

**SECTION 7**  
**TECHNICAL SPECIFICATIONS**  
**STERN DRIVE (SURFACE DRIVE) GEAR FOR TORNADO CLASS**  
**BOATS WITH ASSOCIATED ACCESSORIES (QTY: 08 SETS)**

1. **Preamble.** At present, is operating eight 14.8 m twin screw Tornado Class patrol boats. The boats are fitted with inboard diesel engines and gearboxes, and for propulsion, stern drive system is used. Due to frequent failure of the existing stern drive system, BCG intends to replace the existing drive system with a suitable new surface drive system that would match with the existing engines and gearboxes and transmit the engine power through the drive thus provide propulsion. No major changes in the boat's hull and structure will be considered. The new drive must be compatible and be accommodated in the boats with minor modifications (if required). The existing drive arrangement has been attached at **Section 8** of this tender document.

2. **Scope of Supply.** The scope of supply includes the following:

a. Supply of 08 x surface drives (04 x port and 04 x stbd) along with associated equipment as required (to be fitted in 04 x boats). Drive control e.g. trim control and other associated controls, etc are to be included and integrated with the existing throttle control panel and steering system.

b. Supply of any other equipment and accessories to operate the drive.

c. Technical study report related to this replacement of the stern drives with new surface drives is to be submitted with the offer. The drive layout drawing, installation drawings, instructions and manuals are to be supplied. The supplier will ensure supervision of installation, test, trial and commissioning of the drive and also provide training.

d. Spare parts for three years and special tools (optional for assessment/evaluation) as per manufacturer's recommendation are to be supplied.

3. **Qualification of Bidder (Principal) and Certificate/ Document of Authentication.** The bidder (principal) should either be the manufacturer of the surface drives or any internationally reputed shipyard/ marine consulting firm. The bidder (principal), if not the manufacturer, must be authorized by the manufacturer/ authorized agent of the manufacturer/ authorized sub-agent of the authorized agent of the manufacturer of the quoted surface drives to do the project. The bidder (principal) must provide the following certificate(s) with the offer/ quotation as to the reliability of the sources in order to establish chain of links from the original source regarding the supply of the items:

a. One certificate of authentication by the manufacturer in favor of the bidder (principal) in case of the manufacturer as the direct source of the bidder (principal), or

b. Two certificates of authentication: one by the manufacturer to the authorized agent and the other by the authorized agent to the bidder (principal) in case of authorized agent as the immediate source of the bidder (principal), or

c. Three certificates of authentication: first one by the manufacturer to the authorized agent; the second one by the authorized agent to the authorized sub-agent of the authorized agent; and the third one by authorized sub-agent to the bidder (principal) in case of authorized sub-agent as the immediate source of the bidder (principal).

d. In addition to the above certificates, the bidder (principal) is to provide a certificate authorizing the local agent as its authorized local agent for the project.

4. **Certificate Regarding Suitability of the Offered Propulsion Equipment.** The bidder (principal) is required to provide a certificate making a clear statement that the offered/ quoted surface drives and their associated equipment are compatible with the requirements of the buyer and arrangements are suitable for the concerned boats in respect of the boats' power, speed, stability, structural strength, vibration and noise signature point of view.
5. **Country of Origin.** USA, Canada, Norway, EU countries, Australia, New Zealand and Japan
6. **Country of Manufacturer.** USA, Canada, Norway, EU countries, Australia, New Zealand and Japan.
7. **Record of Sales.** Record of sales of the quoted model of surface drive and other similar drive (if any) is to be included with the quotation.
8. **Classification Standard.** All items supplied should be designed and constructed fulfilling the requirement of any classification society, which is a member of IACS. The standard to which the quoted drive complies is to be specified. Only 'Class Approval' will be required.
9. **Onboard Inspection/ Study.** The prospective bidders, upon their specific request, will be allowed to visit the boat to carry out technical studies about this replacement project at Narayangaj, Dhaka, Bangladesh. All such visits must be in strict compliance with security/ safety requirements and prior permission by BCG.
10. **Existing Principal Particulars of the Boats.** The existing principal particulars of the boats are as follows:

a. **General Features.**

(1)	Length	14.8 m
(2)	Breadth	2.68 m
(3)	Depth	1.54 m
(4)	Displacement	8.31 tons
(5)	Passenger	08
(6)	Crew	03
(7)	Fuel Tank Capacity	1000 Ltr

b. **Engines per Boat (Two in Number).**

(1)	Model	CMD/6BTA5.9-M
(2)	Manufacturer	Cummins Mercruiser Diesel,USA
(3)	Power	370 HP

c. **Gearboxes per Boat (Two in Number).**

(1)	Model	ZF280-1
(2)	Manufacturer	<b>ZF Friedrichshafen AG</b> Headquarter Graf-von-Soden-Platz 1 88046 Friedrichshafen, Germany
(3)	ratio	0.814

d. **Stern Drives per Boat ( Two in Number).**

(1)	Type/ Model	Mer cruiser Bravo II
(2)	Manufacturer	Mercury,USA
(3)	Reduction Ratio	1.65:1
(4)	Maximum Power	400 HP each

e. **Speed.**

- (1) Cruising : 27knots
- (2) Maximum : 38 knots

11. **Expected Changes due to the New Surface Drive.** No major changes of the hull, structure, displacement, draught and hydrostatics will be accepted. The new surface drives and other supplied accessories must be accommodated in the existing drive space of the boats. Minor changes of the transom plate and bottom frame structure (frames and longitudinals including girders), plating and protrusions related to installation of the surface drives are allowed without affecting the existing outer hulls of the boats. Trim of the boats should not change beyond 10% due to the new installation.

12. **Average Operating Hours per Year.** The annual operating hours of the boats should be approximately 1000 hours.

13. **Ambient Condition.** The general ambient conditions in the area of operation of the boats are mentioned below:

- a. Air temperature : 05<sup>o</sup> - 45<sup>o</sup>C
- b. Sea water temperature : 05<sup>o</sup> - 32<sup>o</sup>C
- c. Relative Humidity : Up to 95%
- d. Sea water feature : Sea water is muddy around the operating area.

14. **Speed to be Achieved with New Surface Drive.**

- a. Economical Speed : To be mentioned.
- b. Cruising Speed : To be mentioned .
- c. Maximum Continuous Speed : To be mentioned (Provided that the existing engines can sustain the load).
- d. Maximum Speed : Not less than 32 knots (Provided that the existing engines can sustain the load).

15. **Technical Specification of the Offered New Surface Drives of each Boat.** The offered new stern drives should be powerful enough to transmit full load of the engines keeping reasonable safety margin. The existing drive specification is given as reference for selection of the new drive:

- a. Brand : To be mentioned.
- b. Model : To be mentioned.
- c. Power (Maximum) : To be mentioned.
- d. Maximum Steering Angle : To be mentioned.
- e. Trim Control : Automatic (Details to be mentioned).

- f. Shafting System:
- (1) Type/Model/Brand : To be mentioned.
  - (2) Input Shaft:
    - (a) Length : To be mentioned.
    - (b) Diameter : To be mentioned.
    - (c) Material : To be mentioned.
    - (d) Weight : To be mentioned.
  - (3) Intermediate Shaft:
    - (a) Length : To be mentioned.
    - (b) Diameter : To be mentioned.
    - (c) Material : To be mentioned.
    - (d) Weight : To be mentioned.
  - (4) Propeller Shaft:
    - (a) Length : To be mentioned.
    - (b) Diameter : To be mentioned.
    - (c) Material : To be mentioned.
    - (d) Weight : To be mentioned.
  - (5) Maximum Shaft RPM : To be mentioned.
  - (6) Maximum allowed RPM to avoid whirling : To be mentioned.
- g. Propeller : Surface Piercing Propellers.
- (1) Diameter (D) : To be mentioned.
  - (2) Pitch (P) : To be mentioned.
  - (3) BAR : To be mentioned.
  - (4) P/D Ratio : To be mentioned.
  - (5) Number of Blades : To be mentioned.
  - (6) Propeller Slip : To be mentioned.
  - (7) Propeller Material : To be mentioned.
  - (8) Propeller Weight : To be mentioned.
  - (8) Maximum RPM : To be mentioned.
  - (9) Propeller Efficiency (%) : To be mentioned.
- h. Roller Bearing:
- (1) Brand : To be mentioned.
  - (2) Theoretical Lifetime in Hours : To be mentioned.
  - (3) Safety Factor : To be mentioned.
- j. Drive Control (Trim Control and other associated control) : Automatic trim control (To be mentioned).
- k. Total Weight of the Surface Drive System : To be mentioned.

