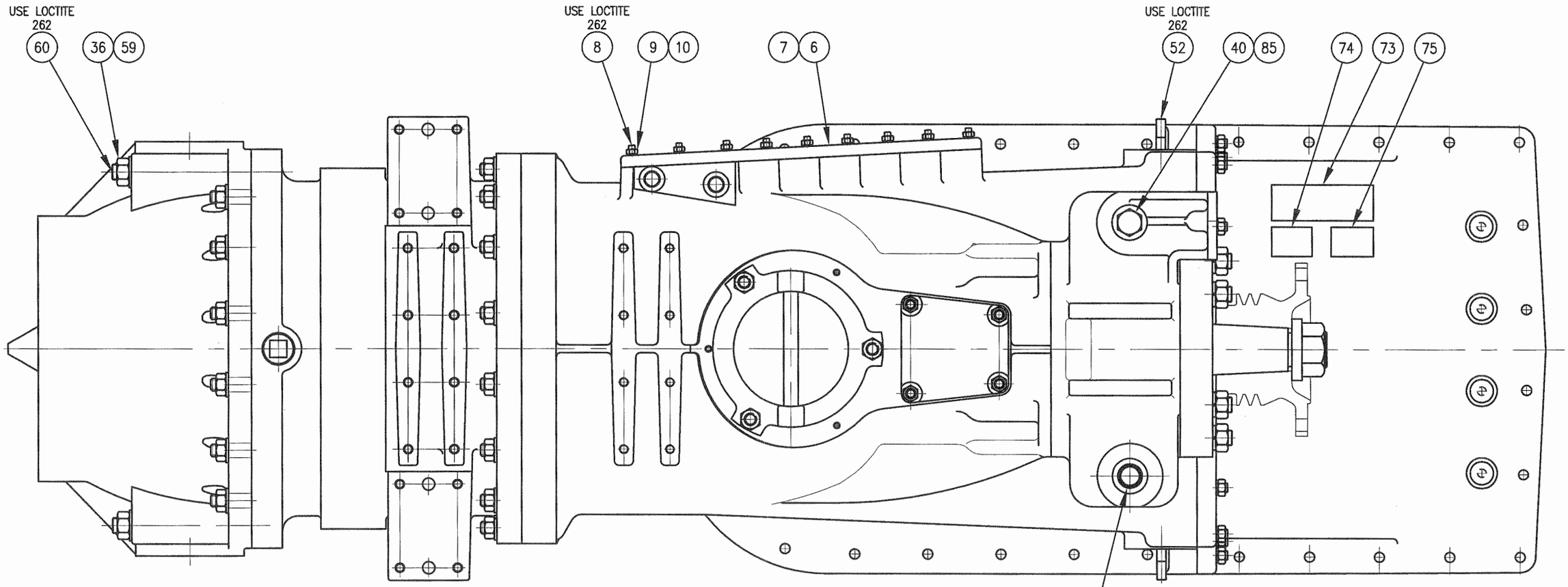
PROJECTION

NAME: BASIC JET ASSEMBLY
HJ 391 JET

SHEET 1 OF 3

		DATE
DESIGNED	K.V.A.	6.4.95
DRAWN	P.A.S.	6.4.95
CHECKED	K.V.A.	11.4.95
APPROVED	K.V.E.	11.4.95

SCALE 1:6 | No: ASSY–HJ391 01 001 | C



52
PRESS FIT USING LOCTITE 680.

LOCTITE APPLICATION:
REFER TO DRAWING No: 85144 FOR THE CORRECT APPLICATION INSTRUCTIONS FOR LOCTITE 262 & 680.

REF	NO.	BY	DATE	AMENDMENTS
				SEE SHEET 1 FOR CHANGES

JET 391

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

PROJECTION

	DATE
DESIGNED K.V.A.	6/4/95
DRAWN P.A.S.	6/4/95
CHECKED K.V.A.	6/4/95
APPROVED K.V.E.	10/4/95

NAME
BASIC JET ASSEMBLY
HJ 391 JET

SHEET 2 OF 3 SHEETS

SCALE -
No: ASSY-HJ391 01 001 C

A	B	C	D	Code	Item	Kit	PartNumber	Qty	ProductDescription	DrawingNbr
						A	105759		TAILPIPE KIT	HJ39101001
						B	108060		IMPELLER RACE KIT	HJ39101001
						C	108061		INTAKE KIT	HJ39101001
						D	111647		ANODE KIT:-TAILPIPE INTERNAL HJ362	THIS
A						Ref	107925	2	INSERT (TAILPIPE) - PIVOT PIN	107925
		C		4	1		107924	1	INTAKE	107924
		C		4	2		107997	1	INTAKE EXTENSION	107997
				3	3		111373	1	MAINSHAFT (SERIES 2)	111373
	B			4	4		107945	1	IMPELLER RACE	107945
				3	5		107934	1	SCREEN (ALM) (std)	107934
		C		4	6		107108	1	OIL COOLER COVER	107108
		C		4	7		107168	1	(JET) O RINGS SPECIAL CORD DIA. 0.13x1130	107168
		C		4	8		JCQHXAH	18	(STUDS) METRIC (316-STST) M8x40 (12/22)	30647
		C18		4	9		JDQHXAC	28	(NUTS) (METRIC ST ST 316) M8	N/A
A10		C18	D10	3	10		JEQKXAC	38	(WASHERS) (SPRING) METRIC ST ST 316 M8	N/A
A				4	13		105946	1	TAILPIPE	105946
A				4	14		105599	1	FAIRING HUB - TAILPIPE.	105599
				3	15		106909	1	BEARING HOUSING	106909
				3	16		103871	1	BEARING RETAINER PLATE ASSEMBLY	103871
				2	17		61524	1	(JET) ROTARY SEALS 3.25" (CS1-H1310CSN-X52)	61524
				4	18		103948	1	PIN (WATER SEAL STATIONARY FACE)	103948
				4	19		104027	1	SEAL FACE HOLDER	104027
		C		4	20		103947	10	(STUDS) METRIC (316-STST) M8x77 (20/20)	30647
				4	21		104028	1	RETAINER	104028
				4	22		103872	1	SLINGER	103872
				3	23		103432	2	SEAL SLEEVE	103432
				2	24		JWKZACB	2	(OIL SEALS) Gaco 9512012	N/A
				2	25		JNODADP	1	(SKF) BEARINGS ALL TYPES (SKF 22218-C)	N/A
				2	26		JNODAEA	1	(SKF) BEARINGS ALL TYPES (SKF 29416E)	N/A
				4	27		103430	1	BEARING SPACER/CARRIER	103430
				4	28		103887	1	DISTANCE SLEEVE	103887
				4	29		103435	1	ROUND KEY	103435
				3	30		JNODAFZ	1	(SKF) NUTS SPECIAL Lock Nut KMT 14	N/A
				2	31		60238	12	(SPRING) (BEARING PRE-LOAD)	60238
				4	32		103911	1	COUPLING KEY	103911
				4	33		103878	1	COUPLING NUT	103878
		C		4	34		30720	6	(STUDS) METRIC (SAF-2205) M20x315 (60/60)	30692
				4	35		JEQKXAL	6	(WASHERS) (SPRING) METRIC ST ST 316 M20	N/A
				4	36		JDQHXAP	10	(NUTS) (METRIC ST ST 316) M20	N/A
				2	37		103874	3	SHIM (0.010)"	103874
				2	38		103875	2	SHIM (0.005)"	103874
				2	39		103876	1	SHIM (0.002)"	103874
				3	40		WAQUAAE	2	PLUG 3/4 BSPP (SF 1012)	N/A
				2	41		HMHRADO	1	(O RINGS) IMPERIAL 0.13x7.25x7.50 (263N70)	N/A
				4	42		64632	REF	EXPANDER PLUG (KOENIG MB 600 090)	N/A
				2	43		HMHRADL	1	(O RINGS) IMPERIAL 0.06x0.63x0.75 (016N70)	N/A
				2	44		104026	1	GASKET SEAL FACE HOLDER	104026
				4	45		104004	1	(JET) DOWELS 5/16" OD 316 STST	103929

A	B	C	D	Code	Item	Kit	PartNumber	Qty	ProductDescription	DrawingNbr
				4	46		103929	1	IMPELLER KEY	103929
				2	47		111117	1	WATER BEARING SLEEVE (10RE51)	111117
A				2	48		106267	1	MARINE WATER BEARING 100x80x260	106264
				2	49		103934	1	IMPELLER SEAL	103934
				3	50		103879	1	IMPELLER NUT ASSY.	103879
				3	51		104720	1	(SET SCREW) SPECIAL (M12 x 30 316SS.)	104720
		C		4	52		103916	19	(STUDS) METRIC (316-STST) M12x64 (24/24)	30639
				4	53		JEOZXAK	4	(WASHERS) (FLAT) METRIC ST ST 316 M12x24x1.6	N/A
A4		C27		4	54		JDQHXAH	31	(NUTS) (METRIC ST ST 316) M12	N/A
A	B			2	55		106994	1	(JET) O RINGS SPECIAL (TAILPIPE/IMPELLER RACE)	106994
				4	56		108182	28	(STUDS) METRIC (SAF-2205) M16x85 (32/32)	30700
	B12			4	57		103451	28	(WASHER) SPECIAL M16 316 STST	103451
				4	58		JDQHXAL	31	(NUTS) (METRIC ST ST 316) M16	N/A
				4	59		103452	4	(WASHER) SPECIAL M20 316 STST	103452
	B			4	60		30688	4	(STUDS) METRIC (SAF-2205) M20x220 (40/40)	30692
A				2	61		103862	2	ANODE	103862
A				4	62		102769	4	(STUDS) METRIC (316-STST) M12x78 (28/28)	30639
A4		C27		4	63		JEQKXAH	31	(WASHERS) (SPRING) METRIC ST ST 316 M12	N/A
		C		4	65		30658	4	(STUDS) METRIC (316-STST) M12x54 (22/22)	30639
	B			2	66		108075	1	INSULATOR (WEAR RING)	105887
	B			4	67		108074	1	WEAR RING	105886
				4	68		104879	1	INSPECTION COVER (ROTARY SEAL)	104879
				1	69		104880	1	GASKET (ROTARY SEAL INSPECTION COVER)	104880
				4	70		104885	1	INSPECTION COVER (MAIN)	104885
				1	71		HMHRACW	1	(O RINGS) IMPERIAL 0.25x6.50x7.00 (439N70)	N/A
		C		4	72		30657	3	(STUDS) METRIC (316-STST) M16x70 (30/30)	30634
		C		4	73		63610	1	(LABELS) (WARNING PLATE)	63610
		C		4	74		63135	1	(LABELS) (PATENT PLATE)	63135
		C		4	75		63097	1	(LABELS) (MODEL & SERIAL No PLATE)	63097
	B			4	76		HIQUAAG	1	(PLUGS) B.S.P.P. PLUG 1-1/4" BSP SQ HD 316 S.S.	N/A
	B			4	77		JMNGAAO	1	(HOSE) TAILS 1-1/4" BSP (#BSP-6-HT-032) 316 STST	N/A
				4	78		107659	1	(STUDS) METRIC (316-STST) HALF STUD (15/0)	107202
				2	79		63895	1	CARBON BRUSH HOLDER 126D36-10	63895
	B	C		2	80		108199	1	(JET) O RINGS SPECIAL INTAKE/IMPELLER RACE	106994
				4	81		JEQKXAJ	3	(WASHERS) (SPRING) METRIC ST ST 316 M16	N/A
				4	82		108200	1	Wood Box Assy HJ 391	108200
		C		4	83		108188	8	(STUDS) METRIC (316-STST) M12x52 (17/24)	30639
				4	84		109416	1	EARTHING WIRE HARNESS	109416
				3	85		WAQUDAE	2	BONDED SEAL 3/4" BSP (400-827-4490-74)	N/A
A			D	2	88		111644	6	ANODE INTERNAL for TAILPIPE	111644
A				4	89		109845	1	ANODE MOUNTING PLATE	109845
A				4	90		109518	4	(STUDS) METRIC (316-STST) M8x41 (16/16)	30647
A			D	4	91		JDQSXAC	10	(NUTS) (METRIC NYLOC ST ST 316) M8	N/A
				4	92		108268	1	THREADED INSERT (BEARING HOUSING)	108268
				4	93		111430	1	391 LABELS KIT	111420
					94		111443	REF	PAINT APPLICATION 391 JET (STD) Gloss Finish.	111178
					95		111553	REF	PAINT APPLICATION 391 JET (OPTIONAL) Antifouled	111178

REF	NO.	BY	DATE	AMENDMENTS
				SEE SHEETS 1 & 2 FOR AMENDMENTS

JET 391

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

PROJECTION

DESIGNED	KVA	06/04/95
DRAWN	PAS	06/04/95
CHECKED	KVA	06/04/95
APPROVED	KVE	10/04/95

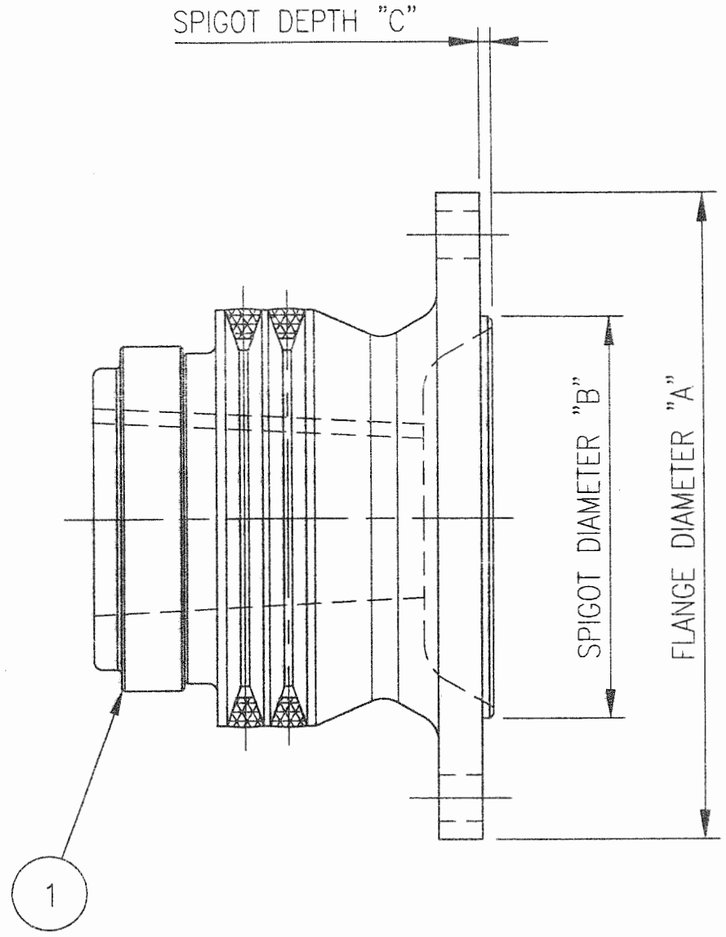
NAME
BASIC JET ASSEMBLY
HJ 391 JET

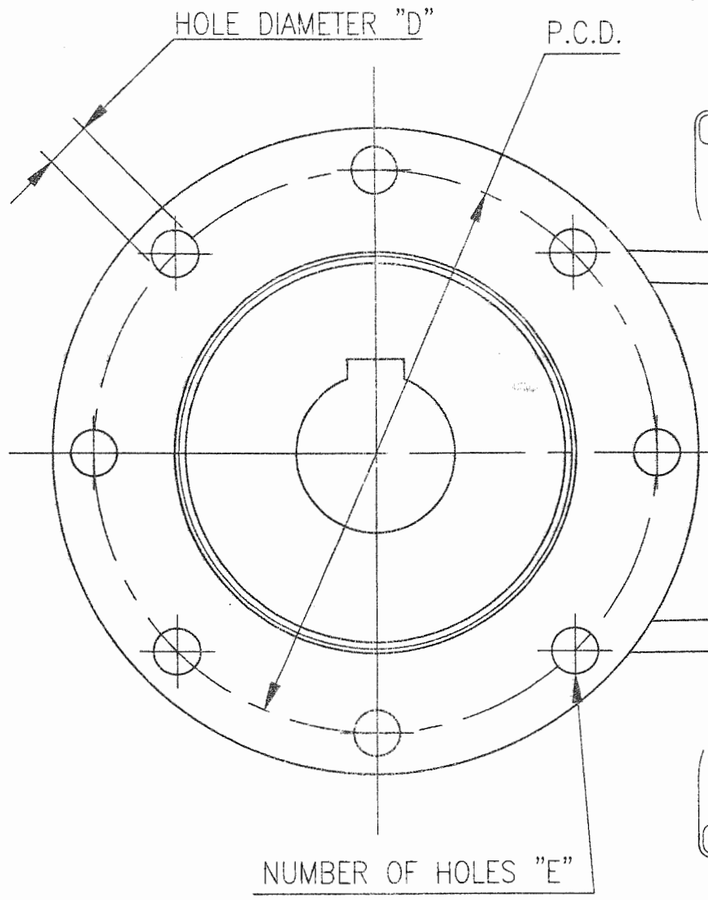
SHEET 3 OF 3 SHEETS

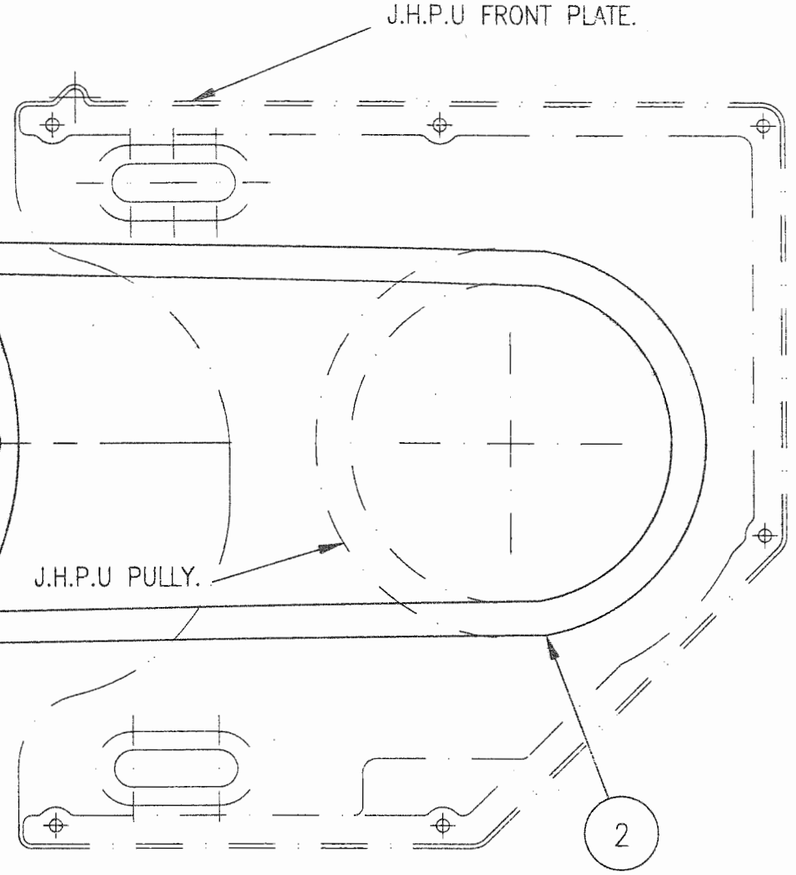
SCALE

No: ASSY-HJ391 01001 C

PROJECTION

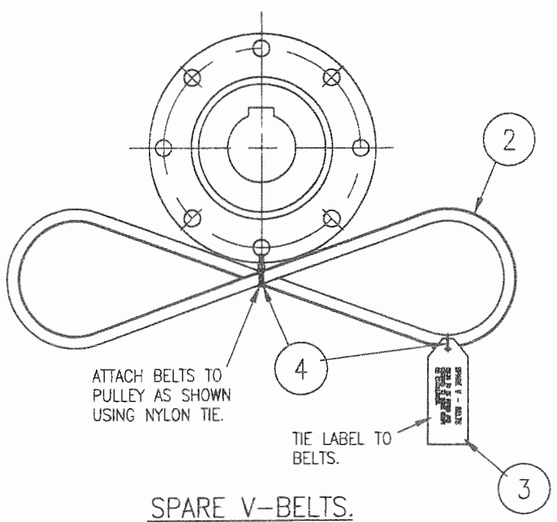






ITEM	PART No		DESCRIPTION	DWG No
A	108056		COUPLING & VEE BELT ASSEMBLY	THIS
B	110406		COUPLING & VEE BELT ASSEMBLY	THIS

COUPLING & VEE BELTS HJ391 02 001													
SPARES ASSY				ITEM	PART No	QTY	DESCRIPTION	DWG No	DIA.A	DIA.B	DEPTH.C	DIA.D	PCD	HOLES (E)
A			4	1	107635	1	COUPLING FLANGE 225-8xM16	107635	225	140	4	16.25	196	8
	B		4	1	110405	1	COUPLING FLANGE SPICER 1910	110405	248	177.8	4	16	209.55	8
A	B		1	2	63829	4	VEE BELT GATES XPA 1000							
A	B			3	108897	1	LABEL	108897						
A	B			4	64500	2	CABLE TIE							



SPARE V-BELTS.

HJ391 02 001 A

REF	NO.	BY	DATE	AMENDMENTS
CL3818	B	P.S.	20/1/98	110406 ADDED.
CL3739	A	R.J.L	19.02.96	SPARE VBELTS ADDED & BELT QTY. WAS 2.
CL3700	0	R.J.L	31/03/95	ISSUED FOR MANUFACTURE.

JET 391

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 — 31-03-95

CHECKED P.S

APPROVED K.V.E — 4-04-95

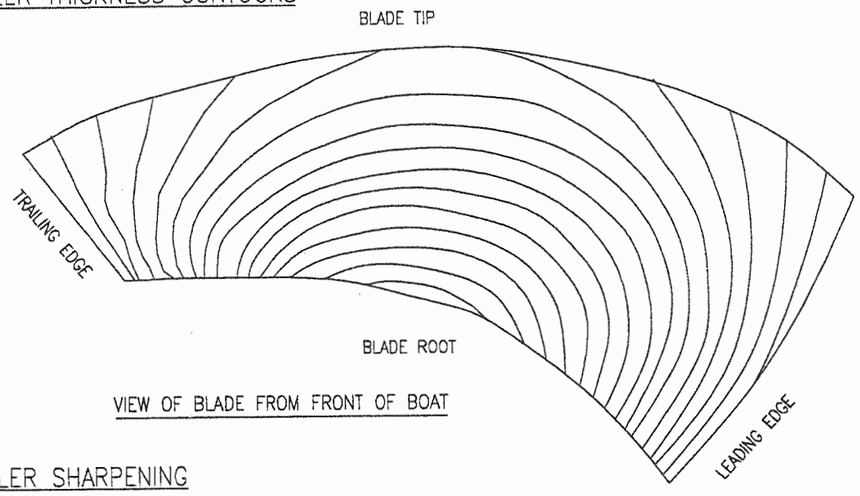
NAME

COUPLINGS & VEE - BELTS for HJ391 JET

SCALE NONE

No: A3-HJ391 02 001 B

IMPELLER THICKNESS CONTOURS

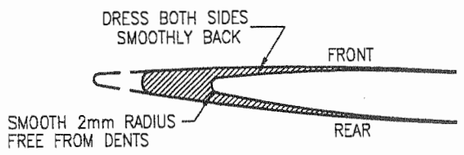


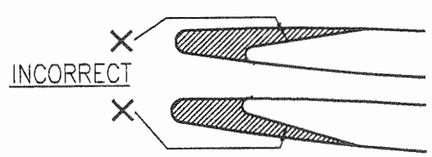
VIEW OF BLADE FROM FRONT OF BOAT

IMPELLER SHARPENING

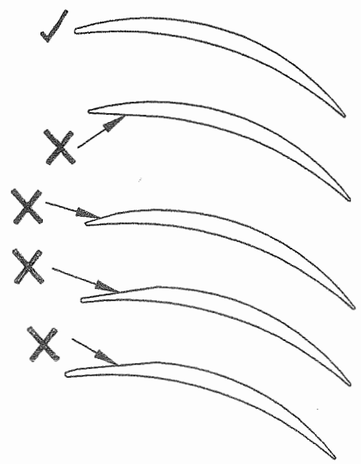
The leading edges of the Impeller may tend to become "blunt" after a period of time with the action of small solid particles in the water. The performance of the Impeller may drop as a result

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

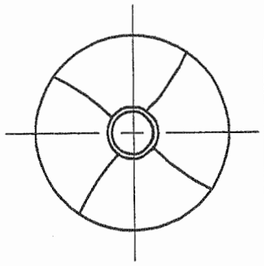




Both front and rear surfaces to be smooth uniform curves. Any flat areas will reduce efficiency and cause cavitation. Use the following sketches as a guide.

