NOTE: DOD-STD-2188 has been redesignated as a Design Criteria Standard. The cover page has been changed for Administrative reasons. There are no other changes to this Document.

METRIC

DOD-STD-2188 (SH)
1 APRIL 1987
SUPERSEDING
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MAY 1961

DEPARTMENT OF DEFENSE
DESIGN CRITERIA

BABBITTING OF BEARING SHELLS (METRIC)

AMSC N/A FSC 3120

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DEPARTMENT OF THE NAVY
NAVAL SEA SYSTEMS COMMAND

Washington, DC 20362-5101

Babbitting of Bearing Shells

1. This Military Standard is approved for use by the Naval Sea Systems Command, Department of the Navy, and is available for use by all Departments and Agencies of the Department of Defense.

2* Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Naval Sea Systems Command, SEA 5523, Department of the Navy, Washington, DC 20362-5101 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

FOREWORD

1. Babbitted bearings are widely used in applications that are not subjected to large reciprocating loads or elevated temperatures. In Naval ships, such applications include the main propulsion turbine, reduction gears and inboard shafting. Tin-based babbitt has long been the bearing surface material of choice in such applications because it combines good corrosion resistance, tolerance of misalignment and oil retention properties with the ability to heal over minor defects and to embed small dirt particles. Machining of bearing lands and surface finishing of babbitted surfaces are also comparatively easy.

2. This standard provides the procedures that are to be followed for preparation and tinning of the shell surfaces before babbitting, for casting the babbitt and for quenching parts and finishing the surfaces after babbitting.

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FIGURES

1. SCOPE

1.1 Scope. This standard provides the requirements for static and centrifugal casting of QQ-T-390, grade 2 babbitt on steel or bronze bearing shells.

2. REFERENCED DOCUMENTS

2.1 Government documents.

2.1.1 Specifications and standards. Unless otherwise specified, the following specifications and standards of the issue listed in that issue of the Department of Defense Index of Specifications and Standards (DoDISS) specified in the solicitation form a part of this standard to the extent specified herein.

SPECIFICATIONS

FEDERAL

QQ-T-371 - Tin, Pig.

QQ-T-390 - Tin Alloy Ingots and Castings and Lead Alloy Ingots and Castings (Antifriction Metal) for Bearing Applications.

STANDARDS

MILITARY

DOD-STD-2183 - Bond Testing, Babbitt Lined Bearings.

MIL-STD-45662 - Calibration Systems Requirements.

(Copies of specifications and standards required by contractors in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting officer.]

2.2 Order of precedence. In the event of a conflict between the text of this standard and the references cited herein, the text of this standard shall take precedence.

3. DEFINITIONS

3.1 Free spread. Free spread is the excess of the shell diameter measured in the plane of the parting line, over the shell diameter measured in the axial plane perpendicular to the plane of the parting line.

4. GENERAL REQUIREMENTS

4.1 General. All bearings ordered to be babbitted or rebabbitted in accordance with this standard shall meet the metallurgical bond test requirements specified in DOD-STD-2183 (see 5.9).

4.2 Manufacturing and quality control procedures. Manufacturing and quality control procedures shall produce babbitted or rebabbitted steel or bronze shell bearings with a ductile continuous bond between the babbitt and shell, and shell dimensions that will permit accurate installation in Naval machinery.

4.3 Manufacturing methods. Procedures shall be adaptable to static or centrifugal casting methods of tin-based babbitt. Shells may be new or rebabbitted, as specified (see 6.2)." Flame or plasma spraying shall not be used to babbitt or rebabbitt bearing shells or to repair bearing surfaces.

4.4 Quality control. Quality control procedures shall ensure that bond extent, strength and ductility meet the requirements of DOD-STD-2183. Quality control procedures shall ensure that bearing dimensions are within all requirements of the manufacturing drawings.

5. DETAILED REQUIREMENTS

5.1 Materials.

5.1.1 Tinning. Tinning processes shall employ commercially pure (99.75 percent) tin in accordance with QQ-T-371, grade A.

5.1.2 Babbitt. Babbitt meeting the requirements of QQ-T-390, grade 2 shall be employed on all bearings manufactured to this standard. Babbitt shall not be contaminated with lead or other impurities beyond the limits specified in QQ-T-390 for grade 2 babbitt.

5.1.3 Fluxes. Ammonium chloride for fluxing tinning pot and zinc chloride and ammonium chloride for fluxing shells shall be of commercial purity, conforming to the manufacturer's technical grade or better.

5.1.4 Cleaning and etching agents. The chemicals used in any of the shell cleaning operations shall be of commercial purity, conforming to the manufacturer's technical grade, or better.

