Product Manual Change Summary

Manual Type		HJ213
Part Number		89213
Revision	R2	30/11/03
Amendment	A52	04/08/2014

Refer to ECN 23235 for amendments.

B&W Manuals in Ring Binder Check List

One check list to be completed and returned with each order

- ❒ Print on Canon 100gsm A4 paper.
- ❒ Print A4 no scaling.
- ❒ Print double sided black and white.
- ❒ Punch 4 holes - ensure correctly spaced.
- ❒ 4 ring white binder.
- ❒ Hamilton indices as required.
- ❒ Hamilton Jet model front cover and spine insert (ensure correct jet model).
- ❒ Check jet model text on front cover is right aligned.
- ❒ Check for missing images - grey boxes (Contact Hamilton Jet).
- ❒ Check for colour consistency within a batch.
- ❒ Ensure manuals are packaged correctly to prevent damage or pages coming loose during transport.
- ❒ Check ring binders for quality i.e. rings close properly, no rips or defects in plastic etc.

HamiltonJet

www.hamiltonjet.co.nz

Installation and Service Manual

HJ213

Jet Unit Manual

R2A52

Manual Type		HJ213
Part Number		89213
Revision	R2	30/11/03
Amendment	A52	09/09/2014

Contents

General Safety Notice

Warnings & Cautions

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 indicated throughout the manual as below.

WARNING

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 .

This is indicated throughout the manual as below.

CAUTION

Limited Warranty

Limited Warranty

Terms of coverage

C.W.F. Hamilton & Co. Ltd. (Hamilton Jet) warrants to the original purchaser that each new Hamilton Jet product is free from defects in material and workmanship under normal use and service for the warranty period.

- In the event that a warranted defect in material or workmanship is disclosed to Hamilton Jet within the warranty period, Hamilton Jet's obligation is limited to, at its option, repairing or replacing the defective product, or component part at its factory or such other location as may be designated by Hamilton Jet.
- Defective products shall be returned to Hamilton Jet or its authorised service representative for inspection with transportation charges prepaid by the purchaser to the location specified by Hamilton Jet.
- This warranty only applies where the product is shown, to the satisfaction of Hamilton Jet, to be defective in material or workmanship during the warranty period.
- Hamilton Jet will supply parts required for warranty repairs free of charge and pay reasonable authorised labour costs.
- To the extent permitted by law, this warranty sets out the original purchaser's exclusive remedies with respect to the product covered by this warranty. In the event that Hamilton Jet determines it is unable to repair or replace any component part(s) found to be defective in materials and/or workmanship, Hamilton Jet's warranty liability shall be limited to payment by Hamilton Jet to the original purchaser of an amount not to exceed the value of the defective part(s), together with shipping charges, if any, incurred.
- All products removed or replaced under the warranty shall become the property of Hamilton Jet.
- All warranty claims shall be lodged with Hamilton Jet or its authorised distributor.

Warranty period

- The warranty period for Hamilton Jet products is limited to a period of twenty-four (24) months from the date of original shipment from the Hamilton Jet factory, or twelve (12) months from the vessel launch date, whichever occurs first.

Limitation of liability

- This warranty is extended only to the original purchaser, and is not transferable to or assignable to any other person or entity, and does not extend to future performance.
- In no event will Hamilton Jet, its distributors, or affiliates be liable for any incidental, punitive or consequential losses, inconveniences, damages or other costs resulting directly or indirectly from any defect in the product covered by this warranty, including, but not limited to, loss of use, revenue or profit.
- Hamilton Jet reserves the right to change its product through changes in design or materials without obligation to incorporate such changes in any products previously manufactured, but any improvement or changes may be incorporated in replacement product.

This warranty does not extend to failures, damages or defects resulting from the following:

- What Hamilton Jet determines to be, misuse, abuse, overloading, improper application, improper transportation or storage, abnormal wear and tear, negligence, carelessness, accident, natural calamity, vandalism, fouling caused by foreign material, peculiar water conditions or chemicals, or other circumstances over which Hamilton Jet has no control.
- Operation or maintenance in any way other than in accordance with the operating and maintenance instructions of Hamilton Jet.
- Vessel-to-shore electrical connections that change the corrosion potential of the vessel. For vessels equipped with shore power this warranty will not extend to the product unless an isolating transformer or galvanic isolator is fitted as described in the applicable HamiltonJet Product Manual.
- Incorrect installation, as per the applicable Hamilton Jet Product Manual and the applicable Hamilton Jet Designer's Manual. This warranty will not extend to the product unless a negative earth bonding system has been installed in the vessel as specified in the respective Hamilton Jet Product Manual, and a Jet Mainshaft critical speed check carried out to Hamilton Jet's written satisfaction.

This warranty does not cover or provide payment or reimbursement for the following:

- Any product which may have been serviced, repaired or altered in any way by anyone other than Hamilton Jet or a Hamilton Jet authorised facility.
- Any repairs or alterations carried out with the use of parts or accessories not manufactured by Hamilton Jet or its authorised representatives.
- Items incorporated in any Hamilton Jet product (other than by Hamilton Jet) when such items have been manufactured by others or are warranted by their respective manufacturers in favour of the purchaser.
- Used or reconditioned parts.
- The cost of transporting the vessel to a repair facility and for all related towing, harbour, docking, slippage, lifting, moorage, launching or retrieval charges.

No representations or express or implied warranty except as herein stated

- To the extent permitted by law, this limited warranty is the only warranty extended by Hamilton Jet and is in lieu of all other warranties, EXPRESSED or IMPLIED, oral or written and of all other obligations or liabilities, including without limitation any IMPLIED WARRANTIES of MERCHANTABILITY or FITNESS for a PARTICULAR PURPOSE. Except as provided in this warranty the product is sold as is, where is.
- No other person or agent or distributor is authorised to modify this warranty, give any other warranty on behalf of HamiltonJet or to assume for Hamilton Jet any other obligation or liability in connection with the sale of its products.
- In the United States and Canada, some states and provinces do not allow limitations on duration of an implied warranty, or the exclusion or limitation of incidental or consequential damages, so the above limitations or exclusions may not apply to you. This limited warranty gives you specific legal rights and you may also have other rights, which vary from state to state.
- In other countries outside the United States and Canada, you may have statutory rights which cannot be affected or limited by the terms of this Warranty.

C.W.F. Hamilton & Co. Ltd. July 2005 [Rev H]

Warranty & Ownership Registration Form

C.W.F. Hamilton & Co Ltd.

To allow Hamilton jet to complete its records and in order to assist any claim under the attached Limited Warranty, please complete this Warranty and Ownership Registration Form in full and return as soon as possible by post or facsimile to:

The Marketing Department, C.W.F. Hamilton & Co Ltd, PO Box 709, Christchurch, New Zealand.
Fax +64 3 348 6969

Hamilton jet encourages the Distributor to take responsibility for ensuring the Purchaser and the Distributor complete this form at the time of sale and return it to Hamilton jet. Please complete one form per vessel only.

Hamilton jet Model		**Serial Number(s)**	
Delivery Date		**Commissioning / In Service Date**	
vessel / Project			
Purchaser			
Address			
Contact Name		**Signed**	
Distributor			
Address			
Contact Name		**Signed**	
Office Use Only	Logged by: **Date:**	**Proj. Code:**	

Part A

Operator Information

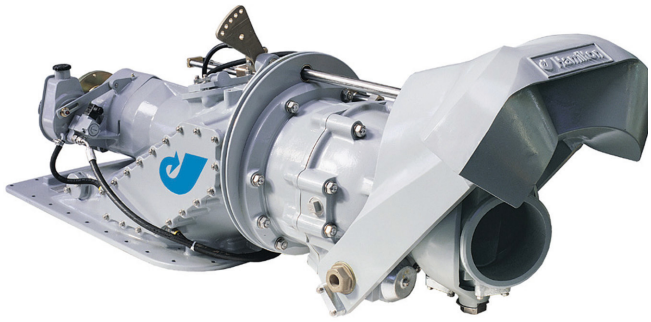
- Introduction and Product Description
- System Operation

Section 1 Introduction & Product Description

1.1 The Hamilton Water Jet System

1.1.1 Introduction

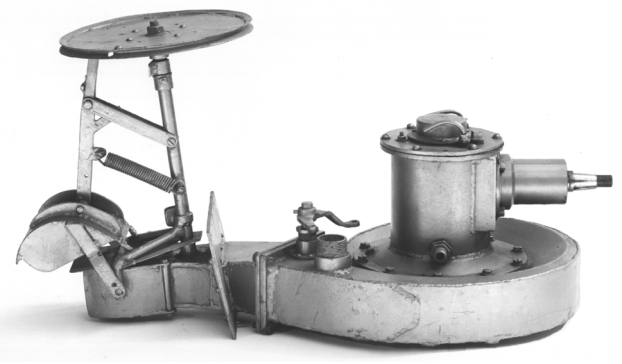
In the modern world, waterjets have rapidly gained acceptance as the leading means of propulsion for all types of high speed marine craft including ferries, work boats, patrol craft and pleasure boats. Recent advances in waterjet technology have put them ahead of conventional propeller systems in both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



Modern Hamilton Jet Circa 2000

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 3000kW 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.



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.

1.1.2 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 on by a thrust bearing inside a bearing housing attached to the 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 and drive shaft

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 direction 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 cylinder. 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-213 to HJ-403 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.

Dry run kit (optional extra on HJ-212 to HJ-362 jet units)

Hamilton jet units are not fitted with the dry run kit as standard - this is an optional extra.

The dry run kit is a simple solution to the problem of starting the engine before putting the vessel in the water, where there is no gearbox fitted. It is particularly useful for man-overboard boats and lifeboats where it is important to ensure that the engine will start before the vessel is in the water. The dry run kit consists of a special bearing which can be run dry for short periods and run for long periods with water lubrication.

Overflow preventor 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.

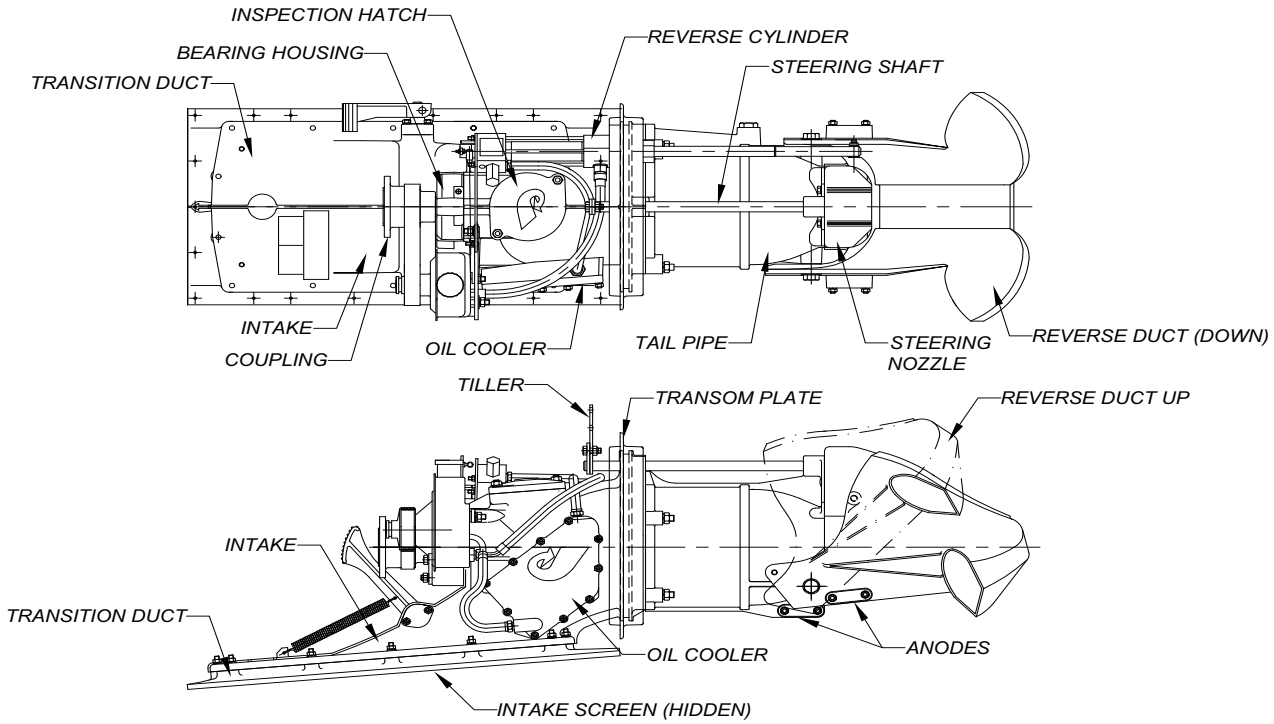


Figure 1: HJ-213 jet unit

1.2 The Hamilton HSRX Reverse System

The Hamilton HSRX reverse system is a self contained hydraulic reverse actuation system.

The actuation is provided by a compact hydraulic reverse cylinder that uses a rotary valve inside the cylinder to give proportional positioning control. This allows fast control response where accurate posistioning is not required (from the fully up position to just prior to the reverse duct entering the waterjet) and fine control of the reverse cylinder position where it is needed (around the zero speed / reverse position).

With the piston restriction (A) fully open, equal pressure acts on both the rod end and cap end of the HSRX cylinder. As the cap end area is larger than the rod end area, the cylinder extends.

With the piston restriction (A) closed, the cylinder retracts. At full retraction, the bypass valve (B) opens, reducing the system pressure and power consumption of the pump.

The back pressure valve (3) Is factory preset at 3.45 MPa (500psi).

The pump assembly (1) is belt driven directly from the jet unit.

The pump assembly comprises, pump, an integral tank, flow control and pressure relief valves.

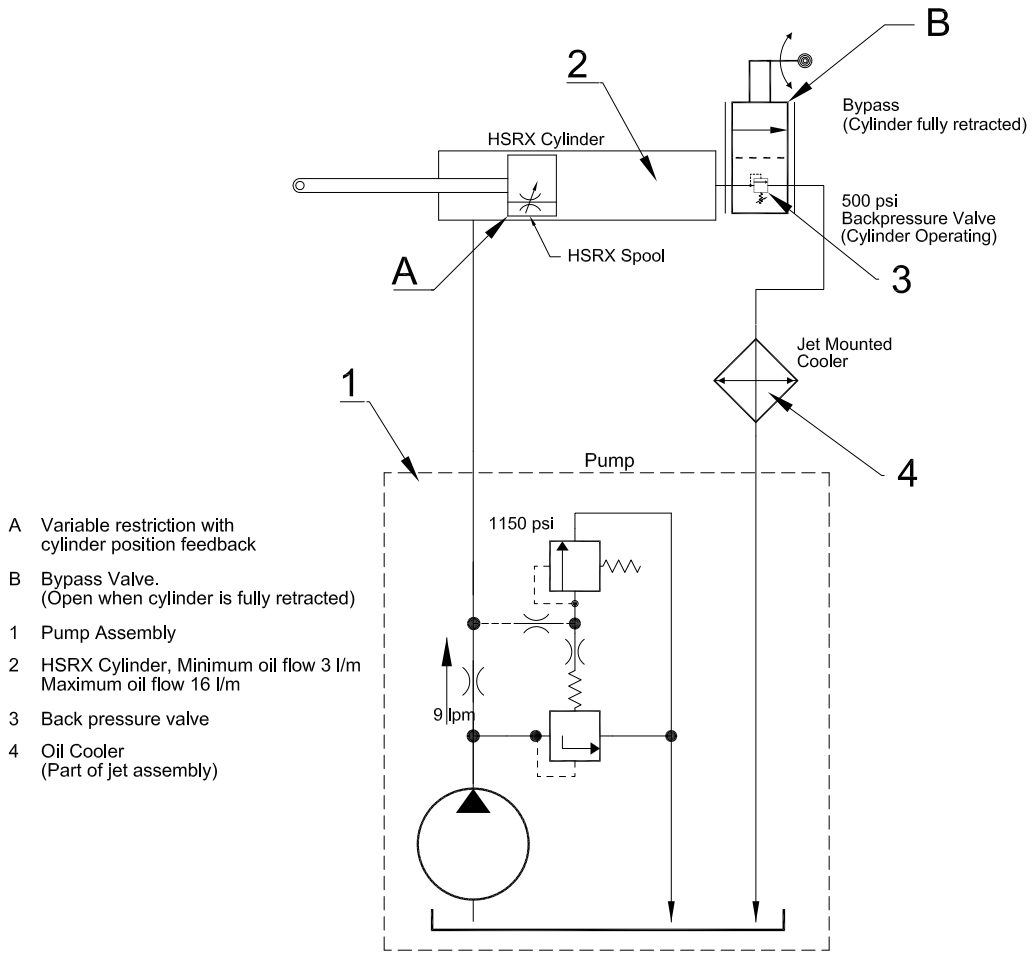


Figure 2: Basic Hydraulic Circuit Diagram

Section 2
System Operation

2.1 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.

Note: With HSRX reverse control, the reverse duct may slowly drop to a full reverse position when the engine is not running.

At start-up, the reverse duct may be in full reverse position, but will move to correspond with the control lever position as soon as the JHPU (Hydraulic pump unit) is running.

1. Before starting engine(s), the following checks should be carried out.
   a) The vessel is securely tied up or well clear of other objects.
   b) The helm is centred and the reverse controls are at zero speed.
   c) Clutches and gearboxes, if fitted, are in neutral position.
2. After starting the engine(s) move the helm and reverse lever, to control vessel movement.

2.2 "Ahead" / "Zero Speed" / Astern" Controls

WARNING

Selecting 'astern' (crash stop) while the vessel is moving ahead at high speed can produce very rapid deceleration. and should only be used in an emergency situation.
New operators should use the "crash stop" feature very carefully.
Do not use full helm control until the vessel has slowed.

"Astern" and "zero speed" are achieved by re-directing the jetstream. If the reverse duct is lowered fully, all of the jetstream is re-directed 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, the “astern” or “zero speed” positions are selected with the throttle left open and the boat moving forward at speed, the resultant “braking effect” can be very severe - even more so than full braking with a motor car.

To "brake" the vessel's forward motion :-

1. Close the throttle.
2. Select "astern".
3. Open the throttle, gently at first until the desired braking is achieved.
4. Close the throttle as soon as the vessel has slowed to a standstill.
5. Do not use full steering until the vessel has slowed.

2.3 Steering

The steering nozzle deflects the Jet of water to port or starboard causing the vessel to steer to port or starboard respectively.

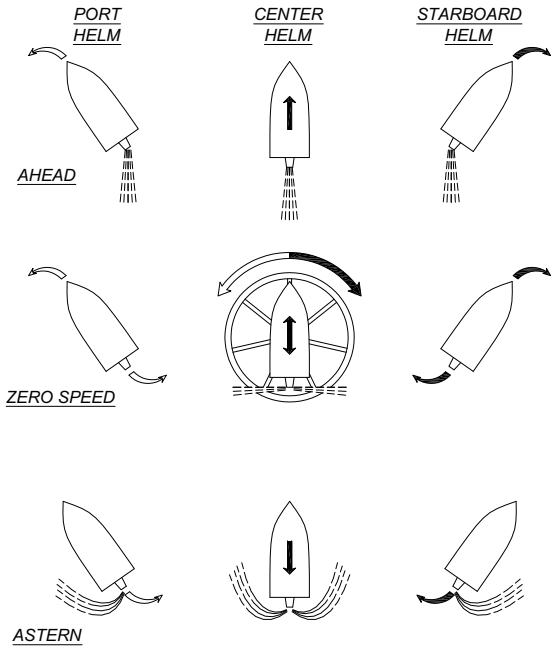


Figure 3: Steering Operation

The following points should be remembered when operating a jet vessel :-

1. If the engine is stopped there is no jet of water to deflect and so the vessel cannot be steered or stopped.
2. Never stop the engine or disengage the drive to the Jet when approaching a mooring or at any time when steering will be required.
3. The more the throttle is opened the greater the steering effect. i.e. the sharper the turn.
4. Steering is available at "zero speed" as well as all ahead and astern speeds - a feature which gives the Hamilton Jet unrivalled manoeuvrability.

When moving ahead, at **"zero speed"**, or astern, **the bow of the vessel will always turn the way the steering wheel is turned.** i.e. move the steering to port, the bow of the vessel will move to port and vice versa.

This means that going astern the vessel has the opposite steering to a motor car, a feature which can be used to advantage when manoeuvring.

The following steering systems are suitable for this application:

a) A manual hydraulic steering system which gives approximately 1.3 turns of the helm from full lock to full lock is recommended. (A greater number of turns will reduce the sensitivity of the steering during low speed manoeuvring).
b) A high quality rotary, or rack and pinion, cable system is an alternative but for single Jets only - the system must not allow more than 1.5 turns of the helm from full lock to full lock.

The steering system is balanced so that power assisted controls are not necessary even for multiple jet units.

2.3.1 Total Hydraulic Failure

Emergency steering control:

In the case of a complete manual hydraulic steering failure, the Jet(s) may be steered by manually moving the jet tiller(s). Open the by-pass valve (or disconnect the hydraulic hoses at the steering cylinder if there is no valve). (or disconnect the cable from the steering arm [17]). Refer to Drawing "HJ-213-06-000 Steering Assembly General Arrangement".

The nozzle position is indicated by the gauge at the helm. Steering may only be possible at low RPM unless an emergency tiller extension is used (not included in CWF Hamilton standard supply).

Emergency manual reverse duct control

This may be carried out in case of failure of the reverse hydraulic control system.

To raise the reverse duct:

1. Attach a rope to the reverse duct.
2. Take the weight of the reverse duct.
3. Disconnect the front hydraulic hoses from the reverse cylinder.
4. 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.

2.4 Manoeuvring and Docking

2.4.1 Low Speed Manoeuvring and Docking

The vessel is best manoeuvred as follows:-

1. Move the reverse control lever to the "zero speed" position.
2. 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).
3. 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.
4. 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.
5. Manoeuvre at a fixed throttle setting, 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, manoeuvering is best carried out using the helm with one hand and both Reverse Levers with the other hand.
2. USE ONLY LOW ENGINE RPM - High RPM will give faster response but will make control of the vessel 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 is 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 the heading.

2.4.2 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

1. Set both engine RPMs to just above idle with slightly higher RPM on the port side.
2. Set steering to ahead.
3. Move the port reverse lever to full astern and the starboard lever to full ahead. (A).
4. As the bow begins to swing to port, turn the helm to starboard to keep the vessel parallel to the jetty (B).
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.

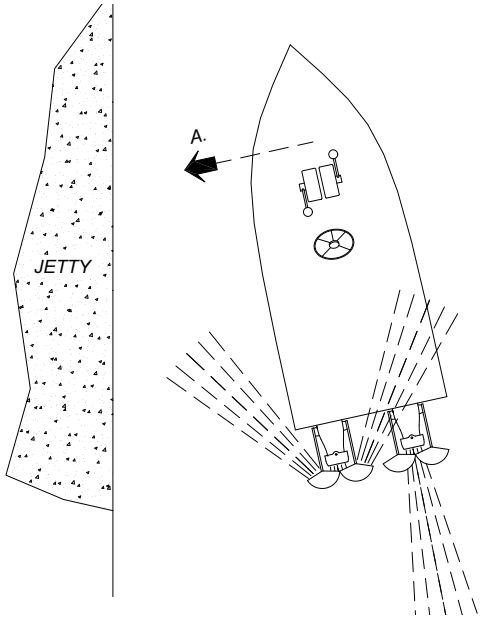


Figure 4: Moving to Port

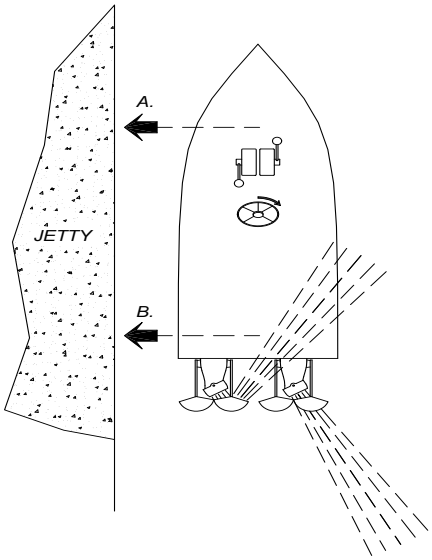


Figure 5: Docking

Docking.

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 position. 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 the 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 manoeuvering will depend on the prevailing sea conditions, higher RPM will improve response).
2. For sideways movement to port, set the port jet to full astern and the starboard jet to full ahead (this is reversed for sideways movement to starboard).
3. Use the centre jet reverse duct to control fore and aft movement (duct should be approximately 80% reversed).
4. Use the helm to control turning (rotation) moments, i.e. for sideways movement to port, turn the helm to starboard to balance the turning moment of the port and starboard Jets.

This method of sideways manoeuvering 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

1. Set the helm to dead ahead, throttle RPM to idle and reverse to zero speed before the vessel reaches the required position.
2. Alternatively set controls to start sideways movement in the opposite direction until vessel stops sideways movement then set the controls to:-
    - Steering dead ahead.
    - Throttle: idle.
    - Reverse: zero speed.

Emergency Manoeuvring:

1. With multiple jets. Shut down the engine driving the jet without reverse and manoeuvre using the other jet(s).
2. With a single jet. The vessel can be partially manoeuvred by raising the reverse duct with a rope and lowering it under its own weight. The engine must be kept at idle RPM.

2.5 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. Therefore, before accelerating to full speed, all jet units should be cleared by BACKFLUSHING. ***Refer to*** 2.9"Blockages (Debris in the jet unit)**.** Backflushing should be done on every trip as soon as clear water is reached.
2. Acceleration should be carried out gradually. Full power cannot be used at low vessel speeds such as when operating on one engine only.
3. If there is any blockage of the jet unit, the engine will run at a higher than normal RPM and the vessel will accelerate slowly, and best speed will be reduced. If such symptoms are noticed, immediately slow the vessel and clear the blockage. ***Refer to*** 2.9"Blockages (Debris in the jet unit).
4. In conditions of severe weather or overload, the engine speed should be reduced accordingly.

2.6 Shallow Water Operation

CAUTION

Do not run the jet unit if the vessel has run aground as damage may occur to the impellers and stator.

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.

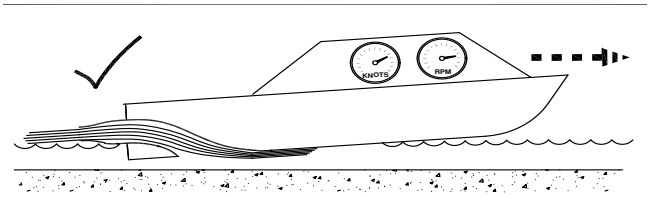


Figure 6: High Speed Planing in Shallow Water

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

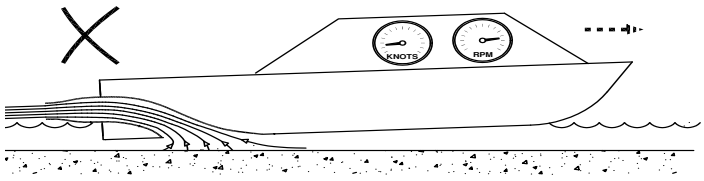


Figure 7: Shallow Water Operation Slow Speed

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.

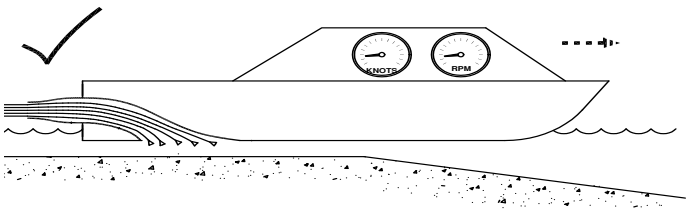


Figure 8: Shallow Water Operation Idle

2.7 Acceleration to High Speed

If leaving an area of shallows, or with debris in the water, ensure the Jet(s) are clear of debris before accelerating to high speed. ***Refer to Section*** 2.9.3"Clearing Blockages. If there is any debris in the jet the engine will run at higher than normal RPM and the vessel will only accelerate slowly, and may not reach full (planing) speed. ***Refer to Section*** 2.9.3"Clearing 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 8.4"Servicing Intervals**.**

CAUTION

Ensure that the water level is below the inspection cover level before removing the inspection cover.

2.8 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 jet 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.

2.9 Blockages (Debris in the jet unit)

2.9.1 Avoiding Blockages

Pieces of debris, water weed or sticks, etc. will not normally block or harm the jet unit. However, it is good practice to steer around such debris where possible as any debris caught in the intake Screen, Impeller or Tailpipe Stator Vanes can affect the jet unit's performance.

2.9.2 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 intake screen in open or clear waters.

Blockages of the jet unit are usually noticed by the following symptoms:

1. Engine unloading (RPM increases).
2. Lack of Jet thrust (vessel speed drops).
3. Abnormal noise and vibration from the jet unit.

2.9.3 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 levels.

The following methods can be used.

1. Slow or stop the engine driving the blocked jet unit. The blockage will often clear itself. This operation works best if the vessel is still moving forward at speed.
2. BACKFLUSH the blocked jet unit (only possible if a reversible gearbox is used) as shown below:
   a) Stop or slow the Vessel to displacement speed.
   b) Move the reverse duct to the zero speed position.
   c) Reverse the rotation direction of the blocked jet unit by engaging reverse gear and opening the throttle slightly. This should clear the blockage. If this fails to work, repeat actions a) to c) several times.
3. Remove the inspection cover on the intake and manually clear the obstruction. ***Refer to Section*** 2.9.4"Using the inspection cover.

Note:

1. Check that the static water level will be safely below the intake inspection cover.
2. If the static water level is too high, ballast should be placed on the bow of the vessel 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 cover to allow inspection of the intake housing at higher water levels. Refer to Drawing "HJ-213-10-004 hatch extension"

2.9.4 Using the inspection cover

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.

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 hatch extension/overflow preventor can be fitted to the inspection hatch opening to allow inspection of the intake at higher water levels.

2.10 Inspection Hatch Extension. (Optional Extra)

Refer to Drawing "HJ-213-10-004 hatch extension"

The inspection hatch extension is an optional extra for use with jet units where the water level is above the normal level of the inspection cover.

1. It is attached to the top of the intake casing in place of the inspection cover. The inspection cover is then fitted to the upper end of the Inspection hatch extension. ***Refer to Section*** 9.10"Hatch Extension ***for fitting and removal instructions.***
2. It provides an increase of approximately 150 mm in allowable water level height.

2.11 Operating with an Engine and jet unit Out of Service

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

Use of shaft brake (if fitted) to stop mainshaft rotation

The shaft brake should be fitted to the output shaft of the gearbox. Apply the shaft brake to stop the jet unit Mainshaft rotation in jet units not in service.

Use of engine to stop mainshaft rotation.

If a shaft brake is not fitted, the jet unit mainshaft can be prevented from rotating by engaging the gearbox of the engine which is out of service.

Note: When using this method, it is possible for the jet unit to rotate the engine. If this occurs, disengage the gearbox and let the jet unit mainshaft rotate.

2.12 HSRX Reverse System

WARNING

The Jet Unit Mainshaft must always be rotating whenever Steering Thrust is required.

Note: The following points should be noted when using the HSRX reverse system.

1. The HSRX reverse system does not have a mechanical connection between the reverse duct position and the control lever position. The control lever can be positioned before the reverse duct has reached the desired position (unlike previous HSRC systems, where the control lever followed the reverse duct position).
2. The HSRX reverse system has a bypass feature. When the control lever is touching the stop pin, the reverse duct will be in the fully raised position and a bypass valve opens. Oil is then passed directly to the tank rather than through the back pressure valve. The pump will now operate at considerably reduced pressure, which will minimise power consumption and maximise component life.
3. The by-pass port is only open when the reverse duct is in the fully raised position. At any position other than fully raised, the reverse system will operate at 500 psi back pressure. The maximum shaft speed for continuous operation of the reverse system, at any position other than fully raised, is 1000 RPM.
4. There is no flow control in the HSRX reverse system. The effect of this is, the higher the engine RPM, the faster the reverse duct will move. In the "crash stop" situation, (Full reverse at full speed) the reverse can be actuated almost instantly, causing a very sudden and severe deceleration.
5. If a "neutral detent and engine start interlock" microswitch is fitted, refer to drawing “CT-CLV-01-003 Reverse Controller”.

CAUTION

If in lightweight planing craft, the “astern” or “zero speed” positions are selected with the throttle left open and the boat moving forward at speed, the resultant “braking effect” can be very severe - even more so than full braking with a motor car.

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.

CAUTION

If a problem is detected, return to the mooring immediately, at reduced power. DO NOT operate the jet unit until the fault has been repaired. refer to section 7 Fault Finding.

Part B

Design and Installation

- Design Basics
- Precautions Against Corrosion
- Installation
- Commissioning

Section 3
Design Basics

3.1 Propulsion System Design

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

3.2 Hull Design

CAUTION

Not all hull shapes are suitable for propulsion by water jets. guidelines on suitable hull shapes, performance and engine matching is provided in the designers manual.

3.2.1 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 in Figure 1:"Hull Loads for HJ-213 jet units.

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.
All loads are transferred to the hull via the intake block. No significant loads are taken by the transom.
The table shows the maximum loads and moments applied at the centre of the jet base. (intake block).

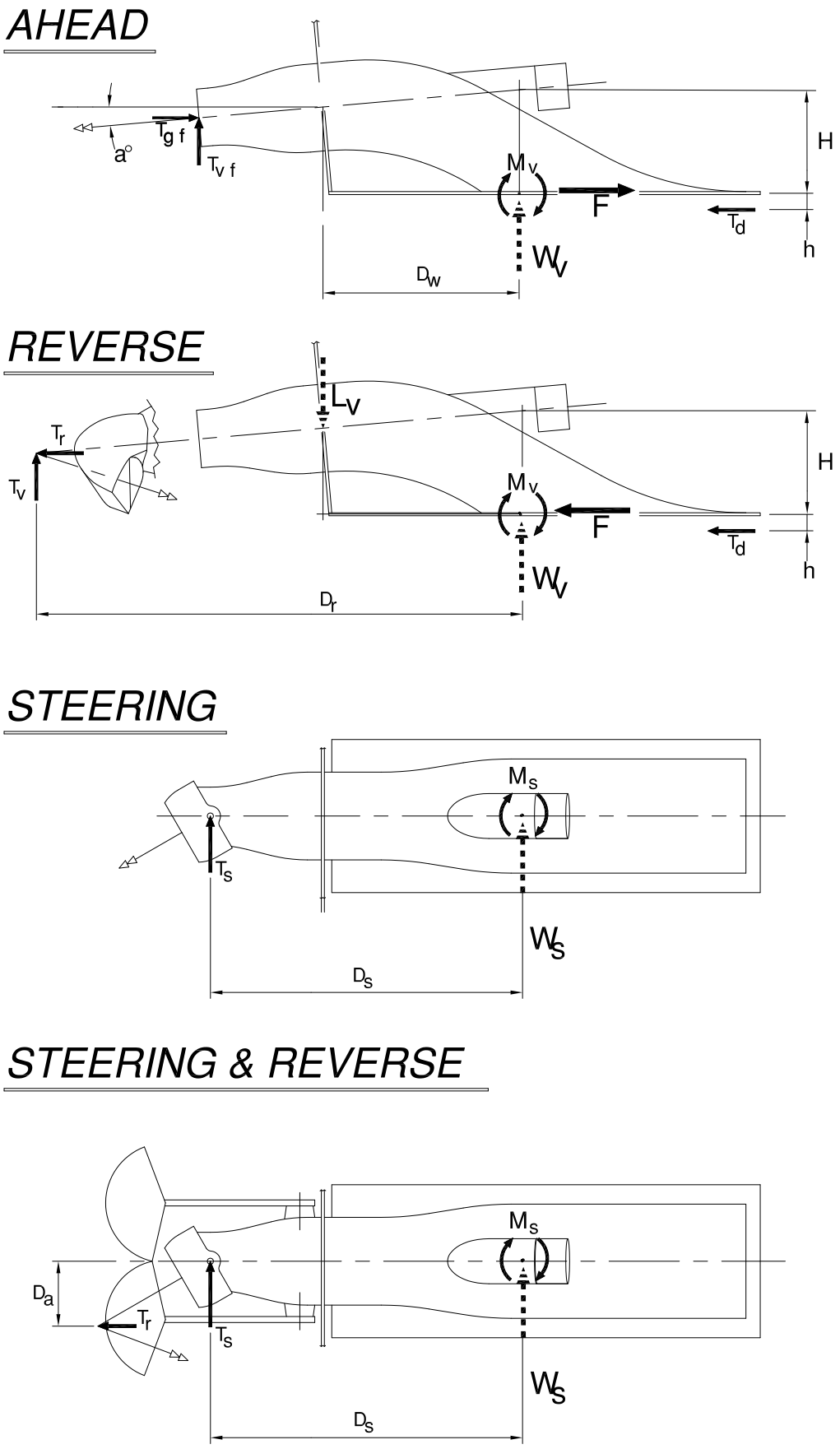


Figure 1: Hull Loads for HJ-213 jet units

Table 1: Table of Dimensions for HJ-213 jet unit

HJ-213 Jet - Relevant data			
Description	**Symbol**	**Units**	**Value**
Maximum power	P	Kw	260
Centre line height	H	m	0.248
Mean inlet depth	h	m	0.03
Steering to base centre	D_s	m	0.841
Reverse to base centre	D_r	m	1.115
Transom to base centre	D_w	m	0.381
Centre to reverse arm	D_a	m	0.125
Waterjet angle	a	degrees	5°

Table 2: Table of Hull Reaction Forces for HJ-213 jet unit

Hull reaction forces- HJ-213 Jet				
Description	**Symbol**	**Units**	**Ahead / steering**	**Reverse**
Axial load in hull bottom	F	kN	8.2	-8.8
Vertical load in base	Wv	kN	1.30	2.86
Side load in base	Ws	kN	6.70	4.03
Vertical moment	M	kN_m	3.97	2.69
Steering moment	Ms	kN_m	5.63	4.96

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.

3.2.2 Mono Hulled Vessel

1. Aerated water generated by the vessel's bow wave must not pass directly aft to the jet unit intake(s).
   a) A vee'd bow stem in conjunction with 10° minimum deadrise angle is recommended.
   b) Mount multiple jet units as close to the keel line as possible ("Staggered" engines can allow closer centres).
   c) Planning strakes, keelsons, "plank keels" and any other appendages 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. ***Refer to*** Figure 2:"Mono Hull Design Recommendations.

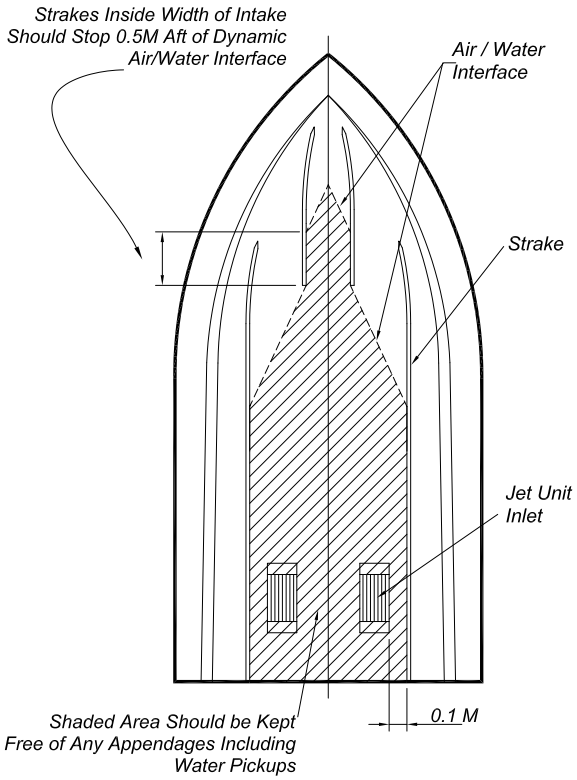


Figure 2: Mono Hull Design Recommendations

2. For speeds over 30 knots, monohedron (constant deadrise) hulls without appendages are recommended for directional stability.
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 water flow 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 (pump water) when the engine is started.
5. Minimum distances between jets for multiple installations. ***Refer to*** Figure 3:"Installation for Multiple Jets.
   a) For dimensions A and B shown in Figure 3:"Installation for Multiple Jets for Twin and Triple Jet Installation refer to the Installation Drawings HJ-213-08-...
   b) For applications using more than three jets consult C.W.F. Hamilton & Co. Ltd for distances between jets.

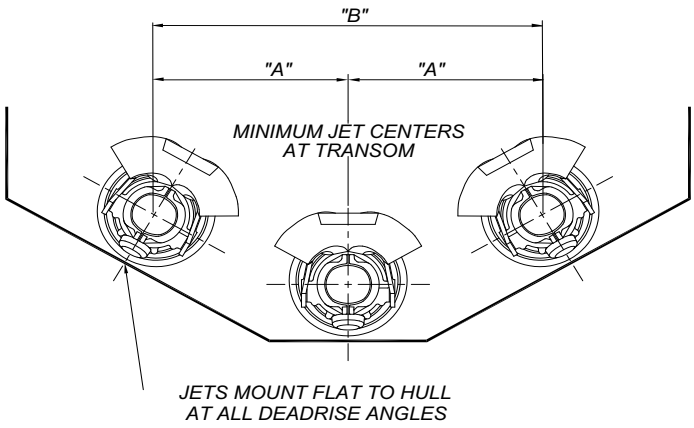


Figure 3: Installation for Multiple Jets

3.2.3 Multi Hulled Vessel

Jet units can 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 & Co. Ltd** in all cases if jet units are proposed in these types of hull.

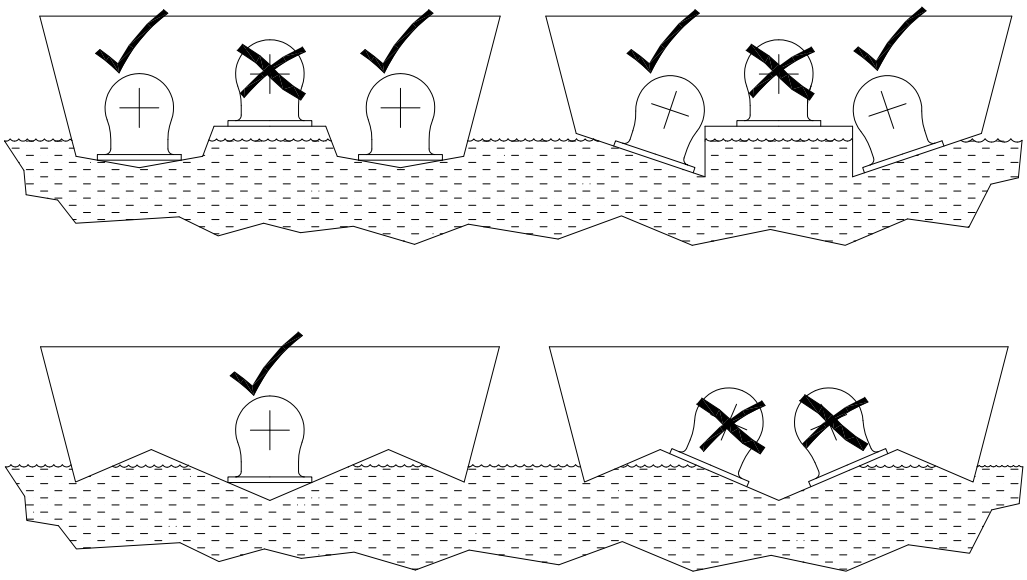


Figure 4: Hull Design Recommendations for Multi Hull Vessels

3.2.4 Trim Tabs

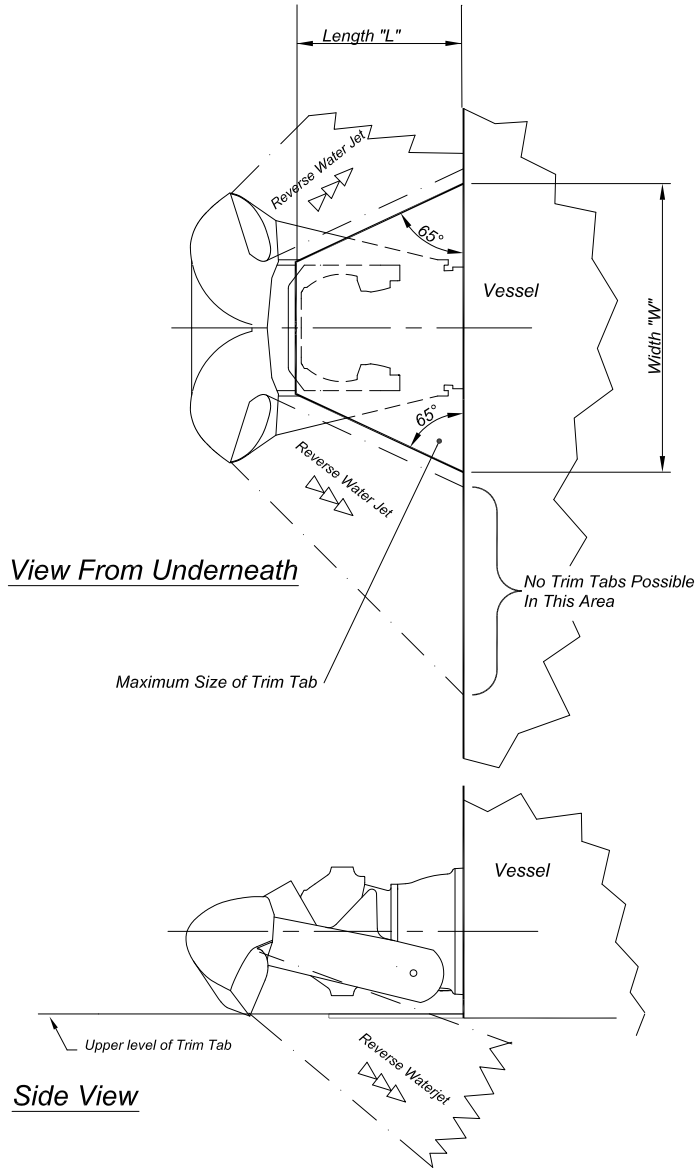
Note: Refer to "Precautions against Corrosion" Section 4.1.4 if fitting satinless steel trim tabs

Trim tabs cannot be mounted directly alongside the jet unit, as when moving astern, the reverse jetstream 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 following diagram serves as a guide to the maximum size of trim tab that may be located under the jet unit. Contact **C.W.F. Hamilton & Co. Ltd** if further details are required.

The diagram shows the area within which the trim tab must lie. From the maximum width "w" at the transom, the area tapers inwards 25° per side until it reaches the same width as the reverse duct bottom corners.



JET	WIDTH "W"	LENGTH "L"
HM-811	2400	1500
HM-721	2130	1330
HM-651	1900	1180
HM-571	1880	1360
HM-521	1730	1250
HM-461	1540	1110
HM-422	1250	800
HJ-403	1250	800
HS-363	1270	950
HJ-364	1100	700
HJ-362	930	580
HJ-322	1030	740
HJ-292	950	640
HJ-274	950	640
HJ-241	850	650
HJ-213	850	550
HJ-212	850	550

Figure 5: Allowable Trim Tabs Location

3.3 Drivelines

CAUTION

Loads on jet unit Thrust Bearing

The jet unit thrust bearing accepts thrust loads from the jet unit to propel the craft. It should not be subjected to excessive loads from other sources as described below:

- The jet thrust bearing will not stand excessive radial loads caused by adapters and belt pulleys overhanging the jet coupling flange.
- The jet thrust bearing will not withstand excessive loads produced by rigid drivelines which do not accommodate misalignment resulting from engine movement.
- There is a limit to the driveshaft weight that can be supported at the jet unit.

3.3.1 Requirements of the Driveline

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

3.3.2 Engineering Checks

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

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 the 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).

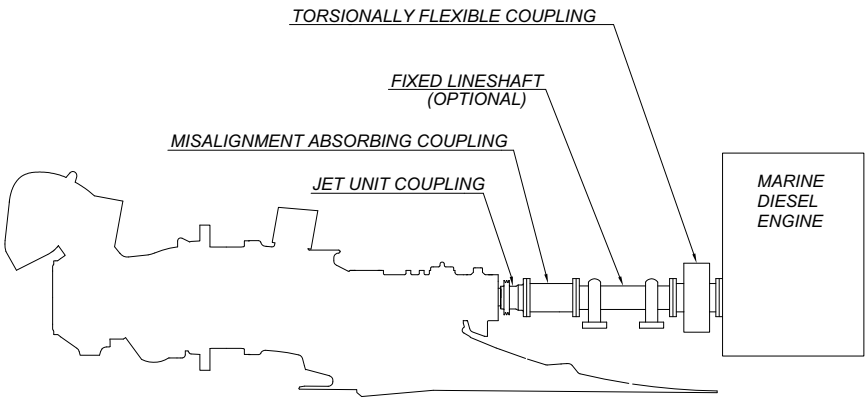


Figure 6: Drive Line Component Description

3.3.3 Drive Shaft Options

The diagrams Figure 7:"Double Universal Slip jointed Driveshaft ***and*** Figure 8:"Torsionally Flexible Flywheel Coupling show two common driveline components and their arrangements. These diagrams are a guide only. Always contact **C.W.F. Hamilton & Co. Ltd.** before designing the driveline.

Universal driveshafts:

These are double universal slip-jointed driveshafts, also called cardan shafts. They bolt directly to the jet unit coupling.

Lengths range from approximately 300mm to 3,000mm. Lengths are limited by the weight which can be allowed at the jet unit coupling. ***Refer to Section*** 3.3.8"Critical Speed of Mainshaft ***and Section*** 3.3.2"Engineering Checks.

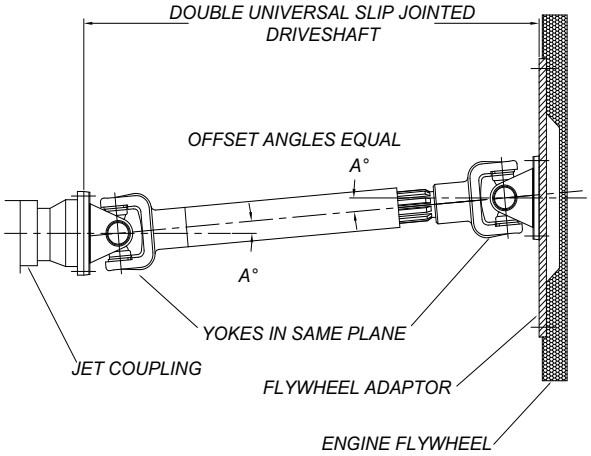


Figure 7: Double Universal Slip jointed Driveshaft

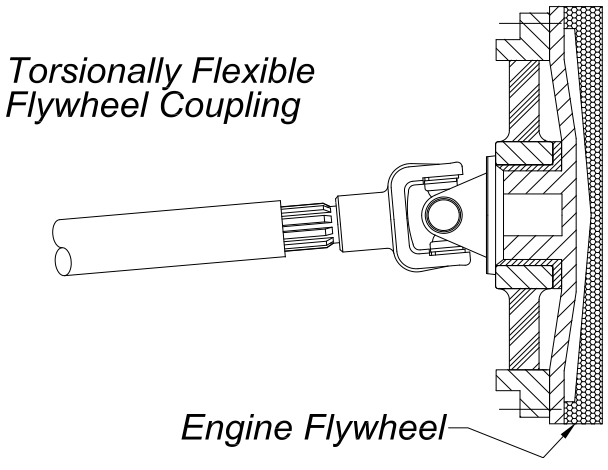


Figure 8: Torsionally Flexible Flywheel Coupling

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.

Double element torsionally flexible couplings:

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

Use a double element torsionally flexible driveshaft with support bearings such as the "Centaflex GZ" type illustrated. The engine/gearbox is located In-line with the jet unit and can be flexibly mounted with this type of coupling.

Length - From approximately 200mm (8") upwards, but limited by the weight which can be allowed at the jet unit coupling. ***Refer to Section*** 3.3.8"Critical Speed of Mainshaft.

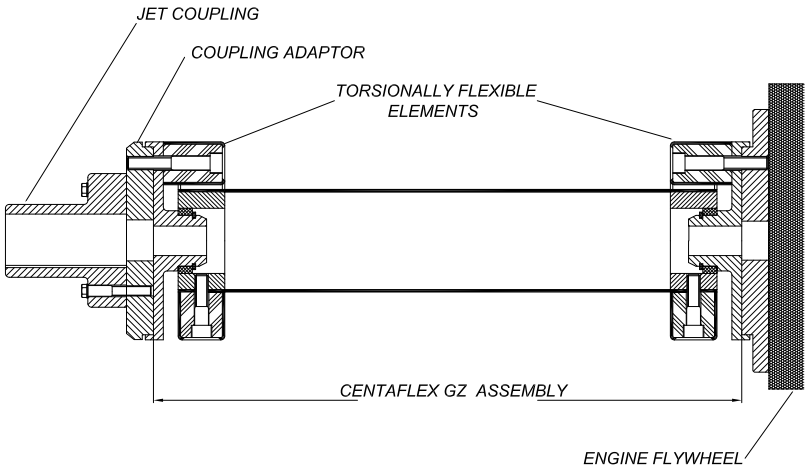


Figure 9: Double Element Torsionally Flexible Coupling

Double element non torsionally flexible couplings:

An example of such a coupling is "Centalink".

Gear couplings:

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

The coupling is formed by two hubs which engage into a flanged sleeve with internal straight parallel teeth. Due to the design of the of the teeth curvature, if shaft misalignment occurs, the hub can oscillate in the flanged sleeve.

The curved face teeth couplings are flexible enough to compensate for misalignments and axial movements of coupled shafts. The same type of coupling also allows for greater shaft offset.

Note: A double jointed coupling is required.

Long driveshafts:
Where the distance between the gearbox flange and the coupling flange exceeds that possible with a MAC, then a fixed lineshaft supported on pedestal bearings should be used in conjunction with either universal driveshafts or torsionally flexible couplings. ***Refer to*** Figure 10:"Long Driveshafts.

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.

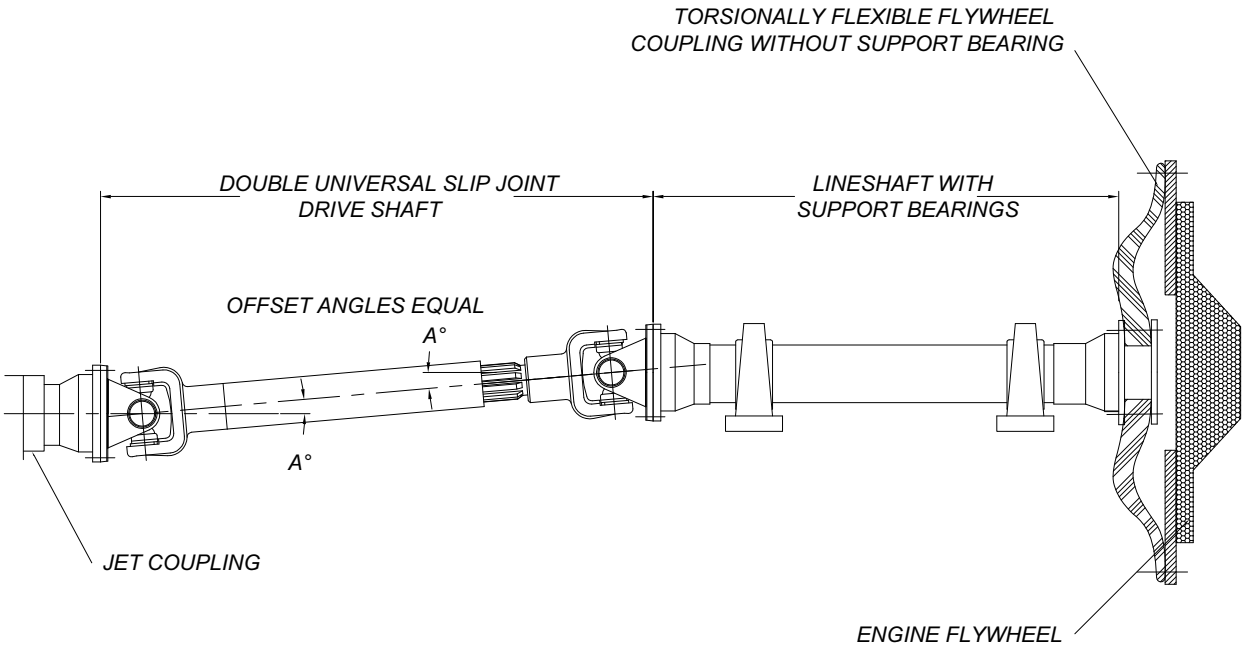


Figure 10: Long Driveshafts

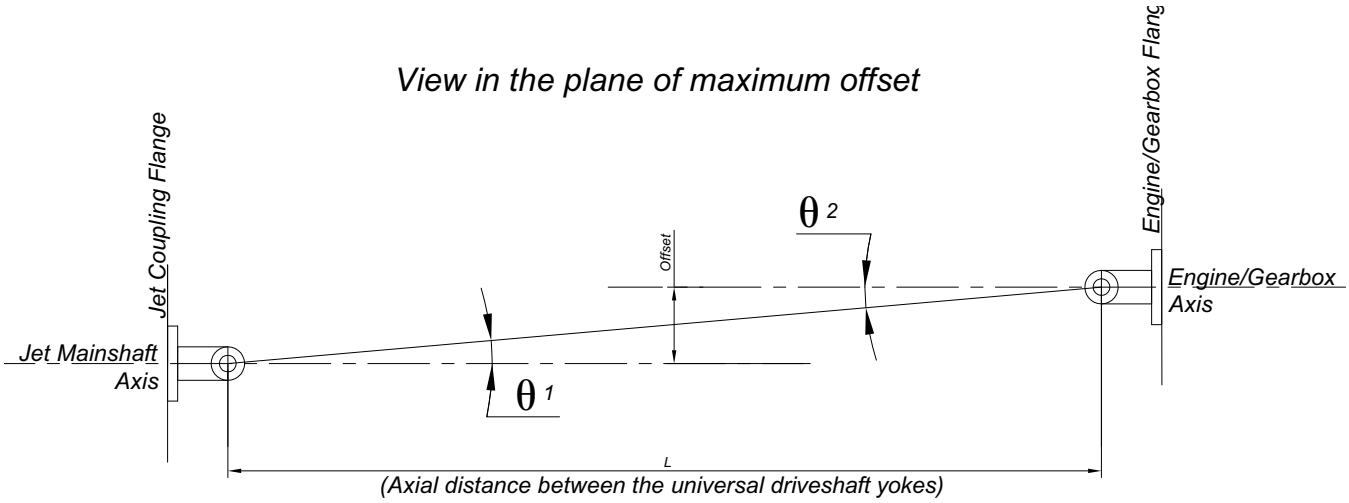
3.3.4 Universal Driveshaft Alignment

1. There are only two allowable configurations for location of centrelines for the jet unit and gearbox. These are shown in Figure 11:"Z Configuration Coupling and Figure 12:"W Configuration Coupling.
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.
5. The engine must be positioned so that the universal joints of the driveshaft have equal offset angles. This is most important. Refer to the driveshaft manufacturers recommendations for joint angles (typical range is between 1.5 and 5 degrees)

Note:

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

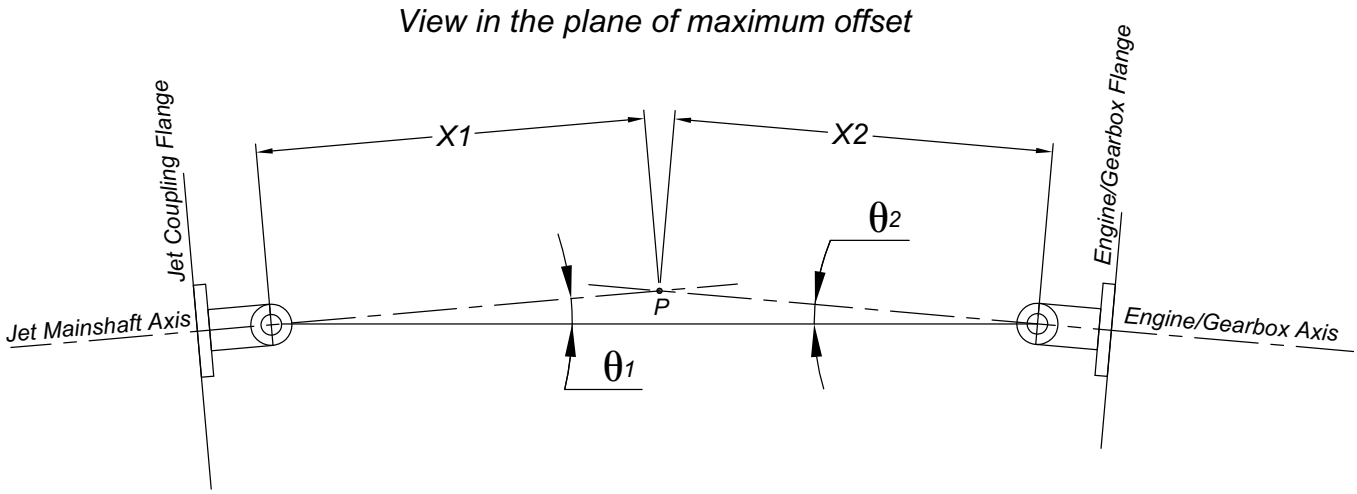
2.When the TFC couples directly to a lineshaft supported on bearings, a support bearing is not required.



Note: θ_1 and θ_2 – must be equal

Offset = L x tan θ

Figure 11: Z Configuration Coupling



Note: θ_1 and θ_2 must be equal.

If X1 = X2 and both input and ouput axes meet at point P then $\theta_1 = \theta_2$

The best method of alignment is to mount pointers on both the jet coupling (or output) flange and engine (or input) flange. The length of each pointer should be exactly the same and equal to half the nominal distance between the 2 flanges. Rotate the shafts to check that the pointers are straight

Figure 12: W Configuration Coupling

3.3.5 Jet Coupling Flange Details

Refer to Drawing "HJ-213-02-001 Couplings and Belts", for all relevant coupling details.

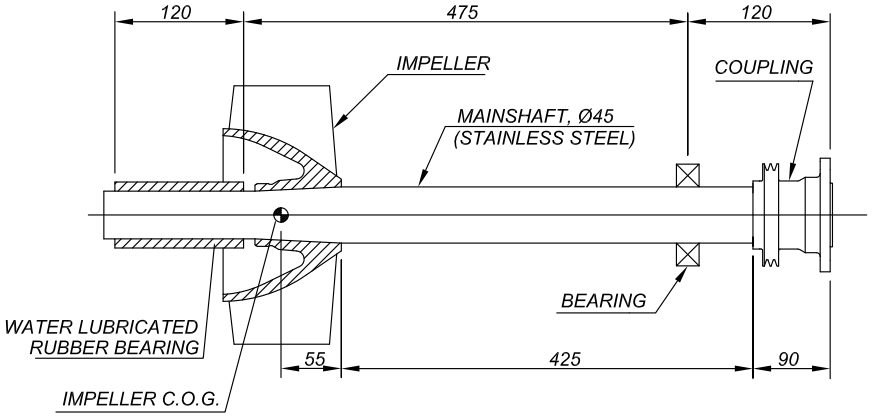
3.3.6 Drivelines for Diesel Engines

A diesel engine installation will require the engine to be separately mounted from the jet with a torsionally flexible coupling normally mounted at the engine flywheel. The coupling needs to be sufficiently flexible to ensure that the slow speed torsional vibration resonance point occurs below engine idle RPM. This can only be determined by carrying out a torsional vibration analysis on the complete drive train - engine, gearbox and jet unit.

3.3.7 Moments of Inertia

A torsional vibration analysis must be carried out for the complete drive-train including engine flexible coupling, gearbox, driveshaft and jet rotational assembly, especially where a universal driveshaft is used without a torsionally resilient member or gearbox in the driveline. It is the responsibility of the vessel builder to see that this is carried out by either the engine manufacturer or the flexible coupling manufacturer.

