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| 图纸 分发 | | | |
|-------------------------------------|------------------------------|-----|----|
| 分发处 | | 分发数 | |
| 汉字 | ENGLISH | FW | FC |
| 综合设计 | Integated Design Division | | |
| 船体构造设计 | Hull Structure Team | | |
| 船体生产设计 | Hull Production Team | | |
| 船装设计 | Hull Outfitting Design | | |
| 船室设计 | Accommodation Design | | |
| 机装详细设计 | Machinery Detail Design | | |
| 机装生产设计 | Machinery Production Design | | |
| 电装设计 | Electrical Design | | |
| 先行舾装 | Preoutfitting Division | | 2 |
| E/R 舾装 | E/R Outfitting | | 2 |
| 船室生产 | Accommodation Production | | |
| 试航部 | Trial Cruise Division | | 1 |
| 采购管理 2 | Procurement Team 2 | | |
| 品质经营 | Quality Assurance | | 2 |
| 塔载管理 | Erection Team | | |
| 精度管理 | Technical Specification Team | | |
| 品质物流(镇海) | Logistics Team (Jinhae) | | |
| 轴舵设计(保管) | Shaft & Rudder Design | 1 | 1 |
| 合计 (Total) | | 1 | 8 |
| <input type="checkbox"/> | For Working | | |
| <input checked="" type="checkbox"/> | For Construction | | |
| <input type="checkbox"/> | For Revision | | |

| | | | |
|---|---|------------------------------|----------------------|
| HULL NO. 1009~1012, 1031~1032 | PROJECT TPC KOREA 33,5K DWT LOG / BULK CARRIER | | |
| APPD BY M. Y. Park | TITLE CALCULATION OF SHAFTING ALIGNMENT | | |
| CHKD BY J. S. Lee | | | |
| DWN BY J. H. Park (Ext. : 0226) | TEL +86) 0631-538-0204 | TOTAL 64 SHEET(S) WITH COVER | |
| Samjin Shipbuilding Industries Co., Ltd. | DEPT RUDDER & SHAFT DESIGN TEAM | DWG NO. RT300M711 | SCALE NONE |
| | | DATE DEC. 04. 2008 | REV. NO. 0 |



Sanjin Shipbuilding
Industries Co., Ltd.

PLAN HISTORY

HULL NO.

1009~1012
1031~1032

2

DWG. NO.

RT300M711

62

DATE

REV.
NO.

DESCRIPTION

DWG

CHKD

APPD

DEC.05,2008

SUBMITTED TO CLASS AND OWNER FOR APPROVAL.

J.H PARK

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ISSUED FOR WORKING.

J.H PARK

✓

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DEC.17,2008

APPROVED BY OWNER WITHOUT COMMENTS.

J.H PARK

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JAN.04,2009

A

APPROVED BY CLASS WITHOUT COMMENTS.

J.H PARK

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JAN.09,2009

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ISSUED FOR CONSTRUCTION.

J.H PARK

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| PLAN HISTORY | | | | | |
|--|---------------------------|--|--|---------------------------|------------|
| REV. | DATE | DESCRIPTION | DRAWN | CHECKED | APPROVED |
| 0 | 2008. 12. 01. | ISSUED & SUBMITTED TO YARD | C. W. Kim | S. P. See | J. G. Park |
| | | | | | |
| NO. OF PAGES (INCL. COVER) : 15 | | | | | |
| YARD | SAMJIN | | HULL NO. | H1009/ 10/ 11/ 12/ 31/ 32 | |
| VESSEL TYPE | 33,500 DWT BULK CARRIER | | CLASS | KR | |
| PLANT | 5S50MC-C7 MAIN PROPULSION | | | | |
| APPRD : J. G. Park | | TITLE : CALCULATION OF SHAFT ALIGNMENT | | | |
| CHKED : S. P. See | | | | | |
| DRAWN : C. W. Kim | | | | | |
| DATE : 2008. 12. 01. | | | | | |
| STX Engine Co., Ltd. 80, Seongsan-dong, Changwon Gyeongsangnam-do, Korea, 641-315 Tel: +82-55-280-2615 Fax: +82-55-280-0250 | | | DOCUMENT NO. SA-0846-LB395 | | |

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| | | REV. | 0 |
| | | DOCU. NO. | SA-0846-LB395 |

1. Introduction

This report contains the results of shaft alignment calculation for the following direct coupled propulsion plant.

- Ship Yard : SAMJIN WEIHAI SHIPYARD
- Hull No. : H1009/ 1010/ 1011/ 1012/ 1031/ 1032
- Kind of Vessel : 33,500 DWT BULK CARRIER
- Engine : 5S50MC-C7 , 7900 kW x 127 rpm

The alignment calculation for the shafting system has been carried out by using the DNV's NAUTICUS SHAFT ALIGNMENT Program.

The shaft alignment procedure should be carried out and submitted according to the shipyards standard method reflecting this calculation results.

The verification of the results of shaft alignment calculation should be carried out according to the shipyards standard methods.(Gap & Sag , Jacking , etc.)

The purpose of this shaft alignment calculation is to find a set of vertical offsets for the intermediate shaft bearing and the engine bearings to ensure that the bearing loads are kept within limits for all bearings.

This report is carried out with reference to relevant drawings received from shipbuilding company.

2. Particulars of Plant (See APPENDIX A)

1) Main engine

- Crankshaft model of the engine : 0794923-8
- Static thrust shaft load : 0794923-8

2) Shafting & propeller

- Propeller particulars
- Propeller cap : 08-P-19-05
- Propeller Hyd. nut : 08-S-19-01
- Shafting plan : DA500M104
- Intermediate shaft bearing : LS1-C043-0447

3) Temporary support & modeling

| | | | |
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3. Definitions and Assumptions

3.1 Reference point

The aft end of the propeller shaft is taken as a reference point.

3.2 Reference line

A horizontal straight line through the center of aft stern tube bearing is taken as reference line.

3.3 Bearing support point type & position

In static condition bearings are defined as single support points, located 1/3 of the shaft diameter from the aft end for aft stern tube bearing and the mid point for all other bearings.

3.4 Bearing stiffness & clearance

Bearings are considered to be infinitely stiff and diametrical clearance is not used when the static shaft alignment calculation is performed as the standard algorithm is assuming a linear behaviour of the shaft beam.

3.5 Load reference direction

- Deflections & offsets are positive when above the reference line.
- External forces directed "downwards" are positive.
- Reactions directed "upwards" are positive.
- Bending moments are positive if the turn is clockwise at the forward end.

3.6 Thermal expansion of engine

The thermal expansion of the engine structure - i.e. from the engine seating to the centre of the main bearings - is 0.24mm, when the engine temperature is raised from cold (20°C) to normal running temperature (55°C).

3.7 Jack load

The jack load is used for verification of the actual load of adjacent bearing.

The shafting is lifted by a jack in the vicinity of a bearing. When the bearing is relieved, the load of the jack should be similar to the calculated jack load.

The jack load test must be carried out with the whole shaft line coupled.

3.8 Temporary supports

Temporary supports must be used in the open shaft condition whenever a shaft section has only one bearing.

The position of the temporary support is to be confirmed by shipbuilding company.

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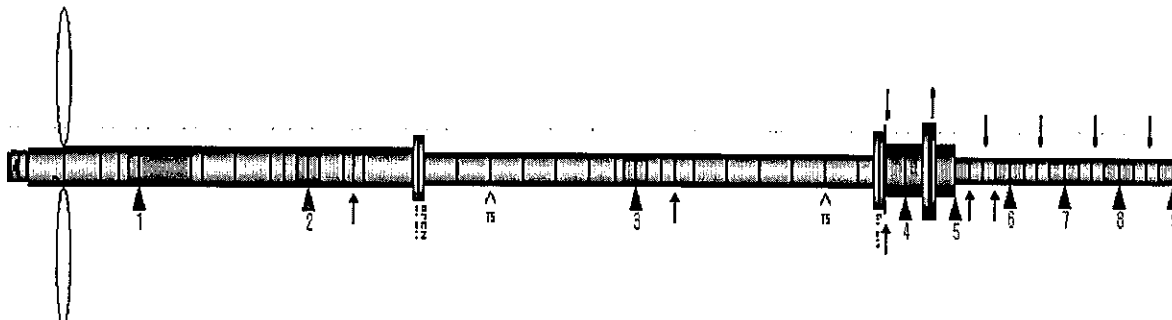
4. Modeling and Input Data (See APPENDIX B)

4.1 Geometry of shafting

| ELEMENT | | DISTANCE (m) | LENGTH (m) | DIAMETER (m) | | IN - DIA. (m) | MATERIAL TYPE |
|---------|------|--------------|------------|--------------|-------|---------------|---------------|
| NO. | TYPE | | | LEFT | RIGHT | | |
| 1 | | 0.050 | 0.050 | 0.335 | 0.335 | 0.000 | 2 |
| 2 | | 0.170 | 0.120 | 0.355 | 0.355 | 0.000 | 2 |
| 3 | | 0.290 | 0.120 | 0.355 | 0.355 | 0.000 | 2 |
| 4 | | 0.310 | 0.020 | 0.340 | 0.340 | 0.000 | 2 |
| 5 | | 0.870 | 0.560 | 0.404 | 0.432 | 0.000 | 2 |
| 6 | | 1.430 | 0.560 | 0.432 | 0.460 | 0.000 | 2 |
| 7 | | 1.700 | 0.270 | 0.460 | 0.460 | 0.000 | 3 |
| 8 | | 1.850 | 0.150 | 0.460 | 0.460 | 0.000 | 3 |
| 9 | BRG | 2.003 | 0.153 | 0.460 | 0.460 | 0.000 | 3 |
| 10 | | 2.800 | 0.797 | 0.460 | 0.460 | 0.000 | 3 |
| 11 | | 2.975 | 0.175 | 0.460 | 0.460 | 0.000 | 3 |
| 12 | | 3.475 | 0.500 | 0.460 | 0.460 | 0.000 | 3 |
| 13 | | 4.005 | 0.530 | 0.460 | 0.460 | 0.000 | 3 |
| 14 | | 4.205 | 0.200 | 0.460 | 0.460 | 0.000 | 3 |
| 15 | | 4.400 | 0.195 | 0.460 | 0.460 | 0.000 | 3 |
| 16 | BRG | 4.575 | 0.175 | 0.460 | 0.460 | 0.000 | 3 |
| 17 | | 4.750 | 0.175 | 0.460 | 0.460 | 0.000 | 3 |
| 18 | | 5.105 | 0.355 | 0.460 | 0.460 | 0.000 | 3 |
| 19 | | 5.255 | 0.150 | 0.460 | 0.460 | 0.000 | 1 |
| 20 | | 5.405 | 0.150 | 0.460 | 0.460 | 0.000 | 1 |
| 21 | | 6.145 | 0.740 | 0.460 | 0.400 | 0.000 | 1 |
| 22 | | 6.225 | 0.080 | 0.740 | 0.740 | 0.000 | 1 |
| 23 | | 6.305 | 0.080 | 0.740 | 0.740 | 0.000 | 1 |
| 24 | | 6.805 | 0.500 | 0.390 | 0.390 | 0.000 | 1 |
| 25 | | 7.305 | 0.500 | 0.390 | 0.390 | 0.000 | 1 |
| 26 | | 7.805 | 0.500 | 0.390 | 0.390 | 0.000 | 1 |
| 27 | | 8.305 | 0.500 | 0.390 | 0.390 | 0.000 | 1 |
| 28 | | 8.805 | 0.500 | 0.390 | 0.390 | 0.000 | 1 |
| 29 | | 9.200 | 0.395 | 0.390 | 0.390 | 0.000 | 1 |
| 30 | | 9.330 | 0.130 | 0.395 | 0.395 | 0.000 | 1 |
| 31 | BRG | 9.500 | 0.170 | 0.395 | 0.395 | 0.000 | 1 |
| 32 | | 9.670 | 0.170 | 0.395 | 0.395 | 0.000 | 1 |
| 33 | | 9.900 | 0.230 | 0.395 | 0.395 | 0.000 | 1 |
| 34 | | 10.100 | 0.200 | 0.390 | 0.390 | 0.000 | 1 |
| 35 | | 10.400 | 0.300 | 0.390 | 0.390 | 0.000 | 1 |
| 36 | | 10.900 | 0.500 | 0.390 | 0.390 | 0.000 | 1 |
| 37 | | 11.400 | 0.500 | 0.390 | 0.390 | 0.000 | 1 |
| 38 | | 11.900 | 0.500 | 0.390 | 0.390 | 0.000 | 1 |
| 39 | | 12.400 | 0.500 | 0.390 | 0.390 | 0.000 | 1 |
| 40 | | 12.900 | 0.500 | 0.390 | 0.390 | 0.000 | 1 |
| 41 | | 13.145 | 0.245 | 0.390 | 0.390 | 0.000 | 1 |
| 42 | | 13.225 | 0.080 | 0.900 | 0.900 | 0.000 | 1 |
| 43 | | 13.290 | 0.065 | 0.900 | 0.900 | 0.085 | 1 |
| 44 | | 13.332 | 0.042 | 1.060 | 1.060 | 0.085 | 1 |
| 45 | BRG | 13.619 | 0.287 | 0.600 | 0.600 | 0.085 | 1 |
| 46 | | 13.873 | 0.254 | 0.600 | 0.600 | 0.085 | 1 |
| 47 | | 13.979 | 0.106 | 1.100 | 1.100 | 0.085 | 1 |
| 48 | | 14.011 | 0.032 | 1.100 | 1.100 | 0.085 | 1 |
| 49 | | 14.085 | 0.074 | 1.100 | 1.100 | 0.085 | 1 |
| 50 | BRG | 14.374 | 0.289 | 0.600 | 0.600 | 0.085 | 1 |
| 51 | | 14.601 | 0.227 | 0.324 | 0.324 | 0.000 | 4 |
| 52 | | 14.799 | 0.198 | 0.324 | 0.324 | 0.000 | 4 |
| 53 | | 14.997 | 0.198 | 0.324 | 0.324 | 0.000 | 4 |
| 54 | BRG | 15.224 | 0.227 | 0.324 | 0.324 | 0.000 | 4 |
| 55 | | 15.451 | 0.227 | 0.324 | 0.324 | 0.000 | 4 |
| 56 | | 15.649 | 0.198 | 0.324 | 0.324 | 0.000 | 4 |
| 57 | | 15.847 | 0.198 | 0.324 | 0.324 | 0.000 | 4 |
| 58 | BRG | 16.074 | 0.227 | 0.324 | 0.324 | 0.000 | 4 |
| 59 | | 16.301 | 0.227 | 0.324 | 0.324 | 0.000 | 4 |
| 60 | | 16.499 | 0.198 | 0.324 | 0.324 | 0.000 | 4 |
| 61 | | 16.697 | 0.198 | 0.324 | 0.324 | 0.000 | 4 |
| 62 | BRG | 16.924 | 0.227 | 0.324 | 0.324 | 0.000 | 4 |
| 63 | | 17.151 | 0.227 | 0.324 | 0.324 | 0.000 | 4 |
| 64 | | 17.349 | 0.198 | 0.324 | 0.324 | 0.000 | 4 |
| 65 | | 17.547 | 0.198 | 0.324 | 0.324 | 0.000 | 4 |
| 66 | BRG | 17.774 | 0.227 | 0.324 | 0.324 | 0.000 | 4 |

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4.2 Modeling of shafting



4.3 Material data

| MATERIAL TYPE | CONDITION | E-MOD (N/m ²) | DENSITY (kg/m ³) |
|---------------|--------------|---------------------------|------------------------------|
| 1 | In Air | 2.10E+11 | 7,850 |
| 2 | In Sea water | 2.10E+11 | 6,850 |
| 3 | In L.O. | 2.10E+11 | 7,000 |
| 4 | Weightless | 2.10E+11 | 0 |

4.4 External load

| ELEMENT NO. | DIST. TO RIGHT END OF ELEM (m) | POINT LOAD (N) | Description |
|-------------|--------------------------------|----------------|-------------------|
| 2 | 0.170 | 5,935.00 | Propeller nut+cap |
| 5 | 0.870 | 137,634.00 | Propeller |
| 43 | 13.290 | 82,875.00 | Turning wheel |
| 47 | 13.979 | -79,100.00 | Chain wheel |
| 52 | 14.799 | 91,400.00 | Crank throw |
| 56 | 15.649 | 91,400.00 | Crank throw |
| 60 | 16.499 | 91,400.00 | Crank throw |
| 64 | 17.349 | 91,400.00 | Crank throw |

4.5 Weight of propeller

- 50% Immersion (Haft immersed)**
 - : 14,030 kg - 946 kg = 13,084 kg
 - Weight of propeller in air : 14,030 kg
 - Lift on propeller haft immered : $1/2 \times 14,030 \text{ kg} / 7.600\text{g/cm}^3 \times 1.025\text{g/cm}^3 = 946 \text{ kg}$
- 75% Immersion**
 - : 14,030 kg - 1,419 kg = 12,611 kg
- 100% Immersion (Fully immersed)**
 - : 14,030 kg - 1,892 kg = 12,138 kg

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5. Calculation Results (See APPENDIX C)

5.1 Reaction Influence Numbers (RIN)

Reaction Influence Numbers is reaction force due to an unit offset 1.0mm.

