INCH-POUND

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SUPERSEDING
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COMMERCIAL ITEM DESCRIPTION

ANTI-GALLING COMPOUND, THREAD LUBRICATING, SEIZING RESISTANT, AND CALCIUM HYDROXIDE CONTAINING

The General Services Administration has authorized the use of this Commercial Item Description, for all federal agencies.

1. SCOPE

1.1 Scope. This description covers a thread lubricant resistant to galling at room temperature, resistant to seizing at elevated temperatures, and having a low coefficient of friction range.

2. Salient characteristics.

2.1 Formulation.

2.1.1 The lubricant shall nominally consist of 15-16 weight percent calcium hydroxide, 10-11 weight percent zirconium dioxide, 5-6 weight percent polyisobutylene, 21 weight percent graphite, and mineral oil (balance).

2.1.2 Detrimental Materials: The lubricant shall contain less than 10 parts per million (ppm) mercury, and less than 250 ppm of each of the following elements: antimony, bismuth, cadmium, lead, tin, zinc, sulfur, phosphorus, chlorine, bromine, and fluorine.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, SEA 03Q, Naval Sea Systems Command, 2531 Jefferson Davis Highway, Arlington, VA 22242-5160 by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A FSC 9150

2.1.3 The lubricant shall have been certified and assigned a "Limited" or "Permitted" usage category in accordance with the Nuclear Powered Submarine Atmosphere Control Manual (NAVSEA S9510-AB-ATM-010 (U)).

2.1.4 The lubricant shall not contain any Class I or Class II ozone depleting substances as designated by the Environmental Protection Agency in 40 CFR 82.

2.2 Galling resistance.

2.2.1 Fastener materials tested in accordance with 2.2.3 shall show no evidence of galling, defined as: (a) inability to achieve loading to 67 percent of the fastener material yield strength, (b) audible "clicking" during the loading cycles of 2.2.3, or (c) gouges, greater than five occurrences of raised metal, or missing material from more than 5 percent of the engaged thread area, when examined at 2 OX magnification.

2.2.2 Fastener material test assemblies shall be prepared from three material combinations: (a) annealed UNS S30400 studs and nuts, (b) UNS G41400 quenched and tempered studs and nuts (minimum yield strength 105 ksi), and (c) UNS N05500 annealed and aged studs with UNS N04400 nuts. Studs shall be 3/4-10 UNC 2A, five inches long, with rolled threads. Nuts shall be 3/4-10 UNC 2B. For each material combination, two assemblies shall be tested. A carbon steel washer shall be used on each test assembly.

Visually inspect the stud and nut threads, the underside of the nuts, and the washer faces to ensure the absence of surface irregularities such as burrs, nicks, or displaced metal. The surface finish of these surfaces shall be 8 - 63 Ra.

2.2.3 Test procedure: Clean the fasteners. Apply the lubricant to the stud and nut threads, the underside of the nuts, and the washer faces. Wipe off any excess. Using a calibrated torque wrench with j_2 percent or better accuracy, torque the assembly to 67 ±5 percent of the yield strength of the stud. A torque-tension tester, such as a Skidmore-Wilhelm Model RL or equivalent, is recommended for this

test, assembled in accordance with figure 1. Untorque. Repeat three more torque/untorque cycles. Then clean off the lubricant completely, and inspect for galling. Reapply the lubricant, and perform four more torque/untorque cycles. Clean off the lubricant and inspect for galling again. All inspections shall be at 2 OX magnification.

2.3 Seizing resistance.

2.3.1 Fasteners tested in accordance with 2.3.3 shall show no evidence of seizing, defined as inability to disassemble the fastener assembly after elevated temperature exposure in accordance with 2.3.3, or a breakaway torque exceeding 300 percent of the installation torque after elevated exposure in accordance with 2.3.3, whichever occurs first. Also, lubricants shall be capable of removal from the studs by cloths dampened with denatured alcohol or isopropyl alcohol, after exposure in accordance with 2.3.3.

2.3.2 Fastener assembly test material combinations shall be the same as those used in the galling resistance test (2.2.2), except that no washer is required. For each material combination, one test assembly shall be tested. Fasteners shall be new and shall not have been used in previous tests.

Visually inspect the stud and nut threads, and the underside of the nuts to ensure the absence of surface irregularities such as burrs, nicks, or displaced metal. The surface finish of these surfaces shall be 8-63 Ra.