5.1.5 Shell materials. The steel or bronze materials for the manufacture of new shells shall be as specified (see 6.2).

5.1.6 Asbestos. Under no conditions shall asbestos or products containing asbestos be used to fulfill any of the requirements mentioned in this standard.

5.2 Shell preparation.

5.2.1 Shells for rebabbitting or babbitting. New shells may be fabricated from plate stock by rolling, or cut from thick-walled cylinders or castings. Rebabbitting shall be limited to shells where the wall thickness is at least 12.5 millimeters (mm) (0.5 inch) and the finished babbitt thickness in the land regions of the babbitt is at least 1.6 mm (0.063 inch). Babbitting or rebabbitting of thin-wall precision inserts, such as for reciprocating engine bearings, is prohibited. Rebabbitting small bearings shall be performed only when it is cost-effective or when there is insufficient time to obtain new replacement bearings, 5.2.2 Shell machining. New shells shall conform to the dimensions specified in the manufacturing drawings except that a free spread of up to 0.18 mm (0.007 inch) is permitted to compensate for the closing in of the bearing that occurs when the babbitt is cast. The precise amount of free spread that should be present before babbitting depends on the shell material, babbitt thickness, pouring temperature and other factors. Generally this amount is determined empirically, and it may be introduced by plastic working of the shell after circular machining. Used shells considered for rebabbitting shall be inspected for major defects such as gross distortions, wear of the seating surface (or ball seat in bearings that have this alignment provision) and large nicks, dents and holes. Necessary repairs including plating, welding, machining and stress relief shall be made before rebabbitting to bring the shell into dimensional conformance with the manufacturing drawing. The original babbitt may be removed by melting out in a heated container or oven, or by machining. Free spread before rebabbitting shall be adjusted by plastic working of the shell to bring it to within the range permitted above for new shells.

5.2.3 Babbitt-shell interface machining. The surface of the shell to be babbitted on old and new bearings shall be finished with a single point high-speed tool bit to a surface finish of 130 roughness height rating or better, without the use of cutting fluid on the final cuts. Care shall be taken that the tool is sharp and that the babbitt shell interface is cut and free from the burnishing produced by worn cutting tool bits. Removal of original babbitt and new interface machining may reduce thickness of used shells below the original manufacturer's dimension. To be accepted for rebabbitting, the shell thickness, after interface machining, must be not less than the original manufacturer's dimension by more than 1.6 mm (0.063 inch) or 10 percent of the original manufacturer's dimension, whichever is smaller.

5.3 Shell cleaning. Shell cleaning is a critical step in preparing the shell for babbitting. High quality tinning will be achieved only if the surfaces are totally clean and free of contaminants. A high quality tin coating on the surfaces to be babbitted is essential for producing a continuous and high strength metallurgical bond between the babbitt and the shell. Various cleaning procedures may be used depending on the shell material and the processing steps that will be employed immediately before the tinning operation. Alternative cleaning procedures and the necessary steps in each case are described in 5.3.1 through 5.3.6. The method selected shall be based on the shell material, available equipment, lot size, comparative costs and other such factors. Once the shells have been cleaned chemically, care shall be taken to prevent any new contamination by oil or grease before tinning and subsequent babbitting. In all the cleaning procedures described in 5.3.1 through 5.3.6, the surfaces of the shell to be tinned and babbitted shall exhibit a clean matte finish after the final rinse. There shall be no breaks in the water surface as the shell is drained. Any break in the water film is evidence of surface contamination. The cleaning process shall be repeated on any shell that exhibits such water breaks after final rinse. The chemicals used in the cleaning procedures are hazardous.

5.3.1 Mild and silver steels, copper and wrought iron bearing shells. Oil and grease shall be removed by the following procedures and in the order s hewn:

(a) Remove oil and grease from the shell surface either by vapor decreasing with chemicals such as trichloroethylene or by immersion in a boiling 4-1/2 percent lye solution (45 grams of lye per liter of water (6 ounces per gallon)).
(b) Rinse in boiling water.
(c) Etch either by immersion in a 25 percent hydrochloric acid solution while the shell is still hot from the boiling water rinse, or by a l-minute. duration pickle in a boiling, 10-percent hydrochloric acid solution.
(d) Final rinse in clean boiling water.

5.3.2 Medium carbon steel bearing shells. Medium carbon steel bearing shells shall be cleaned by the following procedure and in the order shown:

(a) Clean the shell by immersion in a 60 percent nitric acid solution at room temperature until a uniform film of gas bubbles covers the shell.
(b) Rinse in clean boiling water.
(c) Etch either by immersion in a 25 percent hydrochloric acid solution while the shell is still hot from the boiling water rinse, or by a l-minute duration pickle in a boiling, 10-percent hydrochloric acid solution.
(d) Final rinse in clean boiling water.

