

CCGS W.G. George

15.77m Rescue Vessel

Stern Tube Replacement

OUTLINE SPECIFICATION

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Prepared For:

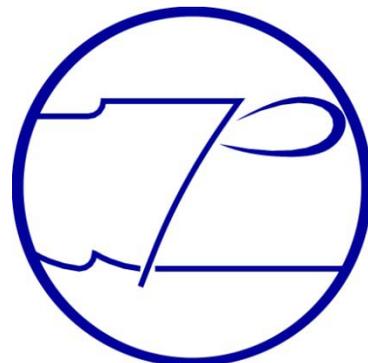
Canadian Coast Guard

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DOCUMENT INFORMATION

Rev	Date	Description	Prepared	Checked	Approved
0	24 November 2015	Issued to CCG for review and comment	W. Maybee	A. Mercer	-
1	03 December 2015	Issued for use	A. Mercer	W. Maybee	-
2	18 February 2016	Revised specific wording as requested by Owner.	A. Mercer	T. Wetzel	-

1.0 PURPOSE

This document is intended to describe the technical scope of work associated with removal and replacement of both the port and starboard stern tubes on the subject vessel.

2.0 DEFINITIONS AND ABBREVIATIONS

Contractor	Unknown	Shipyard
CCG	Canadian Coast Guard	Vessel Owner
PMC	Poseidon Marine Consultants Ltd.	Owner's Representative
TCMS	Transport Canada Marine Safety	National Certifying Authority

3.0 REFERENCE DRAWINGS AND DOCUMENTS

Industries Raymond (1989) Inc.	Shafting Arrangement	190-100-004 Rev. 2
Industries Raymond (1989) Inc.	Structural Details "A" Brackets	190-100-005 Rev. 2
Industries Raymond (1989) Inc.	Machinery Arrg't Plan & Elevation	190-100-001 Rev. 1
Industries Raymond (1989) Inc.	Profile and Decks Tank Top & CL Elevation	180-100-001 Rev. 3
Industries Raymond (1989) Inc.	Profile & Decks Engine Girders	180-100-003 Rev. 2
Industries Raymond (1989) Inc.	General Arrangement Anti-Slip	175-300-003 Rev. 1

4.0 VESSEL PARTICULARS

Name:	W.G. George
Official No.:	817949
Length:	15.77m
Breadth:	5.18m
Depth:	2.05m
Owner:	Canadian Coast Guard
Year Built:	1994
Hull Material:	Aluminum

5.0 PROPULSION SYSTEM PARTICULARS

The twin screw system is comprised of fixed pitch propellers fitted on solid shafts driven by variable high speed diesel engines through reversing reduction gearboxes. The aft bearings,

immediately forward of the propellers, are arranged in fabricated "A" frames while the forward bearings are arranged in integral stern tubes. All bearings are water lubricated. Hull integrity is maintained by way of glands arranged on the forward face of the stern tubes. Main engines and gearboxes are secured on patent resilient mounts, while the gearboxes are coupled to the propeller shafts by way of patent flexible couplings.

Details of the existing components are as follows:

Main Engines:	Caterpillar 3408 TA developing 399 BKW at 2100 RPM
Gearbox:	Twin Disc MG 514G. Ratio 2:1. Close coupled.
Coupling:	Lo-Rez 15RT
Mounts:	Lo-Rez. Model unknown.
Stuffing Gland:	Hawboldt Model RFPB-275
Shaft diameter:	3.75 inches nominal
Shaft material:	Aquamet 22.
Fwd and aft Bearings:	Thordon type "EBRO" water lubricated 11" long
Stern tubes:	Aluminum 6061-T6 alloy 5" OD x 3" ID

6.0 REPAIR METHODOLOGY

Operational alignment of the main engine/gearbox units to the propeller shafts are in itself of utmost importance. Similarly, alignment of the forward and aft propeller shaft bearings are of equal importance, particularly to eliminate the need to make structural modifications to engine support structures.

Renewal of the stern tubes is to be effected in such a manner that the final alignment of the shaft bearings, propeller shafts, stuffing glands and main engines/gearboxes are all within allowable tolerance limits after the stern tubes have been replaced and final alignment of the components is carried out.

Recognizing that contractors have varying tools, equipment, skills and expertise it is not the intent of this document to specifically detail how the repair is to be carried out but rather to describe the process in general terms while giving the Contractor flexibility to utilize their

individual strengths and expertise to remove and replace the stern tubes. Contractors are requested to develop their preferred method to successfully replace the subject stern tubes while encompassing the requirements specified in this document. This procedure is to be provided in outline form with the Contractors repair offer.