I. **RPM Vs Power Curve Comparison between Engine and Offered Surface Drive.** The RPM Vs Power Curve of the offered surface drive must be lower than that of the engine so that the engine is never overloaded with the power demand of the surface drive propeller. Existing Power Vs Speed, RPM Vs Speed and Speed Vs Fuel Consumption Curves are given at **Section 8** of this tender document. The offered surface drive should match either to give equal or better performance than the existing stern drive system (**Section 8**).

16. **Spare Parts.**

a. Manufacturer's recommended lists of spare parts for the surface drives required to carry out routine maintenance for **three years** are to be included in the offer as **mandatory** items indicating item wise price.

b. Separate manufacturer's recommended lists of spare parts for **complete overhaul** of the surface drives are to be included in the offer as **optional** items indicating item wise price.

17. **Special Tools for each Drive.** A recommended list of special tools required for carrying out maintenance of the drives including extensive maintenance work, e.g. complete overhaul of the drives is to be quoted (as optional items for evaluation /assessment) with item wise price.

18. **Factory Acceptance Test (FAT) and Pre-Shipment Inspection (PSI).**

a. One Engineer Officer of Bangladesh Coast Guard (BCG) and one concerned Government Officer will witness the Factory Acceptance Test (FAT) and Pre-Shipment Inspection (PSI) of the surface drives. The officers will stay for 03 (three) working days to carryout FAT and 02 (two) working days to carryout PSI. The supplier will inform the buyer about the date and schedule of FAT and PSI at least 06 (six) weeks prior to the commencement of FAT and PSI. The supplier will also intimate the FAT criteria to the buyer before the commencement of FAT. FAT will be conducted fulfilling the requirement of the Classification Society mentioned at **paragraph 8** above.

b. Joint inspection reports for FAT and PSI will be prepared and signed by both the seller's and the buyer's representatives.

c. On return from the country of the supplier, the FAT and PSI team will submit a report to the Engineering Directorate of the Coast Guard Headquarters (CGHQ). On the basis of the report, CGHQ, within two weeks, will either render clearance to the supplier concerned for shipment of the stores, or ask for further clarification (if any). The supplier will not arrange shipment of any item mentioned in the contract without clearance from the CGHQ.

d. All costs related to FAT and PSI including airfare, accommodation and food for two Officers will be borne by the supplier. Local transportation (air/sea/road/rail) for these two officers within the manufacturer's/ supplier's country, reception and arrangement for entry into the country/ concerned area for FAT and PSI are also to be arranged by the supplier.

19. **Training.** Training on operation and maintenance of the supplied surface drives and associated equipment is to be imparted by the supplier's (principal's) experts/ engineers to 10 CG personnel in Bangladesh for **three** working days. Costs of airfare, accommodation and food for all such experts/ engineers are to be borne by the supplier.

20. **Installation and Installation Supervision.**

- a. The installation works of the drives and associated equipment will be carried out by the purchaser at a suitable shipyard/dockyard in Bangladesh under direct supervision of the supplier's technical expert(s) as per drawings and instructions provided by the supplier.
- b. Required numbers of installation expert(s) of the supplier are to be attached with BCG during the installation works. Numbers of experts with their probable duration of stay are to be specified. Costs of airfare, accommodation and food for all such experts are to be borne by the supplier.
- c. Installation expert team of the supplier should bring necessary special installation kits/items for the surface drive installation.

21. **Installation Drawings, Instructions and Technical Information.** The supplier will prepare and supply the installation drawings, instructions, and all relevant technical information to BCG before/ along with the arrival of the surface drives in Bangladesh.

22. **Manuals, Drawings and Document.** The following manuals and drawings in English, one (01) set for each drive and associated equipment as applicable are to be supplied at the time of delivery:

- a. Operation and maintenance manuals.
- b. Maintenance schedules (if not provided with the operation manual).
- c. Workshop level repair manual.
- d. **Parts Identification Lists (PIL).** The Parts Identification Lists (PIL)/ Parts Catalogues are to be provided with following information for easy identification and correct ordering of parts:
  - (1) Identification of the parts /equipment with labeling.
  - (2) Reference number.
  - (3) Description of the part.
  - (4) Part number.
  - (5) Drawing number.
  - (6) Quantity fitted per drive set with associated control and other equipment.
- e. Electrical and electronic circuit diagrams and fault finding flow charts for drive control panel.

23. **Brochure and Drawings to be Submitted with the Quotation.** Following original brochures/ drawings are to be submitted with the quotation for evaluation and assessment:

- a. One set brochure/booklets having details of the offered drive and associated equipment.
- b. One set of project implementation guide of the offered surface drives and associated equipment/fittings including the drive control system.
- c. One set of scaled assembly drawings (plan and elevation) of the surface drives and control system along with foundation layout.

24. **Tests, Trial and Commissioning.**

a. On completion of installation of the supplied surface drives and associated fittings onboard the boats, trials will be carried out by BCG in harbor and at sea during which the supplier's (principal's) representative(s) will be present. The surface drives will be tested at various operating conditions to ascertain their performance and achievement of the boats' speeds as mentioned at **paragraph 14.**

b. During speed trial the boats will have their new standard load displacement. 50% of POL and 70% of personnel will be considered as standard load for the trial. Wind force shall not exceed

3 Beaufort, the minimum water depth shall not be less than 6 meters and sea state will not be more than 3.

c. The supplier (principal) of the surface drives and associated equipment/ fittings will provide the services of required number of engineer(s) for the supervision of test, trial and commissioning for the duration of the harbor/sea trial. The supplier's (principal's) engineer(s) will be responsible to demonstrate and ensure that the tests, trials and commissioning of the surface drives and associated equipment/ fittings are satisfactory as per the contract requirements. The duration of his/their stay for test and trial is to be specified.

d. Cost of airfare, accommodation and food of the supplier's engineer(s) is to be borne by the supplier.

e. After satisfactory test, trial and commissioning, an 'Acceptance Certificate' will be signed between the buyer's and the supplier's representatives.

f. On receiving the 'Acceptance Certificate', CGHQ, within one week, shall either concur the same or ask the supplier and the Acceptance Team to clarify any matter within a week. However, such clarification will be asked sparingly only in very exceptional circumstances. Even after clarification, if the CGHQ is not convinced to concur, it must go for arbitration within next two weeks, or else, concur the 'Acceptance Certificate'.

25. **Speed Guarantee.**

a. The manufacturer/principal will have to give guarantee that the supplied surface drives, associated controls and equipment/ fittings will enable the boats to achieve the desired maximum speed (as mentioned in **paragraph 14** above), provided that the existing engines can attain their corresponding rpm. In case, the existing engines are unable to attain their maximum rpm due to ageing, the maximum speed of the boats should commensurate with the maximum attainable rpm of the engine along with matching speed as shown in the **Power Vs Speed and RPM Vs Speed Curves** at **Section 8** of this tender document.

b. In case the boat fails to achieve the maximum speed as stated in the contract specification (as per the requirement of **paragraph 14 and 25.a** above), then penalties will be imposed on the supplier for non-compliance of the contract as per the following table:

<b>S No</b>	<b>Deficiency in Speed less than that of mentioned in the contract specification</b>	<b>Penalty in % of total contract value</b>
(1)	0.10 to 0.49 knots	1
(2)	0.50 to 0.99 knots	2
(3)	1.00 to 1.49 knots	4
(4)	1.50 to 1.99 knots	6
(5)	2.00 to 2.49 knots	8
(6)	2.50 to 3.00 knots	10

If the difference between the achieved maximum speed in the trial and maximum speed mentioned in the contract (corresponding to paragraph 14 and 25.a) is more than 3 knots, it will be considered that the contract has not been fulfilled. In the final trial for acceptance the difference between the achieved maximum speed in the trial and maximum speed mentioned in the contract will be allowed beyond 3 knots, as an alternative option, solely on the consideration of the buyer, but up to 3.49 knots only and that too with the deduction of 20% of the contract money and forfeiture of PG.

26. **Performance Guarantee.** The supplier is to provide bank guarantee of 10% of the total contract price for satisfactory performance of the supplied surface drives and associated equipment and fittings including achievement of desired boats' speed within two weeks of signing the contract.

