MIL-STD-1302(SHIPS)
17 June 1966

MILITARY STANDARD

REPORTS, PUMP DESIGN EVALUATION FOR NAVAL SHIPBOARD CENTRIFUGAL PUMPS

FSC MISC

DEPARTMENT OF THE NAVY

NAVAL SHIP ENGINEERING CENTER

WASHINGTON, D. C. 20360

17 June 1966

Reports, Pump Design
Evaluation For Naval Shipboard
Centrifugal Pumps MIL-STD-1302(SHIPS)

1. This standard has been approved by the Naval Ship Engineering Center and is published to establish requirements for reports, pump design evaluation for Naval shipboard centrifugal pumps.

2. Use of this standard by activities under the cognizance of the Naval Ship Engineering Center shall be mandatory effective on date of issue.

3. Recommended corrections, additions, or deletions should be addressed to Commander, Naval Ship Engineering Center, Department of the Navy, Washington, D. C. 20360.

FOREWORD

This standard has been prepared to establish the requirements for reports which are intended for use by Government engineers in evaluating, design review, release for manufacture and as a permanent record of the design considerations, calculations and reliability of the pump(s) under a specific procurement.

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FIGURES

1. SCOPE

1.1 Scope. - This standard covers the requirements for the submission of manufacturer's design and engineering data, in the form of reports required in conjunction with the approval of pumps and release for fabrication of pumps or pump parts for each new design of pump, as specified in the applicable pump specification.

1.2 Classification. - Reports shall be of the following types, as specified (see 7.1):

Type I - Design concept release report.

Type II - Final design report.

2. REFERENCED DOCUMENTS

2.1 The following document, of the issue in effect on date of invitation for bids or request for proposal, forms a part of this standard to the extent specified herein.

PUBLICATIONS

MILITARY
DD441 (Attachment) - Industrial Security Manual for Safeguarding Classified Information.

(Copies of specifications, standards, drawings and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

3. GENERAL REQUIREMENTS

3.1 Material. - Material of the report shall be good commercial quality and shall be entirely suitable for the intended purpose.

3.2 Security. -

3.2.1 Security classification. - Security classification shall be assigned by the command or agency concerned and is usually specified by the Security Requirements Check List, DD Form 254, applicable to the specific contract.

3.2.2 Handling. - Secret and confidential reports shall be handled in accordance with the security requirements of the Industrial Security Manual for Safeguarding Classified Information, DD441.

3.2.3 Marking. - Classified reports shall be plainly and conspicuously marked secret or confidential, as appropriate, near the top and bottom of all pages and on the outside of the front and back covers. Markings shall be well clear of edges so as not to become covered in assembling and shall be in capital letters not less than 1/8 inch in height. In addition to the appropriate classification on each page, classified reports shall have the following paragraph printed on the title page:

> "This material contains information affecting the national defense of the United States within the meaning of the Espionage Laws, Title 18, U.S.C., Sections 793 and 794, the transmission or revelation of which in any manner to an unauthorized person is prohibited by law."

3.2.4 Automatic downgrading and declassification system. - All classified reports shall be assigned to one of four specified groups in accordance with DOD Directive 5200.10. Contractors shall affix this special notation immediately below, or adjacent to and in conjunction with, the classification marking at the bottom of the front cover and bottom of the title page. Group numbers shall be assigned by the command or agency concerned and are usually specified by Security Requirements Check List, DD Form 254 applicable to the specific contract.

3.3 Preparation of reports. -

3.3.1 Language. - It is intended that the material in all respects be written and presented in such fashion as to be readily understood by Government engineering personnel familiar with the subject matter. The text

of the report(s) shall be written in a manner and form that will provide for a permanent engineering record of the design consideration, calculations and reliability of the pump under all operating conditions.

3.3.2 Technical terms. - Familiar technical terms shall not be enclosed in quotation marks. Less familiar terms may be in quotation marks. Where such terms are used, they shall be explained by means of footnotes. Care shall be exercised in the use of letter abbreviations, Greek letter symbols and the like. In case of doubt or possible ambiguity in the use of symbols or terms they shall be explained in a nomenclature table or defined, including the unit of measurement used.

3.3.3 References. -

3.3.3.1 Reference to the paragraphs of the report(s) shall be by paragraph number.

3.3.3.2 Reference to illustrations and drawings shall be made by figure numbers.

3.3.3.3 Reference to the complete equipment and major assemblies thereof shall be made by Government model or type designation when such designations have been assigned. In the event no Government model or type designation is assigned, the contractor shall identify the pump by his own model and type number.

3.3.4 Pagination. - All pages shall be numbered.

3.3.5 Appendices, exhibits, tables, and so forth. - Appendices, exhibits, tables and so forth, shall be considered an integral part of the report and shall be properly designated.