The bearing reaction influence numbers can be used to control the behaviour of adjacent bearings when one bearing is moved up/down 1.0mm.

| | Aft. S/T Bearing (N/mm) | Fwd. S/T Bearing (N/mm) | Inter. Bearing (N/mm) | Main Bearing #8 (N/mm) | Main Bearing #7 (N/mm) | Main Bearing #6 (N/mm) | Main Bearing #5 (N/mm) | Main Bearing #4 (N/mm) | Main Bearing #3 (N/mm) |
|--------------|-------------------------|-------------------------|-----------------------|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|
| Aft. S/T BRG | 26758 | -44647 | 25514 | -23858 | 16422 | -230 | 51 | -10 | 1 |
| Fwd. S/T BRG | -44647 | 78368 | -53983 | 63399 | -43639 | 613 | -136 | 28 | -4 |
| Inter. BRG | 25514 | -53983 | 71393 | -179780 | 138447 | -1945 | 432 | -91 | 13 |
| Main BRG #7 | -23858 | 63399 | -179780 | 1419282 | -2029132 | 917125 | -203863 | 43273 | -6448 |
| Main BRG #6 | 16422 | -43639 | 138447 | -2029132 | 3750502 | -2517144 | 835460 | -177342 | 26425 |
| Main BRG #5 | -230 | 613 | -1945 | 917125 | -2517144 | 2848505 | -1795501 | 644633 | -96056 |
| Main BRG #4 | 51 | -136 | 432 | -203863 | 835460 | -1795501 | 2289027 | -1539905 | 414434 |
| Main BRG #3 | -10 | 28 | -91 | 43273 | -177342 | 644633 | -1539905 | 1644393 | -614979 |
| Main BRG #2 | 1 | -4 | 13 | -6448 | 26425 | -96056 | 414434 | -614979 | 276612 |

5.2 Bearing loads and offsets

5.2.1 Cold condition

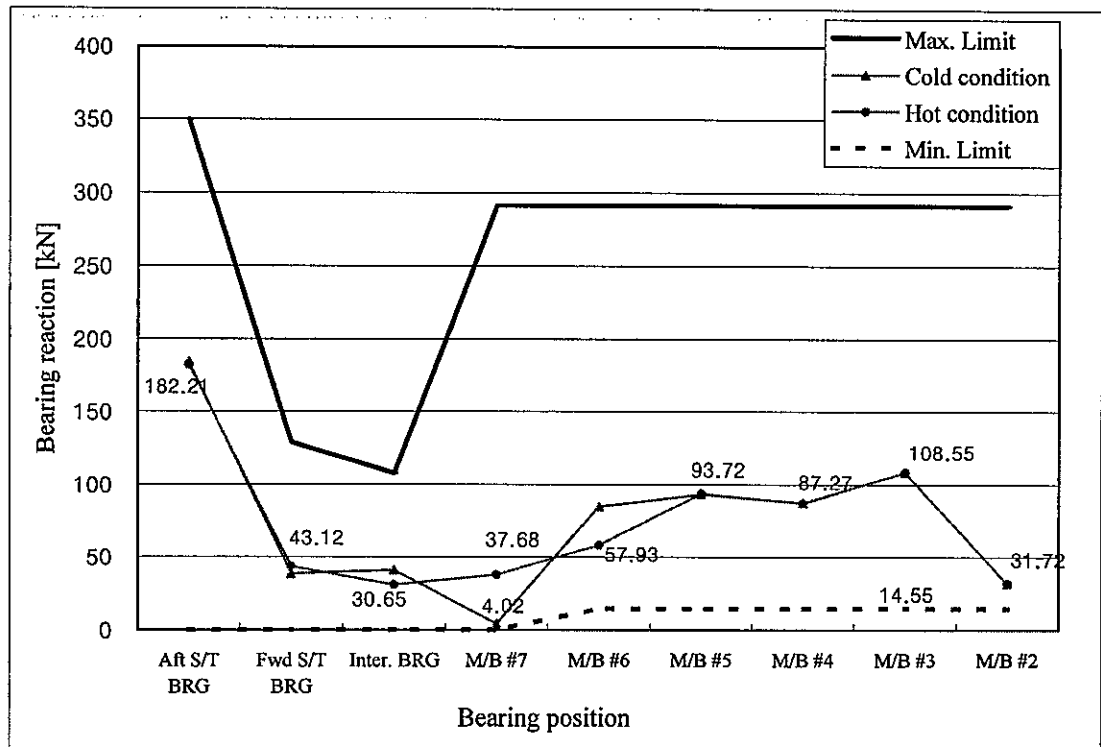
| BEARING POSITION | DIST. (m) | OFFSET (mm) | 100% IMMERSION | | 75% IMMERSION | | 50% IMMERSION | |
|------------------|-----------|-------------|--------------------|-------------------------|--------------------|-------------------------|--------------------|-------------------------|
| | | | REACTION FORCE (N) | NORMAL PRESSURE (N/mm2) | REACTION FORCE (N) | NORMAL PRESSURE (N/mm2) | REACTION FORCE (N) | NORMAL PRESSURE (N/mm2) |
| 1. AFT S/T BRG | 2.003 | 0.00 | 184040 | 0.421 | 191050 | 0.437 | 198060 | 0.453 |
| 2. FWD S/T BRG | 4.575 | 0.00 | 38253 | 0.238 | 35662 | 0.222 | 33071 | 0.205 |
| 3. INTER. BRG | 9.500 | -2.95 | 40952 | 0.305 | 41265 | 0.307 | 41578 | 0.310 |
| 4. M/E BRG #7 | 13.619 | -4.60 | 4018 | 0.012 | 3726 | 0.011 | 3433 | 0.011 |
| 5. M/E BRG #6 | 14.374 | -4.60 | 84629 | 0.273 | 84830 | 0.274 | 85032 | 0.275 |
| 6. M/E BRG #5 | 15.224 | -4.60 | 93342 | 0.635 | 93339 | 0.635 | 93336 | 0.635 |
| 7. M/E BRG #4 | 16.074 | -4.60 | 87351 | 0.594 | 87351 | 0.594 | 87352 | 0.594 |
| 8. M/E BRG #3 | 16.924 | -4.60 | 108535 | 0.738 | 108535 | 0.738 | 108535 | 0.738 |
| 9. M/E BRG #2 | 17.774 | -4.60 | 31722 | 0.429 | 31722 | 0.429 | 31722 | 0.429 |

5.2.2 Hot condition

| BEARING POSITION | DIST. (m) | OFFSET (mm) | 100% IMMERSION | | 75% IMMERSION | | 50% IMMERSION | |
|------------------|-----------|-------------|--------------------|-------------------------|--------------------|-------------------------|--------------------|-------------------------|
| | | | REACTION FORCE (N) | NORMAL PRESSURE (N/mm2) | REACTION FORCE (N) | NORMAL PRESSURE (N/mm2) | REACTION FORCE (N) | NORMAL PRESSURE (N/mm2) |
| 1. AFT S/T BRG | 2.003 | 0.00 | 182210 | 0.417 | 189220 | 0.433 | 196230 | 0.449 |
| 2. FWD S/T BRG | 4.575 | 0.00 | 43116 | 0.268 | 40525 | 0.252 | 37934 | 0.236 |
| 3. INTER. BRG | 9.500 | -2.95 | 30650 | 0.228 | 30963 | 0.231 | 31276 | 0.233 |
| 4. M/E BRG #7 | 13.619 | -4.36 | 37676 | 0.116 | 37383 | 0.115 | 37091 | 0.114 |
| 5. M/E BRG #6 | 14.374 | -4.36 | 57934 | 0.187 | 58135 | 0.188 | 58337 | 0.188 |
| 6. M/E BRG #5 | 15.224 | -4.36 | 93717 | 0.637 | 93714 | 0.637 | 93711 | 0.637 |
| 7. M/E BRG #4 | 16.074 | -4.36 | 87267 | 0.593 | 87268 | 0.593 | 87268 | 0.593 |
| 8. M/E BRG #3 | 16.924 | -4.36 | 108553 | 0.738 | 108552 | 0.738 | 108552 | 0.738 |
| 9. M/E BRG #2 | 17.774 | -4.36 | 31719 | 0.429 | 31719 | 0.429 | 31719 | 0.429 |

5.2.3 Graphical results of bearing loads

The distributions of bearing loads in the different load cases together with relevant limits and bearing offsets are shown.



5.3 Deflection curves

5.3.1 Cold condition (50% Immersion)

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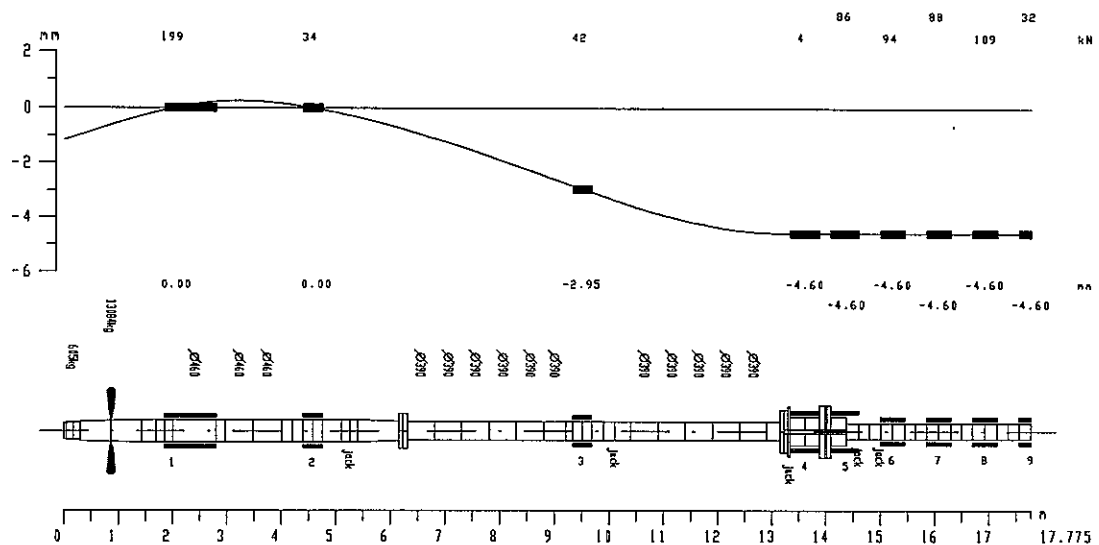
DNV Software

Alignment

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SHAFTLINE

Operating condition 1 (COLD 50%)



5.3.2 Cold condition (75% Immersion)

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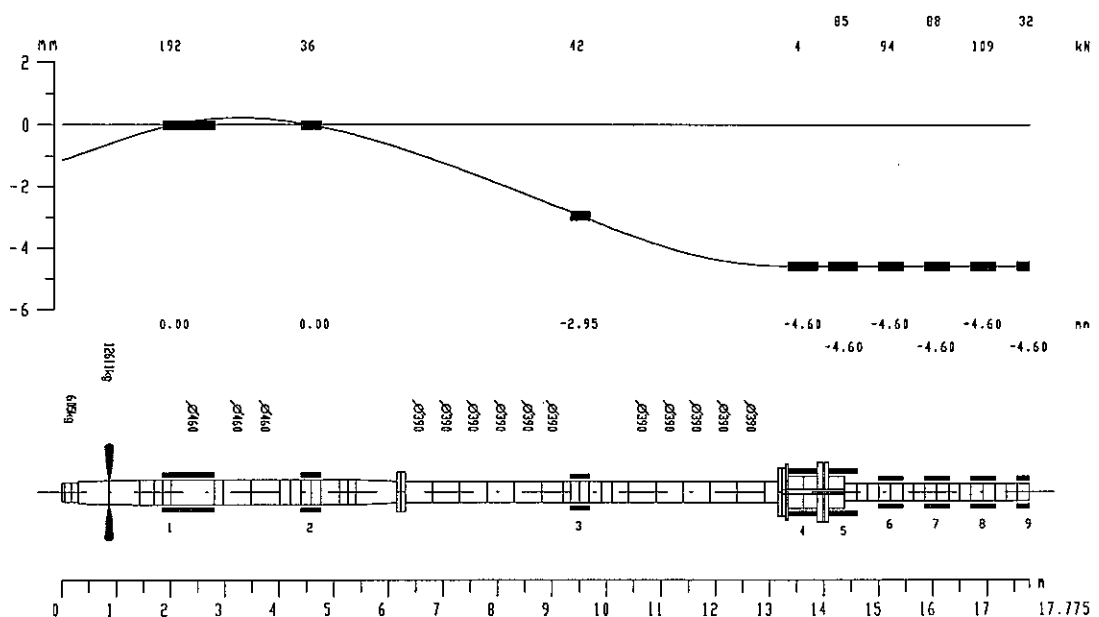
DNV Software

Alignment

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SHAFTLINE

Operating condition 2 (COLD 75%)

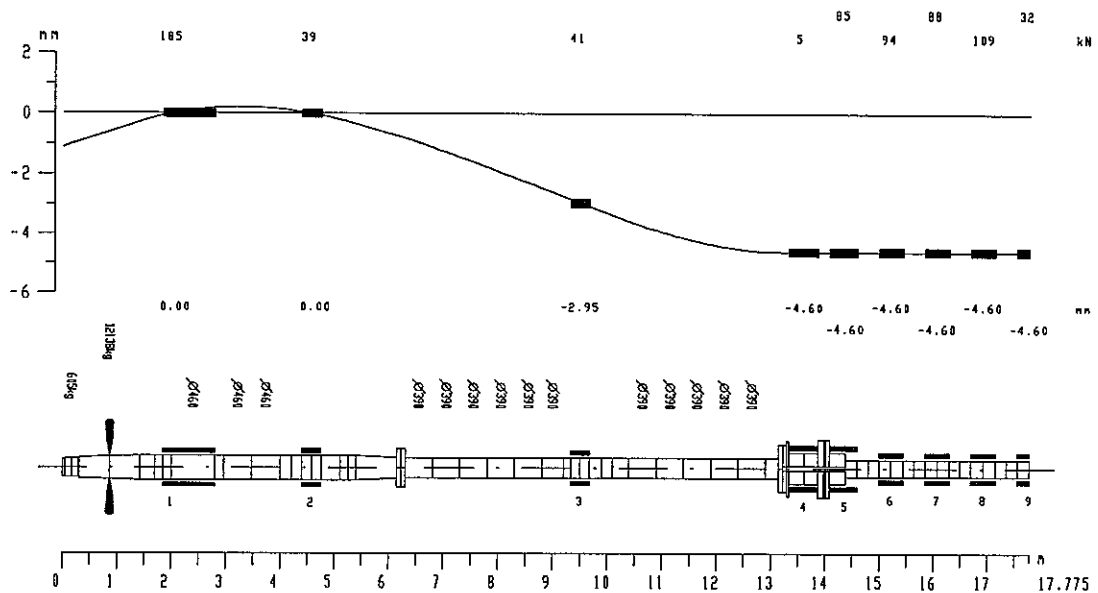


5.3.3 Cold condition (100% Immersion)

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DNV Software
Alignment
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SHAFTLINE
Operating condition 3 (COLD 100%)

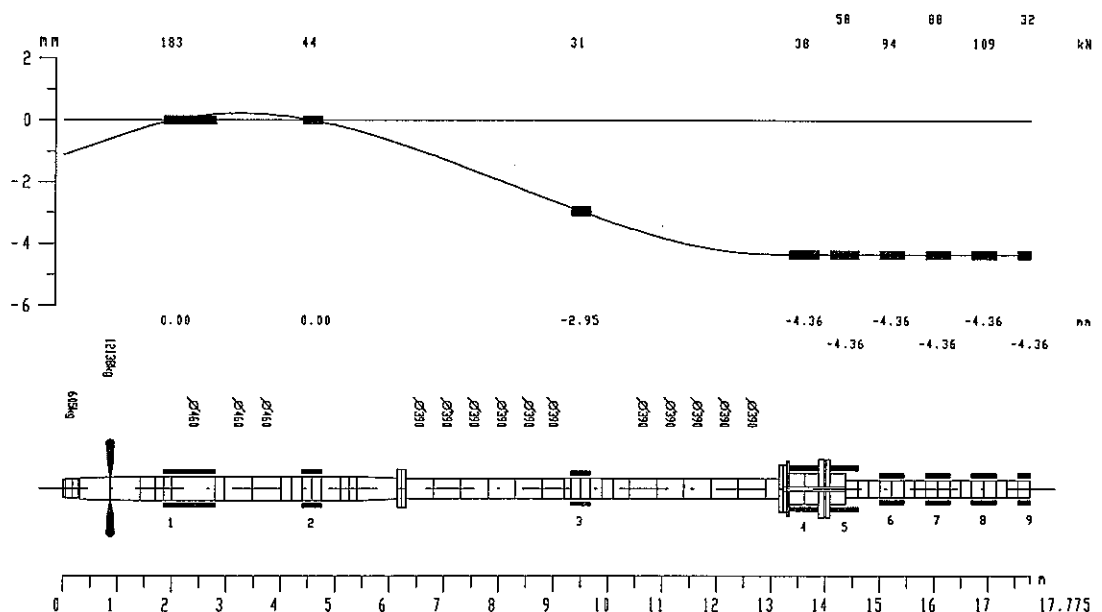


5.3.4 Hot condition (100% Immersion)

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SAMJIN
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DNV Software
Alignment
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SHAFTLINE
Operating condition 4 (HOT 100%)



5.4 Bending moment curves

5.4.1 Cold condition (75% Immersion)

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SAMJIN

<Comments not specified>

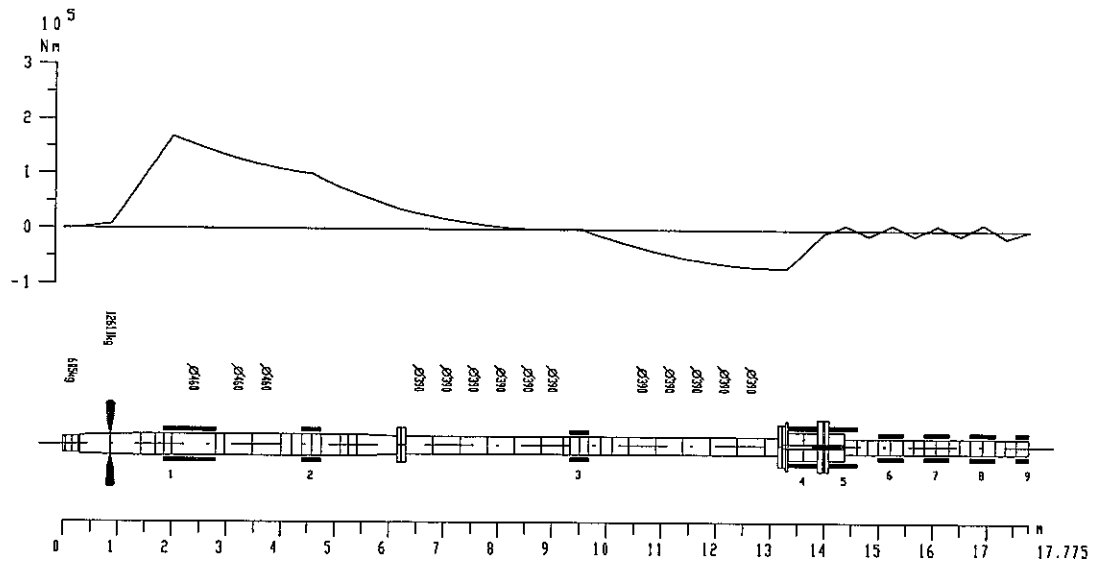
DNV Software

Alignment

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BENDING MOMENT

Operating condition 2 (COLD 75%)