The moment of inertia data for the jet unit is provided below, to enable a torsional vibration analysis to be carried out.



ITEM		TYPE	MASS (kg)	Ip ($kg.m^2$)
MAINSHAFT		Ø45	6.85	0.0015
COUPLING		Ø116	2.4	0.0028
IMPELLERS	4 Blade	1.8 to 2.4	5.6	0.021
	5 Blade	2.5 to 3.2	5.4	0.020
	6 Blade	3.4 to 4.2	5.6	0.0231

Figure 13: Drive line Inertia Data Jet Mainshaft Dimensions

3.3.8 Critical Speed of Mainshaft

Note:

1. In all cases, for the calculation of the "critical speed of the jet mainshaft" consult C.W.F. Hamilton & Co. Ltd.
2. The heavier splined end of the universal driveshaft should be located towards the engine.

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

3.4 Jet Mainshaft Alignment

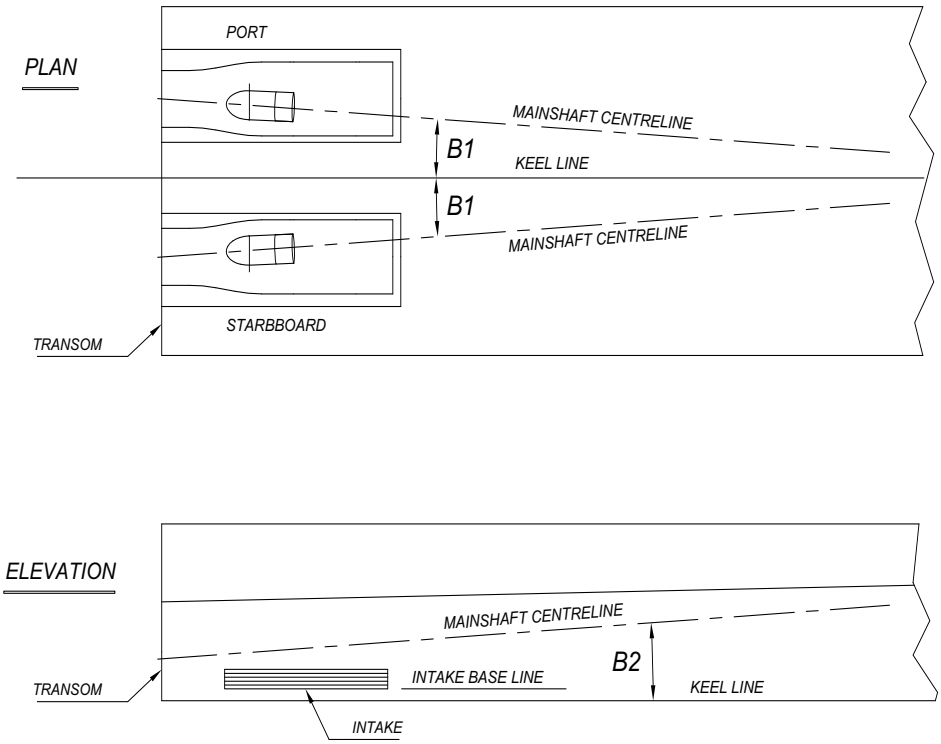
The HJ-213 waterjet mainshaft is inclined at an angle of 5° to the intake base.

When the port and starboard Jets are mounted at the hull deadrise angle, the jet mainshafts are no longer parallel to the keel line in plan. Figure 14:"Jet Mainshaft Alignment lists the angle deviation of the jet mainshaft when the jet base is mounted parallel to the keel line.

For intake base parallel to keel line:

B1 = Shaft angle in plan view.

B2 = Shaft slope in elevation.



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

Figure 14: Jet Mainshaft Alignment

3.5 Water Off-Take

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

CAUTION

The jet unit is fitted with a water offtake which may be used as a supplementary water supply (e.g. for a deck wash). **If it is used as a part of the engine cooling circuit, the designer / builder must satisfy themselves that the available flow is sufficient for the cooling requirements.**

The water offtake point is located on the starboard side of the intake. This is fitted with a bung which can be converted to a 24.5mm dia x 30mm long hose tail by cutting off the end as shown on the basic jet assembly drawing HJ21301000.

This provides water at approximately 7kPa. (1 psi) at 600 rpm and 550kPa. (80 psi) at approximately 4000 rpm. The water may be fed directly to the engine without the need for a raw water pump provided:-

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

To be sure of correct flow for engine cooling, a conventional water pick-up and the engine raw water pump should be used. The jet water offtake can be used for a deck cleaning hose but the pressure is not high enough to be used for a fire hose.

Conventional water pick-up:

Ensure that the engine cooling water pick up is not directly ahead of the jet unit intake, but well to the side to avoid turbulent water flow into the jet.

CAUTION

Alternatively a cooling system separate from the jet unit can be fitted to the engine maker's specifications. The water pick up points must NOT be directly ahead of the jet unit intakes and should be well to the side of the area forward and the same width as the intake opening.

Sandtrap - (optional raw water sand filter).

Refer to Drawing "HJ-213-12-000 Sandtrap".

High pressure water from the Jet is piped into the sand trap before feeding into the engine cooling system.

Sea water (raw water) fed into a centrifuge, drops out foreign matter (sand, shells, stones, etc) into a clear perspex bowl, which can be easily, visually inspected. Opening the dump valve, while water is being fed in, drops out the collected material into the dump line which carries any collected material overboard via a skin fitting, through the hull side or transom.

3.6 HSRX Reverse System Description

The Hamilton HSRX reverse system is a self contained hydraulic reverse actuation system.

The actuation is provided by a hydraulic reverse cylinder that uses a rotary valve inside the cylinder to give variable progresssive positioning control. This allows fast control response where accurate posistioning is not required (from the fully up position to just prior to the reverse duct entering the waterjet) and fine control of the reverse cylinder position where it is needed (around the zero speed / reverse position).

With the piston restriction (A) fully open, equal pressure acts on both the rod end and cap end of the HSRX cylinder. As the cap end area is larger than the rod end area, the cylinder extends.

With the piston restriction (A) closed, the cylinder retracts. At full retraction, the bypass valve (B) opens, reducing the system pressure and power consumption of the pump.

The back pressure valve (3) Is factory preset at 3.45 MPa (500psi).

The pump assembly (1) is belt driven directly from the jet unit.

The pump assembly comprises, pump, an integral tank, flow control and pressure relief valves.

3.6.1 Basic Hydraulic Circuit

Refer to Drawing “CT-HSE-10-001 Hose Kits”.

Table 3: Hydraulic Circuit Items

Item No.	Description
A	Variable restriction with cylinder position feedback.
B	Bypass valve. (open when cylinder is fully retracted)
1	Pump assembly
2	HSRX cylinder Minimum oil flow 3 litres per minute. Maximum oil flow 16 litres per minute.
3	Back pressure valve.
4	Oil cooler (part of jet assembly)

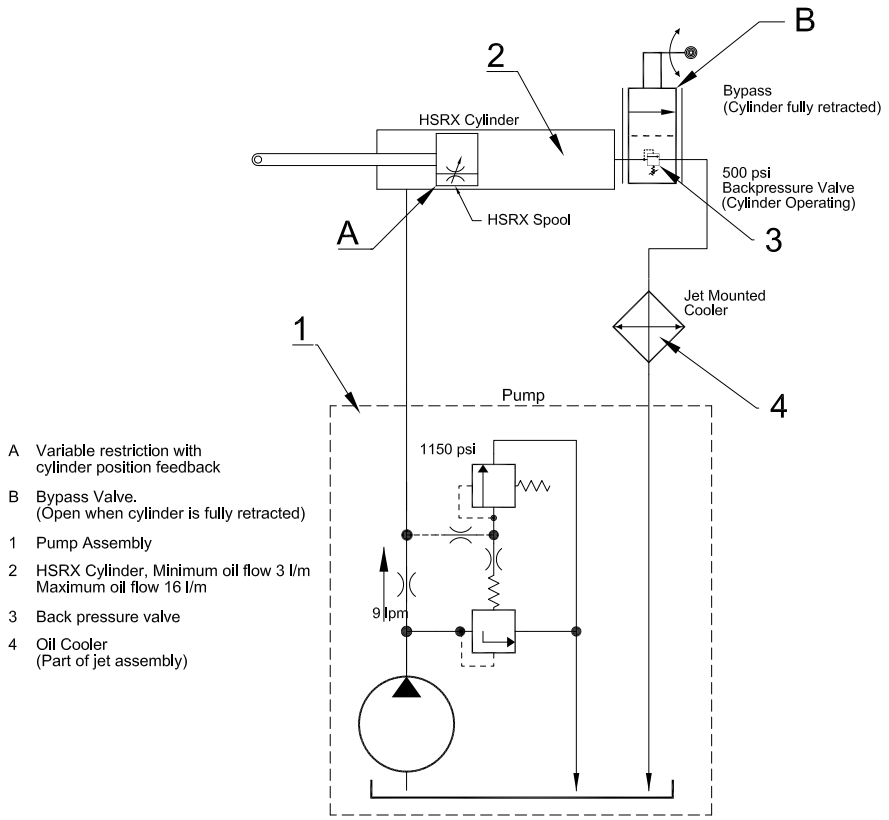


Figure 15: Hydraulic Circuit Diagram

3.6.2 Layout of Components

Refer to Drawing “CT-HPU-01-001 JHPU”.

3.6.3 Scope of Supply

The following list of items are supplied with the HSRX reverse system.

1. HSRX reverse cylinder.
2. Pump assembly.
3. Cooler. (integral part of jet unit).
4. Hoses and fittings.
5. Belts for the pump.
6. Hydraulic oil.

These items are supplied factory assembled and mounted on the jet unit ready for use.

The following items are not supplied:

1. Cable or other actuating devices.

3.7 Engine Location & Mounting

3.7.1 General

The engine(s) should be located in a position that will give the vessel the most suitable fore and aft trim for the proposed boat speed. For semi-planing and moderate planing speed vessels 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 vest trim and speed. Follow the recommendations of the boat designer in this regard or consult C.W.F. Hamilton & Co Ltd.

3.7.2 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 for 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.

3.7.3 Cooling

Jet unit water offtake:

The jet unit incorporates an inboard water offtake point on the starboard side of the intake. This is fitted with a hosetail / bung which can be cut off and a hose connection fitted to the hosetail. This provides water at pressures as follows:

Typical maximum pressure

550kPa (80 psi) at full power.

The water may be fed directly to the engine for cooling without the need for a raw water pump, provided that:

- The flow from the water offtake at idle is sufficient to cool the engine.
- The engine can withstand the maximum pressure from the water offtake.

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

CAUTION

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

The jet unit water offtake can be used for a deck cleaning hose but the pressure is not high enough for a fire hose.

Conventional water pick-up:

CAUTION

Ensure that the engine cooling water pick up is not directly ahead of the jet unit intake, but well to the side to avoid turbulent water flow into the jet.

Alternatively a cooling system separate from the jet unit can be fitted to the engine maker's specifications. The water pick up points must NOT be directly ahead of the jet unit intakes and should be well to the side of the area forward and the same width as the intake opening.

3.7.4 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.

3.7.5 Engine Exhausts

Engine exhausts should not be located below the waterline near the jet units.

If engine exhausts are located in this area, water containing exhaust gases can be ingested by the jet unit when moving astern. This can cause loss of thrust and control of the jet unit.

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.

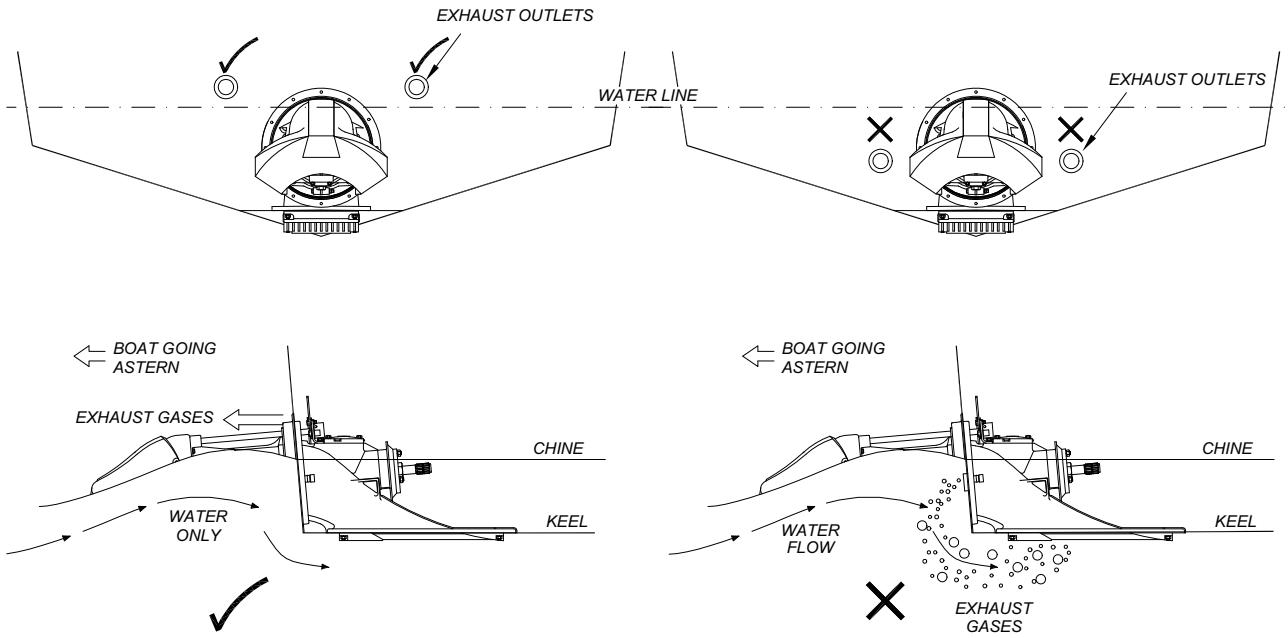


Figure 16: Exhaust System Layout

3.7.6 Governor Settings

The “no load” governor setting (or “high idle”) on diesel engines should be set well clear of the full throttle R.P.M. achieved when driving the jet unit so that there is no chance of the governor reducing power (and performance) at full throttle.

3.8 Description of the Dry Run System (Optional Extra)

Note: Hamilton jet units are not fitted with the dry run kit as a standard fit. The dry run kit is an optional extra which can be fitted to the jet unit at the customers request. Should the customer require a dry run system fitted, it can be purchased at additional cost and should be requested when the initial jet order is placed.

This dry run system is a simple solution to the problem of starting a boat engine before putting the vessel in the water. It is particularly useful for man- overboard boats and lifeboats where it is important to ensure that the engine will start before the vessel is in the water.

The dry run kit consists of a specially formulated bearing which can be run dry for short periods and run for long periods with water lubrication. **The standard rubber marine bearings are designed to run in a water immersed envioronment where the water acts as a coolant and lubricant for the bearing and water seal. These cannot be run out of water.**

3.8.1 Installation

The dry run bearing components are a direct replacement for the standard marine bearing components, therefore there is no requirement for a special installation procedure for converting a jet unit to the dry run system. The dry run bearing components can be fitted as shown for the normal marine bearing replacement in the jet unit manual.

3.8.2 Corrosion

All the components of the dry run kit are made of high quality corrosion resistant materials. The plastic bearing will turn slightly blue / green after being immersed in sea water. This is only a surface discolouration and is not detrimental to the performance of the dry run kit system.

3.8.3 Scope of Use

Because there is no cooling for the dry run system water seal and marine bearing, if a jet unit is run without the vessel being immersed in water, the water seal and the marine bearing will heat up rapidly in the absence of water to act as a coolant.

The following limits must be adhered to, to ensure good component life.

Maximum dry run time	3mins
Maximum dry run engine speed	1000 RPM
Minimum time between dry runs:	1 Hour

The dry run bearing is a compromise for use in both dry and wet running conditions. The best wet running desing solution is the rubber marine bearing which cannot be run dry. The dry run bearing will wear out more rapidly than a standard rubber marine bearing if the dry run system is used constantly in a dirty water environment. When used in silty water, the life of the bearing and sleeve will be reduced, depending on the volume of grit in the water. **THIS SYSTEM SHOULD ONLY BE USED IN A CLEAN WATER ENVIRONMENT.**

If extended use in a dirty water environment is expected, then regular monitoring of marine bearing wear is required.

3.8.4 Fault Finding

Table 4: Fault Finding

Fault	Cause	Remedy
Dry run bearing jams up when dry running.	Excessive heat build up. May have grit in the bearing.	Run in water to cool. Leave overnight to cool. Flush out with clean water.
Clanging sound from the jet.	Impeller hitting the wear ring. Worn dry run bearing.	Check the wear ring and replace if damaged. Replace worn dry run bearing and / or sleeve.
Excessive scouring of the shaft sleeve.	Running in dirty water and sucking sand or silt into jet.	Be careful not to suck sand or silt into the jet, do not use high RPM in water when starting off.

3.8.5 Maintenance

Inspection:

Inspect every 100 hours, 50 dry starts, or yearly, whichever is the soonest.

Remove the tailpipe and inspect.

If the wear on the bearing sleeve is greater than 0.2mm, replace the sleeve. Replace the plastic bearing when replacing the sleeve.

Note: As the dry run bearing runs on only one half of the bearing sleeve, refer to Drawing "HJ-213-01-000 Basic Jet Assembly". The bearing sleeve can be turned end for end when it shows signs of wear.

Assembly notes:

1. When changing the 'dry run bearing sssembly', dismantle and reassemble the whole assembly (plastic and metal shell) to the tailpipe in the same manner as removing or replacing a standard rubber marine bearing. The plastic part of the bearing should be fitted so it sits closest to the impeller. The shell should sit flush with the tailpipe refer to Drawing "HJ-213-01-000 Basic Jet Assembly".
2. The bearing sleeve is the same as the bearing sleeve for the rubber marine bearing. For fitting, refer to ***Section*** Section 9"Overhaul of this manual.

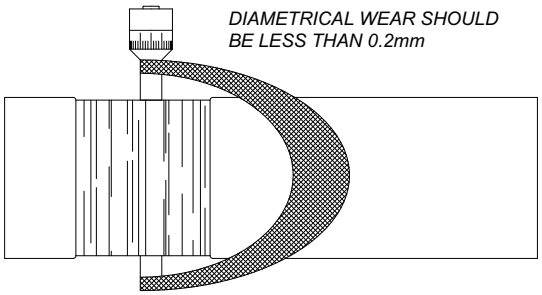


Figure 17: Bearing Sleeve Inspection

3.8.6 Parts List

Refer to Drawings "HJ-213-01-000 Basic Jet Assembly".

Section 4
Precautions Against Corrosion

4.1 General

4.1.1 Electrical Wiring System

CAUTION

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

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.

A. 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. Further information (including circuit diagrams) can be found in American Boat and Yacht Council (ABYC) publication E-11 *AC and DC Electrical Systems on Boats.*

B. 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 preferred over isolators with diodes only.The galvanic isolator must have an indicator or alarm that shows whether the earth current is being blocked or not. This indicator is required since the galvanic isolator only blocks low voltages (typically below 1.2V) and higher voltages will pass through the isolator and cause vessel corrosion damage. If the indicator was not present then the vessel operator would be unaware of the corrosion problem. Monitoring of the galvanic isolator is important to ensure proper operation of the isolator. The isolator must also have sufficient fault capacity to allow circuit breakers to trip under fault conditions. Galvanic isolators that comply with American Boat and Yacht Council recommendations (ABYC A-28, *Galvanic Isolators*) will meet the above requirements and are recommended by Hamilton Jet.

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

4.1.2 Earth Bonding System

CAUTION

Prevention of Corrosion

Vessels using Hamilton Jet units, must be bonded and wired as described in Section 4 "Precautions Against Corrosion" section of the jet unit manual.

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.

If a copper bonding strip is used, it should not be connected directly to the jet unit as galvanic corrosion will occur. The copper bonding strip should be connected to the jet unit via a stainless steel terminal connector.

The bonding wire or strip which runs the length of the hull, should be kept clear of bilge water.

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

An exception exists for steel 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 are carried out:

1. There is a two wire normally current conducting electrical system which is isolated from the hull, jet unit and engine,
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.

4.1.3 Corrosion Monitor

It is recommended that a corrosion monitor be fitted.

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

If the jet units are isolated from the hull, corrosion monitoring of each jet unit external wetted surface and internal intake duct should be carried out.

If the jet units are electrically connected to the hull, corrosion monitoring of the hull only and each jet unit internal intake duct should be carried out.

4.1.4 Trim Tabs and Other Submerged Fittings

When 2 dissimilar metals are electrically connected and submerged in a seawater, then galvanic corrosion can occur.

If a large stainless steel fitting (such as a trim tab) is electrically connected to the jet, then the corrosion protection of the jet unit will be compromised. In order to ensure adequate corrosion protection for the jet, stainless steel trim tabs should be fully painted or electrically isolated from the jet unit, or preferably both. Normally an anode would be fitted to the trim tab to provide corrosion protection to the tab. Trim tabs made of aluminium will not affect the jet corrosion protection.

4.1.5 Earth Plate Connections for Electronic Transmitting Equipment

Radios, radar 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 equipment etc, 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 to.
6. The earth plate should be connected by an insulated wire to the vessels "earth bonding system".

4.1.6 Anodes

The anodes fitted to the jet unit are made from aluminium alloy to MIL-A-24779 (SH) or zinc alloy to MIL-18001H

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 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 corroding when the vessel is in seawater, they are not functioning correctly and the cause should be investigated. One reason could be that 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 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

These anodes are fitted to the reverse duct, steering deflector, reverse cylinder and the main body of the jet unit. Anodes are also fitted internally within the tailpipe and in most jet models, within the intake and under some inspection hatches.

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: 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.

4.1.7 Anti Fouling Paint

CAUTION

Anti Fouling Paints

Do not use copper oxide based anti-fouling paints. Do not paint over the anodes.

4.1.8 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.

4.1.9 Impressed Current Protection

Impressed current protection may be used if desired. Follow the supplier's 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.

4.2 Aluminium, G.R.P. and Wood hulls (Other Than Steel or Carbon Fibre)

4.2.1 Earth Bonding System - (Not Normally Current Conducting)

Refer Drawing:
85114 Earth Bonding System Recommendations and Layout.

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.

4.3 Steel hulls and Carbon Fibre Reinforced F.R.P. hulls

CAUTION

For steel hulls and carbon fibre reinforced F.R.P hulls, the jet unit must be electrically insulated from the hull.

An insulating kit is supplied with the jet unit for steel installations.
For carbon fibre reinforced hulls, an alternative reinforcing fibre (such as glass) must be used in the area where the jet unit is mounted to ensure that carbon fibre does not contact the jet unit or fasteners.

4.3.1 Earth Bonding System (Not Normally Current Conducting)

Refer Drawing:
85114 Earth Bonding System Recommendations and Layout
If a negative earth system is used on the vessel, it **must not** be connected to the jet unit.

7. Every part of the vessel electrical system should have **two** wires to it, a positive and a negative wire.
8. With electrical auxiliary equipment installation be guided by your electrician. Do not earth electrical equipment to the jet unit, but to a separate earth.

4.3.2 Checking the Insulation

The insulation between the jet unit(s) and the steel hull should be regularly checked.

1. With the vessel out of the water
   Rinse the sea salt from the jet/hull area using fresh 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 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 anode in the seawater and electrically connect the hull to the anode.
   f) Repeat the digital voltmeter readings.
   g) If jet unit(s) is insulated from the hull, the mV readings for the jet unit(s) should not change.
   h) The mV readings for the hull should be more negative (eg: The reading could be -800mV without the large anode connected and -850mV with the large 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.

4.4 The HSRX Reverse System

CAUTION

PREVENTION OF CORROSION
Vessels using Hamilton jet units, must be bonded and wired as described in Section 4 "Precautions Against Corrosion" section of the jet unit manual.

All C.W.F. Hamilton & Co Ltd manufactured components on the HSRX reverse system are manufactured from high quality materials, selected for their good corrosion resist properties. Some bought-in items are manufactured in plated steel. As these items are fitted inside the vessel, corrosion should be minimal. Should corrosion commence or if salt spray conditions are likely to be encountered, the following items may be painted to prevent the onset of corrsion:

1. The mounting bracket of the pump.
2. The pump
3. Pulleys (These are manufactured of zinc plated steel)

Section 5 Installation

PREVENTION OF CORROSION

Vessels using Hamilton Jet units, must be bonded and wired as described in Section 4 "Precautions Against Corrosion" section of the jet unit manual.

5.1 Basic Installation Method and Drawing References (jet unit)

For G.R.P. hulls:

Refer to Installation Drawing “HJ-213-08-001 Installation Details G.R.P. Hulls”.

An aluminium "intake block" [2] is supplied with the installation kit for fibre glassing into G.R.P hulls “Intake Block” for 5° shaft line. ***(Part No. 107554)***

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 aluminium hulls:

Refer to Installation Drawings “HJ-213-08-002 Installation Details Aluminium Hulls”.

An aluminium intake block [2] is supplied ready to weld into a prepared opening in the hull bottom. “Intake Block” for 5° shaft line. ***(Part No. 107554).***

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 Weld Procedure for Aluminium Hulls”. Ensure the contours between the hull and the intake block at front and rear are smooth to within 1mm.

For further details contact C.W.F. Hamilton & Co. Ltd.

For steel hulls:

Refer to Installation Drawing “HJ-213-08-003 Installation Details Steel Hulls”.

An aluminium intake block [2] (intake block for 5° shaft line. part no. 107554) is supplied with an installation kit (part no 111197) and intake block gasket (part no 111200).

Special installation is required to ensure that the jet unit is totally insulated from the hull.

An insulation kit is supplied to totally insulate the jet unit from the hull.

5.2 Hull Preparation

In multi jet unit installations, each jet unit may have been configured for port, starboard or centre mounting. Care should be taken to ensure that each jet is fitted in its correct position.

5.2.1 Fixing Intake Block to Hull

G.R.P: hulls:

Refer to Drawings "HJ-213-08-001 Installation Details G.R.P. Hulls".

If possible, tape the intake block into the hull mould prior to moulding the hull. For centre-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 the flat of the intake block. For an existing GRP hull, cut a hole in the hull larger than the intake block base flange to allow a scarfed joint to be formed in GRP between the intake block and the hull, as shown on the installation drawing.

After moulding, drill 22 x 8.5mm diameter holes at the cast dimples in the bottom of the intake block up through the intake block flange and hull. Countersink the holes to accept the countersunk head machine bolts [11]. Liberally smear the bolts [11] with the marine sealant [7] provided.

Fit the bolts [9], flat washers [6], spring washers [5] and nuts [4].

Torque load the nuts [4] to the recommended torque, refer to Drawing "85113 Recommendations for nut and Locking screw Tightening Torques".

Ensure the contours between hull and intake block at the front and rear are smooth to within 1 mm.

Aluminium hulls:

Refer to Drawings "HJ-213-08-002 Installation Details Aluminium Hulls".

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

The intake block is LM6 grade aluminium. Weld the intake block into the hull in accordance with the information given in Drawing "85080 Weld Procedure For Aluminium Hulls". Ensure that the contours between hull and intake block, at front and rear, are smooth to within 1 mm. Grind flat where necessary, especially in front of the intake.

Steel hulls

Refer to Drawings "HJ-213-08-003 Installation Details 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 steel 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 installation drawings.

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 [14].
2. With the intake block in place, from beneath the hull, drill through the 22 countersunk dimples on the intake block with a 8.5mm 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 22 marked positions in the steel edges of the prepared hull opening to 12mm dia to accept the nylon insulating bushes [12]. Remove all burrs. Refer to Drawings "HJ-213-08-003 Installation Details Steel Hulls".
5. Fit the nylon insulating bushes [12] to the drilled holes in the prepared hull opening and trim to the correct length.
6. Liberally smear both sides of the intake block gasket [14] with marine sealant [7] and fit the intake block gasket onto the intake block.

Note: The gasket is designed to fold down around the edges of the intake block.

7. Smear marine sealant [7] on top of the gasket [14] and run a bead of marine sealant around the internal corners of the prepared recess.
8. Ensure that all the bolts [11] are liberally smeared with marine sealant, prior to fitting.
9. Install the intake block and secure in 3 positions with bolts [11], nylon insulating bushes [12], flat washers [6], spring washers [5] and nuts [4]. Hand tighten.
10. Check for electrical isolation between the intake block and the vessel hull before fitting the remaining screws. ***(The resistance between the jet unit and the steel hull should be 1000 ohms or greater. If the reading achieved is below 1000 ohms, the fault should be investigated and rectified before continuing).***
11. Fit the remaining bolts [11], nylon insulating bushes [12], flat washers [6]. spring washers [5] and nuts [4].
12. Torque load all 22 bolts [11] and nuts [4] to the recommended torque to secure the intake block in position.
13. Once the intake block is installed, check again for electrical isolation and then fill any gap at the edges and corners with marine sealant. Clean off any excess sealant and trim off any protruding part of the intake block gasket.

The fixing of the intake block and cross member to the hull and the strength of the transom must be sufficient to carry the loads imposed by the jet unit on the hull.

5.2.2 Transom Preparation

An area at 95º to the jet unit intake base has to be prepared as shown on the appropriate installation drawings.

For GRP hulls:

Refer to Drawings "HJ-213-08-001 Installation Details G.R.P. Hulls".

- An area at 95º to the jet intake base has to be prepared as shown on the hull preparation drawing.
- An insert can be taped into the hull mould so that the required area can be moulded at 95º to the hull.
- Alternatively, the area to be at 95º 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 fibreglass the cut-out back into the transom.

For metal hulls

Refer to Drawing "HJ-213-08-002 Installation Details Aluminium Hulls".

- An area at 95º to the jet intake base has to be prepared as shown on the hull preparation drawing.
- Cut out the required area and reposition at 95º to the jet intake base and re-weld (with required inserts at sides and top) back to the transom.

5.3 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.

5.3.1 Steering Components

Refer to Drawing "HJ-213-06-000 Steering Assembly".

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

However, if problems with installation occur, ***refer to Section*** 9.4"Steering Assembly Removal and Overhaul ***and Section*** 9.5"Steering Assembly Re-Fitting for removal and refitting instructions.

5.3.2 Reverse Components

Refer to Drawings "HJ-213-07-001 Reverse Assembly Hydraulic Reverse".

The jet unit is shipped complete with the reverse cylinder and reverse duct attached. If, during installation, the reverse duct needs to be removed, ***refer to Section*** 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 cylinder.
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.

5.3.3 Removal of Other Parts

The jet unit is shipped with the controls system fitted. Should it be necessary to remove the controls system, refer to the controls manual supplied, for details on the fitting and removal procedures.

5.4 Mounting The jet unit

All cylinder shafts are protected with spiral wrap during shipping.
Make sure the wrap is removed before first operation.

WARNING

Refer to the following installation drawings at the rear of this section.
GRP Hulls: "HJ-213-08-001".
Aluminium Hulls: "HJ-213-08-002"
Steel Hulls: "HJ-213-08-003"

Preparation

After mounting the intake block and making the transom hole in the hull; carry out the following actions:-

1. Remove the reverse duct from the jet unit as shown in ***Section*** 5.3.2"Reverse Components
1. Remove the transom plate and transom seal o-ring [8] from the jet unit as shown in ***Section*** 9.8"transom plate Assembly Overhaul.
2. Temporarily install the jet unit, with intake screen fitted, into the hull to ensure that the hull preparation is correct. This also serves to check for clearances with any other parts of the hull. To carry out this operation, using approved lifting equipment, lift the jet unit into the hull and position the jet unit so that the rear of the jet unit passes out through the transom opening and the intake screen fits centrally in the intake block opening. Should the intake screen require removal during installation, ***refer to Section*** 9.8"transom plate Assembly Overhaul.
3. Check that the jet unit is correctly located in relation to the transom opening, and that the intake block fits neatly with the intake casting. Carry out any corrections to the hull preparation as necessary.
4. Check that the contours between the hull and the jet unit intake, at the front and rear are smooth to within 1mm ($^{1}/_{32}$").

If satisfactory, proceed as follows

5.4.1 Mounting the jet unit

G.R.P. aluminium and steel hulls:

Refer to Drawings

GRP hulls: "HJ-213-08-001".
Aluminium hulls: "HJ-213-08-002"
Steel hulls: "HJ-213-08-003"

Using approved lifting equipment, lift the jet unit off the intake block and move it away from the hull.

5. Smear the threads of the studs [3] with Loctite 263 provided and tighten into the tapped holes in the intake block [2]. A convenient method of fitting the studs is to tighten two nuts together on the top of the stud so that a spanner can be engaged on the nuts to tighten the studs into the base.
6. Liberally apply neutral cure marine sealant [7] to the top of the intake block, to the underside of the jet unit flange and to the heads of the studs [3].
7. Carefully position the jet unit centrally over the intake base and slowly lower the jet unit flange onto the studs [3] fitted to the intake block.
8. Secure the jet unit intake to the intake block with flat washers [6], spring washer [5] and nuts [4]. Torque load to the recommended torque as per Drawing "85113 Recommendations for nut and Locking screw Tightening Torques".
9. Remove any excess sealant from inside and outside the jet unit intake.

For the following paragraphs, Drawing "HJ-213-09-002 Screen Rake Assembly" refers.

10. If not already connected, attach the screen rake spring [7] to the underside of the screen rake actuating arm [2].
11. Attach the spring anchor bracket [8] to the starboard forward edge of the intake block.
12. Attach the screen rake spring [7] to the spring anchor bracket [8].

5.4.2 Assembly of the Transom Plate to the Hull

Ensure that the reverse duct has been removed from the jet unit as shown in Section 9.2.1"Reverse Duct Removal**.**

1. Place the transom plate [1] in over the tailpipe and up against the transom.
2. Centralise the transom plate in relation to the intake and rotate to position the transom plate's vertical centerline square with the jet unit intake base.

G.R.P. and aluminium hulls:

3. Using an 8.5mm diameter drill bit through the holes already drilled in the transom plate, drill 12 holes in the transom for the 12 securing screws [9] to locate through.
4. Slide the transom plate back off the tailpipe and remove all burrs from around the holes drilled in the transom.
5. Liberally apply neutral cure marine sealant [7] (supplied) to the transom plate contact area on the hull, to the joint face of the transom plate and to the heads of the 12 transom plate attachment screws [9].
6. Liberally grease the transom plate o-ring [8] and fit into the o-ring channel in the jet unit intake.
7. Fit the transom plate into place against the transom.
8. Secure the transom plate to the transom using screws [9], nuts [4], flat washers [6] and spring washers [5] as shown in the installation drawing.

Note: Ensure that the screw heads are positioned on the outside of the transom.

9. Tighten all 12, securing screws to the recommended torgue.
10. Wipe off any excess sealant.

Note: The tiller stop should be fitted and adjusted on completion of the steering installation. Refer to section 5.5.3"Tiller Stop Fitting and Adjusting.

Steel hulls

Note: The transom seal assembly must be totally insulated from the hull by a gasket [13] and flanged insulating bushes [12] fitted around the mounting screws [3].

1. Using an 8.5mm diameter drill bit through the holes already drilled in the transom plate, drill 12 holes in the Transom for the 12 securing screws [9] to locate through.
2. Slide the transom plate back off the jet unit and remove all burrs from around the holes drilled in the Transom.
3. With the transom plate removed from the jet unit, **enlarge the holes in the transom plate [1] ONLY** to 12mm dia to enable the insulating bushes [12] to be fitted to the transom plate.
4. Remove all burrs from around the enlarged holes drilled in the transom plate.
5. Fit the insulating bushes to the transom plate and trim to the correct length.

Note: These insulating bushes should be fitted from the outside of the transom plate.

6. Lubricate the transom plate o-ring [2] with vegetable oil and fit in place in the seal groove on the jet unit intake. Take care not to get any oil on the transom where sealant will be applied.

7. Liberally apply neutral cure marine sealant [7] (supplied) to the transom plate contact area on the hull and also to the joint face of the transom plate and the heads of the attachment screws [9].
8. Apply neutral cure marine sealant [7] to the transom gasket [13] and fit to the transom, aligning the transom gasket with the drilled holes in the transom.
9. Slide the transom plate [1] over the o-ring [2] and line up the holes in the transom plate with the drilled holes in the transom.
10. Install the transom plate in place against the transom plate gasket and the transom.
11. With the insulating bushes [12] already fitted to the transom plate, fit flat washers [6] to screw [9] and secure in 3 positions through the transom plate / transom with the screw heads on the outside of the transom.
12. Secure the transom plate with flat washers [6], spring washers [5] and nuts [4], **Hand tighten only.**

Note:

1. Ensure that the screw heads are fitted to the outside of the transom as shown on the installation drawings.
2. Ensure that flat washer [6] are fitted to the screws [3] prior to fitting the screws through the transom / transom plate.

13. The transom plate [1] must be totally insulated from the hull by the transom gasket [13] and insulating bushes [12] fitted to the transom plate.
14. 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).***
15. Fit flat washers [6] to the remaining screws [9]. and secure the transom plate and gasket to the transom with the remaining screws [9], flat washers [6], spring washers [5] and nuts [4] as shown in the installation drawing.

Note:

1. Ensure that the screw heads are fitted to the outside of the transom as shown on the installation drawings.
2. Ensure that flat washer [6] are fitted to the screws [3] prior to fitting the screws through the transom / transom plate.

16. Tighten all 12 securing screws to the recommended torque.
17. Wipe off any excess sealant.
18. Carry out a final check of the insulation between the jet unit and the transom. ***(Any fault should be investigated and rectified before continuing).***

Note: The tiller stop should be fitted and adjusted on completion of the steering installation. Refer to Section 5.5.3"Tiller Stop Fitting and Adjusting.

5.5 Steering Installation

Refer Drawing "HJ-213-06-000 Steering Assembly General Arrangement".

Good steering is of paramount importance on high speed jet boats. This jet, with a steerable nozzle, has a particularly powerful and positive steering effect.

5.5.1 Re-Fitting the Steering Components

1. Steering cylinder. ***Refer to Section*** 9.5"Steering Assembly Re-Fitting for the re-fitting details.
2. Refit any sensors attached to the tiller. Refer to the overhaul section of the controls manual for details.

5.5.2 Steering Wheel, Number of Turns

Steering is normally operated from the helm by a steering wheel, although a tiller is sometimes used. The wheel should have between a half and one turn lock to lock for rapid precise control, ¾ turn lock to lock is normal.

Note: A greater number of turns will reduce the steering sensitivity during low speed manoeuvering. Most wheel and cable systems are designed for long cable strokes and about 3 turns lock to lock. By connecting to the bottom hole in the tiller arm [1], this can be reduced to less than 1 turn from lock to lock. This means that only part of the available stroke of the steering system is used. With excess stroke available, ***it is important that tiller stops are fitted to protect the nozzle from over-travel loads.***

5.5.3 Tiller Stop Fitting and Adjusting

Drawing "HJ-213-06-000 Steering Assembly General Arrangement". refers unless otherwise stated.

WARNING

The tiller stops provided must be fitted and correctly adjusted to prevent the possibility of overloading the steering system components at full lock which, could result in loss of steering control.

Failure to fit the tiller stops will void the warranty on steering components damaged by overloading.

1. From inside the vessel, remove the top 2 or 3 nuts [4], (dependant on whether the jet is fitted on or off the vessel centreline, Refer to Drawing "HJ-213-06-000 Steering Assembly". spring washers [5] and flat washers [6] securing the transom plate [1] to the transom. (Drawings "HJ-213-08-001 Installation Details G.R.P. Hulls", "HJ-213-08-002 Installation Details Aluminium Hulls", "HJ-213-08-003 Installation Details Steel Hulls". refer).
2. **Do not remove the screws [9]**.
3. From inside the vessel, fit the tiller stop [23] over the protruding screws [9]
4. Fit the special washer [24], spring washer [5] and nut [4] to the protruding screw [9]. ("HJ-213-06-000 Steering Assembly refers).
5. Connect the steering cable to the steering tiller.
6. If the steering cable is connected to the top hole of the steering tiller, it may be necessary to mark and trim the adjacent stop until it clears the cable, whilst still stopping the steering tiller.

Note: The steering cable MUST be connected to the front of the steering tiller. If the steering cable has been connected to the rear of the steering tiller, the steering cable must be moved to the front and the mounting point packed out to suit.

7. Prior to adjusting the tiller stop [23], ensure that the screw [18] and nyloc nut [19] securing the steering tiller [17] to the steering shaft [1] are torqued to 35Nm (26lb/ft).
8. Adjust the tiller stop to ensure that the clearance between the nozzle and the nozzle housing is the same in each direction. Tighten the tiller stop securing nuts to 17.5Nm (13lbs/ft).

5.5.4 Assembly of the Jet Steering Tillers

Single jet installations:
Refer to Drawing "HJ-213-06-000 Steering Assembly" for correct configuration of the cotter pin.

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 entering of the jets.

Tightening cotter (taper) pin nuts:-
Ensure that all the cotter (taper) pins are fitted the correct way as shown for single jets above. Fit thick washers first, followed by the spring washers and then the nuts. Torque load all nuts to the recommended torque as shown in Drawing "85113 Recommendations for nut and Locking screw Tightening Torques".

5.5.5 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.

5.6 Final Assembly

Refer to Drawing "HJ-213-07-001 Reverse Assembly"

The reverse duct, reverse cylinder and steering assembly will have been removed prior to the installation of the jet unit.
The reverse duct, reverse cylinder and steering assembly can now be refitted to the jet unit as shown in the following procedures:-

5.6.1 Reverse Cylinder Fitting

The reverse cylinder may now be refitted to the jet unit in accordance with the instructions at ***Section*** 9.3.1"Reverse Cylinder - Refit to the jet unit.

5.6.2 Reverse Duct Re-Fitting

Refit the reverse duct to the jet unit as shown in Section 9.3.2"Reverse Duct - Refit To jet unit.

5.6.3 Reverse Cable

Cable controls should be installed with the minimum number of bends, each with as large a radius as possible.

Note: The cable is required to have a cable clamp at the jet unit end of the cable.

The jet unit, as supplied, has the cable leaving the HSRX handle towards the right hand side of the vessel for a right hand drive. The cable runs up the right side of the vessel to the hand controller at the driver's right hand side.

If the vessel is left hand drive, the cable should leave the HSRX handle towards the left hand side of the vessel. This can be done by rotating the cable mount bracket [26] to accept the cable from the port side of the vessel. ***(Refer to Section*** 9.3.2"Reverse Duct - Refit To jet unit). The cable will then run to a hand controller at the driver's left hand side.

Use the following procedure to install:

1. Follow the manufacturers instructions when setting up push / pull cable lines.
2. When installing the hand controller, **Note, the control lever must "push" the cable when moving the control lever ahead (for ahead thrust).**
3. Install the cable, connect to the hand controller but not to the jet unit.
4. With the cable fitted in place, but disconnected at the jet end, operate the control lever from full stroke to full stroke. Check for freedom of movement.

Morse cable connect:

5. Ensure that the cable mount plate [26] is correctly orientated for either port or starboard positioned morse cable. (This plate can be fitted to the reverse cylinder either facing to port or starboard. ***(Refer to Section*** 9.3.2"Reverse Duct - Refit To jet unit***" for information on re-positioning the Cable Mount Plate")***.
6. Slacken the 2 nuts [38] that clamp the morse cable to the cable mount plate [26] and refit the morse cable through the clamp.
7. Attach the morse cable ball joint [36] to the Lever [31] located on the end of the reverse cylinder and tighten the attachment nut.
8. Retighten the 2 nyloc nuts [38] that attach the clamp bracket on the cable mount plate [26].

5.7 Engine Installation

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

5.7.1 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 conjunctioin with a driveshaft system which does not cause a radial or side load at the jet coupling as the engine moves.

Refer to Section 3.4"Jet Mainshaft Alignment (for 5°option only). ***and also Section*** 3.3.3"Drive Shaft Options for recommended driveshaft and engine installation angles.

5.7.2 Engine Cooling

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

Ensure that the engine cooling water pick up is not directly ahead of the jet unit intake, but well to the side to avoid turbulent water flow into the jet.

The engine may be cooled conventionally or by making use of the inboard water offtake for the jet. The jet is supplied with the water offtake plugged with a water offtake to hostail connection. The bung can be cut from the connection and the cooling system plumbed from that. ***Refer to Section*** 3.5"Water Off-Take.

If shallow water operation is anticipated, a sandtrap should be installed in the cooling lie to prevent sand from clogging the cooling system. A sandtrap kit can be purchased from C.W.F. Hamilton & Co Ltd. ***Refer to Drawing*** "112110 Sand Trap Assembly Sht1.

It is common to use a heat exchanger and a separate cooling water circuit for the engine, so that river or sea water does not enter the engine. In this case the cooling water from the jet unit water offtake goes through the heat exchange circuit.

The water may be fed directly to the engine without the need for a raw water pump, provided that:

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

- To be sure of correct flow for engine cooling, a conventional water pick up and the engine raw water pump should be used.
- The jet unit water offtake can be used for a deck cleaning hose but the pressure is not high enough for a fire hose.

5.7.3 Engine Systems

Engine wiring, instrumentation and throttle systems are all conventional - follow the manufactureres recommendations.

With the standard HSRC reverse system, a two lever (separate) throttle and reverse controls MUST be used.

5.7.4 Exhaust Systems

Refer to Section 3.7.5"Engine Exhausts**.**

5.7.5 Governor Settings

The "no load" governor setting (or "high idle") on diesel engines, should be set well clear of the full throttle R.P.M. achieved when driving the jet unit so that there is no chance of the governor reducing power (and performance) at full throttle.

To check, select neutral if clutch or gearbox fitted but without these unbolt the driveline at the engine flywheel and open the throttle fully. To accurately measure RPM, use a calibrated hand tachometer.

Example: - If the maximum RPM for driving the jet unit is 2800 RPM, then the governor should not begin to operate until at least 2850 RPM. On most diesel engines this means the "no load governor setting" (or "high idle") should be at least 3050 RPM. (i.e. 250 RPM higher than the loaded maximum RPM).

Ensure that the low idle RPM is set high enough to avoid any vibration in the driveline. Extensive idling with the driveline vibrating may damage the jet unit. ***Refer to Section*** 3.3"Drivelines.

5.8 Installation Checks for the Jet Unit

WARNING

All cylinder shafts are protected with spiral wrap during shipping.
Make sure the wrap is removed before first operation.

Carefully inspect all hydraulic cylinder shafts and pushrods for scratches, paint, weld splatter, dirt or any other contamination.
These shafts should be perfectly clean before the hydraulics are used to prevent damage to the seals.

Jet unit mounting:

1. Check that the transition duct is faired to the hull bottom. Contours should be smooth with no steps or protrusions greater than 2mm.
2. Check that there are no flow obstructions forward of the intake (**Refer to Hull details in the Jet Designers Manual and also *Section*** 3.2“Hull Design**and *Section*** 5.2“Hull Preparation **in this manual).**
3. Inspect the intake block for obvious distortion or gaps between the jet unit intake and the intake block.
4. **GRP and aluminium hulls only;** Check that the silicone sealant between the intake block and the jet unit intake has not squeezed out into the water passage. Trim off excess sealant if necessary.
5. **Steel hulls only;** Check that the sealant between the intake block and the jet intake has not squeezed out into the water passage. Check that the intake block gasket and sealant between the intake block and the hull flange has not squeezed out into the water passage. Check that the intake block gasket has been fitted properly, reposition if required and trim off any excess sealant if necessary.
6. Check the transom plate seal is correctly located and secured. ***(Do not over tighten)***. If two people are available and the vessel is indoors, a strong light may be used to check the fit of the transom cutout and transom seal.
7. **Steel hulls only;** Check that the jet unit is insulated from the hull **(Refer to *Section*** 4.3.2“Checking the Insulation **and the Installation Drawings contained in this manual)**.
8. Check that the engine exhausts are above the expected waterline or well clear of the water jets. **Refer to *Section*** 5.7.4“Exhaust Systems **in the "Installation" Section of this manual.**
9. Check that the hull trim tabs (if fitted) will not interrupt reverse flow from the water jets. **Refer to Section** 3.2.4“Trim Tabs **and** Figure 13:“Allowable Trim Tabs Location **in the "Design Basics" Section of this manual.**

Jet unit: general:

1. Ensure that the impeller is fitted to match the engine rating. The impeller part number ***(stamped on the impeller hub)*** can be viewed through the main inspection cover**.**
2. Check that the internal and external anodes are in place and have not been painted over. (Refer to Drawing "HJ-213-13-002 Anode Location Drawing").
3. If antifouling has been applied to the jet unit casing, ensure that it is compatible with aluminium **(i.e. Not copper based)**.
4. Check that the main inspection cover and the water seal inspection cover o-rings and gaskets are correctly located and that the securing nuts are tightened to the recommended torque.
5. Check any water offtake connections (if fitted) for correct fitting and security. Check that any unused water offtakes are correctly plugged.
6. Check that the steering linkage rod ends and clevis are aligned in the same plane.
7. Ensure that the bearing housing is filled with grease prior to operating the jet unit for the first time, Refer: Section 9.6.4"Re-assembly of the Bearing Housing Items18 & 19

Drive shaft:

1. Ensure that the driveline details have been checked and approved by CWF Hamilton & Co Ltd.
2. On universal joint drive shafts **(Refer to *Section* 3.3"Drivelines in the "Design Basics" Section of the Manual)** check the following:-
   - Yoke offset angles are in the same plane, are equal and less than 5°.
   - Yokes are in the same plane.
3. On line shafts supported by bearings (**Refer to *Section* 3.3"Drivelines in the "Design Basics" Section of the Manual)** check the following:-
   - Support bearings are aligned with the engine flywheel.
   - Outer support bearings are positioned close to the end couplings.

5.9 Installing the HSRX Reverse System

Refer to Drawing
"HJ-213-07-001 Reverse Assembly Hydraulic Reverse"

1. Prior to inserting the jet unit through the transom hole, remove the reverse duct as instructed in the overhaul section of the jet unit manual.
2. After the jet unit has been mounted in the vessel and the reverse duct has been re-fitted, connect the HSRX reverse cylinder to the reverse duct, ensuring that the reverse shaft assembly is orientated the same way as it was previously.
3. Ensure that the dot on the end of the reverse shaft assembly is positioned uppermost. If the shaft assembly is 180° out of position, with the cylinder correctly mounted, the HSRX reverse will not work properly. To correct a wrongly positioned shaft assembly, with the cylinder correctly mounted, remove the pin which connects the shaft assembly to the reverse duct and rotate the shaft assembly using an adjustable wrench on the shaft assembly end flats. Do not grip the shaft assembly itself as surface damage on the shaft assembly will damage the cylinder seals.

5.9.1 Remote Operating Systems

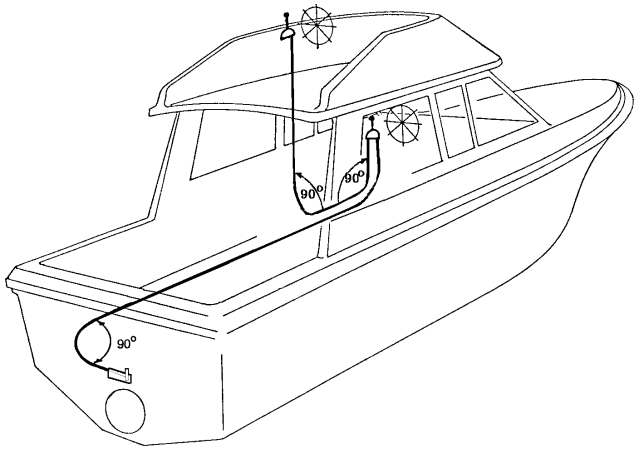


Figure 18: Remote Operating Systems

5.9.2 Cable Installation

The HSRX reverse system is supplied with a cable mounting plate (fitted to the end of the HSRX cylinder).

The recommended cable is the morse 33c supreme (low friction) cable. The cable mounting plate has been designed to suit this cable.

A suitable controller is the morse "S" controller which can be fitted with a **"neutral detent and engine start interlock"** microswitch. This microswitch prevents the engine from being started with any other than the "neutral" position selected on the reverse controller. Refer to Drawing "CT-CLV-01-003 reverse controller"

CABLE RUNS SHOULD NOT EXCEED 12m. Cable runs above this length could result in a reduction in reverse duct control quality.

MINIMISE THE NUMBER OF BENDS. The diagram illustrates the ideal arrangement for a dual station system. Total bend angle per cable in this system is 180°. **Do not exceed 360° per total as this will result in excessive lost motion (backlash)**.

Cable "station exchanger" systems may allow reduced cable length and bends but tend to introduce excessive lost motion (backlash) themselves. For cable runs longer than 12m, refer to **Section** 5.9.4"Alternative Remote Operating Systems.

5.9.3 Reverse Control Lever Adjustment

Refer to Drawing "HJ-213-07-001 Reverse Assembly".

With the reverse control lever in the full ahead position, the HSRX lever should be touching the stop pin. This ensures that the by-pass valve is operating in the full ahead position.

1. Adjust the reverse control lever full ahead stop screw to achieve this with no excess lever movement.
2. If the reverse control lever has no stops, it will be necessary to adjust the cable mounting position on the cable mounting plate and / or the actuation radius at the reverse control lever.
3. Check the oil tank level using the dipstick.
4. Check belt tension refer to Drawing "CT-HPU-01-001 JHPU HSRX" **and Section** 8.5.2"HSRX Controls Servicing Details.

5.9.4 Alternative Remote Operating Systems

Pneumatic (Teletronic, MMC etc).

Electronic.

Consult **C.W.F Hamilton & Co Ltd** if proposing to use an alternative remote operating system.

Section 6 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, as during commissioning the jet unit may produce large thrust forces.

Do not proceed if any of the control systems fault alarms are still activated.

6.1 Pre-Launch Checks

WARNING

All cylinder shafts are protected with spiral wrap during shipping.
Make sure the wrap is removed before first operation.

1. Check that all inspection covers on all jet units are securely attached.
2. STEEL HULLS ONLY:Check that the insulation between the jet unit and the hull of the vessel measures NOT LESS THAN 1000 Ohms. Refer to **Section** 4.3.2“Checking the Insulation for further details.

6.2 Post Launch Checks

Perform the following procedures before the engines are started.

1. Check that there are no water leaks:
   a) At the transom seal.
   b) At the intake base.
   c) From under the bearing housing (water seal leak).
2. Check the JHPU oil level.
3. Check the oil level in the pump reservoir and refill as required. **See Section** 8.5.2"HSRX Controls Servicing Details Item 3.
4. Ensure that the bearing housing is filled with grease prior to operating the jet unit for the first time, Refer: Section 9.6.4"Re-assembly of the Bearing Housing Items18 & 19
5. Ensure that the HSRX control lever is touching the stop pin when the reverse control is in the full ahead position.

CAUTION

If the HSRX control lever does not touch the stop pin when the reverse control is in the "full ahead" position then overheating of the HSRX system may occur.

6. Check that the waterline is up to at least the mainshaft centreline so that the jet unit will prime (pump water properly) when the engine is started.
7. Ensure that the vessel is securely moored fore and aft and is located in deep clean water.

6.3 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 that the vessel is securely moored fore and aft, in deep water.
3. With the reverse lever set to "zero speed", the engine(s) may be started and the engine supplier's representatives can carry out engine checks.
4. If the engine cooling water is taken from the jet unit water offtake, confirm that water is passing out of the engine exhaust outlets, where possible. Periodically check that the engine is running at the correct operating temperatureas this ensures that the engine is receiving sufficient water from the jet unit water offtake. Check that the cooling water hoses are secure.

CAUTION

Failure to check cooling water hoses may result in flooding of the vessel.

5. With the engines set to idle and the vessel securely moored in deep water, have someone monitoring the reservoir and refill as required.
6. Idle the engine at the lowest possible RPM.
7. Run the pump for 5 minutes approximately without moving the controls - this will purge air from the oil cooler. Refill the oil reservoir.

8. Start the engine, operate the controls to stroke each cylinder at least 10 times. This should purge any remaining air out of the system.
9. Top up the pump reservoir.
10. Check the system to ensure that it is not overheating. It should be possible to hold your hand on any component for at least 2-3 seconds.
11. Ensure the intake is under water - either with the boat trailer reversed into the water or with the boat moored securely.
12. Run the engine at idle, and recheck / refill the oil in the tank to the correct level shown on the dipstick.
13. Move the reverse control lever slowly to fully lower and raise the reverse duct several times. This will purge the hydraulic system of air.
14. The reverse control lever should now be moved to full astern position. There is no astern stop for the HSRX Lever. The full astern reverse control lever stop should be adjusted so that the reverse duct travels fully down (cuts across the jetstream completely) with no surplus reverse control lever travel.
15. If more reverse control lever movement is required (for greater sensitivity) and spare cable movement is available, the cable actuation radius can be altered at the reverse control lever.

Note: Not all reverse control levers have an adjustable detent. C.W.F. Hamilton & Co. Ltd. recommend that any reverse control lever detent action is de-activated.(not used). The reason is that the zero speed position will vary with wind and tide and small movements either side of a detented position would become difficult to achieve.

Neutral detent and engine start interlock microswitch adjustment (if fitted).

If microswitch adjustment is required, the manufacturers instructions for the microswitch should be followed.

6.4 Vessel Speed and Handling Trials

CAUTION

If a problem is detected, return to the mooring immediately, at reduced power. DO NOT operate the jet unit until the fault has been repaired. refer to section 7 Fault Finding.

1. Leave the mooring and check that the steering is operating correctly at "forward speed", at "zero speed" and at "astern".
2. Observe the waterjet emerging from the steering nozzles when the vessel is going dead ahead at speed. The waterjet should be a relatively clean with an even shape.
3. Check that the jet unit and driveshaft are running smoothly (no vibration) over the entire engine operating speed range (i.e. from "zero speed" to "full ahead").
4. Periodically check the surface temperature of the bearing housing and record the temperatures once it reaches a steady value. Due to friction caused by the seals, the bearing housing is likely to be warm. ***The bearing housing operating temperature should not exceed of 80° C.*** A faulty bearing will be heard and felt as a vibration through the bearing housing and is likely to cause significant heat build-up in the bearing housing.
5. If practical, check the coupling joint temperatures. Increased joint temperature may indicate driveshaft misalignment.
6. Periodically check the hydraulic oil temperature at the saginaw pump oil reservoir. Record the temperature reading after a sustained run at cruising speed and also after a period of vessel manoeuvering.
7. Record maximum speed (using GPS) and engine revolutions ***(Note that strong currents will result in inaccurate speed readings since the GPS only provides "speed over ground covered" readings).*** At maximum speed the jet unit revolutions should be verified with a hand held tachometer at the jet unit coupling.
8. Record vessel speed at varying engine revolutions if possible.
9. Record observations on vessel trim, loading etc.

6.5 After Initial Trials (After Engine Shut Down)

1. **Refer to Section** 8.4"Servicing Intervals for any after trials maintenance that may be required.
2. Ensure that all important information recorded during trials is stored for later reference.
3. Check for water leaks around the jet unit especially at the transom seal at the intake block and under the bearing housing (water seal leaks).
4. Check the HSRX oil reservoir, oil level and top up as necessary.
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.

Part C
Servicing Information

- Fault Finding
- Maintenance
- Overhaul

Section 7
Fault Finding

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.

7.1 Jet Unit Faults

Table 5: Jet Unit Faults

Symptom			
No	**Possible cause**	**Solution**	**Refer**
1	**The engine unloads (RPM increases).**		
	There is blockage in the jet unit.	The blockage must be removed.	Sect."2.9.
	Air is getting into the jet unit.	Check the inspection cover for correct attachment. Check Hull design; Consult C.W.F. Hamilton & Co Ltd.	Sect."2.9.4.
2	**A lack of jet thrust (boat speed drops).**		
	There is blockage of the jet unit.	The blockage must be removed.	Sect."2.9.
	Air is getting into the jet unit.	Check the inspection cover for correct attachment. Check Hull design; Consult C.W.F. Hamilton & Co Ltd.	Sect."2.9.4.
3	**Excessive noise and vibration coming from the jet unit.**		
	Blockage of the jet unit.	The blockage must be removed.	Sect."2.9.3.
	Blockage of the impeller or stator.	Clear the impeller or stator.	Sect."2.9.3.
4	**Water leaking from under the front bearing.**		
	Faulty water seal.	Replace water seal.	Sect."9.6.

Table 5: Jet Unit Faults

Symptom			
No	**Possible cause**	**Solution**	**Refer**
5	**Excessive high pitched rattling, or rattling whine coming from the jet unit.**		
	Blockage of the jet unit.	Clear blockage.	Sect."2.9.3.
	Faulty thrust bearing.	Inspect and repair the thrust bearing.	Sect."9.6.
	Cavitation is occurring.	Blocked intake screen. Check for blunt or damaged impeller. Excessive impeller tip clearance. Wrong type of impeller fitted. Vessel overloaded. Weight too far aft. Bad weather or sea conditions. Poor installation of jet unit into vessel.	Sect."2.9.3. Sect."9.7.4. Sect."9.7.1. "HJ-213-03-001 Impellers" *refers*. ***Section*** Sect."Section 5.
6	**Bad vibrations from the jet unit.**		
	Blockage of the jet unit. Worn marine water bearing. Bearing housing drain hole blocked. Something caught in the impeller.	The blockage must be removed. Inspect and repair the marine water bearing. Check the bearing housing water drain hole. Check through the inspection cover and clear the obstruction.	Sect."2.9.3. Sect."9.7.5. Sect."9.6. Sect."2.9.3.
	Worn driveshaft universal joints.	Inspect and repair the driveshaft as per manufacturer's recommendations.	***Refer to Manufacturers manuals.***
7	**Engine revolutions gradually increasing over a period of time. Take off performance poor.**		
	Worn or blunt impellers.	Inspect and repair the impeller and wear ring.	Sect."9.7.
	Excessive impeller tip clearance.	Inspect and repair the impeller as well as the wear ring.	Sect."9.7.
8	**Sudden increase in engine revolutions with no noticeable decrease in thrust.**		
	Air ingestion, or cavitation.	See 5 above.	***See 5 above.***
	Faulty tachometer	Repair tachometer.	
9	**Excessive engine revolutions, noisy jet unit and aerated water exiting from the steering nozzle.**		
	Screen blocked with wood, debris or rope through screen and wrapped around mainshaft.	Remove object from the screen or mainshaft.	Sect."2.9.3.
	Object jammed in stators and/or impeller.	Remove object from the stator or impeller.	Sect."2.9.3.

Table 5: Jet Unit Faults

Symptom			
No	**Possible cause**	**Solution**	**Refer**
10	**Low Engine RPM.**		
	Problem with engine.	Investigate the operation of the engine.	***Refer to engine manufacturers manual.***
	Incorrect impeller and nozzle selection.	Contact C.W.F. Hamilton & Co Ltd. for a check to be carried out.	"HJ-213-03-001 Impellers" and "HJ-213-06-000 Steering Assembly".
11	**Main bearing housing excessively hot.**		
	Main bearing or seal failure.	The bearing housing operating temperature at the bearing housing Casing should maintain a temperature of 70° ±5°. A faulty bearing is likely to cause significant heat generation which will be quite noticeable and could even discolour the paint of the bearing housing. Overhaul the main bearing.	Sect."9.6.