2.3.3 Test procedure: Clean the fasteners. Apply the lubricant to the stud and nut threads and to the nut mating surfaces. Wipe off any excess. Using a calibrated torque wrench with *j_2* percent or better accuracy, torque the nuts together to produce 67 15 percent of the yield strength of the stud. Disassemble, clean, and relubricate the threads and nuts. Retorque to 67 .15 percent of the yield strength of the stud, and record the torque value applied. Place the assemblies in a furnace for six weeks at 650°F ± 25°F. Remove and disassemble. Record the breakaway torque. Clean the studs with cloths dampened with denatured alcohol or isopropyl alcohol and visually inspect for lubricant removal.

2.4 Coefficient of friction.

2.4.11 Fasteners of material combination (a) of 2.4.2, when tested in accordance with 2.4.3, shall have a coefficient of friction range between 0.06 and 0.16 at the 90/95 tolerance level (i.e., 90 percent confidence that 95 percent of the data will fall within this range), and a mean value between 0.108 and 0.110. Fasteners of material combination (b), (c) and (d) of 2.4.2 shall have a coefficient of friction range between 0.07 and 0.12 at the 90/95 tolerance level (i.e., 90 percent confidence that 95 percent of the data will fall within this range), and a mean value between 0.089 and 0.100.

2.4.2 Fastener assembly test assemblies shall be prepared from four material combinations: (a) UNS N06625 studs and nuts in accordance with ASTM B446 Grade I, (b) bare UNS G41400 quenched and tempered studs and nuts (minimum 105 ksi yield strength), (c) manganese phosphate coated UNS G41400 quenched and tempered studs and nuts (minimum 105 ksi yield strength), and (d) UNS N05500 annealed and aged studs with UNS N04400 nuts. Studs shall be 3/4-10 UNC 2A, five inches long, with rolled threads. Nuts shall be 3/4-10 UNC 2B. For each material combination, five assemblies shall be tested, except that two assemblies shall be tested for the bare UNS G41400. Fasteners shall be new and shall not have been used in previous tests.

Visually inspect the stud and nut threads, and the underside of the nuts to ensure the absence of surface irregularities such as burrs, nicks, or displaced metal. The surface finish of these surfaces shall be 8-63 Ra.

2.4.3 Test procedure: Clean the fasteners. Apply the lubricant to the stud and nut threads, the underside of the nuts, and the washer faces. Wipe off any excess. Using a calibrated torque wrench with an accuracy of .12 percent or better and a Skidmore Wilhelm Model RL torque tension tester or equivalent, torque each assembly to 67 J.5 percent of the yield strength of the stud, in five approximately equal load increments. See Figure 1. Disassemble, relubricate, and repeat the torquing sequence (five increments up to 67 ±5 percent of the yield strength), recording the torque value for

each increment. Disassemble.

2.4.3.1 Repeat the procedure of 2.4.3.

2.4.3.2 Calculate the coefficient of friction for each torque increment during the relubricated cycles only of 2.4.3 and 2.4.3.1, using the equation given in Figure 2. Determine the 90/95 tolerance level for the range of the data and the mean, using standard statistical tables such as Table A-6 of Handbook 91, Experimental Statistics, U.S. Department of Commerce, published by the U.S. Government Printing Office, Washington DC 20402.

2.5 Corrosion resistance.

2.5.1 Lubricated fasteners tested in accordance with 2.5.3 through 2.5.6 shall show no pitting, corrosion, or degradation beyond that indicated in 2.5.3 through 2.5.6.

2.5.2 Four corrosion tests shall be performed, as detailed below. For Tests I and 2, studs shall be 2.5 inches long. For Tests 3 and 4, studs shall be 5.0 inches long. For all tests, studs shall be 3/4-10 UNC 2A and nuts shall be 3/4-10 UNC 2B. Fasteners shall be cleaned prior to testing.

2.5.3 Detailed requirements for Corrosion Test 1.

2.5.3.1 Specimen Preparation

2.5.3.1.1 Apply the lubricant to one stud and four nuts of each material code listed in table 1. Wipe off excess lubricant.

2.5.3.1.2 Prepare each test specimen by threading four nuts onto a stud of the same material code. Torque the first nut against the second nut and torque the third nut against the fourth nut. Torque to achieve 10 +_ *l* percent of the stud material yield strength.

2.5.3.1.3 After positioning the nuts, wipe the ends of the stud and the side faces of two of the four nuts with a clean cloth dampened with isopropyl alcohol to remove excess lubricant. Ensure that the lubricant covers the side faces of two remaining nuts.