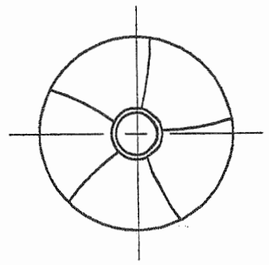


After sharpening balance to within 104 gm.cm



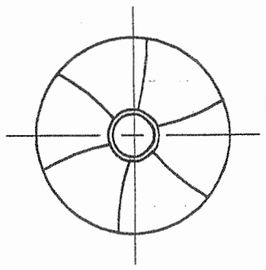
4 BLADE

Item	Kit	PartNumber	Qty	ProductDescription	DrawingNbr
1		105966	1	(JET) IMPELLERS TYPE (53) - (4 BLADE) As Cast	105966
1		105967	1	(JET) IMPELLERS TYPE (49) - (4 BLADE) Trimmed	105966
1		105968	1	(JET) IMPELLERS TYPE (45) - (4 BLADE) Trimmed	105966
1		105969	1	(JET) IMPELLERS TYPE (42) - (4 BLADE) Trimmed	105966



5 BLADE

Item	Kit	PartNumber	Qty	ProductDescription	DrawingNbr
2		106753	1	(JET) IMPELLERS TYPE (70) - (5 BLADE) As Cast	106753
2		107882	1	(JET) IMPELLERS TYPE (68) - (5 BLADE) Trimmed	106753
2		105963	1	(JET) IMPELLERS TYPE (66) - (5 BLADE) Trimmed	106753
2		108039	1	(JET) IMPELLERS TYPE (63) - (5 BLADE) Trimmed.	106753
2		105964	1	(JET) IMPELLERS TYPE (61) - (5 BLADE) Trimmed	106753
2		105934	1	(JET) IMPELLERS TYPE (60) - (5 BLADE) Trimmed	106753
2		105965	1	(JET) IMPELLERS TYPE (57) - (5 BLADE) Trimmed	106753



6 BLADE

Item	Kit	PartNumber	Qty	ProductDescription	DrawingNbr
3		109950	1	(JET) IMPELLERS TYPE (90) - (6 BLADE) As Cast	109950
3		110083	1	(JET) IMPELLERS TYPE (85) - (6 BLADE) Trimmed	109950
3		110084	1	(JET) IMPELLERS TYPE (80) - (6 BLADE) Trimmed	109950
3		110085	1	(JET) IMPELLERS TYPE (75) - (6 BLADE) Trimmed	109950

CL 67	C	R.J.L	23.09.98	6 BLADE IMPELLER TYPE 70 PART No.110086 DELETED.	
CL3815	B	P.S	5.12.97	6 BLADE IMPLERS ADDED.	
CL3717	A	L.E.A	22.08.95	108039 WAS 108093, SPELLING ERROR CORRECTED.	
CL3700	0	R.J.L	3.04.95	ISSUED FOR PRODUCTION	
REF	NO.	BY	DATE	AMENDMENTS	

JET 391

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

PROJECTION

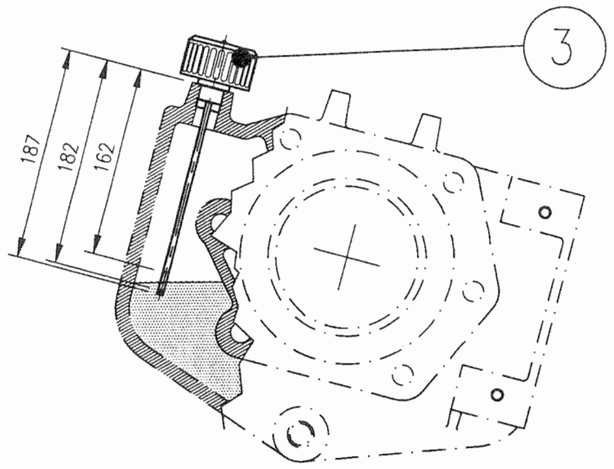
NAME: IMPELLERS for HJ391 JET

DESIGNED	DATE
DRAWN R.J.L	3-04-95
CHECKED K.V.E	4-04-95
APPROVED K.V.E	4-04-95

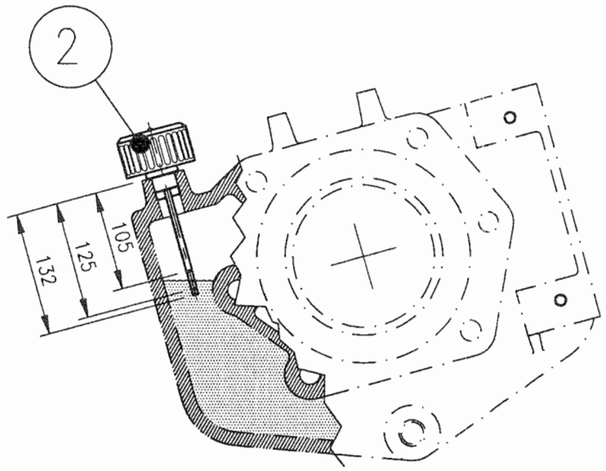
SCALE 2x

No: ASSY-HJ391 03 001 C

PROJECTION

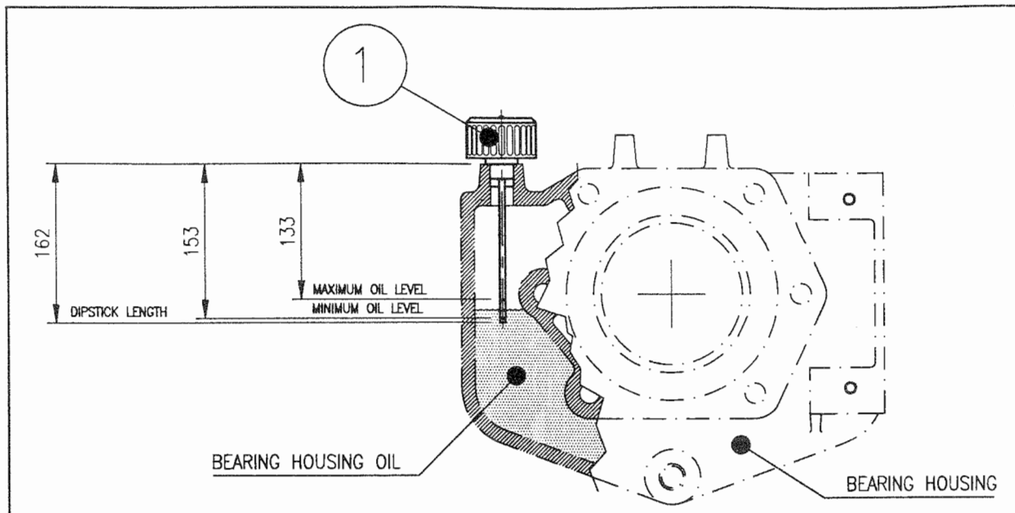


STARBOARD JET UNIT



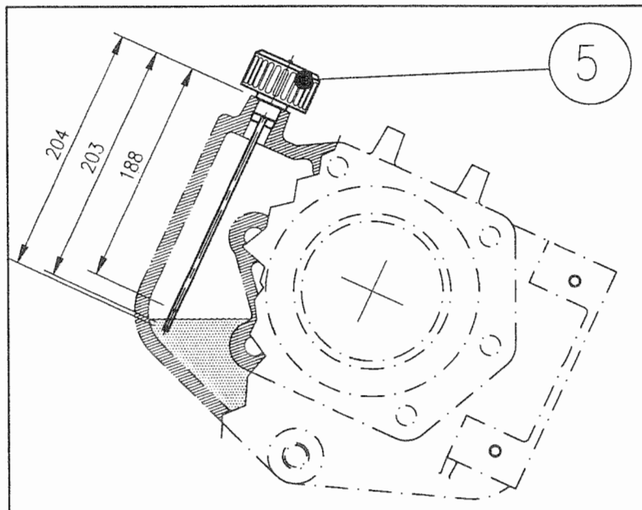
PORT JET UNIT

DIPSTICKS, HJ391, 6° TO 15° DEADRISE HULL HJ391 05 002

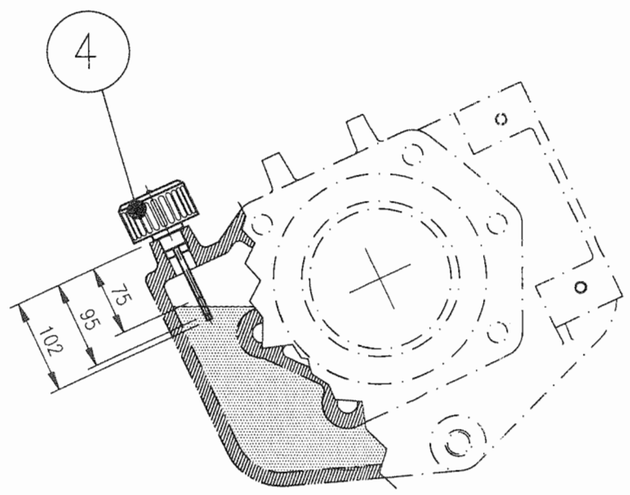


STARBOARD, CENTRE OR PORT JET UNIT

DIPSTICKS, HJ391, 0° TO 5° DEADRISE HULL HJ391 05 001



STARBOARD JET UNIT



PORT JET UNIT

DIPSTICKS, HJ391, 16° TO 25° DEADRISE HULL HJ391 05 003

NOTE:

1. ALL VIEWS ARE LOOKING ASTERN
2. VIEWS ARE SIMPLIFIED FOR CLARITY
3. TERMS ARE DEFINED ON VIEW FOR ITEM (1)
4. ENSURE OIL LEVEL IS KEPT BETWEEN MINIMUM AND MAXIMUM LEVELS
5. TAKE CARE WITH THREAD IN ALUMINIUM BEARING HOUSING WHEN REPLACING DIPSTICK
6. ENSURE DIPSTICK IS FIRMLY TIGHTENED BY HAND WHEN REPLACING

DIPSTICKS, HJ391, 16° TO 25° DEADRISE HULL								HJ391 05 003
			4	5	106992	1	DIPSTICK, 16° TO 25° STBD.	106988
			4	4	106991	1	DIPSTICK, 16° TO 25° PORT	106988

DIPSTICKS, HJ391, 6° TO 15° DEADRISE HULL								HJ391 05 002
			4	3	106990	1	DIPSTICK, 6° TO 15° STBD.	106988
			4	2	106989	1	DIPSTICK, 6° TO 15° PORT.	106988

DIPSTICKS, HJ391, 0° TO 5° DEADRISE HULL								HJ391 05 001
			4	1	106988	1	DIPSTICK, 5° PORT TO 5° STBD.	106988
SPARES ASSY			ITEM	PART NO	QTY	DESCRIPTION		DRG NO CWF H. USE ONLY

B

HJ391 05 001

REF	NO.	BY	DATE	AMENDMENTS
CL3712	B	R.J.L	18-7-95	ITEM Nos. ON VIEWS WERE INCORRECT TO SCHEDULE.
CL3703	A	I.B.W	15.05.95	DIM WAS 105 NOW 162
CL3700	0	I.B.W.	15.5.95.	ISSUED FOR PRODUCTION

JET 391

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

MATERIAL

√ = N9 EXCEPT AS STATED

UNLIMITED DIMENSIONS TO BE ± -

MAT'L CERT

DESIGNED K.V.A. DATE 9/94

DRAWN R.J.L 30-03-95

CHECKED K.V.A. 4.4.95.

APPROVED K.V.E 4.4.95.

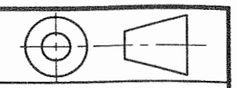
NAME
DIPSTICKS
HJ391

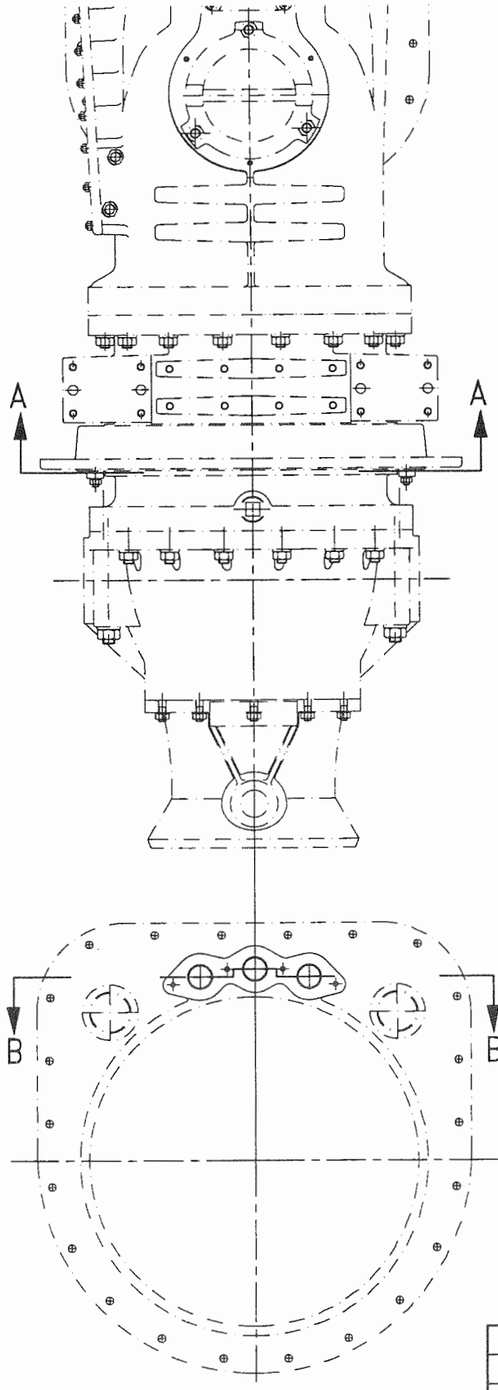
SCALE N.T.S.

No: A3-HJ391 05 001 B

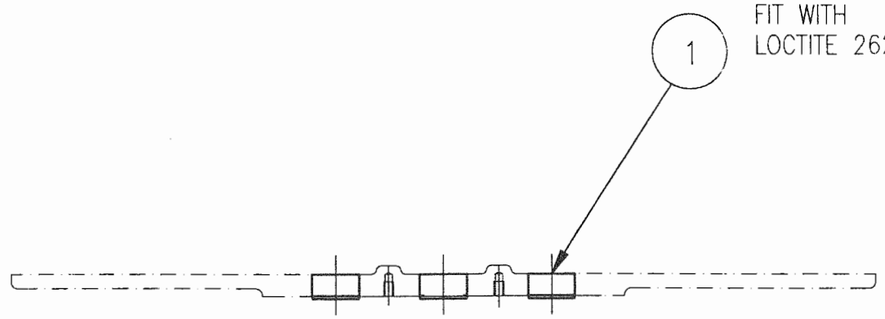
DO NOT SCALE THIS DRAWING.

ALL DIMENSIONS IN mm. UNLESS OTHERWISE SHOWN.

PROJECTION 



SECTION A–A



SECTION B–B

SPARES ASSY	ITEM	PART NO	QTY	DESCRIPTION	DRG NO CWF H USE ONLY
4	1	105619	3	BLANKING PLUG (STG SHAFT)	105619

HJ391 06 004 | 0

REF	NO.	BY	DATE	AMENDMENTS
3703	0	I.B.W.	15.5.95.	ISSUED FOR PRODUCTION

JET 391

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

MATERIAL: SEE ABOVE

✓ = N9 EXCEPT AS STATED

UNLIMITED DIMENSIONS TO BE ± –

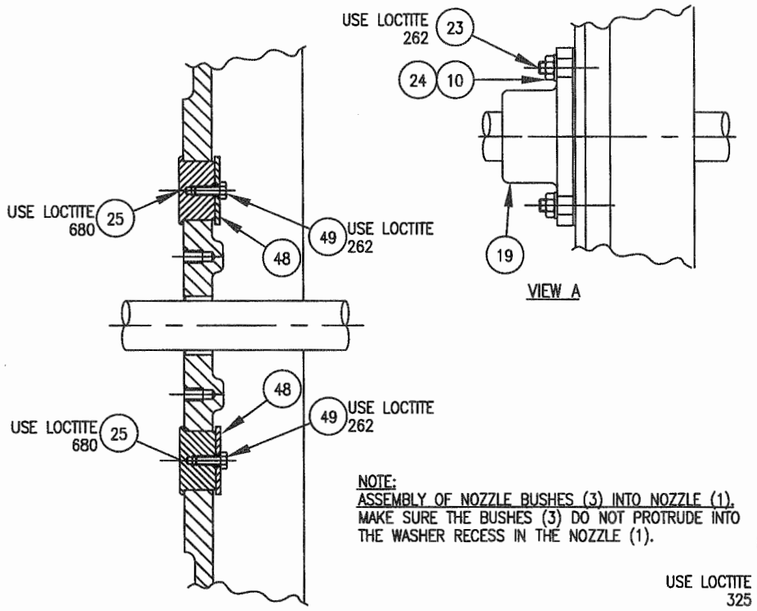
MAT'L CERT

		DATE
DESIGNED	K.V.A.	8/94
DRAWN	I.B.W.	15.5.95.
CHECKED	P.A.S.	15.5.95.
APPROVED	K.V.E.	15.5.95.

NAME: BLANKING PLUGS (NO STEERING)

SCALE: –

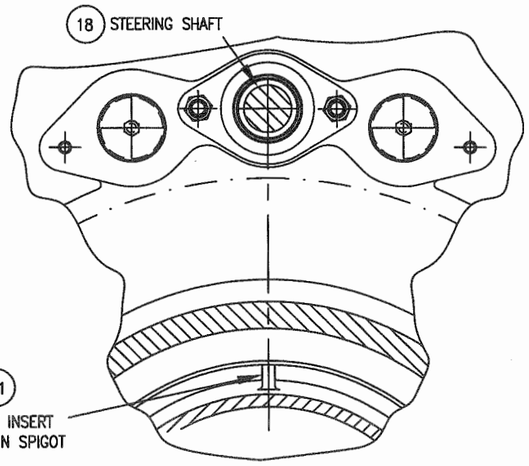
No: A3–HJ391 06 004 | 0



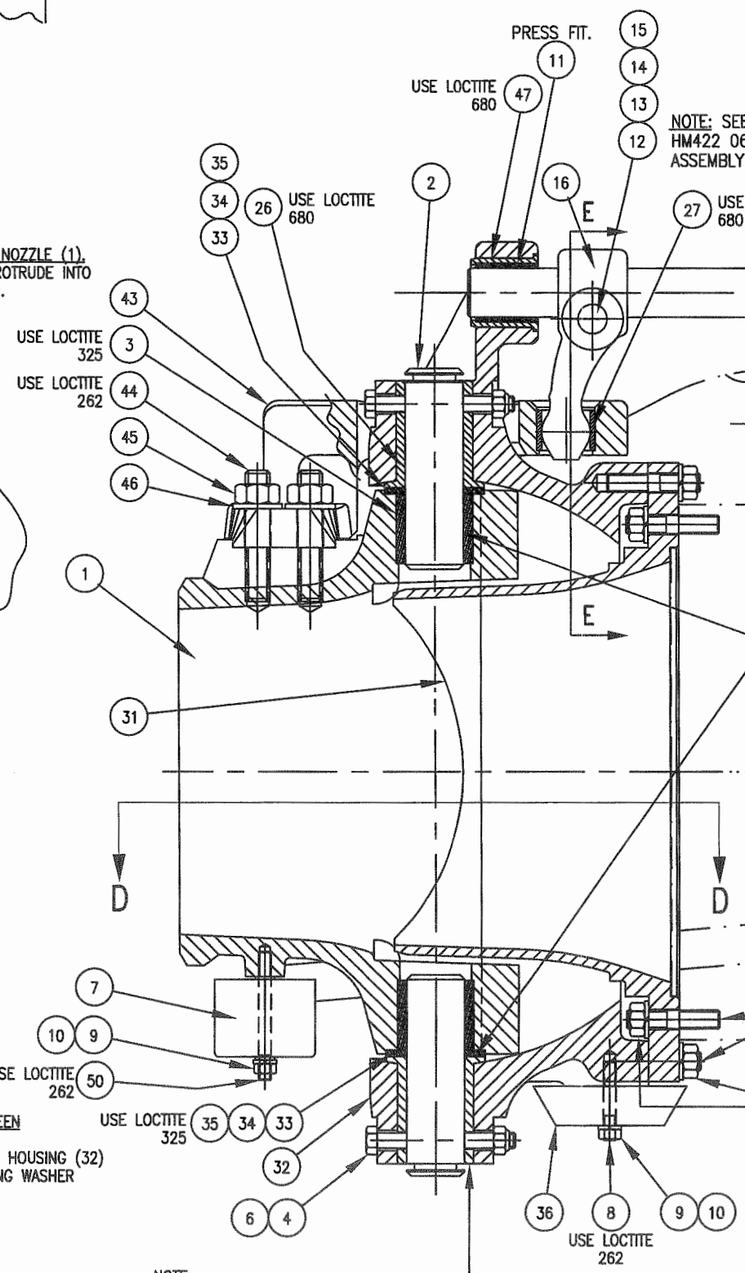
VIEW A

NOTE:
ASSEMBLY OF NOZZLE BUSHES (3) INTO NOZZLE (1).
MAKE SURE THE BUSHES (3) DO NOT PROTRUDE INTO THE WASHER RECESS IN THE NOZZLE (1).

SECTION SHOWING BLANKING PLUGS



NOTE:–NOZZLE INSERT LOCATION.
THE SMALL SPIGOT ON TOP OF NOZZLE INSERT MUST BE INLINE WITH STEERING SHAFT AS SHOWN IN ALL ROTATION APPLICATIONS.

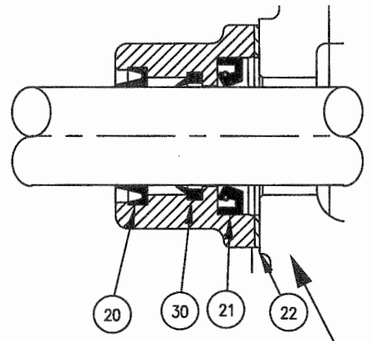


NOTE:
ASSEMBLY OF SPACING WASHERS (33 TO 35) BETWEEN NOZZLE (1) AND NOZZLE HOUSING (32).
TRIAL ASSEMBLE THE NOZZLE (1) INTO THE NOZZLE HOUSING (32) TO OBTAIN THE CORRECT THICKNESS OF THE SPACING WASHER ALLOWING FOR AN END FLOAT OF 0.2 TO 0.5mm.
REFER TO INSTRUCTION No 7 DRAWING No: 85144.

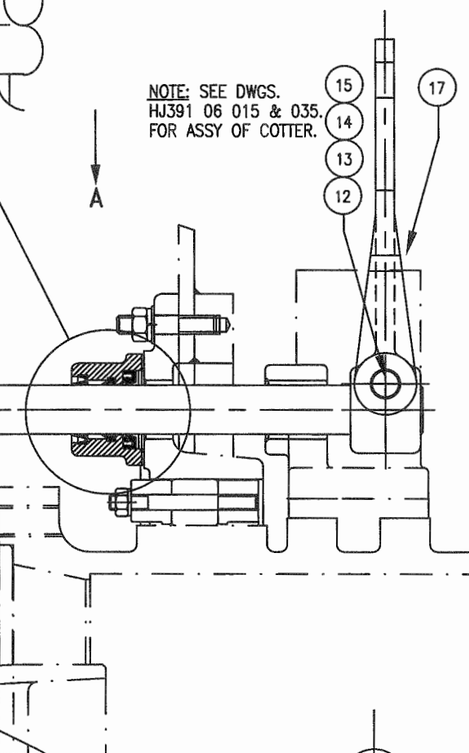
NOTE:
ASSEMBLY OF FLANGED BUSHES (26) INTO NOZZLE HOUSING (32).
ENSURE THAT THE BOLT HOLES IN THE BUSHES (26) AND THE NOZZLE HOUSING (32) ARE IN LINE.

SECTION 'E–E'

ENLARGED VIEW ON SHAFT SEAL HOUSING.

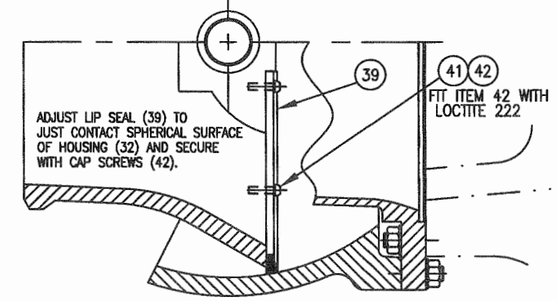


NOTE: SEE DRAWING NoS HM422 06 015 & 035 FOR ASSEMBLY OF COTTER (12).



NOTE: SEE DWGS. HJ391 06 015 & 035. FOR ASSY OF COTTER.

NOTE:–LUBRICATION OF MOVING PARTS.
ALL MOVING PARTS ARE TO BE COATED WITH ENERGREASE MM EP2 ON ASSEMBLY. REFER TO DRAWING 85144 SHEET 2 FOR INSTRUCTIONS.



HALF SECTIONAL VIEW D–D ON DEFLECTOR SEAL.

PAINTING NOTES!
1. STANDARD GLOSS FINISH: REFER TO DRAWING 85135 FOR PAINTING OF JET PARTS.
2. OPTIONAL ANTIFOUL FINISH: REFER TO DRAWING 85134 FOR PAINTING OF JET PARTS.
3. REFER TO DRAWING 85140 FOR PAINTING OF CYLINDER.
4. REFER TO DRAWING 111178 FOR PAINT SPECIFICATION & APPLICATION.

NOTE:– REFER TO DRAWING Sheets 3, 4 & 5 FOR DETAILS ON STEERING ROTATION.

LOCTITE APPLICATION:
REFER TO DRAWING No: 85144 FOR THE CORRECT APPLICATION INSTRUCTIONS FOR LOCTITE 222, 262, 325 & 680.

REF	NO.	BY	DATE	AMENDMENTS
CL245	i	P.S.	19.08.02	ITEM 7 WAS 103359. ITEM 8 WAS 3 OFF. ITEM 50 ADDED
CL229	H	P.M.W	22.04.02	LOCTITE DETAILS UPDATED. ITEM 25 FLANGED. ITEM 48 & 49 ADDED.
CL209	G	R.J.L	12.11.01	Sht.1–ITEM 14 WAS 38. Sht.2–1TEM 14 QTY WAS 2 & ITEM 38 DELETED.
CL198	F	R.J.L	21.08.01	Sht.3–LAYOUTS CLARIFIED & Sht.5–OPTION BOX MOVED.
CL158	E	P.M.W	26.9.00	PAINT SPEC WAS DRG 85020
CL158	E	P.M.W	26.9.00	REF CL 109, 122, 124, 132, 141 FOR CHANGES

JET 391

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

PROJECTION

DESIGNED R.J.L	DATE 16.08.99
DRAWN R.J.L	16–08–99
CHECKED K.V.E	31–08–99
APPROVED K.V.E	31–08–99

NAME
JT STEERING ASSEMBLY
for
HJ391 JET.
Sheet 1 of 5

SCALE –
No: ASSY–HJ391 06 005 i

A	B	C	D	E	F	G	Item	Kit	PartNumber	Qty	ProductDescription	DrawingNbr
								A	111163		JT STEERING KIT HJ391 (RETROFIT FOR T3)	HJ39106005
								B	111164		JT NOZZLE ASSY HJ391	HJ39106005
								C	HJ39106005		JT STEERING GROUP STANDARD	HJ39106005
								D	HJ39106015		JT STEERING GROUP TWIN PORT ROTATED 16-25deg. DEADRISE.	HJ39106005
								E	HJ39106025		JT STEERING GROUP TWIN STARBOARD ROTATED 16-25deg. DEADRISE.	HJ39106005
								F	HJ39106035		JT STEERING GROUP TRIPLE PORT ROTATED 16-25deg. DEADRISE.	HJ39106005
								G	HJ39106045		JT STEERING GROUP TRIPLE STARBOARD ROTATED 16-25deg. DEADRISE.	HJ39106005
A	B	C	D	E	F	G	1		111402	1	NOZZLE (for use with steering arm) HJ391	111402
A		C	D	E	F	G	2		111052	2	PIVOT PIN - JT STEERING DEFLECTOR	110906
A	B	C	D	E	F	G	3		111051	2	BUSH - NOZZLE - PIVOT PIN (D glide F)	110814
A		C	D	E	F	G	4		30792	2	(BOLTS) (METRIC) ST ST 316 M12x90	N/A
A		C	D	E	F	G	6		JDQSXAH	2	(NUTS) (METRIC NYLOC ST ST 316) M12	N/A
A	B	C	D	E	F	G	7		107890	1	ANODE	107890
A		C	D	E	F	G	8		30661	1	(STUDS) METRIC (316-STST) M8x51 (16/16)	30647
A	B2	C	D	E	F	G	9		JEQKXAC	2	(WASHERS) (SPRING) METRIC ST ST 316 M8	N/A
A3	B2	C	D	E	F	G	10		JDQHXAC	4	(NUTS) (METRIC ST ST 316) M8	N/A
A		C	D	E	F	G	11		111247	1	BUSH JT STEERING (Orkot TL)	111247
		C	D	E	F	G	12		105657	2	COTTER	105657
		C	D	E	F	G	13		104908	2	(WASHER) SPECIAL	104908
A		C	D	E	F	G	14		JEQKXAH	24	(WASHERS) (SPRING) METRIC ST ST 316 M12	N/A
A		C	D	E	F	G	15		JDQHXAH	13	(NUTS) (METRIC ST ST 316) M12	N/A
A		C	D	E	F	G	16		111404	1	CRANK (for use with steering arm)	111404
		C	D	E	F	G	17		104840	1	TILLER	104840
A		C	D	E	F	G	18		111407	1	STEERING SHAFT HJ391(JT steering with steering arm)	105655
		C	D	E	F	G	19		110490	1	SHAFT SEAL HOUSING	110490
		C	D	E	F	G	20		61332	1	(SEAL) SCRAPER WYCLIP (62-125)	N/A
		C	D	E	F	G	21		61422	1	(OIL SEALS) Gaco (MIS14)c/w SS Spring	N/A
		C	D	E	F	G	22		105903	1	GASKET SHAFT SEAL	105903
		C	D	E	F	G	23		JCQHXAG	2	(STUDS) METRIC (316-STST) M8x35 (12/22)	30647
		C	D	E	F	G	24		JEOZXAF	2	(WASHERS) (FLAT) METRIC ST ST 316 M8x16x1.2	N/A
		C	D	E	F	G	25		105619	2	BLANKING PLUG FOR STEERING SHAFT	105619
A		C	D	E	F	G	26		111047	2	FLANGED BUSH - NOZZLE HOUSING.	111047
A		C	D	E	F	G	27		104832	1	DEFLECTOR BUSH (STEERING CRANK)	104832
		C	D	E	F	G	30		64865	1	ROD WIPER DO1250 1 1/4" x 1 5/8" x 3/16"	N/A
A		C	D	E	F	G	31		111053	1	NOZZLE INSERT HJ391 - JT STEERING	111053
A		C	D	E	F	G	32		111403	1	NOZZLE HOUSING(for use with steering arm) HJ391 & 422	111403
A	B	C	D	E	F	G	33		111048	2	SPACING WASHER 3.5 thk. - NOZZLE (D glide F)	111048
A	B	C	D	E	F	G	34		111049	2	SPACING WASHER 4.0 thk. - NOZZLE (D glide F)	111048
A	B	C	D	E	F	G	35		111050	2	SPACING WASHER 4.5 thk. - NOZZLE (D glide F)	111048
A		C	D	E	F	G	36		102185	1	ANODE	102185
A		C	D	E	F	G	37		111162	22	(STUDS) METRIC (316-STST) M12x63(26/26)	30639
A	B	C	D	E	F	G	39		111083	2	LIP SEAL JT STEERING	111083
A	B	C	D	E	F	G	41		JEQKXAA	8	(WASHERS) (SPRING) METRIC ST ST 316 M6	N/A
A	B	C	D	E	F	G	42		JBJYXAJ	8	(SCREWS) (CAPSCREWS) METRIC ST ST 316 Socket Hd M6x20	N/A
A		C	D	E	F	G	43		111401	1	STEERING ARM HJ391 & 422	111401
A	B	C	D	E	F	G	44		109178	4	(STUDS) METRIC (SAF-2205) M16x85 (35/25)	30700
A		C	D	E	F	G	45		JDQHXAL	4	(NUTS) (METRIC ST ST 316) M16	N/A
A		C	D	E	F	G	46		103451	4	(WASHER) SPECIAL M16 316 STST	103451
A		C	D	E	F	G	47		111249	1	BEARING SHELL for STEERING SHAFT BUSH JT STEERING	111249
		C	D	E	F	G	48		105619-1	2	RETAINING WASHER FOR STEERING SHAFT BLANKING PLUG	105619
		C	D	E	F	G	49		HZQHXAE	2	(SCREWS) (M/C SCREWS) METRIC ST ST 316 HEX HD M6x16	N/A
A	B	C	D	E	F	G	50		108007	1	(STUDS) METRIC (316-STST) M8x83 (16/16)	30647

REFER TO Sheet 1 FOR CHANGES.