5.3.3 Nickel steel bearing shells. Nickel steel bearing shells shall be prepared for tinning by anodic cleaning and etching. The shell shall be made anodic with a current density of 110 to 330 amperes per square meter (10-30 amperes per square foot) of surface area at 6 to 12 volts direct current (de), in a 30-percent sulfuric acid solution at 105 degrees Celcius ("C) (220 degrees Fahrenheit (*F)) for 3 minutes. All surfaces to be tinned shall have free access to the acid solution and shall not be covered by clamps or electrical connections . After anodic cleaning and etching, the shell shall be final rinsed in clean boiling water.

5.3.4 Tin bronze, phosphor bronze, brass and leaded brass bearing shells, Bronze and brass bearing shells shall be cleaned by the following procedure and in the order shown:

(a) Clean the shell by vapor decreasing with chemicals such as tri-chloroethylene, or by immersion in a boiling, 4-1/2 percent lye solution (45 grams of lye per liter of water (6 ounces per gallon)).
(b) Rinse in clean boiling water.
(c) Etch in 60 percent nitric acid solution.
(d) Dip in a 0.8 percent sodium cyanide solution (7.5 grams of sodium cyanide per liter of water (1 ounce per gallon)).
(e) Final rinse in clean boiling water.

NOTE : The sodium cyanide solution is toxic and suitable precautions must be taken in its preparation, use and disposal.

5.3.5 Cast iron bearing shells. Cast iron bearing shells shall be cleaned, etched and have surface graphite removed in a Kolene salt bath process. The procedure shall be as follows:

(a) Immerse the shell in a Kolene 4 bath at 480°C (900°F) with a minimum current density of 252 amperes per square meter (23.4 amperes per square foot) of shell surface area at 6 volts dc. Apply the following cycles in the order and for the time durations shown:

(1) First reduction cycle for 10 minutes.
(2) Oxidation cycle for 10 to 15 minutes.
(3) Second reduction cycle for 20 to 25 minutes.

(b) Remove shell from bath and rinse in agitated, clean cold water for 1 minute.
(c) Rinse in agitated, clean boiling water for 5 minutes.
(d) Etch by immersion in 10 percent hydrochloric acid solution for 30 seconds.
(e) Final rinse in agitated, clean boiling water.

5.3.6 Steel or bronze bearing shells. If a Kolene 4 bath is available, the following cleaning and etching procedure may be used for any steel or bronze shell in place of the procedures described in 5.3.1 through 5.3.4:

(a) Immerse the shell in the Kolene 4 bath at 480°C (900°F) with a minimum current density of 252 amperes per square meter (23.4 amperes per square foot) of shell surface area at 6 volts dc. Apply the following cycles in the order and for the time durations shown.

(1) First reduction cycle for 5 to 10 minutes.
(2) Oxidation cycles for 5 minutes.
(3) Second reduction cycle for 10 to 15 minutes.

(b) Remove shell from bath and rinse in agitated, clean cold water for 1 minute.
(c) Rinse in agitated, clean boiling water for 5 minutes.
(d) Etch by immersion in 10 percent hydrochloric acid solution for 1 minute.
(e) Final rinse in agitated, clean boiling water.

5.4 Shell stop-off. Shell portions not being tinned or babbitted shall be protected by a stop-off after cleaning and etching. The following are effective coatings or fillers:

(a) 30 percent sodium silicate, 50 percent clay, 20 percent water.
(b) High temperature cement.
(c) 10 percent sodium silicate, 90 percent magnesium hydroxide.
(d) Fire clay.

No stop-off material shall cover any surface requiring tinning. Any material to be immersed into the tin pot shall be heated above 120°C (250°F) to prevent steam explosions upon immersion.

5.5 Shell fluxing. After shell cleaning and stop-off coating, each shell shall have the surfaces to be babbitted fluxed by one of the methods specified in 5.5.1 or 5.5.2.

5.5.1 Bath fluxing. The shell to be bath fluxed shall be immersed in a molten zinc chloride bath at 300 to 350°C (570 to 660°F) for 5 minutes or until the shell comes to the bath temperature. The composition of the zinc chloride bath shall be 82 percent zinc chloride and 18 percent sodium chloride.