3.3.6 Page size. - Page sheets shall be either 8 by 10-1/2 inches or 8-1/2 by 11 inches in size. Line illustrations, charts or graphs which cannot be included in pages of this size shall be arranged and folded to fall within the report.

3.3.7 Drawings. - Drawings shall be prepared with sharp, clean black lines on a white background.

3.3.8 Duplication process. - Copies of the report(s) shall be prepared by any combination of the following processes: mimeograph, duplimat, ozalid printing or processes acceptable to the command or agency concerned.

3.3.9 Title page. - The title page shall immediately precede the first page of the report proper. The information on the title page shall be as shown on figure 1 and shall include the markings specified in 3.2.3.

3.3.10 Abstract page. - The abstract shall consist of a brief summary of the report together with such general explanatory or background information as necessary to an understanding of the purpose and recommendation of the report. Insert next to title page.

3.3.11 Table of contents. - A table of contents identifying each paragraph by subject and page number shall be inserted following the abstract page.

3.3.12 Identification of technicians. - Names of engineers and engineering aides doing design work, making computations or directing the effort shall be identified.

3.3.13 References. - References listing the author, publication, volume or text for all assumptions made in the computations and for all formulae or method of computations not readily identifiable, or unique shall be cited.

4. DETAIL REQUIREMENTS

4.1 Type I, design concept release reports. -

4.1.1 Contents. - Technical contents shall be in sufficient detail to completely describe the design, physical appearance and internal assembly to permit release for preparation of detailed manufacturing

drawings and shall contain a complete analysis of hydraulic, mechanical, and structural considerations. Type I reports shall include a full discussion of the following:

(a) Pump performance curves.
(b) Number of stages, description of choice and reasons applying.
(c) Net positive suction head (NPSH) required under normal, maximum and minimum operating conditions.
(d) Axial hydraulic loads.
(e) Radial hydraulic loads.
(f) Rotating assembly, including shaft, shaft sleeves, wearing rings and other features.
(g) Casing design.
(h) Pump shaft sealing.
(i) Type of coupling.
(j) Pump bearings.
(k) Designed life.
(l) Mounting bracket or bedplate.
(m) Type of drive, description and suitability.
(n) Installation features including method of mounting in the ship.
(o) Any other design features which may be specifically identified in the purchase specifications.
(p) Any other design features which the manufacturer considers of significant interest to describe the proposed unit(s).

4.1.2 Basis for material selection. - Materials proposed for major components of the design shall be discussed and reasons for their selection set forth. These shall include the following:

(a) Casing.
(b) Diffusers and interstage pieces.
(c) Shafting.
(d) Shaft sleeves.
(e) Impellers.
(f) Wearing rings.
(g) Bearings (sleeve type).
(h) Packing or seals.
(i) Bedplate or mounting brackets.

4.1.3 Description of operation. - A complete description of the operating features as applicable to the proposed use of the pump in the system shall be included. Special note shall be made of those areas in which system design conditions, as furnished by the procuring activity, impose difficult or hazardous pump operation, possible redesign which would provide safe operation under all system design conditions, and reasons pertaining thereto.

4.1.4 Assembly and alignment. - A step-by-step description of the assembly and alignment of the unit and the dimensional requirements with tolerances for alignment shall be included. Any special tools, parts, or procedures necessary shall be identified including assembly procedures for repair parts.

4.1.5 Accessibility. - Access to the unit as mounted in the system shall be described. Particular note shall be made to the areas of stuffing box glands or seals, couplings, rotor removal, wearing ring replacement, and bearing replacement. Any areas which may present an accessibility problem to operating personnel shall be specifically pointed out and recommendations made as to how accessibility may be improved.

4.1.6 Operator hazard. - Any features of the design or operation which may present an unusual hazard to operating personnel shall be identified and the proper precautions to be followed shall be described.

4.1.7 Maintenance. - A description of maintenance requirements (periodic and overhaul) for satisfactory in-service operation shall be provided.

4.1.8 Design verification. - Calculations shall be submitted in detail including references, derivations, assumptions, and so forth, to cover the following design features. If necessary, additional subjects shall be covered.

(a) Hydraulic characteristics.
(b) Performance curves.

(c) Shafting analysis of pump and driver assembly including calculation of critical speed.
(d) Axial and radial thrust including direction (see 4.1.9).
(e) Bearing loads including direction and including gyroscopic effect.
(f) Bearing clearance ratios, L/D ratio and characteristic numbers.
(g) Minimum film thickness required and calculated under maximum radial and axial load conditions over the range of specified pump operating conditions.
(h) Lubricant flow rates, temperatures and viscosities.
(i) Centers of gravity and weights.
(k) Stress analysis of parts including stresses due to pressure, hydraulic loading, vibration, shock, thermal expansion, and so forth.
(l) Balancing required for rotating assembly.
(m) Analysis of driver suitability including bearing calculations.
(n) Calculation of the cumulative effect of dimensions and tolerances for parts and locations. These calculations shall demonstrate:

(1) Ability to avoid interferences as-built.
(2) Ability to avoid closing of operating clearances, and hence reduction in life of wearing parts, when these cumulative effects are combined with operational, environmental, and thermal loading.