It is envisaged that different stern tube replacement methodologies may be proposed. These may include but are not limited to the following:

- Stern tube alignment by optical means.
- Stern tube alignment by taut wire.
- Stern tube alignment by mechanical means (use of a jig shaft)
- Other as may be proposed.

The proposed procedure is to include the following aspects believed to be critical to successful renewal of the stern tubes:

1. Measuring and recording of radial and axial alignment of the gearbox output coupling to the propeller shaft coupling with the vessel in an operational condition prior to removing the vessel from the water.
2. Measuring and recording of radial and axial alignment of gearbox output coupling to the propeller shaft coupling after removing the vessel from the water and being placed in the cradle on the repair berth.
3. Measuring and recording of propeller shaft clearances in way of the aft bearing at minimum four positions on both forward and aft faces.
4. Means of aligning the new stern tubes in relation to the aft bearing housing and the main engines/gearboxes.
5. Machining of each stern tube bore in way of the forward bearings in relation to aft bearings and the gearbox output couplings.
6. Machining of each stern tube forward flange to ensure perpendicularity of the stuffing glands.
7. A written welding sequence demonstrating how distortion is to be minimized and monitored is to be developed by a qualified person in accordance with CSA W47.2 and

W59.2. This is to be presented to the attending Transport Canada surveyor prior to commencement of work.

8. Operating clearances of the new forward and aft bearings, once re-assembled, to be within manufacturers specifications.
9. Alignment of the gearbox output flanges to the propeller shafts in the afloat, operational condition is to be within manufacturers written specifications.

Measurements of alignment and clearances are to be completed on both port and starboard propulsion systems.

7.0 STERN TUBE REPLACEMENT

Contractors are to indicate how the existing stern tubes are to be accessed and then removed and replaced. Considerations include but not limited to:

1. Removal of the existing shell insert plates and subsequent replacement.
2. Temporary support of adjacent structural components to retain relative alignment.
3. Temporary additional support of the hull in way of the insert plates prior to removal.
4. Protection of internal structure and machinery components during work period.

8.0 BEARING REPLACEMENT

Irrespective of the stern tube methodology used, both the forward and aft water lubricated bearings are to be renewed using Thordon XL Material with water grooves. Bearings are to be 11 inches in length as existing with 3.75" x 2.75" outside and inside nominal diameter respectively. The bearings are to be machined to suit the shaft and housing diameters once the new stern tubes have been installed, machined, and measured. Machining dimensions are to be in accordance with those provided by the bearing manufacturer's representative/supplier, Avalon Marine Limited. Bearings are to be glued in place with retaining rings installed in accordance with the manufacturer's written instruction and under the direction of the bearing manufacturer's field service representative, to be engaged by the contractor.

The cost of supplying and machining of bearings is to be the responsibility of the contractor and included in the quoted price.

After installation of the new bearings the inside diameters are to be measured and compared against the shaft to ensure the operating clearances are within accepted manufacturer's specification.

9.0 MAIN ENGINE/GEARBOX ALIGNMENT

Should re-alignment of the gearbox and main engine be required subsequent to replacement of the stern tubes, all connections to the units are to be released, temporarily blanked and properly supported. Items are to be re-secured upon completion of re-alignment. All connections are to be modified, made tight and all disturbed systems filled to operating levels. The use of flexible elements to effect re-alignment of connections will not be accepted.

The Contractor is to include the cost of engine and gearbox re-alignment as a separate line item, however should also include it in the overall quoted price.

10.0 REMOVALS OF MISCELLANEOUS EQUIPMENT

The contractor shall remove all equipment in the aft survivor space that interferes with access to the tank top and the stern tubes below. All equipment shall be stored in a safe place until required for re-installation. Equipment that is not removed from the space shall be suitably protected so it is not damaged by fabrication work.

11.0 PROPELLER SHAFT

The contractor shall remove the rudders, propellers, propeller shafts, bearings, stuffing boxes and all other shaft equipment up to the flex couplings. All shaft line parts except the bearings shall be stored in a safe place until required for re-installation. The old bearings shall be disposed of in accordance with all applicable environmental regulations. After the propeller shafts have been removed they shall be inspected by the Owner. If the shafts exhibit excessive wear or damage then they shall be repaired or replaced before they are reinstalled into the vessel. Shaft refurbishing if required, would be an addition to this contract.

12.0 INSPECTION BY BIDDER

Bidders are encouraged to view the vessel and are responsible for assessing the requirements for access to the work site.