7.2 Reverse System Faults

Table 6: Reverse System Faults

Symptom			
No	**Possible cause**	**Solution**	**Refer**
1	**Reverse duct not moving.**		
	Reverse duct jammed by debris.	Remove debris and then check for correct operation of the reverse duct.	Sect.“9.2.
2	**Reverse duct does not go fully down or stay down with high engine RPM.**		
	Back pressure too low.	If the back pressure valve is suspected of being faulty, it should be removed from the reverse cylinder and returned to a hydraulics facility where the valve can be checked. The pressure should be 500psi (34 Bar) at a flow of 9 litres per minute.	Sect.“9.2.4 and Drawing “HJ-213-07-001 Reverse Assembly Hydraulic Reverse. Sht 1
3	**Reverse duct will not lift out of reverse with high engine RPM. Relief valve blowing.**		
	Back pressure too high.	As above.	As above.
4	**Reverse duct not synchronised with the reverse lever.**		
	Cylinder rod 180° out of phase.	Rotate cylinder rod so that the dot on the rod end is uppermost. Also refer to the overhaul section of the jet unit manual).	Sect.“5.9. ***Sect.“9.2.4.***
5	**Excessive heat build-up in the hydraulic system.**		
	HSRX lever not touching the stop pin.	Adjust HSRX lever	Sect.“5.9.3.
6	**Reverse duct does not move.**		
	• Cannot move the controller. Jammed cable. • Controller moves freely. Broken cable. **Hydraulic failure:** **can be caused by:** Broken pump belts. Belts slipping. Blockage in the system. Run out of oil. Split hose. **Jammed cylinder:** **can be caused by:** Bent reverse cylinder rod.	Free or replace the cable. Replace the cable. Replace belts. Adjust belt tension. Dismantle and clean the system. Refill the reservoir and purge the system. Replace hose. Replace the reverse cylinder rod.	Sect.“5.9. Sect.“9.2.1. Sect.“8.5.2. “HJ-213-02-001 Couplings and Belts. “CT-HSE-10-001 Hose Kits”

Table 6: Reverse System Faults

Symptom			
No	**Possible cause**	**Solution**	**Refer**
7	**Reverse duct creeping down form the up position.**		
	Reverse cylinder seals faulty.	Check the reverse assembly.	Sect.“9.2.4.
8	**Reverse cylinder: Oil leaking from the shaft outside the transom.**		
	Reverse cylinder seal failure in the Front head [15]. Suspect seals are:- Wiper seal [12]. Oil seal [17]. Piston seal [21].	Overhaul the reverse cylinder.	Sect.“9.2.4.
9	**Reverse cylinder: Oil leaking from the shaft inside the vessel.**		
	Reverse cylinder seal failure in the Backhead [22]. Suspect seals are:- O-ring [24]. O-ring [50]. V-ring [40].	Overhaul the reverse cylinder.	Sect.“9.2.4.
10	**Reverse cylinder: Oil leaking from around the backhead / fronthead to cylinder interface inside the Transom.**		
	Reverse cylinder seal failure in the backhead [22]. Suspect seals are:- O-ring [18].	Overhaul the reverse cylinder.	Sect.“9.2.4.
11	**Reverse cylinder: Oil leaking from the nipple [32].**		
	Bonded seal [33] failure.	Replace the bonded seal [21] fitted to the nipple [22].	Sect.“9.2.4.
12	**Reverse hydraulic system losing oil.**		
	Leak in the hydraulics system. Damaged cylinder rod. Leaky seals.	Replace or tighten hose connections. Can cause damage to seals, replace the Rod and seals. Replace seals. Overhaul the reverse cylinder.	Sect.“9.2.4
13	**Reverse cylinder: Water leaking in around the fronthead [15].**		
	Reverse cylinder seal failure: Suspect seals are:- Resilient mounts [14]. O-ring [16].	Overhaul the reverse cylinder.	Sect.“9.2.4.

Table 6: Reverse System Faults

Symptom			
No	**Possible cause**	**Solution**	**Refer**
14	**Poor reverse thrust.**		
	Reverse duct not travelling fully down.	Determine the reason for limited reverse travel and correct. Check the reverse assembly.	Sect.“9.2.
	Reverse flow hitting the trim tabs.	Reposition the trim tabs below the jet centre.	Sect.“3.2.4.
	Engine exhaust is being ingested into the intake.	Re-position engine exhausts so that they outlet above the waterline.	Sect.“5.7.4.
15	**Poor forward thrust.**		
	Reverse duct not travelling fully up.	Determine the reason for limited travel and correct.	Sect.“9.2.
16	**Reverse control lever movement is stiff.**		
	Reverse control lever or cable is stiff.	Disconnect the reverse control cable at the lever. Check the controller and control cable movement. Lubricate. Check for bent or loose linkages. Check cable run from the control lever to the reverse cylinder lever to ensure that the cable is not being accidentally bent or crushed and restricting movement. Check cable type, length and route are as specified.	Refer to ***Section*** 5.9“Installing the HSRX Reverse System” in this Manual.
17	**Reverse duct lever or cable is stiff to operate.**		
	Reverse control lever or cable is stiff.	As Item 16.	As Item 16.
18	**Reverse controller *(only for HSRX controls fitted with “neutral detent and engine start interlock”)*.**		
	Engine can be started with either “forward” or “reverse” selected on the reverse controller.	Adjust the “neutral detent and engine start interlock” micro switch in accordance with the manufacturers instructions.	
19	**No hydraulic pressure from the jet hydraulic pump unit (Saginaw pump).**		
	Reverse cylinder is not functioning due to little or no hydraulic pressure from the Saginaw pump.	Increase the engine (Jet) revolutions in quick bursts to about 1500 RPM until the vanes in the Saginaw pump become freed. (This may cure the problem).	

7.3 Steering System Faults

Table 7: Steering System Faults

Symptom			
No	**Possible cause**	**Solution**	**Refer**
1	**Steering is stiff at the helm.**		
	Grit jamming the nozzle.	Rock the helm rapidly from side to side to release the grit. **Caution: *Do not use excessive force to move the helm.***	Sect."9.4.
	Helm wheel or cable system stiff.	Disconnect cable system from the jet Check, rectify and lubricate as necessary.	***Refer to the Controls Manual.***
	Steering tiller shaft stiff.	Disconnect cable system from the steering arm. Check movement of steering shaft, and clearance on steering bushes. Rectify to a loose running fit.	Sect."9.4.
	Grit between nozzle bushes [10], and the nozzle.	Remove bolts [11] bushes [10] and sleeves [12]. Check bushes and sleeves for wear. Replace with new parts as necessary.	Sect."9.2 ***and*** Drawing "HJ-213-06-000 Steering Assembly refers.
	Corrosion build-up under the steering shaft or nozzle bushes.	Remove bushes, clean out the bores and refit using Loctite.	Sect."9.4.
2	**Steering jamming.**		
	Grit jamming the steering nozzle.	Rock the helm rapidly from side to side to release the grit. **Caution: *Do not use excessive force to move the helm.***	Sect."9.4.
	Nozzle pivot bolts loose or bent.	Remove, check and refit the pivot bolts. Torque to the specified torque on the steering drawing.	Sect."9.5.1. and Drawing "HJ-213-06-000 Steering Assembly"
	Nozzle housing [9] deformed by impact.	Remove, rebuild or replace the nozzle housing as necessary.	Sect."9.4 *and* Drawing"HJ-213-06-000 Steering Assembly"

Section 8 Maintenance

8.1 General

This jet unit and controls equipment have been designed to require the absolute minimum of maintenance. However, it is recommended that the jet unit and controls system be regularly examined for wear of bearings, seals and bushes as described in this section.

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 hydraulic connections to components which are not going to be serviced immediatly, plug the connection to prevent loss of oil and entry of foreign particles.

8.2 Jet Surface Coating Procedure.

8.2.1 Introduction and Scope.

The purpose of this procedure is to outline the correct method for applying surface coatings to Hamilton waterjets. This procedure covers the following:

- Repairing/refurbishing paint on aluminium components.
- Repairing/refurbishing paint on steel and stainless steel components.

In all instances, it is necessary to read the paint manufacturers documentation regarding paint application. The paint manufacturer's documentation provides information such as paint compatibility, paint thickness/ coverage, drying times, recoat times, application method, and safety precautions.

8.2.2 Application of Antifoul Coatings

Application of Antifoul over Grey Gloss

Trilux Antifoul is not normally applied over Grey Gloss, since jets are available ex factory with the Antifoul applied to wetted surfaces. The Antifoul requires an epoxy tie coat, however it is not recommended to apply this tie coat on the Grey Gloss since the epoxy is not compatible with the polysiloxane based technology used for Grey Gloss. It is therefore necessary to remove the Grey Gloss, which is a difficult process due to its high durability. If it is required to apply Antifoul over Grey Gloss then use the following process:

1. Sand to remove the Grey Gloss. If the surface is sanded through to bare metal then repair as per "Bare Metal Refurbishment".
2. Apply a tie coat of Interprotect, or alternatively Intergard 263 or Intercure 200 if Interprotect is unavailable. Masking of the jet impeller and mainshaft is optional since it is OK for overspray to coat the mainshaft and impeller.
3. Apply Antifoul. Up to three layers of Trilux Antifoul may be applied; any further coats do not offer better Antifoul protection.

Reapplication of Antifoul over existing Antifoul.

Trilux Antifoul may be applied directly over old Trilux in good condition. This can be done after thorough cleaning/degreasing and light abrading of the old Trilux. Abrasive hand pads (Scotch-Brite) or wet sanding is an acceptable way of hand abrading the old Trilux.

Use of alternative Antifoul.

Alternative Antifouls may be used provided the paint manufacturer has documented that the Antifoul is suitable for use on aluminium substrate. Foul release coatings (such as International Intersleek) have been successfully used on jet boats, however these need to be applied as a complete paint system.

Trilux can be over coated with most other makes of Antifoul, refer to the Antifoul/foul release manufacturer's specifications and recommendations for details.

ANTI FOULING PAINTS

Do not use copper oxide based anti-fouling paints. Do not paint over the anodes.

8.2.3 Maintenance of Jet Unit paint.

Recommended paint system

The aluminium components of Hamilton Jets are coated with a 3-coat paint system for both the Grey Gloss finish and the black Antifoul finish, as listed in the following table. The system consists of zinc chromate etch surface primer, epoxy primer, and top coat of either Grey Gloss or black Antifoul.

The painted steel and stainless steel components of Hamilton Jets are coated with a 3-coat paint system for both the Grey Gloss finish and the Black Antifoul finish, as listed in the following table. The system consists of surface primer, epoxy primer tie-coat, and top coat of either Grey Gloss or black Antifoul.

In October 2012 the Grey Gloss was changed from a polyester urethane based technology to a polysiloxane technology. The two products are not interchangeable and cannot be applied over each other. Refer to Product Bulletin PRB_08_2012 for details.

Any recoating or repair of the International Paints factory applied systems must be done with compatible products. Refer to the paint manufacturers TDS (technical data sheet) of the coating for compatibility, correct application thickness and minimum/ maximum recoat times.

System		Product	Regional Product Name				
			US/Canada	Europe/UK/Africa	Asia	South America	NZ/Australia
Cleaning		Work Preparation Wash	International 950 Cleaner	Super Cleaner	Super Cleaner	Super Cleaner	Awlgr Awlwash
		Bare metal Solvent Wash	Awlprep Plus Wax and Grease Remover T0115	Awlprep Plus Wax and Grease Remover T0115	Awlprep Plus Wax and Grease Remover T0115	Awlprep Plus Wax and Grease Remover T0115	Awlprep Plus Wax and Grease Remover T0115
Aluminium	Grey Gloss System	Aluminium Surface Primer	Viny-lux Primewash	Abrade, then immediately apply Epoxy Primer	Abrade, then immediately apply Epoxy Primer	Abrade, then immediately apply Epoxy Primer	Etch Primer for Aluminium Alloys
		Primer	Intercure 200	Intercure 200	Intercure 200	Intercure 200	Intercure 200
		Grey Gloss	Interfine 878	Interfine 878	Interfine 878	Interfine 878	Interfine 878
	Antifoul System	Aluminium Surface Primer	Viny-lux Primewash	Abrade, then immediately apply Epoxy Primer	Abrade, then immediately apply Epoxy Primer	Abrade, then immediately apply Epoxy Primer	Etch Primer for Aluminium Alloys
		Antifoul Primer	Interprotect, Intergard 263, or Intercure 200	Interprotect, Intergard 263, or Intercure 200	Interprotect, Intergard 263, or Intercure 200	Interprotect, Intergard 263, or Intercure 200	Interprotect, Intergard 263, or Intercure 200
		Antifoul	Trilux 33	Trilux 33	Trilux 33	Trilux 33	Trilux 33
Steel and Stainless Steel	Grey Gloss System	Surface Primer	Interprime 820	Interprime 820	Interprime 820	Interprime 820	Interprime 820
		Primer	Intercure 200	Intercure 200	Intercure 200	Intercure 200	Intercure 200
		Grey Gloss	Interfine 878	Interfine 878	Interfine 878	Interfine 878	Interfine 878
	Antifoul System	Surface Primer	Interprime 820	Interprime 820	Interprime 820	Interprime 820	Interprime 820
		Antifoul Primer	Interprotect, Intergard 263, or Intercure 200	Interprotect, Intergard 263, or Intercure 200	Interprotect, Intergard 263, or Intercure 200	Interprotect, Intergard 263, or Intercure 200	Interprotect, Intergard 263, or Intercure 200
		Antifoul	Trilux 33	Trilux 33	Trilux 33	Trilux 33	Trilux 33

Bare metal refurbishment - aluminium.

The aluminium castings used in the manufacture of Hamilton Jets require special attention when the coating has been damaged down to bare metal. The surface needs to be very clean and freshly abraded prior to the application of a suitable Primer to ensure a good bond is achieved. Masking of the jet impeller and mainshaft is optional, since it is OK for overspray to coat the mainshaft and impeller.

The area of refurbishment and immediate surroundings should be degreased with a water soluble degreaser and thoroughly rinsed off with clean water. The area should be sanded back to fresh bare metal with 80 to 120 grit aluminium oxide abrasive paper or sanding disc feathering the edges until a smooth surface is achieved. The affected area may be lightly sweep blast cleaned using non-metallic blast media. Appropriate masking is required to ensure that pushrods, bearings and seals are not blasted and that blast media does not contaminate bearings, bushes, and seals.

Warning

Heavy or medium abrasive sweep blasting of aluminium castings will cause excessive material loss from the casting. If sweep blasting is used it must be very light.

The surface should then be blown down or washed to remove sanding debris followed by a solvent wash to leave the surface dry and clean. For repairs to Grey Gloss, mask the Grey Gloss since applying epoxy primer over the Grey Gloss is not recommended. Within 30 minutes a coat of aluminium surface primer (Epoxy Primer or Zinc Chromate Etch primer) should be applied to seal the exposed aluminium surface. Using a Zinc Chromate Etch primer will provide optimum paint system performance in terms of corrosion protection. Etch primer shall only be applied to bare metal, and the coating thickness should be very thin since thick layers of etch primer lack strength; see the manufacturer's specifications and recommendations for application details.

Apply primer. Generally a total of 2 coats of epoxy primer are required to achieve an adequate film thickness.

If filling is required to repair the surfaces, use a suitable marine epoxy filler. The filler should be applied after application of the primer. Sand the filler as required then coat with epoxy primer.

Proceed with application of finish coats to primed surfaces

Bare metal refurbishment - steel and stainless steel.

The area of refurbishment and immediate surroundings should be degreased with a water soluble degreaser and thoroughly rinsed off with clean water.

Abrasive blast the surface clean to achieve a finish to Sa 2.5 (or to equivalents - AS1627.4 Class 2.5, NACE 2, SSPC - SP10). Feather the edges back 20-30mm onto sound substrate. Appropriate masking is required to ensure that aluminium castings pushrods, bearings and seals are not blasted and that blast media does not contaminate bearings, bushes, and seals.

Warning

Heavy or medium abrasive sweep blasting of aluminium castings will cause excessive material loss from the casting. If sweep blasting is used it must be very light.

The surface should then be blown down or washed to remove blasting debris followed by a solvent wash to leave the surface dry and clean. For repairs to Grey Gloss, mask the Grey Gloss since applying epoxy primer over the Grey Gloss is not recommended

Within 4 hours (steel) or 1 hour (stainless steel) of abrasive blasting, a coat of Steel Surface Primer should be applied to seal the surface. Apply the surface primer as per the manufacturer's recommendations.

If filling is required to repair the surface, apply a suitable marine epoxy filler. Sand filler to blend surfaces as required.

Apply primer coat to provide further corrosion protection and good adhesion of the top coat.

Proceed with Application of Finish Coats to Primed Surfaces

Application of topcoats to primed surfaces
Ensure the correct primer has been applied for the intended top coat. Refer "Recommended Paint System".

Ensure topcoat is applied within the minimum and maximum recoat times specified on the manufacturers technical date sheet (TDS). For example in order to achieve good adhesion to Interprotect it is necessary to apply Trilux Antifoul within 7 hours at 23°C. If the Epoxy Primer has been left too long prior to application of Antifoul, it will be necessary to abrade the Epoxy Primer and apply a further coat of Epoxy Primer.

If existing Grey Gloss areas had been masked for application of primer, then remove masking in preparation for over-coating with Grey Gloss.

When hard, the repaired area can be blended to the surrounding surfaces with 120 grit wet and dry sandpaper used wet. Once the surfaces are blended satisfactorily, wash area with clean water and allow to dry.

Apply topcoat of Grey Gloss or Antifoul.

ANTI FOULING PAINTS
Do not use copper oxide based anti-fouling paints. Do not paint over the anodes.

Application of Grey Gloss over existing Grey Gloss
The Grey Gloss is based on polysiloxane technology. When applying Grey Gloss over existing Grey Gloss (in sound condition), the existing Grey Gloss requires abrading to provide a key for the new Grey Gloss. A tie coat is not used, since an epoxy tie coat is not recommended on a polysiloxane coating.

For touch up repairs to Grey Gloss, Interfine 1080 or Interfine 878 may be used. Interfine 1080 is a single pack product, which makes application more convenient. Interfine 878 is a 2 pack product that results in a more durable finish than Interfine 1080. Interfine 878 is recommended where optimum paint durability is required, and particularly for Jet Unit internal water passages. Interfine 878 will provide faster drying times than 1080.

Interfine 878 can be overcoated with Interfine 878 or Interfine 1080, however Interfine 1080 should only be used for touch ups and Interfine 1080 can only be overcoated with Interfine 1080

8.3 Preservation: (Pre-Installation)

ANTI FOULING PAINTS

Do not use Copper Oxide based anti-fouling paints. Do not paint over the anodes.

ANTI-SEIZE COMPOUNDS

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

New jet preservation:

The following storage requirements must be provided to ensure that no damage or deterioration occurs to the jet unit:

1. Temperature must be between 10ºC and 40ºC and above the “dew point” (i.e. no condensation is allowed to form).
2. It is desirable to keep bearing housing components coated with grease; turn the mainshaft 180º once every month to achive this.
3. All exposed steel parts (except for stainless steel parts) should be protected from corrosion. As a corrosion preventative treatment, coat all exposed steel parts with a thin layer of rust preventative oil.
4. To protect hydraulic fittings (except for stainless steel) either:
   a) Coat with oil impregnated corrosion protection tape.
   OR,
   b) Spray with a recognised corrosion protection treatment.
5. To prevent the hydraulic seals bonding to hydraulic shafts, move the steering and reverse cylinders a small amount every 3 months. Lossen the by-pass valves (where fitted) to allow manual movement of the cylinders.

Preparation for use:

To prepare the jet unit for use:

6. Ensure that the bearing housing is greased via the nipple on the top of the bearing housing. Refer: Section 9.6.4“Re-assembly of the Bearing Housing Items18 & 19

Preservation: (post installation)

Do not run the jet unit out of the water unless it is fitted with a dry run kit.

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

If the jet unit is to be laid-up, carry out the following:-

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

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

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

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 MONTHLY.

1. Run the jet unit for a short time.
2. Operate 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.

8.4 Servicing Intervals

Please note the following points:

1. Vessel usage is assumed to be 2000 operational hours per year. Adjust your schedule as necessary.
2. The frequency of the following service items may be varied to suit actual operating conditions. Refer to the appropriate section for details.
   - jet unit examination every 5000 hours refer to ***Section*** 8.5"Servicing Details.

8.4.1 Servicing Intervals (Jet)

Servicing intervals (jet)											
Item	**What to do**	**refer to**	**1st 5 HRS.**	**1 day**	**30 Hrs**	**100 hrs.**	**500 hrs.**	**1 mth**	**3 mths**	**1st 2000 hrs.**	**5000 hrs.**
Intake flow path.	Check for blockages and clear.	8.5.1/1		•							
Thrust bearing.	Lubricate.	8.5.1/2			•			•			
Water seal.	Check for leaks.	8.5.1/4		•							
External anodes.	Check condition.	8.5.1/5									
Screen rake/bearings.	Check / lubricate.	8.5.1/6							•		
Steering system	Check integrity.	8.5.1/7		•				•			
Steering shaft and bushes.	Check / lubricate.	8.5.1/8							•		
Steering crank and steering crank ball.	Check crank ball wear/ grease.	8.5.1/***9***							•		
Steering shaft o-ring.	Check condition.	8.5.1/ ***10***							•		
Steering cylinder and hoses (If fitted).	Check for leaks and condition	8.5.1/ 11	•	•				•			
Steering cables (If fitted).	Check integrity and lubricate.	8.5.1/ 12				•		•			
Steering cable attachments points	Check security of attachment	8.5.1/ ***13***	•	•							
Reverse cylinder shaft	Check condition/ lubricate	8.5.1/ 14							•		
Reverse cylinder and hoses	Check for leaks and condition	8.5.1/ 15	•	•				•			
Reverse cable attachments points	Check security of attachment	8.5.1/ ***16***	•	•							
Driveshaft universals.	Lubricate	***8.5.1/ 17***	**Every 500hrs or as recommended by manufacturer**								
Complete jet unit.	Examine / repair.	8.5.1/ 18								•	•
(Steel hull only).	Insulation check.	8.5/18j)						•			

8.4.2 Servicing Intervals (Hydraulic Reverse System)

Please note the following points:

3. The frequency of the servicing interval for the following items may be varied to suit actual operating conditions. For details, refer to the appropriate section referred to.
   - Hydraulic oil change at 1000 hours may be varied to suit conditions.

Table 8: Hydraulic System Servicing Intervals

Servicing intervals (Hydraulic System)						
Item	**What to do**	**refer to**	**1st 5 hrs.**	**Daily**	**1000hrs.**	**Monthly**
Reverse pump oil	Check volume	8.5.2/1		●		
Reverse pump oil	Change	8.5.2/2	●		●	
Reverse cylinder and hoses	Check integrity	8.5.1/15		●		●
Pump-belts	Check belt tension	8.5.2/5	●			●
Pump-belts	Check belt condition	8.5.2/5		●		●
Cable linkages	Check attachment	8.5.1/16		●		
Reverse control lever	Check freedom of movement	5.9.3		●		
Reverse duct	Check that the reverse duct cuts the jet wash completely in the full astern position. Adjust if required.	6.3				●
Actuation lever	Check that the HSRX lever contacts the stop pin in the "full ahead" reverse control lever" position. Adjust if required.	5.9.3				●

Note:

1. If a new belt has been fitted, the belt tension should be checked and re-tensioned as required over a period of 24 to 48 hours "running-In" period to allow for belt settling. After the initial settling in period, the belt should be checked on a monthly basis and re-tensioned as required.
2. This maintenance schedule has been compiled for normal operating conditions. If the vessel is used in severe conditions where the oil is likely to become contaminated, the oil should be replaced at more frequent intervals.

8.4.3 Daily "Pre Use" Servicing Checks

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

Table 9: Daily Servicing Checks (Jet)

Daily servicing checks	
Area	**Operation**
Intake screen. **Impeller.** **Stator blades.**	**Ensure that the water level is below the inspection cover or overflow preventer before removing the inspection cover.** Check via the inspection cover that they are clear of debris. Check for impeller damage.
Reverse hydraulic cylinder and oil lines.	Check for oil leaks, especially if oil has been added to the system.
Steering system.	**Cable steering option:** Check the freedom of movement of the steering cables. Check for security of attachment of the cable outer mount points. **Hydraulic steering option:** Check for oil leaks from the steering system, especially if oil has been added to the system. Check for security of attachment of the hydraulic oil lines and linkages.
Position indicator senders (transmitters).	Check for loose electrical connections, mountings and linkages if fitted on the system.
Thrust bearing housing.	Check for signs of water leaking from under the bearing housing. (leaking water seal). If the water seal is leaking it should be replaced as soon as possible otherwise water could contaminate the thrust bearing causing corrosion and failure of the thrust bearing.

8.5 Servicing Details

8.5.1 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 levels.

Item No	Item	Operation
1	**Intake flow path**	**Daily; Check for blockages inside intake.** Remove inspection cover and check around the impeller and intake screen for obstructions and debris. ***Refer to Section*** 2.9"Blockages (Debris in the jet unit).
2	**Thrust bearing.**	**Every 30 Hours.** ***(Or monthly if not run for 30 hours).*** Grease with a good quality lithium based ball bearing grease every 30 hours running.Refer: Drawing 85018 Recommendations for Lubricants and Oils Sht1 DO NOT OVER GREASE Use only 20ml grease Normal operating temperature is 50 - 55 ° C (120 - 130 ° F) but the bearing can operate up to 120 ºC satisfactorily, noting that most of the heat is generated by the seals. A faulty bearing will be indicated by noise and vibration rather than temperature.
3	**Marine water bearing**	This is a water lubricated marine bearing and requires no attention. ***Do not run the jet unit out of water as this will damage the bearing and water seal. (Unless fitted with a dry run kit. Refer to Section*** 3.8"Description of the Dry Run System (Optional Extra).
4	**Water seal**	**Daily**; Check for water leaks around the bearing housing drain hole. Visually check for water dripping from under the bearing housing, If water is found, the water seal is defective and should be replaced. If the bearing housing is to be removed, visually check the water seal for wear and replace if there is insufficient material to last to the next inspection. The water seal should not be removed unless it is going to be replaced. The water seal need only be replaced if it is leaking or there is insufficient material to last to the next inspection.

Item No	Item	Operation
5	**Anodes**	Check the following: 1. ***The bonding system:*** For loose or corroded connections and test to ensure a low electrical resistance (Less than 0.2 Ohms). 2. ***All sacrificial anodes:*** Replace when 2/3 eroded. For vessels that are continually afloat, check the condition of external anodes every 3 months. Rapid anode consumption may indicate shore connection problems (see section 4-1 for more information on shore connections). The condition of the jet external anodes is indicative of the condition of the jet internal anodes (assuming anodes were all replaced at the same time) so if the external anodes require replacement (replace when or before they are 2/3 eroded) then the internal anodes should also be replaced. For trailer boats (and other vessels that are afloat only periodically) the anode consumption will be low because the anodes are immersed only periodically. For vessels operating in low salinity water (such as rivers and lakes) the anode consumption will be low due to the low electrical conductivity of the water. **Cleaning anodes** Anodes are typically all replaced at the vessels scheduled maintenance haul-out (typically annually). However if the vessel is only afloat periodically (e.g. trailer boats) or operates in low salinity water then anode consumption will be low. If it is expected that the anodes will be less than 2/3 eroded at the following maintenance haul-out, then the anodes may be cleaned rather than replaced. Clean the anodes as follows: Marine growth should be removed by water blasting. If a hard scale layer forms on the anodes then they should be cleaned using a coarse aluminium oxide sandpaper. Sand anodes by hand, orbital, or disc sander. Do not use a wire brush since this can cause metallic contamination of the anode, making it ineffective.
6	**Screen rake and bearings (if fitted)**	**Check every 3 months**; Check for free operation of the screen rake. Stiffness or binding may be caused by debris caught in the screen or seized screen rake bearings. Grease the screen rake bearings with water repellent grease.

Item No	Item	Operation
7	**Steering system**	**Check integrity daily;** A thorough check of the whole steering system is recommended for freedom and range of movement. **Check every 100 hours or monthly, whichever is soonest**; A thorough check of the whole steering system is recommended every month. Check the whole steering system for freedom and range of movement. Check that the tiller stop is adjusted correctly and that the securing nuts are tight. The clearance between the nozzle and steering housing should be the same in both directions. Adjust by loosening the nuts and sliding the tiller stop sideways as required. ***Refer to Section*** 5.5.3"Tiller Stop Fitting and Adjusting.

Note:

1.The HJ-213 steering nozzle system has been designed with minimum clearance between the nozzle and nozzle housing. This allows optimum steering thrust at any lock with the minimum of thrust loss. It is important to keep the pivot pins and bushes in good condition to maintain clearance.

2.Heavy impacts on the nozzle housing may deform it and cause the steering to jam. The steering system should be thoroughly examined after any incidents where jamming or impact has occurred.

7 (cont'd).	**Steering system (cont'd).**	***If a severe jam-up or impact has occurred, all parts of the steering system should be examined for damage. This should include the remote system and the following items on the jet unit.*** **Steering shaft:-** The steering shaft should be removed and checked for straightness, particularly at the crank end of the steering shaft. **Tiller:-** Check that the tiller is not bent and that the steering arm to steering shaft attachment bolt is secure. **Crank and crank ball:-** Check that the crank is not bent or worn. Replace if damaged. The crank ball should be checked for excessive wear. ***The maximum clearance between the crank ball and the nozzle bush is 1.2 mm (0.047ins).*** **Cotter:-** Check that the tapered surface has no indentations. Replace if required. **Steering nozzle:-** Check that the steering arm on the top of the nozzle is not bent. If any cracks are visible on the underside of the steering arm, or in the web adjacent to the pivot boss, ***the nozzle must not be used and should be replaced.*** If no faults are found, the underside of the steering arm should be crack tested using a dye penetrant technique to prove the integrity of the steering arm before re-use.
8	**Steering shaft and bushes**	**Check every 3 months**; Lightly grease the shaft and bushes. Check the play in the steering shaft, it should be a running fit in the bushes with no binding.

Item No	Item	Operation
9	**Steering crank and steering crank ball.**	**Check every 3 months**; Thoroughly check for excessive wear of the steering crank ball. The maximum clearance between the crank ball and the nozzle bush is 1.2mm (0.047ins). Check for security of attachment and grease with water repellent grease.
10	**Steering shaft o-ring.**	**Check every 3 months**; Check the steering shaft o-ring by looking for signs of leaking and by assessing lateral play. Replace the o-ring if excessive lateral play is found, or if signs of leaking around the o-ring is noticed.
11	**Steering cylinder and hoses (if fitted).**	**First 5 hours and then monthly**. Check for leaks, damage or corrosion. Methodically check the steering cylinder and attached hoses for any signs of oil leaks, damage or corrosion of the fittings. Repair as necessary. Refer to the controls manual supplied with this jet unit for information on hose replacement.
12	**Steering cables (if fitted).**	**Check every 100 hours or monthly, whichever is soonest**; Check the steering cable for freedom of movement. If necessary disconnect to check and grease the cable.
13	**Steering cable attachment points.**	First 5 hours and daily; Check the cable attachment points and the cable outer mount points for security of attachment.
14	**Reverse cylinder shaft**	**Check every 3 months**;; Examine the reverse cylinder shaft for wear and pitting. Grease the shaft with a water repellent grease. ***Refer to Section*** 9.3.1"Reverse Cylinder - Refit to the Jet Unit.
15	**Reverse cylinder and hoses.**	**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.
16	**Reverse cable attachment points.**	First 5 hours and daily; Check the cable attachment points and the cable outer mount points for security of attachment.
17	**Driveshaft universals.**	**Every 500 hours; *Or as recommended by the manufacturer.***

Item No	Item	Operation
18	Jet unit	**First 2000 hours operation thereafter,** **Every 5000 hours operation.** 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:- **a) Impeller blades - Check wear clearance.** • Removed 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).

Radial clearance		
New min clearance	New max clearance	Max wear
0.25	0.55	0.82

b) Impeller - Check for wear and damage.
- Look for signs of corrosion and erosion damage on all surfaces of the impeller.
- Check the impeller leading and trailing edges for damage.

c) Reverse duct - Examine.
- Check that the reverse duct pivot pins are tight and that there is no binding in the bushes.
- These items are to be removed in accordance with ***Section*** 9.2.1"Reverse Duct Removal of this manual.

d) Splash guard - Check.
- Check that the splash guard is secure and has adequate clearance on the reverse duct.

Item No	Item	Operation
18 (cont'd).	Jet unit (cont'd).	**e) Steering cables - Disconnect.** • These items are to be removed in accordance with overhaul section of the controls manual. **f) Tailpipe, nozzle & nozzle housing - Removal.** **These items are to be removed in accordance with Section** 9.2"Reverse Assembly Removal and Overhaul. **g) Marine water bearing - Inspect.** • Place the bearing sleeve inside the marine water bearing and use feeler gauges to measure the diametrical clearance. • Inspect the marine water bearing for scoring of localised wear. Replace if excessively worn.

Diametrical clearance		
New min clearance	New max clearance	Max wear limit
0.05	0.28	0.4

h) Jet unit paintwork- Examine and repair.

- The main body of the jet unit is constructed from Silicon - Aluminium Alloy (LM6) which is resistant to corrosion from salt water.
- The castings are finished in an epoxy paint.
- Periodic cleaning down, wire-brushing and repainting may be necessary depending on water conditions prevailing, and extent of use.
- When the vessel is on the slip, preferably annually, (or 5000 hours, whichever is soonest) the complete jet unit should be inspected internally and externally for faults, corrosion, or breakage's. Clean down and repaint the castings where necessary.

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.

ANTI FOULING PAINTS

Do not use Copper Oxide based anti-fouling paints. Do not paint over the anodes.

Item No	Item	Operation
18 (cont.)	**Jet unit (cont.)**	**i) Refit components.** • Refit components in accordance with the overhaul section of this manual. Follow the recommendations on Drawing "85113 Recommendations for nut and Locking screw Tightening Torques" and ***Section*** 8.7"Threaded Fasteners, for thread tightening torque's joint lubrication, thread and joint locking and Drawing "85018 Recommendations for Lubricants & Oils" for bearing housing lubricants and hydraulic fluids. **j) Insulation checks. (Steel hulls only).** • Carry out insulation checks as per ***Section*** 4.3.2"Checking the Insulation on a monthly basis.

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

- Decrease the interval between maintenance periods if the amount of dirt and sand in the water increases.
- Increase the interval between maintenance periods if the amount of dirt and sand in the water decreases.
- Decrease the interval if excessive wear was found during the jet unit internal inspection **(Item 18 above)**.
- Increase the interval between maintenance periods if minimal wear was found during the jet unit internal inspection **(Item 18 above)**.

8.5.2 HSRX Controls Servicing Details

Item No	Item	Operation
1	**HSRX pump oil check**	Daily; Unscrew the filler cap on the top of the pump reservoir (The filler cap is fitted with an integral dipstick) and check the oil level. Insert a funnel and top up the reservoir with oil to the 'MAX' dipstick mark, with an approved oil. Refer to Drawing “85018 Recommendations for Lubricants & Oils”. Should the oil show signs of discoloration, contamination or degradation, the oil should be changed.
2	**HSRX system hydraulic oil replacement**	**Change the HSRX system oil every 1000 hrs (oil changes may be varied to suit operating conditions).** **To change the oil, carry out the following procedure:** 1. Place a suitably sized container beneath the tank. 2. Disconnect the jubilee clip [H4] securing the hose [H3] from the jet mounted oil cooler to the pump. 3. Remove the hose [H3] from the pump and allow the oil to drain from both the pump oil tank and the oil cooler, into the collection container. 4. Once the oil has drained out, refit the hose [H3] to the pump and tighten the jubilee clip [H4]. ***Refer to Section*** 8.5.2“HSRX Controls Servicing Details also r***efer to Figure Hose Connection Schematic.***

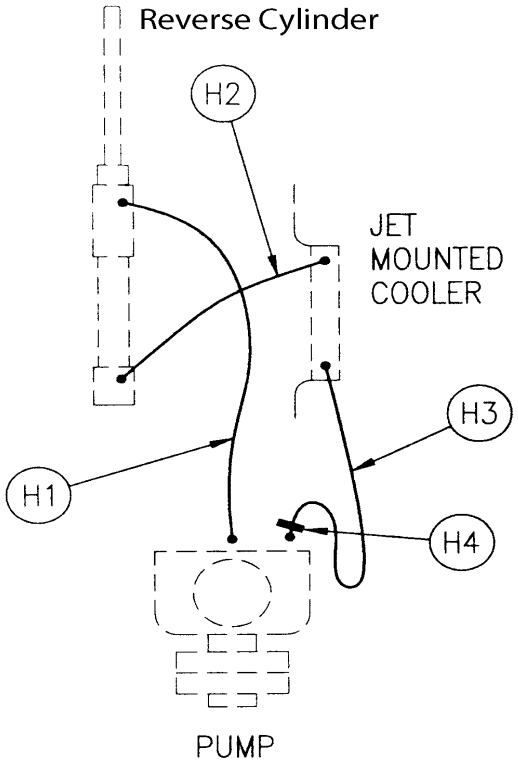


Figure 19: HSRX Hose Connection Schematic

Item No	Item	Operation
3	Filling the HSRX system with oil	The HSRX system is factory tested and delivered completely assembled and filled with oil. *The system oil capacity is approximately 0.9 litres of oil*.

CAUTION

After completion of maintenance on the HSRX system and when the Jet and Pump are first run, the oil level will drop rapidly in the Reservoir. To avoid the Pump running dry the system should be filled as full as possible before the Jet and Pump are run.

1. *Refer to Section 8.8"Recommended Oils and Lubricants.*
2. *All oil should be filtered to prevent the ingress of contaminants.*
3. *When the jet and pump are first run the oil level will drop rapidly in the reservoir. To avoid the pump running dry, the system should be filled as full as possible before the jet and pump are run.*

Fill the oil cooler:

Refer to Hose Connection Schematic shown in *Section 8.5.2"HSRX Controls Servicing Details, Figure 19:"HSRX Hose Connection Schematic*.

Ensure that the pump is empty of oil.

1. Disconnect the HSRX cylinder to cooler return hose [H2] AT THE COOLER return port end.
2. Disconnect the feed hose [H3] to the oil cooler AT THE PUMP and ensure the free end remains higher than the cooler return port.
3. Place a funnel in the cooler return port and, ensuring air can escape, fill the cooler.
4. Reconnect the hoses [H2] and [H3] to the pump and cooler keeping the system as full of oil as possible.

Fill the oil pump reservoir:

Unscrew the filler cap on the top of the pump reservoir. (The filler cap is fitted with an integral dipstick). Insert a funnel and fill the reservoir with oil to the 'MAX' dipstick mark.

The JHPU should now be run to purge air from the system. **It is important that this is carried out as shown in Section *8.5.2"HSRX Controls Servicing Details.***

Item No	Item	Operation
4	Purging the HSRX system	**Whenever maintenance activities have been carried out on the HSRX reverse system, air will be trapped within the system, it is necessary to purge the system. It is important that the following actions are carried out to prevent running the HSRX oil pump dry:-** ***On engine start-up:*** With the engines set to idle and the vessel securely moored in deep water. 1. Have someone monitoring the reservoir and refill as required. 2. Idle the engine at the lowest possible RPM. 3. Run the pump for 5 minutes approximately without moving the controls - this will purge air from the oil cooler. Refill the oil reservoir. 4. Start the engine, operate the controls to stroke each cylinder at least 10 times. This should purge any remaining air out of the system. 5. Top up the pump reservoir. 6. Check the system to ensure that it is not overheating. It should be possible to hold your hand on any component for at least 2-3 seconds.
5	HSRX pump drive belts	**Check the belt tension monthly.** **Refer to Drawing *"CT-HPU-01001 Hydraulic Power Unit*.** .  Over tensioned v-belts will cause reduced pump and jet unit bearing life. ***NOTE:*** 1. ***Belt adjustment should be carried out without the engines running.*** 2. ***If a new belt has been fitted, the belt tension should be checked and re-tensioned as required over a period of 24 to 48 hours "running-In" period to allow for belt settling.*** 3. ***After the initial settling in period, the belt should be checked on a monthly basis and re-tensioned as required.***

Item No	Item	Operation
5 (Cont.d)	HSRX pump drive belts (Cont.d)	*To check the v-belt tension:* The belt tension is correct when a 2.4 mm deflection is achieved when a load of 580 to 870 gr (1.3 to 1.9 lbs) is applied to the centre of the belt. *To adjust the v-belt tension:* **To adjust the belt tension carry out the following procedure:-** 1. Slacken the nut [8] at the elongated slot end of the adjusting link [4]. 2. Slacken the nut [8] at the opposite end of the adjusting link [4]. 3. Slacken the screw [9] attaching the support bracket [3] to the base of the pump. 4. Tension the belt by levering the pump body away from the intake to achieve the tension required above. 5. Tighten the nut [8] at the elongated slot end of the adjusting link [4], which secures the pump [1] to the adjusting link [4] and torque load. 6. Tighten the nut [8] at the opposite end of the adjusting link [4], which secures the adjusting link [4] to the bearing housing and torque load to the recommended torque. 7. Tighten the screw [9] attaching the support bracket [3] to the base of the pump and torque load to the recommended torque. *To check the v-belt condition:* Mark or note a point on the belt. Work your way around the belt, checking for cracks, frayed spots, cuts or unusual wear patterns. Check the belt for excessive heat. While the belt does get hot during operation, if it is too hot to touch, the cause of the overheating should be investigated. The hand can tolerate up to about 60°C (140°F), the maximum temperature at which a properly maintained belt should operate. The belt should be replaced if there are obvious signs of cracking, fraying or unusual wear.

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

- Decrease interval between maintenance periods if excessive wear was found during inspection of the controls system.
- Increase the interval between maintenance periods if minimal wear was found during inspection of the controls system.

8.6 Tools

8.6.1 Standard Recommended Tools

The following tools are required for normal maintenance activities:

1. Torque wrench. ¾"sq/dr.
2. Torque wrench. ½" sq./dr.
3. Ratchet, torque bar and short extension ½" sq./dr.
4. Sockets A/F ½" sq./dr., 13 mm, 19 mm, 24 mm.
5. Spanners A/F. 1 x 9 mm, 2 x 17 mm, 1 x 24 mm.
6. Allen keys 1 x 6 mm and 1 x 8 mm.
7. Pliers long nose.
8. screw driver large, flat blade.
9. Mallet, rubber.

8.6.2 Special Tools

The following tools are included as part of tool kit (Part No 106013) for the HJ-213 jet unit:

1. Puller, coupling and impeller.
2. Puller, bearing.
3. Reaction arm - coupling.
4. Socket 30 AF x ¾" sq./dr.
5. Bolts M8 x 55 long zinc plated (2).
6. Nuts M8 zinc plated (2).
7. Bolts M10 x 55 long zinc plated (2).
8. Nuts M10 zinc plated (2).

8.7 Threaded Fasteners

Drawing "85113 Recommendations for nut and Locking screw Tightening Torques".

TIGHTENING TORQUES:
Ensure that all threaded fasteners are tightened to the correct torque as described in drawing 85113 or the relevant assembly drawings.

Tightening torque's for threaded fasteners:

1. The tightening torque's for special fasteners are shown on the relevant assembly drawings.
2. Ensure that recommended tightening torque's are always used.

Thread locking agents:

Most fasteners require thread locking agents to prevent loosening.

1. Most applications are described on the drawing above.
2. Special applications will be shown on the relevant assembly drawing.

8.8 Recommended Oils and Lubricants

Recommended oils and lubricants required are specified on Drawing "85018 Recommendations for Lubricants & Oils".

Note: Do not use brake fluid or heavier viscosity oils.

Recommended hydraulic oils:

A mineral base hydraulic oil is recommended which contains anti-wear additives of a type that are active under boundary lubrication conditions at low temperatures. Oil viscosity should be 20cS approximately at 40°C and 4cS at 100°C. Normal operating temperature should lie between +30°C and +60°C.

For recommended oils, refer to the drawing referred to above:

Note: Any hydraulic fluids meeting "General Motors Power Steering Specifications" are suitable.

Table 10: Other Lubricants

Type	Equivalent
B.P. Energrease MM EP2.	or similar.
Anti Sieze Compound.	Rocl, YIGG, Jet-Lube, Nikal or similar.

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.

Section 9
Overhaul

Note: The maintenance operations detailed in this section should be carried out when the vessel is on a slip or in dry dock.

Overhaul of the jet unit and controls system should only be carried out after an examination indicates the need for an overhaul. **Refer to *Section*** 8"Maintenance for details of how to examine the jet unit.

The overhaul section of the controls manual contains additional information.

The following overhaul procedures can be carried out on this jet unit:

1. ***Reverse assembly removal and overhaul.*** Sect."9.2.
2. ***reverse cylinder overhaul.*** Sect."9.2.4.
3. ***steering assembly removal and overhaul.*** Sect."9.4.
4. ***tailpipe area overhaul.*** Sect."9.7.
5. ***bearing housing assembly overhaul.*** Sect."9.6.
6. **HSRX hydraulic reverse system overhaul.** Sect."9.11.

Prior to commencement of overhaul: Disconnect and remove all controls equipment attached to components being overhauled. This prevents damage to the less robust control equipment.

Take care to identify electrical or hydraulic connectors so they can be correctly replaced.

Cover all connectors to prevent entry of dirt or loss of hydraulic oil.

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

1. Overhaul the driveshaft (Not described, refer to driveshaft manufacturers manual).
2. Overhaul the reverse assembly.
3. Overhaul the steering assembly.
4. Overhaul and refit the bearing housing assembly to the jet unit.
5. Overhaul and refit the tailpipe assembly to the jet unit.
6. Overhaul and refit the transom plate.
7. Refit the steering assembly.
8. Refit the reverse assembly.
9. Refit the driveshaft (Not described, refer to driveshaft manufacturers manual).
10. Removal of the HSRX pump assembly from the jet unit.
11. Refit the HSRX pump assembly to the jet unit.

On completion of overhaul: Perform the appropriate commissioning of the jet unit and controls system as described in ***Section*** 6"Commissioning.**Commissioning the Jet Unit and Control System.**
It is important that a commissioning of the vessel is carried out on completion of an overhaul activity as adjustments and connections may have been altered during the overhaul operation.

Tools: All tools required for the overhaul of the jet unit are shown on Drawing "HJ-213-11-000 Tool Kits".

9.1 General Information

Care of jet unit paintwork:—All Castings on the jet unit are of Silicon-Aluminium Alloy (LM6) which exhibits good resistance to salt water corrosion.

CAUTION

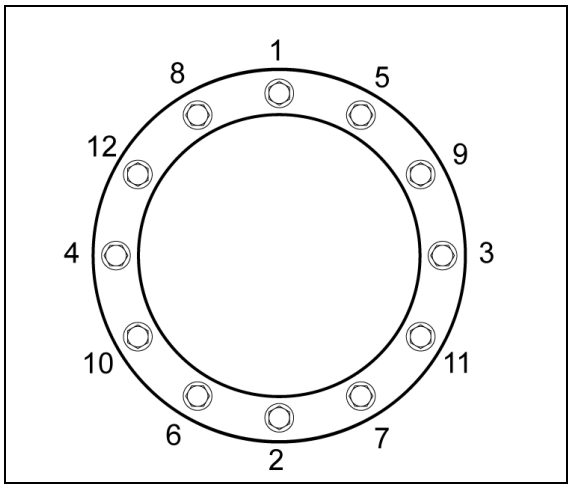
Anti Fouling Paints
Do not use Copper Oxide based anti-fouling paints. Do not paint over the anodes.

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.

Anodes:—Leave all anodes unpainted.

9.1.1 Torquing Sequence of Nuts



Flange nuts must be tightened in the correct sequence so that the flange pulls up square.
Where no specific sequence is given in the manual, do the following:

- Fit 4 nuts (top, bottom, left side, right side) and tighten each 1 turn at a time until the flanges pull together.
- Fit all remaining nuts and hand tighten only.
- Working around the flange, in a crosswise sequence as shown, Tighten nuts to the specified torque.
- Repeat the above torquing sequence until no further movement of the nut occurs.

9.2 Reverse Assembly Removal and Overhaul

Note:

1.The maintenance operations detailed in this section should be carried out when the vessel is slipped.

2.For fault finding with the reverse system, also refer to the controls manual supplied with this jet unit.

3.For the overhaul of the reverse cylinder refer to Section 9.2.4“reverse cylinder Overhaul shown in this manual.

9.2.1 Reverse Duct Removal

Refer to Drawing
“HJ-213-07-001 Reverse assembly”.

1. Disconnect the Morse cable, ball joint [36] from the HSRX handle [31] located on the inboard end of the reverse cylinder.
2. Slacken the 2 nyloc nuts [38] that clamp the Morse cable to the cable mounting plate [26] and remove the Morse cable.
3. Retighten the 2 nyloc nuts [38] to ensure that these are not lost.
4. Unscrew and loosen the reverse cylinder retaining nut [11] from the rear of the reverse cylinder.
5. Whilst supporting the reverse duct [1], remove the nyloc nut [42] and flat washer [43] attaching the reverse cylinder shaft to the stud [41] fitted to the starboard upper shoulder of the reverse duct.
6. Remove the bronze bush [44] from the centre of the reverse cylinder shaft [10] and retain.
7. Remove the reverse cylinder shaft [10] from the stud [41] on the reverse duct, ensuring that the second flat washer [43] is also removed from the stud [41].
8. Lower the reverse duct.
9. Remove the pivot bolts [4] and flat washers [3] attaching the reverse duct to the tailpipe.
10. Remove the reverse duct [1] from the jet unit.

9.2.2 Reverse Duct Overhaul

1. Check the reverse cylinder shaft assembly attachment stud [41] fitted to the upper starboard side of the reverse duct, for security of attachment. Replace if loose, worn or bent.
2. If the bronze bush [44] fitted to the end of the reverse cylinder shaft is bent, worn or damaged, it should be replaced.
3. If the reverse duct pivot [2], pivot bushes [5] and washers [3] are worn or damaged, these should be replaced.

Replacing the reverse duct pivots [2] and pivot bushes [5].

1. Check the threads and shank of the reverse duct attachment bolts [4] for thread damage and wear. Repair or replace if these show any signs of wear or damage.
2. Remove the inner shouldered reverse duct pivots [2] from the reverse duct arms. These should be a loose fit in the pivot bushes [5]. Check the reverse duct pivots [2] and pivot bushes [5] for signs of excessive wear. Replace if worn or damaged.
3. If the pivot bushes [5] require replacement, ensure that the reverse duct is removed from the jet unit.
4. Drift out the old pivot bushes [5] from the reverse duct arms.
5. Ensure that the bores in the reverse duct arms are cleaned of old loctite and any corrosion.
6. Repair any paint damage to the bore.

Note: Do Not apply Activator to the bores or the pivot bush [5] as the activator will react with the painted finish in the bores.

7. Apply Loctite 680 to the whole surface of the bore and also to the outside of the pivot bush [5] before fitting the bush.
8. Fit the new pivot bushes [5] into the bores and rotate the bushes to spread the Loctite evenly. Press the bushes firmly home until the the outer end of the bush is flush with the edge of the bore.

Note: There are to be NO dry areas between the bush [5] and the bore of the reverse duct arms once the bush is fitted.

9. Clean off any excess Loctite.

Replacing the anodes [46] on the reverse duct arms.

Refer to Drawing "HJ-213-13-002 anode Location Drawing".

To replace the anodes [46] fitted to the reverse duct arms, carry out the following actions:-

1. Check the anodes [46] attached to the outer face of the reverse duct arms. If these anodes are less than half their original size, they should be replaced.
2. To replace the anodes, carry out the following actions:-
   a) Unscrew and remove 2 x nuts [23] and spring washers [9] from studs [41] securing the anode [46] to the reverse duct [1].
   b) Remove the anode [46].
   c) Clean up the contact area where the anodes are located to remove any loose paint or corrosion. Repair the paint finish.
   d) Fit a new anode [46] onto studs [41].
   e) Secure with 2 x spring washers [9] and nuts [23] and torque load to the recommended torque.
   f) Carry out items a) to e) for the second anode.
3. If the anodes are in good condition, ensure that they have not been painted over . If a coating has built up on the anodes, scrub down with a wire brush to remove scaling.

9.2.3 Reverse Cylinder Removal

Refer to Drawing.
"HJ-213-07-001 Reverse assembly".

Also refer to the controls manual overhaul section for information on the reverse assembly.

1. Ensure that the Morse ball joint [36] has been disconnected from the lever [31].
2. Disconnect the hose from the cooler to the reverse cylinder connector [34] and fit blanking plugs, ***ensuring that the hose is removed from the cooler connector prior to removing the hose from the reverse cylinder.***
3. Disconnect the hose from hose connector [32] on the HSRX reverse cylinder and fit blanking plugs.
4. Remove the reverse cylinder retaining nut [11] and washer [13] (which was loosened at ***Item 4***. in ***Section*** 9.2.1"Reverse Duct Removal above) from the reverse cylinder shaft [10].
5. The reverse cylinder can now be removed from the transom by pushing the cylinder forwards into the vessel and out of the two resilient mounts [14].
6. Remove the resilient mounts [14] from the jet unit intake.
7. Refit the retaining nut [11] and washer [13] to the reverse cylinder fronthead [15].
8. The reverse cylinder can now be removed from the vessel for further in-depth maintenance.

9.2.4 Reverse Cylinder Overhaul

Dismantling the reverse cylinder assembly:

The reverse cylinder need only be dismantled if it is suspected that a seal has failed and hydraulic oil is found leaking along the piston shaft assembly from either end of the cylinder. This indicates that the piston shaft Seals are defective and must be replaced.

Note: All marine growth must be removed from the reverse cylinder shaft using Scotchbrite or 800 and 1200 Grit water paper prior to dismantling the reverse cylinder.

1. Ensure that the hose connections have been disconnected from the HSRX reverse cylinder. **Refer to Section** 9.2.3"reverse cylinder Removal.
2. Ensure that the reverse cylinder shaft assembly [10] has been disconnected from reverse duct [1]. **Refer to Section** 9.2.1"reverse duct Removal.
3. To remove the reverse cylinder from the jet unit, **Refer to Section** 9.2.3"reverse cylinder Removal.
4. Ensure that the cable clamp kitset [37] has been disconnected from the cable mount plate [26].
5. Remove the Morse cable ball joint from the HSRX handle [31].
6. Slacken the set screw [30] securing the HSRX handle in position and remove the HSRX handle [31].
7. Remove the v-ring [40] from the end of the spool at the backhead end of the reverse cylinder. **Note the correct orientation of the v-ring [40] so that it is refitted correctly.**
8. Remove the pressure relief valve [35] from the backhead [22] by unscrewing the knurled nut on the top of the protective cover [51].
9. Remove the protective cover from over the pressure relief valve [35]. The pressure relief valve can be unscrewed and removed from the backhead.
10. The nipple [32] fitted to the fronthead [15] can be left fitted unless it requires replacing.
11. The pushlock fitting [34] must be removed with the hose from the cooler when removing the hoses.
12. Remove the M6 nuts [28] and spring washers [29] securing the cable mount plate [26] to the backhead and remove the cable mount plate off the 4 cylinder tie rods [27].
13. The backhead [22] can now be withdrawn off the cylinder [19].
14. Remove the bearing [25] from the backhead [22].
15. Remove the HSRX spool [20] from the cylinder [19].
16. Remove the cylinder [19] from the fronthead [15].
17. Withdraw the shaft assembly [10] from the fronthead [15].

Note: The reverse cylinder shaft assembly is not to be dismantled further and should only be replaced as a complete item.

18. Unscrew the 4 x threaded reverse cylinder tie rods [27] from the fronthead [15].
19. Check the stop pin [39] fitted to the backhead [22], for damage, wear and security of fitment. This pin does not need to be removed unless worn, loose or damaged.
20. Remove and discard all o-rings and seals.
21. Thoroughly clean and inspect all components for wear and damage and replace as required. If dimensions do not meet the criteria below, components must be replaced:-
    a) The spool shaft where the Viton shaft o-ring [24] contacts, should be free of any damage and measure no less than ø11.90 mm.
    b) The seal bore in the backhead [22] should measure no more than ø20.033 mm on MK2 cylinders.
    c) The shaft [10] should measure no less than ø19.93 mm.
    d) Cylinder bore should be no more than ø32.00 mm.

Note: Recommendations regarding use and fitting of seals:

- ***Ensure that all metallic particles and other contaminants have been removed from the component into which the seal is being fitted.***
- ***Ensure that the hydraulic system to which components are fitted is free from metallic particles or other contaminants.***
- ***Check that the seal housing is free from damage likely to harm the seal. Remove all sharp edges and burrs from metal parts paying particular attention to ports, grooves and threads over or through which the seal must pass during assembly.***
- ***Clean all seal housing areas. Check that other surfaces adjacent to the passage of the seal on fitting are free of dirt, swarf or other contaminants.***
- ***Where the difference between a thread diameter over which as seal must pass and the seal diameter is small, use some form of protection over the thread, such as a fitting sleeve made of hard plastic.***
- ***Ensure that the seal has not been stored so that it has been distorted. Store seals in a cool, dry and dark place.***
- ***Liberally smear the seal and metal component with a clean fluid of the appropriate type, or a compatible grease, before fitting the seal.***
- ***Where seals, fitted to sub-assemblies such as pistons, are awaiting further fitting operations, ensure that the seals are not subjected to any misaligned or localised loading which will cause local deformation. Ensure sub-assemblies remain clean.***
- ***The use of metal levers is not recommended, but should they be used, it is imperative that they are completely smooth and free from nicks and burrs. When using them, ensure that the metal surfaces adjacent to the seal are not damaged.***

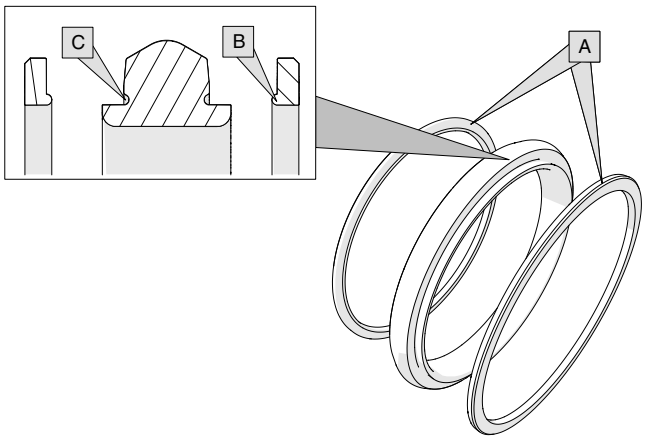
Assembly of the reverse cylinder:

Refer to Drawing
"HJ-213-07-001 Reverse assembly"

Recommended oils and greases to be used for assembly of the H.S.R.X. reverse assembly.

- ***A. BP Energrease MM EP2 or equivalent.***
- ***B. Mineral based oil such as recommended hydraulic oil. Refer to Drawing "85018 Recommendations for Lubricants & Oils.***
- ***C. Non seize compound. (Rocl YIGG, Jet-Lube, Nikal, etc.).***

1. Grease the o-ring seal [18] ***{Using A}*** and fit to the backhead [22].
2. Grease a second o-ring seal [18] ***{Using A}*** and fit to the fronthead [15].
3. Grease and fit the piston seal [21] to the shaft assembly [10].



When fitting the three part piston seal, it is important that the two anti-extrusion rings [A] are fitted the correct way round.
The locating barb on the anti-extrusion ring [B] must fit into the groove on the sealing ring [C].

4. Grease and fit the 'U' seal [17] to the fronthead, ensuring that the seal is correctly orientated. Refer to Drawing "HJ-213-07-001 Reverse assembly Hydraulic Reverse. Sht 1".
5. Grease and fit the o-ring [24] to the backhead, ensure that the U seal is correctly orientated.

6. If the stop pin [39] has been removed, apply 7471 Primer T Activator to one end of the stop pin and allow to dry. Apply Loctite 680 to the same end of the stop pin and fit the stop pin to the backhead [22].
7. Apply Loctite 263 to one end of the 4 x threaded tie rods [27] and tighten into the fronthead [15].
8. Grease both outside ends of the cylinder [19] ***{Using A}*** and push fit one end of the cylinder into the fronthead [15].
9. Lubricate the shaft assembly [10] ***{Using B}*** and fit to the fronthead [15].
10. Ensure that the dot on the outer end of the reverse cylinder shaft assembly is positioned uppermost.

Note: If the dot on the reverse cylinder shaft assembly is wrongly positioned, the reverse cylinder will not function correctly.

11. Fit the bearing [25] to the backhead [22].
12. Lubricate the Spool [20] ***{Using B}***.
13. Whilst supporting the o-ring [24] in the backhead, insert the end of the spool [20] fitted in the end of the cylinder, through the bearing [25] and o-ring [24] already fitted to the backhead.
14. Grease and fit a new o-ring [50] to the o-ring groove located on the front face of the backhead.
15. assemble the backhead and spool combination onto the cylinder and fronthead combination.
16. assemble the cable mounting plate [26] to the backhead, ensuring that the cable mounting plate is correctly located over the stop pin [39]. Secure with nuts [28] and spring washers [29].

Note: Ensure that the cable mounting plate [26] is correctly orientated for either left hand or right hand cable fit. Refer to Section 9.3.2"reverse duct - Refit To jet unit. Sub Section "Re-positioning the cable mount plate:.

17. Hold the reverse cylinder upright with the reverse cylinder shaft assembly at the top. Ensure that the reverse cylinder shaft assembly is fully retracted.
18. Rotate the spool [20] through 360° (this will help to centralise the bearing in the backhead).
19. Torque load the 4 x M6 nuts [28] securing the backhead and cable mount plate to the cylinder.
20. Fit the v-ring [40] to the spool at the backhead end of the reverse cylinder. **Note the correct orientation of the v-ring [40]. Refer to Drawing** "HJ-213-07-001 Reverse assembly".
21. Fit the HSRX handle [31], ensuring that the boss on the handle is facing towards the reverse cylinder.
22. Fit the set screw [30] to the handle using Loctite 263 and tighten to secure the HSRX handle.
23. Fit the back pressure valve [35] to the backhead [22] ensuring that the o-ring is fitted around the base of the relief valve.
24. Fit the protective cover over the relief valve ensuring that the base of the cover fits correctly over the o-ring at the base of the relief valve.
25. Fit the knurled nut to the top of the protective cover and screw the knurled nut onto the threaded part of the pressure relief valve until the o-ring on the underside of the knurled nut sits snugly inside the top of the protective cover.
26. If the nipple [32] has been removed during overhaul, refit with a new bonded seal [33]. Refit to the fronthead [15] and tighten.
27. If the pushlock fitting [34] and cooler hose has been removed during overhaul, refit to the backhead [22] and tighten.
28. Grease a new o-seal [12] and fit to the reverse cylinder retaining nut [11] and ***{Coat threads with C}***. Loosely refit the reverse cylinder retaining nut [11] and special washer [13] to the fronthead [15].
29. The HSRX reverse cylinder can now be re-fitted to the jet unit.
30. **If possible, workshop test the reverse cylinder before re-installing into the vessel. The workshop test pressure for the cylinder is 2500psi (173 Bar)**.

9.3 Reverse Assembly Re-Fitting

Refer to Drawing
"HJ-213-07-001 Reverse assembly".

9.3.1 Reverse Cylinder - Refit to the Jet Unit

1. Remove the reverse cylinder retaining nut [11] and special washer [13] from the fronthead [15].
2. Ensure that a new scraper seal [12] has been fitted to the reverse cylinder retaining nut [11].
3. Ensure that a new o-ring [16] has been fitted to the fronthead [15].
4. Lightly smear the fronthead, from the o-ring to the threaded portion with a suitable grease.
5. Ensure that the 2 resilient mounts [14] are fitted to either side of the transom, where the reverse cylinder passes through.
6. From inside the vessel, pass the reverse cylinder shaft assembly [10] through the resilient mounts fitted to either side of the transom, until the shoulder on the fronthead [15] is firmly against the inboard resilient mount.
7. Ensure that the resilient mounts are still in position on the transom.
8. From outside the vessel, fit the special washer [13] and the reverse cylinder retaining nut [11] onto the reverse cylinder shaft [10] and screw onto fronthead by a few threads to retain the reverse cylinder in position until the reverse cylinder is connected to the reverse duct.
9. Reconnect the hydraulic hoses to the reverse cylinder, ensuring that the hose from the cooler to the pushlock connector [34] on the backhead is connected to the connector [34] on the backhead first.