27. **Warranty.** The manufacturer/ principal is to give Warranty for repair/replacement in Bangladesh at supplier's cost of all the supplied items for a minimum period of 12 months from the date of acceptance by the purchaser. The manufacturer/principal shall undertake the full responsibility to rectify/ replace, free of charges, any defect in the supplied surface drives and associated equipment and fittings, which are due to defective material, construction, miscalculation and/or improper workmanship on the part of the manufacturer/principal or to replace any such defective items, provided that the defects shall appear/ be discovered during the period of **12 (Twelve) months** after satisfactory acceptance of the supplied machinery by BCG. Warranty repair / replacement shall be accomplished within **04 (Four) weeks** of notification of the relevant defect. The warranty will be extended by non operational period of the equipment. For warranty repair/ replacement, the supplier will collect the defective item from CGHQ/East Zone/West Zone/Dhaka Sub-Zone (as applicable) and re-supply the same to the collecting place after warranty repair or for replacement.

28. **Guarantee for Spares.** The manufacturer will guarantee to supply the spares for at least 10 years at reasonable price.

29. **Shipment.**

a. The supplier will arrange transportation of the surface drives and associated equipment and fittings by sea/air to Chittagong port/ Dhaka airport, Bangladesh.

b. All items are to be delivered in sea worthy/ air worthy packing/ container to ensure safe transportation by sea/ air.

c. All packages are to have packing notes showing their contents in detail and all packages shall be marked with the name and address of the consignee and gross weight.

30. **Port of Shipment.** To be specified.

31. **Delivery.**

a. All items are to be delivered within 20 weeks from the date of opening of the L/C after signing the contract to the following consignee:

Director General, Bangladesh Coast Guard  
Attention: Director Engineering  
Coast Guard Headquarters  
Agargaon Admin Area  
Sher-E-Bangla Nogor, Dhaka-1207

b. Place of delivery : The supplier will arrange transportation of all supplied items from Chittagong port/Dhaka airport to CGHQ, Agargaon Admin Area, Sher-E-Bangla Nagor, Dhaka-1207 at the cost and risk of the supplier, where initial inspection will be done by CI & QC; then the supplier will arrange transportation of all supplied items to the sites of installation at the cost and risk of the supplier. The installation sites are as follows:

(1) 1 x port and 1x stbd surface drive and associated equipment and fittings at Dockyard & Engineering Works (DEW) Ltd, Narayanganj, Bangladesh.

(2) 1 x port and 1x stbd surface drive and associated equipment and fittings at Khulna Shipyard (KSY) Ltd, Khulna, Bangladesh.

(3) 2 x port and 2x stbd surface drive and associated equipment and fittings at Bangladesh Navy (BN) Dockyard, Chittagong/NSD Chittagong/ NSSD Dhaka (as applicable).

The number of drives and corresponding installation sites may vary in exceptional cases.

32. **Certificate.** The manufacturer will give a certificate, which will form a part of the contract that all the mechanical, electrical and electronic components of the drive and its associated systems are of current production range. The manufacturer will also provide a certificate that the drive and all major components



are manufactured as per the requirement of the Classification Society's Rules and Classification Society certificate in this regard is to be provided.

33. **Terms of Payment.** L/C for full purchase amount will be opened in favor of the principal supplier with the following terms of payment:

- a. Initial 80% of the L/C amount will be paid after shipment of all items and on production of necessary shipping documents.
- b. Remaining 20% of the L/C amount will be paid on producing 'Acceptance Certificate' duly concurred by CGHQ following successful test and trial jointly carried out by the buyer's and the supplier's representatives.

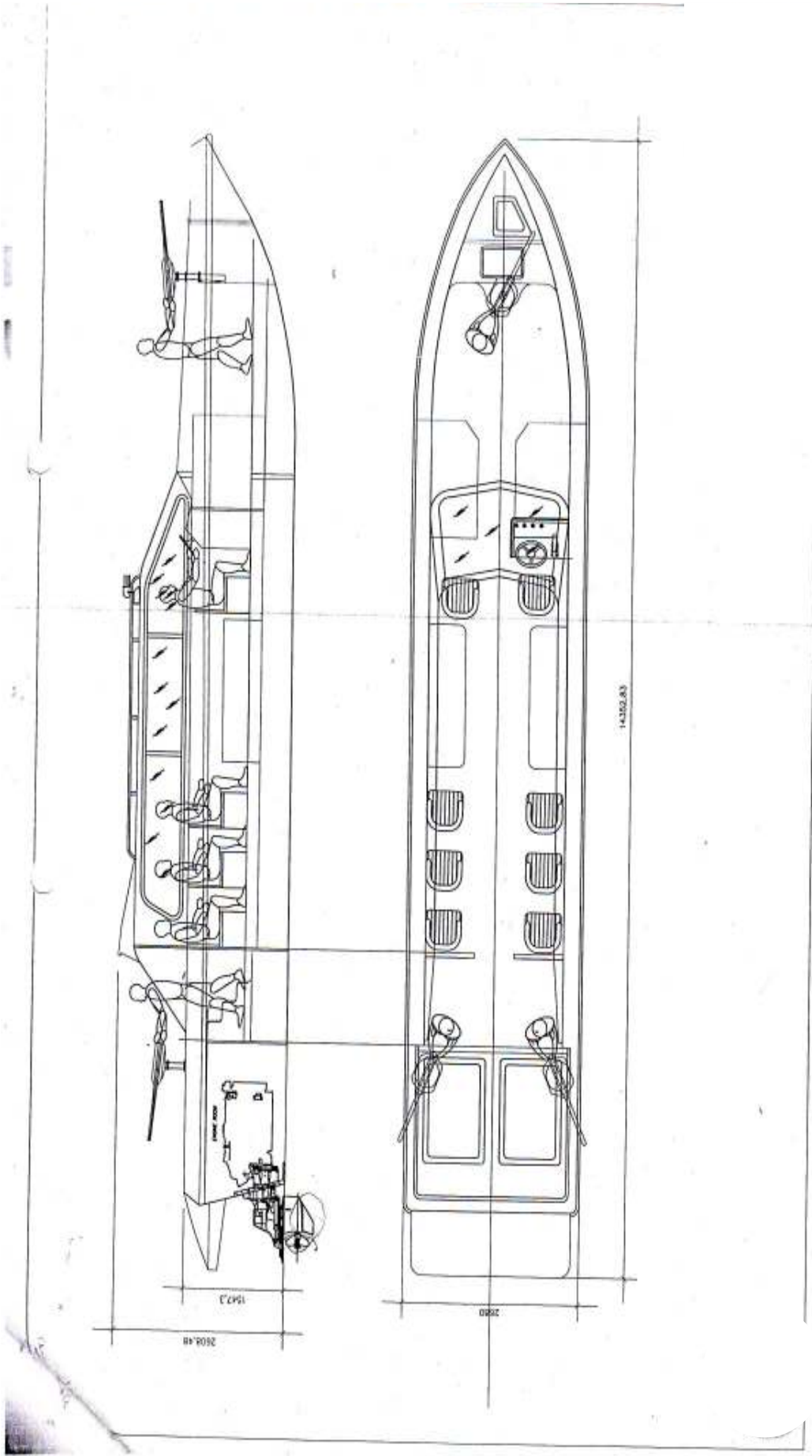
35. **Conditions for Acceptance.** If detailed information regarding specifications of the drive and associated equipment(if any) as mentioned above are not given in the offer against each topic/ paragraph, the buyer will have the right to reject the offer in part or complete without giving any justification to the bidder.

36. **Compliance Statement.** A compliance statement fulfilling all the requirement of the tender is to be submitted for evaluation of the quotations. Stating mere 'Yes' or 'No' will not suffice. Detailed description/information as required is to be given. An incomplete compliance statement may attribute to cancellation of the offer. If any clause of this specification does not commensurate with offered equipment/machinery practically, the deviation has to be spelt out clearly.