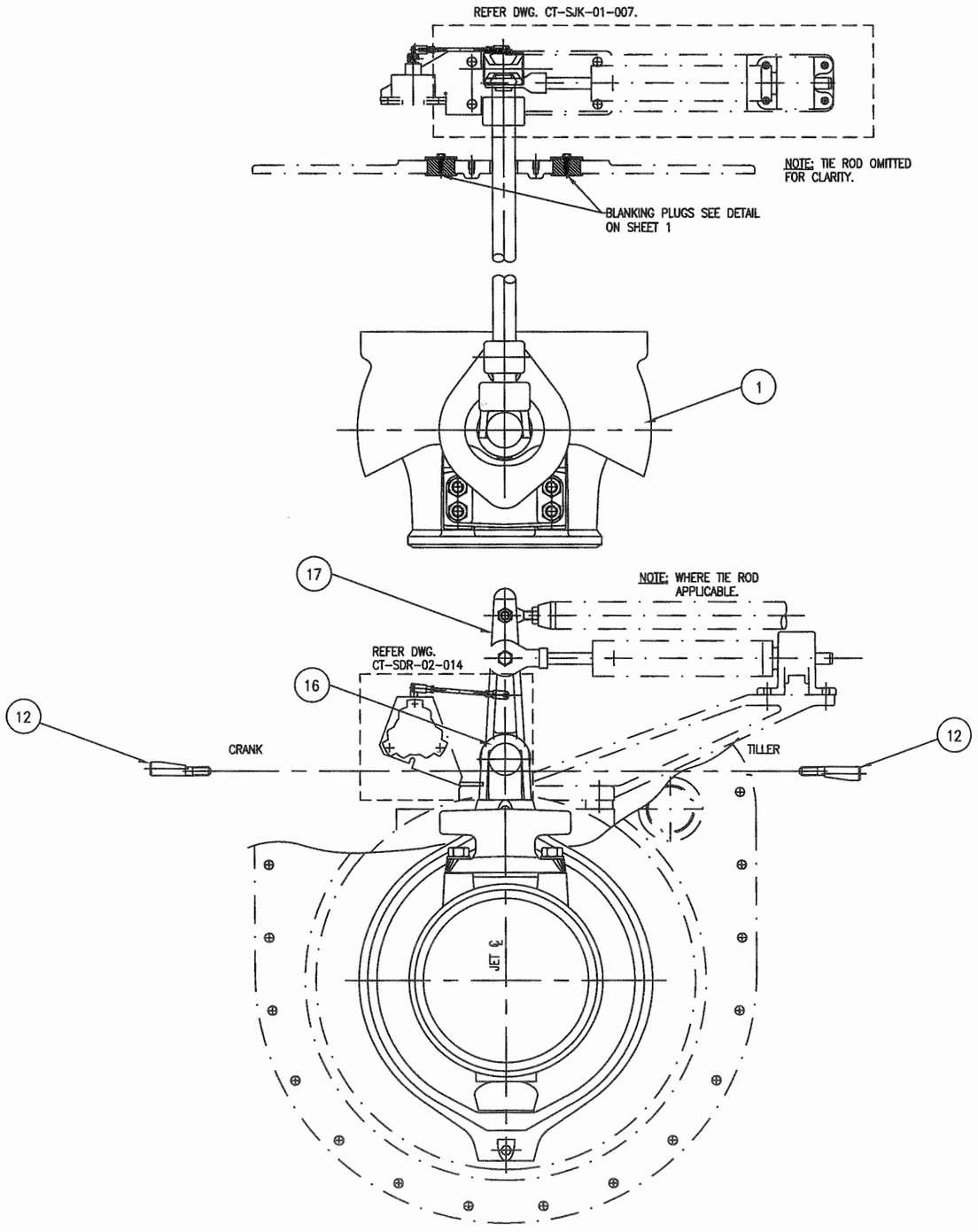
REF	NO.	BY	DATE	AMENDMENTS
JET 391				

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

PROJECTION

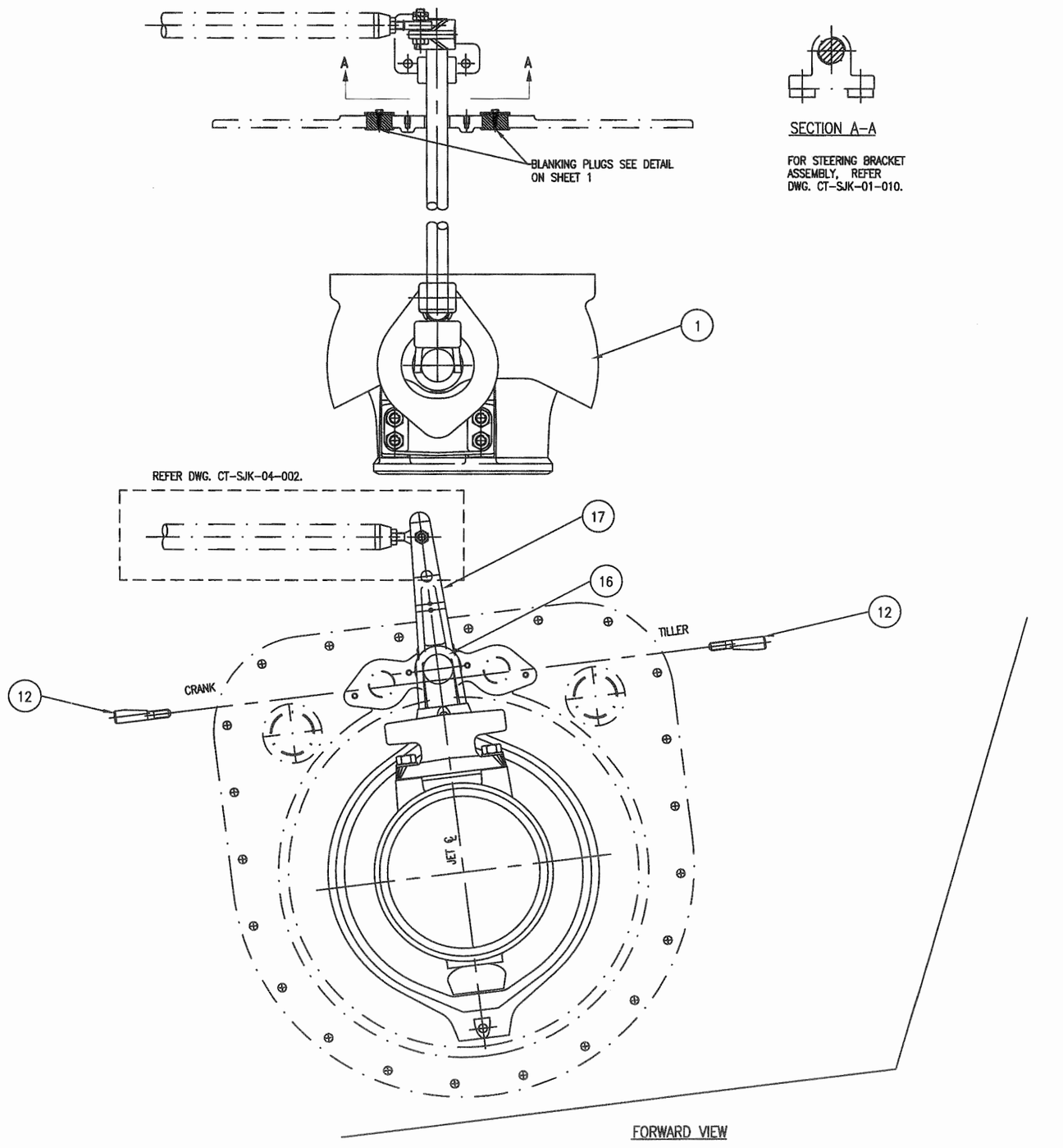
NAME
JT STEERING ASSEMBLY
for
HJ391 JET.
Sheet 2 of 5

DESIGNED RJL	DATE 16.08.99	
DRAWN R.J.L	16-08-99	
CHECKED K.V.E	31.08.99	
APPROVED K.V.E	31.08.99	
SCALE 1.5X	No: ASSY-HJ391 06 005	i



FORWARD VIEW

F CENTRE JET or TWIN PORT JET ROTATION UP TO 16°



FORWARD VIEW

F TWIN STARBOARD JET ROTATION UP TO 16°

HJ391 06 005
F STEERING CONFIGURATION OPTIONS:- STANDARD ROTATION UP TO 16°

REF	NO.	BY	DATE	AMENDMENTS
				REFER TO Sheet 1 FOR CHANGES.

JET 391

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

PROJECTION

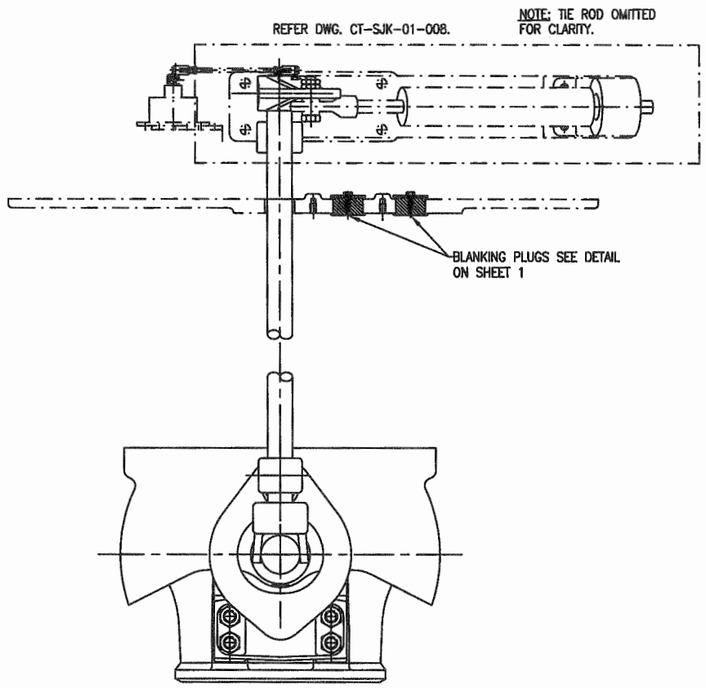
DESIGNED R.J.L	DATE 16.08.99
DRAWN R.J.L	31-08-99
CHECKED K.V.E	31.08.99
APPROVED K.V.E	31.08.99

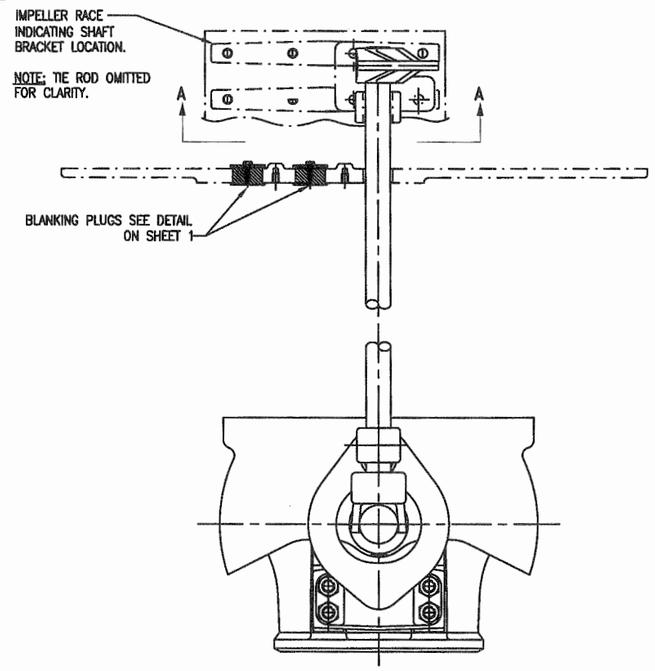
NAME
JT STEERING ASSEMBLY CONFIGURATION ARRANGEMENT for HJ391 JET
Sheet 3 of 5

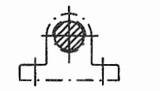
SCALE 1:7.5

No: ASSY-HJ391 06 005 i

PROJECTION

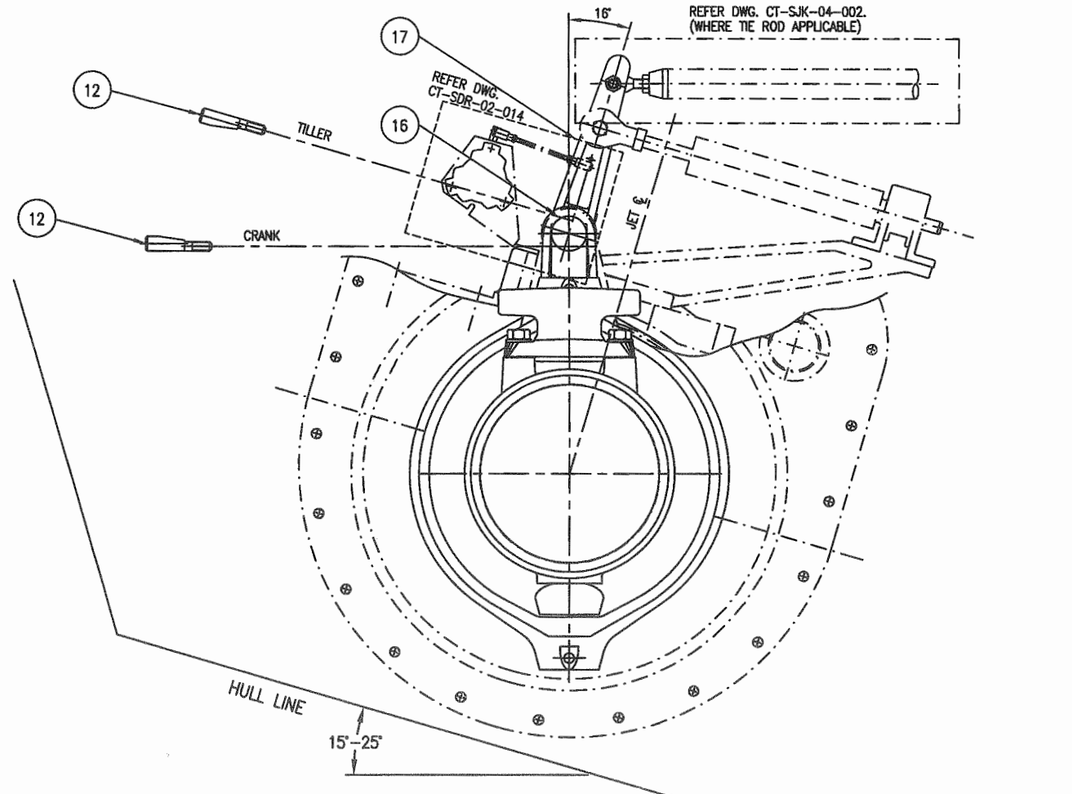






SECTION A–A

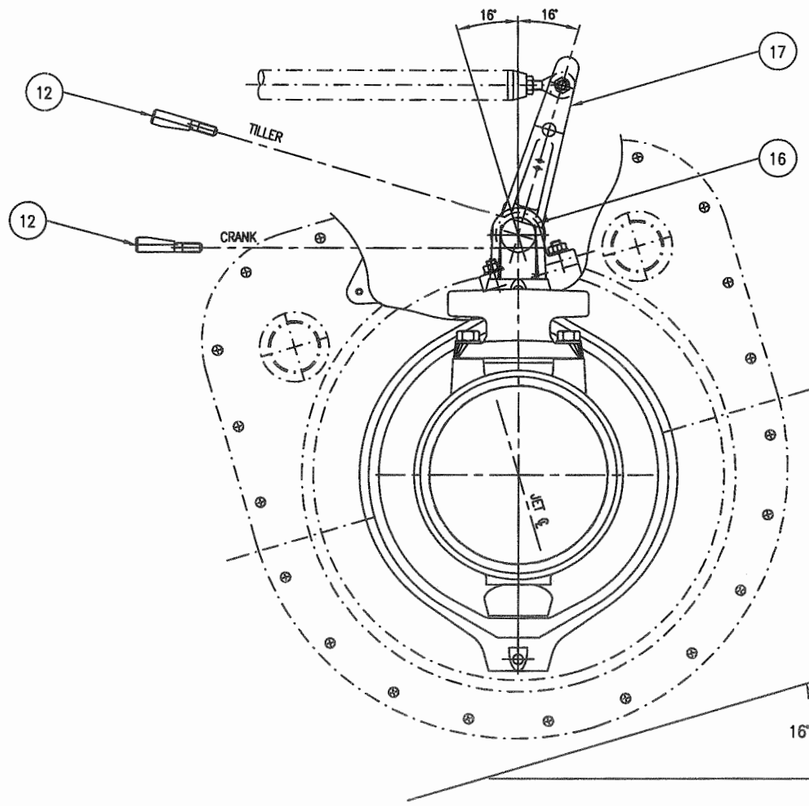
FOR STEERING BRACKET ASSEMBLY, REFER DWG. CT-SJK-01-009.



FORWARD VIEW

HJ391 06 015	
STEERING CONFIGURATION OPTIONS:	– TWIN PORT WITH ROTATION 16°–25°

NOTE: REFER DWG. HJ391 06 005 Sht. 2 FOR PARTS LIST



FORWARD VIEW

HJ391 06 025	
STEERING CONFIGURATION OPTIONS:	– TWIN STBD WITH ROTATION 16°–25°

NOTE: REFER DWG. HJ391 06 005 Sht.2 FOR PARTS LIST

REF	NO.	BY	DATE	AMENDMENTS
JET 391				REFER TO Sheet 1 FOR CHANGES

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

MATERIAL

√ = N9 EXCEPT AS STATED

UNLIMITED DIMENSIONS TO BE ± –

MATL CERT

DESIGNED R.B. 16.08.99

DRAWN R.J.L. 16.08.99

CHECKED K.V.E. 31.08.99

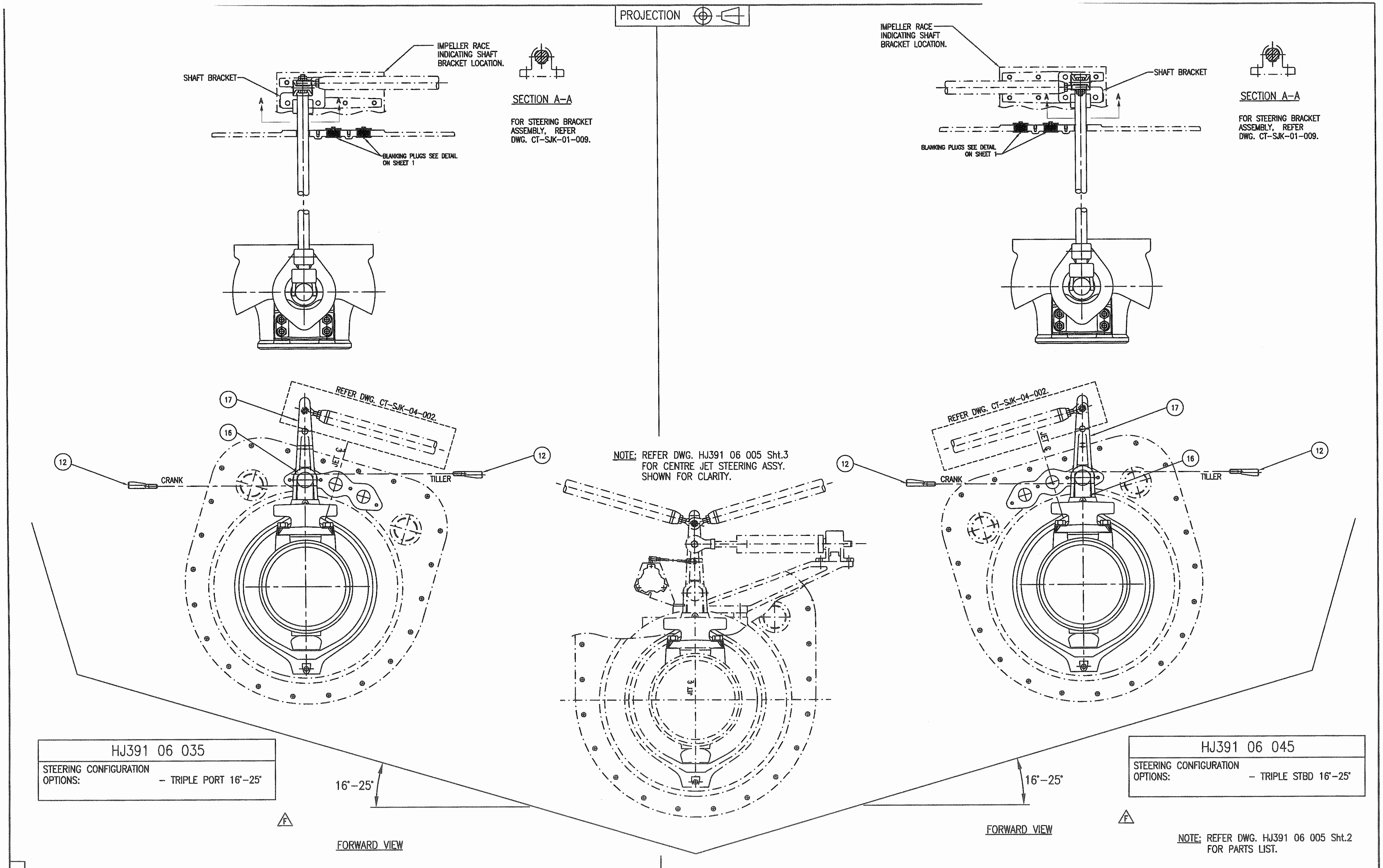
APPROVED K.V.E 31.08.99

NAME

JT STEERING ASSEMBLY CONFIGURATION ARRANGEMENT Sheet 4 of 5

SCALE –

No. A1–HJ391 06 005



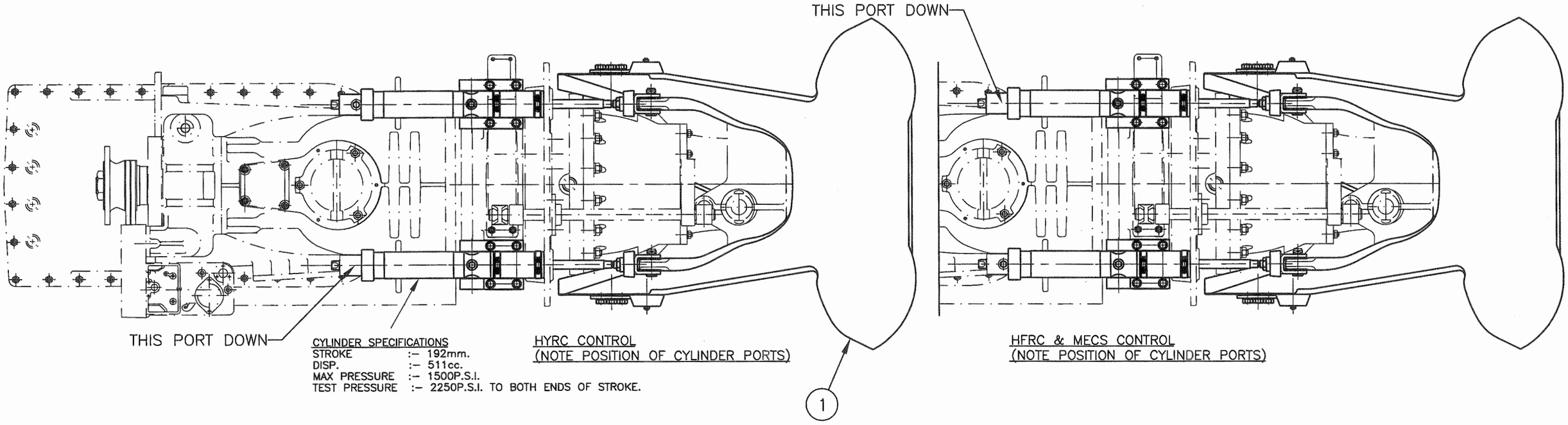
REF	NO.	BY	DATE	AMENDMENTS
				REFER TO Sheet 1 FOR CHANGES.
JET	391			

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

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

MATERIAL		√ = N9 EXCEPT AS STATED
		UNLIMITED DIMENSIONS TO BE ± –
MAT'L CERT		NAME: JT STEERING ASSEMBLY CONFIGURATION ARRANGEMENT Sheet 5 of 5
DESIGNED R.I.L.	DATE 16.08.99	
DRAWN R.J.L.	16.08–99	
CHECKED K.V.E.	31.08.99	SCALE –
APPROVED K.V.E	31.08.99	No: A1–HJ391 06 005 i

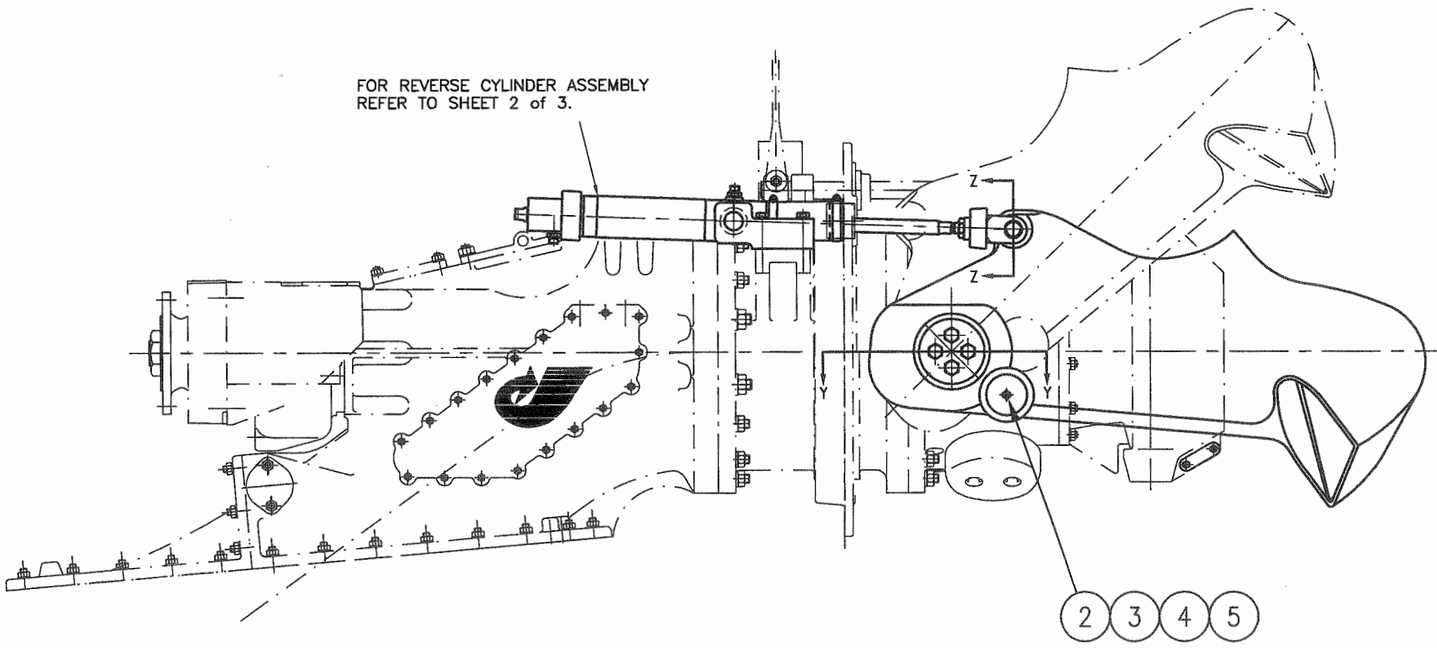
PROJECTION



CYLINDER SPECIFICATIONS
STROKE :– 192mm.
DISP. :– 511cc.
MAX PRESSURE :– 1500P.S.I.
TEST PRESSURE :– 2250P.S.I. TO BOTH ENDS OF STROKE.