9.3.2 Reverse Duct - Refit to Jet Unit

Reverse duct:

1. Ensure that the thread and surfaces of the reverse duct pivot bolts [4], pivots [2] and the reverse duct pivot bushes [5] are clean.
2. Coat the threads of the pivot bolts, reverse duct pivots, pivot bushes and the reverse duct pivot washers [3] with a recommended marine grease.
3. With the pivot bushes [5] already fitted to the reverse duct arms, from the inside of the reverse duct arms, fit the reverse duct pivots [2] inside the reverse duct pivot bushes [5] and push fully home inside the reverse duct arms. Ensure that the the shoulder on the reverse duct pivots [2] are located on the inside of the reverse duct arms.
4. Position the reverse duct to align the reverse duct pivot bushes [5] fitted in the reverse duct with the threaded holes in the tailpipe.
5. Fit flat washers [3] to each of the pivot bolts [4] prior to fitting the bolts.
6. Insert the pivot bolts [4] using Loctite 222 to secure the reverse duct to the tailpipe ensuring that the pivot bushes, pivots and washers are correctly located.
7. Tighten the pivot bolts [4] to the correct torque. (**95Nm {70lbs/ft}**) ("85113 Recommendations for nut and Locking screw Tightening Torques" refers).
8. Raise and support the reverse duct and reconnect the reverse cylinder shaft [10] to the stud [41] located on the starboard upper side of the reverse duct, ensuring that flat washer [43] is fitted onto the stud [41] first, prior to fitting the shaft [10].

Note: Ensure that the centre punch mark on the end of the reverse cylinder shaft is at the top of the shaft when reconnecting the shaft to the reverse duct, stud [41].

9. With the reverse cylinder shaft [10] fitted to the stud [41], insert the bronze bush [44] through the reverse cylinder shaft and over the stud [41].

10. Fit a second flat washer [43] to stud [41] and secure with nyloc nut [42] and torque load to the recommended torque.
11. Apply Loctite 569 to the threads of the fronthead [15] and force the loctite into the threads to thoroughly fill all the threads ***exept the first thread***.
12. Tighten the reverse cylinder retaining nut [11] onto the backhead [15] and ***torque load to the recommended torque (40Nm - 30ft/lbs).***
13. Refit the splash guard [7] to the studs [8] fitted to the tailpipe flange and secure using spring washers [9] and nuts [23]. Tighten to the recommended torque.
14. Carry out a full functional check of the reverse system to ensure correct operation and full range of movement.

Morse cable - Connect:

1. Ensure that the cable mount plate [26] is correctly orientated for either port or starboard positioned Morse cable. (This plate can be fitted to the reverse cylinder either facing to port or to starboard. ***(See paragraph "Re-positioning the cable mount plate" overleaf)***.
2. Slacken the 2 nuts [38] that clamp the Morse cable to the cable mount plate [26] and refit the Morse cable through the clamp.
3. Attach the Morse cable ball joint [36] to the lever [31] located on the end of the reverse cylinder and tighten the attachment nut.
4. Retighten the 2 nyloc nuts [38] that attach the clamp bracket on the cable mount plate [26].

Re-positioning the cable mount plate:

Should the cable mount plate be wrongly orientated for the current fit of the reverse cable, carry out the following to re-position the cable mount plate:-

1. Remove the 2 nuts [38] and cable clamp kitset [37] that retain the Morse cable to the cable mount plate [26] and remove the Morse cable.
2. Slacken set screw [30] from lever [31] and remove the lever from the backhead [22] end of the spool [20].
3. Remove the v-ring [40] fitted between the HSRX handle [31] and the backhead.
4. Unscrew and remove the 4 nuts [28] and spring washers [29].
5. The cable mount plate [26] can now be removed from the backhead [22], ensuring that the stop pin [39] fitted to the backhead, is not loose.
6. Ensure that the o-ring [50] is not disturbed.
7. Refit the cable mount plate [26] at 180° to the previous position, ensuring that the stop pin [39] in the backhead engages into the correct hole in the cable mount plate [26].
8. Refit the 4 nuts [28] and spring washers [29] that secure the cable mount plate to the backhead and torque load to the correct torque
9. Refit the v-ring [40] to the rear of the backhead. **Note the correct orientation of the v-ring [40]. Refer to Drawing** "HJ-213-07-001 Reverse assembly Hydraulic Reverse. Sht 1".
10. Refit the lever [31] to the spool [20] at the backhead end of the reverse cylinder and tighten the set screw [30], ensuring that the set screw locates into the dimple in the spool shaft. Torque load the set screw [30] to the correct torque.
11. Loosely refit the cable clamp kitset to the cable mount plate [26].
12. Refit the Morse cable through the cable clamp.
13. Connect the Morse cable to the lever [31] and tighten the Morse ball joint [36] attachment nut.
14. Retighten the 2 nuts [38] that attach the cable clamp kitset on the cable mount plate [26].

9.4 Steering Assembly Removal and Overhaul

Refer to Drawing
"HJ-213-06-000 steering assembly"

Note: This jet unit can be fitted with either Morse steering control cable or SeaStar steering cylinder steering control option.

9.4.1 Steering Cylinder Removal

Note: If this jet unit is fitted with the "SeaStar" steering cylinder as a steering option, refer to the "SeaStar Manual" supplied with the steering cylinder for overhaul information.

The steering cylinder need only be dismantled if it is suspected that a seal has failed and hydraulic oil is found leaking along the piston rod assembly from either end of the cylinder. This indicates that the piston rod seals are defective and must be replaced. Refer to the SeaStar Manual for information on seal replacement.

Steering cylinder removal:

1. Disconnect any sensors attached to the tiller [24]. **Refer to the Overhaul Section of the Controls Manual**.
2. Disconnect the steering cylinder hose connections from the SeaStar steering cylinder, ensuring that all connections are fitted with blanking plugs to prevent the ingress of moisture and dirt and the leaking of hydraulic oil.
3. Disconnect the steering cylinder rod end from the tiller.
4. Remove the steering cylinder from the vessel.
5. Check all components for signs of corrosion, wear and damage. Replace as required. **Refer to the SeaStar Manual for information on seal replacement**.

9.4.2 Steering Cylinder Overhaul

The steering assembly may use a SeaStar Hydraulic cylinder to operate the steering tiller, refer to the SeaStar Maintenance Manual for any maintenance required on the steering cylinder.

9.4.3 Steering Shaft Removal

Removing the steering shaft:

1. Unscrew and remove the 2 nuts [23] and spring washers [9] from the studs [8] retaining the splash guard [7] to the tailpipe.
2. Remove the reverse duct as shown in ***Section*** 9.2.1"reverse duct Removal of this manual.
3. Disconnect the steering control cable or steering cylinder (whichever option is fitted) from the steering shaft [1] arm.
4. Remove nut [7], spring washer [8] and special washer [6]. Remove the cotter pin [5] retaining the steering crank [4] to the steering shaft [1].
5. Push the steering shaft [1] forwards into the vessel and slide the steering crank [4] off the end of the steering shaft.
6. Remove the steering crank from the steering crank bush [15].
7. Push the steering shaft forwards and remove the steering shaft from the front and rear steering shaft mounts.
8. Check the two steering bushes [3] fitted to the front and rear steering shaft mounts and the o-ring [2] fitted to the forward steering shaft mount, if these require replacing, remove the steering shaft completely. (Refer to Drawing "HJ-213-06-000 steering assembly Sht 1" for additional information on replacing the steering shaft bush [3]).

Inspect the steering shaft and bushes:

9. Check the following components for wear and damage:-
   a) **Steering shaft bushes [3].** Check for wear or damaged. Replace if worn.
   b) **O-ring [2].** Check for wear or damaged. Replace if worn.
   c) **Cotter pin [5].** Check the condition of the cotter pin. Replace if damaged.
   d) **Steering shaft [1].** If the surface of the shaft is damaged, pitted or bent, replace.
   e) **Steering crank [4].** Check the condition of the steering crank ball. ***Replace the steering crank if the diameter of the crank ball has worn below 20.8mm (0.82ins) (This should be measured at 90º to the shaft axis).***

9.4.4 Nozzle Assembly Removal

Nozzle, nozzle housing and nozzle insert removal:

The nozzle, nozzle housing and nozzle insert can be removed from the jet unit as a complete assembly. Should it be necessary to remove just the nozzle from the nozzle housing, refer to Sub-*Section* "Removing the nozzle from the nozzle housing:.

To remove the nozzle housing complete with nozzle and nozzle Insert, carry out the following instructions:-

1. Ensure that the reverse duct has been removed as shown in ***Section*** 9.2.1"reverse duct Removal.
2. Ensure that the splash guard and the steering crank have been removed as shown in ***Section*** 9.4.2"steering cylinder Overhaul.
3. With the steering shaft already removed from the jet unit, remove the nuts [27] and spring washers [28] from the studs [26] attaching the nozzle housing to the tailpipe. (Drawing "HJ-213-01-000 Basic Jet assemblies refer).
4. Tap off the nozzle housing [9] complete with nozzle [16] and nozzle Insert [22], using a rubber hammer. Remove the complete nozzle assembly off the securing studs.
5. Remove the nozzle housing, nozzle and nozzle insert complete from the jet unit.
6. Take note the orientation of the nozzle in the nozzle housing as the nozzle can be fitted either ***"nozzle Up" (Refer to HJ-213-06-005)*** or ***"nozzle Straight" (Refer to*** HJ-213-06-001***)*** as shown on Drawing "HJ-213-06-000 steering assembly"
7. Remove the nozzle insert [22] from the recess in the nozzle housing.

Removing the nozzle from the nozzle housing:

The nozzle may be removed from the jet unit without removing the nozzle housing and nozzle insert.

To remove the nozzle from the nozzle housing, carry out the following actions:-

1. Check the steering crank bush [15] for security of attachment and wear. Replace as required. Refer to ***Sub-Section "steering Crank bush [15] Repair"***
2. Rotate the nozzle [16] through its full arc of travel to check for stiffness or wear in the steering pivot flanged bushes [10] and pivot sleeves [13].
3. Whilst supporting the nozzle, unscrew and remove the upper and lower nozzle attachment bolts [12], pivot sleeves [13] and the stepped adjusting washers [14]. ***Note that the pivot sleeves [13] are threaded onto the attachment bolts [12].***
4. Rotate the nozzle slightly and pull rearwards to remove the nozzle from the nozzle housing [9].
5. Clean all parts thoroughly and examine for wear and damage, replace as necessary.

Inspecting the steering nozzle [16] and nozzle components:—Examine the following components for wear or damage and repair or replace as necessary:-

1. **Nozzle.** Inspect the nozzle for any signs of damage including bending or cracking on the underside of the nozzle arm. ***If any signs of bending,cracking or damage is found, the nozzle is NOT SAFE to use and must be replaced***. If the steering has been subject to high loads due to jamming, the nozzle arm should be crack tested using a dye penetrant procedure before re-use. ***If any cracks are found the nozzle should be replaced*.**
2. **Steering pivot flanged bush [10]**. Replace if worn or damaged.
3. **Pivot bolts [12]**. Replace if worn or damaged.
4. **Steering crank bush [15].** Check for wear or damage and replace as required.
5. **Nozzle insert [22].** Examine for damage and corrosion. Repair or replace as required.
6. **Steering pivot sleeve [13].** Check for wear and damage. Replace.
7. **O-ring [11].** Examine for cuts distortion or fretting. Replace.
8. **Stepped adjusting washers [14]**. Check for wear or damage. Replace if worn.
9. **Anode [21].** Check the condition. Replace if more than 2/3 rds corroded.

9.4.5 Nozzle Assembly Overhaul

Steering crank bush [15] replacement:-
To remove and replace the steering crank bush [15] fitted to the nozzle carry out the following operation:

1. With the nozzle removed from the nozzle housing and secured on a workbench. Use a hacksaw blade to carefully cut out the old bush [15]. **Take care that the steering crank bore is not scored or damaged during removal of the bush [15].**
2. Carefully drift out the pieces of the old steering crank bush.
3. Ensure that the bore in the nozzle boss is cleaned of old loctite and any corrosion.

Note: Do Not paint the bore of the nozzle boss.

4. Apply a thin coating of Loctite Activator 7471 to the outside surface of the crank bush [15] and allow to dry. **Do not apply Activator to the bore of the steering arm.**

Note: Loctite Activator 7471 must be used to refit the nozzle crank bush 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 crank bush and the bore of the steering arm boss once the crank bush is fitted.

6. Insert the replacement crank bush [15] from the underside of the nozzle and outwards, ensuring that the shoulder of the crank bush is hard against the underside of the steering crank before commencing the swaging operation.
7. Using a suitable form tool or press, ***swage the new steering bush to 100 ft/lbs.***
8. Check and ensure that the swaging operation has been performed correctly and that the bush is not loose.
9. Clean off any surplus Loctite from around the replacement swaged steering crank bush [15].

Steering bushes [3] and o-ring [2], replacement:-

To replace the steering shaft bushes and o-ring, carry out the following:-

1. Remove the o-ring [2] fitted to the front of the forward steering shaft bush [3].
2. Drift out the old front and rear steering shaft bushes [3].
3. Clean out the bush bore of old loctite and loctite activator.
4. Remove all evidence of paint from inside the bores.

Note: The bores of the tailpipe and intake flanges are NOT to be painted.

5. Apply a thin coat of Loctite Activator 7471 to the outside of the bush [3] and allow to dry. **Do Not apply Activator to the bores in the tailpipe and intake.**

Note: Loctite Activator 7471 must be used to refit the bush [3] otherwise the Loctite 680 will not cure and retain the bush [3] in position.

6. Apply Loctite 680 to the bore of the tailpipe boss.

Note: There are to be NO dry areas between the bushes [3] and the boss in the tailpipe / intake once the bushes are fitted.

7. Fit the bush to the bore and rotate twice to spread the loctite.
8. Press the bush firmly into the bore until the end of the bush is level with the outer face of the bore.
9. Wipe off any excess loctite.
10. Smear a new o-ring [2] with grease and fit to the seal cavity at the front of the forward steering shaft bush [3].

Steering pivot flanged bushes [10] replacement:-

To replace the steering pivot flanged bush [10] refer to Drawing "HJ-213-06-000 Steering Assembly General Arrangement. Sht1".

1. The nozzle should be taken to a workshop facility and removed from the nozzle housing as shown in ***Section*** 9.4.4"nozzle assembly Removal.
2. To remove the old flanged bushes [10]. It may be necessary to apply heat in the vicinity of the bushes until they can be drifted out.
3. Drift out the flanged bush [10] from the steering housing [9].
4. Clean out the bores of the nozzle to remove any old loctite, damaged loose paint or corrosion.
5. Ensure that any paint damage in the bores of the nozzle housing is repaired prior to fitting new flanged bushes [10].
6. Repaint the bores with the correct paint finish as shown in Drawing "HJ-213-06-000 steering assembly General Arrangement. Sht1".

Note: Do Not apply Activator to the bores or the flanged bush [10] as the activator will react with the painted finish in the bores.

7. Apply Loctite 680 to the whole surface of the bores of the nozzle housing bosses and to the outside face of the replacement flanged bushes [10] before fitting the bushes.

Note: There are to be NO dry areas between the flanged bushes [10] and the bore of the nozzle housing once the bushes are fitted.

8. Insert the replacement flanged bushes [10] from the outside of the nozzle housing, ensuring that the shoulder of the flanged bushes are hard against the outer face of the nozzle housing.
9. Clean off any surplus Loctite from around the replacement flanged bushes.

Replacement of the anode [21] fitted to the nozzle.
Refer to Drawing "HJ-213-13-002" for anode location.

1. Check the anode [21] fitted to the underside of the nozzle [16]. Should it be less than 2/3rds of its original size, it should be replaced.
2. To replace the nozzle anode [21], carry out the following operation:-
   a) Remove nuts [7] and spring washers [8] from studs [20] securing the anode [21] to the underside of nozzle [16].
   b) Remove the anode [21] from the nozzle.
   c) Clean up the contact area where the anodes are located to remove any loose paint or corrosion. Repair the paint finish.
   d) Fit a new anode [21] and attach to the studs [20] on the underside of the nozzle with nuts [7] and spring washers [8].
   e) Torque load to the recommended torque.
3. If the anode is still in good condition, ensure that the anode is not painted over.
4. Scrub the anode with a wire brush if a coating of corrosion has built up on the anode.

9.5 Steering Assembly Re-Fitting

Refer Drawing
"HJ-213-06-000 steering assembly".

Any worn or damaged bushes or components in the steering system should be replaced before re-assembly of the steering system.

CAUTION

The Steering Assembly can be reassembled in several ways. Refer to the Steering Section of the Manual and the relevant Steering Assembly drawings for correct assembly.

9.5.1 Nozzle Assemby Re-Fitting

Inspection of the steering nozzle:
Before re-assembly, the nozzle should be examined for any sign of damage. In the case of a severe jamb-up of the steering system, the nozzle arm may have become bent or cracked. If any cracks are found on the underside of the steering arm or if there is any sign of bending, the nozzle MUST BE REPLACED. NO STRAIGHTENING OR WELDING REPAIR IS PERMITTED.

Note: Ensure that the nozzle housing is fitted to suit the correct nozzle trim required. ("nozzle straight" or "nozzle up" options). Refer to Drawing "HJ-213-06-000 steering assembly".

1. Fit the steering nozzle [16] into the steering housing [9], ensuring that the steering crank boss is uppermost and the nozzle is aligned with the nozzle housing.
2. Rotate the nozzle to align the upper and lower bushes [10] with the upper and lower fixing points in the nozzle housing.
3. Smear the stepped adjusting washers [14] with marine grease and fit to bolts [12], ensuring that the step in the washer faces inwards towards the thread of the bolt.
4. Thread the pivot sleeves [13] fully onto the bolts [12] to retain the stepped adjusting washers [14] in position.
5. Smear new o-rings [11] with an approved marine grease and fit to the seal groove in the pivot sleeves [13].

Note: Do not apply Loctite to the threads of the pivot bolts [12] until "nozzle vertical end float adjustment" has been completed

6. Fit the upper and lower pivot bolts.
7. Tighten both bolts [12] and ***torque load to 40 Nm (30 ft/lbs).***
8. Move the nozzle through its full arc of travel to ensure that there is no restriction.

Nozzle vertical end float adjustment:

Check and ensure that the end float between the nozzle and the nozzle housing is between 0.1 to 0.4mm on the bottom pivot.

1. Measure between the outer shoulder of the steering pivot flanged bush [10] and the inner face of the stepped washer [14] at the bottom steering pivot point. ***The clearance should measure between 0.1mm to 0.4mm.***
2. Invert either one or both of the stepped adjusting washers [14] to achieve the measurement above.

Note: The "end float" can be altered by inverting one or both of the stepped adjusting washers [14].

3. Apply Loctite 222 to the threads of the upper and lower attachment bolts [12] and fit complete with stepped washer [14] and pivot sleeve [13]. screw the bolts in hand tight.
4. Torque load the nozzle attachment bolts [12] to 40Nm (30ft/lbs).
5. The nozzle and nozzle housing complete may now be refitted to the tailpipe of the jet unit.

9.5.2 Re-assemble the Nozzle/ Nozzle Housing to the Tailpipe

1. Refit the nozzle Insert into the recess in the rear of the nozzle housing.
2. Refit the nozzle assembly complete onto the nozzle housing attachment studs [26] with the nozzle fitted for the correct orientation. (Either "nozzle up" or "nozzle down" configuration).
3. Apply Loctite 243 to studs [26] and secure the nozzle assembly to the tailpipe with spring washers [28] and nuts [27]. Torque load to the recommended torque.

9.5.3 Steering Shaft Re-Fitting

1. Smear the ball of the steering crank [4] with grease and refit into the steering crank bush [15] in the nozzle boss.
2. Ensure that the crank [4] is correctly orientated for either "nozzle up" or "nozzle straight" trim.
3. If the steering shaft has been removed to replace the steering bushes. Lightly grease the steering shaft.
4. From inside the vessel, pass the steering shaft through the front steering bush [3] and o-ring [2] and through to the rear steering bush [3], taking care not to dislodge the o-ring [2] fitted to the forward steering bush.
5. From outside the vessel, pull the steering shaft [1] rearwards and fit the steering crank onto the end of the steering shaft ensuring that the steering crank is correctly orientated to suit the nozzle trim required. ***(See "nozzle Up Trim" HJ-213-06-005 and "nozzle Straight Trim" HJ-213-***06-001 shown on Drawing "HJ-213-06-000 steering assembly General Arrangement. Sht1".
6. Fit the cotter [5] to the steering crank [4] and secure with bronze washer [6], spring washer [8] and nut [7] in the correct order. Torque load to the recommended torque.
7. Operate the steering arm [17] and ensure that there is freedom of movement.

9.5.4 Steering Cylinder Re-Fitting

1. If the jet unit is fitted with the Seastar steering system and the steering cylinder has been removed for overhaul, refit the steering cylinder to the vessel.
2. Reconnect the hydraulic hoses to the Seastar steering cylinder.
3. Reconnect the steering cylinder rod end to the steering shaft arm [1].
4. Reconnect any sensors attached to the steering shaft arm [1]. **Refer to the Overhaul Section of the Controls Manual**.

9.5.5 Steering Cylinder / Steering Control Cable Connect

1. Reconnect the steering control cable / steering cylinder (whichever steering option is fitted) to the steering arm [17] and operate to ensure that there is freedom of movement.

Note: After re-assembly of the steering shaft, it is essential that the adjustment of the steering tiller stop [23] is checked. The clearance between the nozzle and the nozzle housing should be the same in both directions. Adjust the tiller stop [23] by loosening the securing nuts and sliding the tiller stop sideways as required. Refer to Section 5.5.3“tiller stop Fitting and Adjusting

2. Re-tighten the securing nuts to the recommended torque.
3. Remount the cable and cable clamp and tighten the cable clamp screws and secure with Loctite.
4. Fit the splash guard [7] as shown in Section 9.3.2“reverse duct - Refit To jet unit of this manual.
5. Fit the reverse duct as shown in Section 9.3.2“reverse duct - Refit To jet unit.
6. Check all steering and reverse functions to ensure correct operation and a full range of movement without restriction through the full arc of travel.

9.6 Bearing Housing Assembly Overhaul

WARNING

Exercise extreme care if water seal replacement is to be carried out in the vessel as water may enter the vessel through the intake opening. Never leave the inspection cover removed.

Note: Overhaul of the bearing housing with the vessel afloat is not recommended as the seal face holder would not remain in place once the bearing housing is dismantled.

WARNING

Exercise extreme care if overhauling the bearing housing with the vessel afloat as water may enter the vessel through the opening in the Intake.

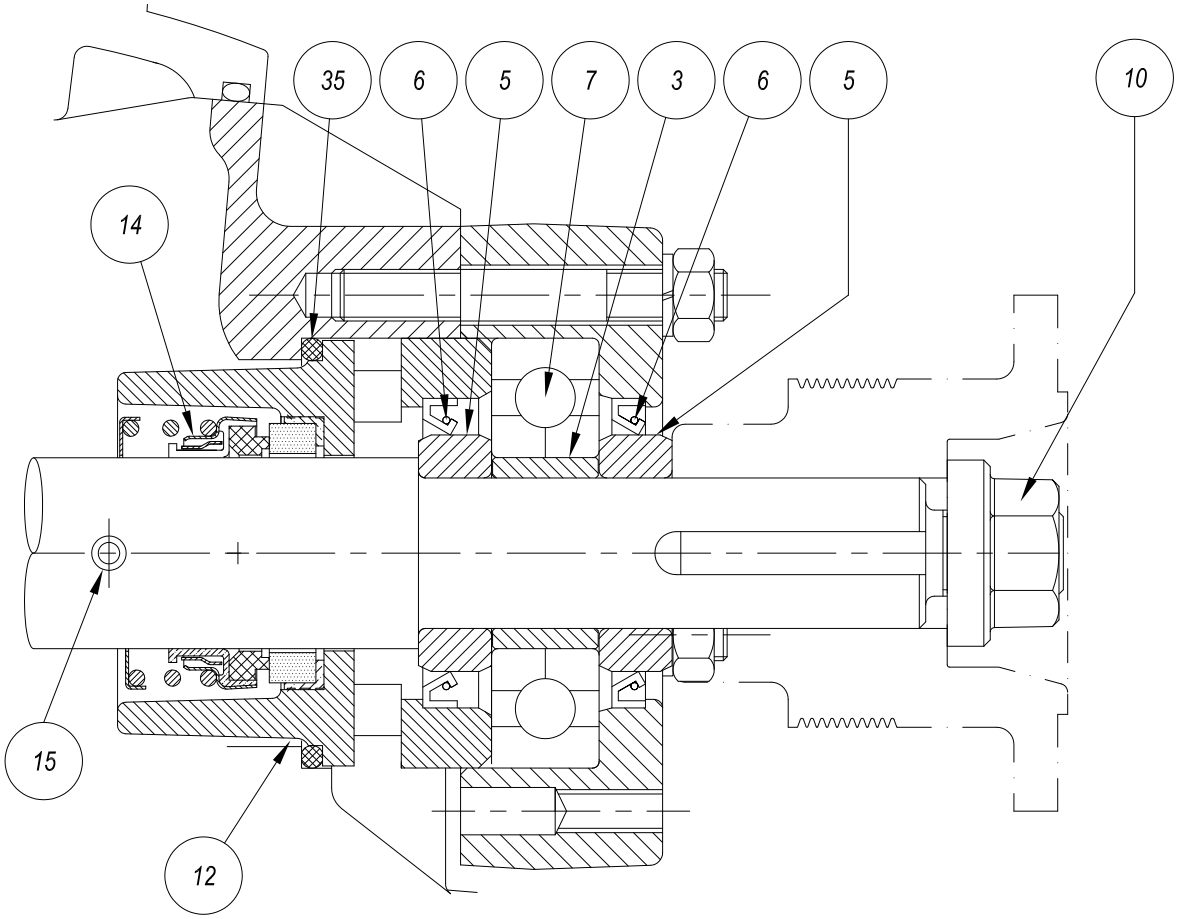


Figure 20: HJ-213 Jet bearing housing and Water Seal

9.6.1 Bearing Housing Dismantling

Refer to Drawing

"HJ-213-01-000 Basic Jet assembly"

CAUTION

The water seal should not be removed unless it is being replaced. The water seal will not perform correctly if it is removed and then reinstalled.
The water seal need only be replaced if it is leaking.

Dismantling the bearing housing assembly:
To dismantle the bearing housing, carry out the following operations:-

1. Disconnect the H bar or drive shaft from the jet unit coupling.
2. Fit the reaction arm tool to the jet unit coupling to prevent the coupling from turning.
3. Unscrew and remove coupling nut [10].
4. Remove the reaction arm tool from the jet unit coupling.
5. Fit the puller to the end of the coupling and remove the coupling. Gently tap the coupling with a hammer during removal.
6. Remove the coupling key [11] from the keyway in the mainshaft.
7. Remove the bearing housing [8] from the intake [19] by removing the nuts [17] and spring washers [16] from the 3 securing studs [43].

Note: If the mainshaft is to remain in the jet, the water seal retaining pin [15] can remain fitted to the mainshaft.

8. Remove the bearing housing [8] complete with bearing [7], outer seal [6] and outer seal sleeve [5].

Note:

1. One half of the bearing inner race will probably stay on the mainshaft. Remove this and keep it with the bearing.
2. Do not swap the bearing inner race halves. Keep the bearing clean.

9. Remove the bearing [7] and the outer seal [6] from the bearing housing [8].
10. Remove the bearing carrier [3] from the mainshaft.

9.6.2 Water Seal Removal

Refer to Drawing
"61483 Shaft Water Seal assembly".

CAUTION

The water seal should not be removed unless it is being replaced. The water seal will not perform correctly if it is removed and then reinstalled.
The water seal need only be replaced if it is leaking.

Note: Take care during removal of the water seal assembly as the stationary face is ceramic and is quite brittle.

1. Remove the seal face holder [12] from the mainshaft along with the seal sleeve [5], seal [6] and the water seal stationary face. Take care to support the mainshaft as the seal face holder comes free.
2. Remove the intake to seal face holder o-ring [35].
3. Remove the water seal carbon face forwards off the mainshaft.
4. If the water seal beoprene bellows is to be replaced, refer to Item [4] of Drawing "61483 Shaft Water Seal".
5. If not already removed, remove the water seal retaining pin [15] and slide the spring cap [7] and spring [6] aft along the mainshaft. **D**rawing "61483 Shaft Water Seal assembly" refers.
6. Break the connection between the water seal neoprene bellows [4] and the mainshaft. Slide the neoprene bellows [4], holder [5] spring [6] and spring cap [7] forward off the mainshaft.

Removing the bearing house assembly complete with mainshaft and water seal:

Note: The bearing housing can be dismantled complete with the jet unit coupling, mainshaft and water seal if the impeller has already been removed.

If the impeller has already been removed, proceed as follows:-

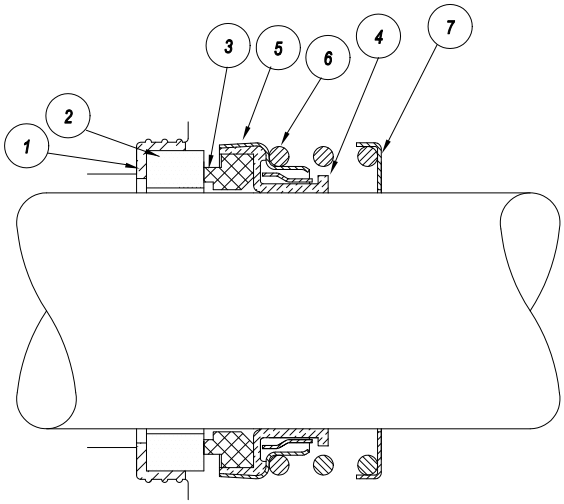
1. Remove the nuts [17] and spring washers [16] on the 3 studs [43] attaching the bearing housing [8] to the intake [19].
2. While supporting the mainshaft, the complete bearing housing, water seal and mainshaft assembly can now be removed by tapping the seal face holder forward from the rear of the jet, using a hammer and wooden drift.
3. The complete assembly can now be removed to a workbench to carry out further dismantling.
4. Continue as for ***"Water Seal Removal",*** to dismantle the remainder of the bearing housing assembly.

Checking for wear:—Clean all components and check the following parts for wear or damage. Obtain replacement parts if significant wear or damage is found.

1. **Inner and outer main bearing seals [6]**. Check seals for wear, cuts or deformity. Replace if damaged.
2. **Inner and outer seal sleeves [5].** Check the Seals for signs of wear, fretting or damage. Replace if damaged. The sleeves may be turned end for end instead of replacing.
3. **Bearing [7].** Check that the bearing has no signs of wear. Replace if any signs of wear are evident.

Note: Do not swap the bearing inner halves. Keep the bearing clean.

4. **Bearing housing [8]**. Ensure that there are no signs of wear, fretting or relative movement in the bearing housing.
5. **Bearing carrier [3]**. Ensure that there are no signs of wear, fretting or damage.
6. **Seal face holder [12].** Ensure that there are no signs of wear, fretting, or relative movement.
7. **Water seal and stationary face assembly ([2] & [3] in Drawing** "61483 shaft Water Seal assembly (1¾ inch) **refers)**. Check the mating faces of **Items [2] & [3]** are not scored, cracked or chipped. The water seal stationary face [2] should be checked without removing it from the seal face holder [12].
8. **It is recommended that all the seal rotary components Items [3], [4], [5], [6] & [7] and the stationary face components Items [1] & [2]** shown in Drawing "61483 shaft Water Seal" are replaced even if only one item appears worn.
9. **O-ring [35].** Check for cuts, deformation or permanent set. Replace the o-ring if any defects or damage are found. ***Ensure that this o-ring is re-fitted on re-assembly***.
10. **Mainshaft [1].** Check for signs of scuffing, pitting, wear or corrosion. Remove any burrs from the water seal area with emery paper. Thoroughly clean the mainshaft on completion.
11. Thoroughly clean all parts prior to re-assembly.



HJ 213 JET WATERSEAL	
ITEM No	DESCRIPTION
1	Neoprene Boot
2	Ceramic Stationary Face
3	Resin Bonded Face
4	Neoprene Bellows
5	Holder
6	Spring
7	Spring Cap

Figure 21: HJ-213 Water Seal

9.6.3 Water Seal Replacement and Re-Fitting

Refer to Drawings
"HJ-213-01-000 Basic Jet assembly
"61483 shaft Water Seal".

CAUTION

All Water seal faces must be clean and free of grease.

1. Coat the mainshaft water seal location area with a 20:1 water and household detergent mix.
2. If the mainshaft has been removed from the jet unit, insert the water seal retaining pin [15] into the mainshaft, folding the legs closely around the mainshaft to avoid their fouling with the seal face holder [12].
3. Slide the water seal spring cap [7] and spring [6] onto the mainshaft, up to the water seal retaining pin [15] fitted in the mainshaft.
4. Carefully slide the remaining water seal rotary components **([3], [4] & [5]** onto the mainshaft, to their approximate final position. If necessary wrap tape around the Mainshaft shoulder to ease the water seal over, this will prevent damaging the water seal.

Note: The neoprene bellows [4] will bind to the mainshaft [1] after about 15 minutes, ensure that the assembly of the bearing housing and water seal is completed within this time.

5. Wipe away all traces of the water and detergent mixture from the mainshaft and water seal. ***(This prevents corrosion of the mainshaft if the jet unit is put into storage)***. Do not allow grease or oil near the water seal face.

9.6.4 Re-assembly of the Bearing Housing

NOTE:

1. The main bearing seals [6] are oriented as shown to ensure that the grease pumped in through the grease nipple (Item [18] of Drawing "HJ-213-01-000 Basic Jet assembly" passes through the bearing, and excess grease can escape out past the front main bearing seal [6] of the bearing housing, where it can be seen.
2. If the inner seal is not fitted correctly, grease may not get into the bearing and will escape into the water seal cavity. Grease on the water seal will attract grit and will form a grinding paste which will destroy the water seal.

1. Fit new main bearing inner and outer seals [6] into the bearing housing [8] and seal face holder [12]. Ensure that the seals are correctly orientated as shown in the drawing, with the lip facing towards the front of the jet unit.
2. Lubricate the rear face of the seal face holder [12] and the neoprene boot (Item [1] of Drawing "61483 shaft Water Seal") with a 20:1 water and household detergent or liquid soap mix.
3. Press fit a new water seal stationary face and neoprene boot (Items [1] & [2] of Drawing "61483 Shaft Water Seal") into the seal face holder [12].
4. Fit a new o-ring [35] to the seal face holder [12].
5. With the mainshaft refitted into the intake and the rear end of the mainshaft supported, slide the seal face holder [12] onto the mainshaft, taking care not to damage the ceramic stationary face of the water seal (Item [2] in Drawing "61483 shaft Water Seal") on the shoulder of the mainshaft.
6. Lightly grease the inner seal sleeve [5] and fit onto the mainshaft [1] ensuring the seal sleeve is correctly fitted for the inner main bearing Seal [6] to run on an unworn surface.
7. Lightly grease and fit the complete bearing [7] into the bearing housing [8].
8. Lightly grease and fit the bearing carrier [3] into the centre of the bearing [7].
9. Fit the bearing housing complete with bearing onto the mainshaft by locating on the three studs [43] and push the bearing housing fully home against the inner seal sleeve [5].
10. Fit spring washers [16] and nuts [17] onto the studs [43],and tighten evenly.
11. Torque load nuts [17] to the recommended torque.
12. Lightly grease the outer seal sleeve [5] and slide it onto the mainshaft and under the lip of the outer main bearing seal [6].
13. Fit the coupling key [11] to the mainshaft.
14. Fit the coupling to the mainshaft, ensuring that the coupling key [11] is not dislodged.
15. Fit the coupling nut [10] to the mainshaft and tighten.
16. Fit the reaction arm tool to the jet unit coupling to prevent the coupling from turning during tightening.
17. Torque load the coupling nut [10] to ***275 Nm (200 ft/lbs).***
18. Refill the bearing housing with an approved bearing grease This should be carried out using the main bearing Grease nipple [18] on the top of the bearing housing. (Drawing "HJ-213-01-000 Basic Jet assembly refers).
19. Add grease to the bearing housing until the grease is just seen escaping between the outer seal sleeve [5] and the outer main bearing seal [6]. Wipe off any excess grease. (**Do not over grease.)**
20. Reconnect the H bar or drive shaft to the jet unit coupling.
21. Put the vessel in the water and run the jet unit to check that the water seal is not leaking.

9.7 Tailpipe Area - Overhaul

Refer Drawing
"HJ-213-01-000 Basic Jet assembly"

If the reverse duct has not already been removed, it must be removed before proceeding. ***Refer to Section*** 9.2.1"reverse duct Removal.
If the steering linkage has not already been disconnected, this must be disconnected before proceeding. ***Refer to Section*** 9.4.2"steering cylinder Overhaul.

9.7.1 Impeller - Checking For Wear

Before dismantling the tailpipe end of the jet, remove the inspection cover [20] (or intake screen [24] if in dry dock) and carry out the following checks :

1. Impeller tip wear check:

Using feeler gauges, check the clearance between the tips of the impeller blades and the wear ring [37] at each side of the unit ***(i.e. not top and bottom).*** ***Maximum recommended worn clearance is 0.92mm (0.036ins) per side.***

2. Marine water bearing wear check:

Push the mainshaft [1] hard from side to side. Check total sideways movement at the blade tips. This indicates the amount of wear in the marine water bearing [2] and marine water bearing sleeve [4].

9.7.2 Tailpipe Area - Dismantling

Tailpipe removal:
If the tailpipe is being removed complete, proceed as follows otherwise refer to ***Section*** 9.4.2"steering cylinder Overhaul for the removal of the steering components prior to removing the tailpipe.

1. Ensure that the procedures shown in ***Section*** 9.2.1"reverse duct Removal of this manual have been carried out to remove the reverse duct and the splash guard [7].
2. Ensure that the steering shaft has either been withdrawn from the steering bush located in the tailpipe or completely removed from the jet unit.
3. Unscrew and remove nuts [17] and spring washers [16] from the intake to tailpipe attachment studs [30].
4. Hit the tailpipe sideways with a rubber mallet to free the joint.
5. Gently ease the tailpipe [41] aft off the studs [30] and slide it carefully off the impeller. The impeller and impeller nut is now exposed.

Impeller removal:

1. Fit the reaction arm to the coupling flange to prevent the mainshaft turning and unscrew the impeller nut [10].
2. Remove the impeller nut [10] from the rear end of the impeller shaft.
3. Remove the marine water bearing sleeve [4].
4. The impeller can now be withdrawn off the mainshaft, using the impeller puller ***(Drawing*** "HJ-213-11-000 Tool Kits ***refers)***.
5. Remove the impeller key [11] from the cut-away on the mainshaft.

9.7.3 Impeller Area Overhaul

Minor corrosion damage around the wear ring / Impeller position 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 intake should be fitted.

9.7.4 Impeller Overhaul

CAUTION

Avoid using excessive heat during welding.

Note: All welds must be passivated to prevent corrosion.
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 0.03%) Post weld heat treatment is not required. Passivation is required after welding is completed.

Inspection:

1. Inspect all surfaces of the Impeller for any sign of corrosion or erosion damage. Damaged areas should be weld repaired and dressed back to a smooth surface.
2. Check the impeller leading and trailing edges for damage. In particular 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 suitable tools. Bring the blade back to it's original smooth profile checking against undamaged blades.
3. Inspect the leading edges, excessively worn or blunt leading edges may be built up by welding. Blunt impellers cause loss of performance and sometimes cavitation.
4. ***Check the impeller O.D***.

Blade leading edge repair procedure:
Refer Drawings
"HJ-213-03-001 Impellers"
"82206 Impeller Blade Dressing"
Shows the desired blade profile. The following information should also be referred to:

1. Dress the edge back to a smooth curve removing the minimum amount of metal.
2. Weld repair damaged edges if required.
3. Dress both faces of the blade taking slightly more metal off the rear side until the leading edge is as shown in Drawings "82206 Impeller Blade Dressing".
4. Blend well back into the original blade surface.
5. Both front and rear surfaces are to be a smooth uniform curve with no sudden bumps or change in direction.
6. Grind or file a smooth radius along the leading edge as shown in Drawings "82206 Impeller Blade Dressing".
7. Impeller outside diameter (O.D.) repair procedure:

1. If the impeller OD is excessively worn it may be built up by welding. After welding turn the impeller on a mandrel to the correct OD. Use light cuts to avoid blade distortion. Dress the faces back flush with the original surfaces.
2. Turn the outside diameter to the dimension shown on the table below making sure that it is concentric with the bore. (Light cuts should be taken when turning outside diameter to avoid deformation of the impeller blades).
3. File and polish the impeller blades.

New max diameter	**New min** diameter	**Worn min** diameter
214.75	214.60	214.1

Balancing:

1. The impeller must be balanced if welding or grinding has been carried out on the impeller.
2. Balance the impeller statically, preferably on the mainshaft with the coupling and all impeller and coupling keys in place. If this is not possible then balance the impeller statically on a suitable mandrel set on horizontal knife edges or bars to within the maximum out of balance specified.
3. ***Balance to within 38 gm-cm (0.5 oz/ins.).*** Balance weights of 316SS may be welded to the inside of the hub and grinding is permitted.

Passivation:

WARNING

Appropriate safety glasses, protective gloves and clothing must be worn to prevent skin exposure to nitric acid.

1. If the impeller has been welded, passivation is required.
2. Immerse the impeller in hot 30% Nitric Acid for at least 2 hours.
3. Rinse in clean water.
4. If nitric acid immersion is not possible, a "brush on" pickling / passivation gel may be used on weld and heat affected areas.

9.7.5 Inspection of the Tailpipe, Marine bearing and Wear Ring

With the tailpipe removed from the jet unit intake as shown at Section 9.7.2“tailpipe Area - Dismantling carry out the following actions:-

1. **Marine water bearing sleeve [4].** Check the condition of the marine bearing, if it is badly scored, it will have to be extracted from the tailpipe and replaced. ***Refer to*** Section 9.7.8“tailpipe Area Re-assembly.
2. **Wear ring [37] and insulator [38].** Check for wear on the wear ring. This should be evident where the impeller has been running. If there is evidence of excessive wear by a 0.5mm lip, or evidence of corrosion through or beneath the wear ring. The wear ring and Insulator should be replaced. ***Refer to Section*** 9.7.6“Wear Ring - Removal and Replacement**.**
3. **Check the insulation between the wear ring and the tailpipe casing.** Using a multimeter, check the insulation between the wear ring and the tailpipe casing. If the insulation has broken down, corrosion will occur beneath the wear ring. The wear ring and Insulator should be removed and replaced as shown in ***Section*** 9.7.6“Wear Ring - Removal and Replacement.
4. **Stator blades.** Check for signs of damage or erosion to the leading edges. Dress off any burrs.
5. **Plug [36] (fitted on tailpipe).** Remove the plug [36] to check the water-offtake screen and remove any stones or debris from the filter holes.

9.7.6 Wear Ring - Removal and Replacement

Removing old wear ring and insulator:

Step 1:

1. Find the joint in the wear ring [37] and force a long thin screw driver between the wear ring [37] and the Insulator [38], adjacent to the wear ring joint, until the end of the wear ring is free ***(See 'Step 1 Removal' in*** Figure 30:"Wear Ring Insertion and Removal Instructions***).***

Step 2:

2. Pull the free end of the wear ring inwards and remove it from the tailpipe. ***(See 'Step 2 Removal' in*** Figure 30:"Wear Ring Insertion and Removal Instructions***).***
3. Remove the wear ring insulator [38] and thoroughly clean and degrease the tailpipe Bore.

Preparing a new wear ring for fitting:

1. Before fitting a new wear ring, it should be trial fitted into the tailpipe bore ***with NO Insulator fitted.***
2. There should be a gap of approximately 1mm between the mating ends of the wear ring, with the wear ring completely fitted into the tailpipe bore.
3. 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 tailpipe 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 tailpipe bore with a thin layer of two pot vinyl etch primer suitable for aluminium and allow to dry. (Alternatively Zinc Phosphate may be used).
2. Apply a coat of zinc phosphate epoxy primer (such as Intercure 200HS) and allow to dry.
3. Paint a second coat of zinc phosphate epoxy primer. ***While the primer is still wet***, fit in a new insulator [38] to the tailpipe, ensuring the insulator is in contact with the primer over the whole surface.
4. Smear the whole insulator surface with a thin layer of grease or oil.

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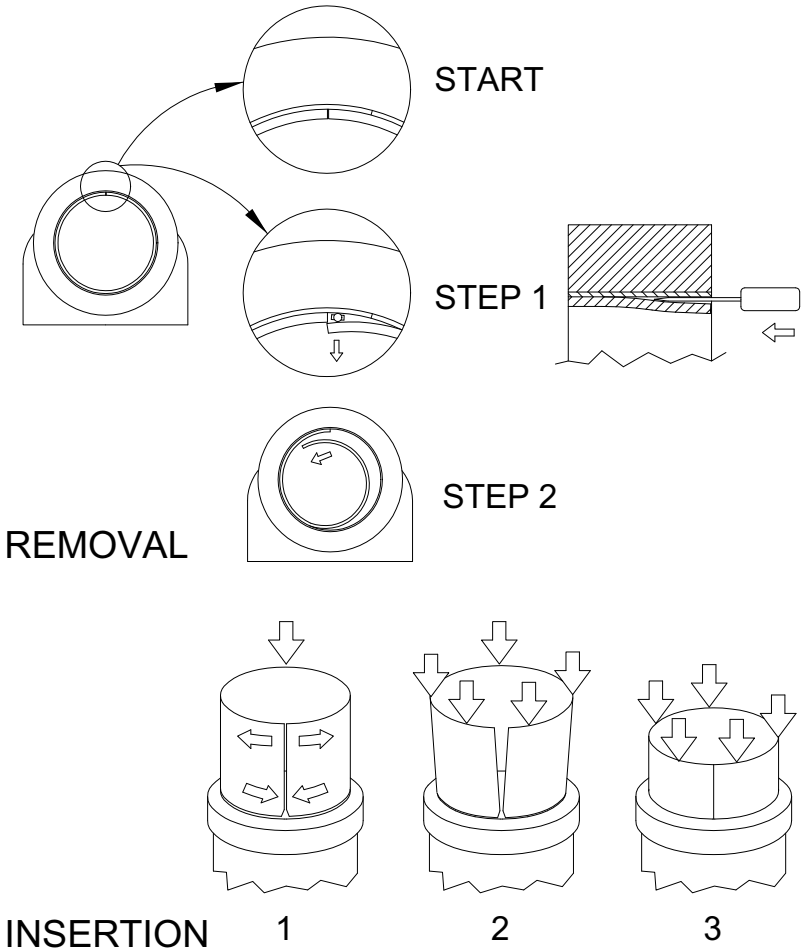


Figure 22: Wear Ring Insertion and Removal Instructions

Fitting a new wear ring:

Step 1:

1. Take a new wear ring [37] and with the chamfer end leading, butt the strip at the chamfers by twisting slightly, (this reduces the lead in diameter) ***(See 'Insertion Step 1' in*** Figure 30:"Wear Ring Insertion and Removal Instructions***).***
2. Gradually feed the wear ring inside the insulator [38] fitted in the tailpipe until the wear ring butts fully. ***(See 'Insertion Step 3' in*** Figure 30:"Wear Ring Insertion and Removal Instructions***).***
3. Slide the wear ring in evenly as far as possible by hand.

Step 2:

4. Place a heavy steel plate against the edge of the wear ring ***(The plate is used to prevent damage to the end of the wear ring and should cover whole diameter of wear ring)***.
5. Drive the wear ring evenly into the tailpipe recess by hitting the plate with a large hammer.
6. Continue pushing the wear ring into the intake until the wear ring sits approximately ***0.8 mm (1/32")*** from the end of the recess in the tailpipe. ***Refer to*** Figure 32:"Wear Ring Aft Position**.**
7. The wear ring must not touch any part of the jet unit except the insulator.
8. The wear ring is correctly fitted when it protrudes by 2 mm from the forward end of the tailpipe. ***Refer to*** Figure 31:"Wear Ring Forward Position**.**

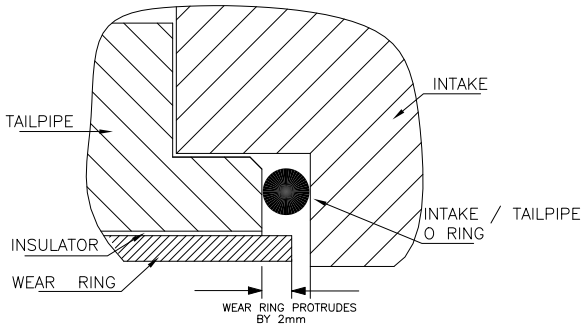


Figure 23: Wear Ring Forward Position

Note: The wear ring is in the correct position when it is located approximately 0.8 mm (1/32") from the end of the recess in the tailpipe Figure 31:"Wear Ring Forward Position and the wear ring protrudes by up to 2 mm from the forward face of the tailpipe. Figure 32:"Wear Ring Aft Position. This gap must be maintained to prevent electrical contact between the wear ring and the tailpipe / intake of the jet unit.

9. On completion of the fitting of the wear ring, electrical insulation between the wear ring and the intake casting should be checked, using a multimeter. The resistance reading should be over1000 ohms.

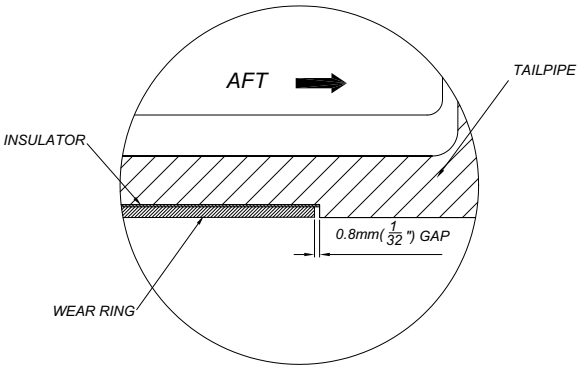


Figure 24: Wear Ring Aft Position

9.7.7 Tailpipe Overhaul

1. Check the marine water bearing [2] and marine water bearing sleeve [4] for wear or severe scoring and if necessary replace. ***Refer to Section*** 8.5"Servicing Details***, Item 12.g.*** Replace the marine water bearing [2] and marine water bearing sleeve [4] automatically if the impeller has just been built up and the wear ring has been replaced.
2. Use an internal extractor to pull the marine water bearing [2] from the tailpipe.
3. Apply grease to the tailpipe bore before inserting a new marine water bearing but ***ensure that grease is kept away from the rubber bearing surfaces.***
4. When pressing in the new marine water bearing, use a wooden block under the nose of the tailpipe to take the load.
5. Press in the new marine bearing.

When shrink fitting of the marine bearing is required, chilling must be achieved by gradual cooling to not more than minus 20°F (-28°C) using a freezer or regular ice. DO NOT USE DRY ICE.

Note: Pounding or shocking the bearing while in a chilled state could cause the rubber to separate from the shell.

External tailpipe anodes [39] replacement:

1. To replace the external tailpipe anodes [39] carry out the following:-
   a) Unscrew and remove 2 x nuts [27] and spring washers [28], attaching the two anodes [39] to the tailpipe [41].
   b) Remove the screws [40].
   c) Remove the anodes [39].
   d) Clean up the contact area where the anodes are located to remove any loose paint or corrosion. Repair the paint finish.
   e) Fit a new anodes [39] and attach with screws [40], spring washers [28] and nuts [27] and torque load to the correct torque.
2. If the anodes have not been replaced and are in good condition, ensure that the anodes are not painted over.
3. Scrub the anodes with a wire brush if a coating of corrosion has built up on the anodes.

Internal tailpipe anodes [48] - replacement:

Refer Drawings

"HJ-213-01-000 Basic Jet assembly"

"HJ-213-13-002 anode Location"

1. Check the 4 x internal tailpipe anodes [48] attached to the anode mounting plate [44], which is fitted to the forward face of the tailpipe. Should these be less than 2/3rds their original size, they should be replaced.
2. To replace the 4 internal tailpipe anodes [48], carry out the following operation:-
   a) With the tailpipe removed from the intake [19], remove the nuts [27] and spring washers [28] from the studs [50] attaching the anode mounting plate [44] to the tailpipe.
   b) Remove the bolts [49], nuts [27] and spring washers [28] attaching each anode to the anode mount plate.
   c) Remove the 4 Internal tailpipe anodes [48].
   d) Clean up the contact area where the anodes are located to remove any loose paint or corrosion. Repair the paint finish.

e) Apply Loctite 243 to the threads of the attachment bolts [49].
f) Fit new Internal tailpipe anodes [48] to the anode mounting plate [44] and secure with bolts [49], nuts [27] and spring washer [28]. Torque load to the recommended torque.
g) Apply Loctite 243 to the threads of studs [50] fitted to the inner face of the tailpipe.
h) Refit the anode mounting plate [44] to the tailpipe and fit to studs [50] with nuts [27] and spring washers [28]. Torque load to the recommended torque.

3. If the anodes have not been replaced and are in good condition, ensure that the anodes are not painted over.
4. Scrub the anodes with a wire brush if a coating of corrosion has built up on the anodes.

9.7.8 Tailpipe Area Re-assembly

1. Smear a light coating of grease over the mainshaft from the end of the impeller nut threads to the end of the impeller keyway.
2. Insert the impeller key [11] into the mainshaft keyway.
3. Slide the impeller onto the mainshaft ensuring that the impeller engages with the impeller key [11]
4. Fit the marine water bearing sleeve [4] onto the mainshaft.
5. Clean any grease off the threads of the mainshaft and apply "Loctite 243" or equivalent to the threads.
6. Fit the impeller nut [10] and ***torque load to 275 Nm (200 ft/lbs)***.
7. Dust the marine water bearing [2] with talcum powder or french chalk.
8. Clean and grease the tailpipe / intake contact faces.
9. Check the intake / tailpipe o-ring [42] for permanent set. Replace if necessary. To refit the o-ring [42], gently stretch the o-ring by hand until it is a snug fit inside the intake recess and holds itself in place. Grease can be used to help keep the o-ring in place and to ensure that the o-ring is not pinched during assembly.
10. Carefully refit the tailpipe over the impeller and onto the intake and tailpipe studs [30].
11. Fit spring washers [16] and nuts [17] and tighten evenly to the correct torque.
12. ***Refer to Section*** 9.5.1“nozzle assembly Re-Fitting to refit the nozzle.
13. Re-connect the steering shaft and steering control cable. ***Refer to Section*** 9.5“steering assembly Re-Fitting.
14. Refit the reverse duct and the splash guard [7]. Refer to Sub-Section “assembly of the reverse cylinder:

Note: Ensure that on completion of the overhaul of the jet unit, a full commissioning is carried out in accordance with Section 6“Commissioning in this manual.

9.8 Transom Plate Assembly Overhaul

Refer Drawings
"HJ-213-01-000 Basic Jet assembly"
Should it be necessary to remove the transom seal assembly from the transom, for repair or replacement of damaged or worn components, carry out the following operation.
To replace the transom plate o-ring [2] or transom plate [1], the reverse duct and tailpipe must be removed complete, to access to the transom plate.

Note: The transom plate o-ring [2] and transom plate [1] should not be removed unless they are suspected of leaking or unless the transom plate [1] is corroded or damaged.

9.8.1 Transom Plate Removal

Note: The reverse duct and tailpipe should be removed complete to allow access to remove the transom plate.

To remove the reverse duct, tailpipe and steering components complete, **refer to *Section*** 9.2"Reverse assembly Removal and Overhaul.

GRP hulls:
Refer to Drawing
"HJ-213-08-001 Installation Details G.R.P. Hulls".

Aluminium hulls:
Refer to Drawing
"HJ-213-08-002 Installation Details Aluminium Hulls".

To remove the transom plate [1] and replace the transom plate *o-ring* [2], carry out the following operation:

1. Remove the splash guard and reverse duct from the jet unit as shown in ***Section*** 9.2.1"reverse duct Removal of this manual.
2. Remove nuts [4], spring washers [5], flat washers [6] and screws [9] securing the tiller stop [23] to the transom.
3. Remove the tiller stop from the jet unit transom plate.
4. Slacken and remove the screws [3], flat washers [6], spring washers [5] and nuts [4] securing the transom plate to the transom.
5. Remove the continuity strap [20] attached to the transom plate attachment screws [3].
6. Remove the transom plate off the jet unit intake.
7. Remove the transom plate o-ring [2] from around the jet unit and discard.
8. Clean off any old marine sealant from the transom plate [1] and the transom and examine for damage and corrosion. Replace or repair as required.

Steel hulls

Refer to Drawing

"HJ-213-08-003 Installation Details Steel Hulls".

To remove the transom plate [1] and replace the transom seal [2], carry out the following operation:

1. Remove the splash guard and reverse duct from the jet unit as shown in ***Section*** 9.2.1"reverse duct Removal of this manual.
2. Remove nuts [4], spring washers [5], flat washers [6], special washers [24] and screws [9] securing the tiller stop [23] to the transom.
3. Remove the tiller stop from the jet unit transom plate.
4. Slacken and remove the screws [3], flat washers [6], spring washers [5] and nuts [4] securing the transom plate to the transom. Note that there are 2 flat washers [6] fitted to either side of the transom / transom plate attachment screws exept where the where the tiller stop attaches.
5. Remove the nylon insulating bushes [12] from around the transom plate.
6. Remove the transom plate off the jet unit intake.
7. Remove the transom gasket [13] from the transom plate / transom interface and discard.
8. Remove the transom plate o-ring [2] from around the jet unit and discard.
9. Clean off any old marine sealant from the transom plate [1] and the transom and examine for damage and corrosion. Replace or repair as required.

9.8.2 Transom Plate Re-Fitting

Refer to Section 5.4.2"assembly of the transom plate to the Hull **Item 6 to Item 18,** for information on how to fit the transom plate.

1. Tighten the screws [9] and nuts [4] to the recommended torque as shown in Drawing "85113 Recommendations for nut and Locking screw Tightening Torques". Wipe off any excess sealant.
2. Refit the reverse duct and splash guard as shown in ***Section*** 9.3.2"reverse duct - Refit To jet unit of this manual.

9.9 Screen Rake Assembly Overhaul (If fitted)

Refer Drawing
"HJ-213-09-002 screen rake assembly".

Before removing the screen rake, ensure that the screen has been removed. ***Refer to Section*** 9.9.4"screen Removal.

The screen rake need only be dismantled if it is suspected of being defective for the following reasons:-

a) The port [4] and starboard [3] screen rake bearings are worn.
b) The o-rings [14] and [15] are leaking.
c) The screen rake [1] is damaged or bent.

9.9.1 Screen Rake Removal

To remove the screen rake assembly, the vessel should be removed from the water to allow access to the underside of the vessel. To remove the screen rake, carry out the following:-

1. support the screen rake beneath the vessel.
2. From inside the vessel, disconnect and remove the spring [7] from the screen rake actuating arm [2] and spring anchor bracket [8] on the starboard side of the intake, in the vicinity of the coupling flange.
3. Remove nut [11], spring washer [12], washer [10] and the cotter pin [9] securing the screen rake actuating arm [2] to the screen rake [1].
4. Remove the screen rake actuating arm [2] and the external spacer [5] from the screen rake spindle.
5. With the screen rake supported beneath the vessel, from inside the vessel, remove the screen rake bearing attachment nuts [11] and spring washers [12] from the starboard screen rake bearing [3].
6. Whilst ensuring that the screen rake is supported, withdraw the starboard screen rake bearing [3]. The starboard screen rake pivot point will now rest on the screen rake bearing housing in the intake.
7. From beneath the vessel, whilst supporting the screen rake move the screen rake fully to starboard to allow the port screen rake pivot point to clear the port screen rake bearing [4].
8. With the port screen rake pivot point clear of the port screen rake bearing [4], move the screen rake fully to port to allow the starboard screen rake pivot point to clear the starboard screen rake bearing housing in the intake.
9. Carefully lower the screen rake [1] from the underside of the intake.
10. Remove the internal spacer [6] from the screen rake spindle.
11. Check the screen rake for distortion, damage and excessive wear at the screen rake bearing attachment points. Repair or replace as required.
12. Remove the screen rake bearing attachment nuts [11] and spring washers [12] from the port screen rake bearing [4] and withdraw the port screen rake bearing from the intake.
13. Check the o-rings [14] and [15] on the starboard screen rake bearing and replace if cut, damaged or distorted.
14. Check the starboard screen rake bearing for wear and damage. Replace as required.
15. Remove the grease nipple [13] from the starboard screen rake bearing [3] and ensure that the grease channels are not blocked.
16. Refit the grease nipple [13].
17. Check the o-ring [14] on the port screen rake bearing and replace if cut, damaged or distorted.
18. Remove the grease nipple [13] from the port screen rake bearing [4] and ensure that the grease channels are not blocked.
19. Refit the grease nipple [13].
20. Thoroughly clean all components and examine for wear, damage and distortion.

9.9.2 Screen Rake Re-Fitting

1. Smear a new o-ring [14] with grease and fit on the port screen rake bearing. Smear the shaft of the port screen rake bearing with marine grease.
2. Smear the bore of the port screen rake bearing [4] with marine grease and fit to the studs [9] on the port side of the intake. Refer to Drawing "HJ-213-01-000 Basic Jet assembly".
3. Secure with spring washer [12] and nuts [11], ensuring that the grease nipple [13] is positioned at the top of the bearing.
4. Torque load to the recommended torque.
5. Smear the port and starboard pivot points on the screen rake with marine grease.
6. From beneath the vessel, whilst supporting the screen rake and before fitting the starboard screen rake bearing, feed the starboard screen rake pivot point through the starboard screen rake mounting point in the intake.
7. Raise the port side of the screen rake and align the pivot point of the screen rake with the port screen rake bearing [4].
8. Push the screen rake fully to port and into the port screen rake bearing [4].
9. From inside the vessel, smear the internal spacer [6] with marine grease and fit over the starboard screen rake pivot point, which is protruding through the intake. Push the internal spacer fully home onto the screen rake pivot point.
10. Smear new o-rings [14] and [15] with marine grease and fit to the starboard screen rake bearing [3].
11. Smear the shaft and bore of the starboard screen rake bearing with marine grease.
12. Fit the starboard screen rake bearing [3] over the starboard screen rake pivot point, which is protruding through the intake.
13. Align the starboard screen rake bearing [3] with the studs [9] on the intake. Refer to Drawing "HJ-213-01-000 Basic Jet assembly.
14. Ensure that the grease nipple [13] is positioned at the top of the starboard screen rake bearing.
15. Secure the starboard screen rake bearing with spring washers [12] and nuts [11]. Torque load to the recommended torque.
16. Smear the external spacer [5] with marine grease and fit over the starboard screen rake pivot point and push fully home up against the outside face of the starboard screen rake bearing [5].
17. Fit the screen rake actuating arm [2] to the starboard screen rake pivot point and fit cotter pin [9]. Secure with washer [10], spring washer [12] and nut [11]. Torque load to the recommended torque.
18. Connect one end of the spring [7] to the spring anchor bracket [8] and connect the other end of the spring to the screen rake actuator [2].
19. Grease the port and starboard screen rake bearings through the grease nipples [13] on the top of the screen rake bearings until grease is seen to ooze from the inboard ends of the screen rake bearings.
20. Remove the support from the screen rake beneath the vessel.
21. Carry out a functional check of the screen rake assembly. Have someone positioned beneath the vessel to observe that the screen rake operates without fouling on the intake screen.