13.0 ACCESS

In order to access the stern tubes from above, the contractor will need to cut access holes in the tank top in the aft survivor space. Existing seams and butts to be used where possible and the size of access holes to be kept to the minimum required to complete renewal work. Holes to have minimum 4" radius corners and edges aligning with under deck stiffening should be cut approximately 3" from structure. If removed material cannot be reused, contractor shall include the cost of required replacement material. Re-installation is to be in accordance with IACS47.

Piping in the engine room in way of the stern tubes to be properly labeled, removed at the flanges, and safely stored until re-installation. Systems affected include but not limited to cooling water, hydraulics, and bilge. Supports for checker plate to be removed as necessary then re-installed as original upon completion of work.

14.0 INSTALLATION OF NEW STERN TUBE

If removal of shell plating was carried out to gain access to the stern tube area all such hull plating and frame sections that were removed be replaced with correctly sized insert plates. Where possible plating removed is to be completed using existing seams and butts.

15.0 STERN TUBE BORING

After all welding is complete the stern tubes shall be bored to suit new shaft bearings. The line boring machine shall be aligned with bore sight line. The machine shall be in line with the existing struts to ensure alignment with them. Stern tube boring must be within the recommended alignment tolerances for the flex coupling, gear box, and engine.

16.0 SHAFT BEARINGS

Shaft bearings are to be installed after re-alignment and boring of new stern tubes. Bearings to be Throdon Bearings "Ebro" or equivalent, 11" long, sized to suit 2-3/4" diameter shaft and 3-3/4" diameter bore. Arrangement is to be as existing.

17.0 INSPECTIONS AND SURVEYS

In addition to the requirements of the contract specifications all work shall be inspected and approved to the satisfaction of the Owner and TCMS with regard to finish, safety, compliance, workmanship, outfit layout and accessibility, ease of maintenance and durability. The cost of all inspections and approvals apart from the Owners inspection shall be at the Contractor's expense. The contractor may determine which method may be employed to ensure that the shell and W.T. Bulkheads IWO of the stern tubes are watertight as intended; however, they will be responsible for repairing any leaks which are found in these compartments. Method chosen shall be acceptable to the Owner and Transport Canada Marine Safety (TCMS). All shell and bulkheads that are affected by this refit shall be tested in the presence of Owner. The Contractor may make air tests, provided the pressure used does not exceed the equivalent of the head of water required for hydrostatic tests in each case. All compartments affected by the refit shall be submitted for a dry inspection before hydrostatic testing if applicable, and before painting, insulation, or other outfitting. All compartments subject to hydrostatic tests are to be wiped dry and prepared for visual inspection.

All welding to be 100% visually inspected. All butt welds on hull, watertight bulkheads, and decks, as well as bulkhead "T" connections to have non destructive testing completed to the satisfaction of Owner and attending Class or TCMS surveyor.

Approval by the Owner, TCMS, or other regulatory body shall not relieve the Contractor of their responsibility with respect to the Contract, acceptance, tests and warranties.

18.0 WORKMANSHIP

Contractor is to use fully qualified and competent tradesmen and supervision, and to ensure a uniform high level of workmanship judged by generally accepted shipbuilding standards. Welders to be CWB certified and procedures specific to the type and grade of Aluminum used are to be employed.

19.0 STRUCTURAL ARRANGEMENT

Structural arrangement of new stern tubes to be as original, per provided drawings where possible. Any contemplated changes to be agreed upon with Owner and approved by TCMS prior to being effected.

20.0 ENGINE MOUNTS

After the bearings have been reinstalled the propeller shaft shall be reinstalled. With the propeller shaft back in place, the contractor shall adjust the existing Low Rez engine mounts to ensure engine alignment with the propeller shaft. The alignment of the engine to the shaft must meet tolerances as specified by the Manufacturers supplied documentation.

21.0 SHAFT GROUNDING

After the shafts have been reinstalled and the alignment complete the contractor shall reinstall the shaft grounding brushes after inspecting components for wear and/or damage. After the brushes have been installed they shall be tested to ensure the shafts are properly grounded and there is no electrical leakage.

22.0 FINISH WORK

All new aluminum and disturbed areas shall be cleaned and shop primed with a primer compatible with ships existing paint system. On completion of all welding, all damaged paintwork shall be cleaned and scraped to remove loose material. Edges of damaged paint areas to be feathered back to sound material. All exposed aluminum to be coated with the

appropriate primer and then top coated in accordance with the existing ship's paint scheme.

23.0 MATERIAL

All shapes to be grade 6061 Aluminum and plate to be grade 5083 Aluminum unless specified elsewhere.