HYRC CONTROL
(NOTE POSITION OF CYLINDER PORTS)

HFRC & MECS CONTROL
(NOTE POSITION OF CYLINDER PORTS)



PAINTING NOTES!
1. STANDARD GLOSS FINISH: REFER TO DRAWING 85135 FOR PAINTING OF REVERSE DUCT.
2. OPTIONAL ANTIFOUL FINISH: REFER TO DRAWING 85134 FOR PAINTING OF REVERSE DUCT.
3. REFER TO DRAWING 111178 FOR PAINT SPECIFICATION AND APPLICATION.

REFER TO SHEET 2 of 3 FOR FURTHER DETAILS.

HJ391 07 001 L

REF	NO.	BY	DATE	AMENDMENTS
CL229	L	J.W.	22.04.02	ORIENTATION OF CYL PORTS ADDED TO DRG, LOCTITE DETAILS UPDATED
				CLs.3701,3710,3724,3766,3779, 3825, 55, 101, 111,133, 158, 187

JET 391

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

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

MATERIAL: AS SHOWN
MATL CERT:
DESIGNED: K.V.A. DATE: 4/4/95
DRAWN: R.J.L. 8-04-95
CHECKED: K.E.V 11-04-95
APPROVED: K.V.E 11-04-95

√ = N9 EXCEPT AS STATED
UNLIMITED DIMENSIONS TO BE ±

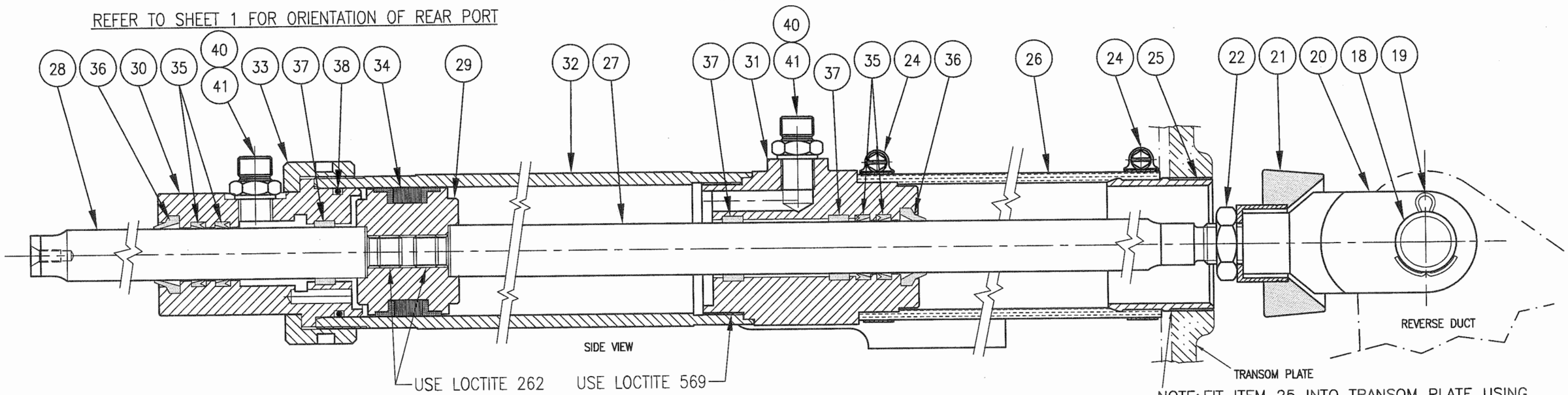
NAME: REVERSE ASSEMBLY for HJ391 JET

SHEET 1 of 3

SCALE: NONE
No: A1–HJ391 07 001 L

PROJECTION

REFER TO SHEET 1 FOR ORIENTATION OF REAR PORT



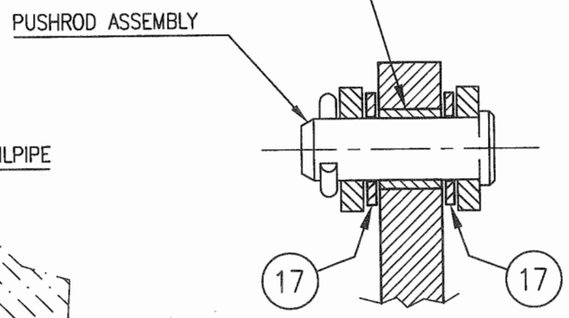
NOTE: FIT ITEM 25 INTO TRANSOM PLATE USING LOCTITE 680. TIGHTEN FIRMLY USING A SOFT TOOL TO GRIP THE OUTSIDE.

LOCTITE APPLICATION:
REFER TO DRAWING No: 85144 FOR THE CORRECT APPLICATION INSTRUCTIONS FOR LOCTITE 262, 325, 569 & 680.

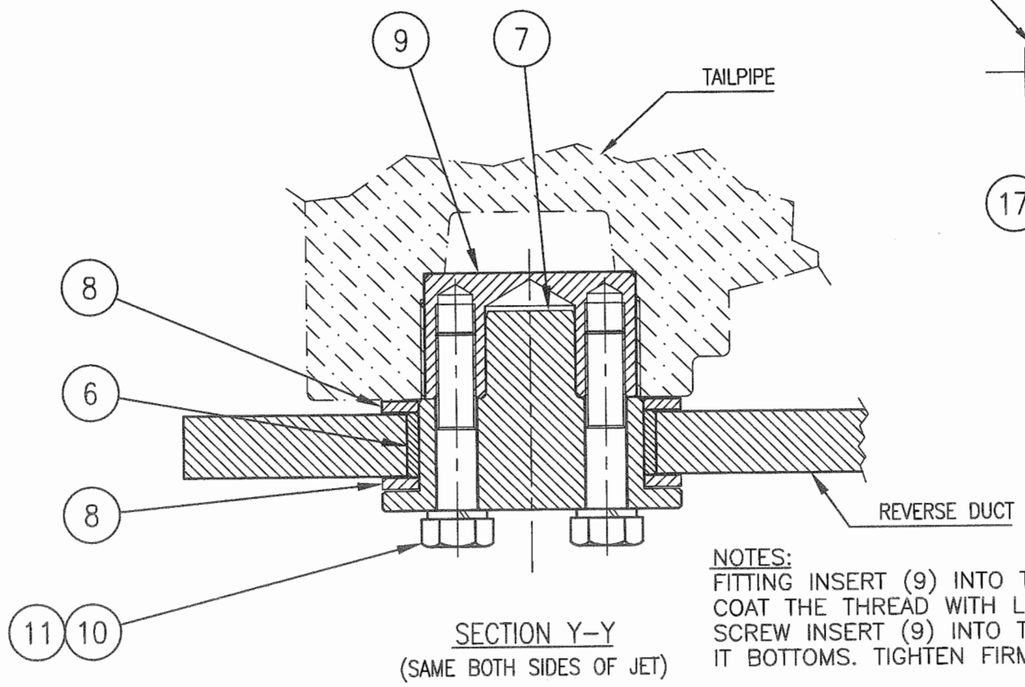
REVERSE CYLINDER ASSEMBLY

REFER TO DRAWING 85140 FOR CYLINDER PAINTING DETAILS.
REFER TO DRAWING 111178 FOR PAINT SPECIFICATION & APPLICATION.

(23) USE LOCTITE 325.
REF DRG No 85144
INSTRUCTION No 7.



SECTION Z–Z

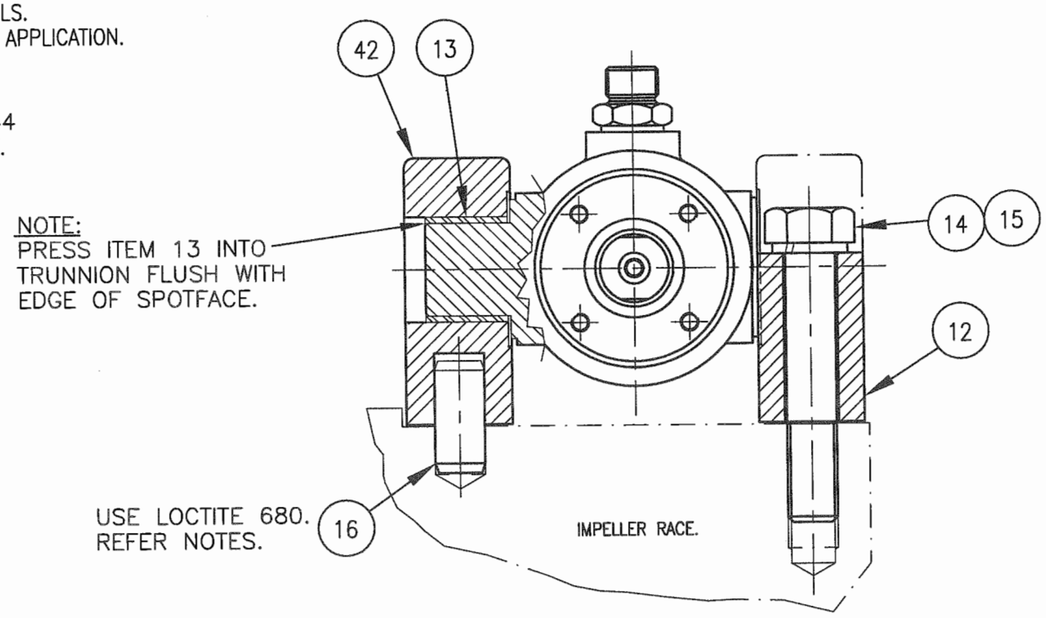


SECTION Y–Y
(SAME BOTH SIDES OF JET)

NOTES:
FITTING INSERT (9) INTO TAILPIPE.
COAT THE THREAD WITH LOCTITE 680.
SCREW INSERT (9) INTO TAILPIPE UNTILL IT BOTTOMS. TIGHTEN FIRMLY.

FITTING PIVOT BUSH (6) INTO REVERSE DUCT (1).
REFER TO DRAWING No: 85144 INSTRUCTION No 6.
USE LOCTITE 325.

TIGHTENING TORQUE ITEM 10 – 150Nm (110ftlbs).



REVERSE CYLINDER ASSEMBLY
(LOOKING ASTERN)

NOTES:
FITTING TRUNNION MOUNT (42).
APPLY LOCTITE 680 TO DOWEL HOLE IN TRUNNION MOUNT (42) ONLY.
DO NOT APPLY LOCTITE TO HOLES IN IMPELLER RACE.

TIGHTENING TORQUE: ITEM 14 – 61Nm (45ftlbs).

REF	NO.	BY	DATE	AMENDMENTS
JET 391				REFER TO SHEET 1 FOR CHANGES

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

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

MATERIAL

DRAWN: R.J.L. 6-04-05
CHECKED: K.V.E 11-04-05
APPROVED: K.V.E 11-04-05

√ = N9 EXCEPT AS STATED
UNLIMITED DIMENSIONS TO BE ±

NAME: REVERSE ASSEMBLY for HJ391 JET Sheet 2 of 3

SCALE: NONE DWG No: A1–HJ391 07 001 L

A	B	C	Item	Kit	PartNumber	Qty	ProductDescription	DrawingNbr
				A	105601	REF	REVERSE CYLINDER	HJ39107001
				B	105926	REF	SEAL KITSET (2 REV. CYL)	HJ39107001
			1		106598	1	REVERSE DUCT 1 PIECE	106598
			2		102185	2	ANODE	102185
			3		HYQHXCJ	2	(BOLTS) (METRIC) ST ST 316 M8x80	N/A
			4		JEQKXAC	2	(WASHERS) (SPRING) METRIC ST ST 316 M8	N/A
			5		JDQHXAC	2	(NUTS) (METRIC ST ST 316) M8	N/A
			6		106694	2	BUSH - DUCT PIVOT (Orkot TL)	106694
			7		106693	2	PIVOT PIN - DUCT	106693
			8		106705	4	(WASHER) SPECIAL THRUST WASHER DUCT (nyloil)	106705
			9		107925	2	INSERT (TAILPIPE) - PIVOT PIN	107925
			10		HYQHXIV	8	(BOLTS) (METRIC) ST ST 316 M16x90	N/A
			11		JEQKXAJ	8	(WASHERS) (SPRING) METRIC ST ST 316 M16	N/A
			12		108009	2	TRUNION MOUNT-REVERSE CYLINDER	108009
			13		KHITXCO	4	(BUSHES) DU MB 3025 DU	N/A
			14		30792	8	(BOLTS) (METRIC) ST ST 316 M12x90	N/A
			15		JEQKXAH	8	(WASHERS) (SPRING) METRIC ST ST 316 M12	N/A
			16		107610	4	(JET) DOWELS 16mm OD 316 STST	107610
			17		63689	4	(WASHER) SPECIAL SPACER CLEVIS	N/A
			18		105761	2	PIN (CLEVIS)	105761
			19		HUILAAY	2	(SPLIT PINS) ST ST 316 0.25x2.00	N/A
			20		105609	2	CLEVIS (REV/STG)	105609
			21		105764	2	ANODE	105764
			22		JDQKXAL	2	(NUTS) (HALF NUTS) M20 (316 STST)	N/A
			23		106695	2	PLAIN BUSH (Orkot TL)	105762
			24		HSIJAAY	4	HOSE CLIP (HAS048) 65-90mm STST	N/A
			25		105617	2	HOSE TAIL TUBE	105617
			26		105618	2	HOSE	105618
A			27		105602	2	MAINSHAFT (REV CYLINDER)	105602
A			28		105603	2	COMPENSATOR SHAFT	105603
A			29		105604	2	PISTON	105604
A			30		105606	2	BACKHEAD	105606
A			31		105605	2	FRONT HEAD	105605
A			32		105607	2	CYLINDER	105607
A			33		105608	2	END CAP (REV/STG CYLINDER)	105608
A	B		34		61435	2	(SEAL) DOUBLE ACTING SPS250187 (POLYPAC)	N/A
A	B		35		64955	8	SHAFT SEAL (HALLITE TYPE 620 CODE 4498400)	N/A
A	B		36		61437	4	(SEAL) ROD WIPER WRS 100-150 (POLYPAC)	N/A
A	B		37		61438	6	(WEAR RING) BEARING RING IPWR 1000 (POLYPAC)	N/A
A	B		38		HMHRABD	2	(O RINGS) IMPERIAL 0.13x2.25x2.50 (228N70)	N/A
A			40		WAQUBCC	4	NIPPLE 3/8BSPP-3/8BSPP (SA10100606)	N/A
A			41		WAQUDAC	4	BONDED SEAL 3/8" BSP (400-823-4490-74)	N/A
			42		110478	2	TRUNION MOUNT OPP. HAND - REVERSE CYLINDER.	108009

FOR CHANGES REFER TO Sheet 1.

REF	NO.	BY	DATE	AMENDMENTS
JET 391				

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

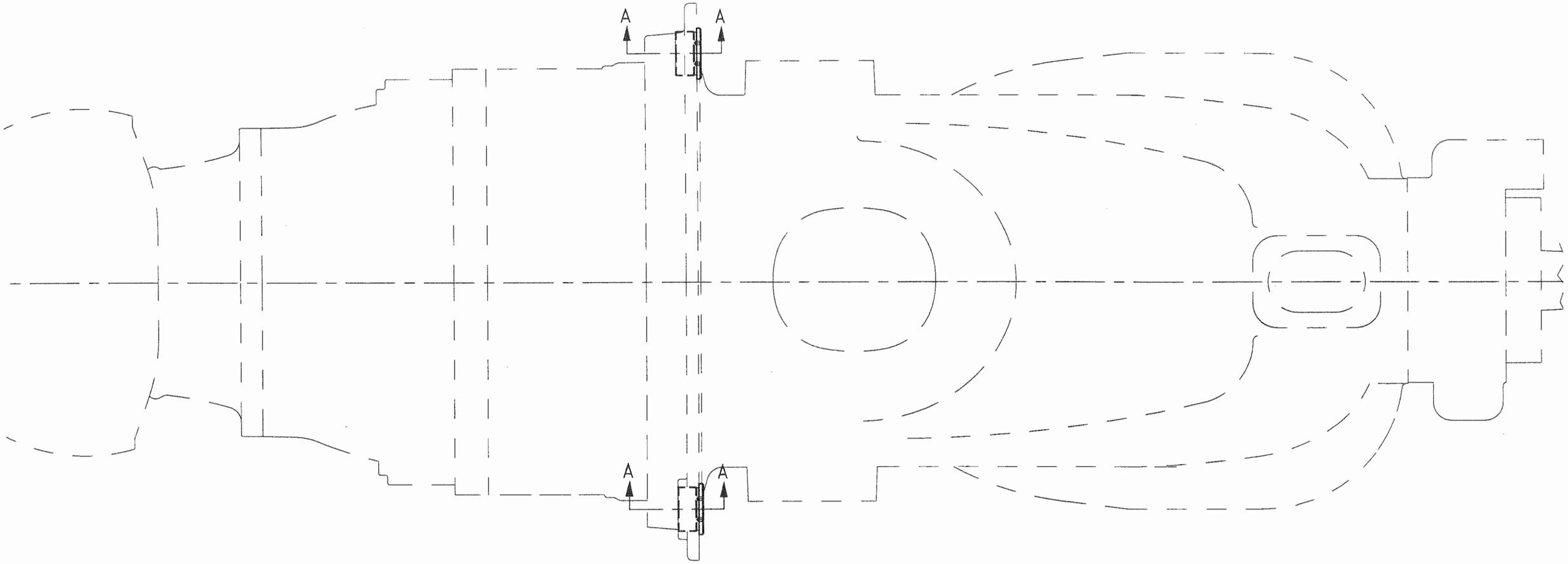
PROJECTION

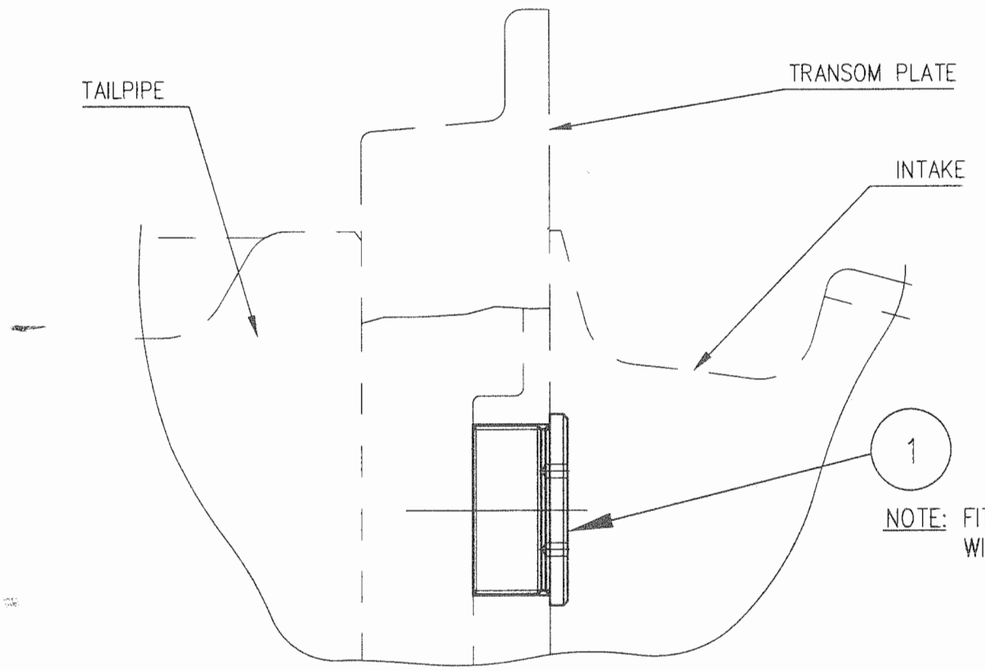
NAME
REVERSE ASSEMBLY
for
HJ391 JET
Sheet 3 of 3

DESIGNED		DATE
DRAWN	R.J.L.	6-04-95
CHECKED	K.V.E	11-04-95
APPROVED	K.V.E	11-04-95

SCALE -

No: ASSY-HJ391 07 001 L





NOTE: FIT BLANKING PLUG WITH LOCTITE 262.

ENLARGED SECTION A–A

SPARES ASSY	ITEM	PART NO	QTY	DESCRIPTION	DRG NO CWF H USE ONLY
4	1	107326	2	BLANKING PLUG	107326

REF	NO.	BY	DATE	AMENDMENTS
CL3787	0	P.A.S.	8/2/96	ISSUED FOR PRODUCTION.

JET 391

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

PROJECTION

NAME: BLANKING PLUGS (NO REVERSE) for HJ391 JETS

DESIGNED	P.A.S.	8/2/96
DRAWN	P.A.S.	8/2/96
CHECKED		
APPROVED	KwE	9-2-96

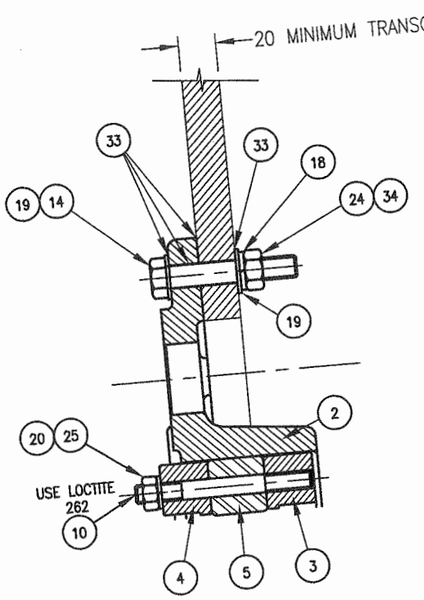
SCALE: -

No: ASSY–HJ391 07 002 0

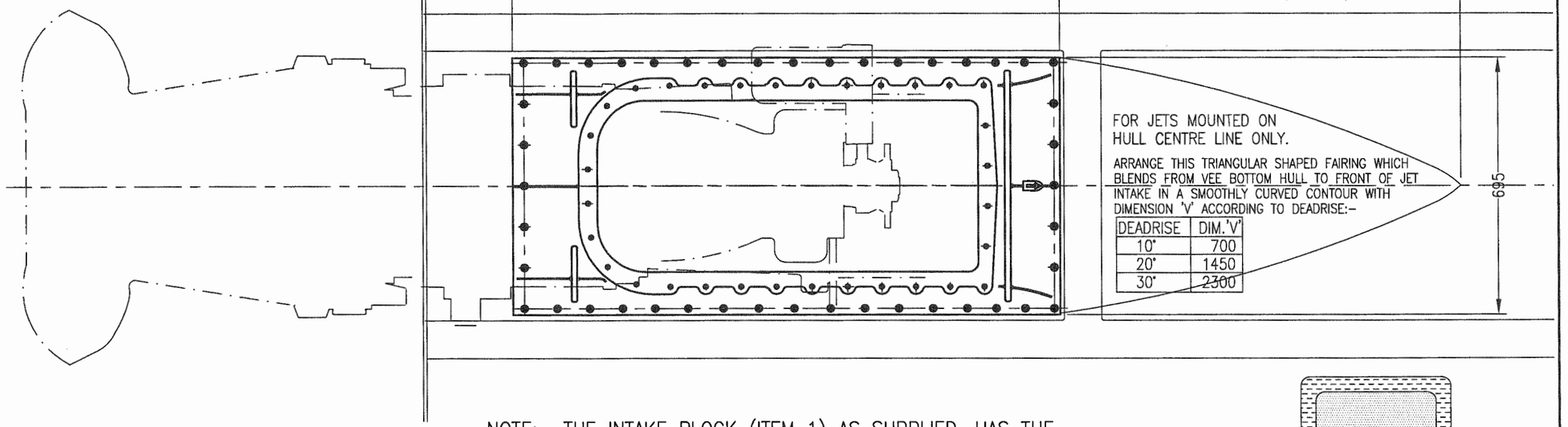
DO NOT SCALE THIS DRAWING

REMOVE ALL SHARP CORNERS

ALL DIMENSIONS IN

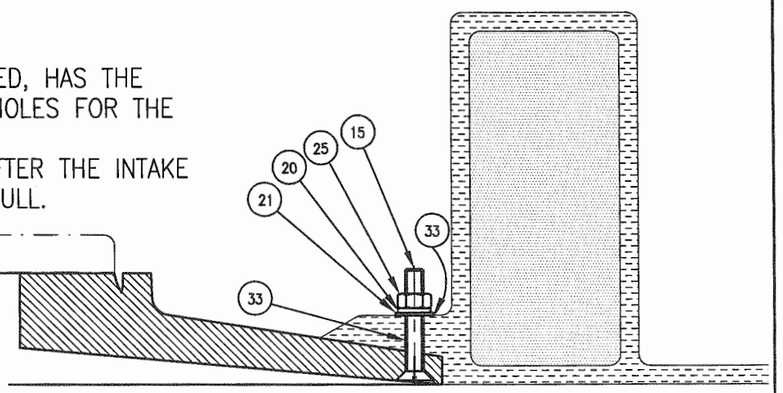


DETAIL OF TRANSOM PLATE TO HULL ATTACHMENT AND TRANSOM PLATE TO JET SEALING ARRANGEMENT

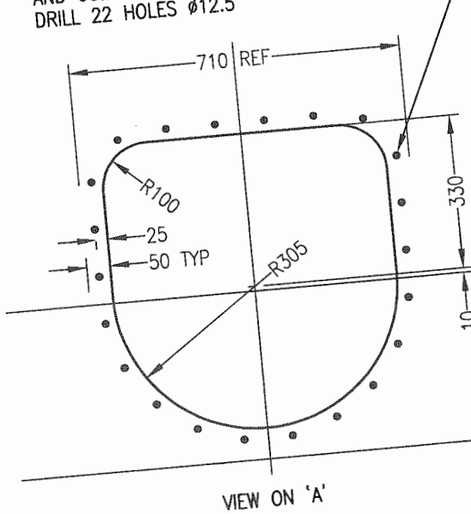


DEADRISE	DIM.'V'
10°	700
20°	1450
30°	2300

NOTE;– THE INTAKE BLOCK (ITEM 1) AS SUPPLIED, HAS THE COUNTERSINK 'DIMPLES' BUT NOT THE HOLES FOR THE M10 CSK. SCREWS (ITEM 15).
THESE HOLES ARE DRILLED THROUGH AFTER THE INTAKE BLOCK HAS BEEN MOULDED INTO THE HULL.

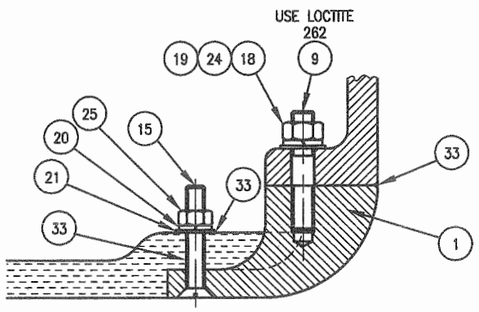


ASSEMBLE TRANSOM PLATE ONTO JET AND USE AS A JIG TO LOCATE HOLES.
DRILL 22 HOLES ø12.5

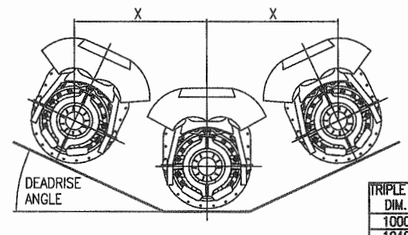


VIEW ON 'A'

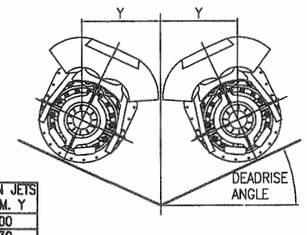
NOTE:– THE FIXING OF THE INTAKE BLOCK AND THE CROSSMEMBER TO THE HULL, AND THE STRENGTH OF THE TRANSOM MUST BE SUFFICIENT TO CARRY THE LOADS IMPOSED BY THE JET UNIT ON THE HULL – REFER TO MANUAL FOR JET LOADS.