(o) Predicted life of the equipment.

4.1.9 Bearing load calculations. - Calculations for bearing loading required in the report shall include the following:

(a) Axial and radial thrust loads and load directions. Loading should be calculated for the design point and also for the highest loaded conditions over the operating range. These loads shall include all operating loads together with those that might be induced by thermal expansion and by build up of tolerances in the completed assembly.
(b) Conditions which might cause thrust reversal shall be described.
(c) Bearing loads imposed by roll, pitch, list and trim of the ship (including gyroscopic effects) shall be considered in the bearing design.
(d) The radial loads at the impeller may be calculated by the formula:

$$P = \frac{KHD_2B_2}{2.31}$$

Where:

P = the radial load in pounds.
H = head in feet.
D_2 = impeller outside diameter, inches.
B_2 = impeller overall width including shroud, inches.
K = a constant which varies with capacity.

Unless data, supported by tests, justifies the selection of a lower value, K shall be assumed in accordance with the following table:

Casing type	K		
	At shut off	At rated flow	At 140 percent rated flow
Single volute	0.36	0.10	0.45
Double volute	0.17	0.05	0.10
Concentric	0.07	0.36	0.50
Vaned diffuser in volute	0.15	0.07	0.15
Vaned diffuser in concentric	0.07	0.03	0.15

4.1.10 Plans. - Sufficient plans shall be submitted to allow an independent review of the design. A sectional assembly and outline drawing with sufficient detail to fully present the unit is a minimum requirement. All dimensions and tolerances necessary to determine clearances between rotating and stationary parts, interference fits and tolerance stack-ups shall be provided.

4.2 Type II, final design report. -

4.2.1 Submission. - The final design report shall be prepared following approval of the design concept release report.

4.2.1.1 Release for manufacture of the units may precede the preparation of the final report. The final report must be completed except as noted in 4.2.3, and forwarded prior to completion of the manufactured unit.

4.2.2 Content. - The final report shall meet all the requirements for type I reports and shall contain the additional information specified in 4.2.2.1 through 4.2.2.4.

4.2.2.1 The final report is to factor in all resolutions of comments and to be complete in describing the unit(s) as built.

4.2.2.2 One complete set of plans including shop drawings are to be submitted with the final report.

4.2.2.3 Changes made to the unit following approval of the design concept release report and prior to the completion of the final report shall be included with justification and sufficient information to permit purchaser evaluation as provided by the design concept release report.

4.2.2.4 The final report shall include descriptions of endurance and acceptance testing, and any special tests which may be performed to verify new design features.

4.2.3 Addenda. - Any changes in pump design made subsequent to issue of the final report, or deviations of the submitted prototype test unit from the design described in the final report shall be submitted to the command or agency concerned for review and approval. When approved such changes shall be incorporated for issuance as an addendum to the final design report. The addendum shall include applicable revised drawings.

5. QUALITY ASSURANCE PROVISIONS

5.1 Reports shall be subject to preliminary inspection by the Government inspector and forwarded to the command or agency concerned for final approval.

5.2 Acceptance or approval of the report material in the course of preparation shall in no case be construed as a guarantee of acceptance of the finished product.

6. PREPARATION FOR DELIVERY

6.1 Reports shall be prepared for delivery in accordance with good commercial practice. Each package shall be labelled appropriately as to contents on the inside protective cover. Material in a classified security status shall be protected and handled in accordance with the Industrial Security Manual for Safeguarding Classified Information DD441.

7. NOTES

7.1 Ordering data. - Procurement documents should specify the following:

(a) Title, number and date of this specification.
(b) Type required (see 1.2).
(c) The number of copies of the design concept release report to be submitted.
(d) The number of copies of the final design report to be submitted.
(e) Security classification of report.
(f) Downgrading and declassification groups.

Preparing activity:
Navy - SH
(Project MISC-N221SH)

(CLASSIFICATION)

(DESIGN CONCEPT RELEASE REPORT)
(FINAL DESIGN REPORT)

FOR

(NOMENCLATURE OF PUMP AND SHIP OR PROJECT NUMBER APPLICABLE)

(DATE)

(NAME OF CONTRACTOR)

(CONTRACTOR'S ADDRESS)

NAVY DEPARTMENT-NAVAL SHIP ENGINEERING CENTER-(DIVISION)

(CONTRACT NUMBER or PURCHASE ORDER) (DATE)

(CLASSIFICATION)

Figure 1 - Title page.