5.5.2 Brush or spray fluxing. The surfaces to be tinned shall be covered with one of the following fluxes:

(a) 50 percent zinc chloride and 50 percent water.
(b) Zinc ammonium chloride (90 percent zinc and 10 percent ammonium chloride) dissolved in water to a specific gravity of 1.5 and with the excess of flux visible in the solution.
(c) Solution consisting of:

Zinc chloride	400 grams	52 ounces
Aluminum chloride	25 grams	3 ounces
Stannous chloride	25 grams	3 ounces
Hydrochloric acid (28 to 30 percent concentration)	10 milliliters	1 ounce
Water	1 liter	1 gallon

The flux shall be applied by brushing or with a pneumatically operated flux sprayer. Shells, after brush or spray fluxing, shall be heated to or near the melting point of the flux to ensure that all water has been removed before the shells are immersed in the tin bath.

5.6 Tinning. A bath of molten tin conforming to QQ-T-371, grade A, shall be used for tinning bearing shells for babbitting. The bath shall be maintained at 305 to 330°C (580 to 630°F). A shallow layer of molten ammonium chloride shall be maintained on the surface of the tin pot to prevent the formation of excessive tin oxide. (Molten National Lead Company's DW Flux, or equal, may be used instead of ammonium chloride.) The bearing shell shall be immersed in the tin pot. The depth of the pot shall allow the tin to cover the shell. The shell shall be held in the tin pot until the shell reaches the temperature of the molten tin for a minimum of 55 seconds or until a smooth mirror-like surface is formed on the shell. A wire brush, applied to the surfaces to be tinned while the shell is immersed in the tin pot, may be used to achieve the required mirror-like surface. Unless the mirror-like surface is achieved, continuation of the babbitting process is not recommended since the bond will be inadequate. A careful inspection of the surfaces to be babbitted shall be made when the shell is withdrawn from the tin pot. Any breaks in the film of tin as it drains is evidence of a contaminated surface. The contaminated area of the shell surface may be wire brushed after the shell is re-immersed in the tin bath. Not more than two attempts shall be made to remove contamination by wire brushing,

5.6.1 Flux removal. After the shell has been withdrawn from the tin pot,
@ the major portion of the flux dragged out with the shell shall be removed by ladling molten tin over the surface of the shell having flux deposits.

5.6.2 Tinning controls. Tinning time and temperature have a significant effect on bond strength as well as the character of the bond obtained. Tinning temperatures less than 300°C (570°F) produce unacceptably weak bonds while temperatures higher than 400°C (750°F) for periods as short as 15 seconds can result in completely brittle bonds. The tinned surface shall have a smooth mirror-like appearance. If there is evidence of tin beading on the surface, the entire process shall be repeated because the surface was contaminated and a satisfactory bond would not have been attained.

5.7 Babbitting process. Either the static or the centrifugal babbitting processes may be used in the manufacture of babbitted or rebabbitted bearing shells to meet the requirements of this standard. Centrifugal casting provides more uniform babbitt structure and bond strength and is the preferred method when the necessary equipment is available. In the static babbitting process, the babbitt is poured into a stationary shell centered around a mandrel and having a riser on top of the shell to provide a positive head of babbitt on the cast lining. In the centrifugal babbitting process the shell is clamped between end plates and rotated so that the poured babbit is forced against the bore of the shell by the centrifugal force. The babbit is cast while the shell is rotating. In both processes the outside of the shell is quenched immediately after the pour is completed to initiate freezing along the bond surface at multiple sites. Detailed requirements are set forth in 5.7.1 through 5.7.2.2.

* 5.7.1 Static babbitting process. Static casting usually employs two half shells assembled to form the shell for a complete bearing. Single half shells may be cast but the jig is more complex. A simple jig that has proven effective is shown on figure 1. A heavy metal plate base is insulated to prevent loss of heat from the bearing shell before pouring. The mandrel is an insulated cylinder to prevent babbitt solidification from proceeding from the inside surface out. A simple wooden mandrel covered with ceramic paper has proven effective for small numbers of casting. More elaborate and permanent mandrels are possible if the production warrants the added cost. The mandrel shall allow substantial clearance between it and the bearing shell to accommodate centering errors and allow sufficient space for pouring babbitt without entrapping gas. The half shells are assembled with metal strips between the half shell parting line surface. The metal strips are faced on either side with ceramic paper. An additional ceramic paper strip backed by a metal strip is used on each side to fully cover each parting line at the outside surface of the assembled shell halves. The two half shells, metal and ceramic paper strips are assembled and clamping pressure is applied by twisted iron wires. Alternative clamping methods such as steel banding or quick acting clamps can be easily devised. The metal strips and ceramic paper between the faces of the parting lines provide for the slot width required in sawing the shells apart after babbitting and for sealing the molten babbitt during casting. A metal or wooden riser is placed on top of the shell assembly and secured by a metal cross-bar clamped in place by a nut and washer threaded onto a bolt which passes through the mandrel and the bottom base plate. The riser is intended to provide a head of molten babbitt of 2 inches or more to prevent gas entrapment and cavities in the shell babbitt. The top inside corner of the riser may be chamfered to provide additional pouring space if required.