DETAIL SHOWING ATTACHMENT OF :-
INTAKE BLOCK TO HULL
INTAKE BLOCK TO INTAKE



TRIPLE JET INSTALLATION



TWIN JET INSTALLATION

TRIPLE JETS DIM. X	DEADRISE ANGLE	TWIN JETS DIM. Y
1000	0°	500
1040	5°	530
1060	10°	560
1075	15°	585
1075	20°	605
1075	25°	620

LOCTITE APPLICATION:
REFER TO DRAWING No: 85144 FOR THE CORRECT APPLICATION INSTRUCTIONS FOR LOCTITE 262.

PAINTING NOTES!
1. STANDARD GLOSS FINISH: REFER TO DRAWING 85135 FOR PAINTING OF TRANSOM PLATE & SCREEN.
2. OPTIONAL ANTIFOUL FINISH: REFER TO DRAWING 85134 FOR PAINTING OF TRANSOM PLATE & SCREEN.
3. REFER TO DRAWING 85145 FOR FINISH OF INTAKE BLOCK.
4. REFER TO DRAWING 111178 FOR PAINT SPECIFICATION AND APPLICATION.

REF	NO.	BY	DATE	AMENDMENTS
CL229	E	P.M.W.	22.04.02	LOCTITE DETAILS UPDATED
CL158	D	P.M.W.	26.9.00	PAINT SPECIFICATION ADDED TO SHEET 1
CL127	C	F.K.	17.2.00	ITEM NUMBERS RATIONALISED
CL3829	B	R.J.L	3.03.98	Sht.2–KIT 'D' 110484 ADDED.
CL3788	A	R.J.L	14.05.97	SHED. MOVED TO Sht.2.
CL3703	0	P.S	9/05/95	ISSUED FOR PRODUCTION

JET 3881

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

MATERIAL

MATL CERT

DESIGNED P.S 27/02/95

DRAWN P.S 27/02/95

CHECKED K.V.E 8/8/95

APPROVED K.V.E 8/8/95

√ = N8 EXCEPT AS STATED

UNLIMITED DIMENSIONS TO BE ± 0.5

NAME
HJ391 JET INSTALLATION DETAILS for G.R.P HULLS. Sht.1 of 2

SCALE IN:

DRG No: A1–HJ391 08 001 E

HJ391 08 001 E

REMOVE ALL SHARP CORNERS

PROJECTION

ALL DIMENSIONS IN mm. UNLESS OTHERWISE SHOWN.

A	B	C	D	E	F	G	H	Code	Item	Kit	PartNumber	Qty	ProductDescription	DrawingNbr
										A	108212		INTAKE BLOCK KIT (GRP HULL)	HJ39108001
										B	108083		INSTALLATION HARDWARE KIT.	HJ39108001
										C	108084		TRANSOM KIT (ALUM & GRP HULL)	HJ39108001
										D	110484		TRANSOM BOLT KIT (ALUM & GRP HULL))	HJ39108001
A									1		108206	1	INTAKE BLOCK - GRP / STEEL	107926
		C							2		108124	1	TRANSOM PLATE	108124
		C							3		103905	2	FRONT HEADER RING	103905
		C							4		103904	2	REAR HEADER RING	103904
		C							5		103906	1	TRANSOM SEAL	103906
		C							6		103910	2	KEEPER PLATE - INBOARD TRANSOM HEADER RING	103910
	B								9		103916	32	(STUDS) METRIC (316-STST) M12x64	30639
		C							10		103914	16	(STUDS) METRIC (316-STST) M10x95	30637
		C							11		JCQHXAO	4	(STUDS) METRIC (316-STST) M10x50	30637
			D						14		HYQHXFX	22	(BOLTS) (METRIC) ST ST 316 M12x70	N/A
A									15		HZPPXEE	44	(BOLTS) (M/C SCREWS) METRIC STST 316 M10x60 (CSK HD)	N/A
	B32		D22						18		JEQKXAH	54	(WASHERS) (SPRING) METRIC ST ST 316 M12	N/A
	B32		D44						19		JEOZXAK	76	(WASHERS) (FLAT) METRIC ST ST 316 M12x24x1.6	N/A
A44		C20							20		JEQKXAE	64	(WASHERS) (SPRING) METRIC ST ST 316 M10	N/A
A									21		JEOZXAI	44	(WASHERS) (FLAT) METRIC ST ST 316 M10x21x1.2	N/A
	B32		D22						24		JDQHXAH	54	(NUTS) (METRIC ST ST 316) M12	N/A
A44		C20							25		JDQHXAE	64	(NUTS) (METRIC ST ST 316) M10	N/A
A1	B1		D1						33		JMNGAAR	3	NEUT-CURE RTV SILICONE 310G	N/A
	B1		D1						34		MRINAAD	2	LOCTITE 262 50ML BOTTLE	N/A
A1	B1		D1						35		63595	3	(JET) PACKAGING BOLT BOX	N/A

HJ391 08 001 E

REF	NO.	BY	DATE	AMENDMENTS
JET	3881			REFER SHEET 1 FOR AMENDMENTS

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

MATERIAL

√ = N8 EXCEPT AS STATED

UNLIMITED DIMENSIONS TO BE ± 0.5

MATL. CERT

DESIGNED PS 27/02/95

DRAWN P.S 27/02/95

CHECKED K.V.E. 6/9/95

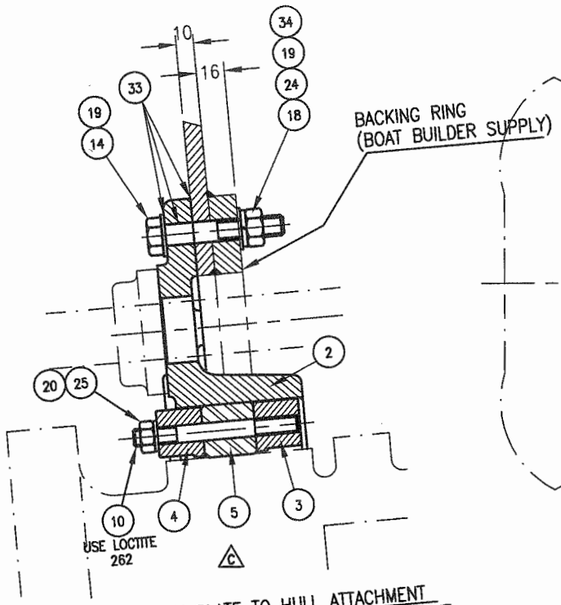
APPROVED K.V.E. 6/9/95

NAME

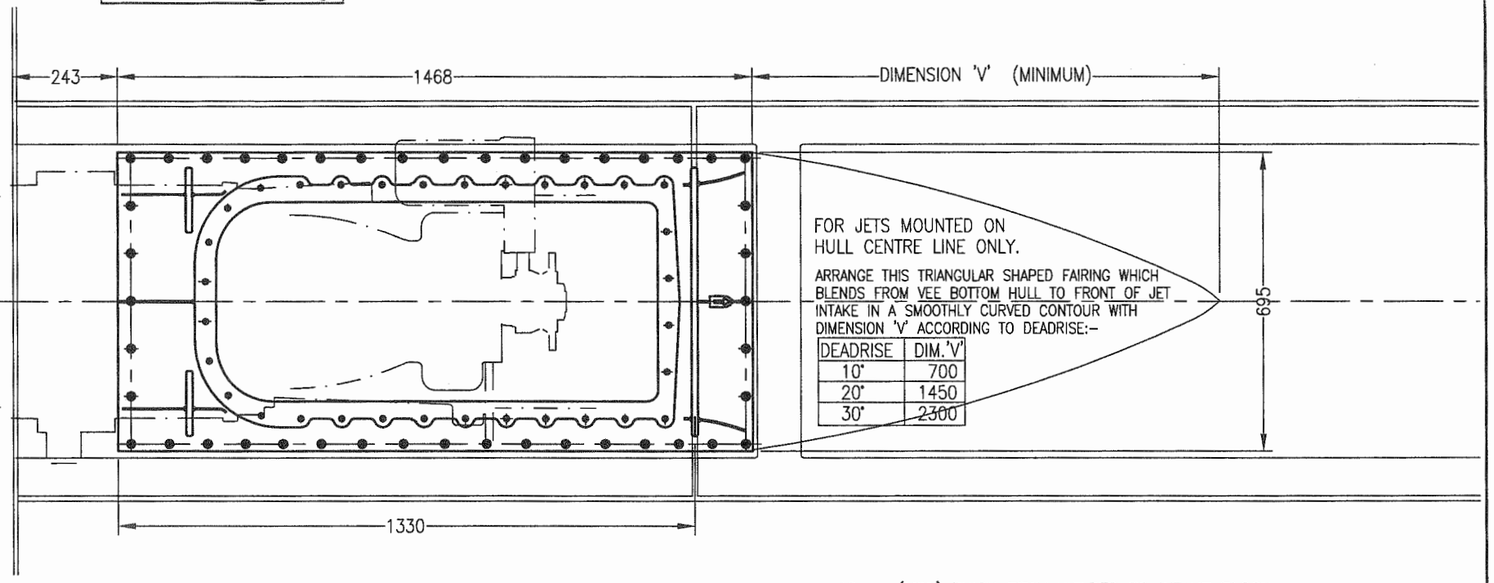
HJ391 JET
INSTALLATION DETAILS for
G.R.P HULLS. Sht.2 of 2

SCALE NIL A1—HJ391 08 001 E

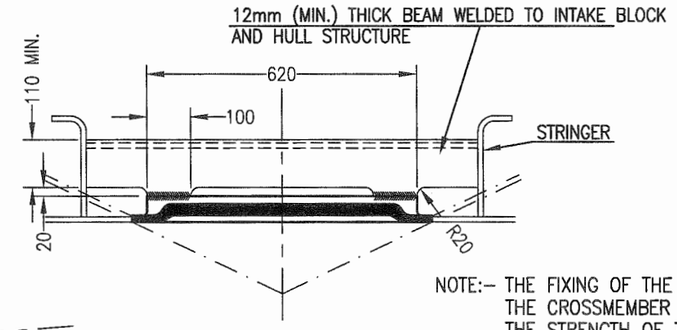
DO NOT SCALE THIS DRAWING | REMOVE ALL SHARP CORNERS | PROJECTION | ALL DIMENSIONS II



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

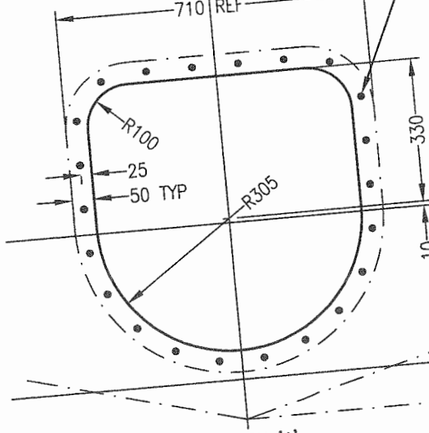


DEADRISE	DIM.'V'
10°	700
20°	1450
30°	2300

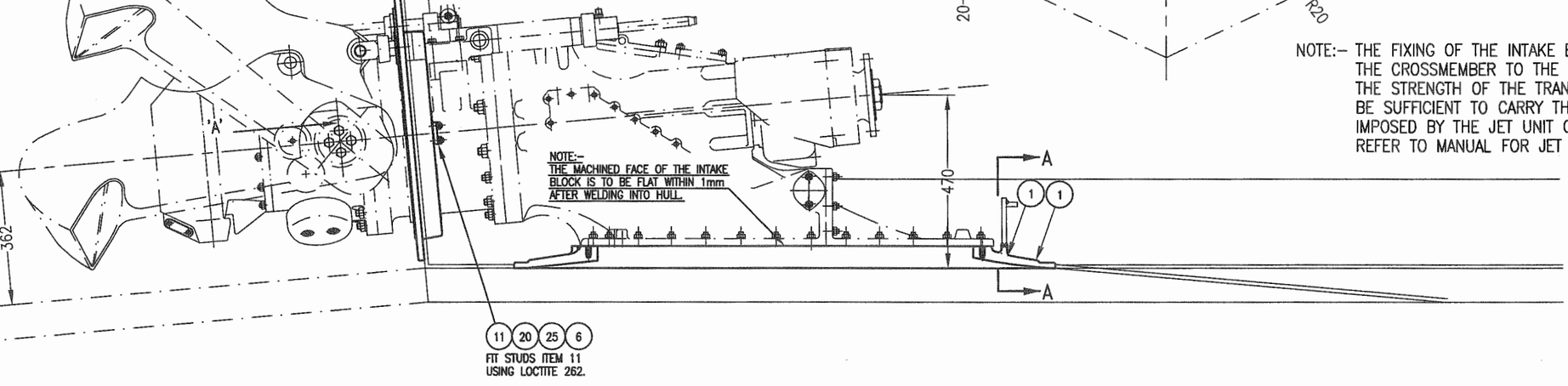


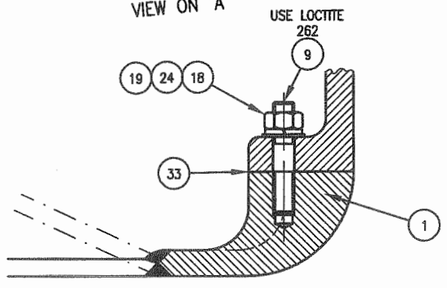
NOTE:- THE FIXING OF THE INTAKE BLOCK AND THE CROSSMEMBER TO THE HULL, AND THE STRENGTH OF THE TRANSOM MUST BE SUFFICIENT TO CARRY THE LOADS IMPOSED BY THE JET UNIT ON THE HULL. REFER TO MANUAL FOR JET LOADS.

ASSEMBLE TRANSOM PLATE ONTO JET
AND USE AS A JIG TO LOCATE HOLES.
DRILL 22 HOLES ø13 THRU.

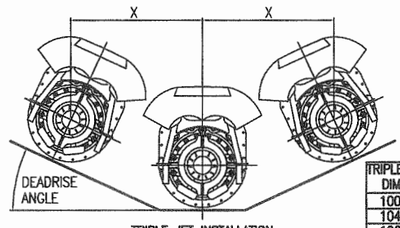


VIEW ON 'A'



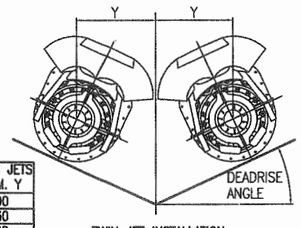


DETAIL SHOWING ATTACHMENT OF :-
INTAKE BLOCK TO HULL
INTAKE BLOCK TO INTAKE



TRIPLE JET INSTALLATION

TRIPLE JETS DIM. X	DEADRISE ANGLE	TWIN JETS DIM. Y
1000	0°	500
1040	5°	530
1060	10°	560
1075	15°	585
1075	20°	605
1075	25°	620



TWIN JET INSTALLATION

LOCTITE APPLICATION:
REFER TO DRAWING No: 85144 FOR THE CORRECT
APPLICATION INSTRUCTIONS FOR LOCTITE 262.

PAINTING NOTES!
1. STANDARD GLOSS FINISH: REFER TO DRAWING 85135 FOR PAINTING OF TRANSOM PLATE & SCREEN.
2. OPTIONAL ANTIFOUL FINISH: REFER TO DRAWING 85134 FOR PAINTING OF TRANSOM PLATE & SCREEN.
3. REFER TO DRAWING 85145 FOR FINISH OF INTAKE BLOCK.
4. REFER TO DRAWING 111178 FOR PAINT SPECIFICATION AND APPLICATION.

REF	NO.	BY	DATE	AMENDMENTS
CL229	F	P.M.W.	22.04.02	LOCTITE DETAILS UPDATED
CL156	E	P.M.W.	26.9.00	PAINT SPEC DRGS ADDED TO SHEET 1.
CL127	D	F.K.	17.2.00	ITEM NUMBERS RATIONALISED
CL3829	C	R.J.L	3.03.98	Sht.1-TRANSOM FIXING CHANGED. Sht.2-ITEMS 2 & 5 QTY. CHANGED & 16 ADDED.
CL3788	B	R.J.L	15.05.97	SCHEDULE MOVED TO SHEET 2.
CL3708	A	P.S	9.06.95	NOTE ADDED RE INTAKE BLOCK FLATNESS AFTER WELDING.
CL3703	0	P.S	9.05.95	ISSUED FOR PRODUCTION

JET 381

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

MATERIAL

√ = N8 EXCEPT AS STATED

UNLIMITED DIMENSIONS TO BE ± 0.5

MAT'L CERT

DESIGNED P.S 27-02-95

DRAWN P.S 27-02-95

CHECKED K.V.E 5-05-95

APPROVED K.V.E 5-05-95

NAME: HJ391 JET INSTALLATION DETAILS for ALUMINIUM HULL. Sheet 1 of 2.

SCALE | No: A1 – HJ391 08 002 | F

HJ391 08 002 | F

DO NOT SCALE THIS DRAWING | REMOVE ALL SHARP CORNERS | PROJECTION | ALL DIMENSIONS IN

A	B	C	D	E	F	G	H	Code	Item	Kit	PartNumber	Qty	ProductDescription	DrawingNbr
										A	107926		INTAKE BLOCK - ALM	107926
										B	108083		INSTALLATION HARDWARE KIT.	HJ39108001
										C	108084		TRANSOM KIT (ALUM & GRP HULL)	HJ39108001
										D	110484		TRANSOM BOLT KIT (ALUM & GRP HULL))	HJ39108001
A									1		107926	1	INTAKE BLOCK - ALM	107926
		C							2		108124	1	TRANSOM PLATE	108124
		C							3		103905	2	FRONT HEADER RING	103905
		C							4		103904	2	REAR HEADER RING	103904
		C							5		103906	1	TRANSOM SEAL	103906
		C							6		103910	2	KEEPER PLATE - INBOARD TRANSOM HEADER RING	103910
	B								9		103916	32	(STUDS) METRIC (316-STST) M12x64	30639
		C							10		103914	16	(STUDS) METRIC (316-STST) M10x95	30637
		C							11		JCQHXAO	4	(STUDS) METRIC (316-STST) M10x50	30637
			D22						14		HYQHXFX	22	(BOLTS) (METRIC) ST ST 316 M12x70	N/A
	B32		D22						18		JEQKXAH	54	(WASHERS) (SPRING) METRIC ST ST 316 M12	N/A
	B32		D44						19		JEOZXAK	76	(WASHERS) (FLAT) METRIC ST ST 316 M12x24x1.6	N/A
		C							20		JEQKXAE	20	(WASHERS) (SPRING) METRIC ST ST 316 M10	N/A
	B32		D22						24		JDQHXAH	54	(NUTS) (METRIC ST ST 316) M12	N/A
		C							25		JDQHXAE	20	(NUTS) (METRIC ST ST 316) M10	N/A
	B1		D1						33		JMNGAAR	2	NEUT-CURE RTV SILICONE 310G	N/A
	B1		D1						34		MRINAAD	2	LOCTITE 262 50ML BOTTLE	N/A
	B1		D1						35		63595	2	(JET) PACKAGING BOLT BOX	N/A

HJ391 08 002 F

REF | NO. | BY | DATE | AMENDMENTS
REFER SHEET 1 FOR AMENDMENTS
JET 391

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

MATERIAL
MATL CERT
DESIGNED P.S 27-02-05
DRAWN P.S 27-02-05
CHECKED K.V.E 5-05-05
APPROVED K.V.E 5-05-05

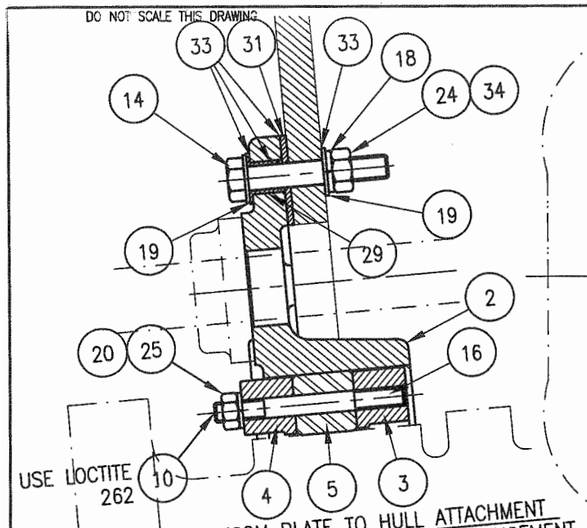
√ = N8 EXCEPT AS STATED
UNLIMITED DIMENSIONS TO BE ± 0.5

NAME: HJ391 JET INSTALLATION DETAILS for ALUMINIUM HULL. Sheet 2 of 2.

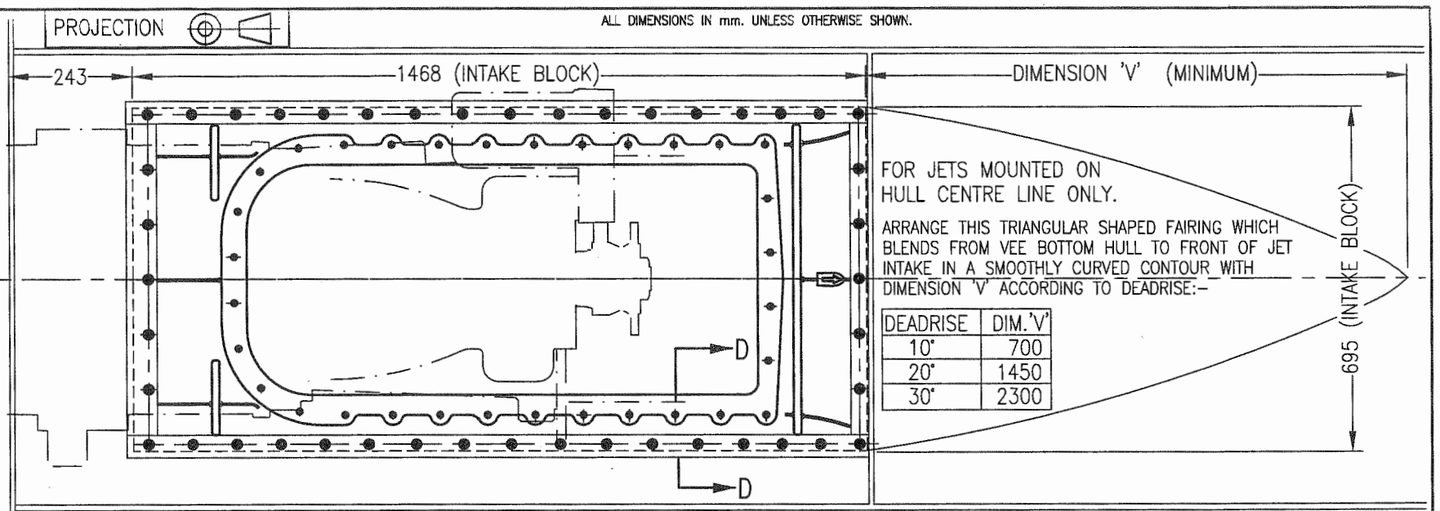
SCALE | No: A1—HJ391 08 002 | F

DO NOT SCALE THIS DRAWING. REMOVE ALL SHARP CORNERS

ALL DIMENSIONS IN mm. UNLESS OTHERWISE SHOWN.

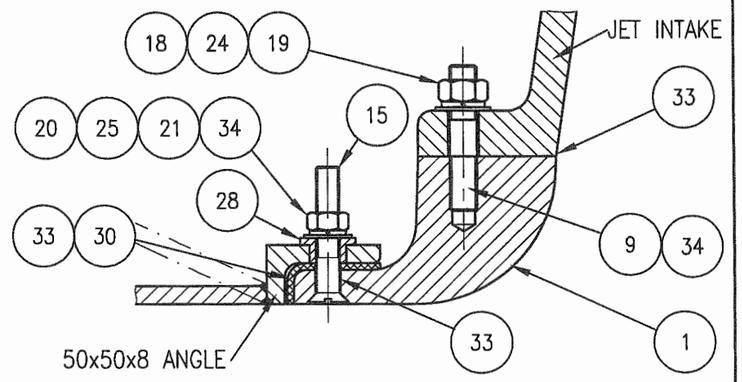


DETAIL OF TRANSOM PLATE TO HULL ATTACHMENT AND TRANSOM PLATE TO JET SEALING ARRANGEMENT

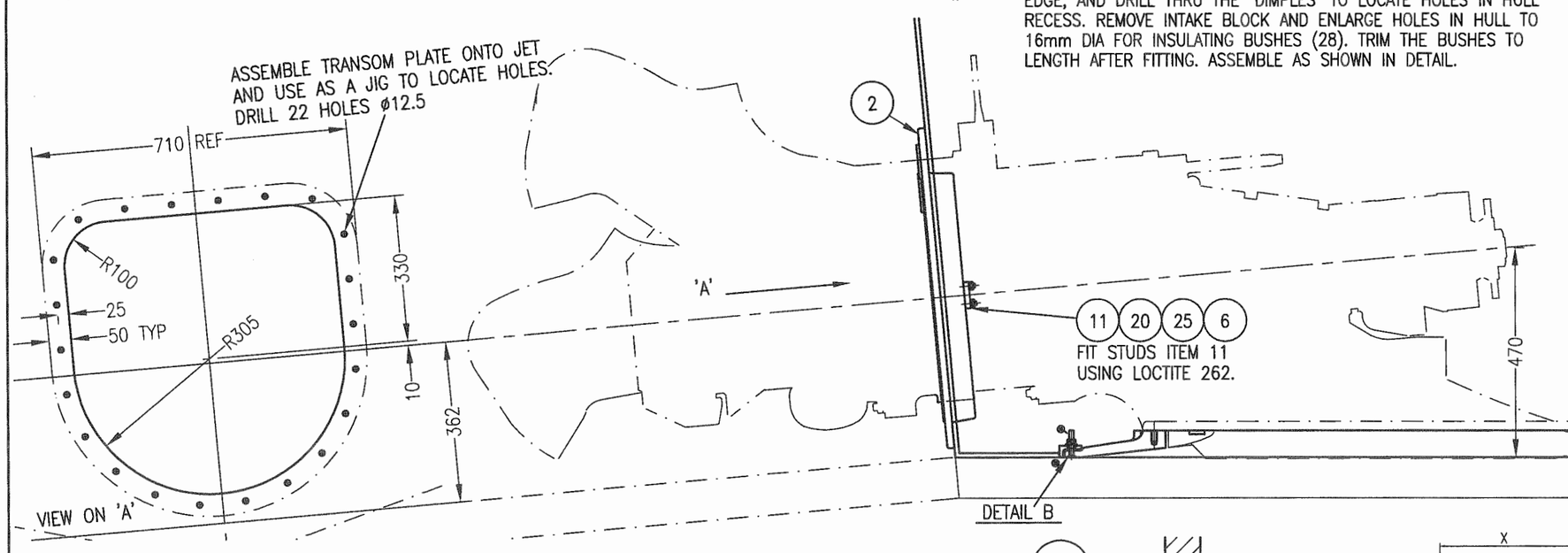


DEADRISE	DIM. 'V'
10°	700
20°	1450
30°	2300

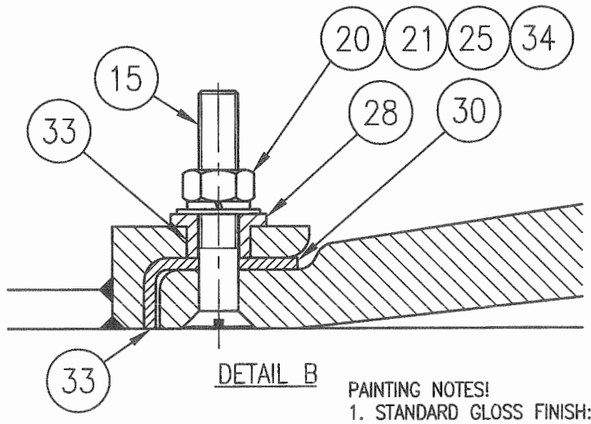
NOTE;- THE INTAKE BLOCK (ITEM 1) AS SUPPLIED, HAS THE COUNTERSINK 'DIMPLES' BUT NOT THE HOLES FOR THE M10 CSK. SCREWS (15). SET THE INTAKE BLOCK INTO HULL RECESS, WITH 3mm GAP AT EDGE, AND DRILL THRU THE 'DIMPLES' TO LOCATE HOLES IN HULL RECESS. REMOVE INTAKE BLOCK AND ENLARGE HOLES IN HULL TO 16mm DIA FOR INSULATING BUSHES (28). TRIM THE BUSHES TO LENGTH AFTER FITTING. ASSEMBLE AS SHOWN IN DETAIL.