9.9.3 Screen Rake Blanking Plugs

Refer to Drawing
"HJ-213-09-001 screen rake blanking plugs".

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.

Should it be necessary to run the jet unit without a screen rake, blanking plugs [1] can be fitted in place of the Port and Starboard screen rake bearings.

To fit the blanking plugs, carry out the following procedure:

1. Remove the screen rake as shown in ***Section*** 9.9.1"screen rake Removal.
2. Ensure that o-ring [4] fitted to the screen rake blanking plug [1] is not damaged, cut or distorted.
3. Liberally coat the shaft of the blanking plug with grease and fit onto studs [9]. Refer to Drawing "HJ-213-01-000 Basic Jet assembly" Secure with spring washer [3] and nut [2]. Torque load to the recommended torque.
4. Repeat Items 2 to 4 above to fit the second blanking plug.

9.9.4 Screen Removal

Refer to Drawing
"HJ-213-01-000 Basic Jet assembly".

To remove the screen from the intake, carry out the following actions:-

1. Whilst supporting the screen [24], remove the 2 nuts [25] and flat washers [29] off the studs [21] securing the front of the screen to the underside of the intake block.
2. Remove the 2 nuts [25] and flat washers [29] off the studs [21] securing the rear of the screen to the underside of the intake block.
3. Lower the screen off the studs [21] and remove from the vessel for repair, refurbishment.

9.9.5 Screen Re-Fitting

Ensure that the screen rake has been re-fitted prior to refitting the screen. ***Refer to Section*** 9.9.2"screen rake Re-Fitting.

1. Ensure that the studs [21] that support the front and rear of the screen are securely fitted to the intake. If these studs are loose, refit using Loctite 263.
2. Offer the screen up to the studs [21] on the front and rear of the underside of the intake and secure in position with flat washers [29] and nuts [25].
3. Tighten to the recommended torque.

9.10 Hatch Extension

Refer to Drawing
"HJ-213-10-004 hatch extension".

C.W.F. Hamilton & Co Ltd can supply, as an optional extra, an inspection hatch extension [1]. This item enables work to be carried out on the jet unit where normally by removing the inspection hatch cover may allow water to enter the vessel. The hatch extension raises the height of the inspection hatch by 140 mm.

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.

9.10.1 Hatch Extension Fitting

To fit the inspection hatch extension [1] carry out the following operation:-

1. Ensure that the water level is below the level of the inspection hatch cover.
2. Ballast the bow end of the vessel to ensure that water does not enter through the inspection hatch.

Refer to Drawing "HJ-213-01-000 Basic Jet assembly"

3. Remove nuts [23] and spring washers [22] from the two studs [61] retaining the inspection cover [20].
4. Remove the inspection cover [20] and o-ring [34].
5. Check the o-ring [34] and replace if damaged or distorted.
6. Smear o-ring [34] with grease and refit to the o-ring groove in the inspection hatch cover [20].

Refer to drawing "HJ-213-10-004 hatch extension".

7. Ensure that o-ring [2] on the base of the inspection hatch extension [1] is not damaged or distorted.
8. Smear the o-ring [2] with grease and refit the hatch extension [1] over the 2 studs [61] (shown on Drawing "HJ-213-01-000 Basic Jet assembly).
9. Secure with spring washers [22] and nuts [23] and torque load to the recommended torque.
10. Fit the inspection cover [20] to studs [3] (shown on Drawing "HJ-213-10-004 hatch extension) and secure with spring washer [5] and nut [4]. Torque load to the recommended torque.
11. Once the vessel is "in use", ensure that the hatch extension is not leaking water.

9.10.2 Hatch Extension Removal

Refer to Drawings
"HJ-213-01-000 Basic Jet assembly"
"HJ-213-10-004 hatch extension".

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 hatch extension, carry out the following operations:-

1. Ensure that the water level is below the level of the intake inspection opening. If necessary, 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.
2. Remove nuts [23] and spring washers [22] from studs [61] securing the inspection cover [20] to the hatch extension.
3. Remove the inspection cover [20] and o-ring [34] from the top of the hatch extension.
4. To remove the hatch extension from the Jet intake opening, remove nuts [23], and spring washers [22] from the studs [61] securing the hatch extension to the intake opening.
5. Remove the hatch extension [1] and o-ring [2] from the securing studs [61] on the intake opening. Refer to Drawing "HJ-213-10-004 hatch extension".
6. Ensure that the o-ring [34] fitted to the inspection cover [20] is not cut or perished. Refer to Drawing "HJ-213-01-000 Basic Jet assembly"
7. Smear the o-ring [34] with marine grease and fit to the o-ring groove on the underside of the inspection cover.
8. Fit the inspection cover over studs [61] fitted around the Inspection opening and secure in position with spring washers [22] and nuts [23].
9. Torque load to the recommended torque.
10. Remove any ballast that may have been added to the bow of the vessel and check the inspection cover for leaks.

9.11 HSRX Hydraulic Reverse System

9.11.1 Removal of the Pump Assembly from the Jet Unit

Refer to Drawings

"CT-HPU-01-001 JHPU HSRX"

"CT-HSE-10-001 hose Kits"

To remove the pump assembly from the jet unit, carry out the following actions:-:—

1. Drain the oil from the pump [1], jet mounted oil cooler and hose connections.
2. Disconnect the high pressure hose [H1] between the forward connection on the cylinder and the 3/8" BSP Adaptor on the rear of the pump.
3. Remove the 3/8" push lock hose [H2] between the rear connection on the cylinder and the outlet on the top of the jet mounted oil cooler.
4. Remove the 3/8" push lock hose [H3] from the lower connection on the jet mounted oil cooler.
5. Remove the hose clip [7] from the inlet to the pump and remove the hose.
6. Fit blanks to all the hydraulic connection points to prevent the ingress of moisture and dirt into the hydraulic system.
7. To remove the belt from the pump, loosen nut [8] from the stud in the elongated slot in the support bracket [4] at the rear of the pump [1].
8. Slacken screw [9] securing the pump [1] to Mount bracket [3] at the pump forward lower attachment point.
9. Slacken nut [8] securing the pump [1] to the intake casting at the rear lower attachment point of the pump.
10. Push the pump inboard towards the bearing housing. It should now be possible to remove the drive belt from the pump pulley.
11. Remove nut [8] and spring washer [7] from stud [5] at the inboard end of the adjusting link [4].
12. Remove nut [8], spring washer [7] and special washer [13] from the stud in the elongated slot in the adjusting link [4] at the rear of the pump [1].
13. Remove the support bracket [4] from the stud on the rear of the pump ensuring that the washer [13], fitted between the adjusting link [4] and the rear of the pump, is removed.
14. Remove screw [9] and spring washer [7] securing the pump [1] to mount bracket [3] at the pump forward lower attachment point.
15. Remove nut [8] and spring washer [7] securing the pump [1] to the intake casting at the rear lower attachment point of the pump.
16. The pump may now be removed from the jet unit.
17. Remove the nuts [8] and spring washers [7] from studs [5] attaching the support bracket [3] to the bearing housing of the jet unit.
18. Remove and retain the support bracket [3].

9.11.2 Re-Fitting the Pump Assembly to the Jet Unit

Mount the pump assembly [1] onto the bearing housing using the following method:-

1. Attach the pump assembly [1] to the intake casting by the stud located at the rear lower attachment point of the pump and secure loosely in position with spring washer [7] and nut [8]. Do Not Torque Load.
2. Attach the support bracket [3] to the 2 x studs [5] on the bearing housing and secure with spring washer [7] and nut [8]. Torque load to the recommended torque.
3. Secure the support bracket [3] to the forward lower attachment point of the pump assembly [1] with spring washer [7] and screw [9]. Tighten screw enough to allow slight movement of the pump.
4. Attach the adjusting link [4] to the stud [5] on the upper part of the bearing housing ensuring that the elongated slot in the adjusting link [4] is outboard of the jet and is located over the stud on the rear of the pump. Ensure that special washer [13] is fitted to the stud on the rear of the pump before fitting the elongated slot in the adjusting link [4] over the stud.
5. Loosely secure the inboard end of the adjusting link, with spring washer [7] and nut [8].
6. Secure the outboard end of the adjusting link, loosely with special washer [13], spring washer [7] and nut [8]. Do Not Torque Load.
7. Fit the pump drive belt and tension by levering the pump body away from the intake until the correct belt tension is achieved.

Note:

1. The belt tension is correct when a 2.4 mm deflection is achieved when a load of 580 to 870 gr (1.3 to 1.9 lbs) is applied to the centre of the belt.
2. If a new drive belt has been fitted, the belt should be re-tensioned after 30 minutes to 4 hours of running at full load, to compensate for initial belt stretch and "bedding" into the pulley grooves.

8. Tighten nut [8] on the inboard end of the adjusting link and torque load to the recommended torque.
9. Tighten the nut [8] at the elongated slot end of the adjusting link [4], which secures the pump [1] to the adjusting link [4]. Torque load the nut [8] to the recommended torque.
10. Tighten screw [9] securing the pump [1] to the support bracket [3] and torque load to the recommended torque.
11. Tighten the nut [8] located at the rear lower attachment point of the pump and torque load to the recommended torque.

Hose connections:

Note:

1. Thread tape should be used on all BSPT to BSPP (parallel to taper) connections.
2. Push lock hoses should be renewed if disassembly is required.

1. Fit the high pressure hose [H1] between the forward connection on the cylinder and the 3/8" BSP adaptor on the pump, ensuring that the hose is routed forward of the inspection cover.
2. Fit 3/8" push lock hose [H2] between the rear connection on the cylinder and the outlet on the top of the jet mounted oil cooler.
3. Fit 3/8" push lock hose [H3] to the lower connection on the jet mounted oil cooler and the opposite hose end onto the inlet to the tank. Secure with hose clip [7].
4. Refill the reverse system with oil as described in ***Section*** 8.5.2"HSRX Controls Servicing Details".
5. Check the HSRX reverse system for oil leaks.

Appendix

- Supplementary Technical Information

A-1 Conversions

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 kilometres
1 millimetre = 0.03937 inches
1 metre = 3.2808 feet
1 kilometre = 0.6214 mile
1 kilometre = 0.539 nautical mile

Area

1 inch^2 = 6.4516 centimetres^2
1 foot^2 = 929.03 centimetres^2
1 centimetre^2 = 0.1550 inch^2
1 metre^2 = 10.76 feet^2

Power

1 horsepower = 0.7457 kilowatts
1 horsepower (Metric) = 0.7355 kilowatts
1 kilowatt = 1.341 horsepower
1 kilowatt = 1.3596 metric horsepower

Force

1 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

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
To Convert Fahrenheit to Celsius, subtract 32 then multiply by 5/9
To convert Celsius to Fahrenheit, multiply by 9/5 then add 32.

Liquid Measure (U.S.)

1 pint = 0.473 litre
1 gallon = 3.785 litres

Speed

1 mile per hour = 0.8690 knots
1 kilometre per hour = 0.5396 knots
1 knot = 1.8532 kilometres per hour
1mile 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/inch^2
1 bar = 14.5038 pounds/inch^2
1 kilogram/metre^2 = 0.2048 pounds/foot^2
1 kilopascal = 0.145 pound/inch^2
1 bar = 100 kilopascal

Temperature

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

A-2 Loctite Application Guide

85144 Issue F

General Practice

No smoking in the presence of Primer, Activator or Accelerator, as these products are highly flammable. Never mix Primer or Activator and Adhesive directly as liquids. For additional safe handling procedures refer to the product material safety data sheets (MSDS) and technical data sheets (TDS) available from www.loctite.com

- All parts must be free from oil and or grease. Do not use paint thinners for cleaning. Use solvent or degreaser such as Methylated spirits, Trichlorethylene or Acetone.
- All painted bores must be fully cured before the application of loctite.
- Fixing and full cure times for all loctite will be increased at reduced temperatures.
- To prevent the product from clogging in the nozzle, do not allow the tip to touch metal surfaces during application.
- In general, nuts that secure anodes use Loctite 243 and a spring washer. Anodes in internal water passages use nylocnuts, external anodes use plain nuts.

Primers, Activators and Accelerators

Primers are used when the surfaces to be threadlocked are not active enough to cause curing, or when the cure is required to be accelerated.

- Primers, Activators or Accelerators are not required on ‘active surfaces’, such as Bronze, Brass and Mild steel.
- For ‘Inactive surfaces’ (including Stainless steel or Aluminium) Primers, Activators or Accelerators are optional for threadlocking and are required for retaining.
- Primers, Activators or Accelerators are not to be applied to any painted surface.
- Allow sufficient time for Primers, Activators or Accelerators, where applied, to dry.

Equivalents

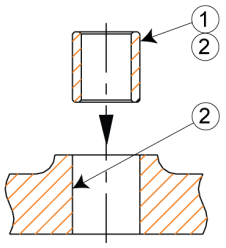
Loctite Grade		Equivalent
222	Purple	**Low Strength Threadlocker:** Loctite 221 (Compatible Primer is 7471) Loctite 225 (Compatible Primer is 7471)
243	Blue	**Medium Strength Threadlocker:** Loctite 242 (Compatible Primer is 7471) Loctite 245 (Compatible Primer is 7471) Loctite 248 (Compatible Primer is 7471)
263	Red	**High Strength Threadlocker:** Loctite 262 (Compatible Primer is 7471 or 7649) Loctite 268 (Compatible Primer is 7471 or 7649) Loctite 276 (No Primer Required) Loctite 277 if necessary (Compatible Primer is 7649)
680	Green	**High Strength Retainer:** Loctite 638 (Compatible Primer is 7471)
325	Amber	**Structural Adhesive:** Loctite 317 (Compatible Primer is 736)
542	Brown	**Hydraulic Thread Sealant:** Loctite 569 (Compatible Primer is 7471 or 7649) Loctite 561 (Compatible Primer is 7471 or 7649) Loctite 577 (Compatible Primer is 7471 or 7649)

Additional Notes for Equivalents

- Primer 7471 and Primer 7649 can be interchanged if necessary, however performance may be reduced
- Loctite 248, 268, 668 and 561 are in stick form.

Unpainted Bores, Stainless Bushes

Loctite	Colour	Primer, Activator, Accelerator		Loctite Cure Speed without Primer Activator, Accelerator		
680	GREEN	Type	Drying Time		Partial	Full
		n/a	n/a		30 Min	4-6Hrs

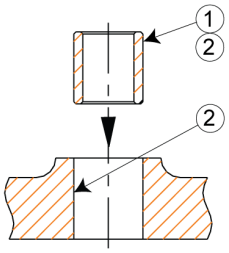


Bushes, sleeves, composite bush assemblies. (extra high strength retaining) primer will be used in all retaining applications.
1 - Apply primer to whole surface of bore and allow to dry before fitting.
2 - Apply Loctite to whole surface of bore and front of bush before fitting.
- There are to be no dry 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.

Unpainted Bores, LG2 Bushes

Loctite	Colour	Primer, Activator, Accelerator		Loctite Cure Speed without Primer Activator, Accelerator		
680	GREEN	Type	Drying Time		Partial	Full
		n/a	n/a		30 Min	4-6Hrs

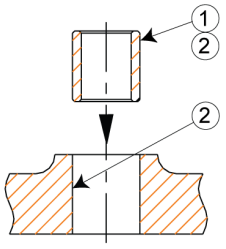


Bushes, sleeves, composite bush assemblies. (extra high strength retaining) primer will be used in all retaining applications.
Do not apply primer to LG2 Bushes
1 - Apply primer to whole surface of bore and allow to dry before fitting.
2 - Apply Loctite to whole surface of bore and front of bush before 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.

Painted Intercure Bores, Stainless Steel Bushes

Loctite	Colour	Primer, Activator, Accelerator		Loctite Cure Speed with Primer Activator, Accelerator		
325	AMBER	Type	Drying Time		Partial	Full
		Activator 7075	1-3Min		5Min	24Hrs

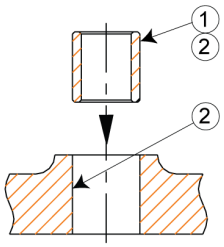


Bushes, sleeves, composite bush assemblies. (high strength adhesive) activator will be used in all retaining applications.
325 loctite will not cure without the activator. Do not apply activator to painted bore.
1 - Apply Activator to outside of bush and allow to dry.
2 - Apply Loctite to whole surface of bore and outside 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

Painted Gloss Bores, Stainless Steel Bushes

Loctite	Colour	Primer, Activator, Accelerator		Loctite Cure Speed without Primer Activator, Accelerator		
680	GREEN	Type	Drying Time		Partial	Full
		n/a	n/a		30 Min	4-6Hrs

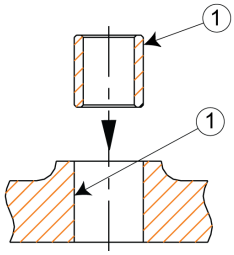


Bushes, sleeves, composite bush assemblies. (Extra high strength retaining)
Primer is used in all retaining applications.
Do not apply primer to painted bore.
1 - Apply primer to outside of outside of bush and allow to dry.
2 - Apply Loctite to whole surface of bore and outside of bush before fitting bush.
- There are to be no dry areas between bush and bore.

Rotate bush when fitting to distribute the Loctite evenly

Painted Gloss Bores, LG2 Bushes

Loctite	Colour	Primer, Activator, Accelerator		Loctite Cure Speed without Primer Activator, Accelerator		
680	GREEN	Type	Drying Time		Partial	Full
		n/a	n/a		30 Min	4-6Hrs

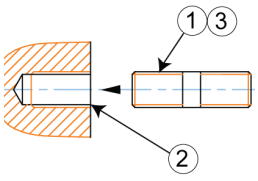


Bushes, sleeves, composite bush assemblies. (Extra high strength retaining)
1 - Apply Loctite to whole surface of bore and outside of bush before fitting bush.
- There are to be no dry areas between bush and bore.

Rotate bush when fitting to distribute the Loctite evenly

Studs M8 and Larger

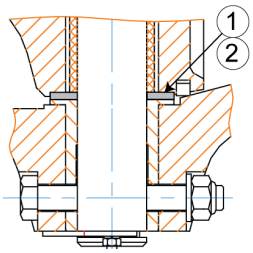
Loctite	Colour	Primer, Activator, Accelerator		Loctite Cure Speed		
263	RED	Type	Drying Time		Partial	Full
		Primer 7649	30-70Sec	With Primer	10Min	2Hrs
		(Optional)	n/a	Without Primer	20Min	6Hrs



Studs high strength locking
Primer is used to improve cure reliability, and reduce cure time.
1 - Apply optional primer to the thread of the stud and allow to dry.
2 - Apply several drops of thread locker down the sides of female thread.
3 - Apply Loctite to the thread engagement area of the stud in sufficient quantity to fill all engaged threads.
Assemble the stud to specifications.

D-Glide Thrust Washers

Loctite	Colour	Primer, Activator, Accelerator		Loctite Cure Speed with Primer Activator, Accelerator		
325	*AMBER*	Type	Drying Time		Partial	Full
		Activator 7075	1-3Min		5Min	24Hrs



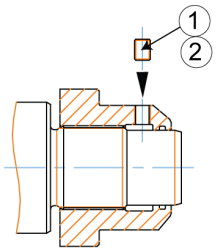
D-glide thrust washer retention (high strength adhesive)
Activator will be used in all retaining applications.
325 Loctite will not cure without the activator.
1 - Apply activator to one side of thrust washer and allow to dry.
2 - Apply Loctite evenly to housing recess.

- 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.

Machine Set Screws, Set Screws, Grub Screws

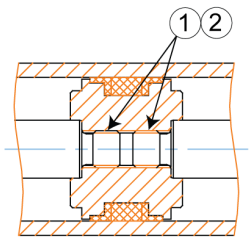
Loctite	Colour	Primer, Activator, Accelerator		Loctite Cure Speed		
243	*BLUE*	Type	Drying Time		Partial	Full
		Primer 7471	30-70Sec	With Primer	10Min	2Hrs
		(Optional)	N/A	Without Primer	20Min	6Hrs
222	*PURPLE*	Primer 7471	30-70Sec	With Primer	10Min	2Hrs
		(Optional)	N/A	Without Primer	20Min	6Hrs



Machine screws, set screws, grub screws (low strength thread locking).
Primer is used to shorten the cure time when the temperature is below 15°.
1 - Apply optional primer to the thread of the screw and allow to dry. Screws fitted into Bronze do not require primer.
2 - Apply Loctite to the thread engagement area of the screw in sufficient quantity to fill all engaged threads.
3 Fit the Screw to the specified torque.

Cylinder Shafts, Compensator Shafts

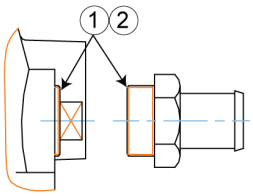
Loctite	Colour	Primer, Activator, Accelerator		Loctite Cure Speed		
263	*RED*	Type	Drying Time		Partial	Full
		Primer 7649	30-70Sec	With Primer	10Min	2Hrs
		(Optional)	n/a	Without Primer	20Min	6Hrs



Cylinder shafts, compensator shafts (hydraulic, pneumatic thread sealant).
Primer is used to shorten the cure time when the temperature is below 15°.
1 - Apply optional primer to the threads of the shafts and allow to dry.
2 - 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.

Water Offtake Bungs and Hose Tails

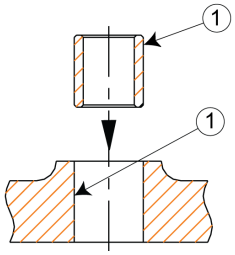
Loctite	Colour	Primer, Activator, Accelerator		Loctite Cure Speed		
567	*White*	Type	Drying Time		Partial	Full
		Accelerator 7649 (Optional)	30-70Sec	With Primer	2Hrs	6Hrs
				Without Primer	12 Hrs	24Hrs



Water offtake bungs & hose tails (thread sealant)
Accelerator is used where cure speed is unacceptably long.
1 - Apply optional accelerator to thread of plug or hose tail and allow to dry.
2 - Do not apply accelerator to brass hose tails.
3 - 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.

Unpainted Bores, D-Glide Bushes

Loctite	Colour	Primer, Activator, Accelerator		Loctite Cure Speed with Primer Activator, Accelerator		
325	*AMBER*	Type	Drying Time		Partial	Full
		Activator 7075	1-3Min		5Min	24Hrs

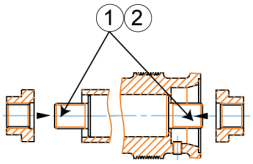


D-glide bush retention (high strength adhesive).
Activator will be used in all retaining applications.
325 Loctite will not cure without the activator.
1 - Apply activator to outside of bush and allow to dry.
2 - Apply adhesive to whole surface of bore.
- There are to be no dry areas between bush and bore.

Press bush into bore within 15 minutes.

Mainshaft Nuts Without Locking Devices

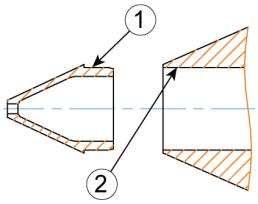
Loctite	Colour	Primer, Activator, Accelerator		Loctite Cure Speed		
243	*BLUE*	Type	Drying Time		Partial	Full
		Primer 7471 (Optional)	30-70Sec	With Primer	10Min	2Hrs
			N/A	Without Primer	20Min	6Hrs



Mainshaft nuts (medium strength thread locking)
Primer is used to shorten the cure time when the temperature is below 15°.
1 - Apply optional primer to the threads on the mainshaft and allow to dry.
2 - 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.

Tailpipe Fairings Without Locking Devices

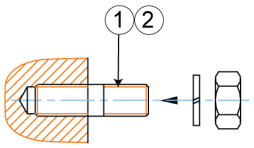
Loctite	Colour	Primer, Activator, Accelerator		Loctite Cure Speed without Primer Activator, Accelerator		
680	*GREEN*	Type	Drying Time		Partial	Full
		n/a	n/a		30 Min	4-6Hrs



Tailpipe fairings without locking devices (extra high strength retaining).
1 - Apply primer to spigot of fairing and allow to dry.
2 - Apply Loctite to spigot bore of tailpipe.
Fit using normal methods.

Nuts on Studs and Bolts (Where Specified)

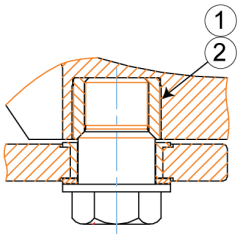
Loctite	Colour	Primer, Activator, Accelerator		Loctite Cure Speed		
243	*BLUE*	Type	Drying Time		Partial	Full
		Primer 7471	30-70Sec	With Primer	10Min	2Hrs
		(Optional)	N/A	Without Primer	20Min	6Hrs
222	*PURPLE*	Primer 7471	30-70Sec	With Primer	10Min	2Hrs
		(Optional)	N/A	Without Primer	20Min	6Hrs



Nuts (low strength thread locking).
Primer is used to shorten the cure time when the temperature is below 15°.
1 - Apply optional primer to the thread of the stud or bolt and allow to dry.
2 - Apply Loctite to the thread engagement area of the stud or bolt in sufficient quantity to fill all engaged threads.
Tighten Nuts to specified torque.

Tailpipe Inserts (Where Fitted)

Loctite	Colour	Primer, Activator, Accelerator		Loctite Cure Speed		
263	*RED*	Type	Drying Time		Partial	Full
		Primer 7649	30-70Sec	With Primer	10Min	2Hrs
		(Optional)	n/a	Without Primer	20Min	6Hrs

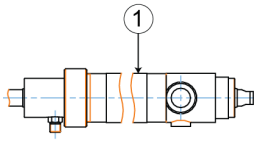


Tailpipe inserts (high strength thread locking).
Primer is used in all retaining applications.
1 - Apply primer to the thread of the insert and allow to dry.
2 - Apply Loctite to the female threads in the tailpipe and the threads of the insert in sufficient quantity to fill all the engaged threads.
- There are to be no dry areas between insert and tailpipe threads.

Screw insert into the tailpipe until it bottoms. Tighten firmly.

Steel Cylinders and AB2 Frontheads

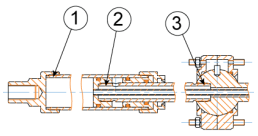
Loctite	Colour	Primer, Activator, Accelerator		Loctite Cure Speed without Primer Activator, Accelerator		
542	*BROWN*	Type	Drying Time		Partial	Full
		N/A	N/A		45Min	24Hrs



Steel cylinders and AB2 frontheads (Med strength hydraulic thread sealant)
Leave the first thread free of sealant.
Force the sealant into the threads to thoroughly fill all threads.
1 - Apply Loctite to the leading threads of the cylinder (fronthead end only).
Assemble the fronthead to the cylinder and tighten firmly.

Stainless Steel Cylinders and Backheads

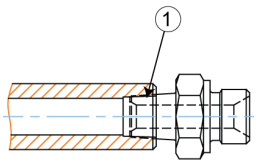
Loctite	Colour	Primer, Activator, Accelerator		Loctite Cure Speed without Primer Activator, Accelerator		
542	*BROWN*	Type	Drying Time		Partial	Full
		N/A	N/A		45Min	24Hrs



Stainless steel cylinders & backheads (Med strength hydraulic thread sealant).
Leave the first thread free of sealant.
Force the sealant into the threads to thoroughly fill all threads.
1 - Apply Loctite to the leading threads of the cylinder (backhead end).
2 - Apply Loctite to the shaft threads (piston end).
3 - Apply Loctite to the shaft thread (connector end).
Fit the shaft into the piston and connector and tighten the backhead to the torque specified on the assembly drawing.

Tapered Male Nipples into Female Holes

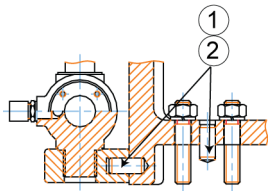
Loctite	Colour	Primer, Activator, Accelerator		Loctite Cure Speed without Primer Activator, Accelerator		
542	*BROWN*	Type	Drying Time		Partial	Full
		N/A	N/A		45Min	24Hrs



Tapered Male Nipples in Female Holes (Medium Strength Hydraulic Thread Sealant).
1 - Apply Loctite to the thread engagement area of the nipple in sufficient quantity to fill all engaged threads.
Fit the nipple and tighten to the specified torque.

Dowel Retention

Loctite	Colour	Primer, Activator, Accelerator		Loctite Cure Speed without Primer Activator, Accelerator		
680	*GREEN*	Type	Drying Time		Partial	Full
		n/a	n/a		30 Min	4-6Hrs



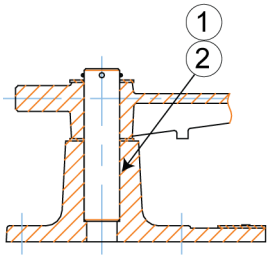
Dowel retention (extra high strength retaining).
Dowels are to be retained at one end only.
1 - Apply primer to one end of dowel and allow to dry.
2 - Apply Loctite to dowel hole in either casting or mounting plate, not both.

- Fit the end of the dowel with the primer into the hole that has the Loctite.

Remove excess Loctite from the dowel, before fitting the mounting plate over the dowel.

Steering Crank Shaft and Mounting Block

Loctite	Colour	Primer, Activator, Accelerator		Loctite Cure Speed without Primer Activator, Accelerator		
680	*GREEN*	Type	Drying Time		Partial	Full
		n/a	n/a		30 Min	4-6Hrs



Steering crankshaft to mounting block (Extra high strength retaining).
1 - Apply primer to bottom half of shaft and allow to dry.
2 - 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

A-3 Installation Checks

Jet Unit Mounting

Item	Check	Completed
1	Check the intake block is flush with the exterior of the hull bottom.	☐
2	Check that there is no flow obstructions forward of the intake (refer to the hull details in Jet Designers manual). Make a record of the size and position of any through hull penetrations or strakes around the jet area, for use when commissioning the jet unit.	☐
3	Inspect the intake base flange for obvious distortion or gaps between the intake base flange and the hull.	☐
4	Check the intake gasket (or silicon sealant) between the base and the mounting surface has not squeezed out into the water passage. Trim off any excess gasket and sealant.	☐
5	Check the transom plate seal is correctly located and secured (do not overtighten). If two people are available and the boat is indoors, a strong light may be used to check the fit of the transom cut out and seal.	☐
6	For steel hulls make sure that the jet unit is insulated from the hull (refer to the drawings and the "Corrosion" section of the product manual).	☐
7	Check that engine exhaust outlets are above the expected waterline and well to the side of jet units (refer to the Design Basics section in the Jet Unit Product manual).	☐
8	Check that the hull trim tabs (if fitted) will not interrupt the reverse flow (refer to the Design Basics section in the Product manual).	☐

Notes:

Jet Unit General

Item	Check	Completed
1	Ensure that the correct impeller is fitted to match engine duty. Impeller part number (stamped on hub) can be seen through the jet unit inspection cover.	☐
2	Make sure that all anodes are in place and have not been painted over (refer to the anode location drawings shown in the Product manual).	☐
	Anti Fouling Paints HJ274 to HJ364 jet models have optional paint finishes: 'grey gloss' or 'antifoul' schemes. HJ403 and larger are available with the antifoul scheme only. Additional coats of antifoul must be applied to the jet unit, typically within two weeks of the launch of the vessel. The supplied antifoul coating will require light abrasion and cleaning prior to further application of antifoul. Refer to section: Application of Antifoul to New Jets. Do not apply copper oxide based anti-fouling paints. Do not paint over the anodes.	☐
3	Check that the inspection hatch seal is correctly located in the seal groove and that the inspection hatch securing bolts are tightened to the correct torque.	☐
4	Check that the correct dipstick is fitted to the bearing housings for the deadrise of the jet (refer to the dipstick drawings shown in the Product manual) and that the oil level in the bearing housings are correct.	☐
5	Check that the water offtake hoses (when fitted) are appropriately and securely fitted.	☐
6	Check that any unused water offtakes are plugged.	☐
7	Check that the bearing housing has been filled with approved grease or oil.	☐

Notes:

Jet Systems Steering

Item	Check	Completed
1	For jet units with tiller type steering check that the cotter pins (tapered pins which locate the tiller arms on the steering shaft) are facing the correct direction for the deadrise angle and the number of jets (refer to the steering drawings in the Product manual).	☐
2	For manual hydraulic helms ensure that:- ▪ Correct steering ratio (1 to 2 turns of helm from lock to lock). ▪ Full lock travel is limited by the cylinder, not the steering linkage. ▪ Steering sense is correct (i.e. port helm provides port nozzle movement). Ensure that all air has been bled from the steering system (feel at the wheel will be soft and spongy if there is still air in the steering system).	☐

Notes:

Drive Shaft

Item	Check	Completed
1	Ensure driveline details have been approved by CWF Hamilton & Co Ltd.	☐
2	On universal joint driveshafts (refer to the design basics section in the product manual) check: ▪ Yoke offset angles are in the same plane, are equal and are less than 5º. ▪ Yokes are in the same plane.	☐
3	On bearing supported line shafts (refer to the design basics section in the product manual) check: ▪ The support bearings are aligned with the engine flywheel. ▪ Outer support bearings are close to the end of the couplings.	☐

Notes:

A-4 Commissioning Checks

Pre Launch Checks

Item	Check	Completed
1	Check that the plastic spiral wrap protective cover (where fitted) has been removed from hydraulic shafts (HM-models only). Check all hydraulic shafts for damage and check that they are free from contamination (weld splatter, grinding dust, fibreglass resin, etc).	☐
2	Check that all the jet unit inspection covers are correctly fitted and secured.	☐
3	Check that all the anodes have been fitted and that they have not been painted over. Refer to anode location drawing.	☐
4	If the steering assembly, tailpipe or reverse duct have been removed during jet installation, check that all fasteners securing these items have been torqued correctly.	☐

Notes:

Post Launch Checks

Item	Check	Completed
1	Check for water leaks at the transom seal, intake base, and from under the bearing housing (water seal leaking).	☐
2	For oil lubricated main bearings (HJ-362 and above), check that the correct dipstick is fitted and that oil level is correct (dipstick length is dependent on the deadrise angle of the jet unit). For HM-651 to HM-811, check that the dipsticks are on the correct side (refer to the dipstick drawings in the Product manual).	☐
3	For grease lubricated main bearings (HJ-322 and below), add grease until grease comes out of the front seal as shown in the "Initial Bearing Housing Re-Assembly" section. ⚠ Make sure that all bearing housings and JHPU tanks are filled with the correct quantity and grade of oil.	☐
4	If a main bearing oil pump is fitted (HM-651 to HM-811) then check the oil pump operation by loosening the oil pipe fitting on top of the bearing housing and checking for oil flow.	☐
5	Check the JHPU oil level and replenish as required.	
6	If the vessel is fitted with shore power, then unplug the shore power and measure the electrical resistance between the hull and the earth pin of the vessel shore power plug. A correctly wired isolation transformer or galvanic isolator will result in high electrical resistance (greater than 1kΩ) between the hull and the earth conductor (refer to "Precautions Against Corrosion" section of the Product manual).	Measured Resistance _____Ω

Engine Checks (Vessel Moored)

Item	Check	Completed
1	The marine bearing (cutless bearing) must operate wet unless the optional dry run kit has been fitted (dry run kit available for HJ-212 to HJ-364 jet units only). For a jet unit fitted with a dry run kit, the following applies: ▪ Maximum dry run time of 3 minutes with engine speed not exceeding 1000rpm. Minimum time between dry runs of 1 hour. ▪ Do not operate the standard 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. For jets specified with a water feed system for the waterseal and marine bearing (specified on jets where the mainshaft is above the static waterline, typically on multi-jet monohulls with high deadrise), check that water is being supplied to the waterseal and marine bearing before running the jet unit.	☐
2	Ensure the vessel is securely moored fore and aft and in deep clean water.	☐
3	With the reverse controls set to "zero speed", the engine(s) may be started and the engine supplier's representatives can carry out engine checks.	☐
4	If the engine cooling water is taken from the jet unit 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. ⚠ Failure to check cooling water hoses may result in flooding of the vessel.	☐
5	If the vessel is equipped with HSRC or HYRC and the pressure alarm sounds, immediately shut the engine off and refer to the Controls Product manual to check adjustments. Failure to immediately shut down the engine may result in serious damage to the hydraulic pump due to overheating.	☐
6	Check for water leaks around the jet unit while the engine is running particularly under the bearing housing (mainshaft water seal).	☐
7	Check that the jet unit and driveshaft are running smoothly (no vibration).	☐
8	Periodically check the bearing housing temperature. The temperature should not exceed 80ºC. On multi-jet installations, all bearing housings should be at a similar temperature.	☐
9	Check that the reverse controls are working by monitoring the reverse duct position while moving the reverse control lever(s).	☐

10	Check that the steering controls are working by monitoring steering nozzle position while moving the helm (check that port helm gives port nozzle deflection, starboard helm gives starboard nozzle deflection and that all nozzles are steering in the same direction).	☐
11	Check that steering travel is limited by the hydraulic steering cylinder and not the steering linkage (for jet units fitted with steering cylinders and linkages).	☐
12	After stopping the engine, check the main bearing and JHPU oil levels and replenish if required.	☐

Notes:

Vessel Trial

Item	Check	Completed
1	Leave the mooring and check that the steering is operating correctly at "Forward Speed", at "Zero Speed" and going "Astern".	☐
2	Observe the jet stream when going "Dead Ahead" at speed to ensure that it is relatively clean with an even shape.	☐
3	Check the jet unit and driveshafts are running smoothly (no vibration) over the entire engine operating speed range (i.e. from idle to full ahead).	☐
4	Periodically check the bearing housing temperature and record the temperature once it reaches a steady value. Due to friction caused by the seals, the bearing housing is likely to be warm. The temperature should not exceed 80ºC.	☐
5	If practical check the driveshaft coupling joint temperatures (if fitted). Increased joint temperature may indicate driveshaft misalignment.	☐
6	Periodically check the hydraulic oil temperature at the oil tank. Record the temperature reading after a sustained run at cruising speed and after a period of vessel manoeuvring.	☐
7	Record 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.	☐
8	Record vessel speed at varying engine revolutions if possible.	☐
9	Record observations on vessel trim, loading, etc.	☐

Notes

After Initial Trials

Item	Check	Completed
1	Refer to the Maintenance section of the Product manual for any servicing that may be required on completion of trials.	☐
2	For steel hulls check that the jet unit is insulated from the hull. The resistance should be approximately 100Ohms but will vary depending on water salinity and hull characteristics. Refer to the Precautions Against Corrosion section of the Product manual.	☐
3	Check for water leaks at the transom seal, intake base, and from under the bearing housing (water seal leaking).	☐

Notes

Jet Unit Trials & Commissioning Data

Commissioning engineer		Commissioning date	
Vessel description		Hamilton jet project number	
Vessel displacement		Jet unit serial numbers	
Jet model(s)		Gearbox ratio	
Impeller rating		Engine power & RPM	
Engine model			

Temperature Readings

Driveshaft joints, bearing housing, hydraulics

Temperature	Location & comments

Speed Trial Readings

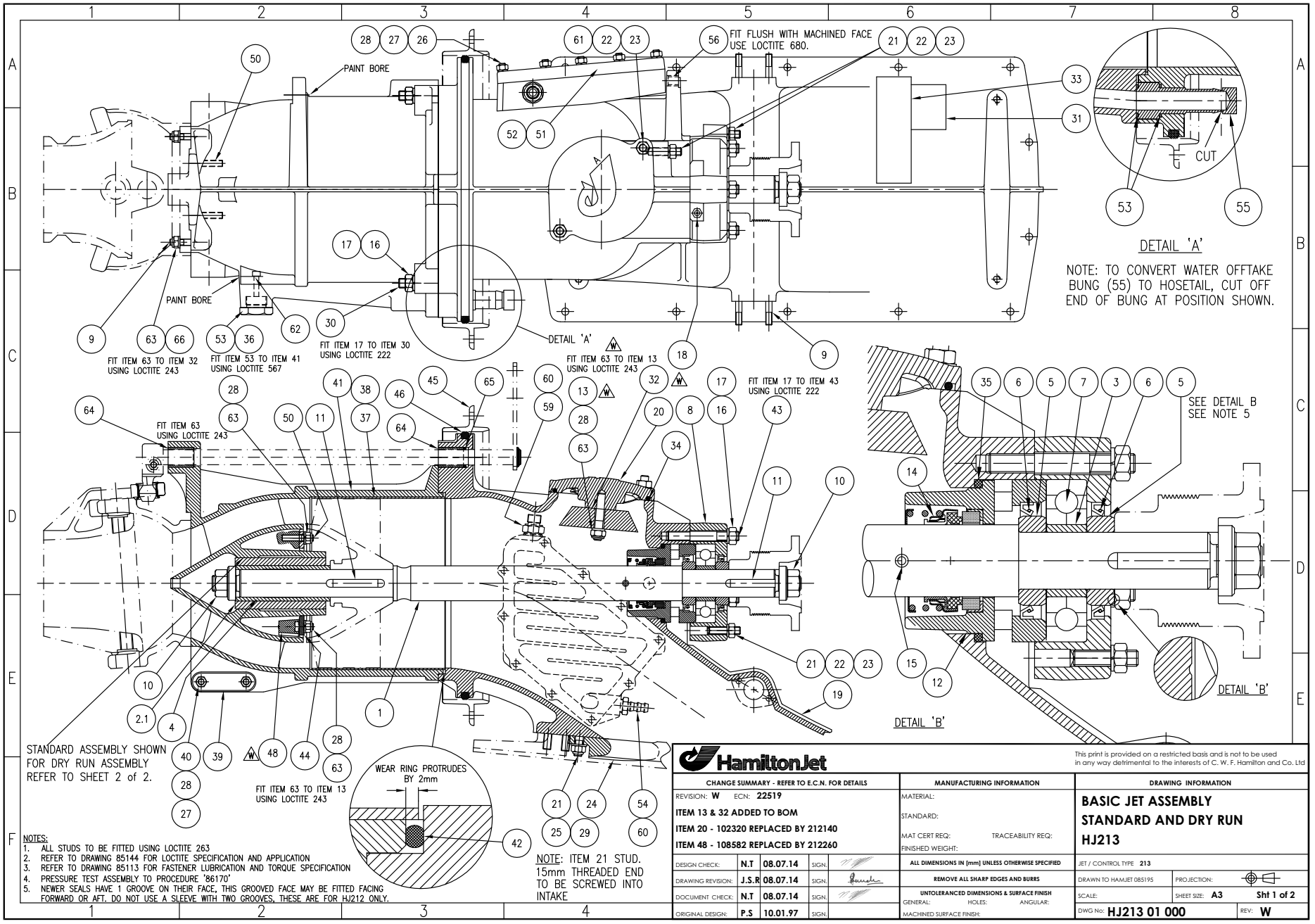
Engine speed	Vessel speed	Comments (loading, sea conditions etc)

Notes

Drawings

- Technical Drawings

HJ-213-01-000 Basic Jet Assemblies Standard & Dry Run Sht 1



NOTES:
1. ALL STUDS TO BE FITTED USING LOCTITE 263
2. REFER TO DRAWING 85144 FOR LOCTITE SPECIFICATION AND APPLICATION
3. REFER TO DRAWING 85113 FOR FASTENER LUBRICATION AND TORQUE SPECIFICATION
4. PRESSURE TEST ASSEMBLY TO PROCEDURE '86170'
5. NEWER SEALS HAVE 1 GROOVE ON THEIR FACE, THIS GROOVED FACE MAY BE FITTED FACING FORWARD OR AFT. DO NOT USE A SLEEVE WITH TWO GROOVES, THESE ARE FOR HJ212 ONLY.

HamiltonJet

CHANGE SUMMARY - REFER TO E.C.N. FOR DETAILS

REVISION: **W** ECN: **22519**

ITEM 13 & 32 ADDED TO BOM

ITEM 20 - 102320 REPLACED BY 212140

ITEM 48 - 108582 REPLACED BY 212260

DESIGN CHECK:	N.T	08.07.14	SIGN.
DRAWING REVISION:	J.S.R	08.07.14	SIGN.
DOCUMENT CHECK:	N.T	08.07.14	SIGN.
ORIGINAL DESIGN:	P.S	10.01.97	SIGN.

MANUFACTURING INFORMATION

MATERIAL:

STANDARD:

MAT CERT REQ: TRACEABILITY REQ:

FINISHED WEIGHT:

ALL DIMENSIONS IN [mm] UNLESS OTHERWISE SPECIFIED

REMOVE ALL SHARP EDGES AND BURRS

UNTOLERANCED DIMENSIONS & SURFACE FINISH

GENERAL: HOLES: ANGULAR:

MACHINED SURFACE FINISH:

DRAWING INFORMATION

BASIC JET ASSEMBLY
STANDARD AND DRY RUN
HJ213

JET / CONTROL TYPE **213**

DRAWN TO HAMJET 085195 PROJECTION:

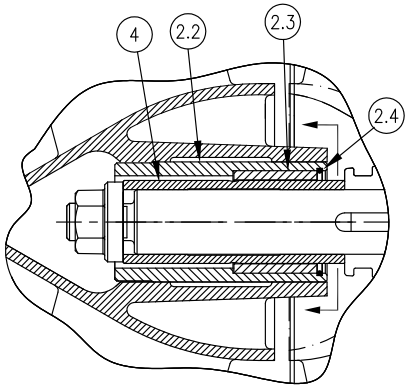
SCALE: SHEET SIZE: **A3** **Sht 1 of 2**

DWG No: **HJ213 01 000** REV: **W**

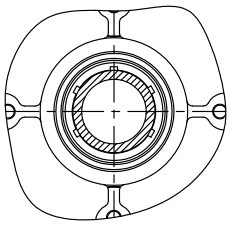
HJ-213-01-000 Basic Jet Assemblies Standard & Dry Run Sht 2

A	B	C	D	E	F	G	Item	Kit	Part Number	Product Description	Drawing
								A	HJ21301001	BASE JET STANDARD FOR HJ213	HJ21301000
								B	HJ21301004	BASE JET DRY RUN FOR HJ213	HJ21301000
								C	109837	INTAKE KIT	HJ21301000
								D	111776	TAILPIPE KIT	HJ21301000
								E	111777	TAILPIPE KIT (DRY RUN)	HJ21301000
								F	109839	BEARING HOUSING KIT	HJ21301000
								G	108213	DRY RUN BEARING ASSEMBLY	HJ21201000
A1	B1						1		109754	MAINSHAFT HJ213	109754
A1			D1				2.1		106011	MARINE WATER BEARING 65x45x115	106264
	B1			E1		G1	2.2		108213-1	BEARING SHELL	108213-1
	B1			E1		G1	2.3		108213-2	BEARING INNER	108213-1
	B1			E1		G1	2.4		104201	(GENERAL) ROUND CIRCLIP	104201
A1	B1				F1		3		106005	BEARING CARRIER	106005
A1	B1						4		110379	WATER BEARING SLEEVE	110379
A2	B2				F2		5		106004	SEAL SLEEVE	106004
A2	B2				F2		6		061458	(OIL SEALS) NAK (#SCW10-55*72*8)	N/A
A1	B1				F1		7		201439	(SKF) BEARINGS ALL TYPES (SKF# QJ309)	N/A
A1	B1				F1		8		108568	BEARING HOUSING	108568
A8	B8	C4	D4	E4			9		030667	(STUDS) METRIC (316-STST) M8x46 (16/16)	30647
A2	B2						10		203395	AB2 IMPELLER-COUPLING NUT	203395
A2	B2						11		110343	IMPELLER / COUPLING KEY	110343
A1	B1						12		111717	SEAL FACE HOLDER MK2 HJ241 & 213	111717
A1	B1						13		109411	(STUDS) METRIC (316-STST) M8x56 (16/16)	30647
A1	B1						14		061483	(JET) ROTARY SEALS (PAC SEAL) (#21-175-06)	61483
A1	B1						15		201074	(SPLIT PINS) ST ST 316 0.19"x2.50"	N/A
A7	B7	C7					16		201396	(WASHERS) (SPRING) M12 SS316	N/A
A7	B7	C7					17		201311	(NUTS) (HEX) M12 SS316	N/A
A1	B1				F1		18		200917	(GREASE) NIPPLES 1/8" BSP STAINLESS STEEL	N/A
A1	B1	C1					19		109746	INTAKE HJ213	109746
A1	B1						20		212140	INSPECTION COVER FOR HJ212 TO HJ241	212140
A4	B4	C4			F2		21		201280	(STUDS) METRIC (316-STST) M10x40 (15/20)	30637
A2	B2	C2			F2		22		201395	(WASHERS) (SPRING) METRIC ST ST 316 M10	N/A
A2	B2	C2			F2		23		201310	(NUTS) (METRIC ST ST 316) M10	N/A
A1	B1						24		109766	INTAKE SCREEN HJ213	109766
A4	B4	C4					25		201331	(NUTS) (METRIC NYLOC ST ST 316) M10	N/A

A	B	C	D	E	F	G	Item	Kit	Part Number	Product Description	Drawing
A10	B10	C10					26		109518	(STUDS) METRIC (316-STST) M8x41 (16/16)	30647
A12	B12	C10	D4	E4			27		201309	(NUTS) (METRIC ST ST 316) M8	N/A
A23	B23	C10	D12	E12			28		201394	(WASHERS) (SPRING) M8 SS316	N/A
A4	B4	C4					29		201384	(WASHERS) (FLAT) METRIC ST ST 316 M10x21x1.2	N/A
A4	B4	C4					30		102769	(STUDS) METRIC (316 STST) M12x78 (28/28)	30639
A1	B1	C1					31		063097	(LABELS) (MODEL & SERIAL NUMBER PLATE)	63097
A1	B1						32		102185	ANODE (ZINC)	102185
A1	B1	C1					33		063610	(LABELS) (WARNING PLATE)	63610
A1	B1	C1					34		200985	(O RINGS) IMPERIAL 0.19x4.50x4.88 (#349N70)	N/A
A1	B1	C1					35		061488	(O RINGS) IMPERIAL 5.34x85.1x95.8 (#340N70)	N/A
A1	B1	C1	D1	E1			36		110019	BUNG for WATER OFFTAKE	110019
A1	B1		D1	E1			37		107537	WEAR RING	105987
A1	B1		D1	E1			38		107538	INSULATOR (WEAR RING)	105988
A2	B2		D2	E2			39		103359	ANODE MK3 (ZINC)	103359
A2	B2		D2	E2			40		201225	(SCREWS) (M/C SCREWS) METRIC ST ST 316 HEX HD M8x70	N/A
A1	B1		D1	E1			41		112668	TAILPIPE MK3	112668
A1	B1	C1	D1	E1			42		200999	(O RINGS) IMPERIAL 0.13x8.75x9.00 (#269N70)	N/A
A3	B3	C3					43		103927	(STUDS) METRIC (316 STST) M12x90 (28/28)	30639
A1	B1		D1	E1			44		109702	ANODE MOUNTING PLATE	109702
							45	REF	108881	TRANSOM PLATE V2.0	108881
							46	REF	107618	(JET) O RINGS SPECIAL TRANSOM PLATE	111183
A1	B1						47		112082	(JET) WOOD TRANSPORT CRATE HJ213	112082
A4	B4		D4	E4			48		212260	ANODE (ZINC)	212260
A4	B4		D6	E6			50		201278	(STUDS) METRIC (316-STST) M8x35 (12/22)	30647
A1	B1	C1					51		109750	OIL COOLER COVER	109750
A1	B1	C1					52		109836	ORING 186x3.53 N70 CUT LENGTH 595	113050
A3	B3	C2	D2	E2			53		064726	(O RINGS) METRIC 2.62x25.07x30.30 (#120N70)	N/A
A1	B1	C1					54		065234	HOSE TAIL 3/8" BSPP MALE PUSH LOC (#3D982-6-6C)	115000
A1	B1	C1					55		212065	HOSETAIL/BUNG 1" for WATER OFFTAKE	212065
A1	B1	C1					56		110806	SLEEVE FOR SAGINAW PUMP MOUNT	110806
A1	B1						57		111424	HJ213 LABELS KIT	111420
A1	B1						58		111551	PAINT APPLICATION 213 JET (STD) GREY GLOSS	111178
A1	B1	C1					59		205065	NIPPLE 3/8" BSPP MALE x 3/8" BSPP MALE (#Z101006)	N/A
A2	B2	C2					60		201767	BONDED SEAL 3/8" BSP (#400-823-4490-74)	N/A
A2	B2	C2					61		030671	(STUDS) METRIC (316-STST) M10x51 (20/20)	30637
A1	B1	C1	D1	E1			62		201259	SCREW CAP SOCKET M6x40 SS316	N/A
A13	B13		D12	E12			63		201330	(NUTS) (METRIC NYLOC ST ST 316) M8	N/A
		C1	D1	E1			64		105998	BUSH STEERING	105998
		C1					65		200964	(O RINGS) IMPERIAL 0.13x3/4"x1.0" (#210N70)	N/A
A4	B4		D4	E4			66		201383	(WASHERS) (FLAT) M8x16x1.2 SS316	N/A



DRY RUN ASSEMBLY



END VIEW.

NOTE: POSITION OF GROOVES, NO GROOVE AT BOTTOM.

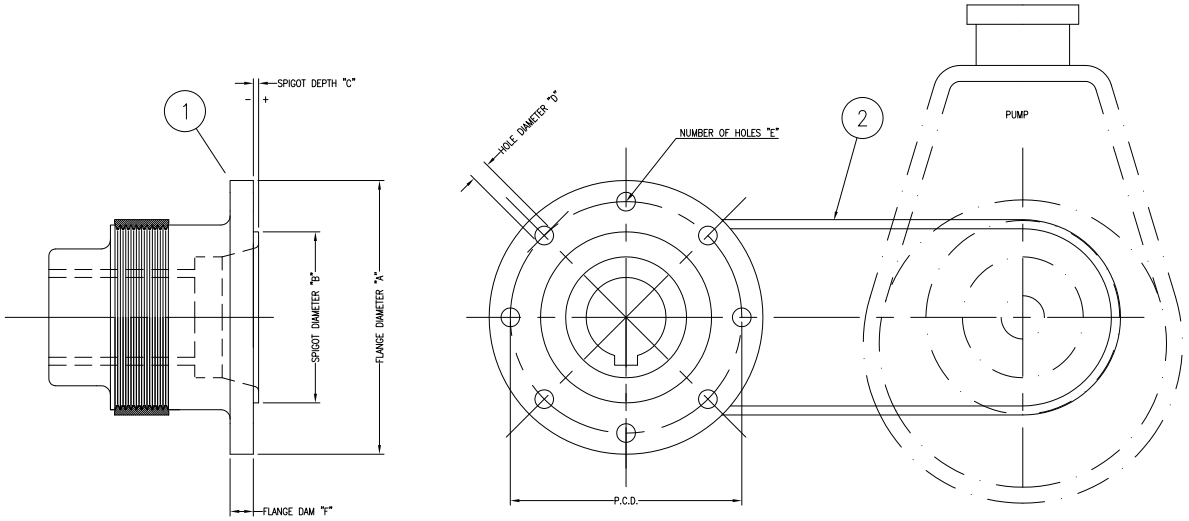
TORQUE CHART	Nm	ft.lbs
IMPELLER NUT (10)	240	177
BEARING RETAINING NUT (9)	240	177
ALL OTHER NUTS AS PER Drg.85018		

HamiltonJet

CHANGE SUMMARY - REFER TO E.C.N. FOR DETAILS	MANUFACTURING INFORMATION	DRAWING INFORMATION
REVISION: ECN:	MATERIAL:	**BASIC JET ASSEMBLY STANDARD AND DRY RUN HJ213**
SEE SHEET 1 FOR DETAILS	STANDARD:	
	MAT CERT REQ: TRACEABILITY REQ:	
	FINISHED WEIGHT:	
DESIGN CHECK: SIGN.	**ALL DIMENSIONS IN [mm] UNLESS OTHERWISE SPECIFIED**	JET / CONTROL TYPE **213**
DRAWING REVISION: SIGN.	**REMOVE ALL SHARP EDGES AND BURRS**	DRAWN TO HAMJET 085195 PROJECTION:
DOCUMENT CHECK: SIGN.	**UNTOLERANCED DIMENSIONS & SURFACE FINISH**	SCALE: SHEET SIZE: **A3** **Sht 2 of 2**
ORIGINAL DESIGN: SIGN.	GENERAL: HOLES: ANGULAR:	DWG No: **HJ213 01 000** REV: **W**
	MACHINED SURFACE FINISH:	

HJ-213-02-001 Couplings and V-Belts

PROJECTION



A	B	C	D	E	Item	Kit	PartNumber	MovexAlias	Qty	ProductDescription	DrawingNbr
						A	108632			COUPLING & V-BELT KIT (ELBE 0.112)	HJ21302001
						B	108633			COUPLING & V-BELT KIT (GWB 287.2 & 387.2)	HJ21302001
						C	108634			COUPLING & V-BELT KIT (HARDY SPICER 1400)	HJ21302001
						D	108635			COUPLING & V-BELT KIT (AQUA DRIVE 14200)	HJ21302001
			D		1		108594		1	COUPLING (SCATRA AQUA DRIVE 14200)	108594
		C			1		108593		1	COUPLING (HARDY SPICER 1400)	108593
	B				1		108592		1	COUPLING (GWB 287.2 & 387.2)	108592
A					1		108591		1	COUPLING (ELBE 0.112)	108591
A	B	C	D		2		64430	064430	1	(VEE BELTS) Gates (PJ559 10 RIB) Micro Vee	N/A

COUPLING	DIA.A	DIA.B	DEP.C	DIA.D	PCD	HOLES(E)	DIM.F
108591	120	75	2.3/2.1	8.2	101.5	8	10
108592	120	75	2.3/2.5	10.2	101.5	8	10
108593	116	69.9R	(-2.0/1.8)	11.5	95.3	4*	10
108594	135	69.9R	(-6.0)	M12x1.75-6H	108	6	30

NOTE:""=EQUI SPACED

HJ213 02 001 A

REF	NO.	BY	DATE	AMENDMENTS
CL412	A	SC	18.04.06	DIM F ADDED
CL31	0	P.S.	12.12.97	ISSUE FOR PRODUCTION

JET 213

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

MATERIAL N.A.

√ = N9 EXCEPT AS STATED

UNLIMITED DIMENSIONS TO BE ± –

MAT'L CERT

DESIGNED P.A.S. DATE 26/10/95

DRAWN P.A.S. 26/10/95

CHECKED

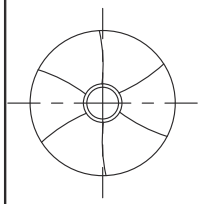
APPROVED

NAME
COUPLINGS & BELTS
HJ213

SCALE N.T.S.

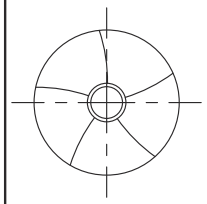
No: A3–HJ213 02 001 A

HJ-213-03-001 Impeller Options



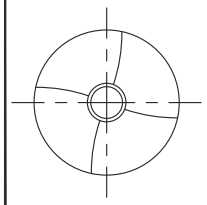
6 BLADE

PART No	QTY	DESCRIPTION	DWG No
211657	1	213 IMPELLER (4.5) - (6 BLADE)	211657
211658	1	213 IMPELLER (4.2) - (6 BLADE)	211657
211659	1	213 IMPELLER (3.9) - (6 BLADE)	211657
211660	1	213 IMPELLER (3.7) - (6 BLADE)	211657
211661	1	213 IMPELLER (3.5) - (6 BLADE)	211657



5 BLADE

PART No	QTY	DESCRIPTION	DWG No
106030	1	213 IMPELLER (3.2) - (5 BLADE)	106030
106228	1	213 IMPELLER (2.9) - (5 BLADE)	106030
106031	1	213 IMPELLER (2.7) - (5 BLADE)	106030
106032	1	213 IMPELLER (2.5) - (5 BLADE)	106030



4 BLADE

PART No	QTY	DESCRIPTION	DWG No
107417	1	213 IMPELLER (2.4) - (4 BLADE)	107417
107418	1	213 IMPELLER (2.2) - (4 BLADE)	107417
107419	1	213 IMPELLER (2.0) - (4 BLADE)	107417
107420	1	213 IMPELLER (1.8) - (4 BLADE)	107417

REFER TO DRAWING 82206 FOR BLADE DRESSING AND BALANCING INSTRUCTIONS.

HamiltonJet

CHANGE SUMMARY - REFER TO E.C.N. FOR DETAILS

REVISION: D ECN: 21326

PART NUMBERS FOR HJ213 CHANGED

ADDED TYPE 4.5

T-3.4 CHANGED TO T-3.5 TO REFLECT TESTED RATING

DESIGN CHECK:	MM	08.03.13	SIGN.
DRAWING REVISION:	SH	08.03.13	SIGN.
DOCUMENT CHECK:	MM	08.03.13	SIGN.
ORIGINAL DESIGN:	PAS	04.04.97	SIGN.