2.5.3.2 Test Procedure

2.5.3.2.1 Place all test specimens into a furnace at 250°F ±

10°F and hold for 750 hours.

2.5.3.2.2 When the test run is completed, remove the test specimens from the furnace. Disassemble and clean the studs and nuts using clean nylon bristle brushes and inspect at 2 OX magnification. The amount of corrosive attack on the lubricated areas of the fasteners shall be no greater than on the unlubricated region of the fasteners.

2.5.4 Detailed requirements for Corrosion Test 2.

2.5.4.1 Specimen Preparation

2.5.4.1.1 Apply the lubricant to one stud and four nuts of each material code listed in table 1. Wipe off excess lubricant.

2.5.4.1.2 Each test specimen shall be prepared by threading four nuts onto a stud of the same material code. Torque the first nut against the second nut and torque the third nut against the fourth nut. Torque to achieve 10 ±l percent of the stud material yield strength.

2.5.4.1.3 After positioning the nuts, wipe the ends of the stud and the side faces of two of the four nuts with a cloth dampened with isopropyl alcohol to remove excess lubricant. Ensure that the lubricant covers the side faces of two remaining nuts.

2.5.4.1.4 For each material code listed in table I, one test specimen shall also be prepared without any lubricant applied to the stud and nut threads.

2.5.4.2 Test Procedure

2.5.4.2.1 Test specimens shall be placed into in a synthetic seawater solution in accordance with ASTM D 1141 at 175°F ± 5°F for a total of 750 hours.

A separate test solution shall be used for each alloy group (as listed in table 1). In addition, a separate test solution shall be used for the unlubricated control test specimen of each alloy group.

These tests shall be conducted in containers of similar size and shape and the same quantity of

solution shall be used in each of these tests. Test assembly should insure that each test specimen is electrically isolated from other test specimens and metallic materials.

2.5.4.2.2 After each 250 hours of exposure, remove the test specimens from the test solution and allow the test specimens to dry before returning them to the test solution.

2.5.4.2.3 When the test run is completed, the test specimens shall be removed from the solution and disassembled.

2.5.4.2.4 The studs and nuts shall be cleaned using clean nylon bristle brushes and inspected at 2 OX magnification. The amount of corrosive attack or degradation on the lubricated fasteners shall be no greater than the amount of attack or degradation on the unlubricated fasteners.

2.5.5 Detailed recruirements for Corrosion Test 3.

2.5.5.1 Specimen Preparation

2.5.5.1.1 Prior to assembling the test specimens, each stud shall be inspected by post-emulsifiable fluorescent liquid penetrant to identify any defects on the thread surface. Studs showing any indications shall be discarded and replaced.

2.5.5.1.2 Apply the lubricant to four studs and eight nuts of each material code in table 1. Wipe off excess lubricant.

2.5.5.1.3 Place two lubricated studs and four lubricated nuts of each material code listed in Table I in a furnace at 650°F ± 25°F for a sufficient time until the lubricant is dry to the touch.

2.5.5.1.4 Prepare six test specimens for each material code listed in table 1. The six test specimens for each material code shall consist of two sets of three different types of specimens- one type prepared from lubricated studs and nuts, one type prepared from lubricated studs and nuts which have been heated to volatilize organic constituents, and one type prepared using unlubricated studs and nuts. In addition, two test specimens shall be controls and shall be prepared using unlubricated studs and nuts.

2.5.5.1.5 Each test specimen shall consist of a stud of each material loaded to 90 to 100 percent of the yield

strength by torquing two nuts separated by a spacer. The spacer shall be fabricated from a nut of each material listed in table 1. The ends of the studs extending beyond the nuts may be cut off after preparing the test specimen.

2.5.5.2 Test Procedure

2.5.5.2.1 One set of three test specimens and one unlubricated control test specimen of each material code shall be immersed in a synthetic seawater solution in accordance with ASTM D 1141. A separate test solution shall be used for each alloy group (as listed in table 1). In addition, a separate test solution shall be used for the control test specimens of each alloy group.

2.5.5.2.2 The second set of three test specimens and one unlubricated control test specimen of each material code shall be immersed in a distilled water solution. A separate test solution shall be used for each alloy group (as listed in table 1). In addition, a separate test solution shall be used for the control test specimens of each alloy group -

2.5.5.2.3 Tests shall be conducted in containers of similar size and shape and the same quantity of test solution shall be used in each of these tests.