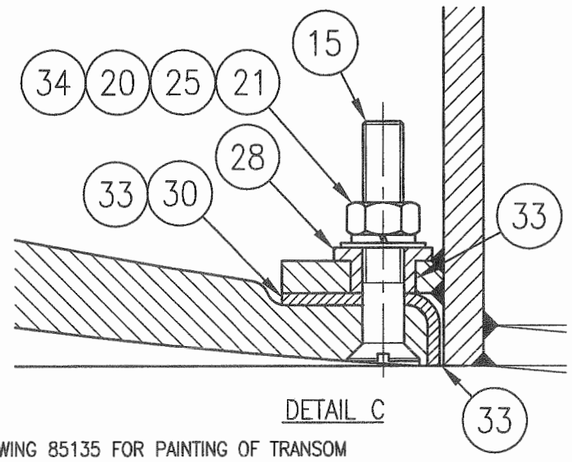


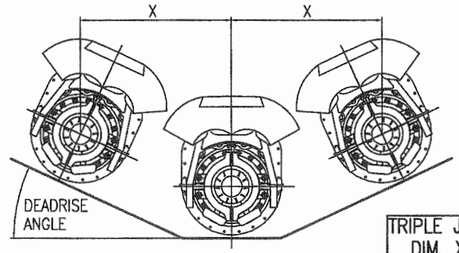
SECTION THRU JOINT BETWEEN HULL, INTAKE BLOCK, & INTAKE



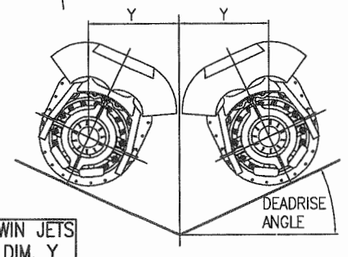
NOTE:- THE FIXING OF THE INTAKE BLOCK AND THE CROSSMEMBER TO THE HULL, AND THE STRENGTH OF THE TRANSOM MUST BE SUFFICIENT TO CARRY THE LOADS IMPOSED BY THE JET UNIT ON THE HULL – REFER TO MANUAL FOR JET LOADS.







TRIPLE JET INSTALLATION



TWIN JET INSTALLATION

TRIPLE JETS DIM. X	DEADRISE ANGLE	TWIN JETS DIM. Y
1000	0°	500
1040	5°	530
1060	10°	560
1075	15°	585
1075	20°	605
1075	25°	620

LOCTITE APPLICATION:
REFER TO DRAWING No: 85144 FOR THE CORRECT APPLICATION INSTRUCTIONS FOR LOCTITE 262.

PAINTING NOTES!
1. STANDARD GLOSS FINISH: REFER TO DRAWING 85135 FOR PAINTING OF TRANSOM PLATE AND SCREEN.
2. OPTIONAL ANTIFOUL FINISH: REFER TO DRAWING 85134 FOR PAINTING OF TRANSOM PLATE & SCREEN.
3. REFER TO DRAWING 85145 FOR FINISH OF INTAKE BLOCK.
4. REFER TO DRAWING 111178 FOR PAINT SPECIFICATION AND APPLICATION.

CL229	G	P.M.W.	22.04.02	LOCTITE DETAILS UPDATED	
CL229	G	P.M.W.	22.04.02	REFER CL3703,3708,3788,3829,57,127,158 FOR CHANGES	
REF	NO.	BY	DATE	AMENDMENTS	

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

MATERIAL

MATL CERT

DESIGNED P.S. 27.02.95

DRAWN P.S. 27.02.95

CHECKED K.V.E. 05.05.95

APPROVED K.V.E. 05.05.95

√ = N8 EXCEPT AS STATED

UNLIMITED DIMENSIONS TO BE ± 0.5

NAME

INSTALLATION DETAILS FOR STEEL HULLS SHEET 1 OF 2

SCALE | No: A1–HJ391 08 003 | G

HJ391 08 003 | G

DO NOT SCALE THIS DRAWING | REMOVE ALL SHARP CORNERS | PROJECTION | ALL DIMENSIONS IN mm. UNLESS OTHERWISE SHOWN.

A	B	C	D	E	F	G	H	Code	Item	Kit	PartNumber	Qty	ProductDescription	DrawingNbr
										A	108204		INTAKE BLOCK KIT (STEEL HULL)	HJ39108003
										B	108083		INSTALLATION HARDWARE KIT.	HJ39108001
										C	108205		TRANSOM KIT (STEEL)	HJ39108003
										D	110485		TRANSOM BOLT KIT (STEEL HULL)	HJ39108003
A									1		108206	1	INTAKE BLOCK - GRP / STEEL	107926
		C							2		108207	1	TRANSOM PLATE (steel hull)	108207
		C							3		103905	2	FRONT HEADER RING	103905
		C							4		103904	2	REAR HEADER RING	103904
		C							5		103906	1	TRANSOM SEAL	103906
		C							6		103910	2	KEEPER PLATE - INBOARD TRANSOM HEADER RING	103910
	B								9		103916	32	(STUDS) METRIC (316-STST) M12x64	30639
		C							10		103914	16	(STUDS) METRIC (316-STST) M10x95	30637
		C							11		JCQHXAO	4	(STUDS) METRIC (316-STST) M10x50	30637
			D						14		HYQHXFX	22	(BOLTS) (METRIC) ST ST 316 M12x70	N/A
A									15		HZPPXEE	44	(BOLTS) (M/C SCREWS) METRIC STST 316 M10x60 (CSK HD)	N/A
	B32		D22						18		JEQKXAH	54	(WASHERS) (SPRING) METRIC ST ST 316 M12	N/A
	B32		D44						19		JEOZXAK	76	(WASHERS) (FLAT) METRIC ST ST 316 M12x24x1.6	N/A
		C							20		JEQKXAE	20	(WASHERS) (SPRING) METRIC ST ST 316 M10	N/A
A									21		JEOZXAI	44	(WASHERS) (FLAT) METRIC ST ST 316 M10x21x1.2	N/A
	B32		D22						24		JDQHXAH	54	(NUTS) (METRIC ST ST 316) M12	N/A
A44		C20							25		JDQHXAE	64	(NUTS) (METRIC ST ST 316) M10	N/A
A									28		64319	44	(BUSHES) NYLON INSULATING S260M	N/A
			D						29		64320	22	INSULATING BUSH; TRANSOM PLATE (S7B/47)	N/A
A									30		108203	1	GASKET INTAKE BLOCK (STEEL HULL)	108203
		C							31		106573	1	GASKET TRANSOM (STEEL HULL)	106573
A1	B1		D1						33		JMNGAAR	3	NEUT-CURE RTV SILICONE 310G	N/A
A1	B1		D1						34		MRINAAD	3	LOCTITE 262 50ML BOTTLE	N/A
A1	B1		D1						35		63595	3	(JET) PACKAGING BOLT BOX	N/A

HJ391 08 003 | G

REF	NO.	BY	DATE	AMENDMENTS
JET 391				REFER SHEET 1 FOR CHANGES

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

MATERIAL | MAT'L CERT

√ = N8 EXCEPT AS STATED

UNLIMITED DIMENSIONS TO BE ± 0.5

		DATE
DESIGNED	P.S.	27.02.95
DRAWN	P.S.	27.02.95
CHECKED	K.V.E.	05.05.95
APPROVED	K.V.E.	05.05.95

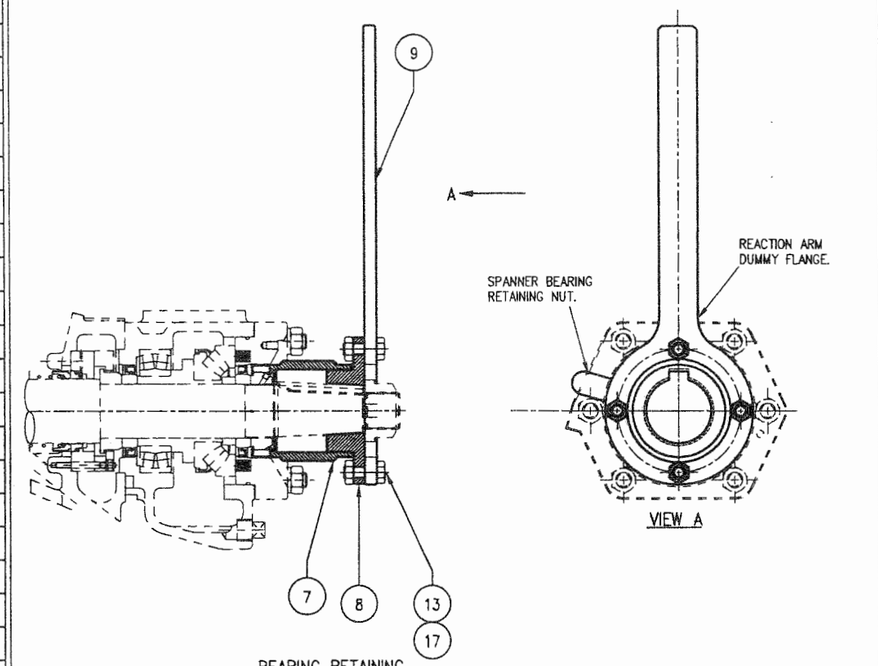
NAME: INSTALLATION DETAILS FOR STEEL HULLS SHEET 2 OF 2

SCALE | No. A1-HJ391 08 003 | G

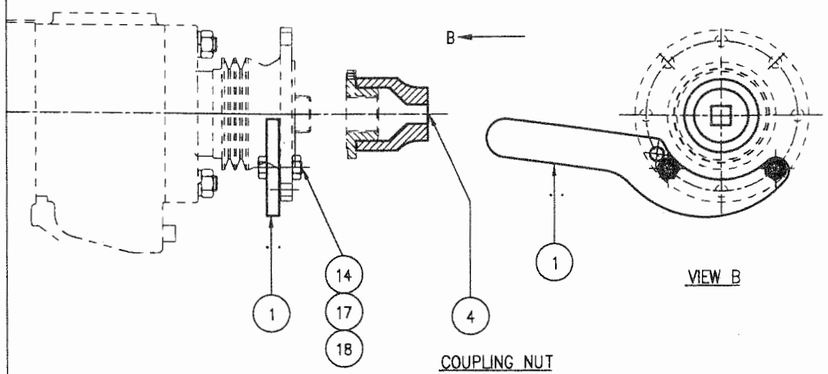
SPARES ASSY	ITEM	PART NO	QTY	DESCRIPTION	DRG NO (CWF H USE ONLY)
A 4	1	105855	1	REACTION ARM – COUPLING FLANGE	105855
A 4	2	103982	1	IMPELLER PULLER	103982
A 4	3	105854	1	COUPLING PULLER	105854
A 4	4	JMNGABV	1	SOCKET, 70 A.F., 1" DRIVE	
A 4	5	105851	1	SHAFT SUPPORT TOOL	105851
A 4	6	108144	1	HOOK BLOCK	108144
A 4	7	106638	1	SPANNER (BEARING NUT)	106638
A 4	8	108185	1	DUMMY FLANGE	108185
A 4	9	107730	1	REACTION ARM – DUMMY FLANGE	107730
A 4	10	103983	1	ROTARY SEAL FIT SLEEVE	103983
A 4	11	108142	1	FORCING SCREW	108142
A 4	12	107029	1	DRIVING TOOL for J.H.P.U	107029
A 4	13	HYQHXIO	4	BOLT, M16 x 60, 316 S.S.	
A 4	14	HYQHXIS	4	BOLT, M16 x 75, 316 S.S.	
A 4	15	HYQHXIV	2	BOLT, M16 x 90, 316 S.S.	
A 4	16	JDQHXAP	1	NUT, M20, 316 S.S.	
A 4	17	JDQHXAL	10	NUT, M16, 316 S.S.	
A 4	18	JEOZXAM	6	WASHER, FLAT, M16, 316 S.S.	
A 4	19	JEOZXAO	1	WASHER, FLAT, M20, 316 S.S.	
A 4	20	108832	1	IMPELLER PULLER INSERT	108832
A 4	21	63594	1	PACKING BOX	

ITEM	SPARES ASSY No.	DESCRIPTION
A	106935	TOOLKIT, TO SUIT ø225, GWB 587.48 COUPLING

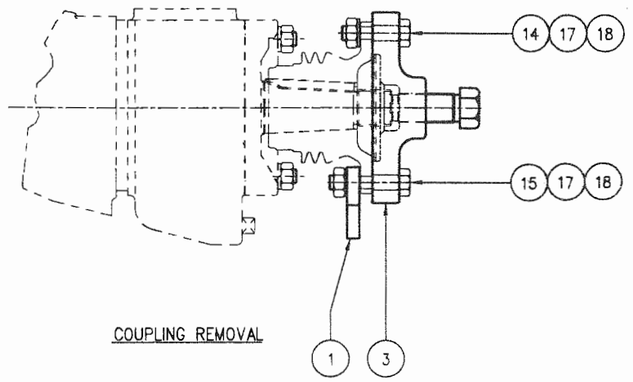
PROJECTION



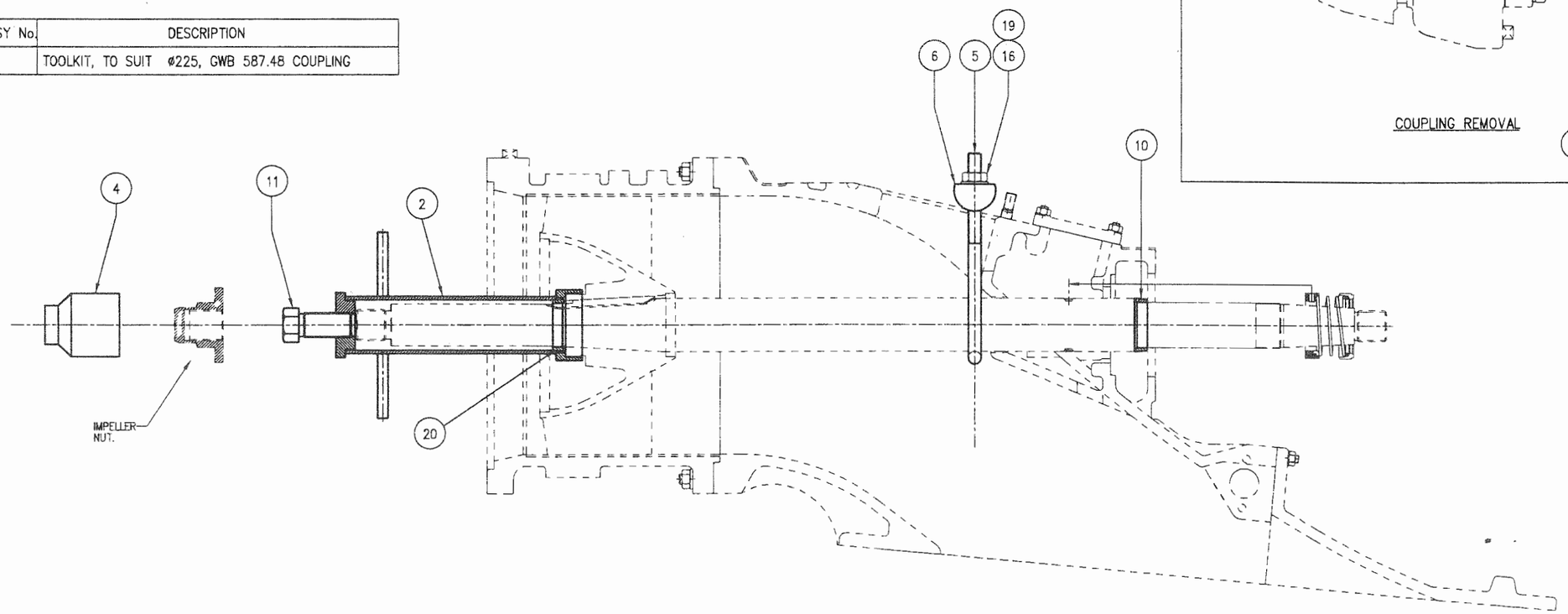
BEARING RETAINING NUT REMOVAL



COUPLING NUT REMOVAL



COUPLING REMOVAL



2729	A	P.S.	29.2.96	ITEMS 20 & 21 ADDED.	
CL 3703	0	R.J.L	15/5/95	ISSUE FOR PRODUCTION	
REF	NO.	BY	DATE	AMENDMENTS	
JET 391					

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

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

MATERIAL N.A.

√ = N9 EXCEPT AS STATED

UNLIMITED DIMENSIONS TO BE ± –

MATL CERT

DESIGNED — DATE

DRAWN R.J.L 12-04-95

CHECKED K.V.E. 15/5/95

APPROVED K.V.E. 15/5/95

NAME
TOOLKITS
HJ391 JET

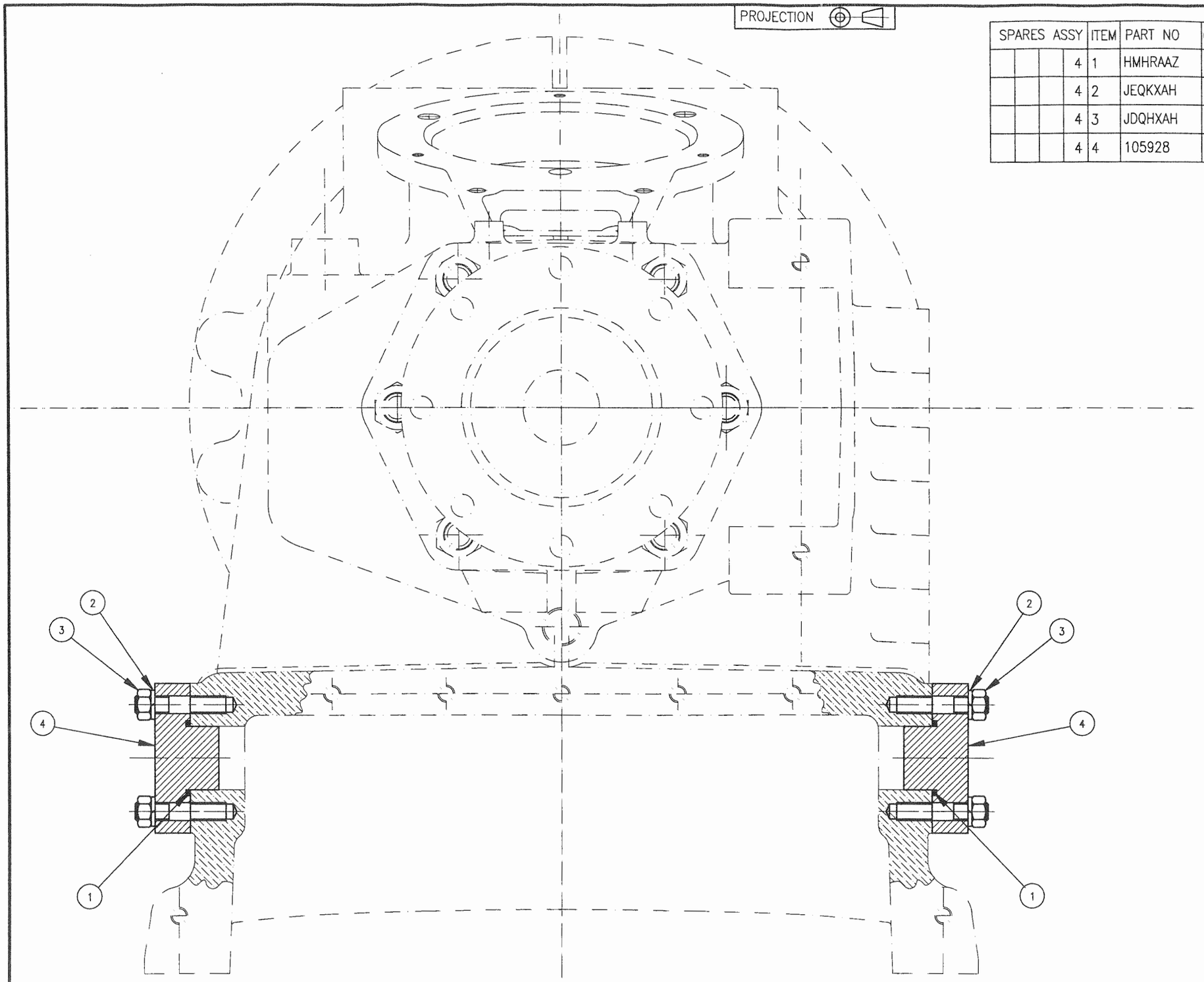
SCALE N.T.S

No: A1–HJ391 1.1 000 A

HJ391 11 000 A

PROJECTION

SPARES ASSY	ITEM	PART NO	QTY	DESCRIPTION	DRG NO CWF H USE ONLY
4	1	HMHRAAZ	2	'0' RING 0.13" X 1.75" X 2.00"	
4	2	JEQKXAH	4	WASHER SPRING M12 316S.S.	
4	3	JDQHXAH	4	NUT M12 316S.S.	
4	4	105928	2	BLANKING PLUG	105928



REF	NO.	BY	DATE	AMENDMENTS
391	0	P.S.	9/5/95	ISSUED FOR PRODUCTION.

JET 391

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

MATERIAL

MAT'L CERT

DESIGNED P.A.S. DATE 9/5/95

DRAWN P.A.S. 9/5/95

CHECKED

APPROVED

✓ = N9 EXCEPT AS STATED

UNLIMITED DIMENSIONS TO BE ± 0.5

NAME

HJ391
SCREEN RAKE
BLANKING PLUGS

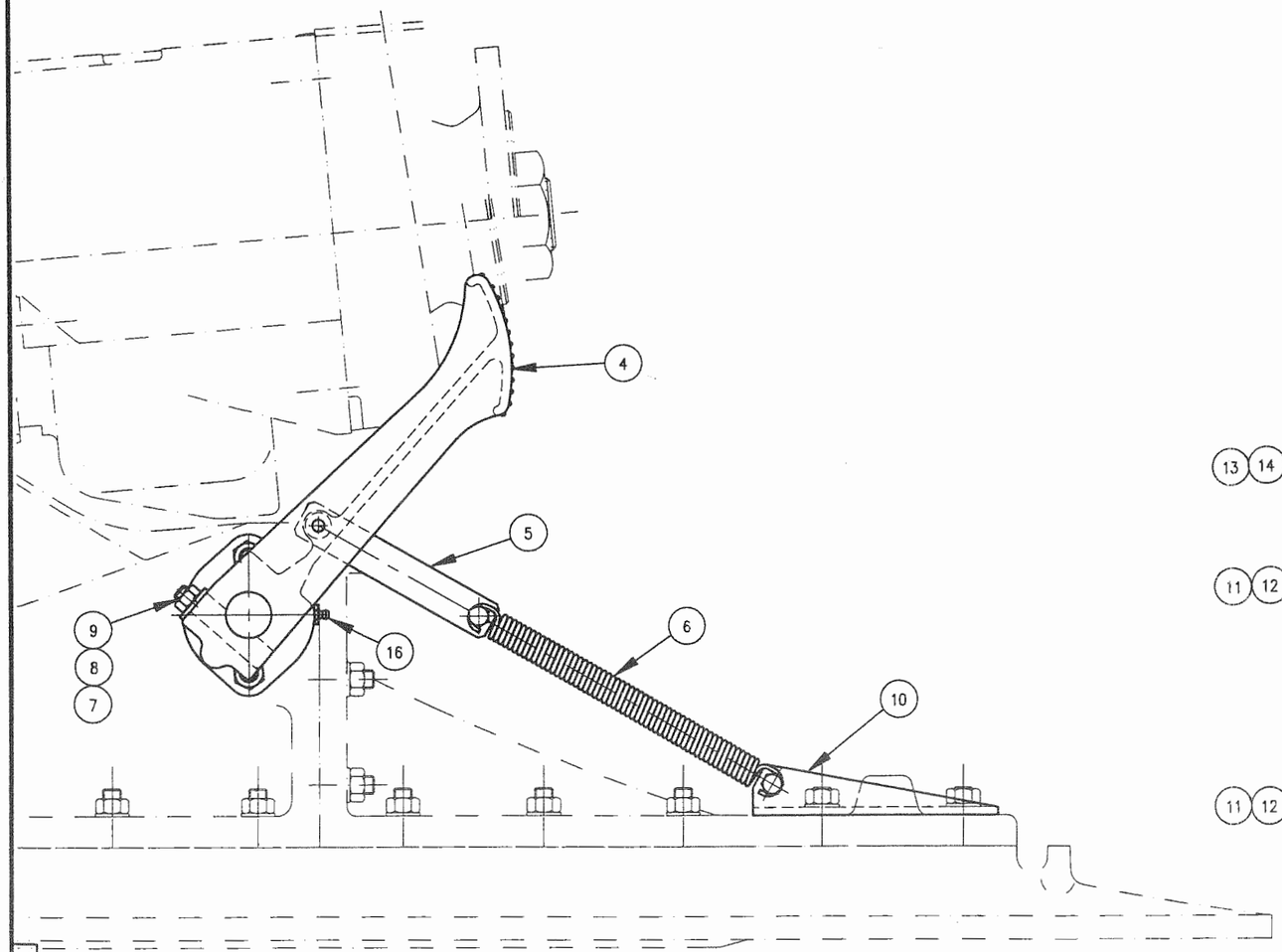
SCALE 1:1 No: A1 – HJ39109001 0

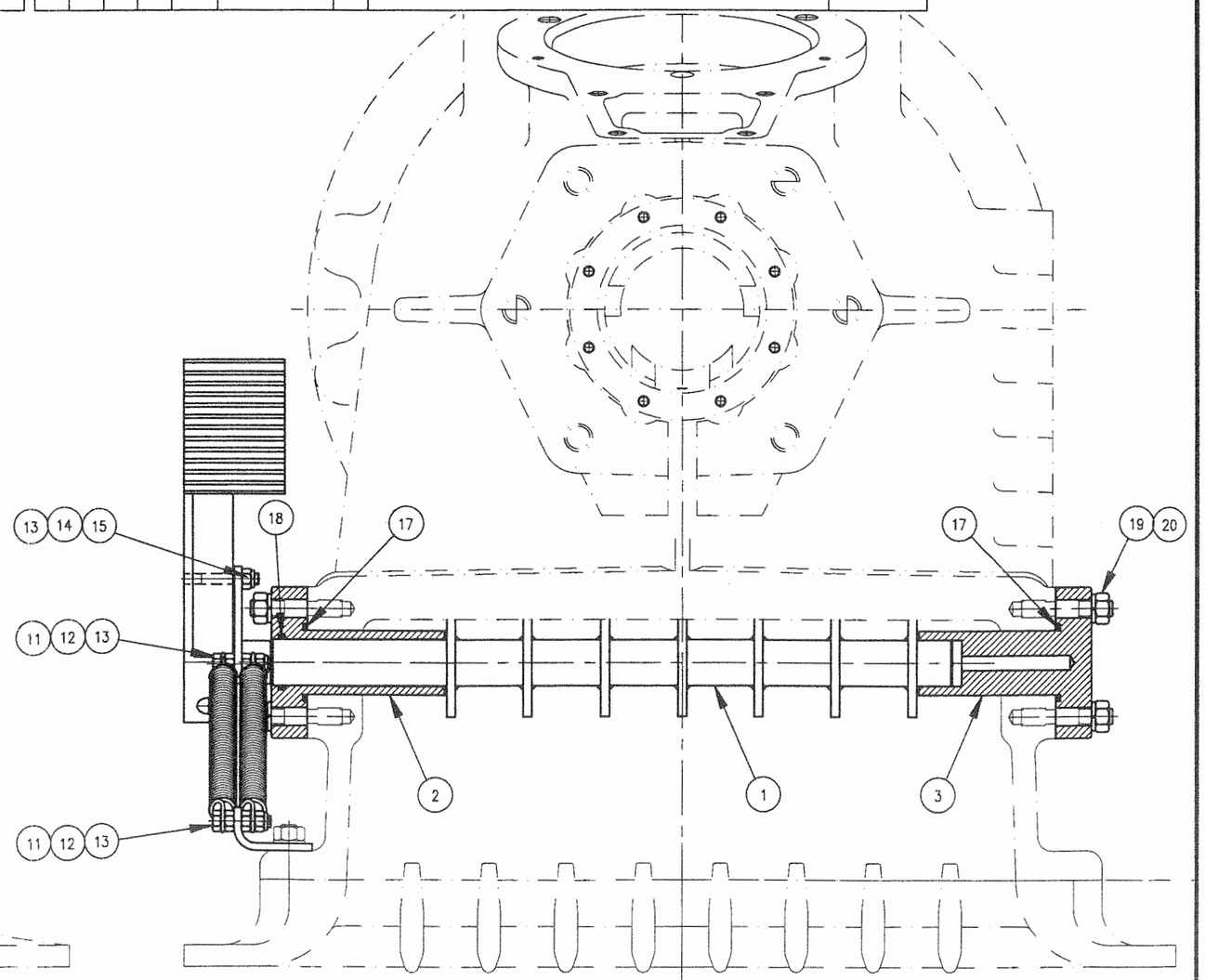
HJ39109001 0

PROJECTION

SPARES ASSY	ITEM	PART NO	QTY	DESCRIPTION	DRG NO CWF H USE ONLY
4	1	108281	1	SCREEN RAKE WELDED ASSEMBLY	108281
4	2	108269	1	BEARING STARBOARD	108269
4	3	108270	1	BEARING PORT	108270
4	4	108304	1	RAKE ACTUATING ARM	108304
4	5	108283	1	LINK	108283
1	6	102364	2	SPRING	102364
4	7	105665	1	COTTER PIN	105665
4	8	102993	1	WASHER	102993
4	9	JDQHXAE	1	NUT M10	
4	10	108296	1	SPRING ANCHOR BRACKET	108296