MANUFACTURING INFORMATION

MATERIAL:

STANDARD:

MAT CERT REQ: TRACEABILITY REQ:

FINISHED WEIGHT: [kg]

ALL DIMENSIONS IN [mm] UNLESS OTHERWISE SPECIFIED

REMOVE ALL SHARP EDGES AND BURRS

UNTOLERANCED DIMENSIONS & SURFACE FINISH

GENERAL: ±0.5 HOLES: Ø0.2 ANGULAR: ± 0.5°

MACHINED SURFACE FINISH: Ra 6.3 µm

DRAWING INFORMATION

HJ213 IMPELLERS

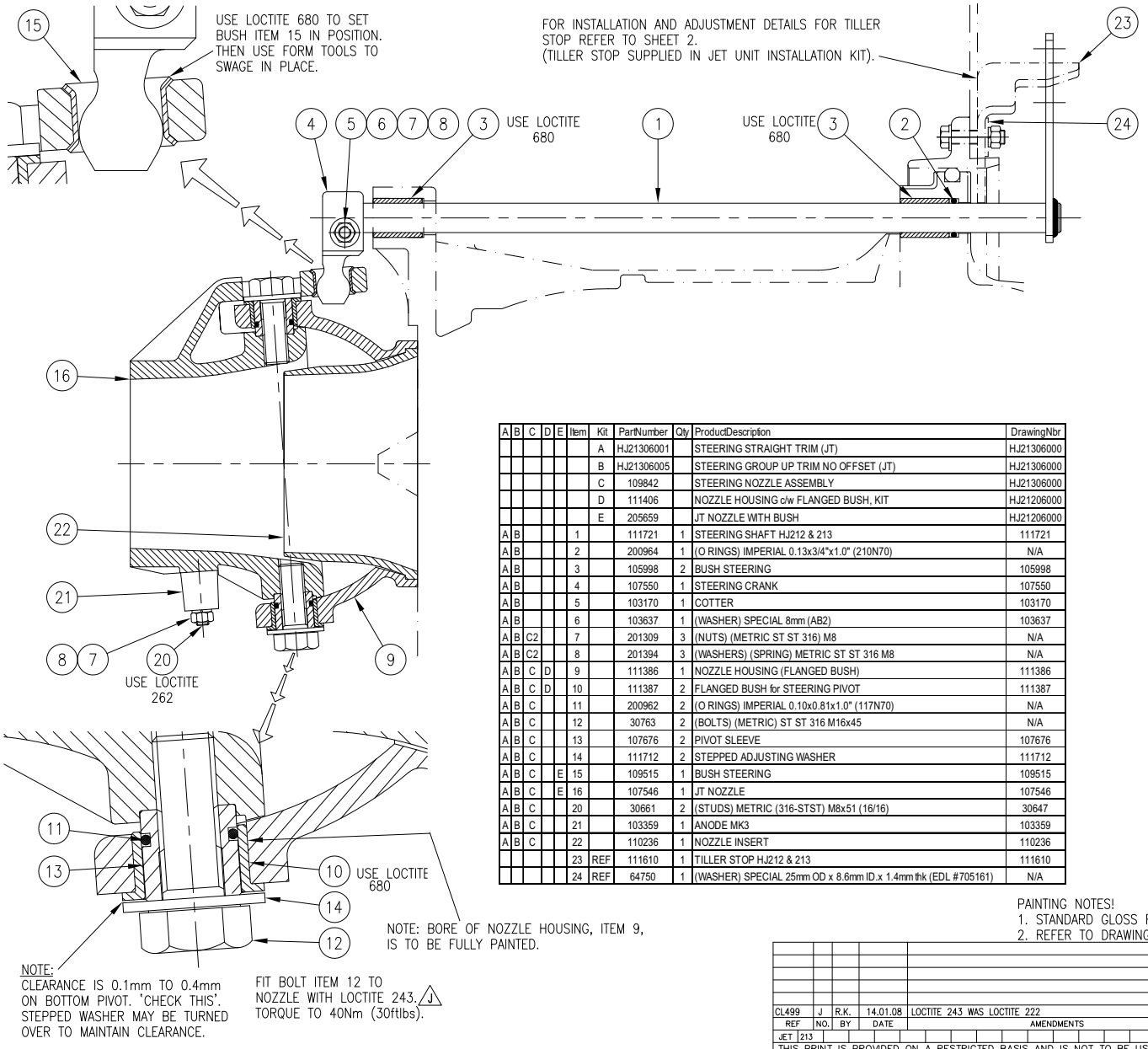
JET / CONTROL TYPE HJ213

DRAWN TO HAMJET 085195 PROJECTION:

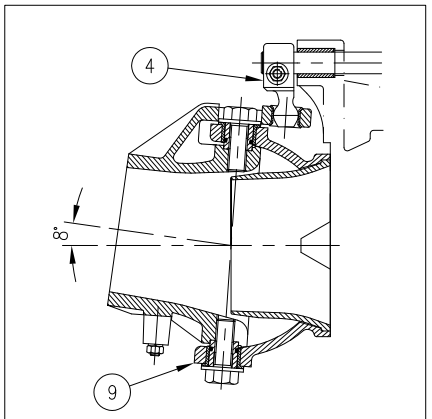
SCALE: SHEET SIZE: A3 Sht 1 of 1

DWG No: HJ21303001 REV: D

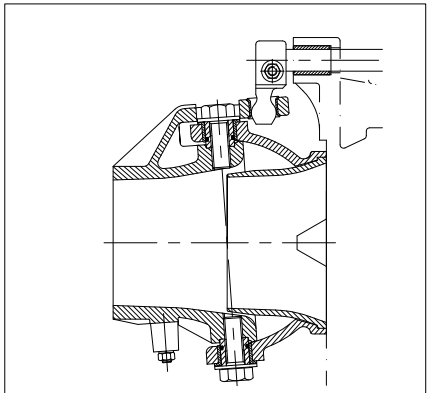
HJ-213-06-000 Steering Assembly Sht1



A	B	C	D	E	Item	Kit	PartNumber	Qty	ProductDescription	DrawingNbr
						A	HJ21306001		STEERING STRAIGHT TRIM (JT)	HJ21306000
						B	HJ21306005		STEERING GROUP UP TRIM NO OFFSET (JT)	HJ21306000
						C	109842		STEERING NOZZLE ASSEMBLY	HJ21306000
						D	111406		NOZZLE HOUSING c/w FLANGED BUSH, KIT	HJ21206000
						E	205659		JT NOZZLE WITH BUSH	HJ21206000
A	B				1		111721	1	STEERING SHAFT HJ212 & 213	111721
A	B				2		200964	1	(O RINGS) IMPERIAL 0.13x3/4"x1.0" (210N70)	N/A
A	B				3		105998	2	BUSH STEERING	105998
A	B				4		107550	1	STEERING CRANK	107550
A	B				5		103170	1	COTTER	103170
A	B				6		103637	1	(WASHER) SPECIAL 8mm (AB2)	103637
A	B	C2			7		201309	3	(NUTS) (METRIC ST ST 316) M8	N/A
A	B	C2			8		201394	3	(WASHERS) (SPRING) METRIC ST ST 316 M8	N/A
A	B	C	D		9		111386	1	NOZZLE HOUSING (FLANGED BUSH)	111386
A	B	C	D		10		111387	2	FLANGED BUSH for STEERING PIVOT	111387
A	B	C			11		200962	2	(O RINGS) IMPERIAL 0.10x0.81x1.0" (117N70)	N/A
A	B	C			12		30763	2	(BOLTS) (METRIC) ST ST 316 M16x45	N/A
A	B	C			13		107676	2	PIVOT SLEEVE	107676
A	B	C			14		111712	2	STEPPED ADJUSTING WASHER	111712
A	B	C		E	15		109515	1	BUSH STEERING	109515
A	B	C		E	16		107546	1	JT NOZZLE	107546
A	B	C			20		30661	2	(STUDS) METRIC (316-STST) M8x51 (16/16)	30647
A	B	C			21		103359	1	ANODE MK3	103359
A	B	C			22		110236	1	NOZZLE INSERT	110236
					23	REF	111610	1	TILLER STOP HJ212 & 213	111610
					24	REF	64750	1	(WASHER) SPECIAL 25mm OD x 8.6mm ID.x 1.4mm thk (EDL #705161)	N/A



NOZZLE 'UP' – HJ21306005



NOZZLE 'STRAIGHT' – HJ21306001

NOZZLE TRIM OPTIONS

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

PAINTING NOTES!
1. STANDARD GLOSS FINISH: REFER TO DRAWING 85132 FOR PAINTING OF PARTS.
2. REFER TO DRAWING 111178 FOR PAINT SPECIFICATION AND APPLICATION.

CL499	J	R.K.	14.01.08	LOCTITE 243 WAS LOCTITE 222
REF	NO.	BY	DATE	AMENDMENTS

JET 213

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

PROJECTION

DESIGNED P.A.S.	DATE 25.1.97
DRAWN P.M.W.	20.3.97
CHECKED P.A.S.	13/10/97
APPROVED K.V.E	

NAME
STEERING ASSEMBLY
GENERAL ARRANGEMENT
HJ 213 JET
Sheet 1 of 2

SCALE 1:2.5 | No. ASSY-HJ213 06 000 | J

HJ-213-06-000 Steering Assembly sht2

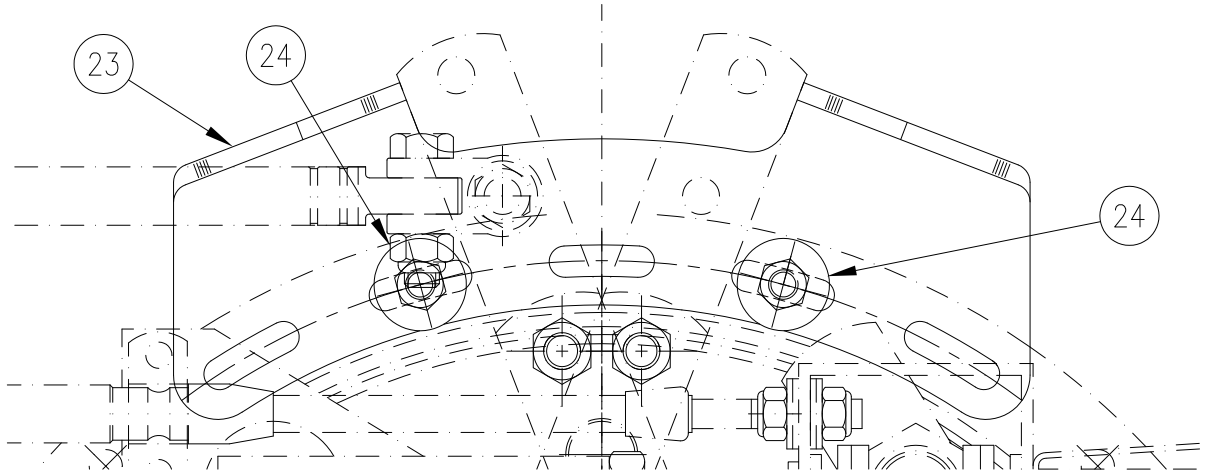
TILLER STOP FITTING INSTRUCTIONS

1/ FROM INSIDE THE BOAT FIT THE TILLER STOP (23) OVER THE PROTRUDING SCREWS FOLLOWED BY THE M8 LARGE WASHER (24), SPRING WASHER & NUT.

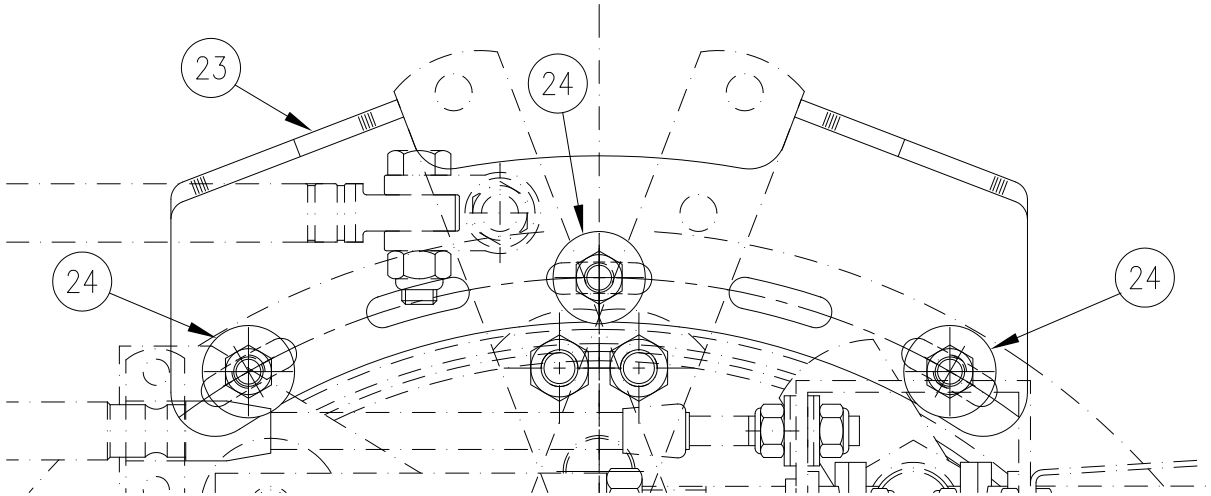
2/ IF THE STEERING CABLE IS TO BE CONNECTED TO THE TOP HOLE IN THE ARM IT WILL BE NECESSARY TO MARK AND TRIM THE ADJACENT STOP UNTIL IT CLEARS THE CABLE WHILE STILL STOPPING THE TILLER ARM.
NOTE THAT THE CABLE END MUST BE CONNECTED TO THE FRONT SIDE OF THE TILLER.

3/ PRIOR TO ADJUSTING THE STOP CHECK THAT THE BOLT AND NUT AT THE BOTTOM OF THE TILLER IS FULLY TIGHTENED TO 35Nm (26lb.ft)

4/ ADJUST THE STOP SO THAT THE CLEARANCE BETWEEN THE NOZZLE AND THE HOUSING IS THE SAME IN EACH DIRECTION. THEN TIGHTEN THE TILLER STOP NUTS TO 13lbs.ft.(17.5Nm)



TILLER STOP BOLTING ARRANGEMENT FOR UNITS WITH TRANSOM PLATE ATTACHED WITH BOLTS EITHER SIDE OF THE JET CENTRELINE



TILLER STOP BOLTING ARRANGEMENT FOR UNITS WITH TRANSOM PLATE ATTACHED WITH BOLTS ON THE JET CENTRELINE

REF	NO.	BY	DATE	AMENDMENTS
JET	213			SEE SHEET 1 FOR AMENDMENTS.

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.

PROJECTION

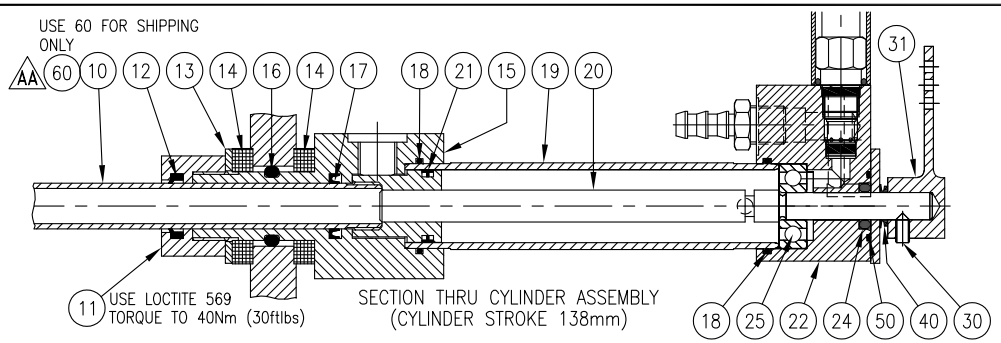
DESIGNED M.J.H.	DATE 19/10/00
DRAWN P.A.S	9/2/01
CHECKED	
APPROVED	

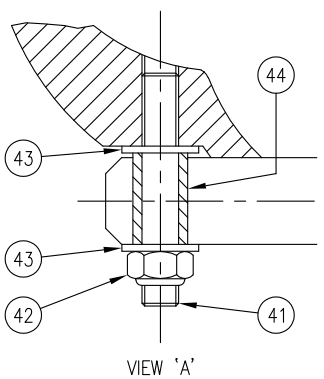
NAME
STEERING ASSEMBLY
GENERAL ARRANGEMENT
TILLER STOP
HJ213 (sheet 2 of 2)

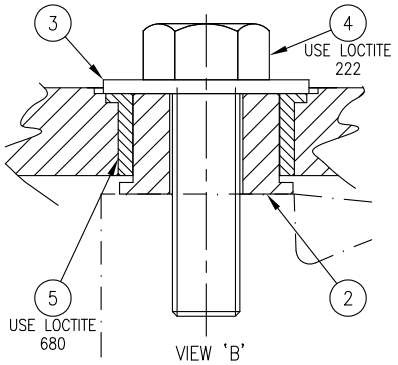
SCALE -

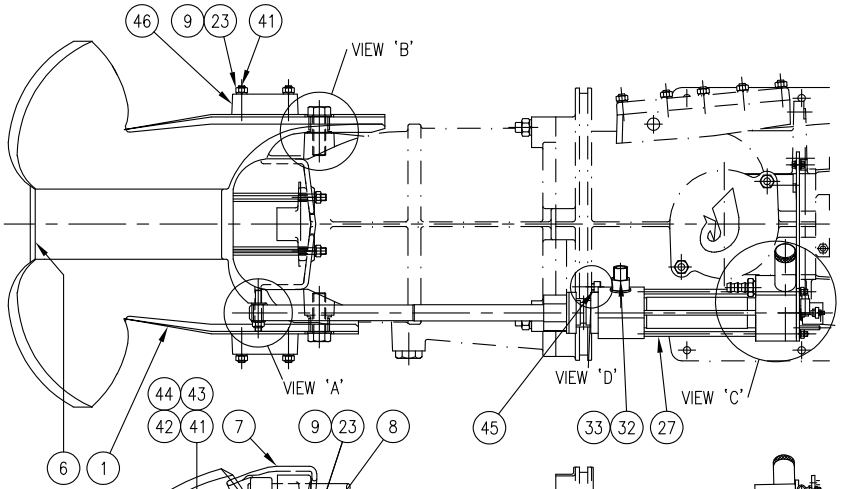
No: ASSY-HJ213 06 000 J

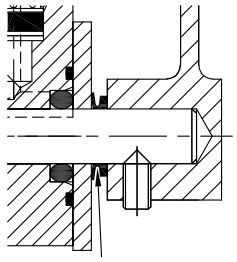
HJ-213-07-001 Reverse Assembly Sht1

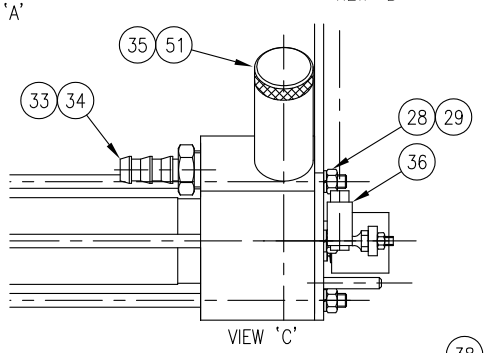


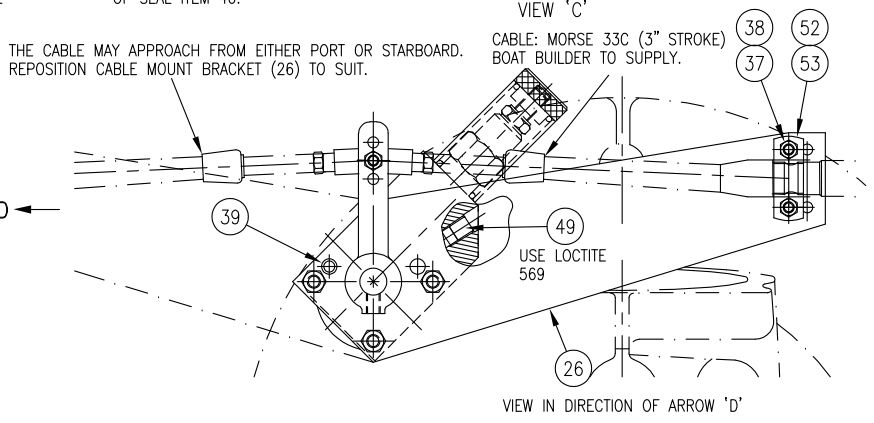












LOCTITE APPLICATION:
REFER TO DRAWING No: 85144 FOR THE CORRECT APPLICATION INSTRUCTIONS FOR LOCTITE 222, 262, 325 & 569.

USE LOCTITE 262 ON ALL STUDS.

PAINTING NOTES!
1. STANDARD GLOSS FINISH: REFER TO DRAWING 85132 FOR PAINTING OF PARTS.
2. REFER TO DRAWING 111178 FOR PAINT SPECIFICATION AND APPLICATION.
3. REFER TO TORQUE DRAWING 85113. AA

REF	NO.	BY	DATE	AMENDMENTS
JET	213			
CL631	AA	J.S.R	02.08.10	PART NO. 065287 & 085159 ADDED TO KIT.
CL445	Z	C.M.	27.11.06	SCREW ADDED TO VIEW. SPRING WASHER DEL. DETAIL VIEW ADDED.
CL422	Y	R.K.	26.06.06	INCORRECT PARTS LIST AMENDED
CL419	X	C.M.B	02.06.06	KIT A ADDED. ITEM 32 – 205065 WAS 201759.
CL347	W	J.W.	01.11.04	ITEM 24 WAS Pt. No. 65179 (ROTARY SHAFT SEAL)
				FOR CHANGES REF CLs.229,236,237,242,250,267,302,307,320,337

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

PROJECTION

DESIGNED | DATE

DRAWN P.M.W. | 25.3.97

CHECKED

APPROVED

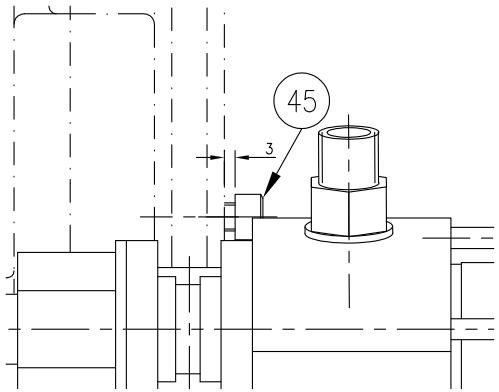
NAME
REVERSE ASSEMBLY
HYDRAULIC REVERSE
HJ 213 JET
SHEET 1 OF 2

SCALE 1:5

No: ASSY–HJ213 07 001 AA

HJ-213-07-001 Reverse Assembly Sht2

A	B	C	D	E	F	G	Item	Kit	PartNumber	ProductDescription	DrawingNbr
								A	HJ21307001	REVERSE GROUP (HYDRAULIC) CONTROL	HJ21307001
A1								B	112079	REVERSE CYLINDER H.S.R.X MK2 HJ213	HJ21307001
								C	112078	SEALS KIT H.S.R.X MK2	HJ24107001
								D	112049	HSRX BACKHEAD KIT	HJ21307001
								E	112239	HSRX FRONT HEAD KIT	HJ21307001
								F	112241	REVERSE DUCT KIT	HJ21307001
								G	080934	CABLE CLAMP KITSET	80934
								REF	085159	INSTRUCTION SHEET, HSRX MK2 SEALS KIT	85159
A1					F1		1		111720	REVERSE DUCT HJ212 & 213	111720
A2							2		111722	REVERSE DUCT PIVOT HJ212 & 213	111722
A2							3		111724	WASHER for REV. DUCT PIVOT HJ212 & 213	111724
A2							4		201160	(BOLTS) (METRIC) ST ST 316 M16x50	N/A
A2					F2		5		111723	REVERSE DUCT PIVOT BUSH HJ212 & 213	111723
A1							6		107562	(LABELS) REVERSE LABEL	107562
A1							7		111649	SPLASH GUARD HJ212 & 213 (MK2)	111649
A2							8		201278	(STUDS) METRIC (316-STST) M8x35 (12/22)	30647
A6					F4		9		201394	(WASHERS) (SPRING) METRIC ST ST 316 M8	N/A
	B1						10		109775	SHAFT ASSEMBLY	108580
	B1			E1			11		108550	REVERSE CYL RETAINING NUT	108550
	B1	C1		E1			12		201511	(SEAL) WIPER SEAL 20x28x4.8 TYPE 839N HALLITE #4630900	N/A
	B1			E1			13		108564	(WASHER) SPECIAL WASHER 30mm OD x 3.0 thk 316 STST	108564
	B2	C2		E2			14		108559	RESILIENT MOUNT 50 x 30 (Rubber)	107135
	B1			E1			15		109607	FRONT HEAD	109607
	B1	C1		E1			16		061487	(O RINGS) METRIC 5.3x25x35.6 DASH NO. 318N70	N/A
	B1	C1		E1			17		201512	(OIL SEALS) 20x28x5 TYPE 605 HALLITE #4611100	N/A
	B2	C2	D1	E1			18		201002	(O RINGS) IMPERIAL 0.10x1.44x1.63 (127N70)	N/A
	B1						19		108572	CYLINDER	106555
	B1						20		108569	SPOOL H.S.R.X	108569
	B1	C1					21		201497	(SEAL) PISTON SEAL-GT 8065-173-HR	N/A
	B1		D1				22		112235	BACKHEAD H.S.R.X Mk3 (HDM8724)	112235
A7					F4		23		201309	(NUTS) (METRIC ST ST 316) M8	N/A
	B1	C1	D1				24		065222	12x4.5 Viton O ring	N/A
	B1		D1				25		201466	(SKF) BEARING 6301	N/A
	B1						26		108553	CABLE MOUNTING PLATE H.S.R.X	108553
	B4						27		109774	(STUDS) METRIC (316-STST) M6x218 (15/15)	30635
	B4						28		201308	NUT HEX M6 SS316	N/A
	B4						29		201392	WASHER SPRING M6 SS316	N/A
	B1						30		201244	(SCREWS) (SET SCREWS) METRIC ST ST 316 Socket M6x10	N/A
	B1						31		106561	HANDLE H.S.R.X	106561
	B1			E1			32		205065	NIPPLE 3/8" BSPP MALE x 3/8" BSPP MALE # Z101006	115000
	B2	C2	D1	E1			33		201767	BONDED SEAL 3/8" BSP (400-823-4490-74)	115000
	B1						34		065234	HOSE TAIL 3/8" BSPP MALE PUSH LOC # 3D982-6-6C	115000
	B1		D1				35		202986	PRESSURE RELIEF VALVE (RDBA-LDN) PRESSURE SET TO 34 BAR (500 psi)	N/A
	B1						36		201553	BALL JOINT MORSE 30C CABLE 10-32 UNF S.S.	201553
	B2					G2	37		201183	SCREW RND 0.19UNCx1 SS316	N/A
	B2					G2	38		201326	NUT NYLOC 019UNC SS316	N/A
	B1		D1				39		108927	PIN 3/16" dia x 40	108250
	B1	C1	D1				40		065187	V-RING (VA-12)	N/A
	B1				F5		41		030661	(STUDS) METRIC (316-STST) M8x51 (16/16)	30647
	B1						42		201330	NUT NYLOC M8 SS316	N/A
	B2						43		201383	WASHER FLAT M8x16x1.2 SS316	N/A
	B1						44		111808	PLAIN BUSH - REVERSE CYLINDER (REPLACES PT No.64452)	111808
A1							45		201261	(SCREWS) (CAPSCREWS) METRIC ST ST 316 Socket Hd M8x20	N/A
A2					F2		46		103359	ANODE MK3	103359
	B1						49	REF	065186	DRYSEAL PRESSURE PLUG 1/16" NPT	N/A
	B1	C1	D1				50		065183	(O RINGS) METRIC 25x2 N70	N/A
	B1		D1				51		065185	COVER KIT (HCO 2240)	N/A
	B2					G2	52		202544	MORSE CABLE CLAMP 30 S.S.	202544
	B2					G2	53		202543	SHIM - MORSE CABLE CLAMP	202543
	B0.18						54		065287	25mm Spiral Tie. Fits 20mm hydraulic shafts. (SPL 25/B).	N/A



VIEW 'D'
ANTIROTATION CAP SCREW (ITEM 45) INSTALLATION:
USE LOCTITE 262 AND LEAVE 3mm STANDOUT.

ITEM 35: VALVE PURCHASED AT STD. PRE-SET PRESSURE OF 500 p.s.i.

REFER TO SHEET 1 FOR CHANGES

REF	NO.	BY	DATE	AMENDMENTS
JET	213			

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

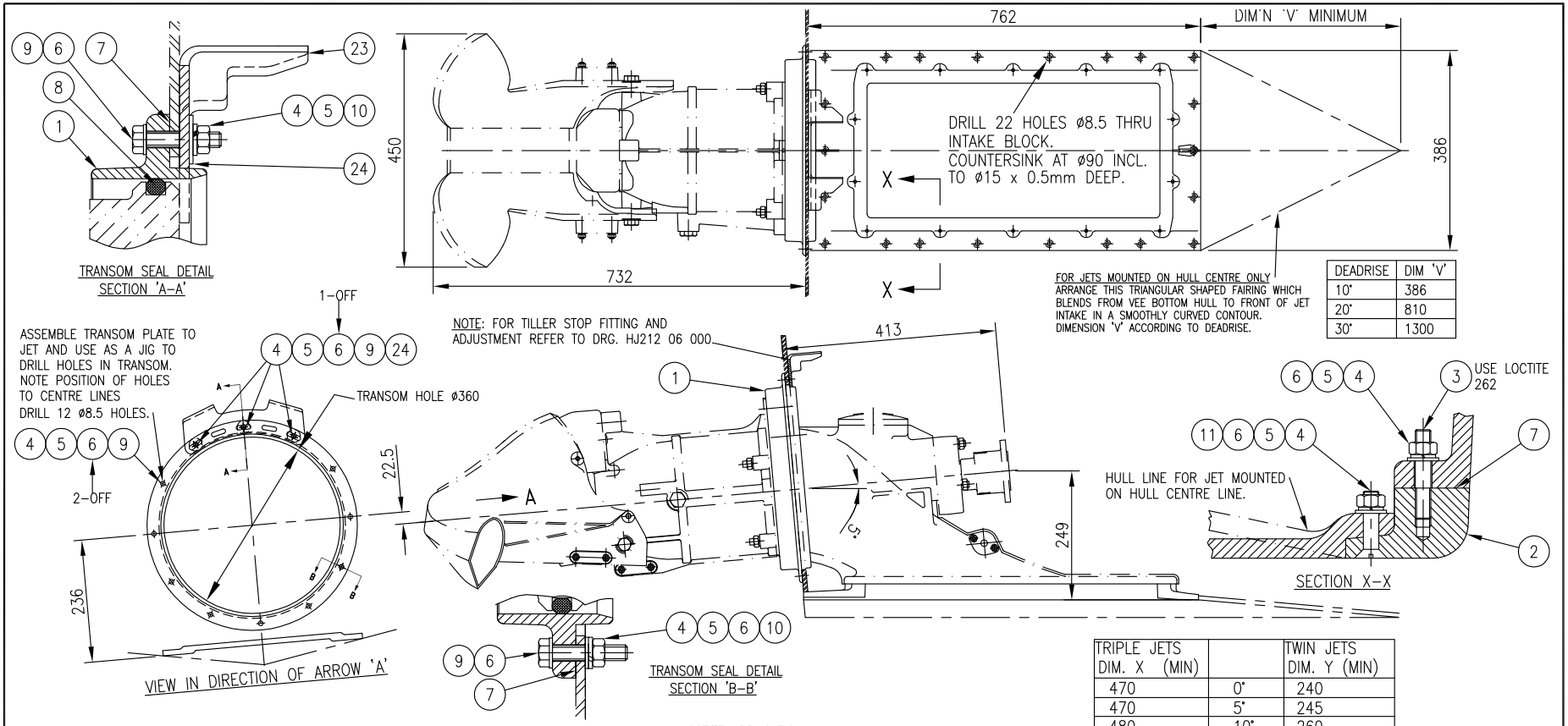
PROJECTION

NAME
REVERSE ASSEMBLY
HYDRAULIC REVERSE
HJ 213 JET
SHEET 2 OF 2

DESIGNED DATE
DRAWN P.M.W. 25.3.97
CHECKED
APPROVED

SCALE -
No: ASSY-HJ 213 07 001 AA

HJ-213-08-001 Installation Details GRP Hulls



DEADRISE	DIM 'V'
10°	386
20°	810
30°	1300

TRIPLE JETS DIM. X (MIN)		TWIN JETS DIM. Y (MIN)
470	0°	240
470	5°	245
480	10°	260
480	15°	265
480	20°	275
480	25°	280

A	B	C	Item	Kit	PartNumber	MovexAlias	Qty	ProductDescription	DrawingNbr
				A	107543		REF	INTAKE BLOCK KIT (GRP HULL)	HJ21208001
				B	107541		REF	INSTALLATION BOLTS KIT GRP/ALM HULL	HJ21208001
				C	107697		REF	TRANSOM PLATE KIT (ALUM & GRP HULL)	HJ21208001
		C	1		108881		1	TRANSOM PLATE V2.0	108881
A			2		107554		1	INTAKE BLOCK - ALM / GRP	107554
	B		3		30667	030667	14	(STUDS) METRIC (316-STST) M8x46 (16/16)	30647
A22	B14	C12	4		JDQHXAC	201309	48	(NUTS) (METRIC ST ST 316) M8	N/A
A22	B14	C12	5		JEQKXAC	201394	48	(WASHERS) (SPRING) METRIC ST ST 316 M8	N/A
A22	B14	C21	6		JEOZXAF	201383	57	(WASHERS) (FLAT) METRIC ST ST 316 M8x16x1.2	N/A
A1	B1		7		JMNGAAR	201414	2	NEUT-CURE RTV SILICONE 310G	N/A
		C	8		107618		1	(JET) O RINGS SPECIAL TRANSOM PLATE	111183
		C	9		HZQHXBC	201221	12	(SCREWS) (M/C SCREWS) METRIC ST ST 316 HEX HD M8x40	N/A
	B		10		MRINAAI	201715	1	LOCTITE 262 10ML BOTTLE	N/A
A			11		HZPPXDI	201200	22	(BOLTS) (M/C SCREWS) METRIC STST 316 M8x30 (CSK HD)	N/A
A1	B1	C1	15		63595	063595	3	(JET) PACKAGING BOLT BOX	N/A
		C	23		111610		1	TILLER STOP HJ212 & 213	111610
		C	24		64750	064750	3	(WASHER) SPECIAL 25mm OD x 8.6mm ID.x 1.4mm thk (EDL #705161)	N/A

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

PAINTING NOTES:
1. STANDARD GLOSS FINISH: REFER TO DRAWING 85132 FOR PAINTING OF PARTS.
2. REFER TO DRAWING 85145 FOR THE FINISH OF THE INTAKE BLOCK.
3. REFER TO DRAWING 111178 FOR PAINT SPECIFICATION AND APPLICATION.

NOTE:
FROM SERIAL No 470 THE INTAKE BLOCK HAS BEEN LENGTHENED AND THE TRANSOM SEAL PLATE CHANGED FROM 107542 ('L' SECTION) TO 108881 ('T' SECTION) TO PROVIDE MORE CLEARANCE BETWEEN THE CLEARANCE BETWEEN THE TRANSOM AND THE STEERING TILLER.

REF	NO.	BY	DATE	AMENDMENTS
CL316	E	F.K.	15.03.04	ITEM 7, RTV SILICONE, ADDED TO KIT A
CL229	D	P.M.W.	22.04.02	LOCTITE DETAILS UPDATED
CL0173	C	R.J.L	19.02.01	ITEMS 23,24 & SECT. B-B ADDED, ITEMS 4, 5 & 6 QTY. WAS 26.
CL0173	B	P.S.	19.02.01	CENTRE DISTANCES ADDED. ITEM 9 WAS HZQHXAZ.
CL158	A	P.M.W.	6.10.00	PAINT SPEC DRGS ADDED
CL3785	0	P.M.W.	7.4.97	ISSUED FOR PRODUCTION

JET 213

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

PROJECTION

NAME: INSTALLATION DETAILS G.R.P. HULL HJ 213 JET

DESIGNED | DATE

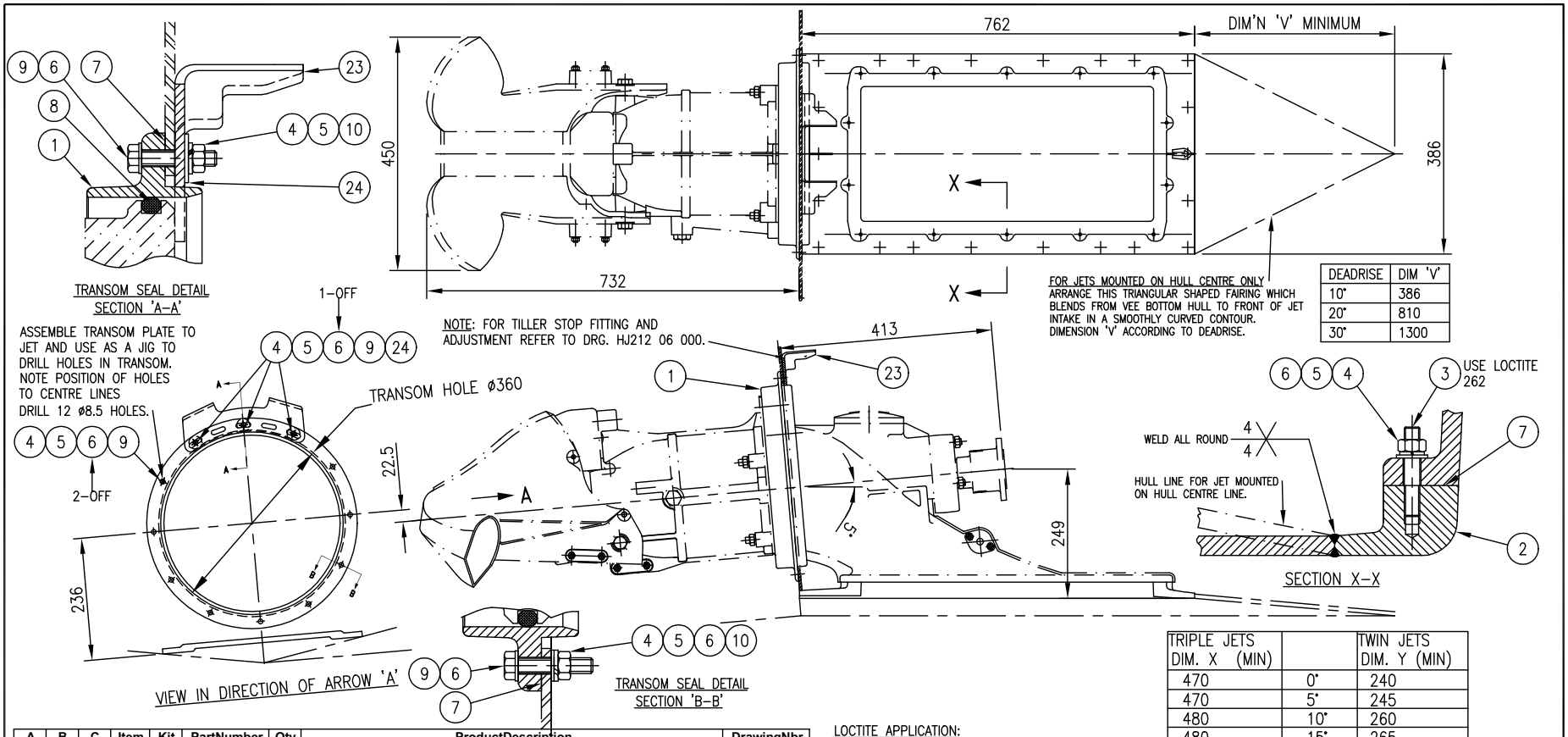
DRAWN P.M.W. | 4.4.97

CHECKED

APPROVED

SCALE 1:7.5 | No: ASSY-HJ 213 08 001 | E

HJ-213-08-002 Installation Details Aluminium Hulls

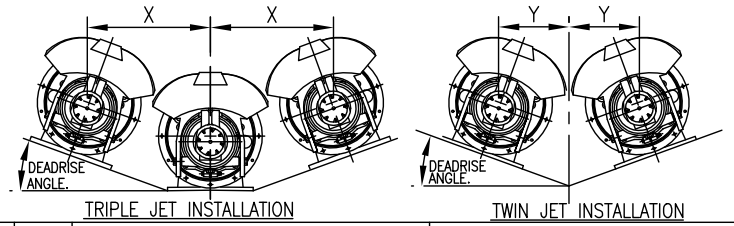


DEADRISE	DIM 'V'
10°	386
20°	810
30°	1300

TRIPLE JETS DIM. X (MIN)		TWIN JETS DIM. Y (MIN)
470	0°	240
470	5°	245
480	10°	260
480	15°	265
480	20°	275
480	25°	280

A	B	C	Item	Kit	PartNumber	Qty	ProductDescription	DrawingNbr
				A	107554	REF	INTAKE BLOCK - ALM / GRP	107554
				B	107541	REF	INSTALLATION BOLTS KIT GRP/ALM HULL	HJ21208001
				C	107697	REF	TRANSOM PLATE KIT (ALUM & GRP HULL)	HJ21208001
		C	1		108881	1	TRANSOM PLATE V2.0	108881
A			2		107554	1	INTAKE BLOCK - ALM / GRP	107554
	B		3		30667	14	(STUDS) METRIC (316-STST) M8x46	30647
	B14	C12	4		JDQHXAC	26	(NUTS) (METRIC ST ST 316) M8	N/A
	B14	C12	5		JEQKXAC	26	(WASHERS) (SPRING) METRIC ST ST 316 M8	N/A
	B14	C21	6		JEOZXAF	35	(WASHERS) (FLAT) METRIC ST ST 316 M8x16x1.2	N/A
	B		7		JMNGAAR	1	NEUT-CURE RTV SILICONE 310G	N/A
		C	8		107618	1	(JET) O RINGS SPECIAL TRANSOM PLATE	111183
		C	9		HZQHXBC	12	(SCREWS) (M/C SCREWS) METRIC ST ST 316 HEX HD M8x40	N/A
	B		10		MRINAAI	1	LOCTITE 262 10ML BOTTLE	N/A
		C	23		111610	1	TILLER STOP HJ212 & 213	111610
		C	24		64750	3	(WASHER) SPECIAL 25mm OD x 8.6mm ID.x 1.4mm thk (EDL #705161)	N/A

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



PAINTING NOTES:
1. STANDARD GLOSS FINISH: REFER TO DRAWING 85132 FOR PAINTING OF PARTS.
2. REFER TO DRAWING 85145 FOR THE FINISH OF THE INTAKE BLOCK.
3. REFER TO DRAWING 111178 FOR PAINT SPECIFICATION AND APPLICATION.

NOTE:
FROM SERIAL No 470 THE INTAKE BLOCK HAS BEEN LENGTHENED AND THE TRANSOM SEAL PLATE CHANGED FROM 107542 ('L' SECTION) TO 108881 ('T' SECTION) TO PROVIDE MORE CLEARANCE BETWEEN THE CLEARANCE BETWEEN THE TRANSOM AND THE STEERING TILLER.

REF	NO.	BY	DATE	AMENDMENTS
CL229	D	P.M.W	22.04.02	LOCTITE DETAILS UPDATED
CL0173	C	R.J.L	19.02.01	ITEMS 23,24 & SECT. B-B ADDED, ITEM 6 QTY. WAS 26. ITEM 9 WAS HZQHXBA.
CL0173	B	P.S.	19.02.01	CENTRE DISTANCES ADDED. ITEM 9 WAS HZQHXAZ.
CL158	A	P.M.W	6.10.00	PAINT SPEC DRGS ADDED
CL3785	0	P.M.W	7.4.97	ISSUED FOR PRODUCTION

JET 213

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

PROJECTION

DESIGNED | DATE

DRAWN P.M.W. 3.4.97

CHECKED

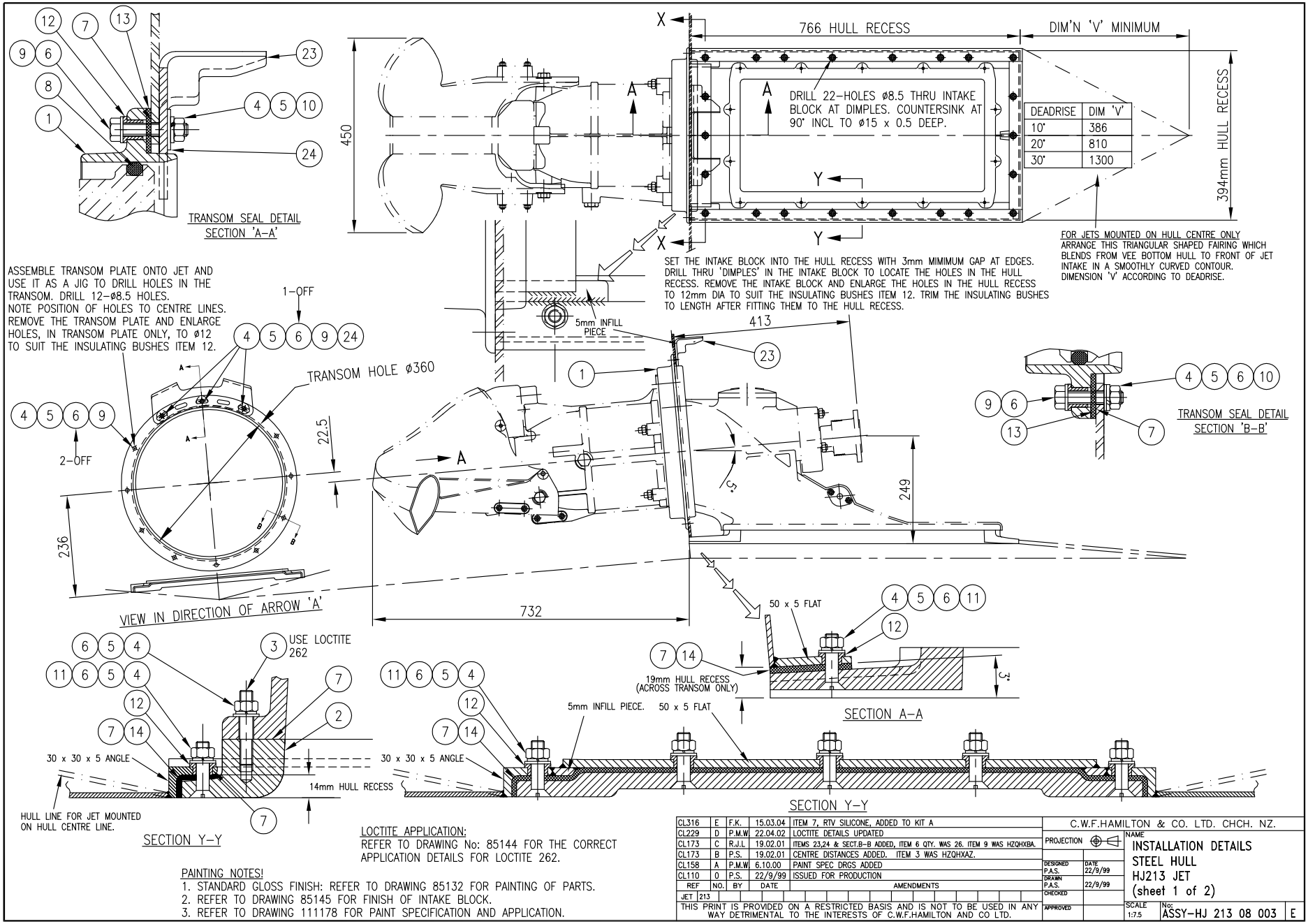
APPROVED

NAME
INSTALLATION DETAILS
ALUMINIUM HULL
HJ 213 JET

SCALE 1:7.5

No: ASSY-HJ 213 08 002 D

HJ-213-08-003 Installation Details Steel Hulls Sht1



LOCTITE APPLICATION:
REFER TO DRAWING No: 85144 FOR THE CORRECT APPLICATION DETAILS FOR LOCTITE 262.

PAINTING NOTES!
1. STANDARD GLOSS FINISH: REFER TO DRAWING 85132 FOR PAINTING OF PARTS.
2. REFER TO DRAWING 85145 FOR FINISH OF INTAKE BLOCK.
3. REFER TO DRAWING 111178 FOR PAINT SPECIFICATION AND APPLICATION.

REF	NO.	BY	DATE	AMENDMENTS
CL316	E	F.K.	15.03.04	ITEM 7, RTV SILICONE, ADDED TO KIT A
CL229	D	P.M.W	22.04.02	LOCTITE DETAILS UPDATED
CL173	C	R.J.L	19.02.01	ITEMS 23,24 & SECT.B-B ADDED, ITEM 6 QTY. WAS 26. ITEM 9 WAS HZQHXBA.
CL173	B	P.S.	19.02.01	CENTRE DISTANCES ADDED. ITEM 3 WAS HZQHXAZ.
CL158	A	P.M.W	6.10.00	PAINT SPEC DRGS ADDED
CL110	0	P.S.	22/9/99	ISSUED FOR PRODUCTION
JET	213			

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

PROJECTION

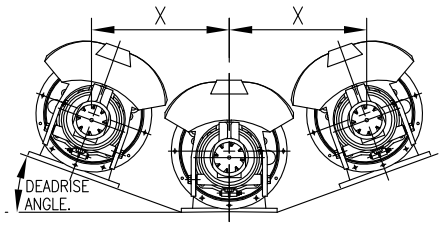
DESIGNED P.A.S.	DATE 22/9/99
DRAWN P.A.S.	22/9/99
CHECKED	
APPROVED	

NAME
INSTALLATION DETAILS
STEEL HULL
HJ213 JET
(sheet 1 of 2)

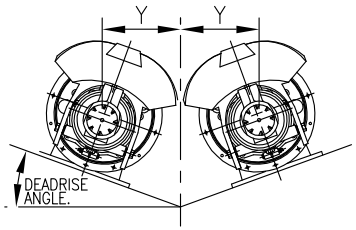
SCALE 1:7.5 | No: ASSY-HJ 213 08 003 | E

HJ-213-08-003 Installation Details Steel Hulls Sht2

TRIPLE JETS DIM. X (MIN)		TWIN JETS DIM. Y (MIN)
470	0°	240
470	5°	245
480	10°	260
480	15°	265
480	20°	275
480	25°	280



TRIPLE JET INSTALLATION



TWIN JET INSTALLATION

A	B	C	Item	Kit	PartNumber	MovexAlias	Qty	ProductDescription	DrawingNbr
				A	111197			INTAKE BLOCK KIT STEEL HULL	HJ21308003
				B	107541			INSTALLATION BOLTS KIT GRP/ALM HULL	HJ21208001
				C	111198			TRANSOM PLATE KIT (STEEL HULL)	HJ21308003
		C	1		108881		1	TRANSOM PLATE V2.0	108881
A			2		107554		1	INTAKE BLOCK - ALM / GRP	107554
	B		3		30667	030667	14	(STUDS) METRIC (316-STST) M8x46 (16/16)	30647
A22	B14	C12	4		JDQHXAC	201309	48	(NUTS) (METRIC ST ST 316) M8	N/A
A22	B14	C12	5		JEQKXAC	201394	48	(WASHERS) (SPRING) METRIC ST ST 316 M8	N/A
A22	B14	C21	6		JEOZXAF	201383	57	(WASHERS) (FLAT) METRIC ST ST 316 M8x16x1.2	N/A
A1	B1		7		JMNGAAR	201414	2	NEUT-CURE RTV SILICONE 310G	N/A
		C	8		107618		1	(JET) O RINGS SPECIAL TRANSOM PLATE	111183
		C	9		HZQHXBC	201221	12	(SCREWS) (M/C SCREWS) METRIC ST ST 316 HEX HD M8x40	N/A
	B		10		MRINAAI	201715	1	LOCTITE 262 10ML BOTTLE	N/A
A			11		HZPPXDI	201200	22	(BOLTS) (M/C SCREWS) METRIC STST 316 M8x30 (CSK HD)	N/A
A22		C12	12		KHACXAF	201528	34	(BUSHES) NYLON FLANGED GS NYLATRON S48M	N/A
		C	13		111199		1	TRANSOM GASKET (STEEL HULL)	111199
A			14		111200		1	INTAKE BLOCK GASKET (STEEL HULL)	111200
A1	B1	C1	15		63595	063595	3	(JET) PACKAGING BOLT BOX	N/A
		C	23		111610		1	TILLER STOP HJ212 & 213	111610
		C	24		64750	064750	3	(WASHER) SPECIAL 25mm OD x 8.6mm ID.x 1.4mm thk (EDL #705161)	N/A

REF	NO.	BY	DATE	AMENDMENTS
JET 213				SEE 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.

PROJECTION

DESIGNED P.A.S. DATE 22/9/99

DRAWN P.A.S. 22/9/99

CHECKED

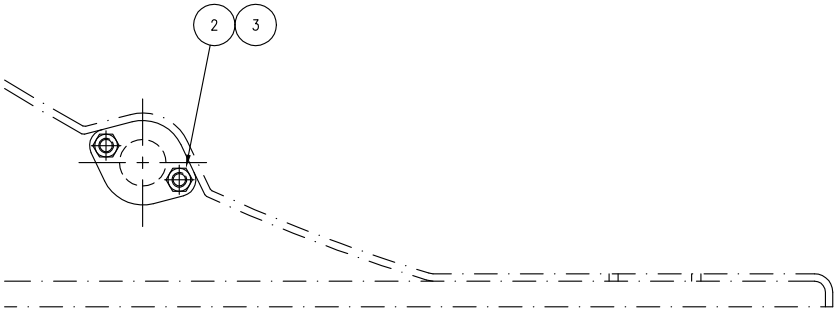
APPROVED

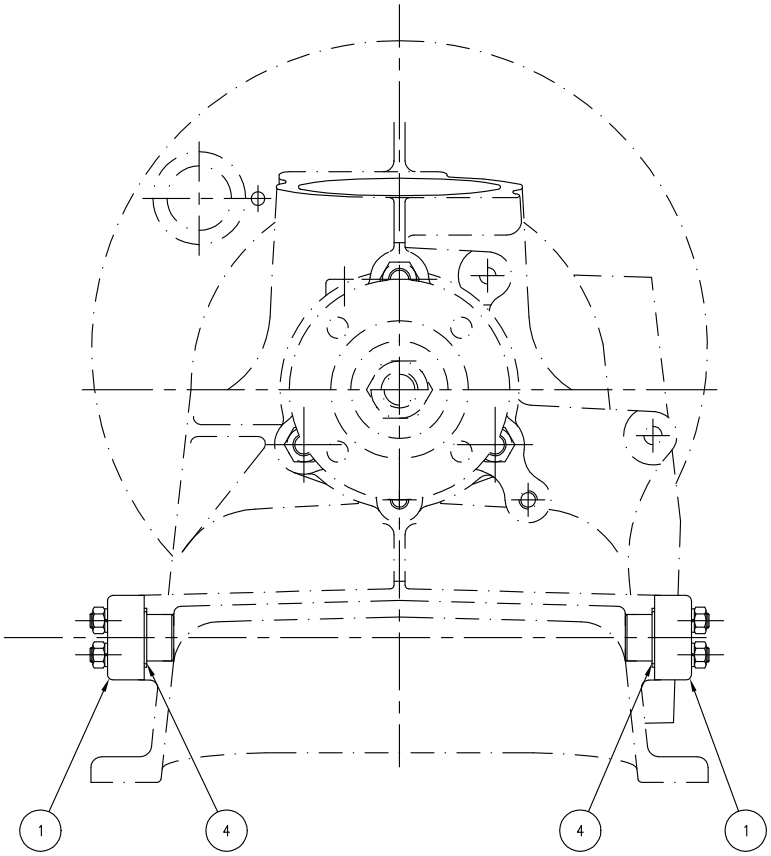
NAME
INSTALLATION DETAILS
STEEL HULL
HJ213 JET
(sheet 2 of 2)

SCALE -

No: ASSY-HJ213 08 003 E

HJ-213-09-001 Screen Rake Blanking Plugs





SPARES ASSY			ITEM	PART No	QTY	DESCRIPTION	DWG No
		4	1	110068	2	SCREEN RAKE BLANKING PLUG	110068
		4	2	JDQHXAC	4	NUT M8 316 S.S.	
		4	3	JEQKXAC	4	SPRING WASHER M8 316 S.S.	
		4	4	HMHRAEJ	2	`O' RING 0.06" X 1.0" X 1.125"	

REF	NO.	BY	DATE	AMENDMENTS
CL3795	A	P.S.	17/7/97	ITEM 1 WAS 105999
CL3785	0	PMW	7.4.97	ISSUED FOR PRODUCTION

JET 213

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

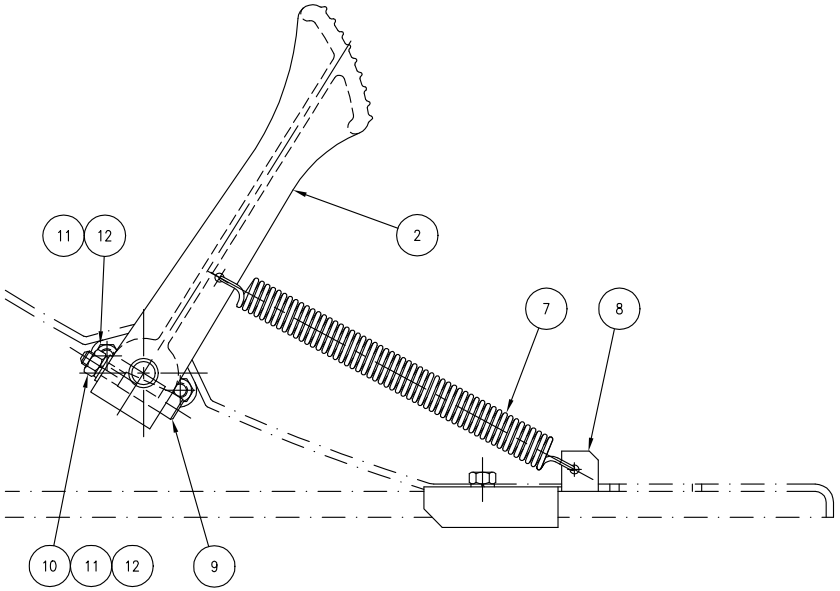
PROJECTION

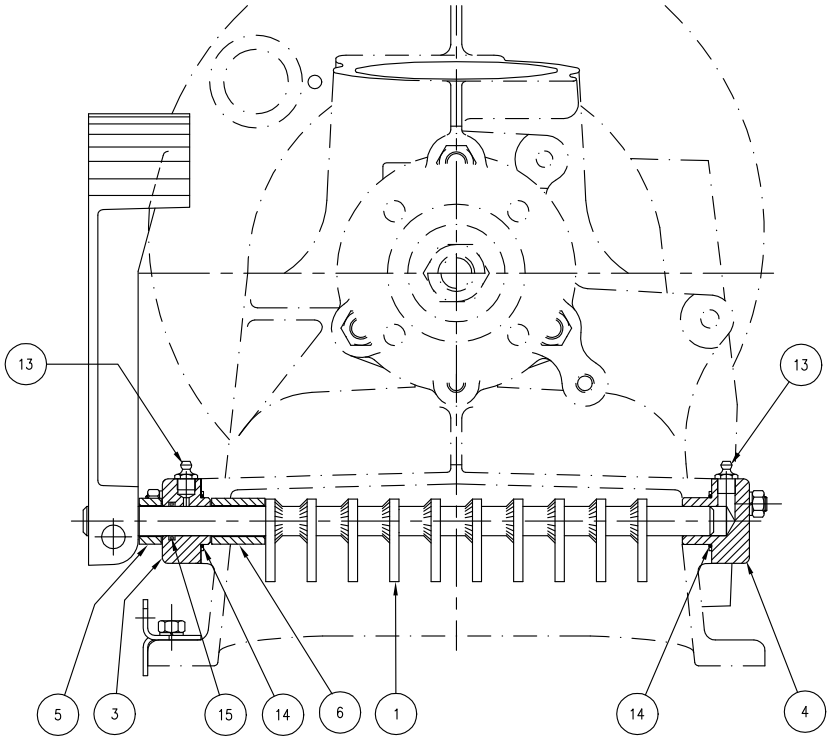
DESIGNED P.A.S.	DATE 2/4/97
DRAWN P.M.W.	02.04.97
CHECKED P.A.S.	17/7/97
APPROVED K.V.E.	28/4/97

NAME
SCREEN RAKE
BLANKING PLUGS
HJ 213 JET

SCALE 1:2.5 | No: ASSY-HJ 213 09 001 | A

HJ-213-09-002 Screen Rake





SPARES ASSY	ITEM	PART No	QTY	DESCRIPTION	DWG No
4	1	109937	1	SCREEN RAKE	109937
4	2	110034	1	SCREEN RAKE ACTUATING ARM	110034
4	3	110035	1	STARBOARD BEARING	110035
4	4	110036	1	PORT BEARING	110036
4	5	110065	1	SPACER (EXTERNAL)	110065
4	6	110066	1	SPACER (INTERNAL)	110066
4	7	102364	1	SPRING	102364
4	8	105359	1	SPRING ANCHOR BRACKET	105359
4	9	105931	1	COTTER PIN	105931
4	10	103637	1	WASHER	103637
4	11	JDQHXAC	5	NUT M8 316 S.S.	
4	12	JEQKXAC	5	M8 SPRING WASHER 316 S.S.	
4	13	HEIDAAA	2	GREASE NIPPLE 1/8" BSP STRAIGHT	
4	14	HMHRAEJ	2	`O' RING 0.07" X 1.0" X 1.13" (022N70)	
4	15	HMHRAAJ	1	`O' RING 0.1" X 0.63" X 0.81" (114N70)	

REF	NO.	BY	DATE	AMENDMENTS
CL3795	A	P.S.	17/7/97	REDESIGNED
CL3785	0	PMW	7.4.97	ISSUED FOR PRODUCTION

JET 213

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

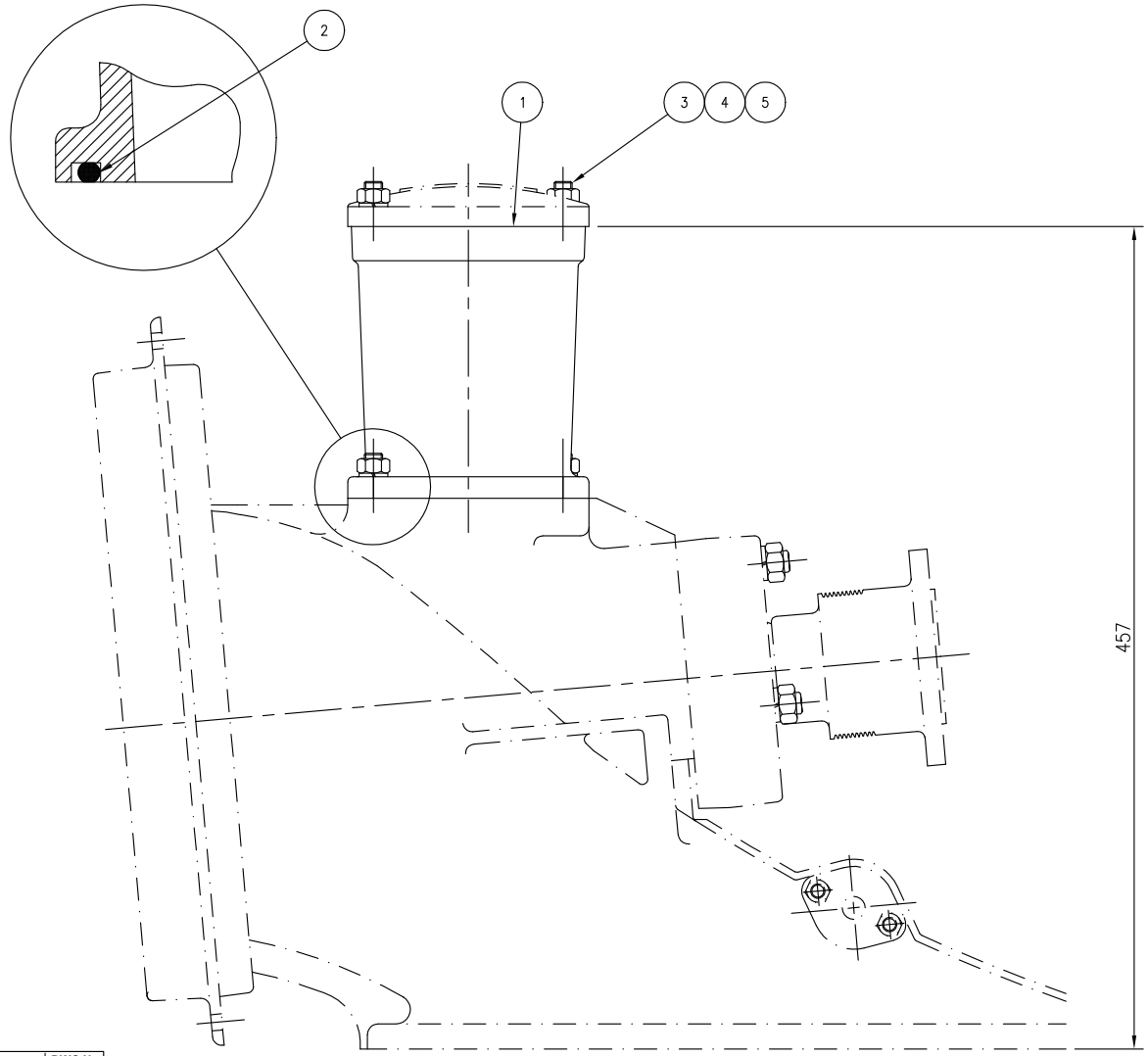
PROJECTION

DESIGNED P.A.S.	DATE 17/7/97
DRAWN P.M.W.	02.04.97
CHECKED P.A.S.	17/7/97
APPROVED	

NAME
SCREEN RAKE ASSEMBLY
HJ 213 JET

SCALE 1:2.5 | No. ASSY-HJ 213 09 002 | A

HJ-213-10-004 hatch extension



SPARES ASSY	ITEM	PART No	QTY	DESCRIPTION	DWG No
	1	107633	1	HATCH EXTENSION	107633
	2	HMHRADF	1	`O' RING: 0.19" x 4.88" x 4.5" 349N70	
	3	JCQHXAN	2	STUD, M10 x 40 316 S.S.	
	4	JDQHXAE	2	HEX NUT M10 316 S.S.	
	5	JEQKXAE	2	SPRING WASHER M10 316 S.S.	