2.5.5.2.4 Each test solution shall be heated to 170°F minimum and held to evaporate all the water. Heat shall be applied to the test solution so that evaporation of all water will take more than 100 hours but not more than approximately 200 hours. Test assembly should insure that each test specimen is electrically isolated from other uest specimens and metallic materials. The contractor shall establish an appropriate heating rate prior to the start of testing.

2.5.5.2.5 Upon completion of evaporation, the test specimens shall be disassembled. The studs and nuts shall be cleaned using clean nylon bristle brushes and inspected at 2 OX magnification. The amount of corrosive attack or degradation on the lubricated fasteners shall be no greater than the amount of attack or degradation on the unlubricated fasteners.

2.5.5.2.6 Each stud shall be inspected by post-emulsifiable fluorescent liquid penetrant to identify any defects on the thread surface. The lubricated studs shall

show no more defects than the unlubricated studs.

2.5.6 Detailed requirements for Corrosion Test 4.

2.5.6.1 Specimen Preparation

2.5.6.1.1 Prior to assembling the test specimens, each stud shall be inspected by post-emulsifiable fluorescent liquid penetrant to identify any defects on the thread surface. Studs showing any indications shall be discarded and replaced.

2.5.6.1.2 Apply the lubricant to four titanium (Ti) studs and four steel (II) nuts - see table 1. Wipe off excess lubricant.

2.5.6.1.3 Place two titanium studs and two II nuts lubricated with the lubricant in a furnace at 650°F ± 25°F to volatilize organic constituents in the lubricant.

2.5.6.1.4 Prepare four test specimens by threading one II nut onto one titanium stud. Two of the test specimens shall consist of an as-lubricated stud and nut and two of the test specimens shall consist of a stud and nut which were lubricated and subsequently heated until the lubricant is dry to the touch.

2.5.6.1.5 Two control test specimens shall also be prepared without any lubricant applied to the titanium stud and II nut.

2.5.6.2 Hot Water Test Procedure

2.5.6.2.1 Two lubricated test specimens and one unlubricated control test specimen shall be immersed in a distilled water solution at 175°F ± 5°F for a total of 750 hours.

One of the two test specimens shall be as-lubricated and one shall consist of the titanium stud and II nut which were lubricated and subsequently heated to volatilize the organic constituents in the lubricant.

2.5.6.2.2 The two lubricated test specimens shall be tested in a separate container. A separate container shall also be used for the unlubricated test specimen. Tests shall be conducted in containers of similar size and shape and the same quantity of solution shall be used in each of these tests. Test assembly should insure that each test specimen is electrically isolated from other metallic materials.

2.5.6.2.3 After each 250 hours of exposure, remove each test specimen from the test solution and allow to dry before returning to the test solution.

2.5.6.2.4 When the test run is completed, the test specimens shall be removed from the solutions and disassembled. The studs and nuts shall be cleaned using clean nylon bristle brushes and inspected at 2 OX magnification. The amount of corrosive attack or degradation on the lubricated fasteners shall be no greater than the amount of corrosive attack or degradation on the unlubricated fasteners.

2.5.6.2.5 Each stud shall be inspected by post-emulsifiable fluorescent liquid penetrant to identify any defects on the thread surface. The lubricated studs shall show no more defects than the unlubricated studs.

2.5.6.3 Hot Air Test Procedure

2.5.6.3.1 Two lubricated test specimens and one unlubricated control test specimen shall be placed in a furnace at 250°F ± 10°F and held for 750 hours.

One of the two test specimens shall be as-lubricated and one shall consist of the titanium stud and II nut which were lubricated and subsequently heated to volatilize the organic constituents in the lubricant.

2.5.6.3.2 When the test run is completed, the test specimens shall be removed from the solution and disassembled.

2.5.6.3.3 The studs and nuts shall be cleaned using clean nylon bristle brushes and inspected at 2 OX magnification. The lubricated fasteners shall show no more corrosive attack or degradation than the unlubricated fasteners.

2.5.6.3.4 Each stud shall be inspected by post-emulsifiable fluorescent liquid penetrant to identify any defects on the thread surface. The lubricated studs shall show no more defects than the unlubricated studs.