5.4.2 Hot condition (100% Immersion)

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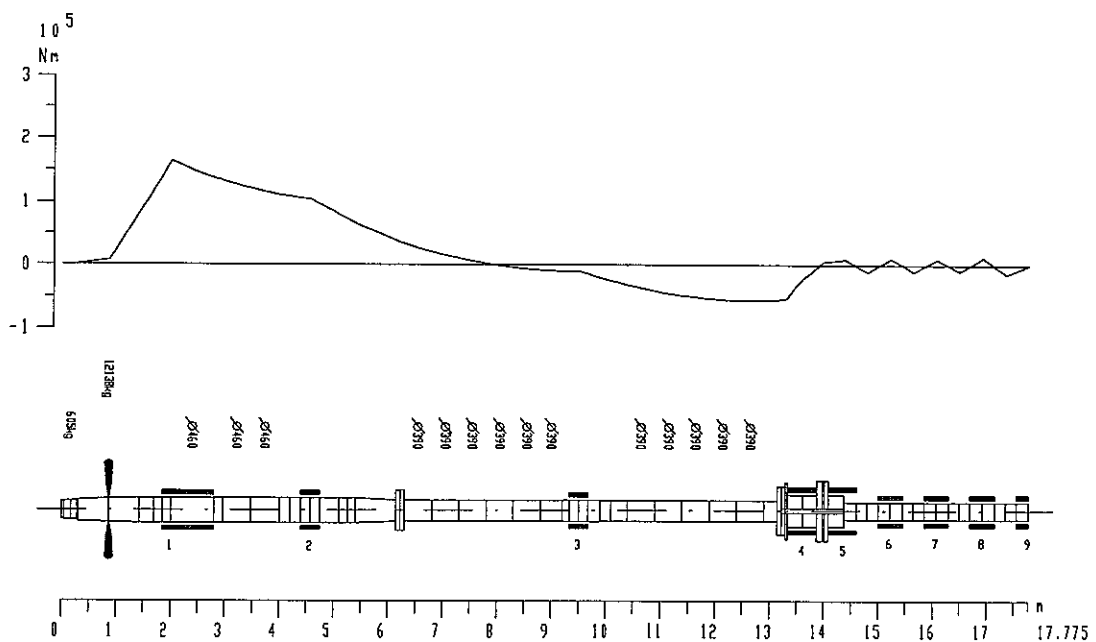
DNV Software

Alignment

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BENDING MOMENT

Operating condition 4 (HOT 100%)



| | | | |
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5.5 Bending stress curves

5.5.1 Cold condition (75% Immersion)

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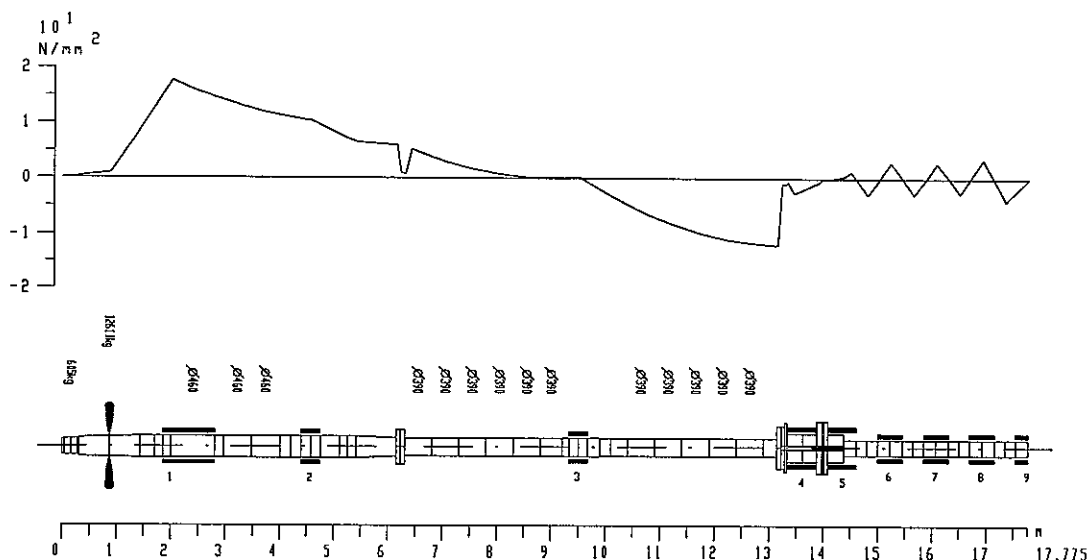
SAMJIN

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DNV Software
Alignment
02004-04

STRESS

Operating condition 2 (COLD 75%)



5.5.2 Hot condition (100% Immersion)

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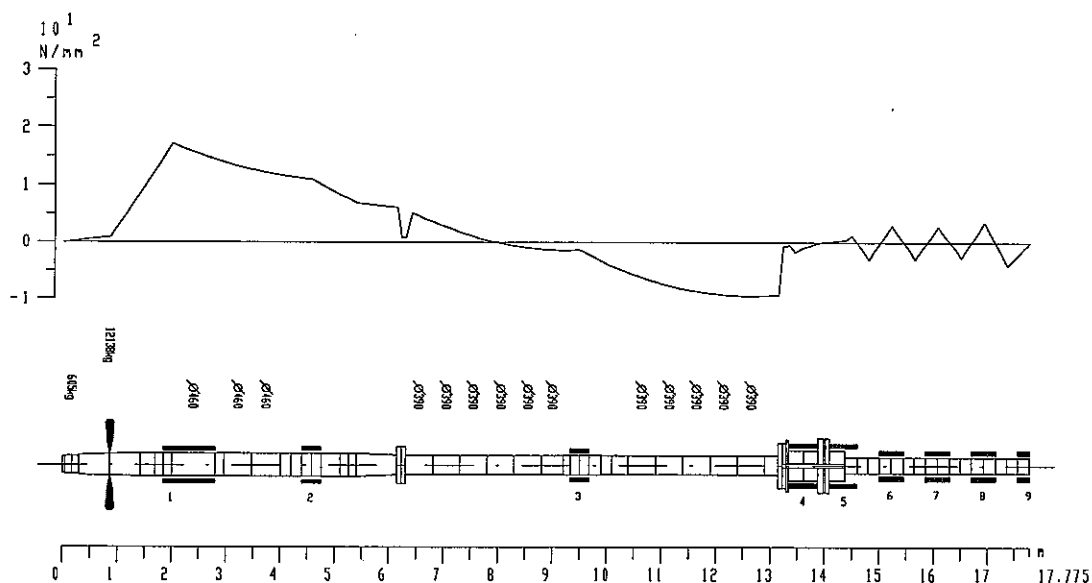
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Alignment
02004-04

STRESS

Operating condition 4 (HOT 100%)



| | | | |
|-----------|--------------------------------|-----------|---------------|
| stxEngine | CALCULATION OF SHAFT ALIGNMENT | PAGE | 11/14 |
| | | REV. | 0 |
| | | DOCU. NO. | SA-0846-LB395 |

5.6 Bending moment and shear force at engine flange

This result is relevant in case the engine manufacturer has certain acceptance criteria with respect to allowable bending moment and shear force. The requirements for static thrust shaft load are shown in drawing no. 0794923-8.

Engine flange = node point 42 : Abscissa 13.225 m

Cold + 50% Immersion : Shaft bending moment : -70.412 [kNm] Shaft shear force : 0.924 [kN]

Cold + 75% Immersion : Shaft bending moment : -70.300 [kNm] Shaft shear force : 1.018 [kN]

Cold + 100% Immersion : Shaft bending momen : -70.188 [kNm] Shaft shear force : 1.111 [kN]

Hot + 100% Immersion : Shaft bending moment : -53.342 [kNm] Shaft shear force : 8.380 [kN]

Shear force contribution from turning wheel : 82.875 [kN]

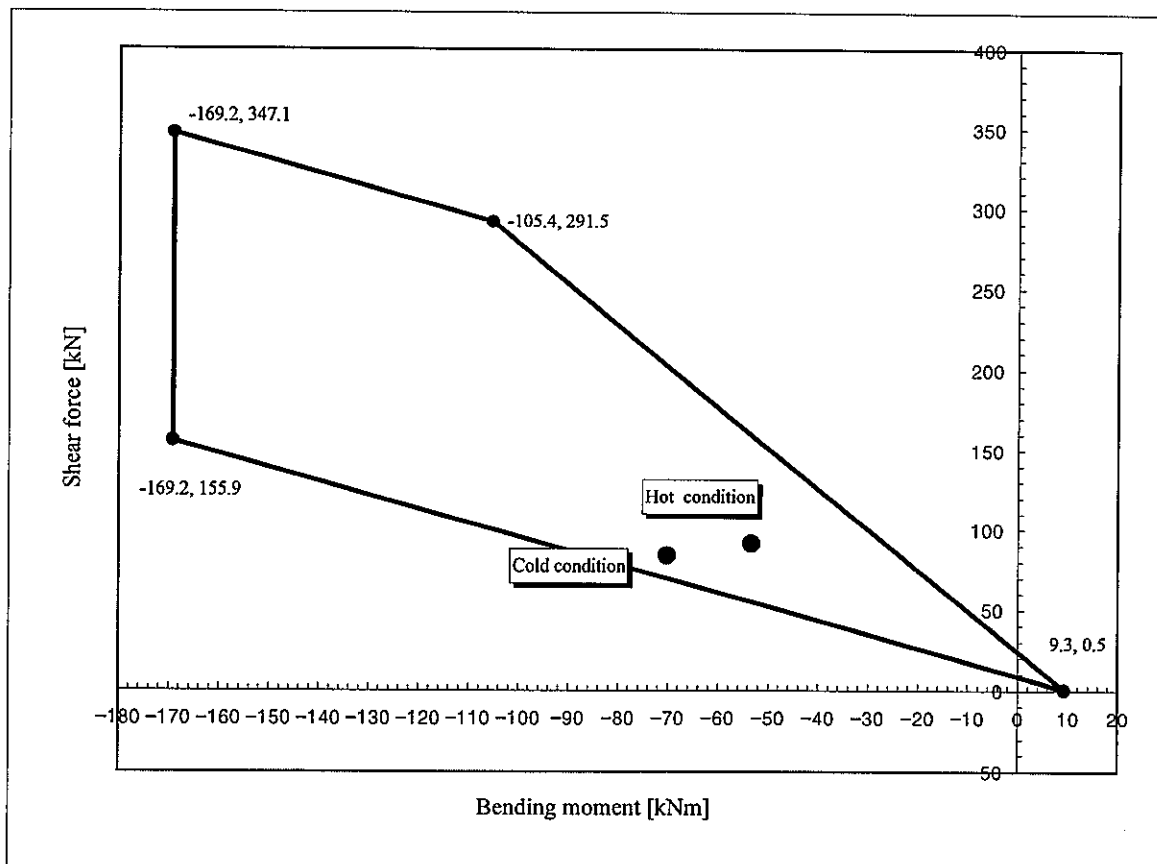
The bending moment and shear force at engine flange have been plotted in the static shaft load diagram.

Cold + 50% Immersion = (-70.412 kNm ; 83.799 kN)

Cold + 75% Immersion = (-70.300 kNm ; 83.893 kN)

Cold + 100% Immersion = (-70.188 kNm ; 83.986 kN)

Hot + 100% Immersion = (-53.342 kNm ; 91.255 kN)



5.7 Gap & Sag

All flanges are uncoupled. The intermediate shaft is placed on two points of temporary support.

- Engine side : 745 mm from aft edge of the forward flange on the intermediate shaft with height of -3.75 mm from the reference line.
- Prop. side : 1000 mm from fwd edge of the after flange on the intermediate shaft with height of -1.90 mm from the reference line.

Apply the jack down force of four(4) tons at the position of forward flange on the propeller shaft.

| | DISTANCE (m) | 100% IMMERSION | | 75% IMMERSION | | 50% IMMERSION | | 0% IMMERSION | |
|--------------------|-----------------|----------------|----------|---------------|----------|---------------|----------|--------------|----------|
| | | Gap (mm) | Sag (mm) | Gap (mm) | Sag (mm) | Gap (mm) | Sag (mm) | Gap (mm) | Sag (mm) |
| Propeller Flange | 6.225 | -0.05 | 0.74 | -0.05 | 0.73 | -0.05 | 0.72 | -0.04 | 0.71 |
| Fwd. Inter. Flange | 13.225 | 0.20 | 0.67 | 0.20 | 0.67 | 0.20 | 0.67 | 0.20 | 0.67 |

A Gap is positive if the opening is on the lower side.

A Sag is positive if the aft part is above the forward part.

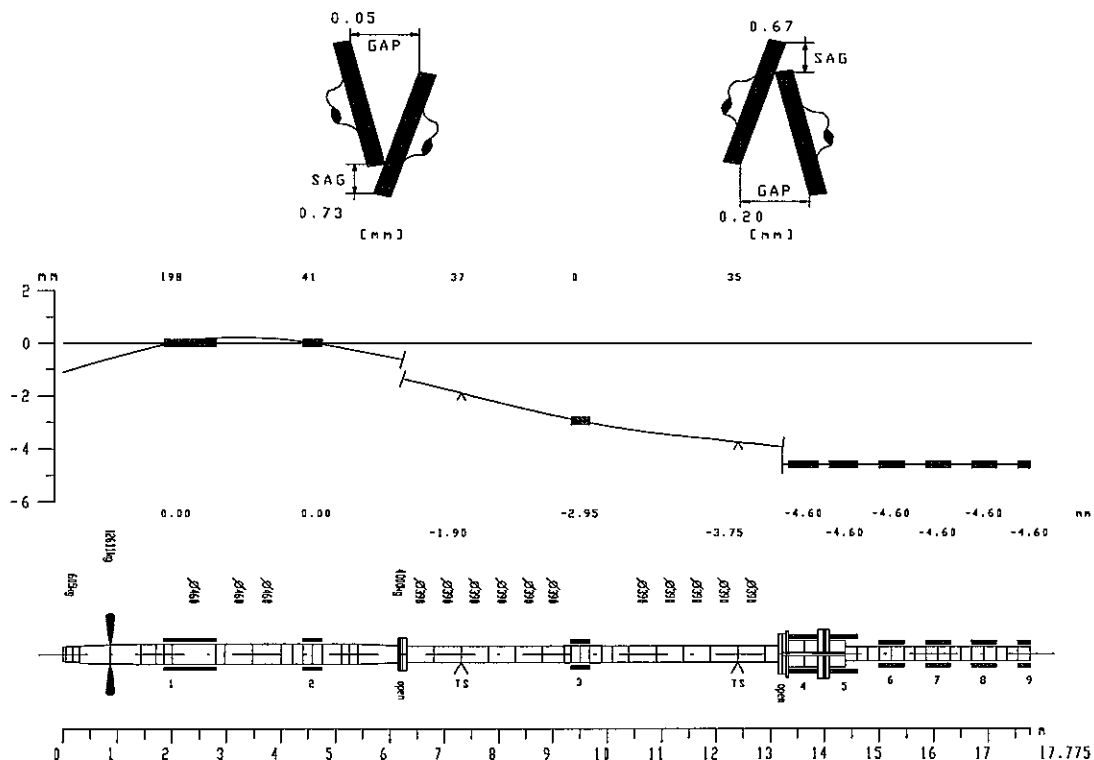
The tolerance gives ± 0.1 mm

Cold condition (75% Immersion)

2008-12- 1 14:46
SAMJIN
<Comments not specified>

DNV Software
Alignment
02004-04

GAP AND SAG
OPEN CONDITION



| | | | |
|-------------------|---------------------------------------|-----------|---------------|
| stx Engine | CALCULATION OF SHAFT ALIGNMENT | PAGE | 13/14 |
| | | REV. | 0 |
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5.8 Jack up loads and correction factors

5.8.1 Cold condition (75% IMMERSION)

| | DISTANCE (m) | LOAD (N) | CORRECTION FACTOR |
|------------------------|-----------------|-------------|----------------------|
| Fwd S/T Brg | 4.575 | 35662 | |
| Jack load verification | 5.255 | 32247 | 1.1059 |
| Inter Brg | 9.500 | 41265 | |
| Jack load verification | 10.100 | 43864 | 0.9408 |
| Jack load verification | 13.332 | 2709 | 1.3756 |
| M/E #7 | 13.619 | 3725 | |
| M/E #6 | 14.374 | 84830 | |
| Jack load verification | 14.601 | 74290 | 1.1419 |
| Jack load verification | 14.997 | 96191 | 0.9704 |
| M/E #5 | 15.224 | 93338 | |

5.8.2 Cold condition (100% IMMERSION)

| | DISTANCE (m) | LOAD (N) | CORRECTION FACTOR |
|------------------------|-----------------|-------------|----------------------|
| Fwd S/T Brg | 4.575 | 38252 | |
| Jack load verification | 5.255 | 34590 | 1.1059 |
| Inter Brg | 9.500 | 40952 | |
| Jack load verification | 10.100 | 43531 | 0.9408 |
| Jack load verification | 13.332 | 2921 | 1.3756 |
| M/E #7 | 13.619 | 4018 | |
| M/E #6 | 14.374 | 84629 | |
| Jack load verification | 14.601 | 74114 | 1.1419 |
| Jack load verification | 14.997 | 96194 | 0.9704 |
| M/E #5 | 15.224 | 93341 | |

The tolerance for Inter. bearing load gives $\pm 20\%$ load change.

The limitation of M/E bearing load ;

- Aftmost bearing of engine : Min. 0 N , Max. 291000 N

- Other main bearings : Min. 14550 N , Max. 291000 N

| | | | |
|------------------|---------------------------------------|-----------|---------------|
| stxEngine | CALCULATION OF SHAFT ALIGNMENT | PAGE | 14/14 |
| | | REV. | 0 |
| | | DOCU. NO. | SA-0846-LB395 |

5.9 Slope boring evaluation for aft S/T bearing

For this installation, the diametrical bearing clearance is 0.7 mm and the bearing length is 950 mm.