5.7.1.2 Pouring for static babbitting. After assembly in the pouring jig, the shells shall be preheated and maintained at a temperature of 245°C (475°F) minimum to ensure that the tin is melted when the babbitt is poured. To avoid oxidation associated with prolonged heating, the preheat shall be done just before the babbitt is poured. When a torch is used for the preheating, the flame shall be reducing or neutral. If a metal mandrel is used, it must also be preheated to at least the same temperature as the shells. The babbitt used shall conform to QQ-T-390, grade 2. The babbitt shall be melted and held in a babbitt pot at 370 to 400°C (700 to 750°F). The babbitt shall be poured rapidly at a temperature of 360 to 400°C (675 to 750°F) by means of a pouring ladle. The ladle shall have been preheated and shall have sufficient capacity to complete the pour without the babbitt temperature dropping below 360°C (675°F). A bottom pour ladle is preferred, but a side pour ladle may be used provided there is an effective method of preventing oxides or other dross from entering the bearing babbitt. The riser shall be completely filled with babbitt upon completion of the pour. The babbitt in the riser shall be the last to solidify since the function of the riser is to provide a source of liquid babbitt to fill shrinkage cavities as the babbitt in the shell freezes.

5.7.1.3 Quenching static cast babbitted shells. The outside of the shell shall be quenched immediately upon completing the babbitt pour. Quenching the outside ensures that solidification will begin at many sites on the shell surface. This will prevent the formation of very large, similarly oriented crystals that can lead to the development of patterns of ripples on the bearing face and even to thermal cycle fatigue. This problem is most severe with thick-walled bearings. Quenching is best accomplished with a spray of cold water. A suitable arrangement for quenching is shown on figure 2. It consists of a circular annulus supplied by a 12.5 mm (0.5 inch) diameter pipe. Radial nozzles are drilled at intervals around the annulus so that complete 360-degree coverage of the outside of the bearing shell is achieved. The spray shall be directed at the bottom of the shell when first applied and gradually raised until the top of the shell is reached. Water shall not be allowed to contact the top bearing surface until it has frozen solid. Quenching shall continue until the babbitt temperature is reduced to 150 $\pm$ 5°C (300 $\pm$ 9°F), then allowed to air cool to room temperature.

5.7.2 Centrifugal casting process. Bearing shells shall be provided with spacers at the parting lines of the bearing to allow the two halves to be separated by sawing after the casting process is completed, means for retaining the spacers under the centrifugal loads imposed during the casting process and means for sealing the spacer-parting line interfaces under the fluid pressures generated by the centrifugal action during rotation. A variety of techniques are available for accomplishing the retention and sealing including the use of heavy metal ring clamps with high temperature sheet gasketing as separators, and steel cables or bands with metal spacers. The assembly of the half shells may be accomplished before or after tinning. The particular process used by the manufacturer is acceptable provided that the babbitt bond is satisfactory. The axis of rotation of the machine used for centrifugal casting may be either horizontal or vertical. The end plates contacting the bearing shell before the babbitt is poured shall be preheated to at least 260°C (500°F) and the pouring trough to 370°C (700°F). The manufacturer's normal practice in centering the shells for spinning is satisfactory if the resultant unbalance is less than 1 gram (0.036 ounce). Spinning speeds shall be within the following range:

Minimum revolutions per minute (r/rein) = $6000 / (D - 12.5)^{1/2}$,

Maximum r/rein = $7000 / (D - 12.5)^{1/2}$,

Where
D = Inside diameter of shell in mm.

Minimum r/rein = $1200 / (d - 0.5)^{1/2}$,

Maximum r/rein = $1400 / (d - 0.5)^{1/2}$,

Where
d = Inside diameter of shell in inches.

Higher speeds may be employed if it is demonstrated that the microstructure of the babbitt remains uniform from the shell to the bore of the finished bearing.

5.7.2.1 Pouring for centrifugal babbitting. After assembly in the machine used for the centrifugal casting, the shells shall be reheated and maintained at a temperature of 245°C (475°F) minimum before pouring the babbitt. A gas torch with reducing to near neutral flame shall be used for this purpose. The shell shall be at the full required spinning speed before the babbitt is poured. The babbitt used shall conform to QQ-T-390, grade 2, and the pouring temperature shall be 360 to 400°C (675 to 75001?). The pouring ladle shall have been pre-heated and shall have sufficient capacity to complete the pour without the temperature of the babbitt dropping below 360°C (675°F). A bottom pour ladle is preferred, but a side pour ladle may be used provided there is an effective method of preventing oxides or other dross from entering the bearing babbitt.