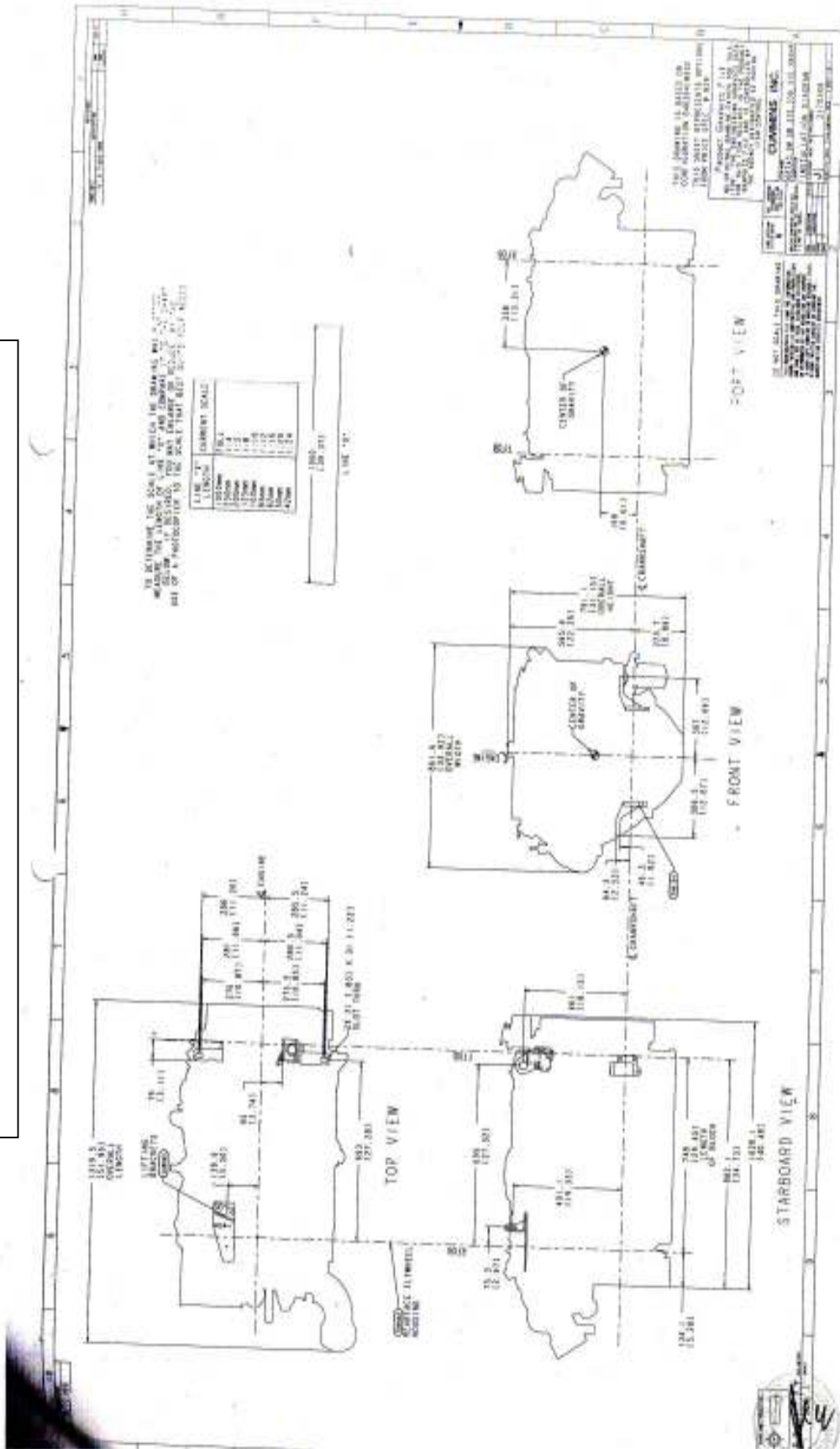
## **Section 8. Drawings**

1.	GA Drawing of Tornado (14.8 m) Boat	- 01 (One) Page.
2.	Engine & Stern Drive Installation Drawings	- 08 (Eight) Pages.
3.	Lines Plan	- 01 (One) Page.
4.	Power Vs Speed, RPM Vs Speed and Speed Vs Fuel Consumption Curve	- 01 (One) Page.
5.	Cummins Mercruiser Diesel (Marine Performance Curves)	- 01 (One) Page.

