

NAVAL SHIPS' TECHNICAL MANUAL

CHAPTER 631

PRESERVATION OF SHIPS IN SERVICE - GENERAL

DISTRIBUTION STATEMENT C: DISTRIBUTION AUTHORIZED TO U.S. GOVERNMENT AGENCIES AND THEIR CONTRACTORS; ADMINISTRATIVE AND OPERATIONAL USE (11 NOV 1992). OTHER REQUESTS FOR THIS DOCUMENT WILL BE REFERRED TO THE NAVAL SEA SYSTEMS COMMAND 05P23.

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DESTRUCTION NOTICE: DESTROY BY ANY METHOD THAT WILL PREVENT DISCLOSURE OF CONTENTS OR RECONSTRUCTION OF THE DOCUMENT.

THIS CHAPTER SUPERSEDES CHAPTER 631 VOLUME 1 Rev 2, VOLUME 2 Rev 1, VOLUME 3 Rev 2.

REVISION RECORD

REVISION NO.	DATE	TITLE AND/OR BRIEF DESCRIPTION/PREPARING ACTIVITY
3	1 NOV 2008	SEE DESCRIPTION BELOW.
• ALL CHANGES PREPARED BY NSWCCD-SSES CODE 614. • GENERAL: REPLACED ALL REFERENCES TO SPAR VARNISH PER TT-V-119 WITH MASTER PAINTERS INSTITUTE (MPI) REFERENCE COATING #28. • GENERAL: STANDARDIZED ON USE OF TWO COATS OF TT-P-645 FORMULA 84 WHEREVER SPECIFIED, VS. A MIX OF REQUIREMENTS FOR SYSTEMS USING 1 OR 2 COATS. • GENERAL: DELETE REFERENCES TO FORMULA 25A PAINTS AS UNIQUE, SPECIFIC PAINTS, SINCE THEY ARE NOW COVERED UNDER MIL-PRF-24596. • GENERAL: DELETED TEXT, TABLE LINES PERTAINING TO DECOMMISSIONED SUBMARINES. • GENERAL: LAYOUT CHANGES TO IMPROVE PLACEMENT AND ORGANIZATION OF TABLES, TABLE NOTES, AND FIGURES. TYPOGRAPHICAL ERROR CORRECTIONS. UPDATE OF MILITARY SPECIFICATION DESIGNATIONS (E.G. MIL-P-24441 CHANGED TO MIL-DTL-24441). • GENERAL: LANGUAGE REVISION TO CLARIFY REQUIREMENTS VS. GUIDANCE. (REF. TMDER A00000-04-0225) ADDITIONAL CHANGES WILL BE MADE IN NEXT REVISION. • GENERAL: UPDATED COMPANY SOURCE OF SUPPLY INFORMATION, NSNS FOR A VARIETY OF PRODUCTS. • GENERAL: UPDATED SPECIFICATIONS P-D-680 DRY CLEANING SOLVENT AND TT-P-291 PAINT THINNER TO MIL-PRF-680 DEGREASING SOLVENT AND ASTM D235 TYPE I MINERAL SPIRITS. • GENERAL: DELETED REFERENCE TO SNAME TECHNICAL AND RESEARCH BULLETIN NO. 4-21, ABRASIVE BLASTING GUIDE FOR AGED OR COATED STEEL SURFACES AS A VISUAL STANDARD FOR