5.7.2.2 Quenching centrifugally cast babbitted shells. Immediately after the pour is completed, the outside surface of the spinning shell shall be quenched with a strong water spray. The quench shall continue until the shell reaches 150°C (300°F). The shell shall then be allowed to air cool to room temperature.

5.8 Post-babbitting machining. After removing the babbitted shell from the casting jig and sawing off the riser section, the two halves of the bearing shall be separated by sawing fully through the metal spacers and cast babbitt (all the way to the mandrel when used). A free spread of up to 0.018 mm (0.007 inch) is permitted after babbitting. Bearings which have closed in during babbitting may be corrected by springing their shells open beyond the drawing dimension and letting them come back to a positive free spread. Bearings which exhibit excessive free spread may be corrected by applying a steady compressive force parallel to the parting line of sufficient magnitude to plastically work the shell. Such corrections shall be limited to 1 percent (0.010 inch per inch) of shell outer diameter in order not to introduce excessive stresses. Shells requiring larger free spread corrections after babbitting should not be used but, when cost effective, they may be salvaged after removal of the babbitt by one or more cycles of reshaping and stress relief. Post-babbitting free spread shall not be corrected by peening or otherwise plastically working the babbit surface because such working affects babbitt structure and hardens the surface.

5.8.1 Finished bearing. After verification of the post-babbitting free spread in the bearing shell, the parting lines and distribution grooves shall be milled to conform to the requirements of the drawing. Unless otherwise specified in the contract or order, this drawing shall be prepared (see 6.3) and the assembled bearing shall be finish bored to the required clearance. The blending of the oil distributing grooves into the bearing surface shall be smooth and free of any sharp edges. The finished bearing shall be inspected for full conformance to the production or manufacturing drawings.

5.9 Metallurgical bond test. Bearings accepted as conforming to this specification shall be tested by the ultrasonic method for bond extent and by the Chalmers and chisel test methods for bond strength and ductility. Testing procedures and acceptance criteria shall be as specified in DOD-STD-2183. The ultrasonic test for bond extent is required for all bearings babbitted or re-babbitted in conformance with this specification. The Chalmers test and the chisel test are required on samples to be selected as specified in DOD-STD-2183.

5.10 Metrology equipment and facilities. Manufacturing shall have equipment and facilities suitable for the measurement of all manufacturing dimensions specified in bearing drawings up to a length of 1 meter (39.37 inches) with an accuracy of 0.025 mm (0.001 inch) or better. A system of calibration to control the accuracy of the measuring and test equipment in accordance with MIL-STD-45662 shall be employed.

5.10.1 Inspection system. An inspection system shall be prepared (see 6.3) for bearing dimensional measurements and for the tests of babbitt bond extent, strength and ductility.

6. NOTES

6.1 Intended use. This standard is intended to provide the procedures that must be followed for preparation and tinning of the shell surfaces before babbitting, for casting the babbitt and for quenching the parts and finishing the surfaces after babbitting.

6.2 Implementation guidance. When this standard is invoked, the following should be specified:

(a) If shells are to be new or rebabbitted (see 4.3).
(b) Steel or bronze materials to be used for new shells (see 5.1.5).

6.3 Data requirements. When this standard is used in an acquisition which incorporates a DD Form 1423, Contract Data Requirements List (CDRL), the data requirements identified below shall be developed as specified by an approved Data Item Description (DD Form 1664) and delivered in accordance with the approved CDRL incorporated into the contract. When the provisions of DoD FAR Supplement, Part 27, Sub-Part 27.410-6 (DD Form 1423) are invoked and the DD Form 1423 is not used, the data specified below shall be delivered by the contractor in accordance with the contract or purchase order requirements. Deliverable data required by this standard are cited in the following paragraphs.

Paragraph no.	Data requirement title	Applicable DID no.	Option
5.8.1	Drawings, engineering associated lists	DI-E-7031	Level 3
5.10.1	Inspection system program plan	DI-R-4803	