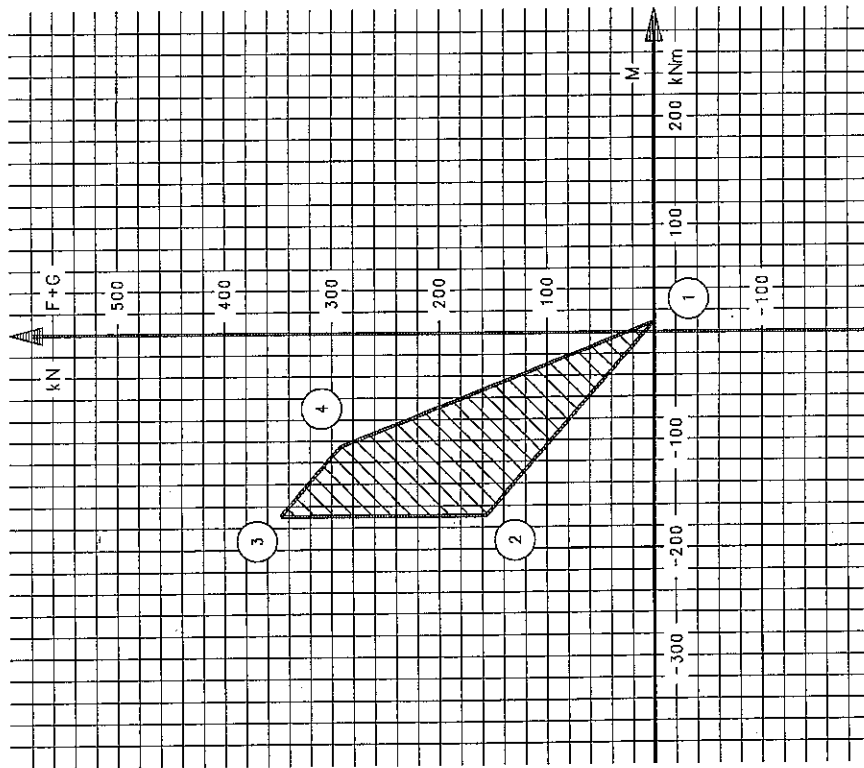
| | |
|---------------------------------|----------------|
| Cold Condition (50% Immersion) | 0.2853E-03 rad |
| Cold Condition (75% Immersion) | 0.2789E-03 rad |
| Cold Condition (100% Immersion) | 0.2726E-03 rad |
| Hot Condition (100% Immersion) | 0.2768E-03 rad |

The calculated slope angles are well within 0.300E-03 rad.

The conclusion is that slope boring is not necessary.

APPENDIX A

PARTICULARS OF PLANT



| | M | F |
|---|--------|-------|
| 1 | 9.3 | 0.5 |
| 2 | -169.2 | 155.9 |
| 3 | -169.2 | 347.1 |
| 4 | -105.4 | 291.5 |

Deflectional and Angular rigidity (C) at crank shaft flange when only $F=100$ kN and $M=100$ kNm is acting at the flange :

$$C_d F = 0.007 \text{ mm/100kN} \quad C_d F = 0.014 \text{ (mm/m)/100kN}$$

$$C_d M = 0.014 \text{ mm/100kNm} \quad C_d M = 0.044 \text{ (mm/m)/100kNm}$$

Maximum permissible shear force and bending moment at thrust shaft flange (static condition)

Max. permissible bearing reactions (R): max. min.

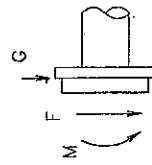
1) Aftmost bearing of engine : 291 kN 0%

2) Aftmost main bearing : 291 kN 5%

The reactions are not to be less than 5% of R max.

Max. permissible bending stress in thrust shaft : 15 N/mm²

Max. permissible bending moment (numerical): 169 kNm

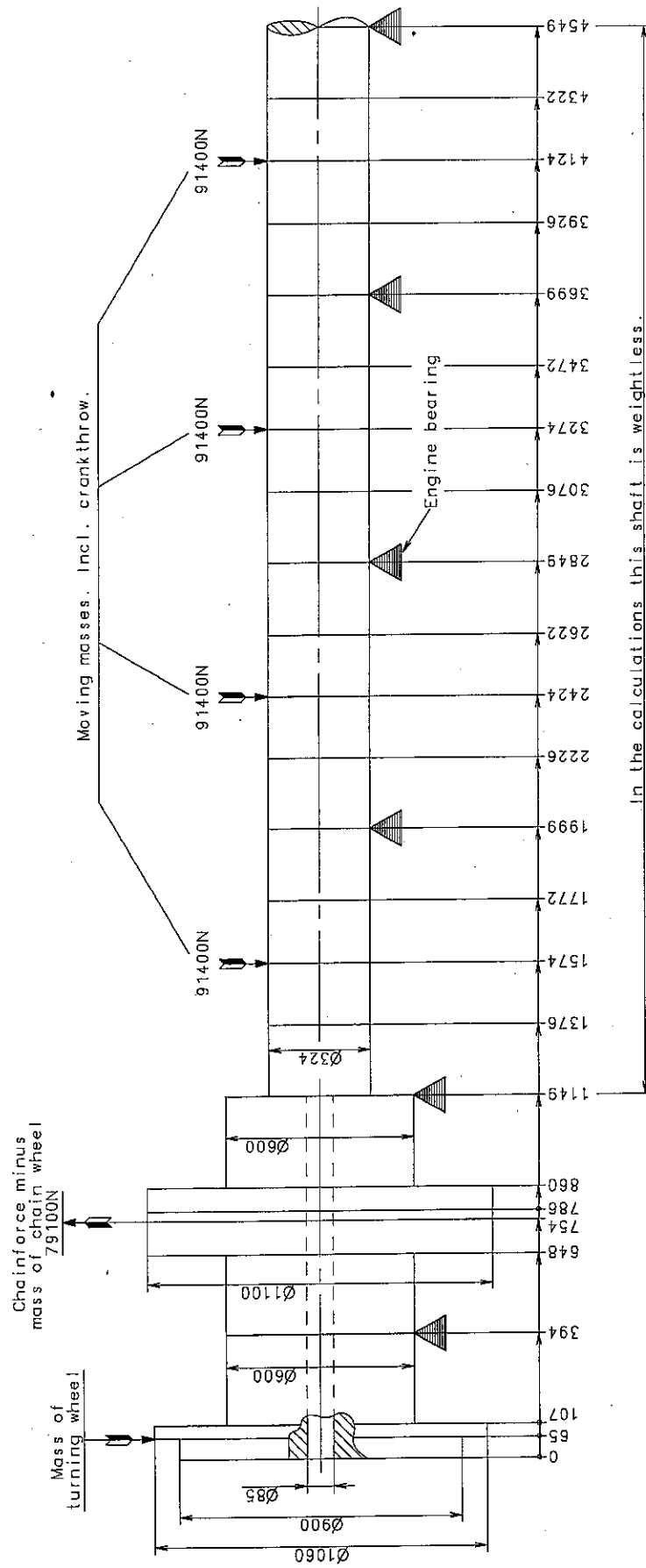


F : shear force (kN)

M : bending moment (kNm)

G : weight of turning wheel (kN)

Valid for Crank shaft: 3178765-6.1



Valid for Crank shaft: 3178765-6.1

The thermal expansion of the engine structure - i.e. from the engine seating to the centre of the main bearing - is 0.24 mm, when the engine temperature is raised from cold (20°C) to normal running temperature (55°).

20060607 IBBCEJCEJZ4 Engine type S50ME-B7/8 added.
20030626 IBBCEJCEJZ4 Pictorial corrections on page 2.
20030310 IBBCEJCEJ

4-6S50MC-C/ME-B7/8 01 02

387701

DATA FOR SHAFT ALIGNMENT

0794923-8

1. MAIN ENGINE

| | |
|------------------------|-------------------------|
| MODEL | STX-MAN B&W 5S50MC(MK7) |
| MAX. CONTINUOUS OUTPUT | 10,740 BHP |
| REVOLUTION PER MINUTE | 127.0 RPM |

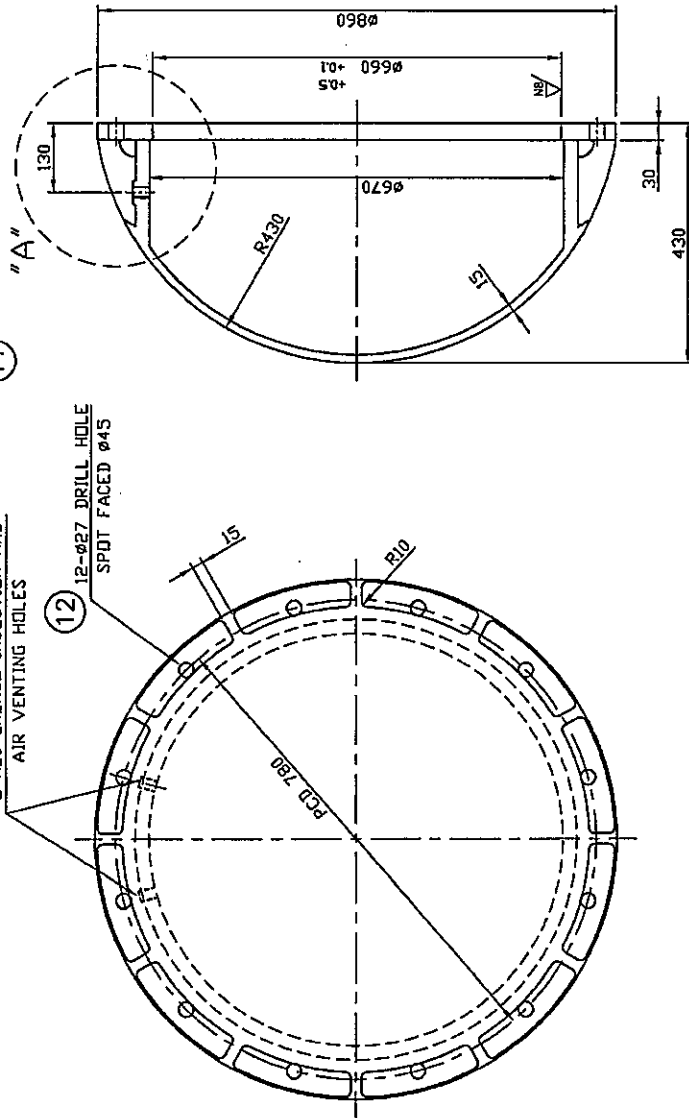
2. PROPELLER PARTICULARS

| | |
|---------------------|---|
| DIAMETER | D = 5.600 M |
| PITCH AT 0.7R | $P_{0.7} = 4.0115 \text{ M}$ |
| PITCH RATIO AT 0.7R | $P_{0.7}/D = 0.7163$ |
| MEAN PITCH | $P_{\text{MEAN}} = 3.9194 \text{ M}$ |
| MEAN PITCH RATIO | $P_{\text{MEAN}}/D = 0.6999$ |
| NO. OF BLADE | Z = 4 EA |
| EXPANDED AREA | $A_e = 15.517 \text{ M}^2$ |
| EXPANDED AREA RATIO | $A_e/A_o = 0.6300$ |
| BOSS RATIO | $D_{\text{hub}}/D = 0.170$ |
| RAKE | RK = 0.0 DEG |
| SKEW | SK = 24.5 DEG |
| TURNING DIRECTION | R.H(LOOKING FROM STERN) |
| MATERIAL | Ni-Al-Br (CU3) |
| SECTION | NACA 66, $a=0.8$ |
| PROPELLER WEIGHT | abt. 14030 kg |
| M.O.I IN WATER | abt. 259,200 $\text{kg} \cdot \text{cm} \cdot \text{sec}^2$ |

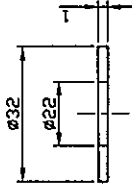
2-M20 GREASE INJECTION AND
AIR VENTING HOLES

12- $\phi 27$ DRILL HOLE
SPOT FACED $\phi 45$

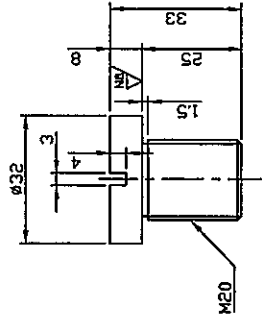
11



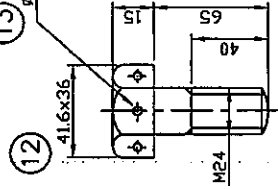
15



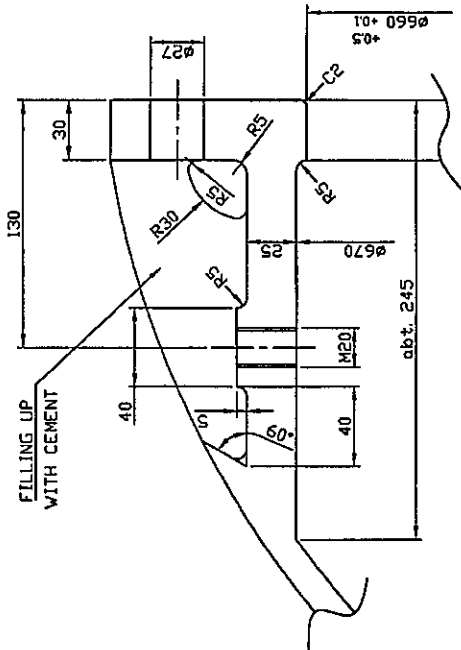
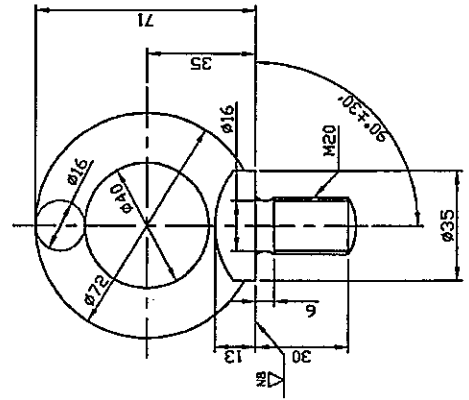
14 N11/N8



13 $\phi 3$ DRILL HOLES
FOR WIRE $\phi 2.6$



16 N8



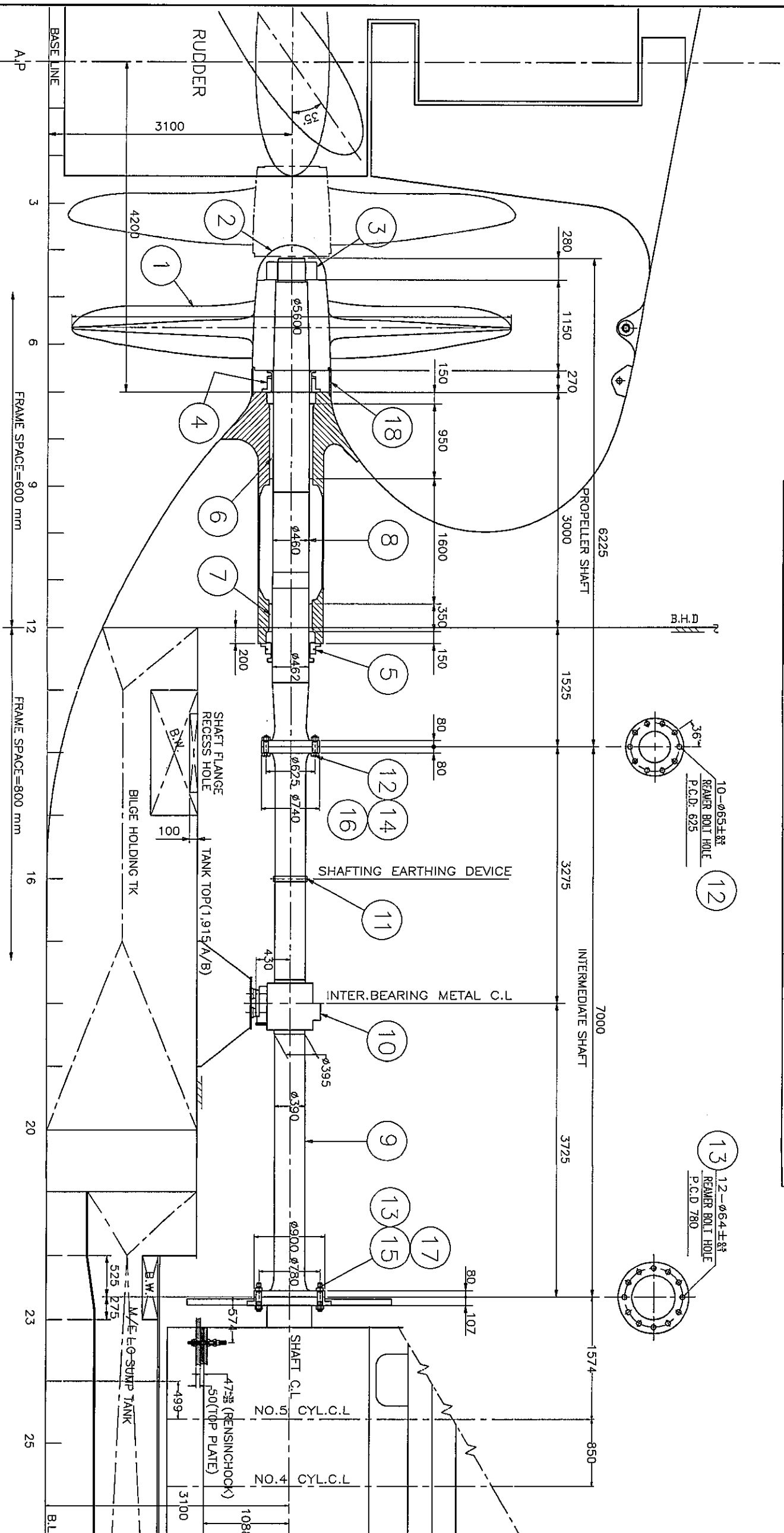
"A" DETAIL

| NO | DESCRIPTION | MATERIAL | Q'TY | WEIGHT | REMARK |
|---|---------------------|----------|--------|--------|----------------------|
| 16 | EYE BOLT | SS41 | 1 | | M20 |
| 15 | PACKING | C1100P-0 | 2 | | |
| 14 | PLUG FOR CAP | C2700BD | 2 | | M20 |
| 13 | WIRE FOR CAP | SUS304 | 1 | | $\phi 2.6 \times 3m$ |
| 12 | WIRING BOLT FOR CAP | SUS304 | 12 | | M24x65L |
| 11 | PROPELLER CAP | Mn-Br | 1 | 245 Kg | |
| APP.BY | SUB.BY | CHK.BY | DWG.BY | SCALE | DATE |
| | | | | NONE | 2008. 08 |
| SAMJIN SHIPBUILDING INDUSTRIES CO.,LTD. | | | | | |
| 33,500 DWT LOG / BULK CARRIER | | | | | |
| H-1009/10/11/12/51/32 | | | | | |
| PROPELLER CAP | | | | | |
| CLASS K R | | | | | |
| DWG.NO 08-P-19-05 | | | | | |
| ALT.NO | | | | | |
| BUSAN KOREA | | | | | |