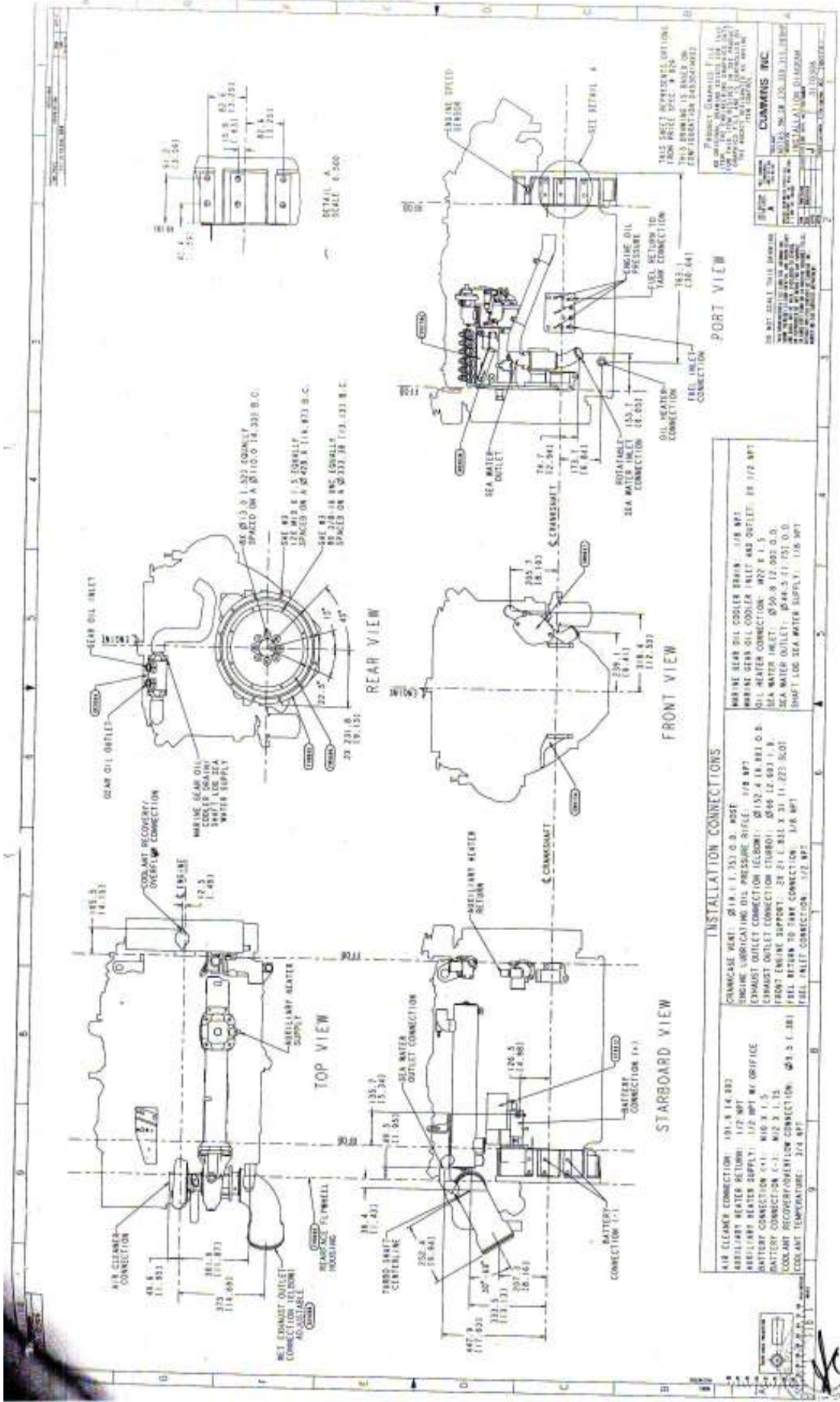
# GENERAL ARRANGEMENT



# ENGINE AND STERN DRIVE INSTALLATION DIAGRAM

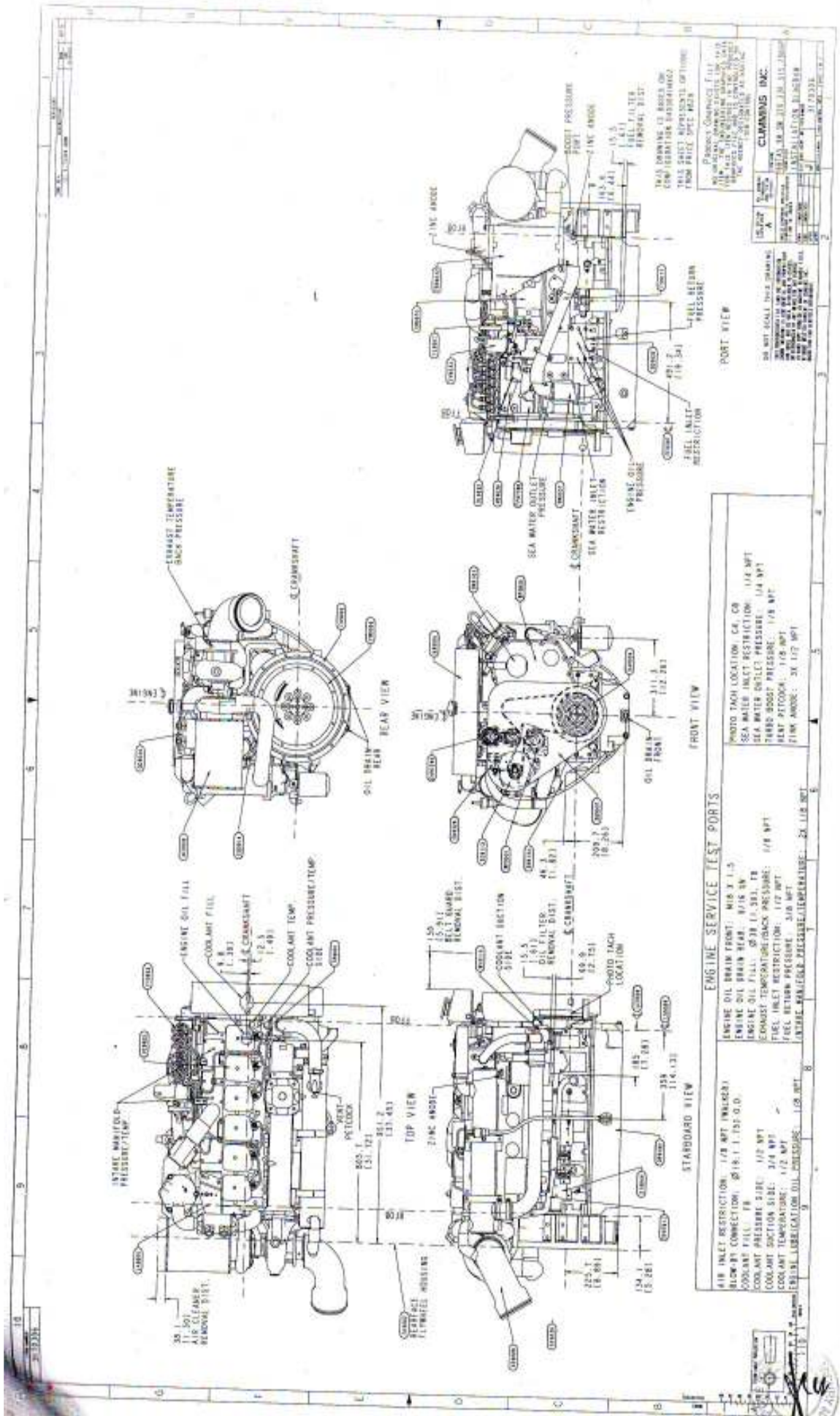


# ENGINE AND STERN DRIVE INSTALLATION DIAGRAM

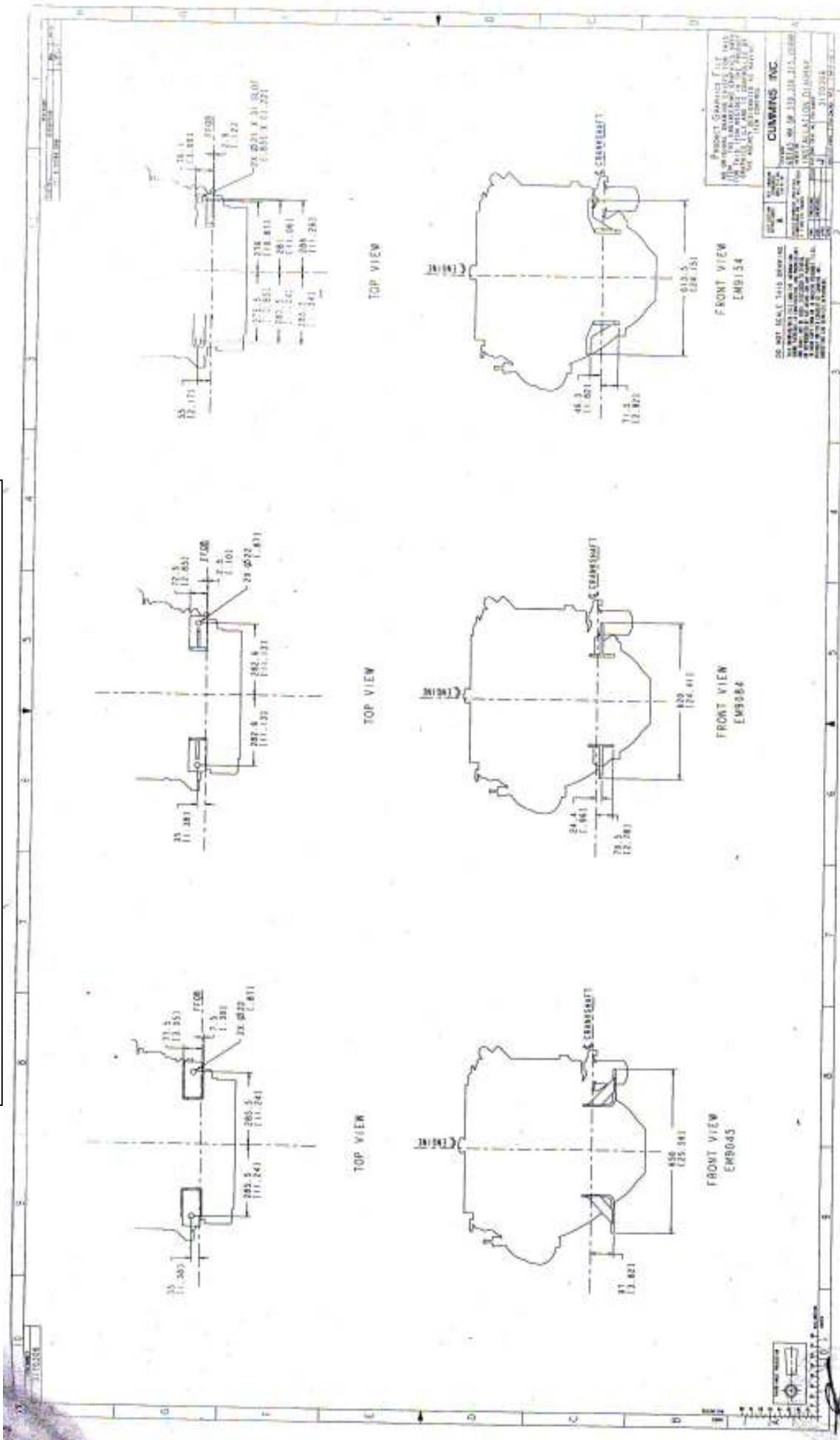




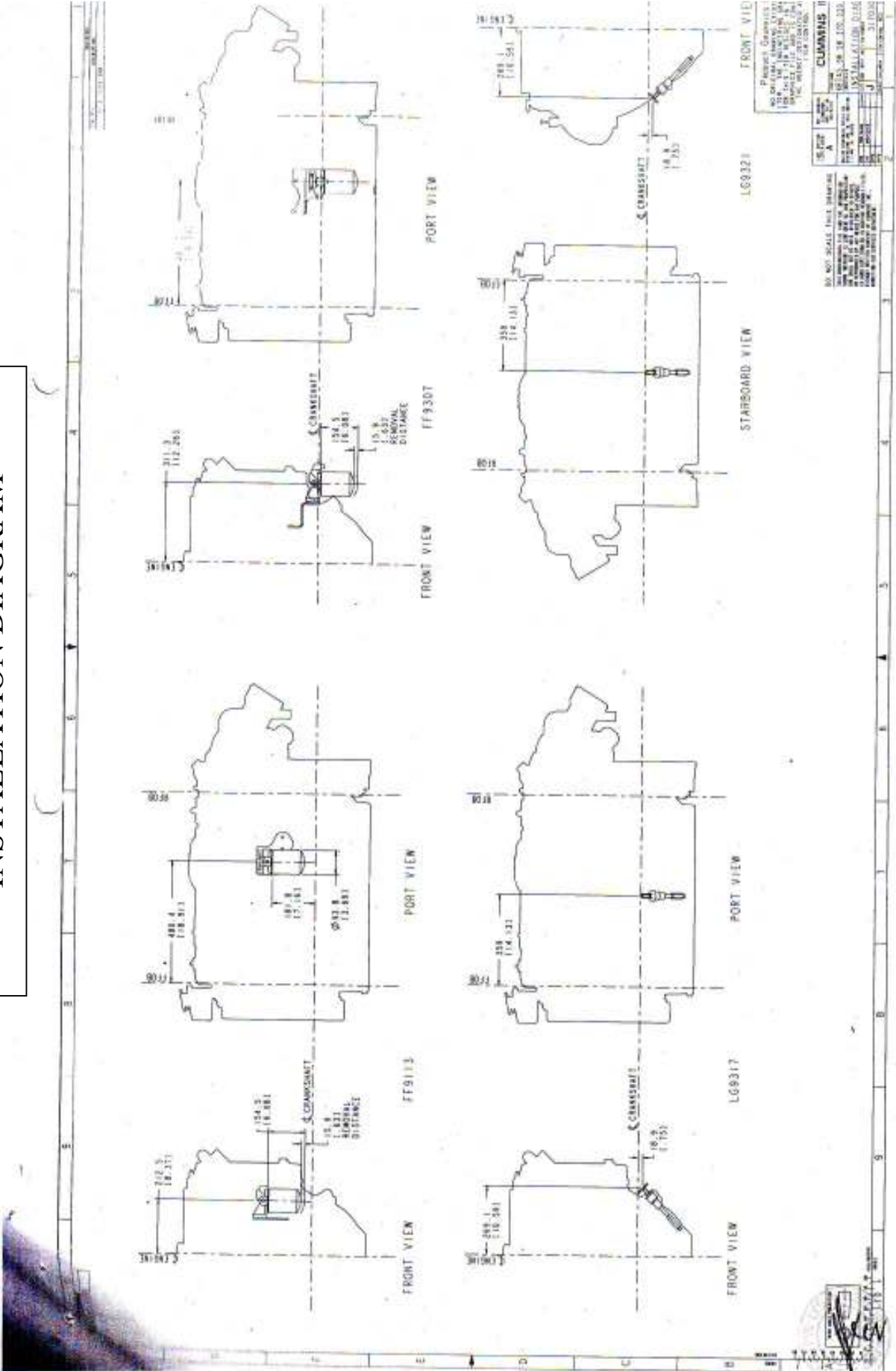