SPARES ASSY	ITEM	PART NO	QTY	DESCRIPTION	DRG NO CWF H USE ONLY
4	11	HZQHXBC	2	M8 X 40 HEX. HEAD MACHINE SCREW	
4	12	JDQHXAC	4	M8 NUT	
4	13	JDQSXAC	3	M8 NYLOC NUT	
4	14	JCQHXAH	1	M8 X 40 STUD	
4	15	JEOZXAF	1	M8 WASHER	
4	16	HEIDAAA	2	GREASE NIPPLE 1/8" BSP STRAIGHT	
4	17	HMHRAAZ	2	'O' RING 0.13 X 1.75 X 2.0 (224N70)	
4	18	HMHRAAU	1	'O' RING 0.13 X 1.25 X 1.5 (218N70)	
4	19	JDQHXAH	4	M12 NUT	
4	20	JEQKXAH	4	M12 SPRING WASHER	





8710	A	P.S.	21/6/95	ITEM 4 WAS 106275	
CL3708	0	P.S.	16/6/95	ISSUED FOR PRODUCTION	
REF	NO.	BY	DATE	AMENDMENTS	
JET 391					

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

MATERIAL

MAT'L CERT

√ = N9 EXCEPT AS STATED

UNLIMITED DIMENSIONS TO BE ± 0.5

		DATE
DESIGNED	P.A.S.	16/6/95
DRAWN	P.A.S.	16/6/95
CHECKED	K.V.A.	16/6/95
APPROVED	K.V.E.	19/6/95

NAME

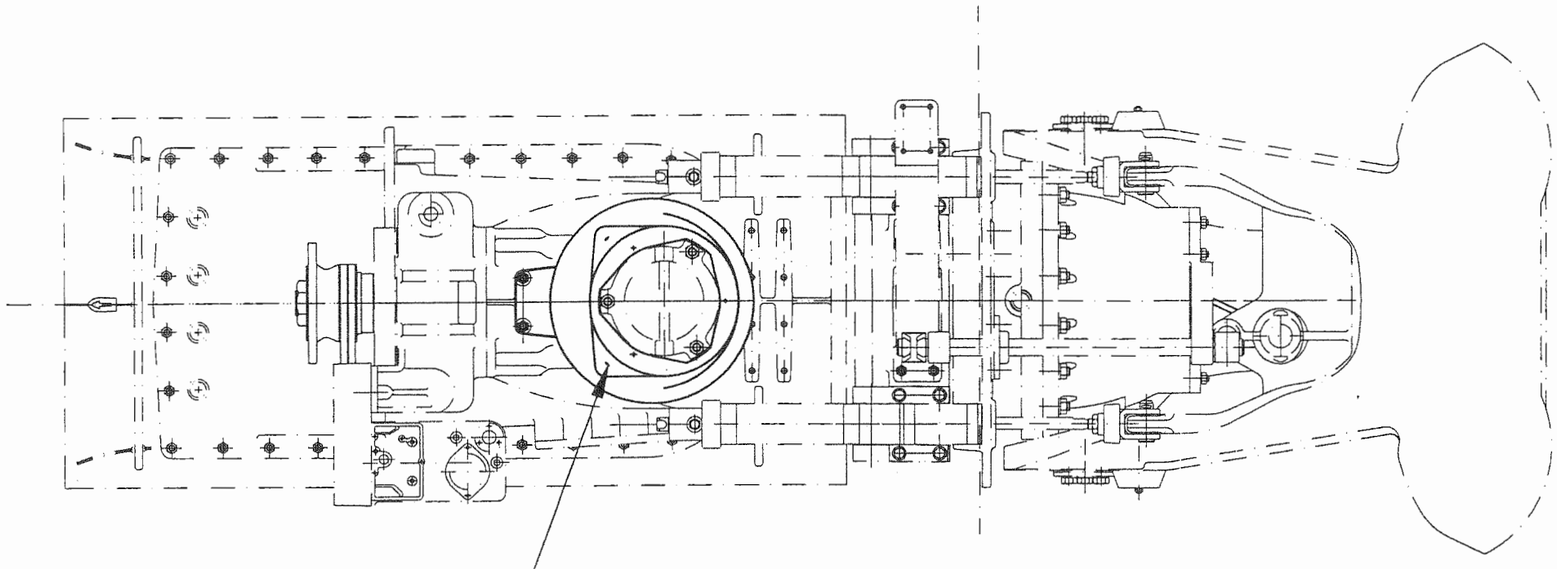
SCREEN RAKE ASSEMBLY
HJ391

SCALE 1:1 | No. A1-HJ39109002 | A

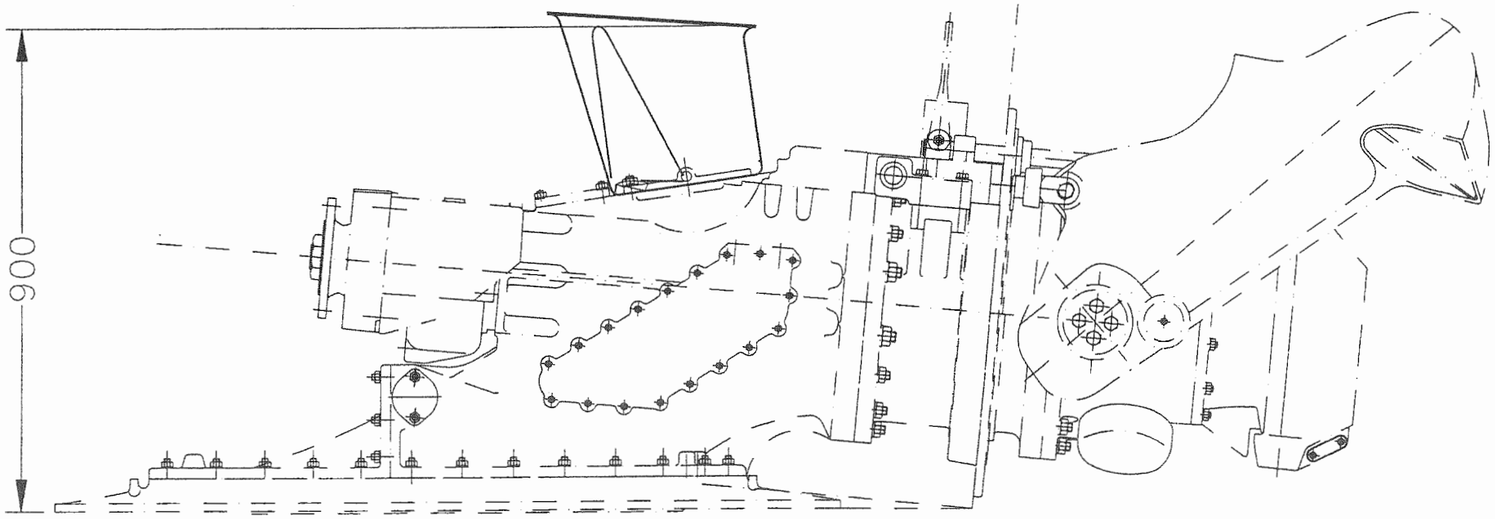
HJ39109002 A

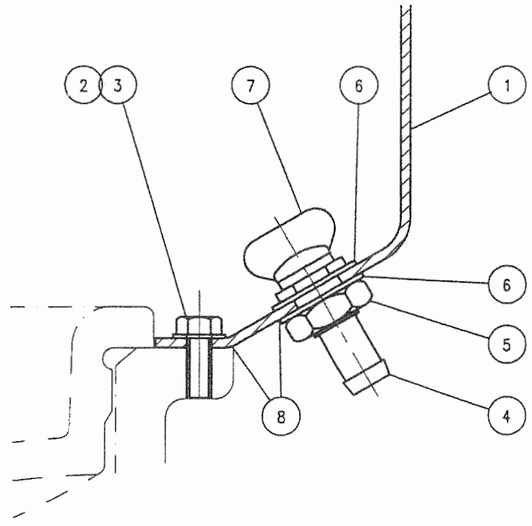
PROJECTION

SPARES ASSY	ITEM	PART NO	QTY	DESCRIPTION	DRG NO CWF H USE ONLY
3	1	107866	1	OVERFLOW PREVENTER	107866
3	2	HZQHXAY	3	M8 X 20 HEX. HEAD SCREW. 316 S.S.	
3	3	JEOZXAF	3	WASHER M8 316S.S.	
3	4	107298	1	DRAIN CONNECTION	107298
3	5	JDQKXAJ	1	NUT THIN M16 316S.S.	
3	6	JEOZXAM	2	WASHER M16 316S.S.	
2	7	63825	1	DRAIN BUNG 'NATRA'	63825
2	8	JMNGAAS	1	RTV SILICONE SEALANT (NEUTRAL CURE)	



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





DETAIL OF DRAIN CONNECTION

A1-HJ 391 10 001 0

REF	NO.	BY	DATE	AMENDMENTS
JET	391			
3761	0	P.S.	12/4/95	ISSUED FOR PRODUCTION.

ITEM NO | PART NO | REQD | DESCRIPTION | DWG NO

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

MATERIAL

√ = N9 EXCEPT AS STATED

UNLIMITED DIMENSIONS TO BE ± 0.5

MAT'L CERT

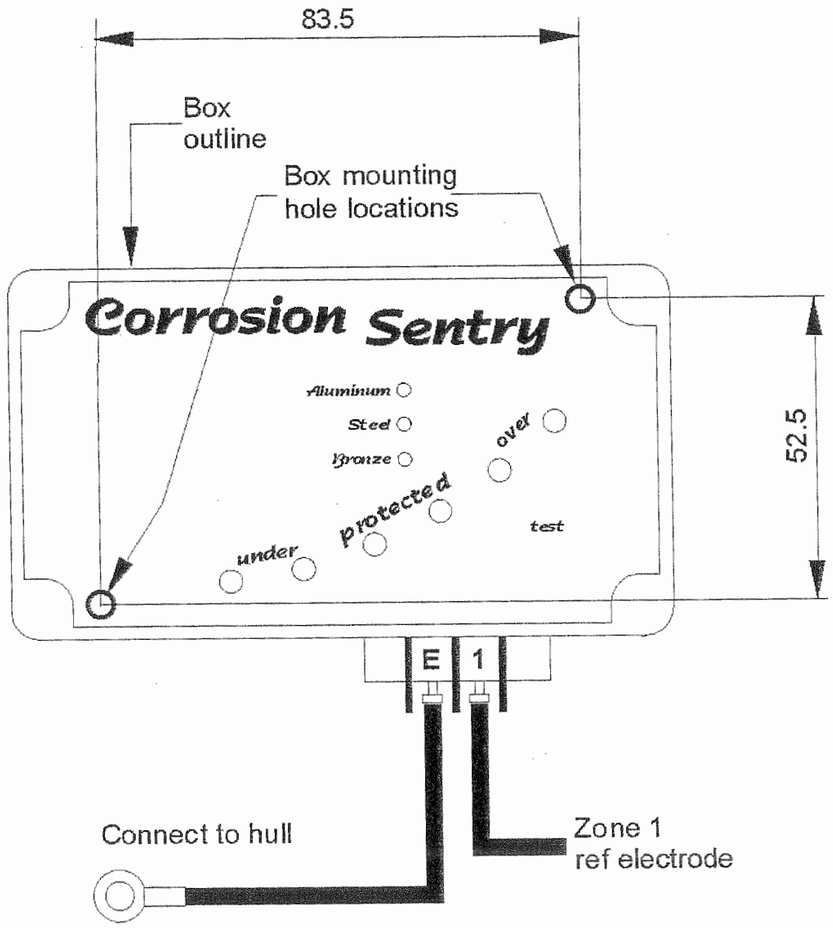
NAME

OVERFLOW PREVENTER
OPTION
HJ391

		DATE
DESIGNED	P.A.S.	12/4/95
DRAWN	P.A.S.	12/4/95
CHECKED	K.V.A.	12/4/95
APPROVED	K.V.E.	17-4-95

SCALE | No: A1- HJ39110 001 0

For Correct Installation Of Corrosion Monitor Refer To Information Sheet 85148 In The Manual.



Item	Kit	PartNumber	Qty	ProductDescription	DrawingNbr
	A	65153		SENTRY CORROSION MONITOR KIT (SINGLE ZONE)	85148
1		65154	1	SENTRY CORROSION MONITOR 1 ZONE (SN-01)	85148
2		65155	1	RERERENCE ELECTRODE TYPE B (REF-REC-ZN)	85148

REF	NO.	BY	DATE	AMENDMENTS
CL196	C	P.M.W	06.08.01	ITEM 1 WAS PT No: 63974 & ITEM 2 WAS PT No: 64275
CL108	B	R.J.L	22.09.99	DRAWING CHANGED EARTHING DETAILS MOVED TO DRG.85114
CL3760	B	R.J.L	23.06.97	ISSUED FOR PRODUCTION.

JET 391

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

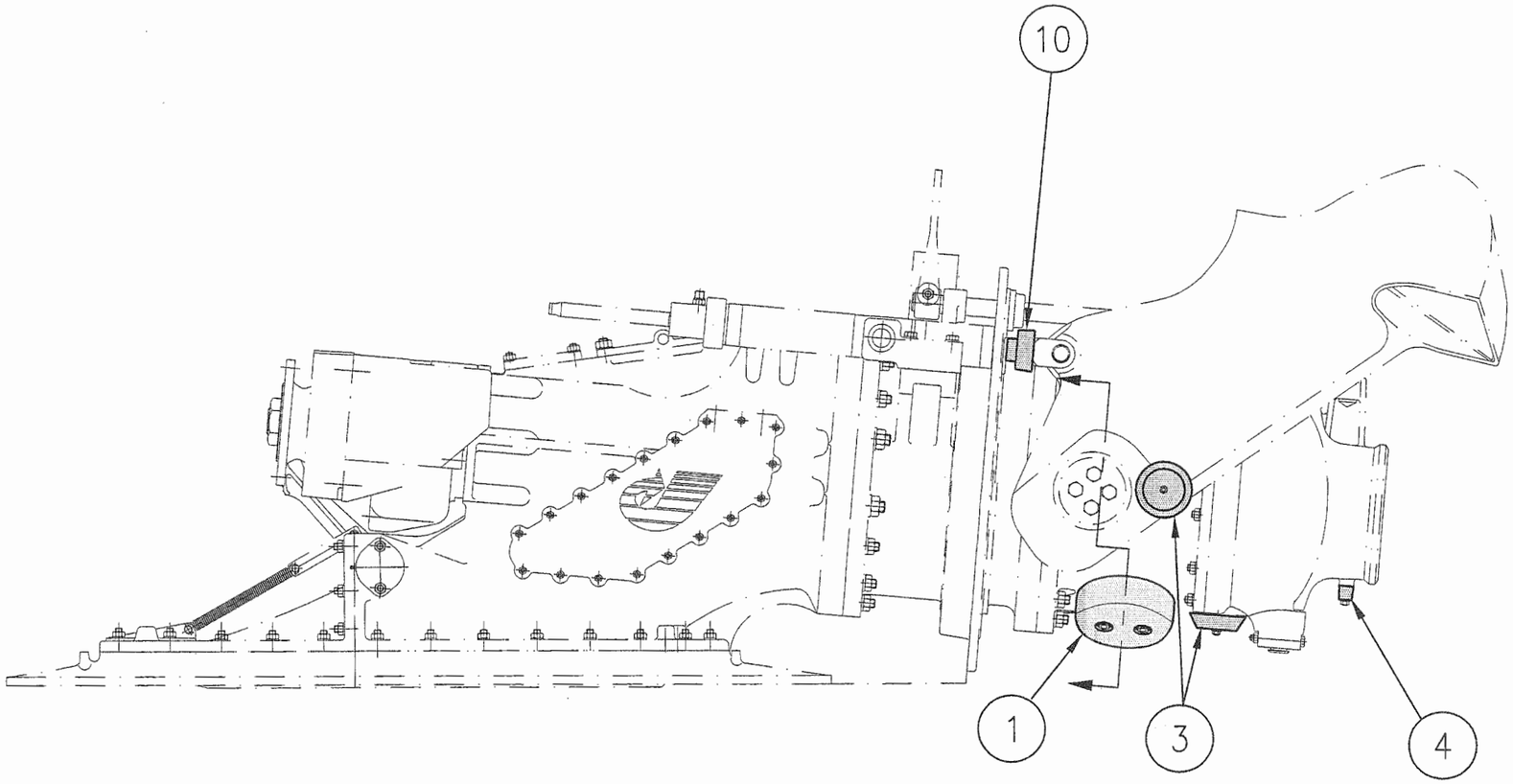
PROJECTION

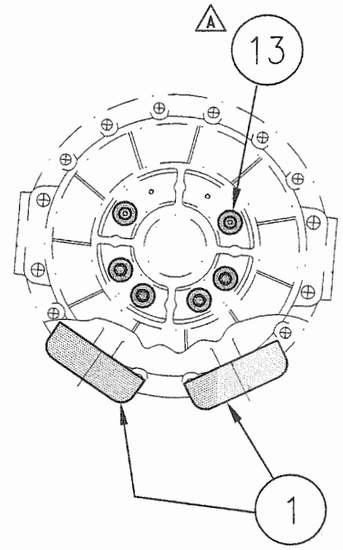
NAME: ANODE CONDITION MONITOR for HJ391 JET.

DESIGNED	DATE
DRAWN R.J.L	19-08-99
CHECKED K.V.E	
APPROVED K.V.E	

SCALE: -

No: ASSY-HJ391 13 001 C





SECTION THROUGH TAILPIPE
SHOWING ANODES.

	Item	PartNumber	Qty	ProductDescription	DrawingNbr
	1	103862	2	ANODE	103862
	3	102185	3	ANODE	102185
A	4	103359	1	ANODE MK3	103359
	10	105764	2	ANODE	105764
A	13	111644	3	ANODE INTERNAL	111644

REF	NO.	BY	DATE	AMENDMENTS
CL 165	A	R.J.L	29.11.00	WAS 3 & ITEM 13 NEW ANODE ADDED.
CL 165	A	R.J.L	29.11.00	INTERNAL TAILPIPE ANODES WERE ITEM 4 NOW 13, ITEM 4 QTY
CL0137	0	R.J.L	8.05.00	ISSUED FOR INFORMATION.
JET 391				

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

PROJECTION

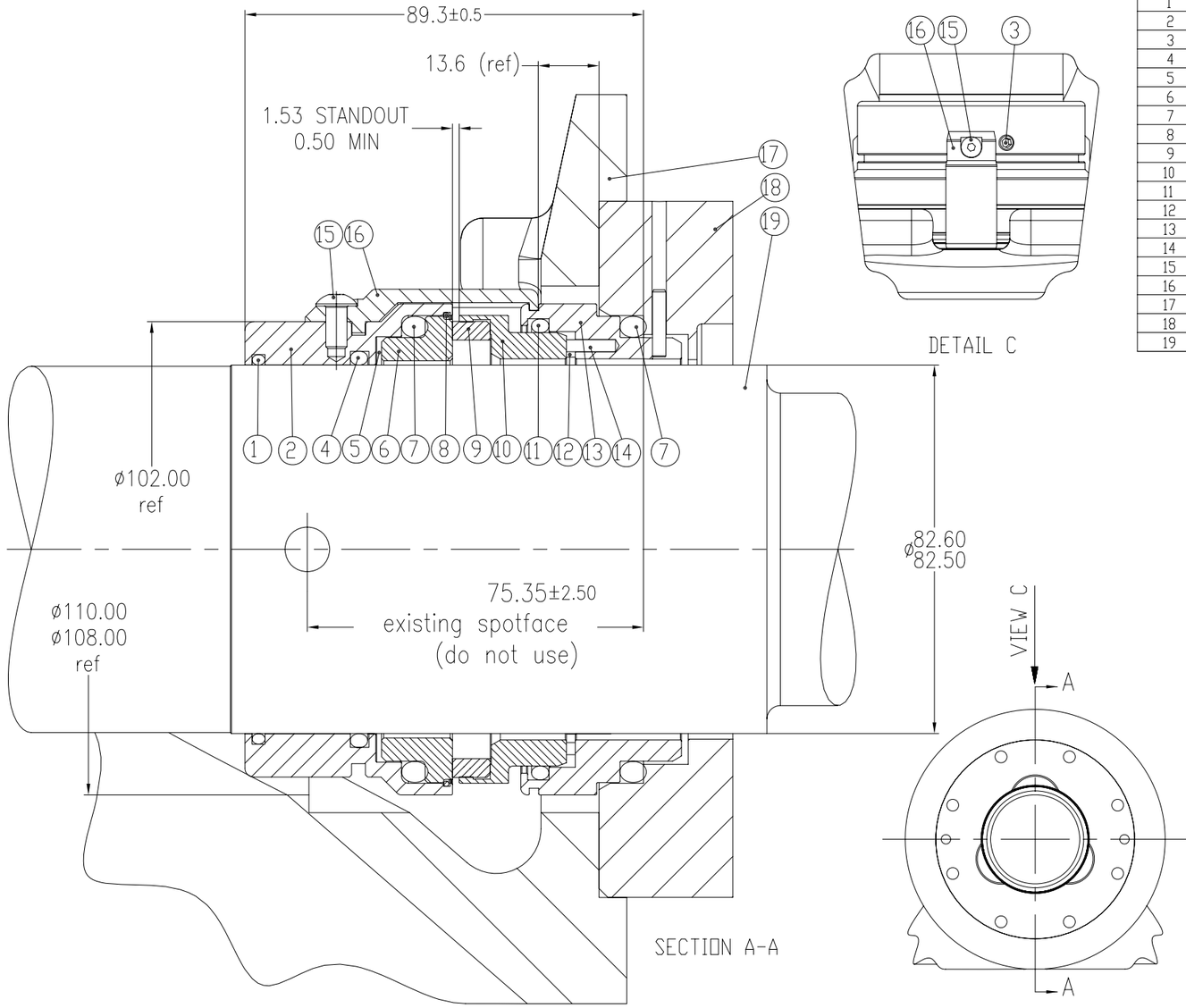
DESIGNED R.J.L	DATE 3-05-00
DRAWN R.J.L	3-05-00
CHECKED K.V.E	8-05-00
APPROVED K.V.E	8-05-00

NAME
ANODE LOCATION
for
HJ391 JET.

SCALE -

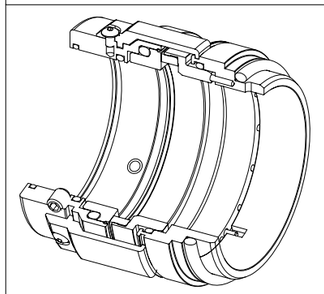
No: ASSY-HJ391 13 002 A

DO NOT SCALE THIS DRAWING | REMOVE ALL SHARP CORNERS | ALL DIMENSIONS IN mm. UNLESS OTHERWISE SHOWN | PROJECTION



ITEM NO.	QTY.	PART NO.	MATERIAL	DESCRIPTION
1	1	OR-__-152	NBR OR FKM	O RING
2	1	CS1-F1816S20-X52	316 STST	MATING RING HOLDER
3	3	GSC-M08-010-S20	316 STST	CUP POINT GRUBSCREW
4	1	OR-__-236	NBR OR FKM	O RING
5	1	PIN-238-087-S20	316 STST	PIN
6	1	MR1-F1364H85-X52	SiC	MATING RING (WIRE RETAINED)
7	2	OR-__-343	NBR OR FKM	O RING
8	1	CIR-F1366P14-X52	ALLOY 625	MATING RING RETAINING WIRE
9	1	BLX-XXC-XXX-X54	CARBON	BLX SEAL RING INSERT
10	1	CS1-F1817Y50-X52	SAFF 2205	SEAL RING SHELL
11	1	OR-__-241	NBR OR FKM	O RING
12	2	PIN-M04-140-S20	316 STST	PIN
13	1	CS1-F1815S20-X52	316 STST	STATIONARY ADAPTOR
14	15	SPR-D6157N30-PLN	ALLOY C276	SPRING
15	3	CSB-188-375-S15	304 STST	BUTTON HEAD CAPSCREW
16	3	CS1-F1830A08-X52	ALUMINIUM	SETTING CLIP
17	1	INTAKE CASTING	AS SPEC	HJ 391 INTAKE FRAME (EXISTING)
18	1	A1-104027	LM6	HJ 391 SEAL HOLDER PLATE (EXISTING)
19	1	A1-108034	SAFF 2205	HJ 391 MAIN SHAFT (EXISTING)

ENGINEERED IN 3D CAD



CHANGE NOTICE

ISS.	DATE	DRW	CHKD	DESCRIPTION OF CHANGE
G	19.07.01	BM		~~PART NUMBERS INCONSISTANT WITH BOM.~~ REF.;
H	19.07.01	BM		~~PART NUMBERS INCONSISTANT WITH BALLONS, CORRECTED ACCORDINGLY~~ REF.;
J	26.03.03	WBD		~~EXTENDED THE BACK OF MATING RING HOLDER, 89.3 WAS 77.8. BOM ORDER CHANGED.~~ REF.;WO#E23752 ADDED DETAILS ON INSERT STANDOUT
K	01.07.06	WBD		~~RELIEF ADDED NEXT TO DYNAMIC ORING~~ REF.;
F	27.04.00	BM		~~REMOVE SETTING INSTRUCTIONS, ADD REF DIMENSION 13.6, UPDATE HJ391 PART DESCRIPTIONS~~ REF.:E#18039

INFORMATION

REMOVE ALL BURRS } R0.10 to
BREAK ALL CORNERS } R0.25mm

ORIGINAL DWG SIZE =A3

ANGLES ±0.5°
XX DECIMALS ±0.13
X DECIMALS ±0.25

(V) LAP FLAT WITHIN 3 LIGHTBANDS

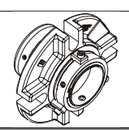
SURFACE FINISH 0.8µm RMS
UNLESS SHOWN OTHERWISE

ALL DIMENSIONS IN MILLIMETRES
UNLESS SHOWN OTHERWISE

THIRD ANGLE PROJECTION

TITLE:
3.250" CS1 SEAL ASSEMBLY
HAMILTON JET HJ391 - Part No. 61524

EKK EAGLE INTERNATIONAL



EAGLE MECHANICAL SEALS

DRN BY:	BM
CHKD BY:	
DATE:	09.02.99
SCALE:	NTS
REF. No.:	E18039
MATERIAL:	AS SPECIFIED
EKK GROUP CO:	ENZ
NEXT ASSY:	61524
PART No.:	CS1-H1310CS_-X52
DRAWING No.	H1310-X52
ISSUE	K

Note:

Seal 61524 is only used on HJ391 serial numbers 113 and later.
Seal 61419 is used on HJ391 serial numbers 112 and earlier.

REF	NO.	BY	DATE	AMENDMENTS
CL445	0	F.K.	04.12.06	NOTE REF SERIAL NUMBERS ADDED
CL337	N	R.J.L	23.08.04	NEW DRAWING AMENDMENT K FROM EAGLE SEALS.
CL337	N	R.J.L	23.08.04	FOR PAST CL's. REFER CL135,137,192,196,217,287,309.