PREVIOUSLY PAINTED STEEL, SINCE SSPC-VIS 1 HAS BEEN MODIFIED TO INCLUDE EQUIVALENT PHOTOS. • GENERAL: PROHIBITED USE OF METHYLENE CHLORIDE PRODUCTS. • GENERAL: DUE TO ISSUE OF REV. H OF TT-P-28 HEAT RESISTANT PAINT TO INCLUDE TWO TYPES (TYPE I CONVENTIONAL PAINT AND TYPE II POWDER COATING), FOR MOST REFERENCES TO THIS SPECIFICATION, DISTINGUISHED BETWEEN TYPE I VS. TYPE II WHERE APPROPRIATE. • PARAGRAPH 631-1.1.1: ADDED TEXT DESCRIBING MANDATORY REQUIREMENTS VS. GUIDANCE. • PARAGRAPH 631-1.1.2: ADDED NEW PARAGRAPH GIVING AN OVERVIEW OF THE ORGANIZATION OF THE SECTIONS IN THIS NSTM. • PARAGRAPH 631-1.3 (OLD): DELETED THIS PARAGRAPH CITING OBSOLETE TRAINING FILM. • PARAGRAPH 631-1.3 (NEW): COMPLETELY REVISED OLD PARA. 1.4 THAT CONTAINED "GUIDELINES" AND MADE THIS A REQUIREMENTS PARAGRAPH. INCLUDED DEFINITIONS OF VARIOUS SCOPES OF WORK FOR PAINTING, TAKEN FROM STD. ITEM 009-32, AND WAIVED THE QA DOCUMENTATION REQUIREMENTS FOR DEFINED "TOUCH-UP" AREAS ON SURFACE SHIPS AND AIRCRAFT CARRIERS. SEPARATE TOUCH-UP DEFINITIONS APPLY TO SUBMARINES, WITH SEPARATE QA DOCUMENTATION REQUIREMENTS. ADDED NEW PARAGRAPHS DEFINING COSMETIC PAINTING, AND ASSOCIATED DECISION FACTORS. ADDED REQUIREMENTS FOR COATING CONDITION ASSESSMENTS IN ORDER TO MAKE REPAIR/REPLACE DECISIONS. ADDED INSPECTION PERIODICITIES FOR CRITICAL COATED AREAS, AND FOR TANKS AND VOIDS, INVOKED USE OF CCIMS FOR RETENTION OF INSPECTION DATA AND COATING REPAIR/REPLACE PROTOCOLS. INVOKED USE OF 009-32 FOR PERFORMANCE OF CONTRACTED COATING WORK. INVOKED USE OF ASTM F718 DATA SHEETS. INVOKED USE OF CCIMS TECHNICAL PUBLICATION FOR COATING ASSESSMENTS. ADDED SUB-PARAGRAPH ON FED-STD-595 COLOR NUMBERS. • PARAGRAPH 631-1.5: ADDED PARAGRAPH DESCRIBING NAVSEA COGNIZANT TECHNICAL AUTHORITY (CTA) ROLE AND RESPONSIBILITY. DELETED ALL OTHER REFERENCES THROUGH ALL SECTIONS OF THIS MANUAL TO NAVSSES (NSWCCD-SSES) AND NRL. • PARAGRAPH 631-1.6: NEW PARAGRAPH ADDED DESCRIBING THE DOD "CORROSION PREVENTION AND CONTROL PROGRAM" POLICY AND RESOURCES.		