# ENGINE AND STERN DRIVE INSTALLATION DIAGRAM



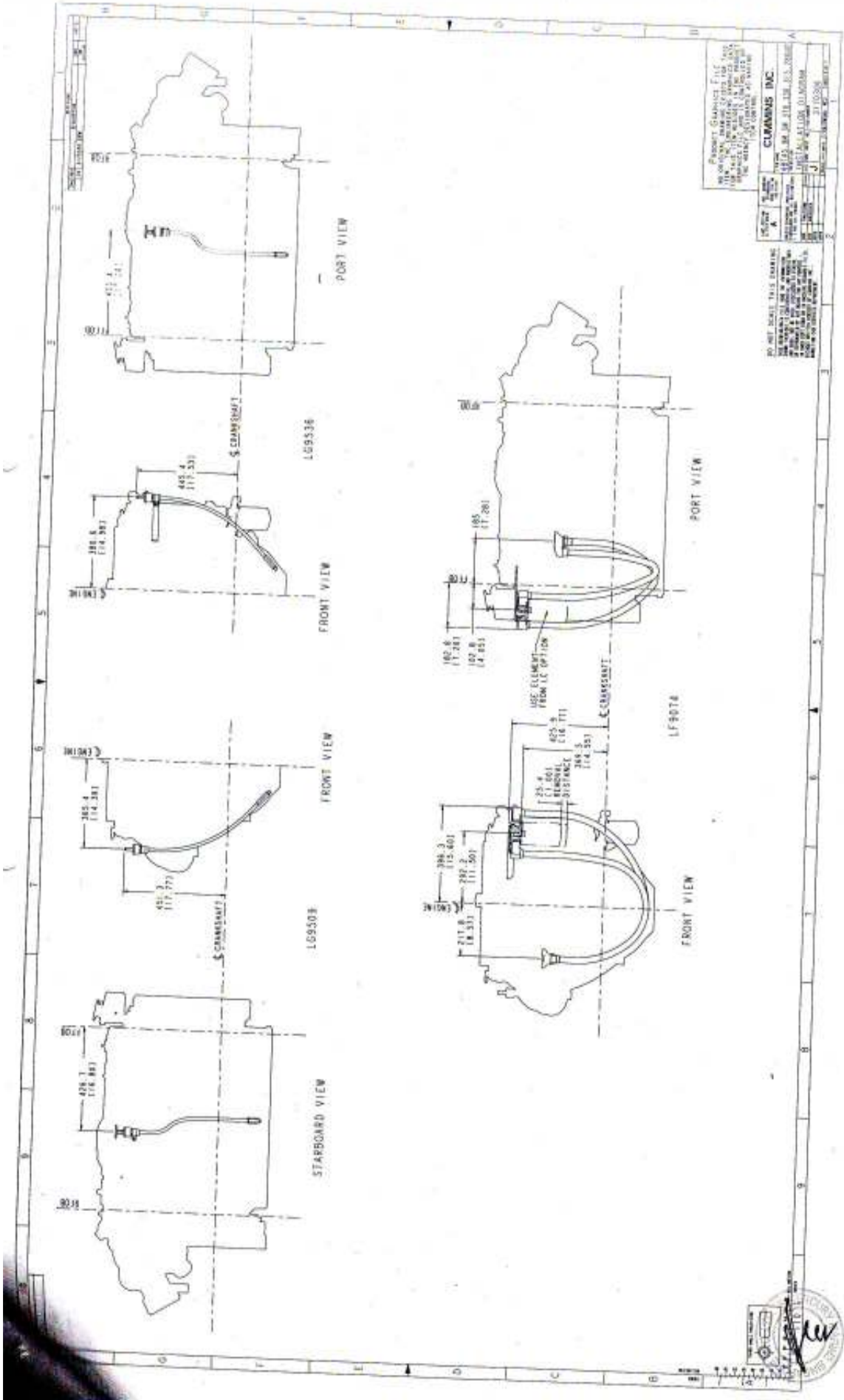
# ENGINE AND STERN DRIVE INSTALLATION DIAGRAM



# ENGINE AND STERN DRIVE INSTALLATION DIAGRAM







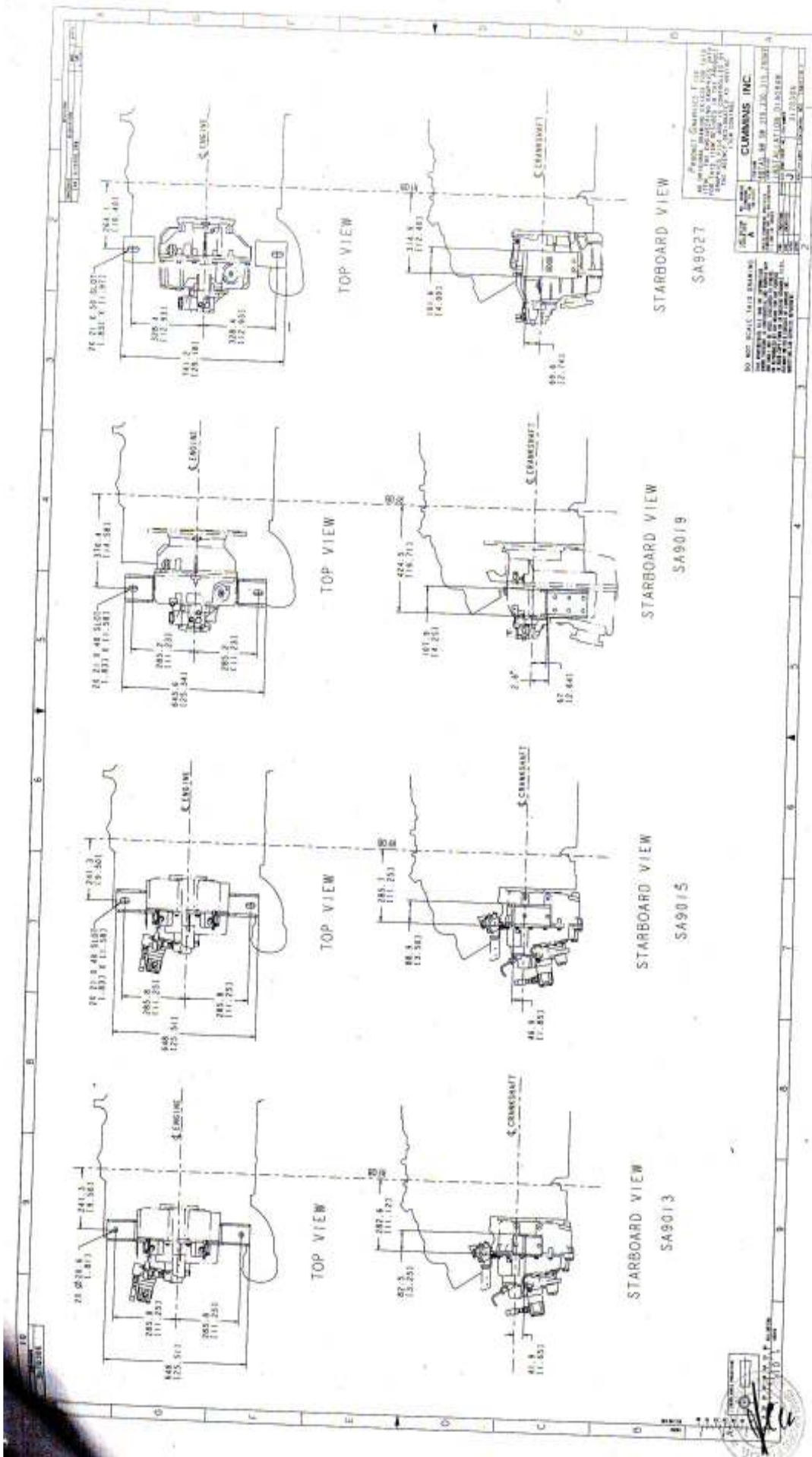
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# ENGINE AND STERN DRIVE INSTALLATION DIAGRAM