JET 391

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

MATERIAL: AS SHOWN
MAT'L CERT
DESIGNED DATE
DRAWN R.J.L 13.04.00
CHECKED
APPROVED

√ = N9 EXCEPT AS STATED
UNLIMITED DIMENSIONS TO BE ±

NAME: 3.250" MECHANICAL SEAL ASSEMBLY for HJ391 JETS.

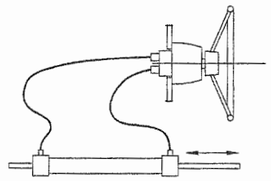
SCALE | No: A3-61524 | 0

61524 0

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

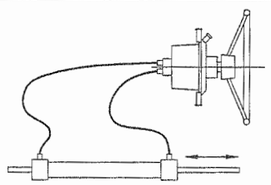
EXAMPLES

SEASTAR:	HA5430
SHELL:	AERO SHELL FLUID #4
ESSO:	UNIVIS N15 OR J13
TEXACO:	HO15

TOTAL OIL VOLUME in Litres: N/A

USED ON JET MODEL: HJ241, HJ273, HJ291, HJ321

WAGNER MANUAL HYDRAULIC STEERING



FLUID

HYDRAULIC OIL OF VISCOSITY: I.S.O. GRADE 32
DO NOT USE:
BRAKE FLUID
HEAVIER VISCOSITY FLUIDS

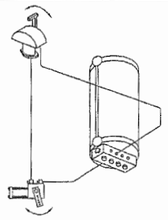
EXAMPLES

SHELL:	TELLUS 32
ESSO:	NUTO H32
TEXACO:	RANDO HD32 or RANDO HD AZ

TOTAL OIL VOLUME in Litres: N/A

USED ON JET MODEL: HJ362, HS363, HJ391, HM422, HM461, HM521, HM571

HYNAUTIC REMOTE CONTROL SYSTEMS



FLUID

50/50 VOLUMETRIC MIXTURE OF:
ETHYLENE-GLYCOL / DISTILLED WATER
DO NOT USE:
BRAKE FLUID or HYDRAULIC OILS.

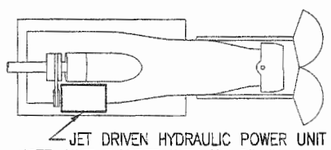
EXAMPLES

HYNAUTIC: MCO-03

TOTAL OIL VOLUME in Litres: N/A

USED ON JET MODEL: HJ362, HS363, HJ391, HM422, HM461, HM521, HM571

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

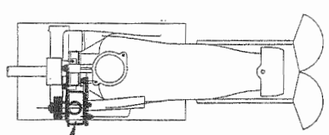
HYDRAULIC OIL OF I.S.O. 3448 VISCOSITY GRADE.
VISCOSITY:- 60cSt @ 40°C
10cSt @ 100°C
DO NOT USE:
BRAKE FLUID
HEAVIER VISCOSITY FLUIDS

EXAMPLES

SHELL:	TELLUS 46
CASTROL:	HYSPIN AWS 32/68
MOBIL:	DTE 25
B.P.:	HLP HM46

JET MODEL	CONTROL TYPE HSRC (lt)	HYRC (lt)	HFRC (lt)	MECS (lt)	VPJHPU (lt)
HJ321	5.25				
HJ362	5.25			5.25	
HS363					
HJ391		7.5	7.5	7.5	
HM422		7.5	7.5	7.5	
HM461		7.5		7.5	
HM521		7.5		7.5	
HM571		7.5		7.5	
HM651					21
HM721					21
HM811					21

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

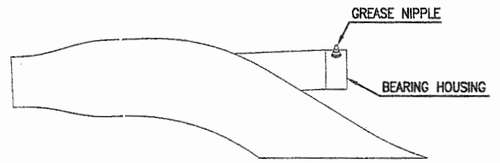
SHELL:	DONAX TM	Auto Transmission Oil.
	DEXRON 111	Auto Transmission Oil.
MOBIL:	ATF	Auto Transmission Oil.
CASTROL:	TQ DEXRON 111	Auto Transmission Oil.
ESSO:	PSF #91423	Power Steering Fluid
TEXACO:	TL-11872	Power Steering Fluid
	TL-15216	Power Steering Fluid

JET MODEL	CONTROL TYPE HSRX (lt)	HSRC (lt)
HJ213	1.0	
HJ241	1.0	
HJ273	1.2	
HJ274	1.2	
HJ291	1.2	
HJ292		1.2
HJ322		2.0

BEARING HOUSING LUBRICATION

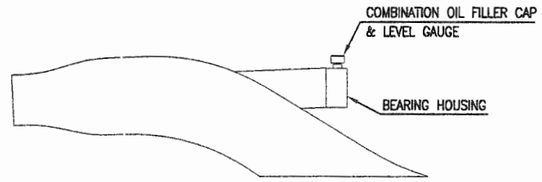
JET UNIT	VOLUME (lt)	
HJ211	0.3	
HJ212	0.3	
HJ241	0.3	
HJ273	0.5	
HJ291	0.5	
HJ321	0.5	
JET UNIT	VOLUME (lt)	
HJ362	0.7	
HS363	1.4	
HJ391	1.4	
HJ402	1.4	
HM422	1.4	
HM461	1.4	
HM521	2	
HM571	3.5	
HM651	5	*5
HM721	7	*5
HM811	10	*5

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.

PROJECTION

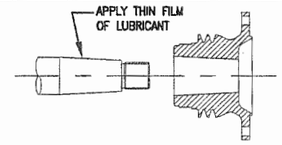
NOTE!
JET UNIT OIL LEVELS WILL VARY DEPENDING ON DEADRISE OF HULL. OIL VOLUMES SHOWN ARE FOR CENTRALLY MOUNTED UNITS. WITH NO DEADRISE.
OIL LEVELS MUST BE WITHIN THE MARKS SHOWN ON THE DIPSTICK.

NOTE!
ALL VOLUMES SHOWN ARE IN LITRES (lt).

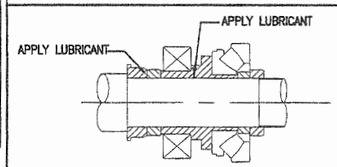
OIL VOLUMES SHOWN ARE FOR TOTAL SYSTEM.

JOINT LUBRICATION

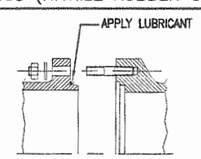
TAPERS (IMPELLERS & COUPLINGS)



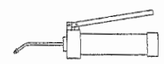
STEEL TO STEEL



O-RINGS (NITRILE RUBBER ONLY)



LUBRICANT



GREASE:
MULTIPURPOSE LITHIUM BASE.
EG: SHELL ALVANIA RL12 OR EQUIVALENT.

NOTE! DO NOT GREASE BARRIER CORD 'O' RINGS.

REF	NO.	BY	DATE	AMENDMENTS
CL252	J	P.M.W	14.10.02	JOINT LUBRICATION CHART ADDED.
CL241	I	J.W.	22.07.02	HJ292 & HJ322 ADDED TO TABLE.
CL127	H	J.W.	17.01.00	EXTRA OIL EXAMPLES ADDED TO JHPU LIST.
				CL3646, 3740, 3831, 066, 084, 104

JET

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

MATERIAL

√ = N9 EXCEPT AS STATED

UNLIMITED DIMENSIONS TO BE ± 0.5

MAT'L CERT

DESIGNED DATE

DRAWN R.J.L. 21-12.93

CHECKED

APPROVED

NAME
RECOMMENDATIONS FOR LUBRICANTS AND OILS

SCALE N/A

No: A3-85018 J

J

85018

Weld Procedure For Welding Cast Intake Blocks Into Aluminium Hulls

. 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.

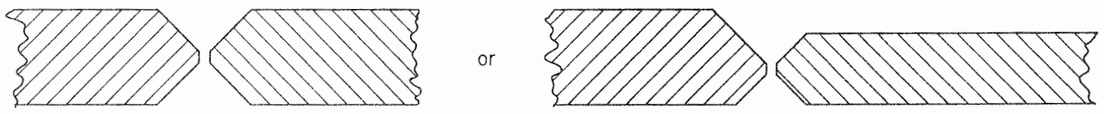
5. Welding Process: – M.I.G.

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

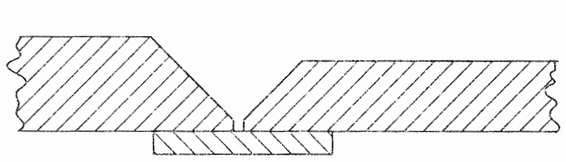
7. Shield Gas: – Argon or helium..

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.



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

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

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

3. 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

4. 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.

5. 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
0	P.S.	6/6/95	ISSUED FOR PRODUCTION.
A	P.S.	24/9/96	REDRAWN ON CAD.OVERHEAD OPTION ADDED.
B			

CL3765
CL3607

JET 211 212 213 241 273 272 291 321 363 391

C.W.F.HAMILTON & CO. LTD. CHCH. N.Z.

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

√ = N9 EXCEPT AS STATED
UNLIMITED DIMENSIONS TO BE ±

NAME

WELD PROCEDURE for WELDING CAST INTAKEBLOCKS into ALUMINIUM HULLS

SCALE | No: A3–85080 | B

PROJECTION

DO NOT SCALE THIS DRAWING

REMOVE ALL SHARP CORNERS

ALL DIMENSIONS IN mm. UNLESS OTHERWISE SHOWN

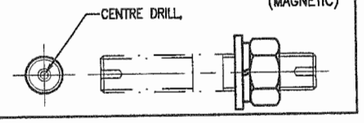
PROJECTION

NUT TIGHTENING TORQUES

SIZE	N.m	lbs.ft	NUTS ON 316 ST. STL STUDS
M6	5	4	(NON MAGNETIC)
M8	12	9	
M10	24	18	
M12	45	33	
M16	60	45	
M20	120	90	

C

SIZE	N.m	lbs.ft	NUTS ON SAF 2205 ST. STL STUDS
M12	60	44	(MAGNETIC)
M16	160	120	
M20	260	190	
M24	450	330	

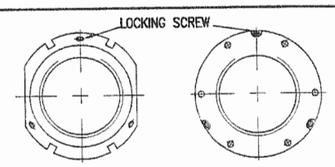


NOTES:

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 LITHIUM BASE GREASE. EXAMPLE: SHELL ALVANIA RL2.

TIGHTENING TORQUES FOR LOCKING SCREWS ON KMT OR KMTA NUTS

SCREW SIZE	N.m	lbs.ft
M6	5	4
M8	12	9
M10	20	15



NOTE 3:

FOR SPECIFIC INSTRUCTIONS ON TIGHTENING TORQUES FOR IMPELLER NUTS, COUPLING NUTS, BEARING LOCK NUTS, AND OTHER SET SCREWS REFER TO THE RELEVANT JET ASSEMBLY DRAWING.

C

85113

REF	NO.	BY	DATE	AMENDMENTS
CL253	C	R.J.L	21.10.02	M16 316 NUT TORQUE WAS 75Nm & 90 lbs.ft.
CL252	B	P.M.W	14.10.02	REF TO THREAD & JOINT LOCKING & 85144 DELETED FROM NOTE 3
CL252	B	P.M.W	14.10.02	2205 STUDS NUT TORQUES M12 WAS 54 & 40, M16 WAS 130 & 95
CL252	B	P.M.W	14.10.02	316 STUDS NUT TORQUES: M12 WAS 45 & 35, M16 WAS 60 & 45.
CL252	B	P.M.W	14.10.02	THREAD & JOINT LOCKING AND JOINT LUBRICATION INFO DELETED
CL188	A	P.M.W	30.05.01	NOTE 3 ADDED, 680 LOCTITE ADDED TO BUSHES & SLEEVES
CL104	0	R.J.L	18.06.99	ISSUED FOR PRODUCTION.
JET	ALL			

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

MATERIAL N/A

MAT'L CERT

DESIGNED R.J.L. DATE

DRAWN R.J.L. 18.06.99

CHECKED

APPROVED

√ = N9 EXCEPT AS STATED

UNLIMITED DIMENSIONS TO BE ± N/A

NAME
RECOMMENDATIONS FOR NUT AND LOCKING SCREW TIGHTENING TORQUES

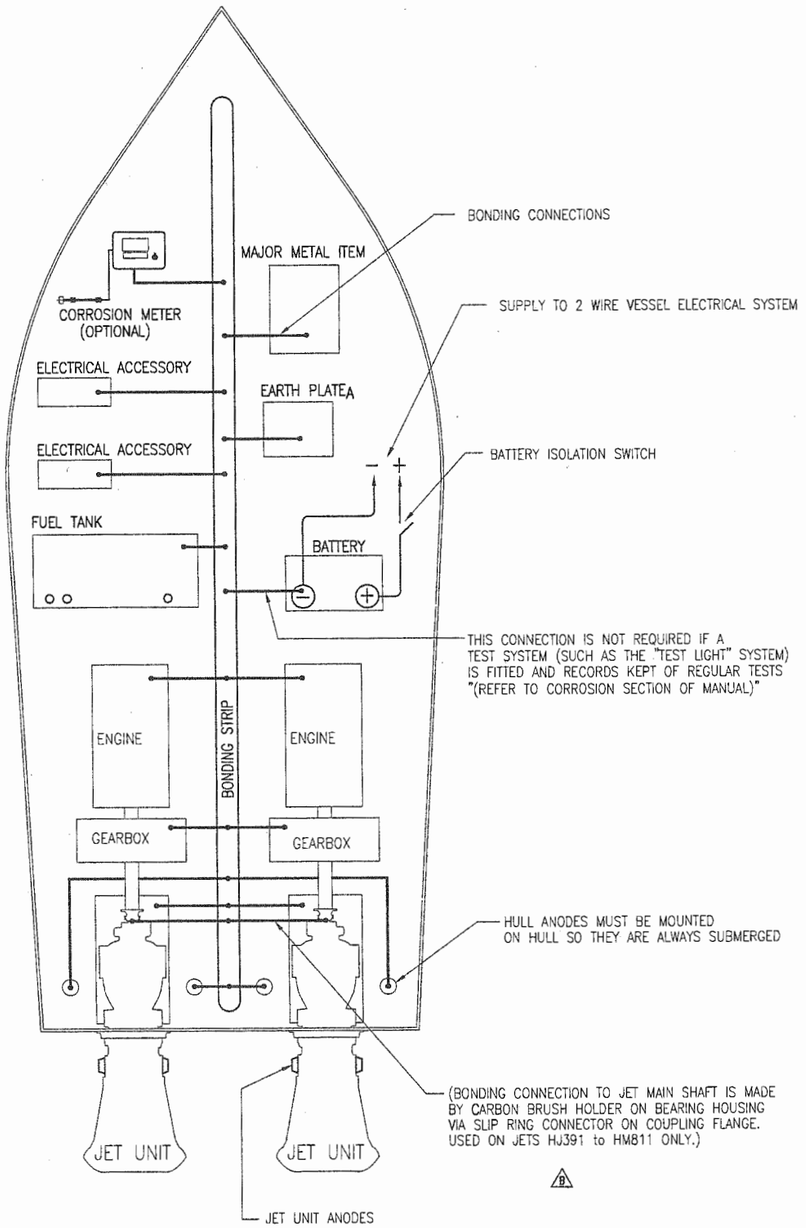
SCALE N/A

No: A3–85113 C

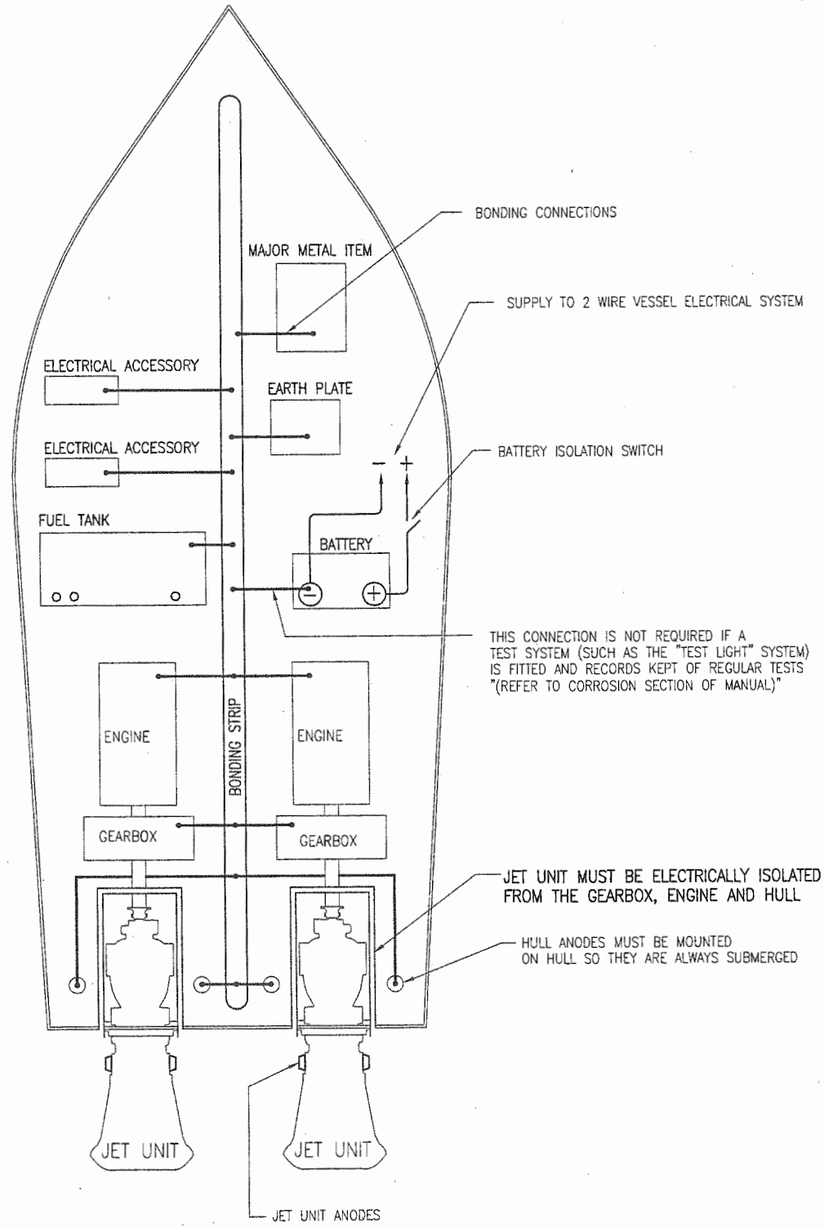
DO NOT SCALE THIS DRAWING.

PROJECTION

ALL DIMENSIONS IN mm. UNLESS OTHERWISE SHOWN.



EARTH BONDING SYSTEM FOR ALUMINIUM, G.R.P. AND WOODEN HULLS



EARTH BONDING SYSTEM FOR STEEL HULLS

NOTE: APPLYING TO BOTH DIAGRAMS ABOVE

ANODES PLACED ON THE CRAFT TRANSOM WILL BE "DRY" AND THUS NOT ACTIVE WHEN THE CRAFT IS AT PLANING SPEEDS THEREFORE ANODES SHOULD BE PLACED UNDER THE HULL WHERE THEY WILL BE "WET" AT ALL TIMES.
THESE ANODES SHOULD BE UNIFORMLY SPACED OVER THE WETTED HULL LINES. THEY SHOULD BE RECESSED INTO THE HULL OR STREAMLINED IN SHAPE TO MINIMISE RESISTANCE.
THEY SHOULD NOT BE LOCATED DIRECTLY AHEAD OF THE JET UNIT INTAKE AS THEY MAY DISTURB THE INLET FLOW.

REF	NO.	BY	DATE	AMENDMENTS
CL	B	R.J.L	23.11.99	SHAFT BONDING NOTE CLARIFIED.
CL0108	A	R.J.L	16.09.99	SPELLING CORRECTED.
CL0104	0	R.J.L	18.08.99	ISSUED FOR PRODUCTION.

JET ALL

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

MATERIAL N/A

√ = N9 EXCEPT AS STATED

UNLIMITED DIMENSIONS TO BE ±

MAT'L CERT	
DESIGNED	DATE
DRAWN R.J.L	18-08-99
CHECKED L.E.A	18-08-99
APPROVED K.V.E	

NAME
EARTH BONDING SYSTEM RECOMMENDATIONS AND LAYOUT

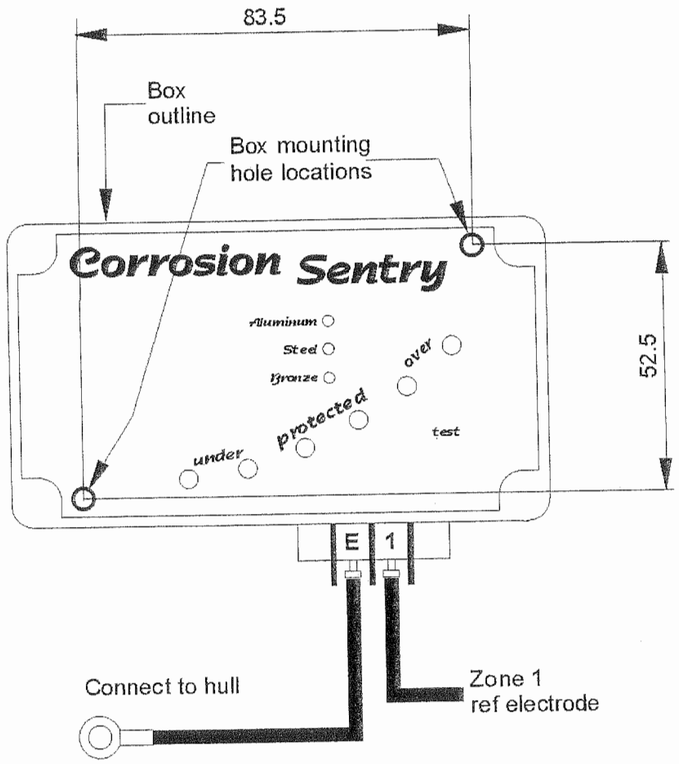
SCALE -

No: A2-85114

Sentry Corrosion Monitor Kit

Installation – Sentry Monitor

The **Sentry** monitor kit (part no. 65154) comprises a **Sentry** monitor, mounting screws, 3 AA batteries, and an earth lead.



1. The **Sentry** may be bulkhead mounted in any convenient location such as in the engine room or in the vessel's bridge/pilot house. The box dimensions are 115 mm x 65 mm x 40 mm deep.
2. Drill two 3.8mm diameter holes at 83.5 mm by 52.5 mm centers on the hull bulkhead or other suitable mounting location.
3. Remove the **Sentry** lid taking care to keep it supported to avoid damaging the connecting wires. Mount the **Sentry** box using the two 8g x 12 mm self-tapping screws provided.
4. Insert the 3 AA batteries supplied. Re-fasten the **Sentry** lid.
5. Connect Terminal E to the earth bonding strip, which must be connected to the waterjets, with the earth lead provided.
6. Connect Terminal 1 to the reference electrode (Refer to sheet 2 of 2 for details).

Sentry Operation

Press the test button - all the light emitting diodes (LED's) will illuminate momentarily to indicate the unit is working. The LED corresponding to the material being protected (in this case aluminum) will light and the corrosion protection level will be shown by the illumination of two adjacent LED's on the 6-LED scale. Note that to conserve battery life the **Sentry** operates normally in 'power down' mode.

The **Sentry** LED's indicate the level of cathodic protection, according to the following schedule;

Green + Green	Full protection
Green + Red	Slight under or over-protection – check anode condition
Red + Red	Under or over-protection – corrosion may be occurring and a check of the cathodic protection system and/or vessel electrical system should be made
Red (flashing)	Severe under or over-protection OR a unit fault OR reference electrode fault

Specifications

Dimensions	115 x 65 x 40mm	**Battery life**	2 years
Mounting	Bulkhead	**Ref. electrode**	Zinc
Power	3 alkaline AA cells	**Zones**	Single zone
Operating temp.	0 to 50^0 C	**Resolution**	+/- 5 mV
Range	-1200mV to +1200mV	**Protection**	IP 65

Sentry Web Site: ***www.seaguard.co.nz***

CL201	B	R.J.L	10.09.01	TEXT ALIGNED & PROTECTION IP WAS 67.	
CL198	A	R.J.L	17.08.01	DRAWING NOW ON 2 SHEETS FOR CLARITY.	
CL196	0	P.M.W	06.08.01	ISSUED FOR INFORMATION	
REF	NO.	BY	DATE	AMENDMENTS	
JET ALL					

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

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

MATERIAL AS SHOWN
MAT'L CERT
DESIGNED DATE
DRAWN P.M.W.
CHECKED R.J.L 15-08-01
APPROVED K.V.E 16-08-01

√ = N9 EXCEPT AS STATED
UNLIMITED DIMENSIONS TO BE ± 0.5

NAME
ANODE CONDITION MONITOR for ALL JETS
Sht.1 of 2

SCALE none
No: A3-85148 B

85148 Sht.1 B

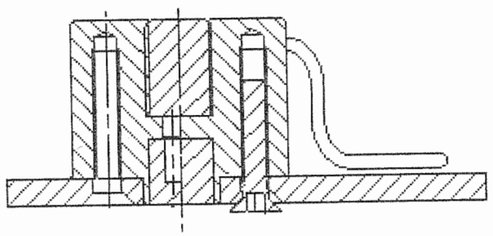
Installation - Reference Electrode

A cross section view of the Type-B reference electrode (part no. 65155) is shown below. This electrode is suitable for hulls from 5 to 15mm thick. The electrode must be in contact with the water when the vessel is moored and during operation (ie. at planning speeds) and should not be placed near a hull anode. The electrode may be placed on the hull bottom anywhere between the transom and mid-hull length. The central electrode sensor must not be painted over or the monitor will not work. The electrode may be mounted onto an aluminium, GRP or steel hull.

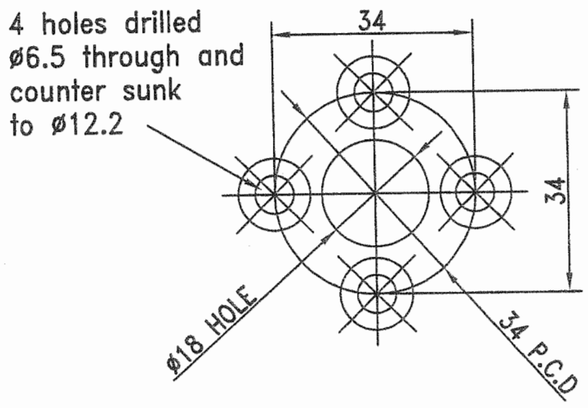
Important Notes!

The Type-B reference electrode mounting arrangement may not be suitable for classification society approval. Please consult the relevant classification society rules on this matter. In some cases, a draft tube that is higher than the maximum static waterline level may need to be fitted around the reference electrode.

For hull sections in excess of 15mm thick (eg. foam cored composite hulls and wooden hulls) the reference electrode may need to be mounted in a specially prepared hull section no more than 15mm thick.



Type-B Reference Electrode (Part No. 65155)
Reference Electrode.



Hole Pattern for Type-B

a) Mark the required position of the reference electrode and drill an 18mm dia. hole through the hull.
b) With the 18mm hole at the center, drill 4 x 6.5mm dia. holes equi-spaced on a 34mm PCD (pitch circle diameter).
c) Countersink the 6.5mm holes so that the M6 x 35 countersunk machine screws are flush with the hull bottom.
d) Liberally apply a marine grade sealant such as Bostik Seal-N-Flex (a one part polyurethane sealant) to the sealing surfaces and under the heads of the countersunk machine screws.
e) Fit the body of the reference electrode to the inside of the hull and fix in place with the M6 x 35 machine screws.
f) Wipe any excess sealant from the outer surface of the electrode – it should be clean and bright.

B
85148 Sht.2

REF	NO.	BY	DATE	AMENDMENTS
JET	ALL			FOR CHANGES REFER TO SHEET 1.

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

MATERIAL AS SHOWN	√ = N9 EXCEPT AS STATED
	UNLIMITED DIMENSIONS TO BE ± 0.5
MAT'L CERT	NAME ANODE CONDITION MONITOR for ALL JETS Sht.2 of 2.
DESIGNED / DATE	
DRAWN P.M.W.	
CHECKED R.J.L	
APPROVED K.V.E	SCALE none No: A3-85148 B