TABLE I FASTENER HARDWARE

Alloy Group	Material Code	Stud Material	Nut Material
Iron Base Alloys	11	UNS G41400 ASTM A193 Grade B7	UNS G41400 ASTM A194, Grade 4
	12	UNS S30400 ASTM F593, Group 1	UNS S30400 ASTM F594, Group 1
Copper Base Alloys	Cl	UNS C71500 ASTM B151	UNS C71500 ASTM B151
	C2	UNS C63000 ASTM B124 or B150	UNS C63000 ASTM B124 or B150
Nickel Base Alloys	Nl	UNS N05500 QQ-N-286, Class A	UNS N04400 QQ-N-281, Class A
	N2	UNS N06625 ASTM B446, Grade 1	UNS N06625 ASTM B446, Grade 1
Titanium Base Alloys	Tl	UNS R50400 ASTM B348, Grade 2	UNS R50400 ASTM B348, Grade 2

3. Regulatory requirements . All appropriate regulatory requirements that apply to items offered on the commercial market shall apply to those offered to the Government.

4. Quality assurance provisions.

4.1 Contractor certification. The contractor shall certify and maintain substantiating evidence that the product offered meets the salient characteristics of this Commercial Item Description, and that the product conforms to the producer's own drawings, specifications, standards, and quality assurance practices, and is the same product offered for sale in the commercial marketplace. The Government reserves the right to require proof of such conformance prior to first delivery and thereafter as may be provided for under the provisions of the contract.

4.2 Preproduction Requirements. Prior to supplying material to this Commercial Item Description, the supplier shall provide objective evidence of successful completion of preproduction testing, consisting of 2.1.2, 2.1.3, 2.2, 2.3, 2.4, and 2.5.

Preproduction testing shall be repeated if the lubricant formulation is changed.

5. Preservation, packaging, labeling and marking. The lubricant shall be premixed and its container shall include a built-in applicator brush extending to within 1/4 inch of the bottom of the container. Preservation, labeling, marking and other packaging requirements shall be as specified in the contract or order, except as a minimum, the following warning shall be on each product container:

WARNING!

IRRITATES EYES, WEAR GOGGLES. IRRITATES SKIN, AVOID SKIN CONTACT, WEAR GLOVES. USE WITH VENTILATION TO MAINTAIN FUMES WITHIN INHALATION GUIDELINES, ESPECIALLY DURING THE FIRST 24 HOURS OF HIGH TEMPERATURE OPERATIONS AND DURING WELDING AND FLAME CUTTING.

In addition, the label shall include the following statement: STIR PRIOR TO USE.

6. Notes.

6.1 Suggested source of supply:

Molykote P37 (Manufacturer: Dow Corning, South Saginaw Road, Midland, MI 48686)

6.2 Source of Reference Documents.

6.2.1 ASTM Standards are available from the American Society for Testing and Materials, 1916 Race Street, Philadelphia PA 19103.

6.2.2 The Unified Numbering System (UNS) handbook is available from the Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

6.2.3 The Nuclear Powered Submarine Atmosphere Control Manual (NAVSEA S9510-AB-ATM-010(U)) is available from the Naval Sea Systems Command, SEA 03V22, 2531 Jefferson Davis Highway, Arlington, VA 22242-5160.

6.2.4 The Code of Federal Regulations (CFR) is available from the Superintendent of Documents, Government Printing Office, Washington, DC 20402.

6.3 Reguests for certification of lubricants not listed in Table A-12 of NAVSEA S9510-AB-ATM-010(U) can be made to the Naval Sea Systems Command in accordance

with paragraph 7-2.2 of the Nuclear Powered Submarine Atmosphere Control Manual (NAVSEA S9510-AB-ATM-010) . Product samples shall be submitted to the Naval Sea Systems Command, SEA 03V22, 2531 Jefferson Davis Highway, Arlington, VA 22242-5160. Upon successful completion of tests, NAVSEA 03V22 will certify the lubricant and include the product in Table A-12.

Preparing activity:
Navy – SH
(Project 9150-N823)