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		• TABLE 631-1-1: UPDATED AND ADDED SSPC, ASTM AND NACE REFERENCES, AND SSPC AND NACE ADDRESSES. ADDED OR DELETED SEVERAL OTHER REFERENCES AS REFLECTED THROUGHOUT THE MANUAL. • TABLES 631-1-2, 631-1-3, 631-1-4: CHANGES TO TABLE HEADERS AND VARIETY OF CHANGES TO TABLES AND COATING SYSTEM NOTES TO REFLECT NEW COATINGS AND CHANGES IN COATING POLICY, TO COMPLEMENT CHANGES MADE IN SECTION 8. TABLE 631-1-3 (PAINTING INTERIOR OF SHIPS) REVISED TO SEPARATE SHIP STRUCTURE FROM MACHINERY AND EQUIPMENT. NEW TABLE 631-1-4 ADDED TO PROVIDE A SINGLE COATING SCHEDULE FOR SHIPS, TO ACCOMPANY TABLES 631-1-2 AND 631-1-3. • TABLES 631-1-5 AND 631-1-6: REVISED LAYOUT AND RENUMBERED TABLES 631-1-4 AND 631-1-5 FOR SUBMARINES. UPDATED COATINGS TO REFLECT 009-32 FY08. ADDED NEW LINES AND COATING SYSTEMS FOR PAINTING OF SUBMARINE BOW DOMES; SEE ALSO PARAGRAPH 631-8.15.2. • TABLE 631-1-6: DELETED LINES, COATING SYSTEMS PERTAINING TO DECOMMISSIONED SUBMARINE CLASSES. DELETED COATING SYSTEM NUMBERS 18-20 AND 22-26 AS THEY ARE NO LONGER REFERENCED IN THE TABLE. CHANGED COATING SYSTEM NUMBER 21 TO 18. UPDATED COATING SYSTEM 6 FOR POTABLE WATER, RESERVE FEEDWATER, AND FRESH WATER DRAIN COLLECTING TANKS. • ALL REFERENCES TO NAVSSES CHANGED TO NAVSEA PER ACCOMPANYING CHANGE REGARDING TECHNICAL AUTHORITY IN 631-1.6. • SECTION 2: IN ADDITION TO THE SPECIFIC CHANGES DESCRIBED BELOW, EXTENSIVE REVISIONS TO INCORPORATE CHANGES RECOMMENDED BY THE NAVAL ENVIRONMENTAL HEALTH CENTER (NEHC) 18 JULY 2001, ENDORSED BY BUMED 31 JULY 2001. THESE CHANGES ALSO SUBSTANTIALLY REORGANIZED THE ORDER OF MATERIAL IN SECTION 2, AND AS A RESULT, MANY OF THESE CHANGES ARE NOT MARKED WITH CHANGE BARS, AND PARAGRAPH NUMBERING HAS CHANGED. • TABLE 631-2-2 VENTURI EXHAUST BLOWERS: DELETED TABLE. • SECTION 2: PROHIBITED USE OF METHYLENE CHLORIDE, CRESOL, AND PHENOL PRODUCTS. REVISED TO PROHIBIT ALL USE OF CHEMICAL PAINT STRIPPERS AND REMOVERS UNLESS SPECIFIC APPROVAL IS GRANTED. • SECTION 2: ADDED SAFETY PRECAUTIONS FOR USING WATER-BASED PAINTS. • SECTION 2: REVISED HEALTH AND SAFETY REQUIREMENTS CONCERNING POLYURETHANE COATINGS. • SECTION 2: REFERENCES TO ORGANTIN ANTI-FOULING PAINTS REMOVED THROUGHOUT THE DOCUMENT, AS THEY ARE NO LONGER PERMITTED IN THE U.S. BRIEF PARAGRAPH IN 631-2.8.3 STATING THE TBT PROHIBITION REMAINS. • SECTION 2: DELETED REQUIREMENT TO TEST INDIVIDUAL PAINT LAYERS FOR CHROMATES AND LEAD UPON PAINT REMOVAL. • PARAGRAPH 631-2.7.7: EDITED TO ADDRESS PLURAL COMPONENT SPRAYING SAFETY PRECAUTIONS ALONG WITH AIRLESS SPRAYING. • PARAGRAPH 631-3.2.9: MATERIAL ON METAL SPRAYED COATINGS MOVED TO 631-7.6 AND INTEGRATED WITH EXISTING MATERIAL THERE. • PARAGRAPH 631-3.3: COMPLETELY REVISED SECTION ON DFT AND WFT GAGES AND REQUIREMENTS. DELETED FIGURES 631-3.2 THROUGH 631-3.4 AND TABLES 631-3-2 THROUGH 631-3-4. ADDED TEXT TO INVOKE SSPC-PA 2 FOR DFT MEASUREMENTS, AND SPECIAL SITUATIONS FOR NON-MAGNETIC AND NON-METALLIC SUBSTRATES. ADDED NEW PARAGRAPH ON ESTIMATING DFT FROM WFT MEASUREMENTS. (REFER TO SECTION 631-7.1.4 FOR NEW/REVISED DFT AND WFT QA REQUIREMENTS.) • PARAGRAPH 631-3.4.2: UPDATED CONTENT, AND REPLACED PARAGRAPH 631-3.4.2.1 WITH A BRIEF DESCRIPTION OF THE SHIPS HAZARDOUS MATERIAL LIST (SHML). MOVED CONTENT OF OLD PARAGRAPH 631-8.5 (NAVSEA-APPROVED COATINGS FROM PROPRIETARY SOURCES) TO HERE, AS THIS IS A MORE APPROPRIATE LOCATION.