SIL LA METAL CO., LTD

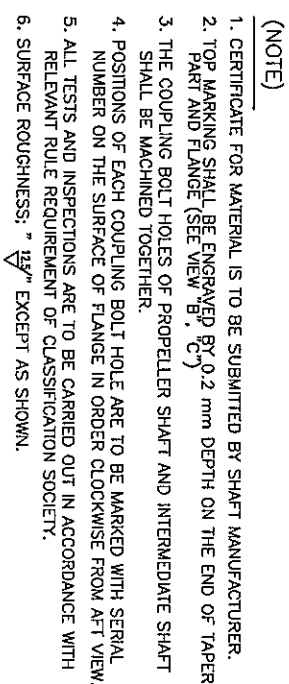
| MAIN ENGINE | | PROPELLER PARTICULARS | |
|-------------|---------------------|-----------------------|-----------------------|
| TYPE | MAN B&W 5S50MC-C7 | TYPE | FIXED PITCH PROPELLER |
| MCR | 7,900kW at 127RPM | NO.OF BLADE | 4 |
| NCR | 6,715kW at 120.3RPM | DIAMETER | abt.5,600 MM |



| | |
|----------|------------------------|
| HULL NO. | 1009-1012 1031-1032 |
| DWG. NO. | DA50CM104 |
| SCALE | 1/50 |

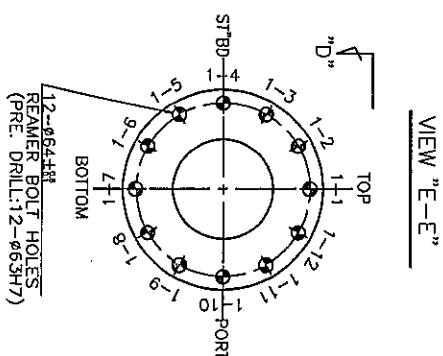
SHAFTING PLAIN

INTERMEDIATE
SHAFT SIDE



| | |
|----------|------------------------|
| HULL NO. | 1009-1012 1031-1032 |
| DWG. NO. | DA500M104 |
| SCALE | 1/30 |

SHAFTING PLAN

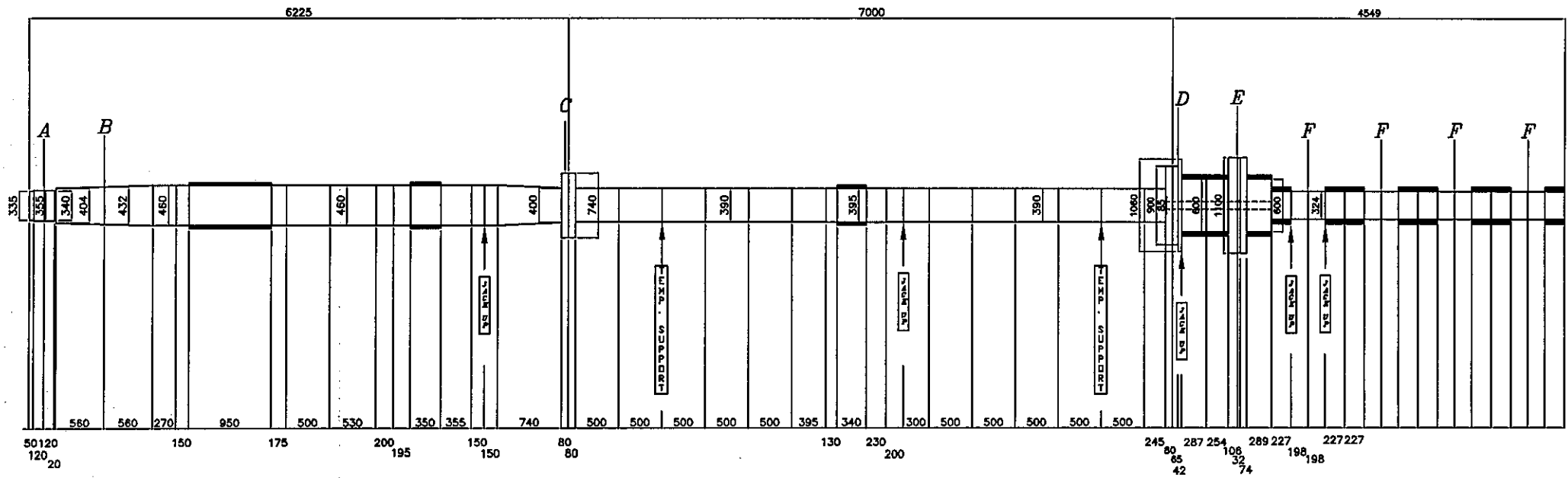


1. CERTIFICATE FOR MATERIAL IS TO BE SUBMITTED BY SHAFT MANUFACTURER.
2. TOP MARKING SHALL BE ENGRAVED BY 0.2 mm DEPTH ON THE END OF TAPER PART AND FLANGE (SEE VIEW "B", D)
3. COUPLING BOLT HOLES OF INTERMEDIATE SHAFT AND THRUST SHAFT SHALL BE MACHINED TOGETHER.
4. POSITIONS OF EACH COUPLING BOLT HOLE ARE TO BE MARKED WITH SERIAL NUMBER ON THE SURFACE OF FLANGE IN ORDER CLOCKWISE FROM AFT VIEW.
5. ALL TESTS AND INSPECTIONS ARE TO BE CARRIED OUT IN ACCORDANCE WITH RELEVANT RULE REQUIREMENT OF CLASSIFICATION SOCIETY.
6. SURFACE ROUGHNESS: " $\frac{12.5}{\sqrt{A}}$ " EXCEPT AS SHOWN.

| | | |
|----------|------------------------|---------------|
| HULL NO. | 1009-1012 1031-1032 | SHAFTING PLAN |
| DWG. NO. | DA500M104 | |
| SCALE | 1/30 | |

MODELING FOR SHAFT ALIGNMENT

(Yard : SAMJIN - H1009/ 10/ 11/ 12/ 31/ 32)



A. PROPELLER NUT+CAP : 605 kg
 B. PROPELLER WEIGHT
 - IN AIR : 14,030 kg
 - 100% IMMERSION : 12,138 kg
 - 75% IMMERSION : 12,611 kg
 - 50% IMMERSION : 13,084 kg

C. JACK DOWN FORCE : 3,000 kg
 D. TURNING WHEEL : 8,448 kg
 E. CHAIN WHEEL : -79,100 N
 F. CRANKTHROW : 91,400 N

APPENDIX B

INPUT DATA

2008-12- 1 15:42

DNV Software

SAMJIN

Alignment

<Comments not specified>

@2004-04

INPUT

DISTANCE

[m]

0.050 Shaft

LENGTH: 0.050 m

OUTER DIAMETER: 0.335 m

INNER DIAMETER: 0.000 m

Buoyancy in water

DENSITY: 6850 kg/m3

0.170 Shaft

LENGTH: 0.120 m

OUTER DIAMETER: 0.355 m

INNER DIAMETER: 0.000 m

Program default

DENSITY: 6850 kg/m3

0.170 Propeller nut+cap

MASS: 605 kg

POLAR MOMENT OF INERTIA: 0 kg*m2

DIAMETRAL MOMENT OF INERTIA: 0 kg*m2

0.290 Shaft

LENGTH: 0.120 m

OUTER DIAMETER: 0.355 m

INNER DIAMETER: 0.000 m

Buoyancy in water

DENSITY: 6850 kg/m3

0.310 Shaft

LENGTH: 0.020 m

OUTER DIAMETER: 0.340 m

INNER DIAMETER: 0.000 m

Buoyancy in water

DENSITY: 6850 kg/m3

0.870 Shaft

LENGTH: 0.560 m

AFT OUTER DIAMETER: 0.404 m

INNER DIAMETER: 0.000 m

FWD OUTER DIAMETER: 0.432 m

Program default

DENSITY: 6850 kg/m3

0.870 Propeller mass

MASS IN AIR: 14030 kg

POLAR MOMENT OF INERTIA: 0 kg*m2

DIAMETRAL MOMENT OF INERTIA: 0 kg*m2

Operating condition 1 (COLD 50%)

PROPELLER WEIGHT: 13084 kg

Operating condition 2 (COLD 75%)

PROPELLER WEIGHT: 12611 kg

Operating condition 3 (COLD 100%)

PROPELLER WEIGHT: 12138 kg

Operating condition 4 (HOT 100%)

PROPELLER WEIGHT: 12138 kg

OPEN CONDITION

PROPELLER WEIGHT: 14030 kg

1.430 Shaft

LENGTH: 0.560 m

AFT OUTER DIAMETER: 0.432 m

INNER DIAMETER: 0.000 m

FWD OUTER DIAMETER: 0.460 m

Buoyancy in water

DENSITY: 6850 kg/m3

1.700 Shaft

LENGTH: 0.270 m

OUTER DIAMETER: 0.460 m

INNER DIAMETER: 0.000 m

Buoyancy in oil

DENSITY: 7000 kg/m3

1.850 Shaft

LENGTH: 0.150 m

OUTER DIAMETER: 0.460 m

INNER DIAMETER: 0.000 m

Buoyancy in oil

DENSITY: 7000 kg/m3

2.003 Bearing element

LENGTH: 0.153 m

OUTER DIAMETER: 0.460 m

INNER DIAMETER: 0.000 m

Buoyancy in oil

DENSITY: 7000 kg/m3

2.003 Aft S/T Brg

EXTENSION: 0.950 m

DIAMETRICAL CLEARANCE: 0.000 mm

REFERENCE

2.800 Bearing element

LENGTH: 0.797 m

OUTER DIAMETER: 0.460 m

INNER DIAMETER: 0.000 m

Buoyancy in oil

DENSITY: 7000 kg/m3

2.975 Shaft

LENGTH: 0.175 m

OUTER DIAMETER: 0.460 m

INNER DIAMETER: 0.000 m

Buoyancy in oil

DENSITY: 7000 kg/m3

3.475 Shaft

LENGTH: 0.500 m

OUTER DIAMETER: 0.460 m

INNER DIAMETER: 0.000 m

Buoyancy in oil

DENSITY: 7000 kg/m3

4.005 Shaft

LENGTH: 0.530 m

OUTER DIAMETER: 0.460 m

INNER DIAMETER: 0.000 m

Buoyancy in oil

DENSITY: 7000 kg/m3

4.205 Shaft

LENGTH: 0.200 m

OUTER DIAMETER: 0.460 m

INNER DIAMETER: 0.000 m

Buoyancy in oil

DENSITY: 7000 kg/m3

4.400 Shaft

LENGTH: 0.195 m

OUTER DIAMETER: 0.460 m

INNER DIAMETER: 0.000 m

Buoyancy in oil

DENSITY: 7000 kg/m3

4.575 Bearing element

LENGTH: 0.175 m

OUTER DIAMETER: 0.460 m

INNER DIAMETER: 0.000 m

Buoyancy in oil

DENSITY: 7000 kg/m3

4.575 Fwd S/T Brg

EXTENSION: 0.350 m

DIAMETRICAL CLEARANCE: 0.000 mm

4.750 Bearing element

LENGTH: 0.175 m

OUTER DIAMETER: 0.460 m

INNER DIAMETER: 0.000 m

Buoyancy in oil

DENSITY: 7000 kg/m3

5.105 Shaft

LENGTH: 0.355 m

OUTER DIAMETER: 0.460 m

INNER DIAMETER: 0.000 m

Buoyancy in oil

DENSITY: 7000 kg/m3

5.255 Shaft

LENGTH: 0.150 m

OUTER DIAMETER: 0.460 m

INNER DIAMETER: 0.000 m

Jack load verification

5.405 Shaft

LENGTH: 0.150 m

OUTER DIAMETER: 0.460 m

INNER DIAMETER: 0.000 m

6.145 Shaft

LENGTH: 0.740 m

AFT OUTER DIAMETER: 0.460 m

INNER DIAMETER: 0.000 m

FWD OUTER DIAMETER: 0.400 m

6.225 General flange

LENGTH: 0.080 m

DIAMETER: 0.740 m

INNER DIAMETER: 0.000 m

Gap & sag

GAP AND SAG

6.305 General flange

LENGTH: 0.080 m

DIAMETER: 0.740 m

INNER DIAMETER: 0.000 m

6.805 Shaft

LENGTH: 0.500 m

OUTER DIAMETER: 0.390 m

INNER DIAMETER: 0.000 m

7.305 Shaft

LENGTH: 0.500 m

OUTER DIAMETER: 0.390 m

INNER DIAMETER: 0.000 m

Temporary support

TEMPORARY SUPPORT OFFSET: -1.90 mm

7.805 Shaft

LENGTH: 0.500 m

OUTER DIAMETER: 0.390 m

INNER DIAMETER: 0.000 m

8.305 Shaft

LENGTH: 0.500 m
OUTER DIAMETER: 0.390 m
INNER DIAMETER: 0.000 m

8.805 Shaft

LENGTH: 0.500 m
OUTER DIAMETER: 0.390 m
INNER DIAMETER: 0.000 m

9.200 Shaft

LENGTH: 0.395 m
OUTER DIAMETER: 0.390 m
INNER DIAMETER: 0.000 m

9.330 Shaft

LENGTH: 0.130 m
OUTER DIAMETER: 0.395 m
INNER DIAMETER: 0.000 m

9.500 Bearing element

LENGTH: 0.170 m
OUTER DIAMETER: 0.395 m
INNER DIAMETER: 0.000 m

9.500 Inter Brg

EXTENSION: 0.340 m
DIAMETRICAL CLEARANCE: 0.000 mm

Bearing offset horizontal

OFFSET HORIZONTAL: 0.00 mm

Bearing offset vertical

OFFSET VERTICAL: -2.95 mm

9.670 Bearing element

LENGTH: 0.170 m
OUTER DIAMETER: 0.395 m
INNER DIAMETER: 0.000 m

9.900 Shaft

LENGTH: 0.230 m

OUTER DIAMETER: 0.395 m

INNER DIAMETER: 0.000 m

10.100 Shaft

LENGTH: 0.200 m

OUTER DIAMETER: 0.390 m

INNER DIAMETER: 0.000 m

Jack load verification

10.400 Shaft

LENGTH: 0.300 m

OUTER DIAMETER: 0.390 m

INNER DIAMETER: 0.000 m

10.900 Shaft

LENGTH: 0.500 m

OUTER DIAMETER: 0.390 m

INNER DIAMETER: 0.000 m

11.400 Shaft

LENGTH: 0.500 m

OUTER DIAMETER: 0.390 m

INNER DIAMETER: 0.000 m

11.900 Shaft

LENGTH: 0.500 m

OUTER DIAMETER: 0.390 m

INNER DIAMETER: 0.000 m

12.400 Shaft

LENGTH: 0.500 m

OUTER DIAMETER: 0.390 m

INNER DIAMETER: 0.000 m

Temporary support

TEMPORARY SUPPORT OFFSET: -3.75 mm

12.900 Shaft

LENGTH: 0.500 m

OUTER DIAMETER: 0.390 m

INNER DIAMETER: 0.000 m

13.145 Shaft

LENGTH: 0.245 m

OUTER DIAMETER: 0.390 m

INNER DIAMETER: 0.000 m

13.225 General flange

LENGTH: 0.080 m

DIAMETER: 0.900 m

INNER DIAMETER: 0.000 m

Gap & sag

GAP AND SAG

Allowable engine flange loads

1 BENDING MOMENT: 9 kNm

1 SHEAR FORCE: 0 kN

2 BENDING MOMENT: -105 kNm

2 SHEAR FORCE: 291 kN

3 BENDING MOMENT: -169 kNm

3 SHEAR FORCE: 347 kN

4 BENDING MOMENT: -169 kNm

4 SHEAR FORCE: 155 kN

13.290 Engine flange

LENGTH: 0.065 m

DIAMETER: 0.900 m

INNER DIAMETER: 0.085 m

13.290 Load in vertical

Operating condition 1 (COLD 50%)

LOAD VERTICAL: 82874 N

13.290 Load in vertical

Operating condition 2 (COLD 75%)

LOAD VERTICAL: 82874 N

13.290 Load in vertical

Operating condition 3 (COLD 100%)

LOAD VERTICAL: 82874 N

13.290 Load in vertical

Operating condition 4 (HOT 100%)

LOAD VERTICAL: 82874 N

13.332 Engine shaft element

LENGTH: 0.042 m

OUTER DIAMETER: 1.060 m

INNER DIAMETER: 0.085 m

Jack load verification

13.619 Bearing element

LENGTH: 0.287 m

OUTER DIAMETER: 0.600 m

INNER DIAMETER: 0.085 m

13.619 M/E #7

EXTENSION: 0.541 m

DIAMETRICAL CLEARANCE: 0.000 mm

Bearing offset horizontal

OFFSET HORIZONTAL: 0.00 mm

Bearing offset vertical

OFFSET VERTICAL: -4.60 mm

Thermal expansion vertical

Operating condition 4 (HOT 100%)

THERMAL EXPANSION VERTICAL: 0.24 mm

13.873 Bearing element

LENGTH: 0.254 m

OUTER DIAMETER: 0.600 m

INNER DIAMETER: 0.085 m

13.979 Engine shaft element

LENGTH: 0.106 m

OUTER DIAMETER: 1.100 m

INNER DIAMETER: 0.085 m

13.979 Load in vertical

Operating condition 1 (COLD 50%)