REF	NO.	BY	DATE	AMENDMENTS
CL3785	0	P.M.W.	7.4.97	ISSUED FOR PRODUCTION

JET 213

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

PROJECTION

DESIGNED DATE

DRAWN P.M.W. 01.04.97

CHECKED

APPROVED

NAME
HATCH EXTENSION
HJ 213 JET

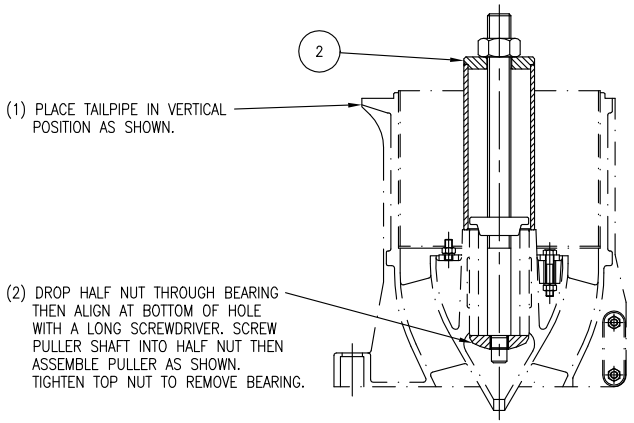
SCALE 1:2.5

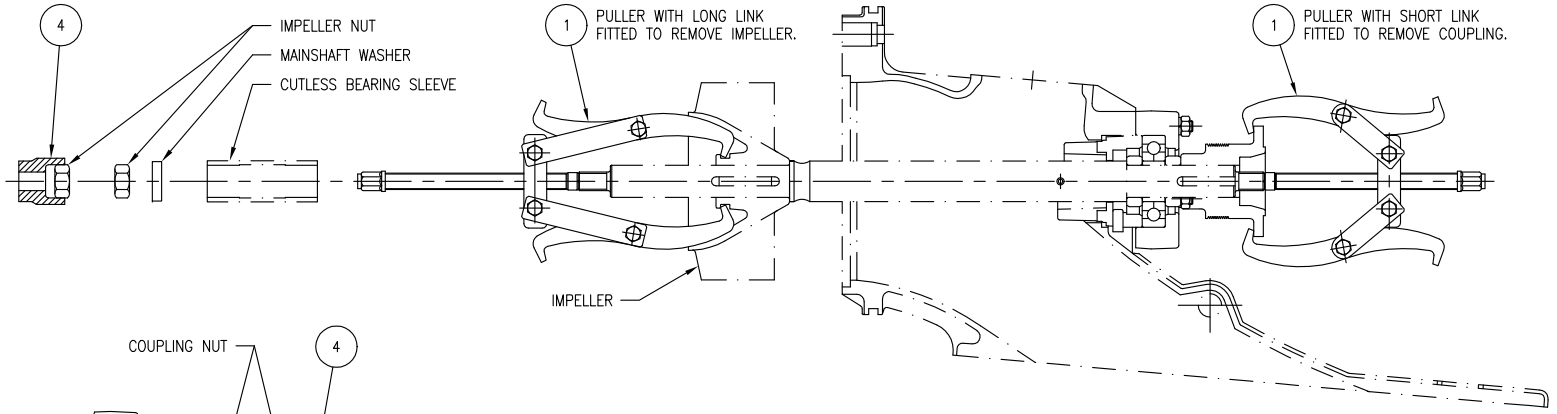
No: ASSY-HJ 213 10 004 0

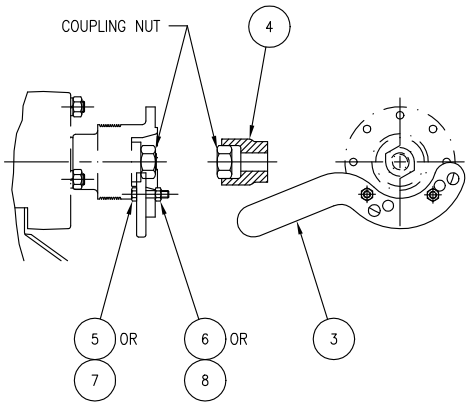
HJ-213 11-000 Tool Kit

SPARES ASSY				ITEM	PART No	QTY	DESCRIPTION	DWG No
A			4	1	106212	1	PULLER: COUPLING & IMPELLER	106212
A			4	2	106215	1	PULLER: BEARING	106215
A			4	3	105797	1	COUPLING REACTION ARM	105797
A			4	4	SPCMBDA	1	SOCKET 30mm AF x 3/4" SQUARE DRIVE	
A			4	5	HYIXXBF	2	BOLT M8 x 55 LONG ZINC PLATED	
A			4	6	JDPVYAC	2	NUT M8 ZINC PLATED	
A			4	7	HYIXXCC	2	BOLT M10 x 55 LONG ZINC PLATED	
A			4	8	JDPVYAE	2	NUT M10 ZINC PLATED	
A				9	63594	1	CARTON	

ITEM	KIT No		DESCRIPTION	DWG No
A	106013		MAINTENANCE TOOLS KIT	THIS







CL3785	0	P.M.W	8.4.97	Issue for Production	
REF	NO.	BY	DATE	AMENDMENTS	
JET 213					

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.

PROJECTION

DESIGNED DATE

DRAWN P.M.W. 8.4.97

CHECKED

APPROVED

NAME
TOOL KITS
HJ 213 JET

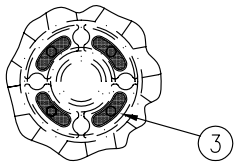
SCALE 1:5

No: ASSY-HJ 213 11 000 0

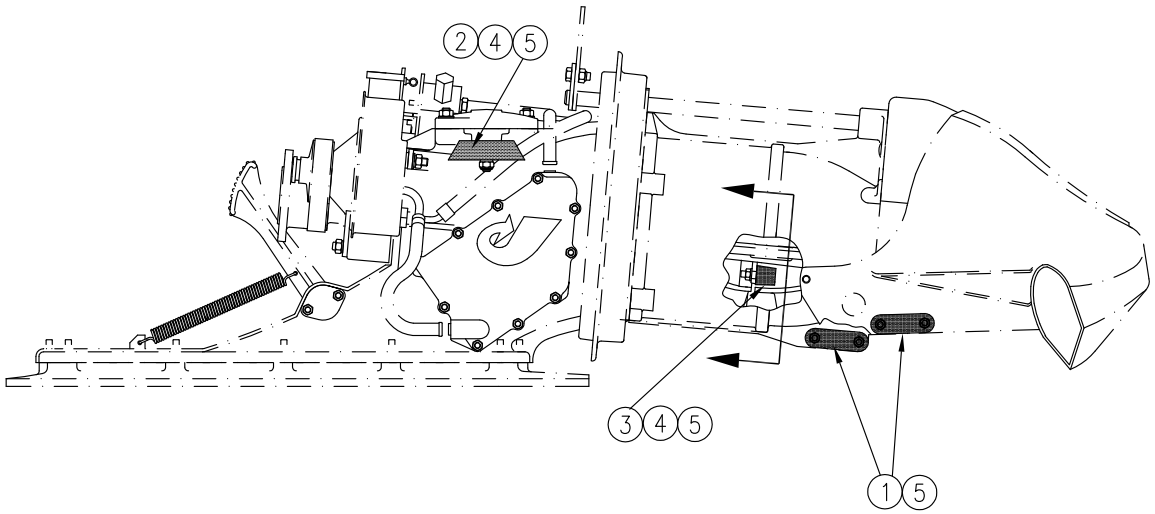
HJ-213-13-002 Anode Locations

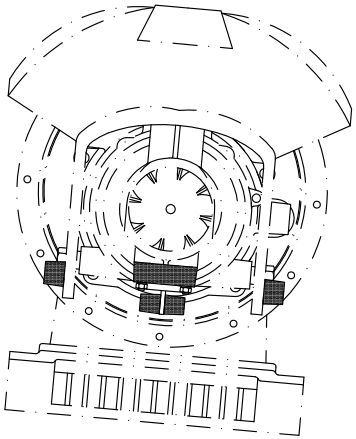
NOTES:

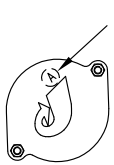
1. QUANTITIES OF FASTENERS SUPPLIED WITH ANODE KIT:
   FOR INTERNAL ANODES NYLOC FASTENERS ARE USED. A FULL SET OF NYLOC NUTS IS SUPPLIED AND SHOULD BE USED EACH TIME THE INTERNAL ANODES ARE CHANGED.
   FOR EXTERNAL ANODES STANDARD NUTS ARE USED. NO STANDARD NUTS ARE SUPPLIED FOR EXTERNAL ANODES ON THE BASIS THAT IF ANY ARE LOST THEN A REMOVED NYLOC MAY BE FITTED IN ITS PLACE. APPROXIMATELY 25% OF SPRING WASHERS ARE SUPPLIED TO REPLACE ANY THAT ARE LOST OR DAMAGED.
2. REFER TO PRODUCT BULLETIN PRB_10_2014 FOR MORE INFORMATION ON THE INTRODUCTION OF THE INTAKE HATCH ANODE



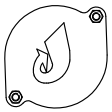
SECTION THROUGH TAILPIPE
SHOWING ANODES



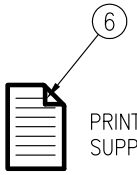




INSPECTION HATCH 212140
SUITS KIT A – WITH INTAKE
HATCH ANODE



INSPECTION HATCH 102320
SUITS KIT B – WITHOUT INTAKE
HATCH ANODE



PRINT A COPY OF THIS DRAWING AND
SUPPLY IT WITH THE ANODE KIT

A	B	Item	Kit	Part Number	Product Description	Drawing
			A	212175	JET ANODE SPARES KIT FOR HJ213 AND HJ241 (WITH HATCH ANODE)	HJ24113002
			B	212361	JET ANODE SPARES KIT FOR HJ213 AND HJ241 (WITHOUT HATCH ANODE)	HJ24130002
A5	B5	1		103359	ANODE MK3 (ZINC)	103359
A1		2		102185	ANODE (ZINC)	102185
A4	B4	3		212260	ANODE (ZINC)	212260
A5	B4	4		201330	(NUTS) (METRIC NYLOC ST ST 316) M8	N/A
A4	B4	5		201394	(WASHERS) (SPRING) M8 SS316	N/A
		6	REF	N/A (PRINT)	PAPER COPY OF THIS DRAWING	N/A

HamiltonJet

CHANGE SUMMARY - REFER TO E.C.N. FOR DETAILS

REVISION: **A** ECN: **21955**

ITEM 3 - 108582 REPLACED WITH 212260

ITEM 2 ADDED TO BOM

DWG PICTORIALLY UPDATED TO SHOW NEW ITEM 3

DESIGN CHECK:	N.T	11.07.17	SIGN.
DRAWING REVISION:	J.S.R	11.07.17	SIGN.
DOCUMENT CHECK:	N.T	11.07.17	SIGN.
ORIGINAL DESIGN:	R.J.L	01.12.00	SIGN.

MANUFACTURING INFORMATION

MATERIAL:
STANDARD:
MAT CERT REQ: TRACEABILITY REQ:
FINISHED WEIGHT:

ALL DIMENSIONS IN [mm] UNLESS OTHERWISE SPECIFIED

REMOVE ALL SHARP EDGES AND BURRS

UNTOLERANCED DIMENSIONS & SURFACE FINISH
GENERAL: HOLES: ANGULAR:
MACHINED SURFACE FINISH:

DRAWING INFORMATION

ANODE LOCATION FOR HJ213

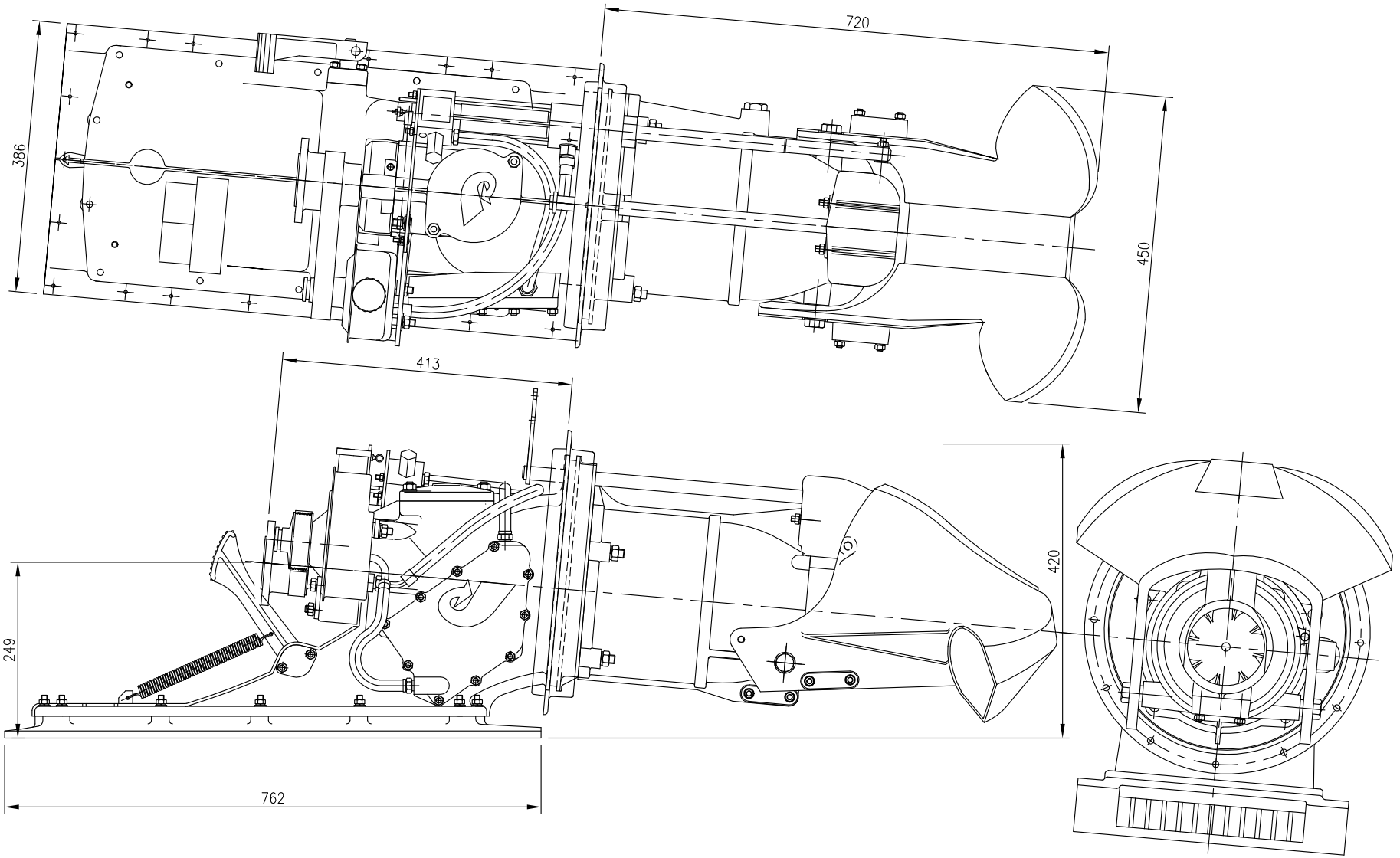
JET / CONTROL TYPE **HJ213**

DRAWN TO HAMJET 085195 PROJECTION:

SCALE: SHEET SIZE: **A3** **Sht 1 of 1**

DWG No: **HJ213 13 002** REV: **A**

HJ-213-30-001 General Arrangement



CL183	C	P.M.W.	27.04.01	DIM'N 413 WAS INCORRECT AT 422
CL178	B	P.S.	27.03.01	TILLER AND SPLASH GUARD REVISED.
CL027	0	P.S.	04.11.97	ISSUED FOR PRODUCTION
REF	NO.	BY	DATE	AMENDMENTS

JET 213

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

PROJECTION

NAME: GENERAL ASSEMBLY HJ213

DESIGNED P.A.S.	DATE 4/11/97
DRAWN P.A.S.	4/11/97
CHECKED	
APPROVED	

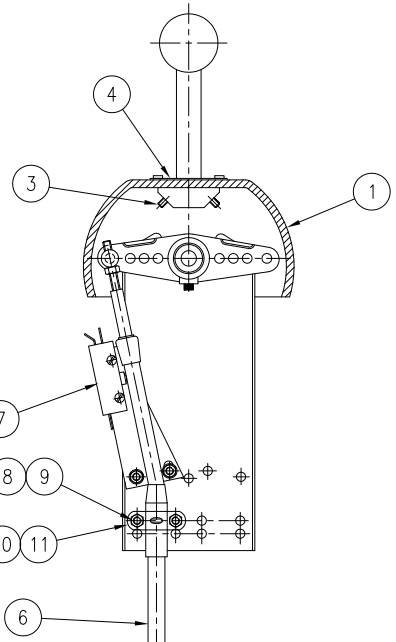
SCALE 1:5

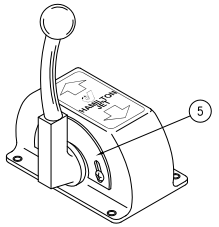
No: ASSY-HJ213 30 001 C

CT-CLV-01-003 Reverse/Throttle Controller

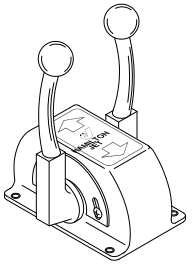
NEUTRAL DETENT AND ENGINE START INTERLOCK.

THE REVERSE DUCT CAN BE PLACED AT ANY POSITION BETWEEN FULL AHEAD AND FULL ASTERN, WITH THE "NEUTRAL" POINT (i.e. FORWARD AND REVERSE THRUSTS EQUAL) BEING APPROXIMATLEY 1/3 UP THROUGH THE JET STREAM FROM THE FULL ASTERN POSITION. THE EXACT POSITION BEING OBTAINED ON TRIALING THE BOAT.
THE DETENT PLATE MUST BE ADJUSTED TO CORRESPOND TO THIS NEUTRAL POSITION AND THE ENGINE START INTERLOCK SWITCH MUST BE ARRANGED TO ALLOW THE ENGINE TO START ONLY IN THIS SAME NEUTRAL POSITION.

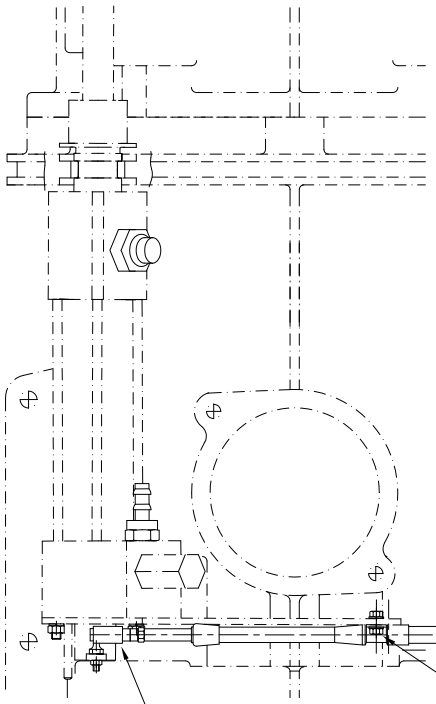




MODEL S



MODEL TWIN S



LENGTH OF CABLE MUST BE SPECIFIED BY CUSTOMER

8 9 10 11

(REF ONLY, SUPPLIED WITH REVERSE JACK)

(BALL JOINT SUPPLIED WITH REVERSE JACK)

A	B	C	Item	Kit	PartNumber	MovexAlias	Qty	ProductDescription	DrawingNbr
				A	110021			CLV SINGLE LEVER FOR SINGLE JET WITH NEUTRAL INTERLOCK	CTCLV01003
				B	110022			CLV TWIN LEVER FOR TWIN JETS WITH NEUTRAL INTERLOCK	CTCLV01003
				C	80934	080934		CABLE CLAMP KITSET	80934
	B		1		63566	063566	1	MORSE CONTROLLER TWIN 'S'	CTCLV01003
A			1		63526	063526	1	MORSE CONTROLLER SINGLE 'S'	CTCLV01003
A2	B4		3		203089		4	(SCREWS) (CAP SCREWS) IMPERIAL ST ST 304 3/16"UNFx3/4" (BUTTON HEAD)	N/A
A	B		4		63529	063529	1	(LABELS) "UP" (J)"DOWN"	CTCLV01003
A1	B2		5		104552-8		2	(LABELS) DETENT PLATE	CTCLV01003
A1	B2		7		64727	064727	1	NEUTRAL INTERLOCK SWITCH MORSE 047307	N/A
A2	B4	C2	8		HZJXAAD	201183	2	(SCREWS) (M/C SCREWS) IMPERIAL ST ST 316 3/16"UNCx1.0" (ROUND HEAD)	N/A
A2	B4	C2	9		JDQSAAA	201326	2	(NUTS) (IMPERIAL NYLOC ST ST 316) 3/16"UNC	N/A
A1	B2	C1	10		202543		1	SHIM - MORSE CABLE RETAINER.	202543
A1	B2	C1	11		202544		1	CLAMP - MORSE CABLE RETAINER.	202544

REF	NO.	BY	DATE	AMENDMENTS
CL346	E	I.G.G	19.10.04	CORRECTED QTYS ON 080934
CL330	D	I.G.G	05.07.04	203089 WAS HZJXAAC, DELETED ITEM 2 (106261)
CL307	C	I.G.G	22.12.03	ITEMISED CABLE CLAMP KITSET, UNC FASTENERS WERE M6
CL 31	B	P.S.	3/12/97	OPTION WITHOUT ENGINE INTERLOCK SWITCH DELETED.
CL3791	A	P.S.	13/6/97	PART No.110021, 110022 & ITEM 7 ADDED. NOTE ADDED
CL3732	0	L.C.	19/12/95	ISSUED FOR PRODUCTION

JET 213 241 273

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

PROJECTION

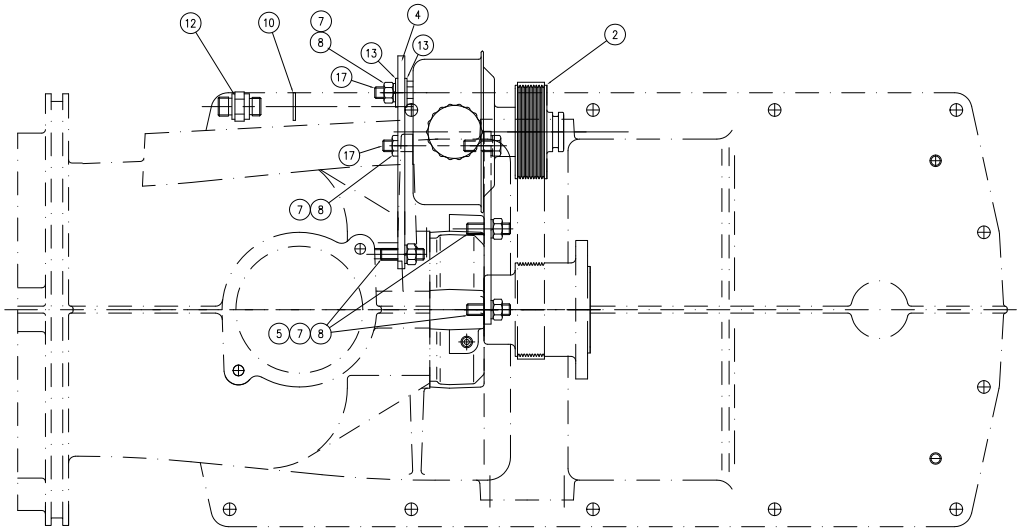
DESIGNED	K.V.A.	DATE 10.95
DRAWN	L. COOPER	20.11.95
CHECKED	K.V.A.	25/11/95
APPROVED	K.V.E.	15/12/95

NAME
REVERSE CONTROLLER
MORSE S
WITH ENGINE START INTERLOCK
H.S.R.X. ONLY.

SCALE -

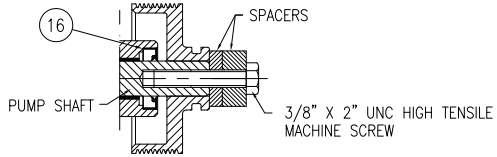
No: ASSY-CT CLV 01 003 E

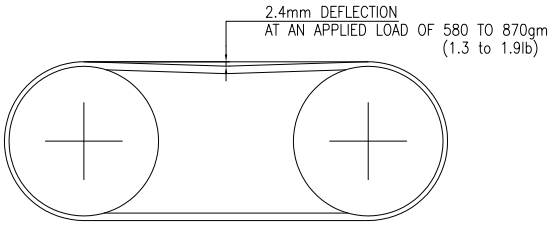
CT-HPU-01-001 JHPU



FITTING PULLEY TO PUMP SHAFT

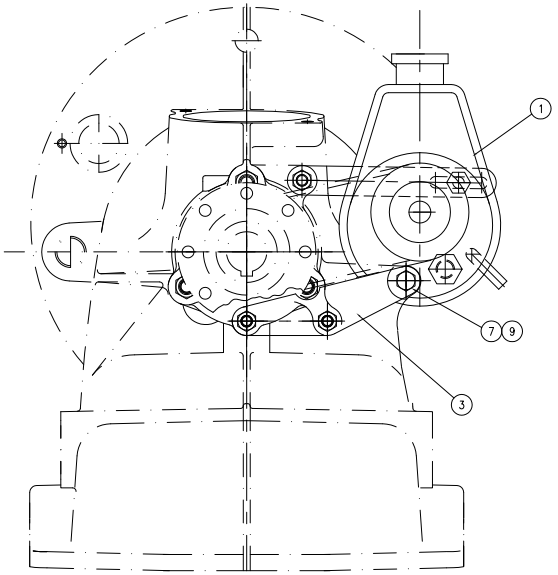
THE PULLEY IS AN INTERFERENCE FIT AND IS DRAWN ONTO THE PUMP SHAFT, IN 2 STAGES, WITH A HIGH TENSILE BOLT AND SUITABLE SPACERS UNTIL IT IS FLUSH WITH THE END OF THE SHAFT. SEE DETAIL BELOW.
REMOVE BOLT AND SPACERS AFTER INSTALLATION.





THE DRIVE SHOULD BE TENSIONED CORRECTLY AND RETENSIONED AFTER BETWEEN 30 MINUTES AND 4 HOURS AT FULL LOAD, TO COMPENSATE FOR THE SMALL INITIAL BELT STRETCH AND "BEDDING" INTO THE PULLEY GROOVES.

SETTING BELT TENSION



A	B	Item	Kit	PartNumber	MovexAlias	ProductDescription	DrawingNbr
			A	CTHPU01001		JET HYDRAULIC POWER UNIT (SAGINAW) HSRX SYSTEM	CTHPU01001
			B	110857		SAGINAW PUMP & PULLEY ASSEMBLY	CTHPU01003
A1	B1	1		206264		SAGINAW PUMP	206264
A1	B1	2		108628		DRIVE PULLEY SAGINAW PUMP	108628
A1		3		108618		SUPPORT BRACKET	108618
A1		4		108617		ADJUSTING LINK	108617
A3		5		JCQHXAN	201280	(STUDS) METRIC (316-STST) M10x40 (15/20)	30637
A6		7		JEQKXAE	201395	(WASHERS) (SPRING) METRIC ST ST 316 M10	N/A
A6		8		JDQHXAE	201310	(NUTS) (METRIC ST ST 316) M10	N/A
A1		9		HZQHXBN	201226	(SCREWS) (M/C SCREWS) METRIC ST ST 316 HEX HD M10x20	N/A
A1		10		64996	064996	BONDED SEAL M16 (400-870-4490-74)	N/A
A1		12		68001	068001	Adaptor 3/8 BSPP male X M16 x 1.5 metric male # SA10650616HJ	68001
A2		13		102993		(WASHER) SPECIAL 25mm ODx11mm IDx3mm thk	102993
A1		14		DEXRON-III	200120	OIL CASTROL DEXRON III 1 LITRE	N/A
A1		15		111614		PAINT APPLICATION JHPU'S With Saginaw Pump (Std) Gloss Finish	111178
		16	REF	203005		SEAL SAGINAW RSI 045131	N/A

PAINTING NOTES!
1. REFER TO DRG 85139 SHT 3 FOR PAINTING OF SAGINAW PUMP, SUPPORT BRACKET AND ADJUSTING LINK.
2. REFER TO DRG 111178 FOR PAINT SPECIFICATION AND APPLICATION.

REF	NO.	BY	DATE	AMENDMENTS
CL497	K	P.M.W	28.05.07	SAGINAW PUMP CHANGED TO KIT 206264
CL322	J	I.G.G	03.05.04	ADDED ITEM 16 AS SPARE PARTS
CL159	H	P.M.W	9.10.00	PAINT SPEC WAS 85020, PART No 111614 ADDED TO LIST
CL129	G	J.W.	28.02.00	ITEM 14 WAS Pt. No. AWS22OIL
CL118	F	P.S.	23/11/99	SEE THIS CL FOR PREV. AMENDMENTS. ITEM 6 WAS JEOZXAI.

JET 213 241

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

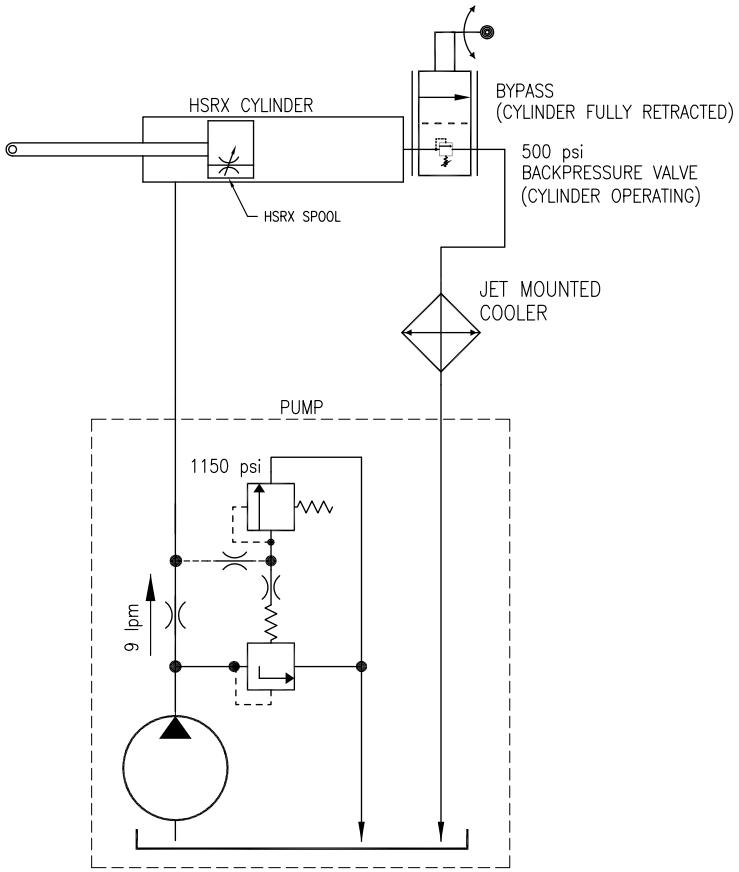
PROJECTION

NAME
J.H.P.U.
H.S.R.X.
(SAGINAW PUMP)

		DATE
DESIGNED	P.A.S.	25/10/95
DRAWN	P.A.S.	25/10/95
CHECKED		
APPROVED	K.V.E	13/12/95

SCALE: -
No: ASSY-CTHPU01001 K

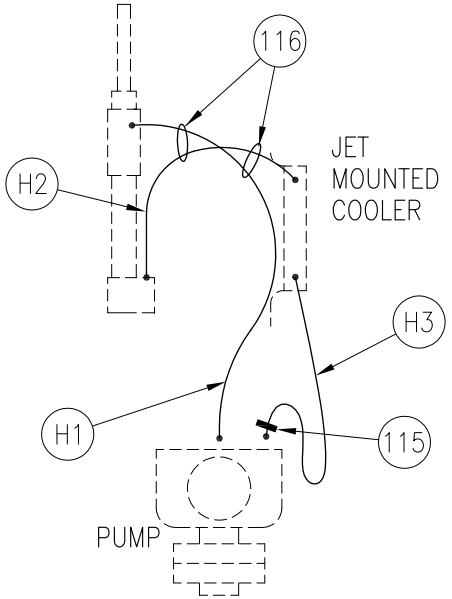
CT-HSE-12-001 Hose Kit



HYDRAULIC CIRCUIT DIAGRAM

for

CT HPU 01 001 & 002



HOSE CONNECTION SCHEMATIC

REF	NO.	BY	DATE	AMENDMENTS
CL697	D	J.S.R	10.11.11	NEW KIT D ADDED TO B.O.M
CL633	C	J.S.R	16.08.10	UPDATED BOM TO INCLUDE ITEM 7 & 8 IN THE LIST
CL467	B	S.K.	21.05.07	HOSE 115145 HAS HAD 15mm ADDED TO THE LENGTH
CL418	A	CMB	26.05.06	ISSUED FOR PRODUCTION

JET 213 241 274 241A

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

PROJECTION

DESIGNED J.W. DATE 08.10.02

DRAWN CMB DATE 18.04.06

CHECKED

APPROVED

NAME
HOSE KITS
STAINLESS STEEL FITTINGS
HJ 213, 241 & 274
Sheet 1 of 2

SCALE -

No. ASSY-CT HSE 12 001 D

CT-HSE-12-001 Hose Kit Sht 2

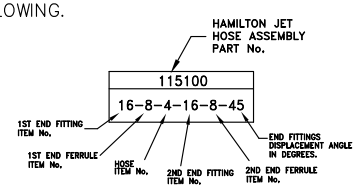
HAMILTON JET (HAM SPEC) HOSE KIT INSTRUCTIONS.

FOR A COMPLETE BREAKDOWN OF ALL PARTS NEEDED TO BUILD THESE KITS THIS DRAWING SHOULD BE USED IN CONJUNCTION WITH DRAWING 115000 Sheets 1 & 2.

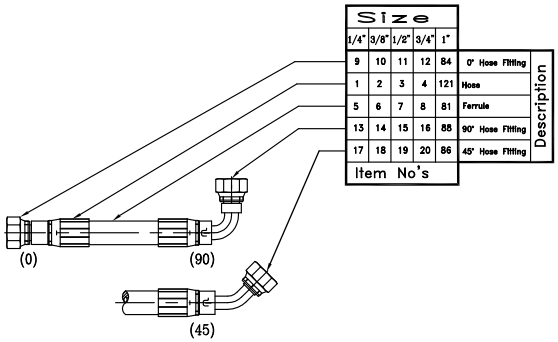
IN THE PARTS LIST ON THIS DRAWING, THE ITEMS REQUIRED TO BUILD EACH HOSE ASSEMBLY ARE LISTED IN EACH HOSE'S DESCRIPTION.

PartNumber	ProductDescription
115100	HOSE 3/4" L=0450mm 90-90 deg **16-8-4-16-8-45**

THE NUMBERS IN THE DESCRIPTION MEAN THE FOLLOWING.



FOR GENERIC DESCRIPTIONS OF COMMON FITTINGS USE THE DIAGRAM BELOW. FOR COMPLETE DESCRIPTIONS OF ALL ITEM NUMBERS REFER TO DRAWING 115000 Sheets 1 & 2.



Notes:

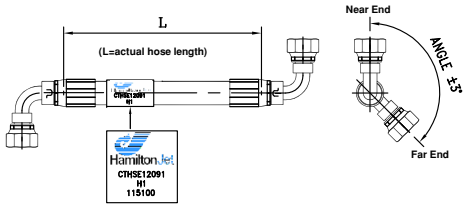
(1) ALL FITTINGS TO BE STAINLESS STEEL

(2) THREAD FORM TO BE B.S.P.P.

(3) HOSE ASSEMBLIES TO BE ASSEMBLED BY TRAINED PERSONAL ONLY.

(4) HOSE ASSEMBLIES TO BE ASSEMBLED AS PER HOSE ASSEMBLY PROCEDURE MANUAL 85167.

(5) ALL HOSES TO BE CLEANED BY THE "AIR MATE" SYSTEM PRIOR TO THE INSERTION OF FITTINGS.



EACH HOSE MUST HAVE A HOSE LABEL SHOWING THE HOSE KIT NUMBER, 'H' NUMBER, AND HOSE PART NUMBER AS SHOWN ABOVE.

Displacement Angle

Specified only if two elbow fittings are used. Starting with either end as the near end, measure the angle clockwise to describe the displacement.

A	B	C	D	Item	Kit	PartNumber	ProductDescription	DrawingNbr
					A	CTHSE12002	HSRX HOSE KIT (SAGINAW pump) 213	CTHSE12001
					B	CTHSE12003	HSRX HOSE KIT (SAGINAW pump) 241	CTHSE12001
					C	CTHSE12004	HSRX HOSE KIT (SAGINAW pump) 274	CTHSE12001
					D	CTHSE12005	HINKLEY HOSE KIT (SAGINAW pump) 241A	CTHSE12001
A1	B1	C1	D1	115		201056	CLAMP HOSE 316SS 12-20 mm NORMA W5 #NHCSS012	N/A
A2	B2	C2		116		064500	CABLE TIE FARNELL PART # 149-327 150LG x 3.5 WIDE	115000
A1				213	H1	115142	HOSE 3/8" L=0350mm 45-00 deg 18-6-2-10-6-0	CTHSE12001
A1				213	H2	115143	HOSE 3/8" L=0300mm 90-00 deg 99-0-114-0-0	CTHSE12001
A1				213	H3	111211	HOSE 3/8" L=0300mm 00-00 deg 0-0-114-0-0-0	CTHSE12001
	B1			241	H1	115145	HOSE 3/8" L=0430mm 90-90 deg 14-6-2-117-6-315	CTHSE12001
	B1			241	H2	115146	HOSE 3/8" L=0395mm 00-00 deg 98-0-114-0-0	CTHSE12001
	B1		D1	241	H3	111213	HOSE 3/8" L=0300mm 00-00 deg 0-0-114-0-0-0	CTHSE12001
		C1		274	H1	115148	HOSE 3/8" L=0630mm 00-45 deg 10-6-2-18-6-0	CTHSE12001
		C1		274	H2	115149	HOSE 3/8" L=0585mm 00-00 deg 98-0-114-0-0	CTHSE12001
		C1		274	H3	111217	HOSE 3/8" L=0300mm 00-00 deg 0-0-114-0-0-0	CTHSE12001

REF | NO. | BY | DATE | AMENDMENTS

REFER TO SHEET 1 FOR AMENDMENT

JET | 213 | 241 | 274 | 241A

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

PROJECTION

DESIGNED J.W. DATE 08.10.02

DRAWN CMB DATE 18.04.06

CHECKED

APPROVED

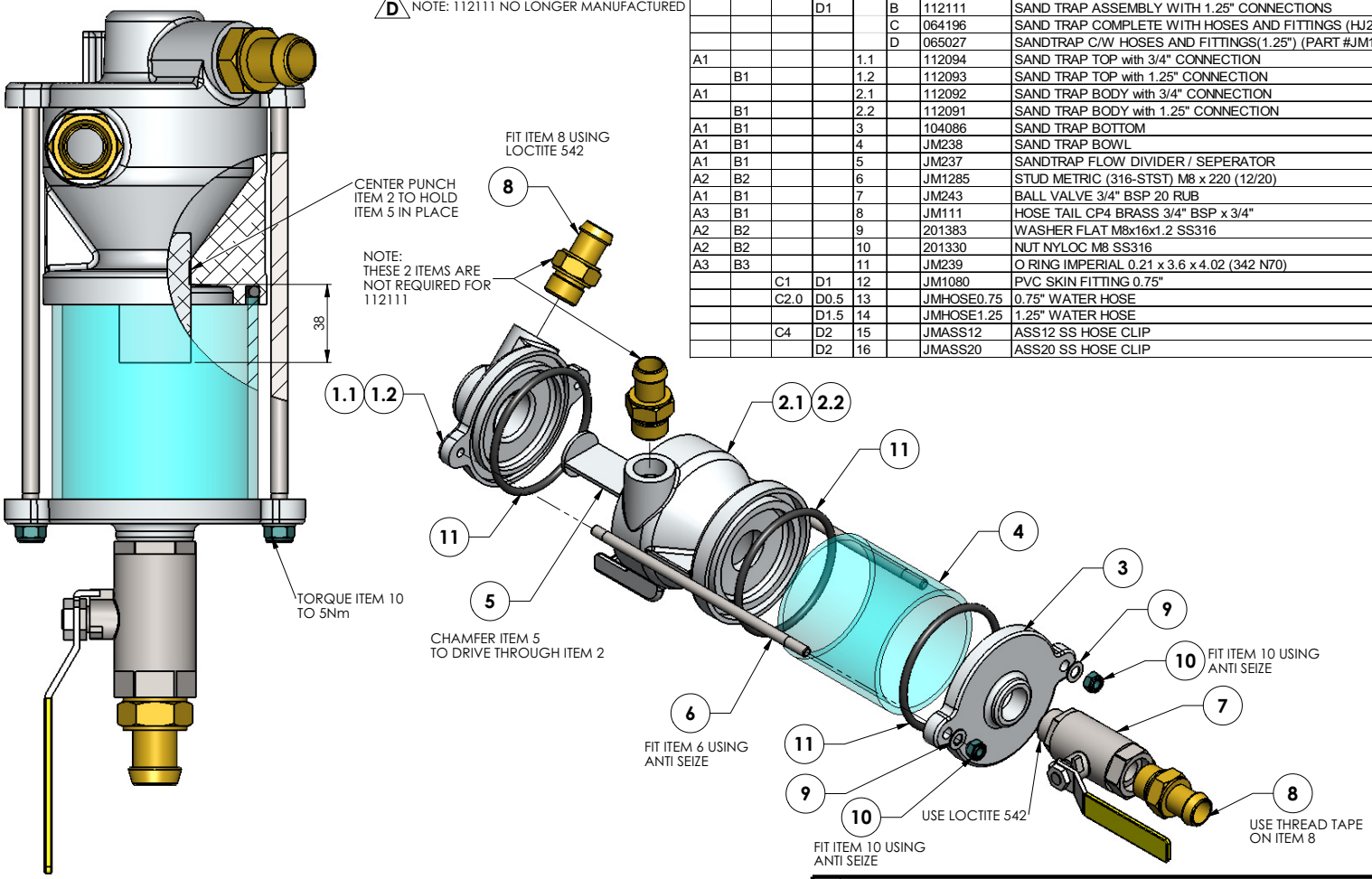
NAME
HOSE KITS
STAINLESS STEEL FITTINGS
HJ 213, 241 & 274
Sheet 2 of 2

SCALE -

No: ASSY-CT HSE 12 001 D

112110 Sand Trap Assembly Sht1

A	B	C	D	Item	Kit	PartNumber	ProductDescription	DrawingNbr
		C1			A	112110	SAND TRAP ASSEMBLY WITH 3/4" CONNECTIONS	112110
			D1		B	112111	SAND TRAP ASSEMBLY WITH 1.25" CONNECTIONS	112110
					C	064196	SAND TRAP COMPLETE WITH HOSES AND FITTINGS (HJ212 - HJ241)	64196
					D	065027	SANDTRAP C/W HOSES AND FITTINGS(1.25") (PART #JM1104-1031) (HJ274)	112110
A1				1.1		112094	SAND TRAP TOP with 3/4" CONNECTION	112093
	B1			1.2		112093	SAND TRAP TOP with 1.25" CONNECTION	112093
A1				2.1		112092	SAND TRAP BODY with 3/4" CONNECTION	112091
	B1			2.2		112091	SAND TRAP BODY with 1.25" CONNECTION	112091
A1	B1			3		104086	SAND TRAP BOTTOM	104086
A1	B1			4		JM238	SAND TRAP BOWL	N/A
A1	B1			5		JM237	SANDTRAP FLOW DIVIDER / SEPERATOR	N/A
A2	B2			6		JM1285	STUD METRIC (316-STST) M8 x 220 (12/20)	N/A
A1	B1			7		JM243	BALL VALVE 3/4" BSP 20 RUB	N/A
A3	B1			8		JM111	HOSE TAIL CP4 BRASS 3/4" BSP x 3/4"	N/A
A2	B2			9		201383	WASHER FLAT M8x16x1.2 SS316	N/A
A2	B2			10		201330	NUT NYLOC M8 SS316	N/A
A3	B3			11		JM239	O RING IMPERIAL 0.21 x 3.6 x 4.02 (342 N70)	N/A
		C1	D1	12		JM1080	PVC SKIN FITTING 0.75"	N/A
		C2.0	D0.5	13		JMHOSE0.75	0.75" WATER HOSE	N/A
			D1.5	14		JMHOSE1.25	1.25" WATER HOSE	N/A
		C4	D2	15		JMASS12	ASS12 SS HOSE CLIP	N/A
			D2	16		JMASS20	ASS20 SS HOSE CLIP	N/A



C. W. F. Hamilton & Co. Ltd

CHANGE HISTORY

LATEST AMENDMENT:
D - 112111 NO LONGER MANUFACTURED
C - KITS C AND D ADDED TO BOM
B - ITEM 10 WAS M8 NUT TORQUE SPEC ADDED

AMENDED BY:	S.H.	12/03/12	ECN:	19614
AMENDMENT REVIEW:	D.B.	12/03/12		
DESIGNED BY:	P.A.S	15/03/02	ECN:	
DESIGN REVIEW:		01/01/01		

MANUFACTURING INFORMATION

MATERIAL: **N/A**
STANDARD:
MAT. CERT REQ.: **No** TRACEABILITY REQ.: **No**
WEIGHT; CAST [kg]: MACHINED [kg]:
ALL DIMENSIONS IN [mm] UNLESS OTHERWISE SPECIFIED
UNTOLERANCED DIMENSIONS & SURFACE FINISH
GENERAL:+/- 0.5 HOLES Ø: +/- 0.2 ANGULAR: +/- 0.5°
MACHINED SURFACE FINISH: Ra **6.3** µm

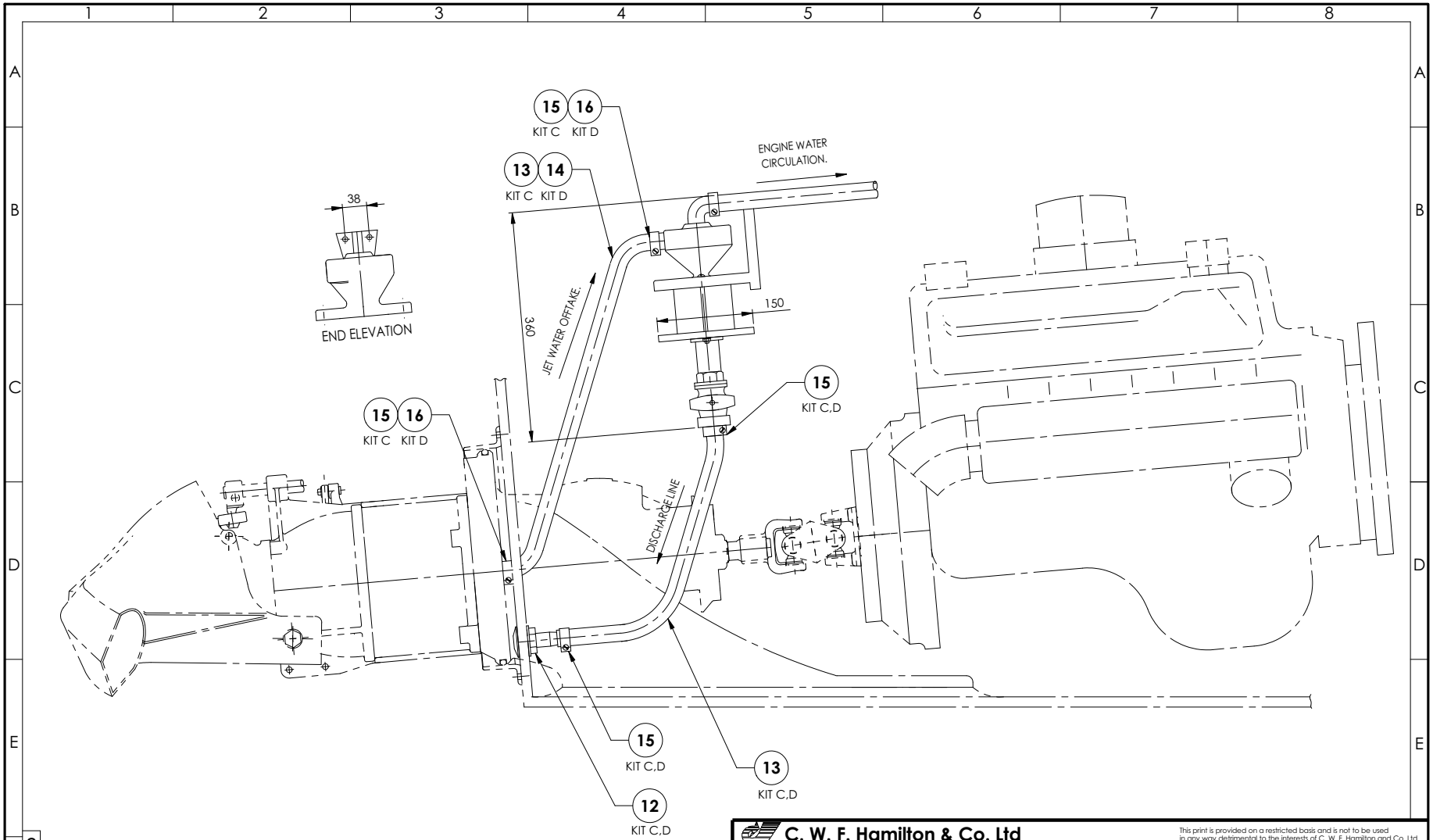
DRAWING INFORMATION

SAND TRAP ASSEMBLY

JET / CONTROL TYPE:
DRAWN TO HAMJET 085195 PROJECTION:
SCALE: **1:5** SHEET SIZE **A3** **Sheet1/2**
DWG No.: **112110** REV: **D**

DWG No 112110 D

112110 Sand Trap Assembly Sht2



NOTE:
1. DRAWING IS A PICTORIAL REFERENCE ONLY
2. SHIPYARD TO SUPPLY BULKHEAD THROUGH FITTING FOR KIT D
3. KIT C SUITS JETS (HJ212-HJ241) AND KIT D SUITS JET HJ274

DWG No 112110 D

C. W. F. Hamilton & Co. Ltd

CHANGE HISTORY				
LATEST AMENDMENT: D - 112111 NO LONGER MANUFACTURED; C - KITS C AND D ADDED TO BOM; B - ITEM 10 WAS M8 NUT TORQUE SPEC ADDED				
AMENDED BY:	S.H.	12/03/12	ECN:	19614
AMENDMENT REVIEW:	D.B.	12/03/12		
DESIGNED BY:	P.A.S	15/03/02	ECN:	
DESIGN REVIEW:		01/01/01		

MANUFACTURING INFORMATION
MATERIAL: N/A
STANDARD:
MAT. CERT REQ.: No TRACEABILITY REQ.: No
WEIGHT: CAST [kg]: MACHINED [kg]:
ALL DIMENSIONS IN [mm] UNLESS OTHERWISE SPECIFIED
UNTOLERANCED DIMENSIONS & SURFACE FINISH GENERAL:+/- 0.5 HOLES Ø:+/- 0.2 ANGULAR:+/- 0.5° MACHINED SURFACE FINISH: Ra 6.3 µm

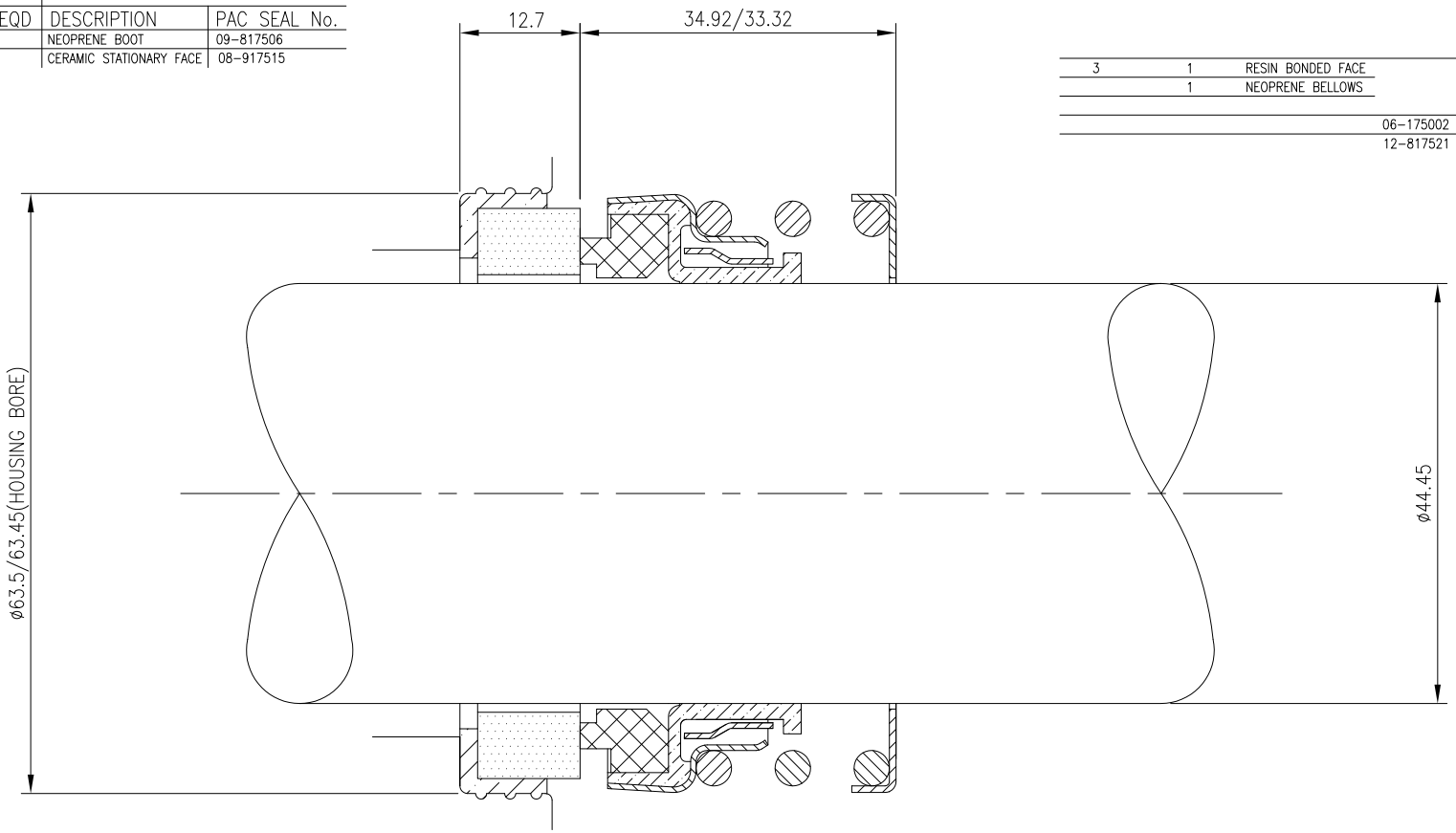
DRAWING INFORMATION			
SAND TRAP ASSEMBLY			
JET / CONTROL TYPE:			
DRAWN TO HAMJET 085195	PROJECTION:		
SCALE: 1:5	SHEET SIZE A3	Sheet2/2	
DWG No.: 112110		REV: D	

61483 Water Seal

PROJECTION

ITEM NO	NO REQD	DESCRIPTION	PAC SEAL No.
1	1	NEOPRENE BOOT	09-817506
2	1	CERAMIC STATIONARY FACE	08-917515
3	1	RESIN BONDED FACE	06-175002
	1	NEOPRENE BELLOWS	12-817521

`01



CL3727		P.S.	13/11/95	
REF	NO.	BY	DATE	AMENDMENTS
JET				

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 ± 0.5

MAT'L CERT

DESIGNED K.V.A. DATE 10.07.95

DRAWN P.A.S.

CHECKED

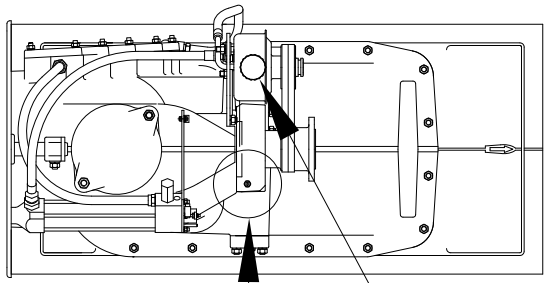
APPROVED

NAME
SHAFT WATER SEAL ASSEMBLY (1 3/4 INCH) HJ211

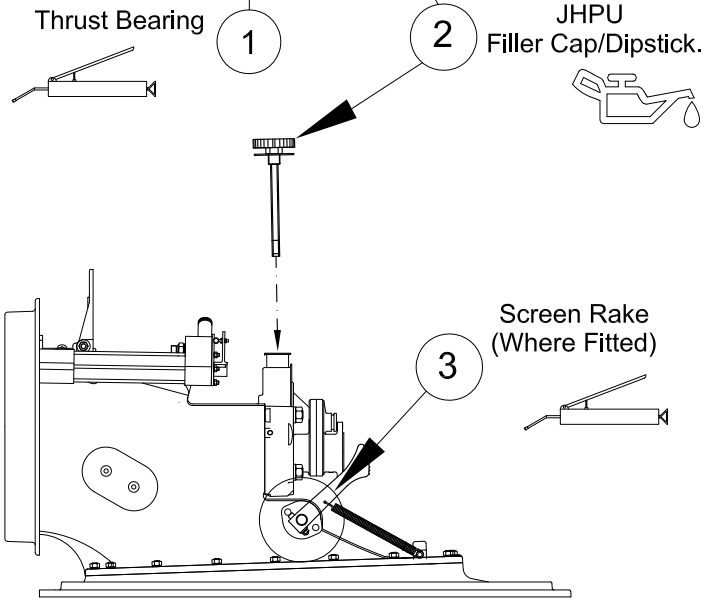
SCALE 2:1 No: A3- 61483 0

61483 0

Hamilton Jet Regular Lubrication Chart



Plan View of Jet



Starboard View of Jet

Note:

1. Refer to drawing 85018 for lubricant specifications.
2. Refer to service manual for detailed service schedule, filter specifications and maintenance instructions.
3. Grease driveline as specified by driveline manufacturer.

Item No	Item Discription	Task
1	Thrust Bearing	Grease every 100 hours. It is preferable that mainshaft is turning when adding grease
2	Hydraulic Power Unit Oil Level	Check oil level Daily. Change after first 10 to 50 hrs then every 1000 hrs of running
3	Screen Rake	Grease every 3 months

REF	NO.	BY	DATE	AMENDMENTS
CL463	A	SK	23.04.07	ISSUED FOR INFORMATION

JET 274 241 213

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

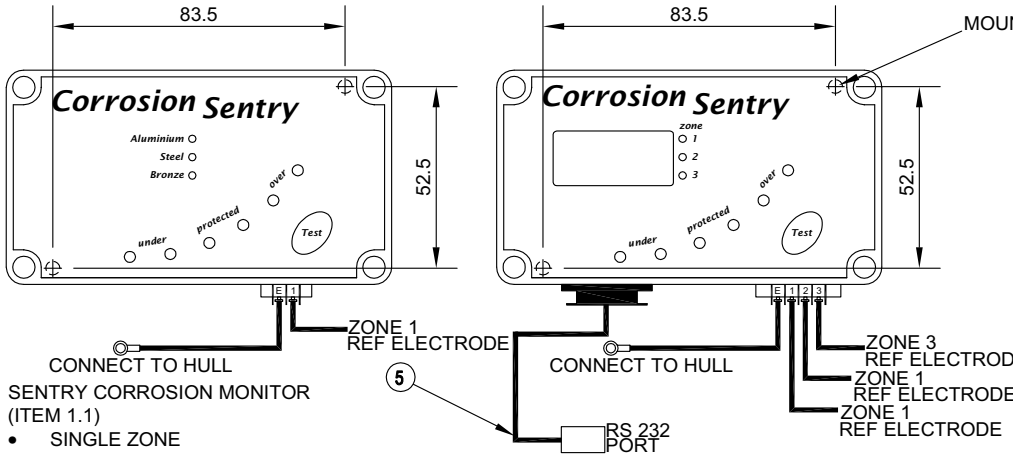
PROJECTION

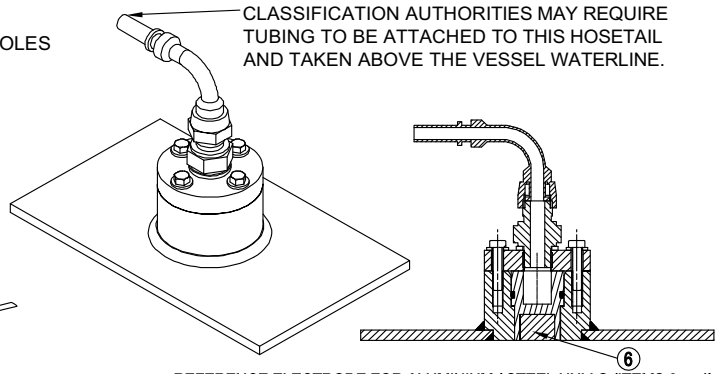
DESIGNED SK 23.10.06
DRAWN SK 23.10.06
CHECKED N.T. 13.04.07
APPROVED

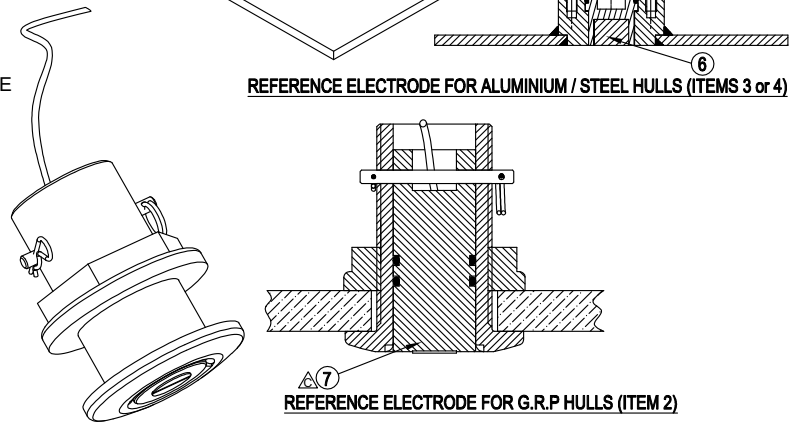
NAME
REGULAR LUBRICATION CHART for HJ274, 241 & 213 JETS.

SCALE NTS
No: ASSY-205754
A

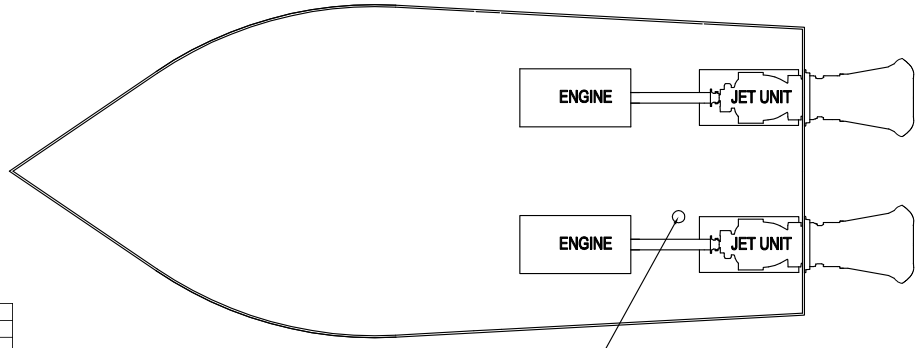
HM00013001 anode Condition Monitor







FOR CORRECT INSTALLATION OF CORROSION MONITOR AND REFERENCE ELECTRODES, REFER TO THE INFORMATION SUPPLIED WITH THE "CORROSION SENTRY". TYPICALLY THE REFERENCE ELECTRODE IS INSTALLED NEAR THE FORWARD END AND INBOARD OF THE WATERJETS (REFER TO ILLUSTRATION). THE REFERENCE ELECTRODE SHOULD BE INSTALLED AT LEAST 1M (3FT) FROM ANY HULL ANODES. THE DISPLAY UNIT IS TYPICALLY MOUNTED ON A BULKHEAD WHERE ACCESS IS CONVENIENT FOR MONITORING, OR IN THE WHEELHOUSE. THE UNIT IS BATTERY OPERATED SO DOES NOT REQUIRE EXTERNAL POWER.