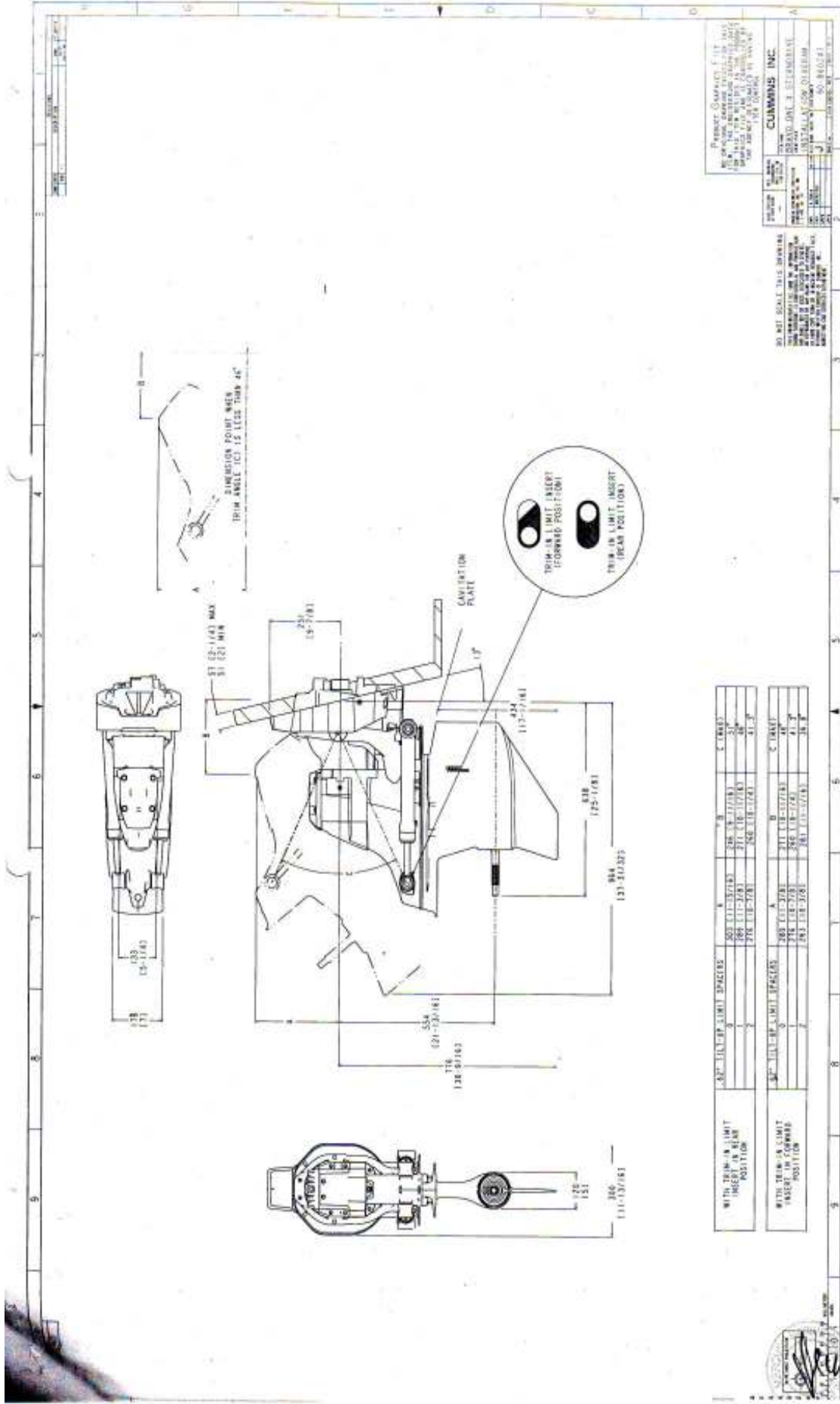
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DATE: 01/15/03  
BY: J. P. B. / J. P. B.  
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# ENGINE AND STERN DRIVE INSTALLATION DIAGRAM



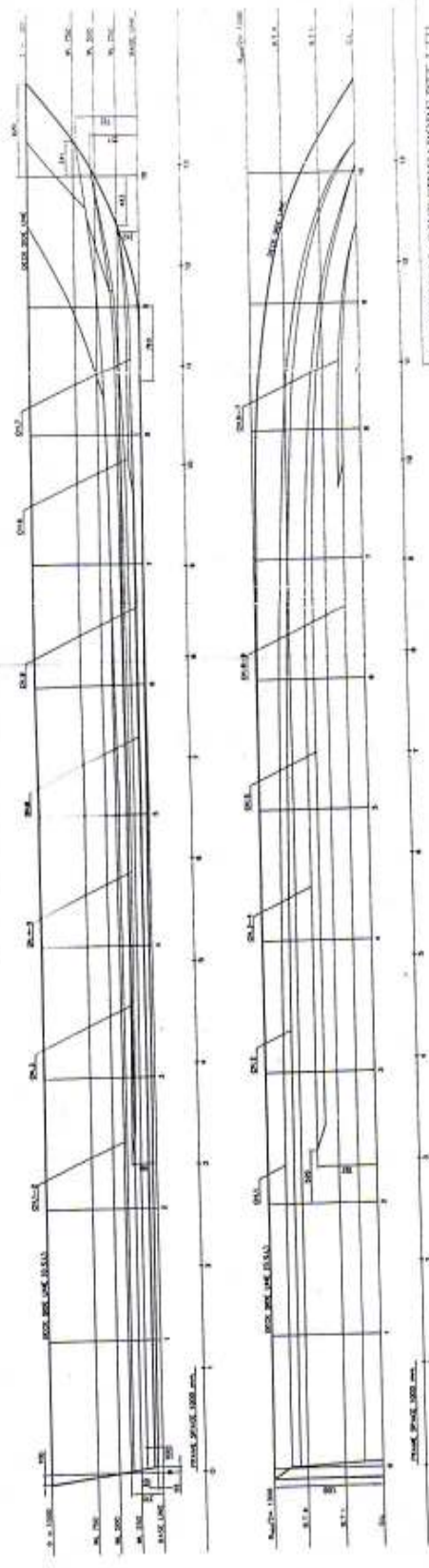
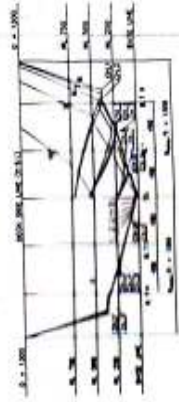
# LINES PLANE

OFFSET TABLE

STATION	OFFSET OF BOUNDARY		BOUNDARY LINE											
	1	2	1	2	3	4	5	6	7	8	9	10	11	12
1	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
2	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
3	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
4	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
5	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
6	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
7	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
8	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
9	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
10	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
11	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
12	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000

PRINCIPAL PARTICULARS

SCALE	1:1000
DATE	10/10/2000
PROJECT	Mercury Terminal
CLIENT	Mercury Terminal
DESIGNER	Mercury Terminal
CHECKER	Mercury Terminal
APPROVER	Mercury Terminal
DATE OF ISSUE	10/10/2000
SCALE OF BOUNDARY	1:1000