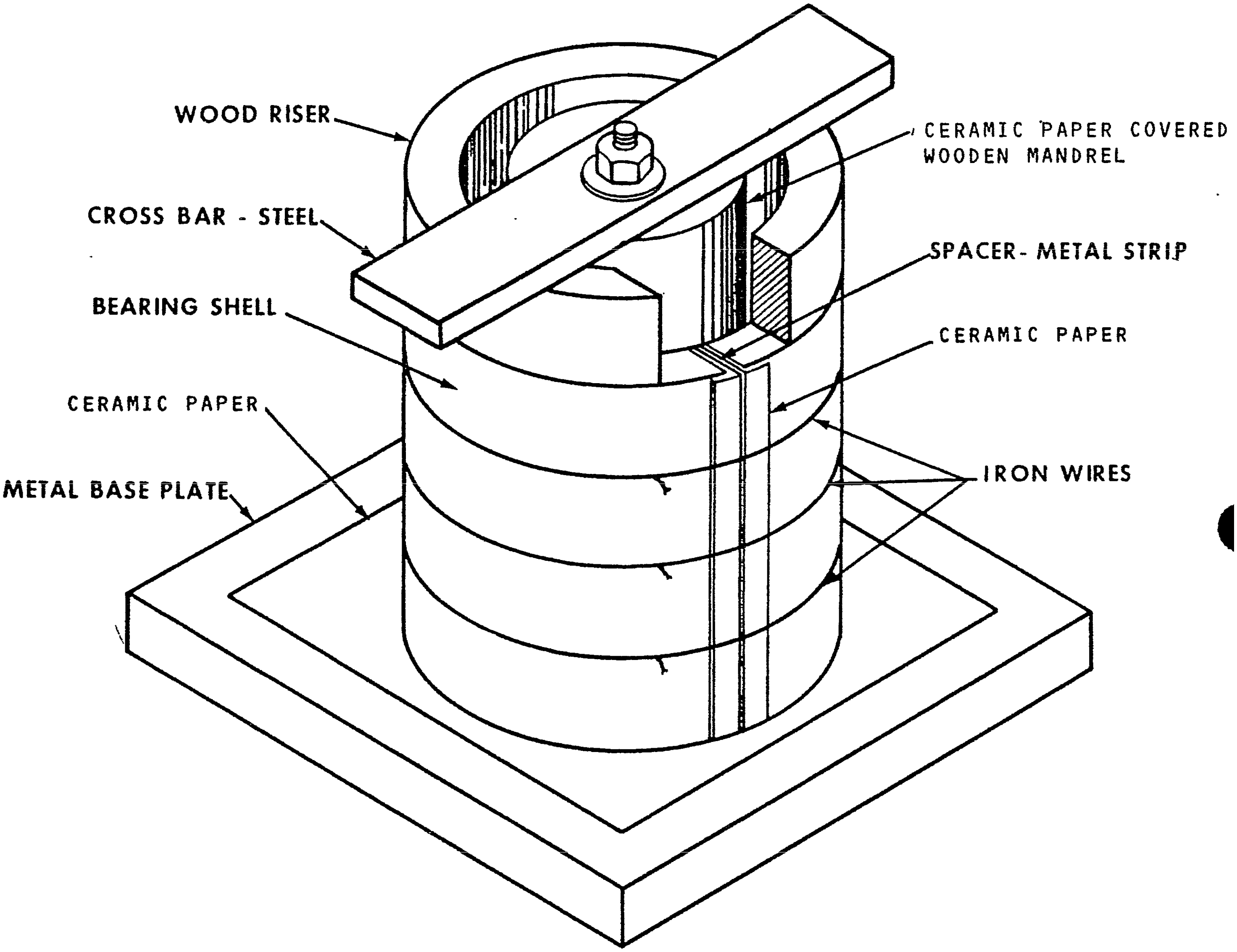
(Data item descriptions related to this standard, and identified in section 6 will be approved and listed as such in DoD 5010.12-L., AMSDL. Copies of data item descriptions required by the contractors in connection with specific acquisition functions should be obtained from the Naval Publications and Forms Center or as directed by the contracting officer.)

6.3.1 The data requirements of 6.3 and any task in sections 3, 4, or 5 of this standard required to be performed to meet a data requirement may be waived by the contracting/acquisition activity upon certification by the offeror that identical data were submitted by the offeror and accepted by the Government under a previous contract for identical item acquired to this standard. This does not apply to specific data which may be required for each contract regardless of whether an identical item has been supplied previously (for example, test reports).