FIGURE 1

ANTI-GALLING TEST ASSEMBLY

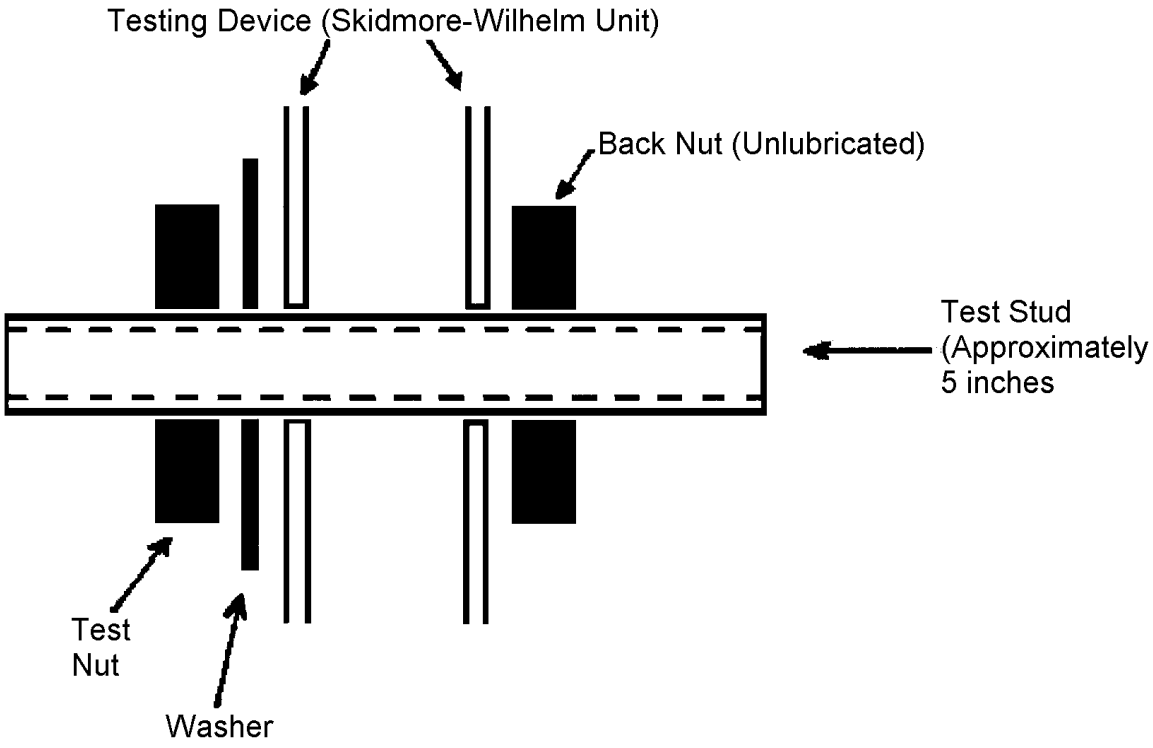

FIGURE 2

EQUATION FOR CALCULATING THE
COEFFICIENT OF FRICTION (μ)

$$\mu = -\left[\frac{C + \sqrt{C^2 - 4d_b A \sin\lambda}}{2D_b \sin\lambda}\right]$$

where

$$C = -\left[D_b \cos\alpha_n \cos\lambda + \frac{24T}{P} \sin\lambda + E \cos\lambda\right]$$

$$A = \left[\frac{24T}{P} \cos\alpha_n \cos\lambda - E \cos\alpha_n + \sin\lambda\right]$$

T = Torque, ft-lb.

P = Axial load. lb.

E = Minimum pitch diameter, in.

D_h = Flats diameter of nuts, in.

B = Diameter of hole in washer, in.

$$D_b = \frac{2}{3}\frac{D_h^3 - B^3}{D_h^2 - B^2}$$

N = Number of threads per inch

α = One-half the thread profile angle

λ = Helix angle = arc tan $\frac{1}{NE\pi}$

α_n = Arc tan (tan α cos λ)

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4,5,6, and 7 and send to preparing activity.
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I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER A-A-59004A	2. DOCUMENT DATE *(YYYYMMDD)* 1995/09/07

3. DOCUMENT TITLE
ANTI-GALLING COMPOUND, THREAD LUBRICATING, SEIZING RESISTANT, AND CALCIUM HYDROXIDE CONTAINING

4. NATURE OF CHANGE *(Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed)*

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME *(Last, First, Middle Initial)*	b. ORGANIZATION	
c. ADDRESS *(Include Zip Code)*	d. TELEPHONE *(Include Area Code)* (1) Commercial (2) DSN *(if applicable)*	7. DATE SUBMITTED *(YYYYMMDD)*

8. PREPARING ACTIVITY

a. NAME Mr. Kelly Powers, Code SEA 08J	b. TELEPHONE *(Include Area Code)* (1) Commercial (703) 602-8545 (2) DSN
c. ADDRESS *(Include Zip Code)* Commander, Naval Sea Systems Command ATTN: SEA 03Q, 2531 Jefferson Davis Hwy Arlington, VA 22242-5160	IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT: Defense Standardization Program Office (DLSC-LM) 8725 John J. Kingman Road, Suite 2533, Fort Belvoir, VA 22060-6221 Telephone (703) 767-6888 DSN 427-6888