A	B	C	D	E	F	Item	Kit	Part Number	Product Description	Drawing
							A	065153	SENTRY CORROSION MONITOR KIT (SINGLE ZONE GRP HULL)	HM00013001
							B	065316	SENTRY CORROSION MONITOR KIT (SINGLE ZONE ALUMINIUM HULL)	HM00013001
							C	065317	SENTRY CORROSION MONITOR KIT (SINGLE ZONE STEEL HULL)	HM00013001
							D	209812	SENTRY CORROSION MONITOR KIT LOGGING VERSION FOR GRP HULLS	HM00013001
							E	209811	SENTRY CORROSION MONITOR KIT LOGGING VERSION FOR ALUMINUM HULLS	HM00013001
							F	209813	SENTRY CORROSION MONITOR KIT LOGGING VERSION FOR STEEL HULLS	HM00013001
A1	B1	C1				1.1		065154	SENTRY CORROSION MONITOR 1 ZONE (SN-01)	HM00013001
			D1	E1	F1	1.2		209815	SENTRY CORROSION MONITOR LOGGING VERSION (SN-03L-K2000)	HM00013001
A1			D1			2		065155	REFERENCE ELECTRODE GRP (REF-SKN-ZNK)	HM00013001
	B1			E1		3		065318	REFERENCE ELECTRODE ALUMINUIM HULL (REF-COM-AL-ZN)	HM00013001
		C1			F1	4		065319	REFERENCE ELECTRODE STEEL HULL (REF-COM-ST-ZN)	HM00013001
			D	E	F	5	REF	210814	CORROSION LOGGER CABLE	HM00013001
	B	C		E	F	6	REF	210823	REFERENCE ELECTRODE (SPARE ZINC ELECTRODE WITH WIRE) FOR AL OR STEEL HULL	HM00013001
⚠A			D			7	REF	210926	REFERENCE ELECTRODE (SPARE ZINC ELECTRODE WITH WIRE) FOR GRP HULL	HM00013001

REF	NO.	BY	DATE	AMENDMENTS
19958	C	J.S.R	04.07.12	ADDED ITEM 7 TO BOM
19547	B	J.S.R	15.03.12	ITEM 5 AND 6 ADDED TO KIT.
CL621	A	N.T.	24.05.10	ISSUED FOR PRODUCTION

JET

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

PROJECTION

NAME: ANODE CONDITION MONITOR

DESIGNED | DATE

DRAWN N.T. 12.05.10

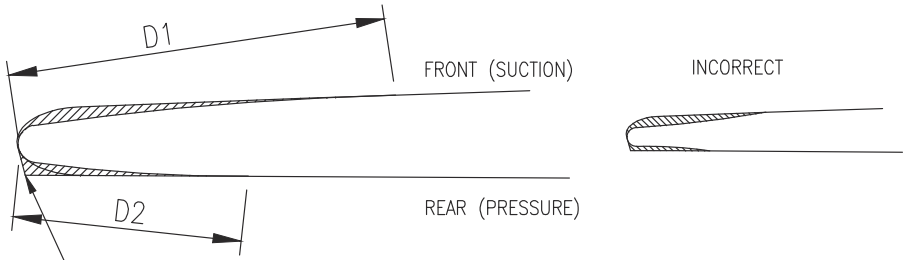
CHECKED

APPROVED

SCALE -

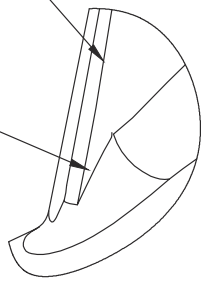
No: ASSY–HM000 13 001 C

FACTORY IMPELLER LEADING EDGE DRESSING



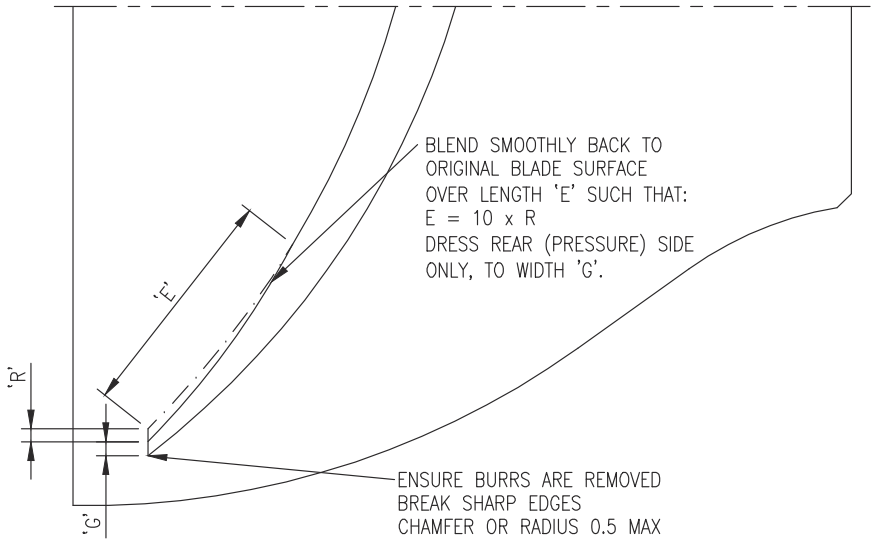
DRESS THE SQUARE EDGE OF THE IMPELLER BLADE LEADING EDGE BACK, AND SHARPEN BLADE AS SHOWN, TO RADIUS GIVEN BELOW IN TABLE 1.

AT THE BLADE–HUB INTERFACE, BLEND THE LE RADIUS INTO THE BLADE–HUB RADIUS.



IMPELLER TRAILING EDGE DRESSING

NOTE: ONLY REQUIRED FOR TRIMMED IMPELLERS



BLEND SMOOTHLY BACK TO ORIGINAL BLADE SURFACE OVER LENGTH 'E' SUCH THAT:
E = 10 x R
DRESS REAR (PRESSURE) SIDE ONLY, TO WIDTH 'G'.

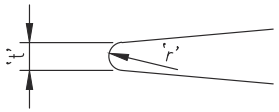
ENSURE BURRS ARE REMOVED
BREAK SHARP EDGES
CHAMFER OR RADIUS 0.5 MAX

T.E. WIDTH 'G' mm	JET MODELS
2	212 213
2.5	241
3	274 292 322 362 364
4	391 403
4	FIRST TRIM IMPELLERS IF 'G' LESS THAN 5

NOTE: AFTER SHARPENING & DRESSING BLADES IMPELLER MUST BE BALANCED.

TABLE 1: LEADING EDGE RADIUS

DRESS TO THICKNESS 't'.
SMOOTH TO RADIUS 'r' AT LEADING EDGE, FROM MID–BLADE HEIGHT TO OD.



THICKNESS 't' MAX	RADIUS 'r' MAX	D1 (MIN)		D2 (MIN)		JET MODELS
		OD	HUB	OD	HUB	
1.7	0.85	25	15	20	10	212–322
2.0	1.0	35	20	25	12.5	364–403

REFER TO DRAWING 82207 FOR HM AND HT JETS

HamiltonJet

CHANGE SUMMARY - REFER TO E.C.N. FOR DETAILS
REVISION: L ECN: 23199
ADDED SHEET 5 ON STAMPING

DESIGN CHECK:	IH	26.08.14	SIGN.
DRAWING REVISION:	SH	26.08.14	SIGN.
DOCUMENT CHECK:	IH	26.08.14	SIGN.
ORIGINAL DESIGN:	MJH	26.06.03	SIGN.

MANUFACTURING INFORMATION
MATERIAL:
STANDARD:
MAT CERT REQ: TRACEABILITY REQ:
FINISHED WEIGHT:
ALL DIMENSIONS IN (mm) UNLESS OTHERWISE SPECIFIED
REMOVE ALL SHARP EDGES AND BURRS
UNTOLERANCED DIMENSIONS & SURFACE FINISH
GENERAL: ±0.5 HOLES: Ø0.2 ANGULAR: ± 0.5°
MACHINED SURFACE FINISH: Ra 6.3 µm

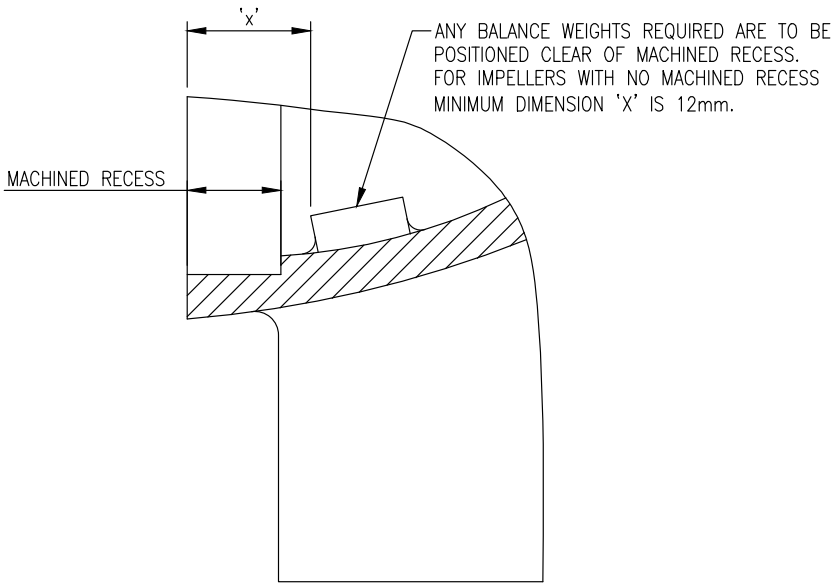
DRAWING INFORMATION
HJ IMPELLER BLADE DRESSING INSTRUCTIONS AND BALANCING INFORMATION
JET / CONTROL TYPE HJ
DRAWN TO HAMJET 085195 PROJECTION:
SCALE: SHEET SIZE: A3 Sht 1 of 5
DWG No: 082206 REV: L

82206 impeller Dressing Instruction Sht2

JET MODEL	BALANCE LIMIT (g.cm)	MAX WEIGHT @ OD (g)
212 TURBO	11	2.0
212	22	2.0
213	22	2.0
241 TURBO	24	2.0
241	24	2.0
273	46	3.4
274	46	3.4
291	50	3.4
292	50	3.4
322	96	6.0
362/364	110	6.0
391/403	220	11.0

BALANCE LIMIT TABLE

REFER TO 85182 FOR BALANCING PROCEDURE



BALANCE WEIGHT POSITION

HamiltonJet

CHANGE SUMMARY - REFER TO E.C.N. FOR DETAILS	MANUFACTURING INFORMATION	DRAWING INFORMATION
REVISION: ECN: REFER TO SHEET 1 FOR AMENDMENTS	MATERIAL: STANDARD: MAT CERT REQ: TRACEABILITY REQ: FINISHED WEIGHT:	HJ IMPELLER BLADE DRESSING INSTRUCTIONS AND BALANCING INFORMATION
DESIGN CHECK: SIGN.	ALL DIMENSIONS IN [mm] UNLESS OTHERWISE SPECIFIED	JET / CONTROL TYPE HJ
DRAWING REVISION: SIGN.	REMOVE ALL SHARP EDGES AND BURRS	DRAWN TO HAMJET 085195 PROJECTION:
DOCUMENT CHECK: SIGN.	UNTOLERANCED DIMENSIONS & SURFACE FINISH GENERAL: ±0.5 HOLES: Ø0.2 ANGULAR: ± 0.5°	SCALE: SHEET SIZE: A3 Sht 2 of 5
ORIGINAL DESIGN: SIGN.	MACHINED SURFACE FINISH: Ra 6.3 µm	DWG No: 082206 REV: L

82206 impeller Dressing Instruction Sht3

REPAIR OF SURFACE DEFECTS ON STAINLESS STEEL IMPELLERS.

1. SURFACE DEFECTS IN BLADES.

(A) SHALLOW PITS UP TO A MAXIMUM DEPTH OF 0.5mm ARE TO BE WELD REPAIRED AND GROUND BACK FLUSH TO ADJACENT SURFACE.

(B) BLADE THICKNESS MAY BE REDUCED LOCALLY BY UP TO 0.5mm FOR THE PURPOSE OF GRINDING OUT INCLUSIONS OR OTHER SURFACE FLAWS.

(C) WHERE THE SURFACE DEFECT IS GREATER THAN 0.5mm DEEP, THE DEFECT IS TO BE GROUND OUT TO CLEAN METAL, AS SHOWN, REPAIRED BY WELDING AND GROUND BACK FLUSH TO ADJACENT SURFACE.

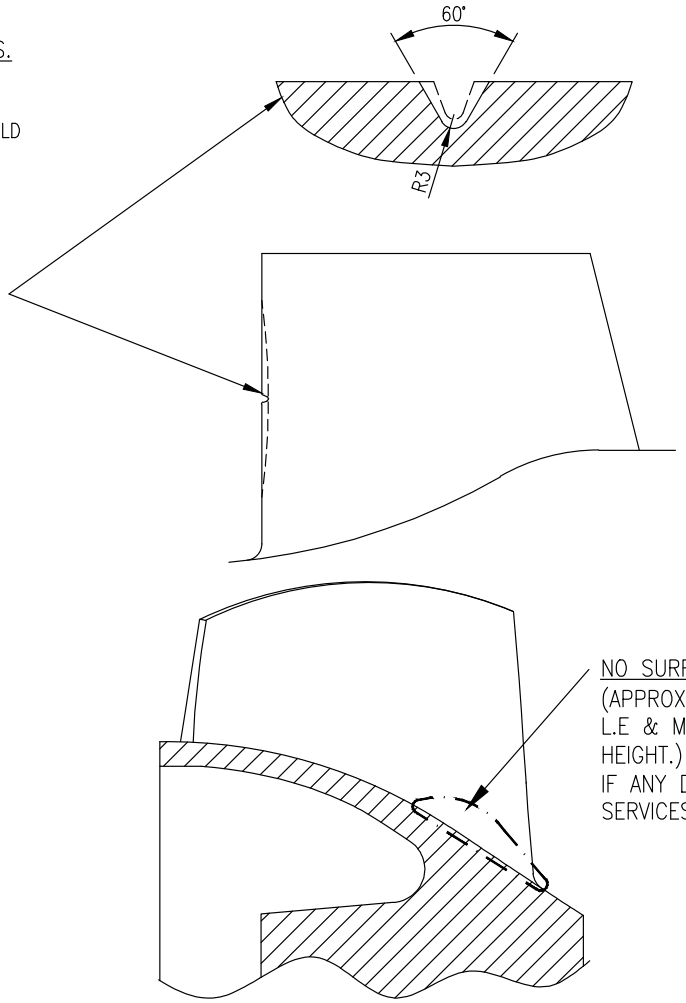
(D) THE SURFACE ROUGHNESS IS TO BE Ra 3.2um (N8) OR BETTER AFTER FETTLING.

(E) THE FILLET IS DEFINED AS PART OF BLADE.

2. SURFACE DEFECTS IN THE HUB.

THESE ARE TO BE TREATED THE SAME AS BLADE DEFECTS EXCEPT THAT FOR INSTRUCTIONS (A), (B) AND (C) A MAXIMUM DEPTH OF 1mm IS ALLOWED INSTEAD OF 0.5mm.

THE SURFACE ROUGHNESS IS TO BE Ra 6.3um (N9) OR BETTER AFTER FETTLING.

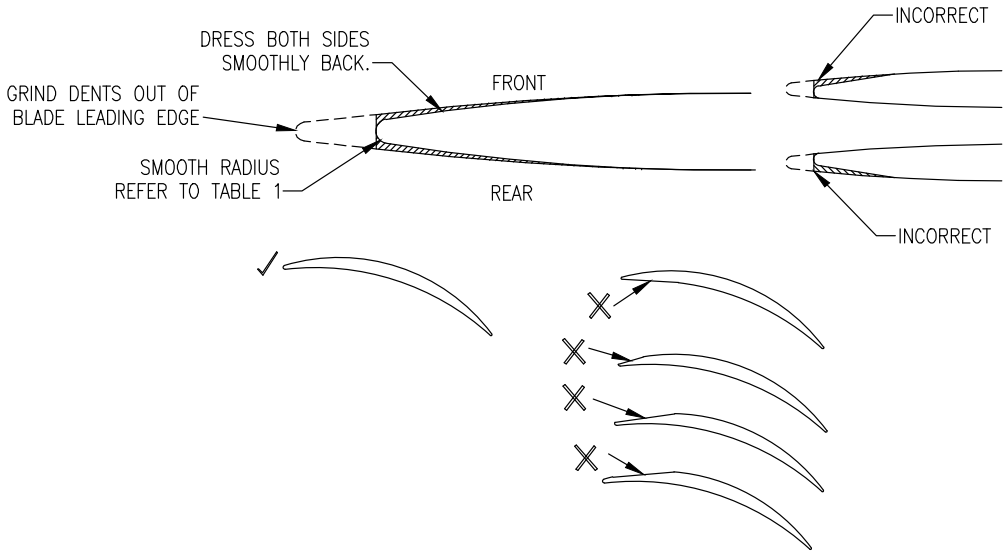


NO SURFACE DEFECTS ALLOWED
(APPROX ½ OF ROOT LENGTH FROM L.E & MAXIMUM DOUBLE THE FILLET HEIGHT.) ON SIDE.
IF ANY DOUBT CONTACT TECHNICAL SERVICES.

HamiltonJet

CHANGE SUMMARY - REFER TO E.C.N. FOR DETAILS	MANUFACTURING INFORMATION	DRAWING INFORMATION
REVISION: ECN: REFER TO SHEET 1 FOR AMENDMENTS	MATERIAL: STANDARD: MAT CERT REQ: TRACEABILITY REQ: FINISHED WEIGHT:	HJ IMPELLER BLADE DRESSING INSTRUCTIONS AND BALANCING INFORMATION
DESIGN CHECK: SIGN.	ALL DIMENSIONS IN [mm] UNLESS OTHERWISE SPECIFIED	JET / CONTROL TYPE HJ
DRAWING REVISION: SIGN.	REMOVE ALL SHARP EDGES AND BURRS	DRAWN TO HAMJET 085195 PROJECTION:
DOCUMENT CHECK: SIGN.	UNTOLERANCED DIMENSIONS & SURFACE FINISH GENERAL: ±0.5 HOLES: Ø0.2 ANGULAR: ± 0.5°	SCALE: SHEET SIZE: A3 Sht 3 of 5
ORIGINAL DESIGN: SIGN.	MACHINED SURFACE FINISH: Ra 6.3 µm	DWG No: 082206 REV: L

CUSTOMER IMPELLER LEADING EDGE DRESSING



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.

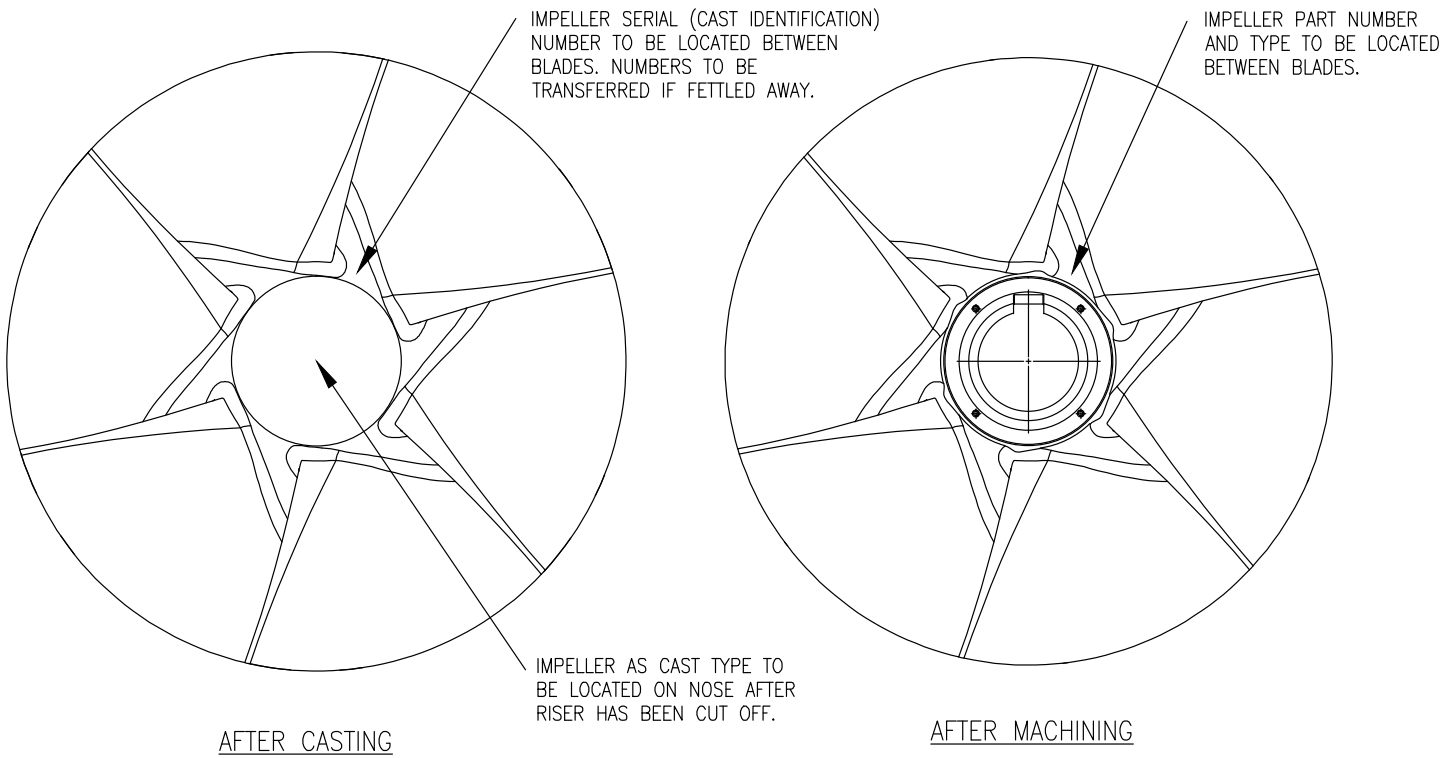
ANY TIME THE INSPECTION COVER IS REMOVED, THE LEADING EDGE OF THE BLADES SHOULD BE INSPECTED FOR WEAR. IF BADLY WORN, REMOVE THE IMPELLER (SEE MANUAL ON DISMANTLING JET UNIT) AND SHARPEN AS SHOWN ABOVE.

BOTH FRONT AND REAR SURFACES TO BE SMOOTH UNIFORM CURVES. ANY FLAT AREAS WILL REDUCE EFFICIENCY AND CAUSE CAVITATION.

HamiltonJet

CHANGE SUMMARY - REFER TO E.C.N. FOR DETAILS	MANUFACTURING INFORMATION	DRAWING INFORMATION
REVISION: ECN: **REFER TO SHEET 1 FOR AMENDMENTS**	MATERIAL: STANDARD: MAT CERT REQ: TRACEABILITY REQ: FINISHED WEIGHT:	**HJ IMPELLER BLADE DRESSING INSTRUCTIONS AND BALANCING INFORMATION**
DESIGN CHECK: SIGN.	ALL DIMENSIONS IN [mm] UNLESS OTHERWISE SPECIFIED	JET / CONTROL TYPE HJ
DRAWING REVISION: SIGN.	REMOVE ALL SHARP EDGES AND BURRS	DRAWN TO HAMJET 085195 PROJECTION:
DOCUMENT CHECK: SIGN.	UNTOLERANCED DIMENSIONS & SURFACE FINISH GENERAL: ±0.5 HOLES: Ø0.2 ANGULAR: ± 0.5°	SCALE: SHEET SIZE: A3 Sht 4 of 5
ORIGINAL DESIGN: SIGN.	MACHINED SURFACE FINISH: Ra 6.3 µm	DWG No: 082206 REV: L

IDENTIFICATION PROCESS ⚠L



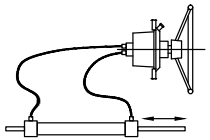
HamiltonJet

CHANGE SUMMARY - REFER TO E.C.N. FOR DETAILS	MANUFACTURING INFORMATION	DRAWING INFORMATION
REVISION: ECN: **REFER TO SHEET 1 FOR AMENDMENTS**	MATERIAL: STANDARD: MAT CERT REQ: TRACEABILITY REQ: FINISHED WEIGHT:	**HJ IMPELLER BLADE DRESSING INSTRUCTIONS AND BALANCING INFORMATION**
DESIGN CHECK: SIGN.	**ALL DIMENSIONS IN [mm] UNLESS OTHERWISE SPECIFIED**	JET / CONTROL TYPE **HJ**
DRAWING REVISION: SIGN.	**REMOVE ALL SHARP EDGES AND BURRS**	DRAWN TO HAMJET 085195 PROJECTION:
DOCUMENT CHECK: SIGN.	**UNTOLERANCED DIMENSIONS & SURFACE FINISH** GENERAL: **±0.5** HOLES: **Ø0.2** ANGULAR: **± 0.5°**	SCALE: SHEET SIZE: **A3** **Sht 5 of 5**
ORIGINAL DESIGN: SIGN.	MACHINED SURFACE FINISH: **Ra 6.3 µm**	DWG No: **082206** REV: **L**

85018 Recommendations for Lubricants and Oils Sht1

HYDRAULIC FLUIDS	JET	VOLUME (L)

JASTRAM MANUAL HYDRAULIC STEERING



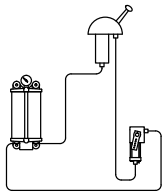
FLUID
ISO VG32 HYDRAULIC OIL

EXAMPLES

CASTROL:	HYSPIN AW32
SHELL:	TELLUS 32
ESSO/EXON/MOBIL:	NUTO H32/DTE EXCEL 32
TEXACO/CHEVRON/CALTEX:	RANDO HD32/AW32
GULF:	HARMONY AW32

JET	VOLUME (L)
HJ364	REFER TO JET MANUAL

HYNAUTIC REMOTE CONTROL SYSTEMS



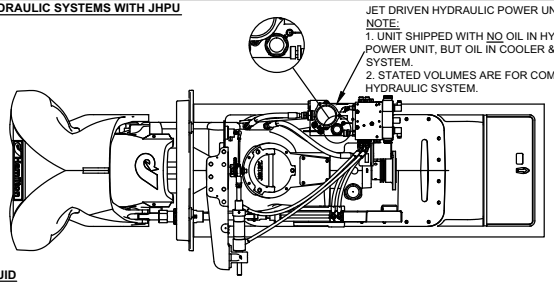
FLUID
50/50 MIXTURE BY VOLUME OF DISTILLED WATER AND ETHYLENE-GLYCOL (ANTI-FREEZE). ETHYLENE-GLYCOL SHOULD BE AS PURE AS POSSIBLE (NO ADDITIVES).

EXAMPLES
MCO-03 HYNAUTIC

DO NOT USE
BRAKE FLUID OR OIL

JET	VOLUME (L)
HJ364	REFER TO JET MANUAL
HJ403	
HM422	
HM461	
HM521	
HM571	

HYDRAULIC SYSTEMS WITH JHPU



JET DRIVEN HYDRAULIC POWER UNIT
NOTE:
1. UNIT SHIPPED WITH NO OIL IN HYDRAULIC POWER UNIT, BUT OIL IN COOLER & CONTROL SYSTEM.
2. STATED VOLUMES ARE FOR COMPLETE HYDRAULIC SYSTEM.

FLUID
USE MINERAL OR SYNTHETIC BASED HYDRAULIC FLUID CONFORMING TO ISO 11158, DIN 51524-2/DIN 51524-3 STANDARDS. THE HYDRAULIC FLUID SELECTED SHOULD BE WITHIN THE OPERATING TEMPERATURE RANGE. THE OPERATING VISCOSITY FOR HAMILTON JET HYDRAULIC SYSTEMS IS WITHIN THE VISCOSITY RANGE OF 16-36 CST.

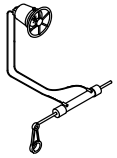
EXAMPLES

SHELL:	TELLUS 46
CASTROL:	HYSPIN AWS M46
ESSO/EXON/MOBIL:	DTE 10 EXCEL 46
B.P:	BARTRAN® HV46
GULF:	HARMONY AW46

JET	VOLUME (L)
HJ364	5.25
HJ403	7.5
HM422	7.5
HM461	7.5
HM521	7.5
HM571	7.5
HM651	21
HM721	21
HM811	21
HT810	21
HT900	60
HT1000	80

HYDRAULIC FLUIDS	JET	VOLUME (L)

SEASTAR MANUAL HYDRAULIC STEERING



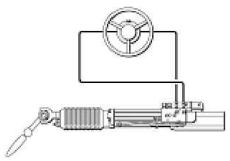
FLUID
FLUIDS MEETING MIL H5606C SPECIFICATIONS

EXAMPLES

SEASTAR:	HA5430 (1 QT), HA5440 (1 US GAL.)
SHELL:	SHELL AERO FLUID 41 OR 4
ESSO/MOBIL:	UNIVIS N15 OR J13/ MOBIL AERO HFA
TEXACO/CHEVRON:	HO15/ AVIATION HYDRAULIC FLUID A
PETRO CANADA:	HARMONY HV115

JET	VOLUME (L)
HJ213	REFER TO JET MANUAL
HJ241	
HJ274	
HJ292	
HJ322	
HJ364	
HJ403	

SEASTAR POWERED HYDRAULIC STEERING



FLUID
FLUIDS MEETING MIL H5606C SPECIFICATIONS

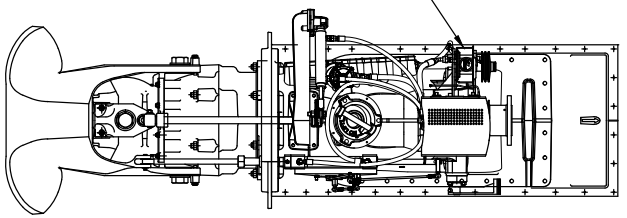
EXAMPLES

SEASTAR:	HA5430 (1 QT), HA5440 (1 US GAL.)
SHELL:	SHELL AERO FLUID 41 OR 4
ESSO/MOBIL:	UNIVIS N15 OR J13/ MOBIL AERO HFA
TEXACO/CHEVRON:	HO15/ AVIATION HYDRAULIC FLUID A
PETRO CANADA:	HARMONY HV115

JET	VOLUME (L)
HJ403	REFER TO JET MANUAL
HM461	
HM521	
HM571	

HYDRAULIC SYSTEMS WITH SAGINAW HPU

JET DRIVEN HYDRAULIC POWER UNIT
NOTE: UNIT SHIPPED FILLED WITH OIL.



FLUID
FLUIDS MEETING GM SPECIFICATION NO. 9985010

EXAMPLES

SHELL:	DONAX TF / SPIRAX
ESSO/MOBIL:	DEXRON ®/ ATF
CASTROL:	TRANSMAX DEX 111
TEXACO/CHEVRON:	TEXAMATIC 7045E/ HD-389
GULF:	DEXRON VI

DO NOT USE
HYDRAULIC OIL

JET	HSRX / HSRC	BLUE ARROW
HJ213	1.0	N/A
HJ241	1.0	N/A
HJ274	1.2	N/A
HJ292	1.2	1.8
HJ322	1.7	2.3

HamiltonJet

CHANGE SUMMARY - REFER TO E.C.N. FOR DETAILS				
REVISION: V	ECN: 20317			
BEARING HOUSING GREASE INFORMATION UPDATED				
SHEET 2 - BALL JOINT GREASE REQUIREMENT ADDED				
SHEET 2 - IMPELLER SEAL GREASE REQUIREMENT ADDED				
DESIGN CHECK:	N.T	04.06.13	SIGN:	
DRAWING REVISION:	J.S.R	31.05.13	SIGN:	
DOCUMENT CHECK:	S.K	04.06.13	SIGN:	
ORIGINAL DESIGN:	RJL	21.12.93	SIGN:	

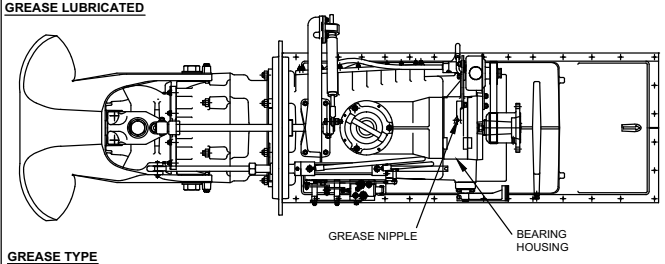
MANUFACTURING INFORMATION	
MATERIAL:	
STANDARD:	
MAT CERT REQ:	TRACEABILITY REQ:
FINISHED WEIGHT:	
ALL DIMENSIONS IN [mm] UNLESS OTHERWISE SPECIFIED	
REMOVE ALL SHARP EDGES AND BURRS	
UNTOLERANCED DIMENSIONS & SURFACE FINISH	
GENERAL: HOLES: ANGULAR:	
MACHINED SURFACE FINISH:	

DRAWING INFORMATION		
RECOMMENDATIONS FOR LUBRICANTS AND OILS		
JET / CONTROL TYPE		
DRAWN TO HAMJET 085195	PROJECTION:	
SCALE:	SHEET SIZE: A3	SHT 1 / 3
DWG No: 85018	REV: V	

85018 Recommendations for Lubricants and Oils Sht2

BEARING HOUSING LUBRICATION	JET	VOLUME (L)

GREASE LUBRICATED



JET	VOLUME (L)
HJ212	REFER TO JET MANUAL
HJ213	
HJ241	
HJ274	
HJ292	
HJ322	

GREASE TYPE

MULTI PURPOSE EXTREME PRESSURE (EP) CALCIUM SULPHONATE COMPLEX OR LITHIUM HYDROXYSTEARATE. TO ENSURE GREASE COMPATIBILITY, PURGE THE HOUSING INLINE WITH GREASE MANUFACTURERS GUIDELINES IF GREASE TYPE IS CHANGED. EX-FACTORY GREASE IS CALCIUM SULPHONATE BASED.

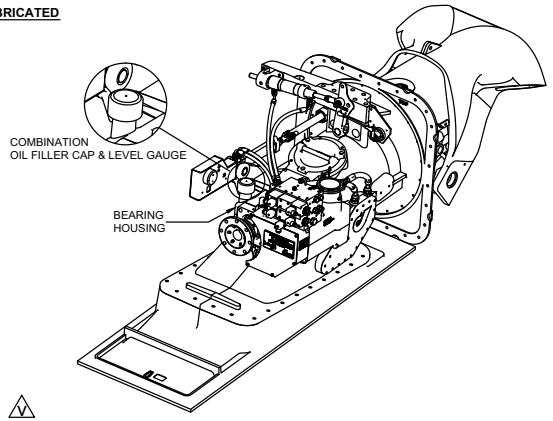
EXAMPLES

BP: ENERGREASE MP-MG2
CASTROL: MOLUB-ALLOY 6040/150
MOBIL: MOBILUX EP 2
SHELL: GADUS S2 V100

DO NOT USE

CALCIUM COMPLEX
BENTONITE CLAY
POLYUREA

OIL LUBRICATED



	BEARING	COOLER
HJ364	1.1	N/A
HJ403	3.6	N/A
HM422	3.6	N/A
HM461	3.6	N/A
HM521	3.7	N/A
HM571	3.7	N/A
HM651	6.2	2.6
HM721	7.0	5.0
HM811	9.3	5.0
HT810	9.3	5.0
HT900	14	6.0
HT1000	31.2	1.0

FLUID

MINERAL OR SYNTHETIC BASED HYDRAULIC OIL TO ISO 11158 OR DIN 51524-2/ DIN 51524-3. STRAIGHT MINERAL OILS WITH EP ADDITIVES ARE RECOMMENDED FOR ROLLING BEARING LUBRICATION. RECOMMENDED MINIMUM OIL VISCOSITY INDEX IS 95. THE OPERATING VISCOSITY FOR HAMILTON JET SYSTEMS IS WITHIN THE VISCOSITY RANGE OF 16-36 CST.

EXAMPLES

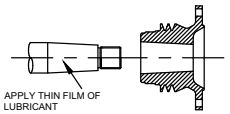
SHELL: TELLUS 46
CASTROL: HYSPIN AWS M46
ESSO/EXON/MOBIL: DTE 10 EXCEL 46
B.P: BARTRAN® HV46
GULF: HARMONY AW46

NOTES:

1. JET UNIT OIL LEVELS WILL VARY DEPENDING ON DEADRISE OF HULL.
2. OIL VOLUMES SHOWN ARE FOR CENTRALLY MOUNTED UNITS WITH NO DEADRISE.
3. OIL LEVELS MUST BE WITHIN THE MARKS SHOWN ON THE DIPSTICK.
4. ALL VOLUMES SHOWN ARE IN LITRES (LT).

JOINT LUBRICATION

TAPERS (IMPELLERS & COUPLINGS)



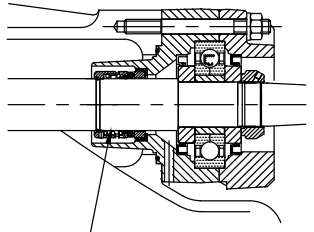
GREASE

MULTIPURPOSE LITHIUM BASE.
OR CALCIUM SULPHATE BASED.

EXAMPLES

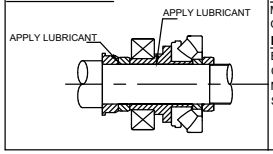
BP: ENERGREASE MP-MG2
CASTROL: MOLUB-ALLOY 6040/150
MOBIL: MOBILUX EP 2
SHELL: GADUS S2 V100

FITTING OF ROTARY SEAL



USE ONLY P-80® TEMPORARY RUBBER ASSEMBLY LUBRICANT (P/N 902021). OR
DETERGENT: WATER (20:1)
DO NOT LUBRICATE SEAL FACES
DO NOT USE GREASE OR OIL

STEEL TO STEEL



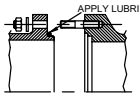
GREASE

MULTIPURPOSE LITHIUM BASE.
OR CALCIUM SULPHATE BASED.

EXAMPLES

BP: ENERGREASE MP-MG2
CASTROL: MOLUB-ALLOY 6040/150
MOBIL: MOBILUX EP 2
SHELL: GADUS S2 V100

O-RINGS (NITRILE RUBBER ONLY)



NOTE: DO NOT GREASE BARRIER CORD O-RINGS

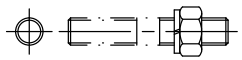
GREASE

MULTIPURPOSE LITHIUM BASE.
OR CALCIUM SULPHATE BASED.

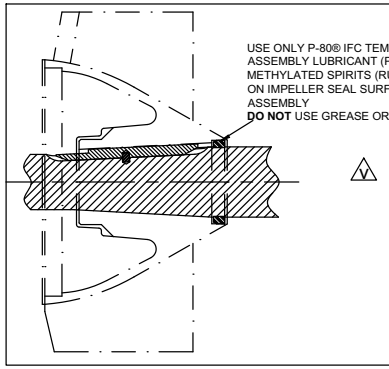
EXAMPLES

BP: ENERGREASE MP-MG2
CASTROL: MOLUB-ALLOY 6040/150
MOBIL: MOBILUX EP 2
SHELL: GADUS S2 V100

THREADS



REFER TO DRAWING NUMBER: 85113



USE ONLY P-80® IFC TEMPORARY RUBBER ASSEMBLY LUBRICANT (P/N 902021) OR METHYLATED SPIRITS (RUBBING ALCOHOL) ON IMPELLER SEAL SURFACE TO AID ASSEMBLY
DO NOT USE GREASE OR OIL

BALL JOINT

GREASE

MULTIPURPOSE LITHIUM BASE.
OR CALCIUM SULPHATE BASED.

EXAMPLES

BP: ENERGREASE MP-MG2
CASTROL: MOLUB-ALLOY 6040/150
MOBIL: MOBILUX EP 2
SHELL: GADUS S2 V100

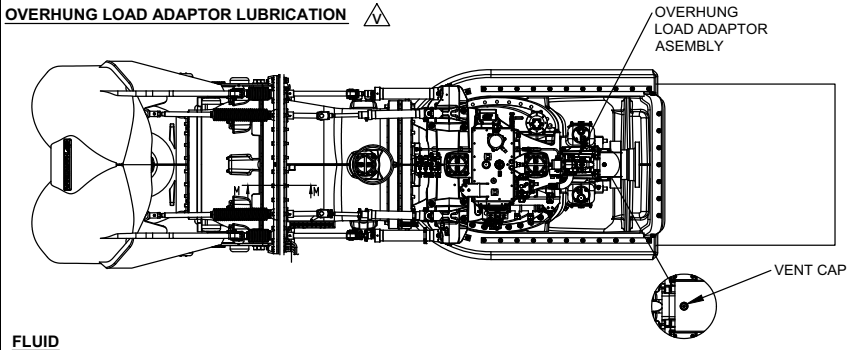
HamiltonJet

CHANGE SUMMARY - REFER TO E.C.N. FOR DETAILS	MANUFACTURING INFORMATION	DRAWING INFORMATION
REVISION: ECN: SEE SHEET 1 FOR DETAILS	MATERIAL: STANDARD: MAT CERT REQ: TRACEABILITY REQ: FINISHED WEIGHT:	RECOMMENDATIONS FOR LUBRICANTS AND OILS
DESIGN CHECK: SIGN.	ALL DIMENSIONS IN [mm] UNLESS OTHERWISE SPECIFIED	JET / CONTROL TYPE
DRAWING REVISION: SIGN.	REMOVE ALL SHARP EDGES AND BURRS	DRAWN TO HAMJET 085195 PROJECTION:
DOCUMENT CHECK: SIGN.	UNTOLERANCED DIMENSIONS & SURFACE FINISH GENERAL: HOLES: ANGULAR: MACHINED SURFACE FINISH:	SCALE: SHEET SIZE: A3 SHT 2 / 3
ORIGINAL DESIGN: SIGN.		DWG No: 85018 REV: V

85018 Recommendations for Lubricants and Oils Sht3

JET	VOLUME (L)
HT900	REFER TO JET MANUAL FOR INSTRUCTIONS ON ACHIEVING CORRECT OIL LEVEL
HT1000	

OVERHUNG LOAD ADAPTOR LUBRICATION ⚠V



FLUID

USE MINERAL OR SYNTHETIC BASED HYDRAULIC FLUID CONFORMING TO ISO 11158, DIN 51524-2/DIN 51524-3 STANDARDS. THE HYDRAULIC FLUID SELECTED SHOULD BE WITHIN THE OPERATING TEMPERATURE RANGE. THE OPERATING VISCOSITY FOR HAMILTON JET HYDRAULIC SYSTEMS IS WITHIN THE VISCOSITY RANGE OF 16-36 CST.

EXAMPLES

SHELL:	TELLUS 46
CASTROL:	HYSPIN AWS M46
ESSO/EXON/MOBIL:	DTE 10 EXCEL 46
B.P:	BARTRAN® HV46
GULF:	HARMONY AW46

HamiltonJet

CHANGE SUMMARY - REFER TO E.C.N. FOR DETAILS	MANUFACTURING INFORMATION	DRAWING INFORMATION
REVISION: ECN: SEE SHEET 1 FOR DETAILS	MATERIAL: STANDARD: MAT CERT REQ: TRACEABILITY REQ: FINISHED WEIGHT:	RECOMMENDATIONS FOR LUBRICANTS AND OILS
DESIGN CHECK: SIGN.	ALL DIMENSIONS IN [mm] UNLESS OTHERWISE SPECIFIED	JET / CONTROL TYPE
DRAWING REVISION: SIGN.	REMOVE ALL SHARP EDGES AND BURRS	DRAWN TO HAMJET 085195 PROJECTION:
DOCUMENT CHECK: SIGN.	UNTOLERANCED DIMENSIONS & SURFACE FINISH GENERAL: HOLES: ANGULAR:	SCALE: SHEET SIZE: A3 SHT 3 / 3
ORIGINAL DESIGN: SIGN.	MACHINED SURFACE FINISH:	DWG No: 85018 REV: V

PROJECTION

Aluminium Weld Procedure for Hamilton Jet Installation or Repair

1. Welds

To be full penetration and conform to relevant Classification Society requirements (e.g. ABS, Lloyds Register, DNV).

2. Welder Qualifications

Properly qualified welder to relevant Classification Society requirements, in downhand or overhead as required.

3. Inspection

Inspection to be done by a welding inspector qualified to relevant Classification Society requirements.

4. Site

The site must be:
Dry and free from steel dust or any other contaminates that could effect the finished weld condition.
Sheltered from draughts to prevent disturbance to shielding gas.

5. Welding Process

M.I.G.

6. Welding Wire

Plate (5086 or 5083) to Plate (5086 or 5083), use 5356 Filler Wire
Casting (EN AC 44100) to Casting (EN AC 44100), use 4043 Filler Wire

Casting (EN AC 44100) to Plate (5086 or 5083), use 4043 Filler Wire. 5356 filler wire may be used if the local process/conditions show superior weld quality to 4043, however adequate inspection shall be performed as per paragraph 15.

7. Shield Gas

Argon or helium.

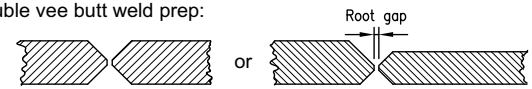
8. Weld Position

Weld position options are:
Flat downhand. Turn hull over to do the other side flat downhand. Requires double vee prep.
Single vee prep. Use backing strip. Weld flat downhand one side only, then grind off backing strip.
Double vee prep. Flat downhand one side. Overhead other side.

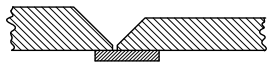
9. Weld Prep

Minimise root gap on weld preps. Recommended maximum gap 1.5mm ($\frac{1}{16}$") for welds to cast material.

Double vee butt weld prep:



Single vee butt weld prep with backing strip:



10. Cleanliness

Dress all surfaces to be welded just prior to welding to remove surface oxides. Cast aluminium that has been submerged in salt water must be thoroughly rinsed in fresh water then dried, prior to final dressing.

11. Preheat

Remove chill 50° - 60° C (120° - 140° F) to ensure weld prep area is dry.

12. Support

A rigid strong back should be clamped or tacked to intake blocks during welding to prevent distortion of the block.

13. Weld Runs

Multipass runs may be necessary depending on plate and casting thickness. Stitch 75mm with 75mm gaps for first 2 runs to minimise distortion. Stitch sequence for intake blocks to be a star sequence, rather than proceeding linearly around the block circumference.
Grind stop starts before filling in.
Subsequent runs may be full length runs.

14. Back Gouging

Chipping, Routing, Milling, grinding or other suitable methods are to be employed at the root or under side of the weld to obtain sound metal before applying subsequent beads.
Grind stop/start craters.

15. Inspection of Welds

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 joints 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
CL660	D	N.T.	02.03.11	PARAGRAPHS 6 AND 13 AMMENDED
CL460	C	N.T.	02.04.07	BASE METAL OPTIONS ADDED, NOW SUPERSEDES 85103
CL3765	B	P.S.	24.09.96	REDRAWN ON CAD.OVERHEAD OPTION ADDED.
CL3607	A	P.S.	06.06.95	
CL3620	0	PS		ISSUED FOR PRODUCTION.

JET ALL 272 291 321 363 391

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. 06.06.95

CHECKED

APPROVED K.V.E 30.10.96

NAME
ALUMINIUM WELD PROCEDURE
for JET INSTALLATION
or REPAIR

SCALE No: A3–85080 D

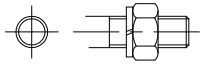
D
85080

85113 Threaded Fastener Tightening Torques

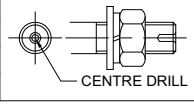
DO NOT SCALE THIS DRAWING REMOVE ALL SHARP CORNERS ALL DIMENSIONS IN mm. UNLESS OTHERWISE SHOWN PROJECTION

NUT TIGHTENING TORQUES

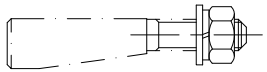
SIZE	N.m	lbs.ft	NUTS ON 316 ST. STL STUDS
M6	5	4	(NON MAGNETIC)
M8	12	9	
M10	24	18	
M12	45	33	
M16	75	55	
M20	120	90	



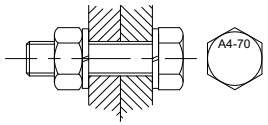
SIZE	GREASED		ANTISEIZED		NUTS ON 2205 ST. STL STUDS
	N.m	lbs.ft	N.m	lbs.ft	
M12	60	44	45	33	(MAGNETIC)
M16	150	110	110	80	
M20	270	200	210	155	
M24	470	345	350	260	
M30	900	660	650	480	CENTRE DRILL



SIZE	N.m	lbs.ft	NUTS ON 316 ST. STL COTTER PINS
M6	5	4	
M8	12	9	
M10	24	18	
M12	45	33	

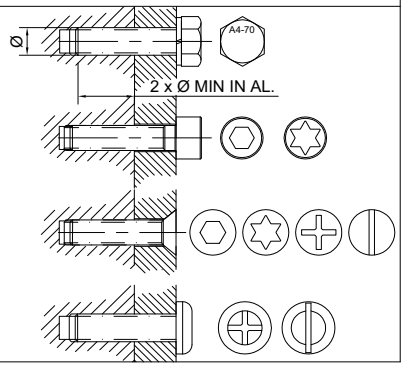


SIZE	N.m	lbs.ft	NUTS ON BOLTS / SCREWS
METRIC			
M3	0.8	0.6	
M4	2	1.5	
M5	4	3	
M6	7	5	
M8	16.5	12	
M10	33	24	
M12	60	44	
M16	140	103	
M20	260	190	
M24	410	300	
IMPERIAL			
1/4" UNC	7.5	5.5	
5/16" UNC	15.3	11.3	
3/8" UNC	27	20	
1/2" UNC	65	48	
5/8" UNC	130	96	
3/4" UNC	230	170	



SCREW TIGHTENING TORQUES

SIZE	N.m	lbs.ft	BOLTS & SCREWS IN ALL METALS
METRIC			NOTE: 2 x DIAMETER MIN THREAD LENGTH REQUIRED IN ALUMINIUM CASTINGS
M2	0.2	0.15	
M2.5	0.35	0.25	
M3	0.6	0.4	
M4	1.5	1.1	
M5	3	2.2	
M6	5	4	
M8	12	9	
M10	24	18	
M12	45	33	
M16	95	70	
M20	180	133	
IMPERIAL			
1/4" UNC	5	4	
5/16" UNC	11	8	
3/8" UNC	19	14	
1/2" UNC	45	31	
5/8" UNC	89	66	
3/4" UNC	160	120	

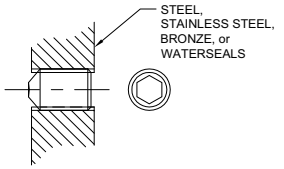


Notes:

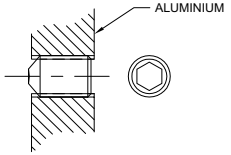
1. Ensure all threads are clean.
2. Where the assembly drawing does not specify Loctite or thread lubricant, use the thread lubricant specified on sheet 2 of this drawing.
3. Where Loctite is specified, refer to Loctite Application Guide drawing 85144.
4. For specific instructions on tightening torques for impeller nuts, coupling nuts, and bearing lock nuts refer to the relevant jet assembly drawing.
5. Torques specified in assembly drawings take precedence over this drawing. Use this drawing when the assembly drawing does not specify torque for the fastener.

SET SCREW TIGHTENING TORQUES

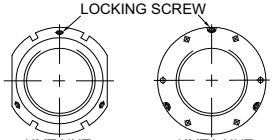
SIZE	N.m	lbs.ft	SET SCREWS EXCEPT IN ALUMINIUM
M3	0.6	0.4	
M4	1.5	1.1	
M5	3	2.2	
M6	5	4	
M8	12	9	
M10	24	9	
M12	45	33	



SIZE	N.m	lbs.ft	SET SCREWS IN ALUMINIUM
M3	0.4	0.3	
M4	1.0	0.7	
M5	2.0	1.5	
M6	3.3	2.5	
M8	8	6	
M10	16	12	
M12	30	22	



SIZE	N.m	lbs.ft	SET SCREWS ON KMT OR KMTA NUTS
M6	8	6	LOCKING SCREW
M8	18	13	
M10	35	26	
			KMT NUT KMTA NUT



CL707	T	S.H.	20.02.12	ADDED HOSE CLAMP TORQUES. HYDRAULIC FITTINGS IN CASTINGS CHANGED	
CL686	S	S.K.	01.09.11	M2 & M2.5 TORQUE ADDED. TORX, FLATHEAD & POZI/PHILLIPS IMAGES ADDED.	
CL676	R	N.T.	20.06.11	ANTISEIZE TORQUES ADDED FOR 2205 STUDS, M24 NUT ON BOLT ADDED	
REF	NO.	BY	DATE	AMENDMENTS	

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. 16.08.99 | CHECKED | APPROVED

√ = N9 EXCEPT AS STATED

UNLIMITED DIMENSIONS TO BE ± N/A

NAME: THREADED FASTENER TIGHTENING TORQUES Sheet 1 of 2.

SCALE N/A | No: A3-85113 | T

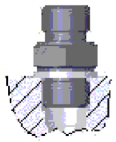
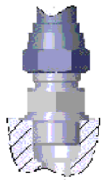
85113 T

85113 Threaded Fastener Tightening Torques Sht2

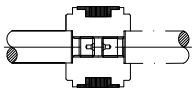
DO NOT SCALE THIS DRAWING REMOVE ALL SHARP CORNERS ALL DIMENSIONS IN mm. UNLESS OTHERWISE SHOWN PROJECTION

HYDRAULIC FITTING TORQUES

BSPP HYDRAULIC FITTINGS

	FITTINGS EXCEPT IN JET CASTINGS		FITTINGS IN JET CASTINGS		HOSES	
						
SIZE	N.m	lbs.ft	N.m	lbs.ft	N.m	lbs.ft
1/8	9	7	4	3	7	5
1/4	35	26	10	7	20	15
3/8	45	33	20	15	35	26
1/2	65	48	40	30	60	44
3/4	130	96	63	46	115	85
1	160	118	105	77	140	103
1-1/4	240	177	142	105	210	155
1-1/2	320	240	320	240	290	214
2	500	370	500	370	400	300

HYDRAULIC CYLINDER PISTON TORQUE

SIZE	N.m	lbs.ft	STAINLESS THREADS ON MILD STEEL
M16 X 2	75	55	
M24 X 3	250	184	

HOSE CLAMP TIGHTENING TORQUES

PART	SIZE	N.m	lbs.ft
201056	12-20	2.3	1.6
201057	14-32	4	2.9
201058	30-45	5	3.6
201059	40-60	5	3.6
205780	50-70	5	3.6

PART	SIZE	N.m	lbs.ft
201060	60-80	5	3.6
206094	80-100	5	3.6
064924	51-55	15	11
209872	59-63	15	11

THREAD LUBRICANTS

THREAD TYPE	DESCRIPTION OF LUBRICANT
316 STAINLESS STUDS	MULTIPURPOSE MARINE GRADE GREASE.
2205 STAINLESS STUDS	MULTIPURPOSE MARINE GRADE GREASE OR MARINE GRADE ANTI SEIZE. ANTI SEIZE WILL REDUCE THE RISK OF THREAD GALLING SO IS RECOMMENDED ON M20 AND LARGER
OTHER METRIC FASTENERS	MULTIPURPOSE MARINE GRADE GREASE.
1/4" UNC - 1/8" UNC	MULTIPURPOSE MARINE GRADE GREASE.
3/4" UNC	MARINE GRADE ANTI SEIZE.
BRONZE IMPELLER OR COUPLING NUTS	MULTIPURPOSE MARINE GRADE GREASE.
HYDRAULIC FITTINGS	GENERAL PURPOSE GREASE OR HYDRAULIC OIL. EXAMPLE: ACCROLUBE

MULTIPURPOSE MARINE GRADE LITHIUM OR CALCIUM SULPHATE BASED GREASE

Examples:
Shell: Shell Alvania RL2
Mobile: Mobilux 2, Mobilux EP 2
Castrol: Molub - Alloy 6040
BP: Engergrease MP-MG 2

MARINE GRADE ANTI SEIZE

Use Only:
LOCTITE MARINE GRADE ANTI SEIZE

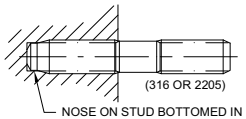
DO NOT USE ANTISEIZES CONTAINING COPPER,NICKEL,GRAPHITE OR METAL FLAKE

ONLY USE LOCTITE MARINE GRADE ANTI SEIZE WHEN USING ANTI SEIZE ON NUTS FITTED TO 2205 STUDS, IN ORDER TO ACHIEVE CORRECT STUD PRELOAD

STUD INSTALLATION

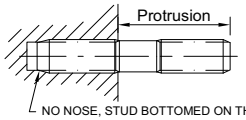
SIZE	N.m	lbs.ft
M12	18	13
M16	30	22
M20	48	35
M24	180	130
M30	370	270

ROLL FORMED STUDS WITH NOSE



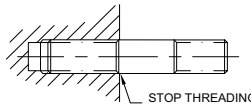
Thread stud into casting until thread bottoms. Confirm protrusion is equal to stud length minus thread length as per stud description

ROLL FORMED STUDS WITHOUT NOSE



Thread stud into casting until thread dissappears. Do not thread past this point.

CUT THREAD STUDS



REFER TO SHEET 1 FOR AMENDMENTS.

REF	NO.	BY	DATE	AMENDMENTS
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. 18.08.99
CHECKED
APPROVED

√ = N9 EXCEPT AS STATED
UNLIMITED DIMENSIONS TO BE ± N/A

NAME THREADED FASTENER TIGHTENING TORQUES Sheet 2 of 2.

SCALE N/A No: A3-85113 T

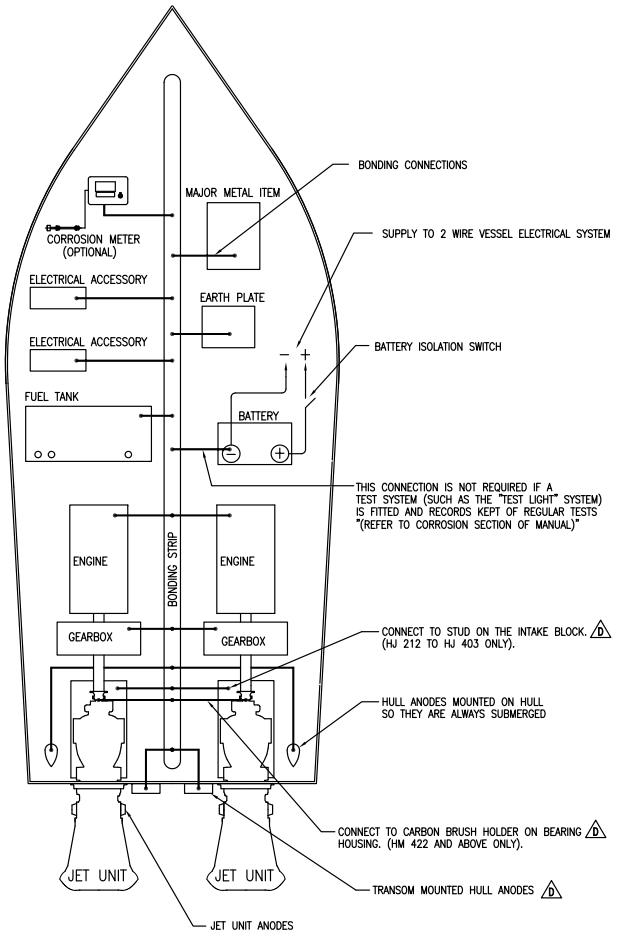
T 85113

85114 Earth Bonding system

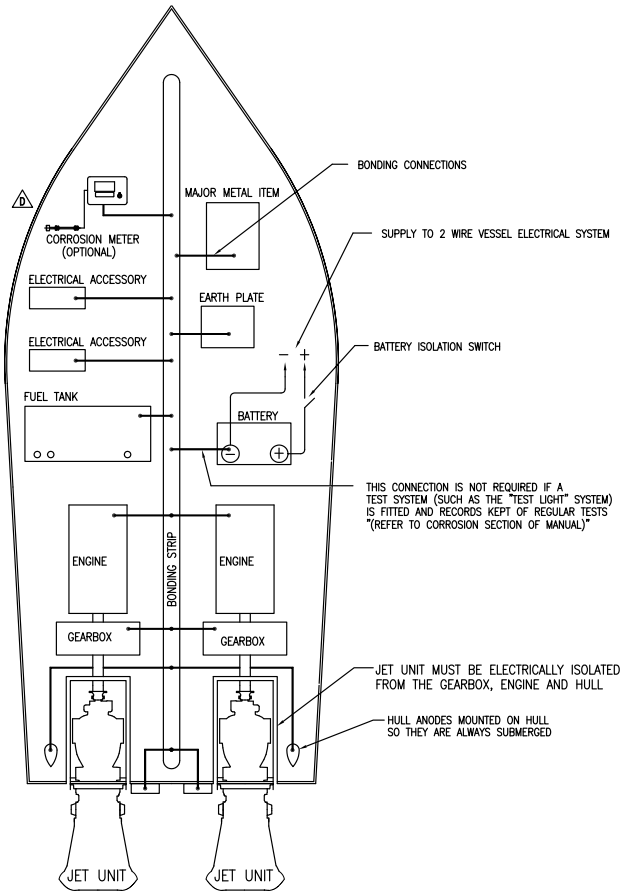
DO NOT SCALE THIS DRAWING.

PROJECTION

ALL DIMENSIONS IN mm. UNLESS OTHERWISE SHOWN.



EARTH BONDING SYSTEM FOR ALUMINIUM AND G.R.P. HULLS



EARTH BONDING SYSTEM FOR STEEL AND CARBON FIBRE 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 ADDITIONAL 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 DRAG.
THEY SHOULD NOT BE LOCATED DIRECTLY AHEAD OF THE JET UNIT INTAKE AS THEY MAY DISTURB THE INLET FLOW.

REF	NO.	BY	DATE	AMENDMENTS
CL532	D	N.T.	12.05.03	TRANSOM ANODES ADDED. CORROSION MONITOR ON STEEL HULL
CL275	C	P.M.W.	12.05.03	NOTES RE STUD ON INTAKE & CARBON BRUSH HOLDER ADDED
CL275	C	P.M.W.	12.05.03	'WOODEN' REMOVED FROM L.H. SIDE TITLE.
CL118	B	R.J.L	23.11.99	SHAFT BONDING NOTE CLARIFIED.
CL108	A	R.J.L	16.09.99	SPELLING CORRECTED.
CL104	0	R.J.L	18.08.99	ISSUED FOR PRODUCTION.
JET	ALL			

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

MATERIAL N/A

MAT'L CERT

DESIGNED DATE

DRAWN R.J.L 18-08-99

CHECKED L.E.A 18.08.99

APPROVED K.V.E

√ = N9 EXCEPT AS STATED

UNLIMITED DIMENSIONS TO BE ±

NAME EARTH BONDING SYSTEM RECOMMENDATIONS AND LAYOUT

SCALE -

No: A2-85114

D

Notes

Hamilton jet is an international company committed to meeting their customer's needs through the production of waterjet propulsion systems of the highest standards. Dedicated to waterjet propulsion. Hamilton jet is globally represented by an extensive supportnetwork.

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