LOAD VERTICAL: -79100 N

13.979 Load in vertical

Operating condition 2 (COLD 75%)

LOAD VERTICAL: -79100 N

13.979 Load in vertical

Operating condition 3 (COLD 100%)

LOAD VERTICAL: -79100 N

13.979 Load in vertical

Operating condition 4 (HOT 100%)

LOAD VERTICAL: -79100 N

13.979 Load in vertical

OPEN CONDITION

LOAD VERTICAL: -79100 N

14.011 Engine shaft element

LENGTH: 0.032 m

OUTER DIAMETER: 1.100 m

INNER DIAMETER: 0.085 m

14.085 Engine shaft element

LENGTH: 0.074 m

OUTER DIAMETER: 1.100 m

INNER DIAMETER: 0.085 m

14.374 Bearing element

LENGTH: 0.289 m

OUTER DIAMETER: 0.600 m

INNER DIAMETER: 0.085 m

14.374 M/E #6

EXTENSION: 0.516 m

DIAMETRICAL CLEARANCE: 0.000 mm

Bearing offset horizontal

OFFSET HORIZONTAL: 0.00 mm

Bearing offset vertical

OFFSET VERTICAL: -4.60 mm

Thermal expansion vertical

Operating condition 4 (HOT 100%)

THERMAL EXPANSION VERTICAL: 0.24 mm

14.601 Bearing element

LENGTH: 0.227 m

OUTER DIAMETER: 0.324 m

INNER DIAMETER: 0.000 m

Program default

DENSITY: 0 kg/m3

Jack load verification

14.799 Engine shaft element

LENGTH: 0.198 m

OUTER DIAMETER: 0.324 m

INNER DIAMETER: 0.000 m

Program default

DENSITY: 0 kg/m3

14.799 Load in vertical

Operating condition 1 (COLD 50%)

LOAD VERTICAL: 91400 N

14.799 Load in vertical

Operating condition 2 (COLD 75%)

LOAD VERTICAL: 91400 N

14.799 Load in vertical

Operating condition 3 (COLD 100%)

LOAD VERTICAL: 91400 N

14.799 Load in vertical

Operating condition 4 (HOT 100%)

LOAD VERTICAL: 91400 N

14.997 Engine shaft element

LENGTH: 0.198 m

OUTER DIAMETER: 0.324 m

INNER DIAMETER: 0.000 m

Program default

DENSITY: 0 kg/m3

Jack load verification

15.224 Bearing element

LENGTH: 0.227 m

OUTER DIAMETER: 0.324 m

INNER DIAMETER: 0.000 m

Program default

DENSITY: 0 kg/m3

15.224 M/E #5

EXTENSION: 0.454 m

DIAMETRICAL CLEARANCE: 0.000 mm

Bearing offset horizontal

OFFSET HORIZONTAL: 0.00 mm

Bearing offset vertical

OFFSET VERTICAL: -4.60 mm

Thermal expansion vertical

Operating condition 4 (HOT 100%)

THERMAL EXPANSION VERTICAL: 0.24 mm

15.451 Bearing element

LENGTH: 0.227 m

OUTER DIAMETER: 0.324 m

INNER DIAMETER: 0.000 m

Program default

DENSITY: 0 kg/m3

15.649 Engine shaft element

LENGTH: 0.198 m

OUTER DIAMETER: 0.324 m

INNER DIAMETER: 0.000 m

Program default

DENSITY: 0 kg/m3

15.649 Load in vertical

Operating condition 1 (COLD 50%)

LOAD VERTICAL: 91400 N

15.649 Load in vertical

Operating condition 2 (COLD 75%)

LOAD VERTICAL: 91400 N

15.649 Load in vertical

Operating condition 3 (COLD 100%)

LOAD VERTICAL: 91400 N

15.649 Load in vertical

Operating condition 4 (HOT 100%)

LOAD VERTICAL: 91400 N

15.847 Engine shaft element

LENGTH: 0.198 m

OUTER DIAMETER: 0.324 m

INNER DIAMETER: 0.000 m

Program default

DENSITY: 0 kg/m3

16.074 Bearing element

LENGTH: 0.227 m

OUTER DIAMETER: 0.324 m

INNER DIAMETER: 0.000 m

Program default

DENSITY: 0 kg/m3

16.074 M/E #4

EXTENSION: 0.454 m

DIAMETRICAL CLEARANCE: 0.000 mm

Bearing offset horizontal

OFFSET HORIZONTAL: 0.00 mm

Bearing offset vertical

OFFSET VERTICAL: -4.60 mm

Thermal expansion vertical

Operating condition 4 (HOT 100%)

THERMAL EXPANSION VERTICAL: 0.24 mm

16.301 Bearing element

LENGTH: 0.227 m

OUTER DIAMETER: 0.324 m

INNER DIAMETER: 0.000 m

Program default

DENSITY: 0 kg/m3

16.499 Engine shaft element

LENGTH: 0.198 m

OUTER DIAMETER: 0.324 m

INNER DIAMETER: 0.000 m

Program default

DENSITY: 0 kg/m3

16.499 Load in vertical

Operating condition 1 (COLD 50%)

LOAD VERTICAL: 91400 N

16.499 Load in vertical

Operating condition 2 (COLD 75%)

LOAD VERTICAL: 91400 N

16.499 Load in vertical

Operating condition 3 (COLD 100%)

LOAD VERTICAL: 91400 N

16.499 Load in vertical

Operating condition 4 (HOT 100%)

LOAD VERTICAL: 91400 N

16.697 Engine shaft element

LENGTH: 0.198 m

OUTER DIAMETER: 0.324 m

INNER DIAMETER: 0.000 m

Program default

DENSITY: 0 kg/m3

16.924 Bearing element

LENGTH: 0.227 m

OUTER DIAMETER: 0.324 m

INNER DIAMETER: 0.000 m

Program default

DENSITY: 0 kg/m3

16.924 M/E #3

EXTENSION: 0.454 m

DIAMETRICAL CLEARANCE: 0.000 mm

Bearing offset horizontal

OFFSET HORIZONTAL: 0.00 mm

Bearing offset vertical

OFFSET VERTICAL: -4.60 mm

Thermal expansion vertical

Operating condition 4 (HOT 100%)

THERMAL EXPANSION VERTICAL: 0.24 mm

17.151 Bearing element

LENGTH: 0.227 m

OUTER DIAMETER: 0.324 m

INNER DIAMETER: 0.000 m

Program default

DENSITY: 0 kg/m3

17.349 Engine shaft element

LENGTH: 0.198 m

OUTER DIAMETER: 0.324 m

INNER DIAMETER: 0.000 m

Program default

DENSITY: 0 kg/m3

17.349 Load in vertical

Operating condition 1 (COLD 50%)

LOAD VERTICAL: 91400 N

17.349 Load in vertical

Operating condition 2 (COLD 75%)

LOAD VERTICAL: 91400 N

17.349 Load in vertical

Operating condition 3 (COLD 100%)

LOAD VERTICAL: 91400 N

17.349 Load in vertical

Operating condition 4 (HOT 100%)

LOAD VERTICAL: 91400 N

17.547 Engine shaft element

LENGTH: 0.198 m

OUTER DIAMETER: 0.324 m

INNER DIAMETER: 0.000 m

Program default

DENSITY: 0 kg/m3

17.774 Bearing element

LENGTH: 0.227 m

OUTER DIAMETER: 0.324 m

INNER DIAMETER: 0.000 m

Program default

DENSITY: 0 kg/m3

17.774 M/E #2

EXTENSION: 0.228 m

DIAMETRICAL CLEARANCE: 0.000 mm

Bearing offset horizontal

OFFSET HORIZONTAL: 0.00 mm

Bearing offset vertical

OFFSET VERTICAL: -4.60 mm

Thermal expansion vertical

Operating condition 4 (HOT 100%)

THERMAL EXPANSION VERTICAL: 0.24 mm

No optimization of bearing offset (forward be

17.775 Bearing element

LENGTH: 0.001 m

OUTER DIAMETER: 0.324 m

INNER DIAMETER: 0.000 m

Program default

DENSITY: 0 kg/m3

17.775 TOTAL

MASS: 32837 kg

DISTANCE TO THE CENTRE OF GRAVITY: 4.887 m

DENSITY: 7850 kg/m3

MODULUS OF ELASTICITY: .21*10¹² N/m2

SHEAR MODULUS: .81*10¹¹ N/M2

APPENDIX C

STATIC CONDITIONS

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Alignment

<Comments not specified>

@2004-04

Operating condition 1 (COLD 50%)

Vertical plane

A positive moment turns clockwise at the forward end.

A positive shear force points upward at the forward end.

| ELEMENT | DISTANCE | DEFLECTION | SLOPE | MOMENT | STRESS | SHEAR FORCE |
|-------------------|----------|------------|------------|--------|---------|-------------|
| ***** | ***** | ***** | ***** | ***** | ***** | ***** |
| | [m] | [mm] | [rad] | [Nm] | [N/mm2] | [N] |
| AFT END | 0.000 | -1.168 | 0.6305E-03 | 0 | 0 | 0 |
| Shaft | 0.050 | -1.136 | 0.6305E-03 | 7 | 0 | 296 |
| Shaft | 0.170 | -1.060 | 0.6305E-03 | 90 | 0 | 1093 |
| Propeller nut+cap | 0.170 | -1.060 | 0.6305E-03 | 90 | 0 | 7026 |
| Shaft | 0.290 | -0.985 | 0.6301E-03 | 981 | 0 | 7824 |
| Shaft | 0.310 | -0.972 | 0.6300E-03 | 1139 | 0 | 7946 |
| Shaft | 0.870 | -0.621 | 0.6234E-03 | 7003 | 0 | 13111 |
| Propeller mass co | 0.870 | -0.621 | 0.6234E-03 | 7003 | 0 | 141421 |
| Shaft | 1.430 | -0.285 | 0.5608E-03 | 87811 | 9 | 147300 |
| Shaft | 1.700 | -0.139 | 0.4977E-03 | 127998 | 13 | 150380 |
| Shaft | 1.850 | -0.067 | 0.4524E-03 | 150683 | 15 | 152091 |
| Bearing element | 2.003 | 0.000 | 0.3986E-03 | 174086 | 18 | 153837 |
| Aft S/T Brg | 2.003 | 0.000 | 0.3986E-03 | 174086 | 18 | -44222 |
| Bearing element | 2.800 | 0.204 | 0.1263E-03 | 142464 | 14 | -35130 |
| Shaft | 2.975 | 0.221 | 0.7344E-04 | 136491 | 14 | -33134 |
| Shaft | 3.475 | 0.221 | -.6596E-04 | 121350 | 12 | -27429 |
| Shaft | 4.005 | 0.150 | -.1976E-03 | 108415 | 11 | -21383 |
| Shaft | 4.205 | 0.106 | -.2437E-03 | 104366 | 10 | -19101 |
| Shaft | 4.400 | 0.054 | -.2870E-03 | 100858 | 10 | -16877 |
| Bearing element | 4.575 | 0.000 | -.3247E-03 | 98079 | 10 | -14880 |
| Fwd S/T Brg | 4.575 | 0.000 | -.3247E-03 | 98079 | 10 | -47951 |

| | | | | | | |
|-------------------|--------|--------|------------|--------|-----|--------|
| Bearing element | 4.750 | -0.060 | -.3603E-03 | 89862 | 9 | -45955 |
| Shaft | 5.105 | -0.201 | -.4233E-03 | 74267 | 7 | -41905 |
| Shaft | 5.255 | -0.266 | -.4465E-03 | 68125 | 7 | -39986 |
| Shaft | 5.405 | -0.335 | -.4677E-03 | 62271 | 6 | -38067 |
| Shaft | 6.145 | -0.719 | -.5704E-03 | 37310 | 5 | -29781 |
| General flange | 6.225 | -0.765 | -.5704E-03 | 35033 | 0 | -27132 |
| General flange | 6.305 | -0.810 | -.5704E-03 | 32968 | 0 | -24483 |
| Shaft | 6.805 | -1.112 | -.6275E-03 | 21876 | 3 | -19885 |
| Shaft | 7.305 | -1.436 | -.6637E-03 | 13083 | 2 | -15287 |
| Shaft | 7.805 | -1.774 | -.6839E-03 | 6588 | 1 | -10689 |
| Shaft | 8.305 | -2.119 | -.6929E-03 | 2393 | 0 | -6091 |
| Shaft | 8.805 | -2.466 | -.6956E-03 | 497 | 0 | -1493 |
| Shaft | 9.200 | -2.741 | -.6963E-03 | 625 | 0 | 2139 |
| Shaft | 9.330 | -2.832 | -.6967E-03 | 982 | 0 | 3365 |
| Bearing element | 9.500 | -2.950 | -.6976E-03 | 1691 | 0 | 4969 |
| Inter Brg | 9.500 | -2.950 | -.6976E-03 | 1691 | 0 | -36608 |
| Bearing element | 9.670 | -3.069 | -.6967E-03 | -4395 | 0 | -35004 |
| Shaft | 9.900 | -3.229 | -.6890E-03 | -12197 | -2 | -32835 |
| Shaft | 10.100 | -3.366 | -.6761E-03 | -18580 | -3 | -30995 |
| Shaft | 10.400 | -3.566 | -.6470E-03 | -27465 | -4 | -28237 |
| Shaft | 10.900 | -3.873 | -.5755E-03 | -40434 | -6 | -23638 |
| Shaft | 11.400 | -4.139 | -.4791E-03 | -51104 | -8 | -19040 |
| Shaft | 11.900 | -4.351 | -.3628E-03 | -59475 | -10 | -14442 |
| Shaft | 12.400 | -4.500 | -.2313E-03 | -65547 | -11 | -9844 |
| Shaft | 12.900 | -4.581 | -.8953E-04 | -69319 | -11 | -5246 |
| Shaft | 13.145 | -4.594 | -.1774E-04 | -70329 | -12 | -2993 |
| General flange | 13.225 | -4.596 | -.1774E-04 | -70412 | 0 | 924 |
| Engine flange | 13.290 | -4.597 | -.1774E-04 | -70249 | 0 | 4079 |
| Load in vertical | 13.290 | -4.597 | -.1774E-04 | -70249 | 0 | 86954 |
| Engine shaft elem | 13.332 | -4.598 | -.1752E-04 | -66537 | 0 | 89789 |
| Bearing element | 13.619 | -4.600 | -.6056E-05 | -39889 | -1 | 95910 |
| M/E #7 | 13.619 | -4.600 | -.6056E-05 | -39889 | -1 | 92477 |
| Bearing element | 13.873 | -4.600 | -.7465E-06 | -15712 | 0 | 97894 |
| Engine shaft elem | 13.979 | -4.600 | -.6736E-06 | -4927 | 0 | 105603 |
| Load in vertical | 13.979 | -4.600 | -.6736E-06 | -4927 | 0 | 26503 |
| Engine shaft elem | 14.011 | -4.600 | -.6640E-06 | -4041 | 0 | 28830 |

| | | | | | | |
|-------------------|--------|--------|------------|--------|----|--------|
| Engine shaft elem | 14.085 | -4.600 | -.6498E-06 | -1709 | 0 | 34212 |
| Bearing element | 14.374 | -4.600 | -.1414E-05 | 9068 | 0 | 40376 |
| M/E #6 | 14.374 | -4.600 | -.1414E-05 | 9068 | 0 | -44655 |
| Bearing element | 14.601 | -4.603 | -.9408E-05 | -1068 | 0 | -44655 |
| Engine shaft elem | 14.799 | -4.605 | 0.1595E-06 | -9909 | -2 | -44655 |
| Load in vertical | 14.799 | -4.605 | 0.1595E-06 | -9909 | -2 | 46744 |
| Engine shaft elem | 14.997 | -4.603 | 0.9366E-05 | -654 | 0 | 46744 |
| Bearing element | 15.224 | -4.600 | 0.7234E-07 | 9956 | 2 | 46744 |
| M/E #5 | 15.224 | -4.600 | 0.7234E-07 | 9956 | 2 | -46591 |
| Bearing element | 15.451 | -4.603 | -.9256E-05 | -619 | 0 | -46591 |
| Engine shaft elem | 15.649 | -4.605 | -.1362E-06 | -9845 | -2 | -46591 |
| Load in vertical | 15.649 | -4.605 | -.1362E-06 | -9845 | -2 | 44808 |
| Engine shaft elem | 15.847 | -4.603 | 0.9292E-05 | -972 | 0 | 44808 |
| Bearing element | 16.074 | -4.600 | 0.1073E-05 | 9198 | 2 | 44808 |
| M/E #4 | 16.074 | -4.600 | 0.1073E-05 | 9198 | 2 | -42543 |
| Bearing element | 16.301 | -4.602 | -.7659E-05 | -458 | 0 | -42543 |
| Engine shaft elem | 16.499 | -4.604 | 0.4820E-06 | -8882 | -2 | -42543 |
| Load in vertical | 16.499 | -4.604 | 0.4820E-06 | -8882 | -2 | 48856 |
| Engine shaft elem | 16.697 | -4.602 | 0.7534E-05 | 791 | 0 | 48856 |
| Bearing element | 16.924 | -4.600 | -.5128E-05 | 11881 | 3 | 48856 |
| M/E #3 | 16.924 | -4.600 | -.5128E-05 | 11881 | 3 | -59678 |
| Bearing element | 17.151 | -4.604 | -.1534E-04 | -1665 | 0 | -59678 |
| Engine shaft elem | 17.349 | -4.608 | -.2135E-05 | -13481 | -4 | -59678 |
| Load in vertical | 17.349 | -4.608 | -.2135E-05 | -13481 | -4 | 31721 |
| Engine shaft elem | 17.547 | -4.606 | 0.1589E-04 | -7200 | -2 | 31721 |
| Bearing element | 17.774 | -4.600 | 0.2308E-04 | 0 | 0 | 31721 |
| M/E #2 | 17.774 | -4.600 | 0.2308E-04 | 0 | 0 | 0 |
| Bearing element | 17.775 | -4.600 | 0.2308E-04 | 0 | 0 | 0 |

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Alignment

<Comments not specified>

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Operating condition 2 (COLD 75%)

Vertical plane

A positive moment turns clockwise at the forward end.