6.4 Subject term (key word) listing.

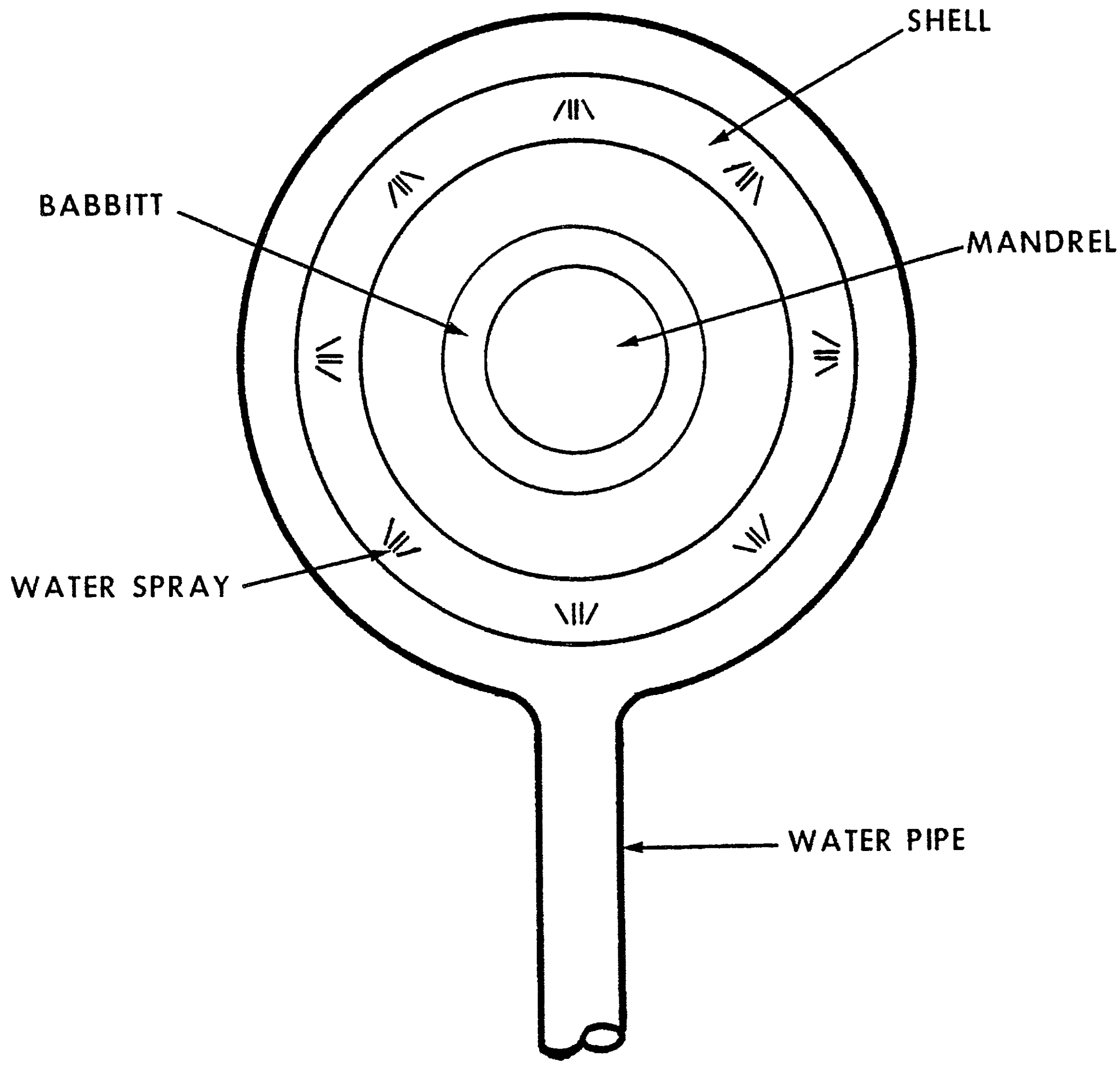
Babbitting
Bearing, shells, babbitting
Casting, static and centrifugal, babbitt
Inboard shafting, babbitting
Reduction gears, babbitting
Tin-based babbitting
Tinning, shell surfaces
Turbines, main propulsion, babbitting

Preparing activity:
Navy - SH
(Project 3120-N001)



SH 131807

FIGURE 1. Static casting jig.



SH 131808

FIGURE 2. Cooling water arrangement.

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions – Reverse Side)

1. DOCUMENT NUMBER	2. DOCUMENT TITLE
DOD-STD-2188(SH)	BABBITTING OF BEARING SHELLS (METRIC)

3a. NAME OF SUBMITTING ORGANIZATION

b. ADDRESS *(Street, City, State, ZIP Code)*

4. TYPE OF ORGANIZATION *(Mark one)*

- ☐ VENDOR
- ☐ USER
- ☐ MANUFACTURER
- ☐ OTHER *(Specify)*: ______

5. PROBLEM AREAS

a. Paragraph Number and Wording:

b. Recommended Wording:

c. Reason/Rationale for Recommendation:

6. REMARKS

7a. NAME OF SUBMITTER *(Last, First, MI)* – Optional

b. WORK TELEPHONE NUMBER *(Include Area Code)* – Optional

c. MAILING ADDRESS *(Street, City, State, ZIP Code)* – Optional

8. DATE OF SUBMISSION *(YYMMDD)*