MERCURY MARINE SINGAPORE PTE LTD  
29, Loyang Drive, Singapore - 508 944

Project	Mercury Terminal
Client	Mercury Terminal
Title	Lines plan

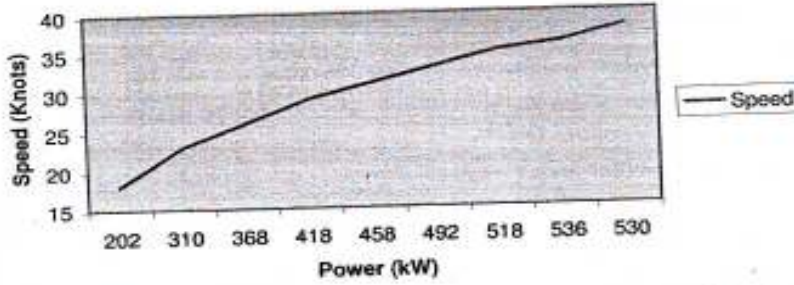
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# RPM VS SPEED CURVE

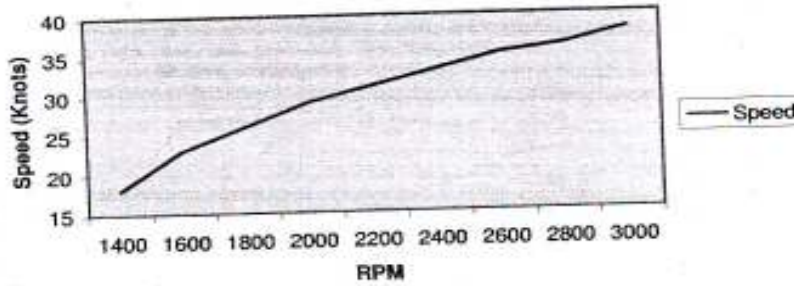
## Tornado 14.8m with Twin 6BTA 370 HO

Power VS Speed Curve



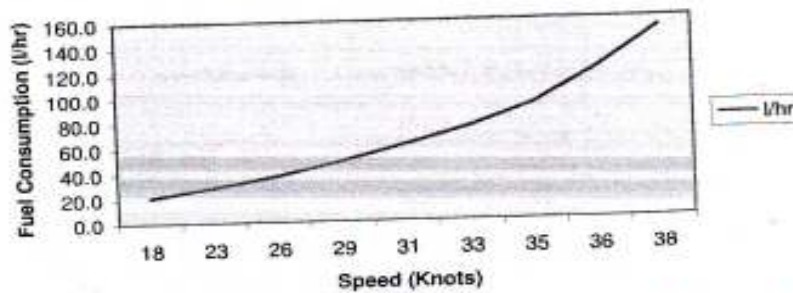
Speed	kW
18	202
23	310
26	368
29	418
31	458
33	492
35	518
36	536
38	530

RPM VS Speed Curve



rpm	Speed
1400	18
1600	23
1800	26
2000	29
2200	31
2400	33
2600	35
2800	36
3000	38

Speed VS Fuel Consumption Curve



Speed	l/hr
18	20.6
23	28.2
26	36.8
29	47.6
31	60.6
33	74.0
35	92.2
36	119.2
38	152.2

# RPM VS SPEED CURVE



**CUMMINS MERCUISER DIESEL**  
 Charleston, SC 29405  
**Marine Performance Curve**

Basic Engine Model:  
**6BTA5.9-M**

Curve Number:  
**M-91260**

Marine  
 Pg. No.  
**6B  
 271**

Engine Configuration:  
**D403041MX02**

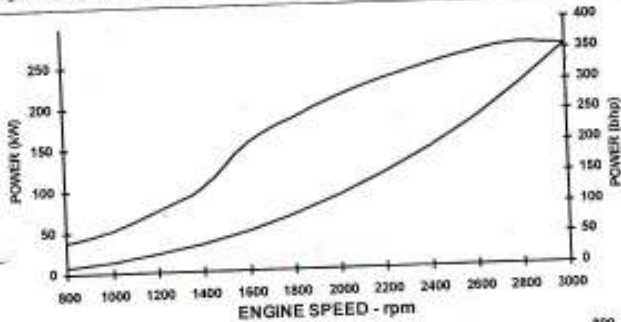
CPL Code:  
**8457**

Date:  
**22Sep05**

Displacement: **5.9 liter [359 in<sup>3</sup>]**  
 Bore: **102 mm [4.02 in]**  
 Stroke: **120 mm [4.72 in]**  
 Fuel System: **Bosch P7100**  
 Cylinders: **6**

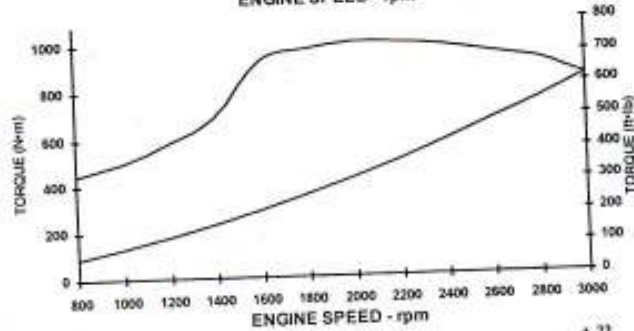
Advertised Power: **kW [bhp, mhp] @ rpm  
 265 [355, 370] @ 3000**  
 Aspiration: **Turbocharged/Aftercooled**  
 Rating Type: **High Output**

CERTIFIED: This marine diesel engine conforms with the NOx requirements of the International Maritime Organization (IMO), MARPOL 73/78 Annex VI, Regulation 13 as applicable.



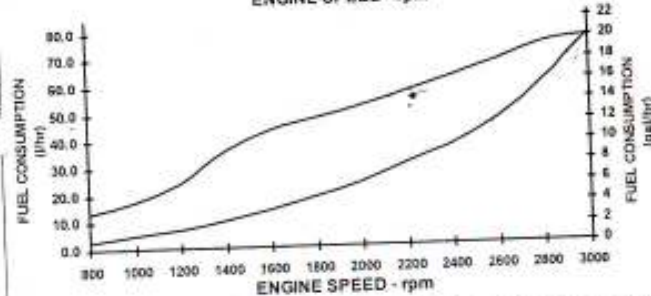
**RATED POWER OUTPUT CURVE**

rpm	kW	bhp
3000	265	355
2800	268	359
2600	259	347
2400	246	330
2200	229	307
2000	209	281
1800	184	246
1600	155	208
1400	101	135
1200	73	98
1000	52	69
800	37	50



**FULL LOAD TORQUE CURVE**

rpm	N·m	ft·lb
3000	842	621
2800	914	674
2600	949	700
2400	979	722
2200	993	732
2000	999	737
1800	975	719
1600	925	682
1400	686	506
1200	582	429
1000	495	365
800	445	328



**FUEL CONSUMPTION - PROP CURVE**

rpm	l/hr	gal/hr
3000	76.1	20.1
2800	59.6	15.7
2600	46.1	12.2
2400	37.0	9.8
2200	30.3	8.0
2000	23.8	6.3
1800	18.4	4.9
1600	14.1	3.7
1400	10.3	2.7
1200	7.0	1.9
1000	4.9	1.3
800	3.0	0.8

Rating Conditions: Ratings are based upon ISO 8865 and SAE J1228 reference conditions: air pressure of 101 kPa (29.512 in Hg), air temperature 25°C (77°F), and 30% humidity. Power is rated in accordance with IMCI procedures, Member NMMA.

Rated Curves (upper) represent rated power at the crankshaft for mature gross engine performance capabilities obtained and corrected in accordance with ISO 3046. Prop Curve (lower) is based on a typical fixed propeller demand curve using a 2.7 exponent. Propeller Shaft Power is approximately 3% less than rated crankshaft power after 1 reversal/reduction gear losses and may vary depending on the type of gear or propulsion system used.

Fuel Consumption is based on fuel of 35° API gravity at 15°C (60°F) having LHV of 42,780 kJ/kg (19390 Btu/lb) and weighing 838.9 g/liter (7.001 lb/U.S. gal).

High Output Rating: This Rating is for use in variable load applications where full power is limited to one (1) hour out of every eight (8) hours of operation. Also, reduced operations must be 4% or below 200 RPM of the maximum rated RPM. This rating is for closure/non-revenue generating applications that operate 300 hours per year.

\_\_\_\_\_  
 CHIEF ENGINEER

*[Handwritten signature]*