A positive shear force points upward at the forward end.

| ELEMENT | DISTANCE | DEFLECTION | SLOPE | MOMENT | STRESS | SHEAR FORCE |
|-------------------|----------|------------|------------|--------|---------|-------------|
| ***** | ***** | ***** | ***** | ***** | ***** | ***** |
| | [m] | [mm] | [rad] | [Nm] | [N/mm2] | [N] |
| AFT END | 0.000 | -1.139 | 0.6148E-03 | 0 | 0 | 0 |
| Shaft | 0.050 | -1.108 | 0.6148E-03 | 7 | 0 | 296 |
| Shaft | 0.170 | -1.034 | 0.6148E-03 | 90 | 0 | 1093 |
| Propeller nut+cap | 0.170 | -1.034 | 0.6148E-03 | 90 | 0 | 7026 |
| Shaft | 0.290 | -0.960 | 0.6144E-03 | 981 | 0 | 7824 |
| Shaft | 0.310 | -0.948 | 0.6143E-03 | 1139 | 0 | 7946 |
| Shaft | 0.870 | -0.605 | 0.6077E-03 | 7003 | 0 | 13111 |
| Propeller mass co | 0.870 | -0.605 | 0.6077E-03 | 7003 | 0 | 136782 |
| Shaft | 1.430 | -0.278 | 0.5468E-03 | 85213 | 8 | 142661 |
| Shaft | 1.700 | -0.136 | 0.4856E-03 | 124148 | 12 | 145741 |
| Shaft | 1.850 | -0.065 | 0.4417E-03 | 146137 | 15 | 147453 |
| Bearing element | 2.003 | 0.000 | 0.3895E-03 | 168831 | 17 | 149198 |
| Aft S/T Brg | 2.003 | 0.000 | 0.3895E-03 | 168831 | 17 | -41851 |
| Bearing element | 2.800 | 0.200 | 0.1246E-03 | 139099 | 14 | -32759 |
| Shaft | 2.975 | 0.217 | 0.7297E-04 | 133541 | 13 | -30762 |
| Shaft | 3.475 | 0.218 | -.6387E-04 | 119585 | 12 | -25058 |
| Shaft | 4.005 | 0.148 | -.1942E-03 | 107907 | 11 | -19011 |
| Shaft | 4.205 | 0.104 | -.2402E-03 | 104332 | 10 | -16730 |
| Shaft | 4.400 | 0.053 | -.2836E-03 | 101287 | 10 | -14505 |
| Bearing element | 4.575 | 0.000 | -.3215E-03 | 98923 | 10 | -12509 |
| Fwd S/T Brg | 4.575 | 0.000 | -.3215E-03 | 98923 | 10 | -48171 |

| | | | | | | |
|-------------------|--------|--------|------------|--------|-----|--------|
| Bearing element | 4.750 | -0.060 | -.3574E-03 | 90668 | 9 | -46174 |
| Shaft | 5.105 | -0.199 | -.4211E-03 | 74995 | 7 | -42124 |
| Shaft | 5.255 | -0.265 | -.4444E-03 | 68820 | 7 | -40205 |
| Shaft | 5.405 | -0.333 | -.4658E-03 | 62933 | 6 | -38286 |
| Shaft | 6.145 | -0.716 | -.5698E-03 | 37809 | 6 | -30000 |
| General flange | 6.225 | -0.762 | -.5698E-03 | 35515 | 0 | -27351 |
| General flange | 6.305 | -0.807 | -.5698E-03 | 33433 | 0 | -24703 |
| Shaft | 6.805 | -1.108 | -.6277E-03 | 22231 | 3 | -20105 |
| Shaft | 7.305 | -1.433 | -.6646E-03 | 13328 | 2 | -15506 |
| Shaft | 7.805 | -1.772 | -.6852E-03 | 6724 | 1 | -10908 |
| Shaft | 8.305 | -2.117 | -.6944E-03 | 2419 | 0 | -6310 |
| Shaft | 8.805 | -2.465 | -.6970E-03 | 413 | 0 | -1712 |
| Shaft | 9.200 | -2.741 | -.6975E-03 | 454 | 0 | 1919 |
| Shaft | 9.330 | -2.831 | -.6978E-03 | 783 | 0 | 3146 |
| Bearing element | 9.500 | -2.950 | -.6985E-03 | 1454 | 0 | 4749 |
| Inter Brg | 9.500 | -2.950 | -.6985E-03 | 1454 | 0 | -36515 |
| Bearing element | 9.670 | -3.069 | -.6974E-03 | -4616 | 0 | -34911 |
| Shaft | 9.900 | -3.229 | -.6896E-03 | -12396 | -2 | -32741 |
| Shaft | 10.100 | -3.367 | -.6765E-03 | -18760 | -3 | -30902 |
| Shaft | 10.400 | -3.566 | -.6473E-03 | -27617 | -4 | -28143 |
| Shaft | 10.900 | -3.874 | -.5754E-03 | -40540 | -6 | -23545 |
| Shaft | 11.400 | -4.139 | -.4789E-03 | -51163 | -8 | -18947 |
| Shaft | 11.900 | -4.351 | -.3625E-03 | -59487 | -10 | -14349 |
| Shaft | 12.400 | -4.500 | -.2310E-03 | -65512 | -11 | -9751 |
| Shaft | 12.900 | -4.581 | -.8937E-04 | -69238 | -11 | -5153 |
| Shaft | 13.145 | -4.594 | -.1769E-04 | -70224 | -12 | -2899 |
| General flange | 13.225 | -4.596 | -.1769E-04 | -70300 | 0 | 1017 |
| Engine flange | 13.290 | -4.597 | -.1769E-04 | -70131 | 0 | 4172 |
| Load in vertical | 13.290 | -4.597 | -.1769E-04 | -70131 | 0 | 87047 |
| Engine shaft elem | 13.332 | -4.598 | -.1747E-04 | -66415 | 0 | 89882 |
| Bearing element | 13.619 | -4.600 | -.6030E-05 | -39741 | -1 | 96004 |
| M/E #7 | 13.619 | -4.600 | -.6030E-05 | -39741 | -1 | 92278 |
| Bearing element | 13.873 | -4.600 | -.7434E-06 | -15614 | 0 | 97695 |
| Engine shaft elem | 13.979 | -4.600 | -.6710E-06 | -4850 | 0 | 105404 |
| Load in vertical | 13.979 | -4.600 | -.6710E-06 | -4850 | 0 | 26304 |
| Engine shaft elem | 14.011 | -4.600 | -.6617E-06 | -3971 | 0 | 28631 |

| | | | | | | |
|-------------------|--------|--------|------------|--------|----|--------|
| Engine shaft elem | 14.085 | -4.600 | -.6477E-06 | -1653 | 0 | 34012 |
| Bearing element | 14.374 | -4.600 | -.1418E-05 | 9067 | 0 | 40177 |
| M/E #6 | 14.374 | -4.600 | -.1418E-05 | 9067 | 0 | -44653 |
| Bearing element | 14.601 | -4.603 | -.9409E-05 | -1069 | 0 | -44653 |
| Engine shaft elem | 14.799 | -4.605 | 0.1598E-06 | -9910 | -2 | -44653 |
| Load in vertical | 14.799 | -4.605 | 0.1598E-06 | -9910 | -2 | 46746 |
| Engine shaft elem | 14.997 | -4.603 | 0.9367E-05 | -654 | 0 | 46746 |
| Bearing element | 15.224 | -4.600 | 0.7320E-07 | 9956 | 2 | 46746 |
| M/E #5 | 15.224 | -4.600 | 0.7320E-07 | 9956 | 2 | -46592 |
| Bearing element | 15.451 | -4.603 | -.9256E-05 | -619 | 0 | -46592 |
| Engine shaft elem | 15.649 | -4.605 | -.1362E-06 | -9844 | -2 | -46592 |
| Load in vertical | 15.649 | -4.605 | -.1362E-06 | -9844 | -2 | 44807 |
| Engine shaft elem | 15.847 | -4.603 | 0.9291E-05 | -972 | 0 | 44807 |
| Bearing element | 16.074 | -4.600 | 0.1073E-05 | 9198 | 2 | 44807 |
| M/E #4 | 16.074 | -4.600 | 0.1073E-05 | 9198 | 2 | -42543 |
| Bearing element | 16.301 | -4.602 | -.7659E-05 | -458 | 0 | -42543 |
| Engine shaft elem | 16.499 | -4.604 | 0.4820E-06 | -8882 | -2 | -42543 |
| Load in vertical | 16.499 | -4.604 | 0.4820E-06 | -8882 | -2 | 48856 |
| Engine shaft elem | 16.697 | -4.602 | 0.7534E-05 | 791 | 0 | 48856 |
| Bearing element | 16.924 | -4.600 | -.5128E-05 | 11881 | 3 | 48856 |
| M/E #3 | 16.924 | -4.600 | -.5128E-05 | 11881 | 3 | -59678 |
| Bearing element | 17.151 | -4.604 | -.1534E-04 | -1665 | 0 | -59678 |
| Engine shaft elem | 17.349 | -4.608 | -.2135E-05 | -13481 | -4 | -59678 |
| Load in vertical | 17.349 | -4.608 | -.2135E-05 | -13481 | -4 | 31721 |
| Engine shaft elem | 17.547 | -4.606 | 0.1589E-04 | -7200 | -2 | 31721 |
| Bearing element | 17.774 | -4.600 | 0.2308E-04 | 0 | 0 | 31721 |
| M/E #2 | 17.774 | -4.600 | 0.2308E-04 | 0 | 0 | 0 |
| Bearing element | 17.775 | -4.600 | 0.2308E-04 | 0 | 0 | 0 |

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Alignment

<Comments not specified>

@2004-04

Operating condition 3 (COLD 100%)

Vertical plane

A positive moment turns clockwise at the forward end.

A positive shear force points upward at the forward end.

| ELEMENT | DISTANCE | DEFLECTION | SLOPE | MOMENT | STRESS | SHEAR FORCE |
|-------------------|----------|------------|-------------|--------|---------|-------------|
| ***** | ***** | ***** | ***** | ***** | ***** | ***** |
| | [m] | [mm] | [rad] | [Nm] | [N/mm2] | [N] |
| AFT END | 0.000 | -1.110 | 0.5991E-03 | 0 | 0 | 0 |
| Shaft | 0.050 | -1.080 | 0.5991E-03 | 7 | 0 | 296 |
| Shaft | 0.170 | -1.008 | 0.5991E-03 | 90 | 0 | 1093 |
| Propeller nut+cap | 0.170 | -1.008 | 0.5991E-03 | 90 | 0 | 7026 |
| Shaft | 0.290 | -0.936 | 0.5987E-03 | 981 | 0 | 7824 |
| Shaft | 0.310 | -0.924 | 0.5986E-03 | 1139 | 0 | 7946 |
| Shaft | 0.870 | -0.590 | 0.5920E-03 | 7003 | 0 | 13111 |
| Propeller mass co | 0.870 | -0.590 | 0.5920E-03 | 7003 | 0 | 132144 |
| Shaft | 1.430 | -0.271 | 0.5328E-03 | 82615 | 8 | 138023 |
| Shaft | 1.700 | -0.132 | 0.4735E-03 | 120298 | 12 | 141103 |
| Shaft | 1.850 | -0.063 | 0.4309E-03 | 141591 | 14 | 142814 |
| Bearing element | 2.003 | 0.000 | 0.3804E-03 | 163576 | 17 | 144560 |
| Aft S/T Brg | 2.003 | 0.000 | 0.3804E-03 | 163576 | 17 | -39480 |
| Bearing element | 2.800 | 0.196 | 0.1230E-03 | 135733 | 14 | -30387 |
| Shaft | 2.975 | 0.213 | 0.7250E-04 | 130590 | 13 | -28391 |
| Shaft | 3.475 | 0.214 | -0.6179E-04 | 117821 | 12 | -22686 |
| Shaft | 4.005 | 0.146 | -0.1908E-03 | 107399 | 11 | -16640 |
| Shaft | 4.205 | 0.103 | -0.2366E-03 | 104299 | 10 | -14358 |
| Shaft | 4.400 | 0.052 | -0.2801E-03 | 101716 | 10 | -12134 |
| Bearing element | 4.575 | 0.000 | -0.3183E-03 | 99767 | 10 | -10137 |
| Fwd S/T Brg | 4.575 | 0.000 | -0.3183E-03 | 99767 | 10 | -48390 |

| | | | | | | |
|-------------------|--------|--------|------------|--------|-----|--------|
| Bearing element | 4.750 | -0.059 | -.3546E-03 | 91473 | 9 | -46394 |
| Shaft | 5.105 | -0.198 | -.4188E-03 | 75722 | 7 | -42344 |
| Shaft | 5.255 | -0.263 | -.4424E-03 | 69515 | 7 | -40425 |
| Shaft | 5.405 | -0.331 | -.4640E-03 | 63595 | 6 | -38506 |
| Shaft | 6.145 | -0.713 | -.5692E-03 | 38308 | 6 | -30219 |
| General flange | 6.225 | -0.759 | -.5692E-03 | 35997 | 0 | -27571 |
| General flange | 6.305 | -0.804 | -.5692E-03 | 33897 | 0 | -24922 |
| Shaft | 6.805 | -1.105 | -.6280E-03 | 22585 | 3 | -20324 |
| Shaft | 7.305 | -1.430 | -.6655E-03 | 13573 | 2 | -15726 |
| Shaft | 7.805 | -1.769 | -.6865E-03 | 6859 | 1 | -11128 |
| Shaft | 8.305 | -2.116 | -.6958E-03 | 2444 | 0 | -6530 |
| Shaft | 8.805 | -2.464 | -.6983E-03 | 329 | 0 | -1931 |
| Shaft | 9.200 | -2.740 | -.6987E-03 | 283 | 0 | 1700 |
| Shaft | 9.330 | -2.831 | -.6989E-03 | 584 | 0 | 2926 |
| Bearing element | 9.500 | -2.950 | -.6995E-03 | 1218 | 0 | 4530 |
| Inter Brg | 9.500 | -2.950 | -.6995E-03 | 1218 | 0 | -36421 |
| Bearing element | 9.670 | -3.069 | -.6982E-03 | -4836 | 0 | -34817 |
| Shaft | 9.900 | -3.230 | -.6902E-03 | -12595 | -2 | -32648 |
| Shaft | 10.100 | -3.367 | -.6770E-03 | -18941 | -3 | -30808 |
| Shaft | 10.400 | -3.567 | -.6475E-03 | -27770 | -4 | -28050 |
| Shaft | 10.900 | -3.874 | -.5754E-03 | -40645 | -6 | -23451 |
| Shaft | 11.400 | -4.140 | -.4787E-03 | -51221 | -8 | -18853 |
| Shaft | 11.900 | -4.351 | -.3622E-03 | -59499 | -10 | -14255 |
| Shaft | 12.400 | -4.501 | -.2308E-03 | -65477 | -11 | -9657 |
| Shaft | 12.900 | -4.581 | -.8922E-04 | -69157 | -11 | -5059 |
| Shaft | 13.145 | -4.594 | -.1763E-04 | -70120 | -12 | -2806 |
| General flange | 13.225 | -4.596 | -.1763E-04 | -70188 | 0 | 1111 |
| Engine flange | 13.290 | -4.597 | -.1763E-04 | -70013 | 0 | 4266 |
| Load in vertical | 13.290 | -4.597 | -.1763E-04 | -70013 | 0 | 87141 |
| Engine shaft elem | 13.332 | -4.598 | -.1741E-04 | -66294 | 0 | 89976 |
| Bearing element | 13.619 | -4.600 | -.6003E-05 | -39592 | -1 | 96097 |
| M/E #7 | 13.619 | -4.600 | -.6003E-05 | -39592 | -1 | 92079 |
| Bearing element | 13.873 | -4.600 | -.7402E-06 | -15516 | 0 | 97496 |
| Engine shaft elem | 13.979 | -4.600 | -.6685E-06 | -4773 | 0 | 105205 |
| Load in vertical | 13.979 | -4.600 | -.6685E-06 | -4773 | 0 | 26105 |
| Engine shaft elem | 14.011 | -4.600 | -.6593E-06 | -3900 | 0 | 28432 |

| | | | | | | |
|-------------------|--------|--------|------------|--------|----|--------|
| Engine shaft elem | 14.085 | -4.600 | -.6457E-06 | -1597 | 0 | 33813 |
| Bearing element | 14.374 | -4.600 | -.1422E-05 | 9065 | 0 | 39978 |
| M/E #6 | 14.374 | -4.600 | -.1422E-05 | 9065 | 0 | -44651 |
| Bearing element | 14.601 | -4.603 | -.9410E-05 | -1070 | 0 | -44651 |
| Engine shaft elem | 14.799 | -4.605 | 0.1602E-06 | -9911 | -2 | -44651 |
| Load in vertical | 14.799 | -4.605 | 0.1602E-06 | -9911 | -2 | 46748 |
| Engine shaft elem | 14.997 | -4.603 | 0.9368E-05 | -654 | 0 | 46748 |
| Bearing element | 15.224 | -4.600 | 0.7405E-07 | 9957 | 2 | 46748 |
| M/E #5 | 15.224 | -4.600 | 0.7405E-07 | 9957 | 2 | -46592 |
| Bearing element | 15.451 | -4.603 | -.9256E-05 | -619 | 0 | -46592 |
| Engine shaft elem | 15.649 | -4.605 | -.1363E-06 | -9844 | -2 | -46592 |
| Load in vertical | 15.649 | -4.605 | -.1363E-06 | -9844 | -2 | 44807 |
| Engine shaft elem | 15.847 | -4.603 | 0.9291E-05 | -972 | 0 | 44807 |
| Bearing element | 16.074 | -4.600 | 0.1073E-05 | 9198 | 2 | 44807 |
| M/E #4 | 16.074 | -4.600 | 0.1073E-05 | 9198 | 2 | -42543 |
| Bearing element | 16.301 | -4.602 | -.7659E-05 | -458 | 0 | -42543 |
| Engine shaft elem | 16.499 | -4.604 | 0.4820E-06 | -8882 | -2 | -42543 |
| Load in vertical | 16.499 | -4.604 | 0.4820E-06 | -8882 | -2 | 48856 |
| Engine shaft elem | 16.697 | -4.602 | 0.7534E-05 | 791 | 0 | 48856 |
| Bearing element | 16.924 | -4.600 | -.5128E-05 | 11881 | 3 | 48856 |
| M/E #3 | 16.924 | -4.600 | -.5128E-05 | 11881 | 3 | -59678 |
| Bearing element | 17.151 | -4.604 | -.1534E-04 | -1665 | 0 | -59678 |
| Engine shaft elem | 17.349 | -4.608 | -.2135E-05 | -13481 | -4 | -59678 |
| Load in vertical | 17.349 | -4.608 | -.2135E-05 | -13481 | -4 | 31721 |
| Engine shaft elem | 17.547 | -4.606 | 0.1589E-04 | -7200 | -2 | 31721 |
| Bearing element | 17.774 | -4.600 | 0.2308E-04 | 0 | 0 | 31721 |
| M/E #2 | 17.774 | -4.600 | 0.2308E-04 | 0 | 0 | 0 |
| Bearing element | 17.775 | -4.600 | 0.2308E-04 | 0 | 0 | 0 |

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Alignment

<Comments not specified>

@2004-04

Operating condition 4 (HOT 100%)

Vertical plane

A positive moment turns clockwise at the forward end.

A positive shear force points upward at the forward end.

| ELEMENT | DISTANCE | DEFLECTION | SLOPE | MOMENT | STRESS | SHEAR FORCE |
|-------------------|----------|------------|-------------|--------|---------|-------------|
| ***** | ***** | ***** | ***** | ***** | ***** | ***** |
| | [m] | [mm] | [rad] | [Nm] | [N/mm2] | [N] |
| AFT END | 0.000 | -1.118 | 0.6034E-03 | 0 | 0 | 0 |
| Shaft | 0.050 | -1.088 | 0.6034E-03 | 7 | 0 | 296 |
| Shaft | 0.170 | -1.016 | 0.6034E-03 | 90 | 0 | 1093 |
| Propeller nut+cap | 0.170 | -1.016 | 0.6034E-03 | 90 | 0 | 7026 |
| Shaft | 0.290 | -0.943 | 0.6030E-03 | 981 | 0 | 7824 |
| Shaft | 0.310 | -0.931 | 0.6028E-03 | 1139 | 0 | 7946 |
| Shaft | 0.870 | -0.595 | 0.5962E-03 | 7003 | 0 | 13111 |
| Propeller mass co | 0.870 | -0.595 | 0.5962E-03 | 7003 | 0 | 132144 |
| Shaft | 1.430 | -0.273 | 0.5371E-03 | 82615 | 8 | 138023 |
| Shaft | 1.700 | -0.134 | 0.4778E-03 | 120298 | 12 | 141103 |
| Shaft | 1.850 | -0.064 | 0.4352E-03 | 141591 | 14 | 142814 |
| Bearing element | 2.003 | 0.000 | 0.3846E-03 | 163576 | 17 | 144560 |
| Aft S/T Brg | 2.003 | 0.000 | 0.3846E-03 | 163576 | 17 | -37650 |
| Bearing element | 2.800 | 0.199 | 0.1260E-03 | 137192 | 14 | -28557 |
| Shaft | 2.975 | 0.216 | 0.7490E-04 | 132369 | 13 | -26561 |
| Shaft | 3.475 | 0.218 | -6.182E-04 | 120514 | 12 | -20856 |
| Shaft | 4.005 | 0.149 | -1.1945E-03 | 111062 | 11 | -14810 |
| Shaft | 4.205 | 0.106 | -2.2420E-03 | 108329 | 11 | -12528 |
| Shaft | 4.400 | 0.054 | -2.873E-03 | 106102 | 11 | -10304 |
| Bearing element | 4.575 | 0.000 | -3.272E-03 | 104474 | 10 | -8307 |
| Fwd S/T Brg | 4.575 | 0.000 | -3.272E-03 | 104474 | 10 | -51423 |

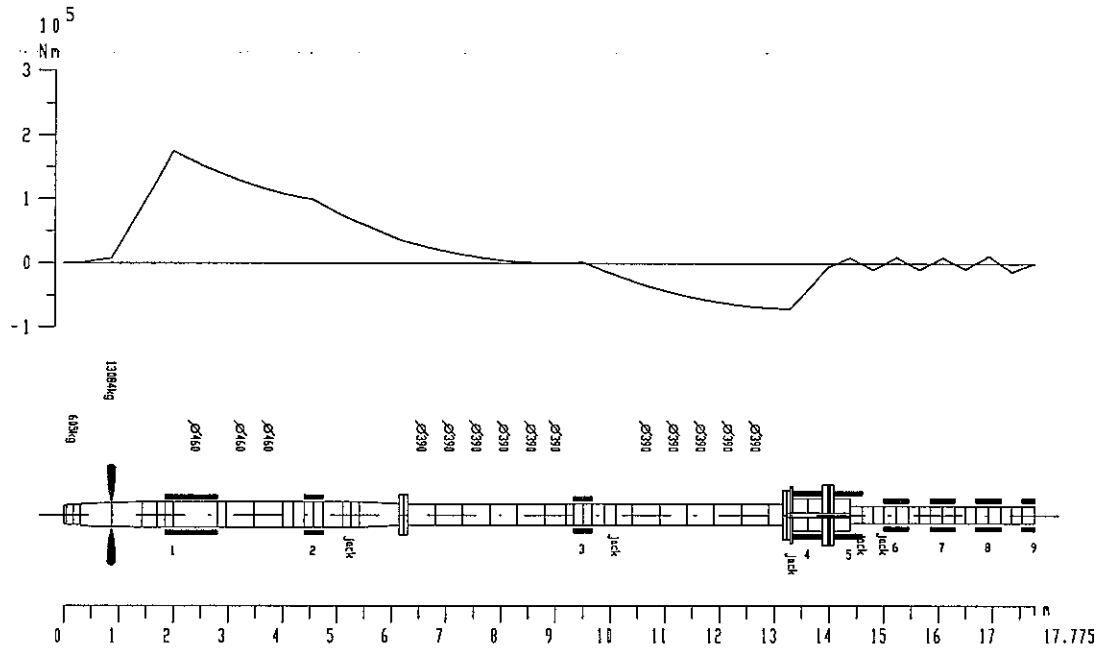
| | | | | | | |
|-------------------|--------|--------|------------|--------|----|--------|
| Bearing element | 4.750 | -0.061 | -.3651E-03 | 95649 | 10 | -49427 |
| Shaft | 5.105 | -0.204 | -.4321E-03 | 78822 | 8 | -45377 |
| Shaft | 5.255 | -0.271 | -.4566E-03 | 72159 | 7 | -43458 |
| Shaft | 5.405 | -0.342 | -.4790E-03 | 65784 | 6 | -41539 |
| Shaft | 6.145 | -0.736 | -.5863E-03 | 38253 | 6 | -33252 |
| General flange | 6.225 | -0.782 | -.5863E-03 | 35699 | 0 | -30604 |
| General flange | 6.305 | -0.829 | -.5863E-03 | 33357 | 0 | -27955 |
| Shaft | 6.805 | -1.139 | -.6423E-03 | 20529 | 3 | -23357 |
| Shaft | 7.305 | -1.469 | -.6739E-03 | 9999 | 1 | -18759 |
| Shaft | 7.805 | -1.811 | -.6859E-03 | 1769 | 0 | -14161 |
| Shaft | 8.305 | -2.154 | -.6830E-03 | -4161 | 0 | -9563 |
| Shaft | 8.805 | -2.493 | -.6700E-03 | -7793 | -1 | -4964 |
| Shaft | 9.200 | -2.755 | -.6559E-03 | -9036 | -1 | -1332 |
| Shaft | 9.330 | -2.840 | -.6512E-03 | -9130 | -1 | -106 |
| Bearing element | 9.500 | -2.950 | -.6450E-03 | -9012 | -1 | 1497 |
| Inter Brg | 9.500 | -2.950 | -.6450E-03 | -9012 | -1 | -29152 |
| Bearing element | 9.670 | -3.059 | -.6373E-03 | -13831 | -2 | -27549 |
| Shaft | 9.900 | -3.205 | -.6218E-03 | -19918 | -3 | -25379 |
| Shaft | 10.100 | -3.328 | -.6030E-03 | -24810 | -4 | -23540 |
| Shaft | 10.400 | -3.504 | -.5675E-03 | -31458 | -5 | -20781 |
| Shaft | 10.900 | -3.770 | -.4915E-03 | -40699 | -6 | -16183 |
| Shaft | 11.400 | -3.994 | -.3985E-03 | -47641 | -8 | -11584 |
| Shaft | 11.900 | -4.168 | -.2933E-03 | -52284 | -8 | -6986 |
| Shaft | 12.400 | -4.287 | -.1808E-03 | -54628 | -9 | -2388 |
| Shaft | 12.900 | -4.348 | -.6583E-04 | -54673 | -9 | 2209 |
| Shaft | 13.145 | -4.357 | -.1004E-04 | -53856 | -9 | 4462 |
| General flange | 13.225 | -4.358 | -.1004E-04 | -53342 | 0 | 8380 |
| Engine flange | 13.290 | -4.359 | -.1004E-04 | -52695 | 0 | 11535 |
| Load in vertical | 13.290 | -4.359 | -.1004E-04 | -52695 | 0 | 94410 |
| Engine shaft elem | 13.332 | -4.359 | -.9874E-05 | -48670 | 0 | 97245 |
| Bearing element | 13.619 | -4.360 | -.2476E-05 | -19882 | 0 | 103366 |
| M/E #7 | 13.619 | -4.360 | -.2476E-05 | -19882 | 0 | 65690 |
| Bearing element | 13.873 | -4.360 | -.3249E-06 | -2509 | 0 | 71108 |
| Engine shaft elem | 13.979 | -4.360 | -.3347E-06 | 5437 | 0 | 78817 |
| Load in vertical | 13.979 | -4.360 | -.3347E-06 | 5437 | 0 | -282 |
| Engine shaft elem | 14.011 | -4.360 | -.3463E-06 | 5465 | 0 | 2044 |

| | | | | | | |
|-------------------|--------|--------|------------|--------|----|--------|
| Engine shaft elem | 14.085 | -4.360 | -.3738E-06 | 5815 | 0 | 7425 |
| Bearing element | 14.374 | -4.360 | -.1929E-05 | 8852 | 0 | 13589 |
| M/E #6 | 14.374 | -4.360 | -.1929E-05 | 8852 | 0 | -44344 |
| Bearing element | 14.601 | -4.363 | -.9561E-05 | -1213 | 0 | -44344 |
| Engine shaft elem | 14.799 | -4.365 | 0.2070E-06 | -9994 | -2 | -44344 |
| Load in vertical | 14.799 | -4.365 | 0.2070E-06 | -9994 | -2 | 47055 |
| Engine shaft elem | 14.997 | -4.363 | 0.9507E-05 | -676 | 0 | 47055 |
| Bearing element | 15.224 | -4.360 | 0.1871E-06 | 10004 | 2 | 47055 |
| M/E #5 | 15.224 | -4.360 | 0.1871E-06 | 10004 | 2 | -46661 |
| Bearing element | 15.451 | -4.363 | -.9222E-05 | -587 | 0 | -46661 |
| Engine shaft elem | 15.649 | -4.365 | -.1468E-06 | -9826 | -2 | -46661 |
| Load in vertical | 15.649 | -4.365 | -.1468E-06 | -9826 | -2 | 44738 |
| Engine shaft elem | 15.847 | -4.363 | 0.9260E-05 | -967 | 0 | 44738 |
| Bearing element | 16.074 | -4.360 | 0.1048E-05 | 9187 | 2 | 44738 |
| M/E #4 | 16.074 | -4.360 | 0.1048E-05 | 9187 | 2 | -42528 |
| Bearing element | 16.301 | -4.362 | -.7667E-05 | -466 | 0 | -42528 |
| Engine shaft elem | 16.499 | -4.364 | 0.4843E-06 | -8886 | -2 | -42528 |
| Load in vertical | 16.499 | -4.364 | 0.4843E-06 | -8886 | -2 | 48871 |
| Engine shaft elem | 16.697 | -4.362 | 0.7541E-05 | 789 | 0 | 48871 |
| Bearing element | 16.924 | -4.360 | -.5122E-05 | 11883 | 3 | 48871 |
| M/E #3 | 16.924 | -4.360 | -.5122E-05 | 11883 | 3 | -59680 |
| Bearing element | 17.151 | -4.364 | -.1533E-04 | -1663 | 0 | -59680 |
| Engine shaft elem | 17.349 | -4.368 | -.2135E-05 | -13480 | -4 | -59680 |
| Load in vertical | 17.349 | -4.368 | -.2135E-05 | -13480 | -4 | 31719 |
| Engine shaft elem | 17.547 | -4.366 | 0.1589E-04 | -7200 | -2 | 31719 |
| Bearing element | 17.774 | -4.360 | 0.2308E-04 | 0 | 0 | 31719 |
| M/E #2 | 17.774 | -4.360 | 0.2308E-04 | 0 | 0 | 0 |
| Bearing element | 17.775 | -4.360 | 0.2308E-04 | 0 | 0 | 0 |

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SAMJIN
<Comments not specified>

DNV Software
Alignment
E2004-04

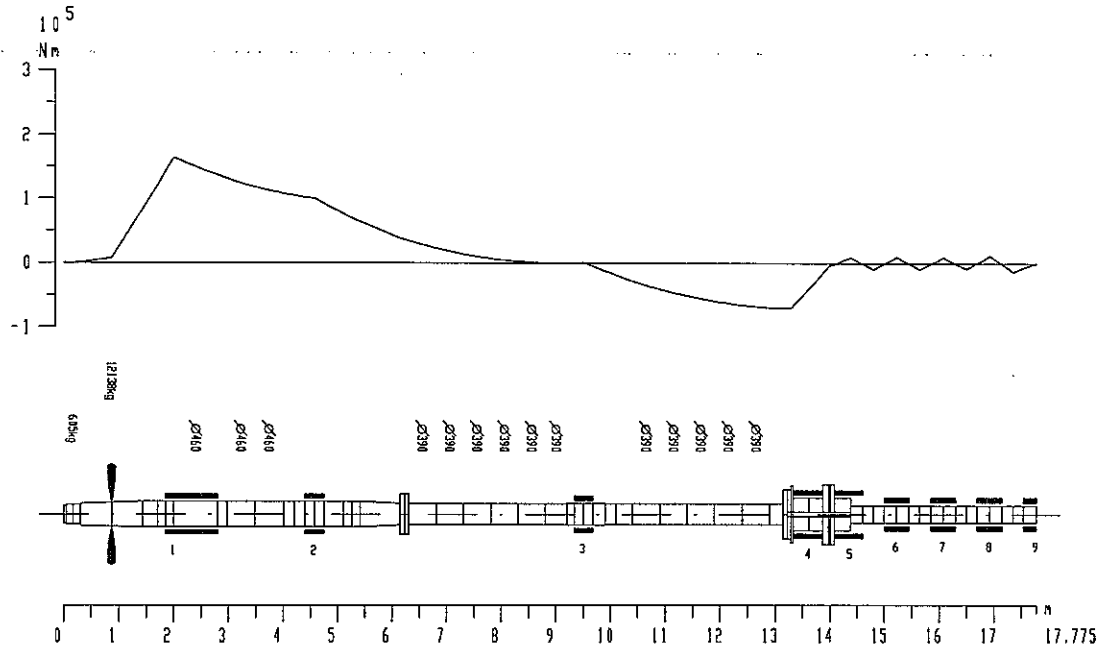
BENDING MOMENT Operating condition 1 (COLD 50%)



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SAMJIN
<Comments not specified>

DNV Software
Alignment
82004-04

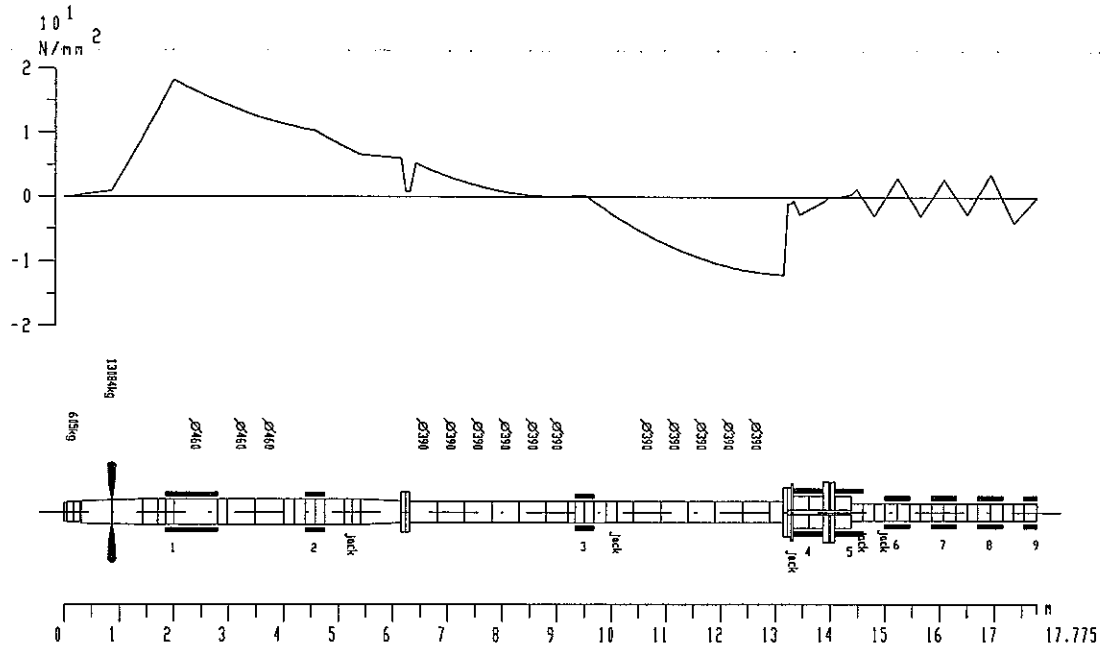
BENDING MOMENT
Operating condition 3 (COLD 100%)



2008-12- 1 15:42
SAMJIN
(Comments not specified)

DNV Software
Alignment
02004-04

STRESS
Operating condition 1 (COLD 50%)



DNV Software
Alignment
02004-04

Operating condition 3 (COLD 100%)