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• PARAGRAPH 631-3.4.3: INSERTED NEW PARAGRAPH REGARDING RECEIPT INSPECTION OF COATINGS FOR NON-CRITICAL COATED AREAS. FOR CRITICAL COATED AREAS, REFERRED TO SECTION 11. • PARAGRAPH 631-3.4.5: ADDED TEXT TO INDICATE PAINT STOREROOMS MUST PREVENT EXPOSURE TO FREEZING CONDITIONS AND EXPOSURE TO DIRECT SUNLIGHT. ADDED REQUIREMENT THAT EXPIRED PAINT MUST BE SEGREGATED FROM UNEXPIRED PAINT IN STORAGE FACILITY. • TABLE 631-3-2: DELETED OBSOLETE FORMULA NUMBERS 34, 109, AND 120. ADDED LINE FOR FORMULA 20L. DELETED VINYL AF PAINTS FORMULAS 121A AND 129A. ADDED AND UPDATED NSNS FOR SEVERAL PAINTS. • TABLE 631-3-3: ADDED ALTERNATE ANTI-SWEAT COATING, AND INFORMATION ON HIGH-TEMPERATURE PAINT PER TT-P-28. DELETED OR EDITED OBSOLETE NSN'S AND SPECIFICATIONS. ADDED COLORS AND NSN'S FOR MIL-PRF-24635 GLOSS, SEMI-GLOSS, AND LOW GLOSS PAINTS. ADDED MIL-PRF-24763 WATER-BASED ACRYLIC ENAMELS. ADDED MIL-PRF-24596 NON-FLAMING PAINTS. DELETED INTUMESCENT COATING MIL-PRF-46081. EDITED POWDER COATING SPECIFICATIONS, TYPES, AND CLASSES. • PARAGRAPH 631-3.4.9: NEW PARAGRAPH ADDED TO DESCRIBE MILITARY AND FEDERAL, AND PRF AND DTL SPECIFICATIONS. • PARAGRAPH 631-3.4.9.1: NEW PARAGRAPH ADDED TO DESCRIBE ASSIST ONLINE QUALIFIED PRODUCTS DATABASE (QPD). • PARAGRAPH 631-3.4.10.1: ADDED NEW PARAGRAPH ON REGULATORY NESHAP VOC LIMITS FOR MARINE COATINGS. • TABLE 631-3-5: ADDED NEW TABLE GIVING NESHAP VOC LIMITS FOR MARINE COATINGS BY USAGE CATEGORY. • TABLE 631-3-6: ADDED NEW TABLE GIVING VOC LIMITS OF COMMON NAVAL VESSEL COATING SPECIFICATIONS. • SECTION 4: CONTENT OF SECTION 4 WAS DELETED AND MOVED TO NSTM 079, VOLUME III. • PARAGRAPH 631-5.2.1: REPLACED REFERENCE TO MIL-STD-271 WITH NAVSEA T9074-AS-GIB-010/271. • PARAGRAPH 631-5.2.2: REVISED TO DISCUSS PRE-SURFACE PREPARATION REQUIREMENTS FOR CRITICAL COATED AREAS REGARDING SURFACE FINISHING OF WELDS AND USE OF VISUAL COMPARATOR/REPLICA FOR WELD EVALUATION; BREAKING OF EDGES; AND LOW PRESSURE FRESH WATER WASHING TO REMOVE RESIDUAL SALTS PRIOR TO SURFACE PREPARATION FOR PAINTING. NEW PARAGRAPH CONTAINS INFORMATION PREVIOUSLY IN 631-5.2.4.1.1. TEXT THAT WAS HERE SPECIFIC TO UNDERWATER HULL COATING MOVED TO 631-8.4. • PARAGRAPHS 631-5.2.3.2.1 AND 5.2.3.2.2: DELETED THESE PARAGRAPHS CONCERNING CONDITION-BASED REPLACEMENT OF COATINGS AND BLISTER CRITERIA FOR WARM WATER TANKS. THIS TYPE OF EVALUATION AND CRITERIA IS COVERED BY NEW PARAGRAPHS IN 631-1.3. • PARAGRAPH 631-5.2.3.3: TEXT AND NOTE REGARDING OVER-COATING OF ABLATIVE COPPER AF HULL COATINGS MOVED TO PARAGRAPH 631-8.4 FOR CLARITY. • PARAGRAPH 631-5.2.3.4: DELETED THIS PARAGRAPH DESCRIBING USE OF SOLVENT WIPING OR COMPRESSED AIR BLOW-DOWN IN ORDER TO PAINT DAMP EXTERIOR SURFACES, AS THESE PRACTICES ARE NO LONGER RECOMMENDED, AND HAVE NEGATIVE AIR POLLUTION AND SAFETY IMPLICATIONS. • TABLE 631-5-1: DELETED TABLE ON REPAIR OF CORRODED ALUMINUM AND STEEL STRUCTURE, AS IT WAS GENERAL, NON-BINDING GUIDANCE, AND REQUIREMENTS ARE SET IN OTHER DOCUMENTS, SUCH AS NSTM CHAPTER 100 AND GSO. • PARAGRAPH 631-5.2.4.1: CLEARLY STATED REQUIREMENT FOR SURFACE PROFILE ON STEEL SURFACES AS 2-4 MILS.		

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		• PARAGRAPH 631-5.2.4.1.1: PARAGRAPH DELETED, AND CONTENTS SPLIT AND MOVED TO 3 DIFFERENT LOCATIONS IN ORDER TO IMPROVE LOGICAL FLOW AND APPLICABILITY OF REQUIREMENTS. SOLUBLE SALT CONDUCTIVITY TEST METHOD AND CRITERIA MOVED TO SECTION 5.14 (SURFACE PREPARATION QA). WATER WASHING REQUIREMENTS FOR CRITICAL SURFACES MOVED TO 631-5.2.2. TEXT REGARDING ABRASIVE BLAST FACILITY COMPLIANCE MOVED TO NEW PARAGRAPH 631-5.2.4.1.3. DELETED RULE OF THUMB REGARDING SURFACE PROFILE REQUIREMENTS. • PARAGRAPH 631-5.2.4.1.4 (OLD): PARAGRAPH DEALING WITH SPECIAL PRE-SURFACE PREPARATION CLEANING OF WELL DECKS MOVED TO 631-8.18.2. 631-8.23.2. • PARAGRAPH 631-5.2.5.3: REVISED SURFACE PREPARATION OF WOOD SURFACES TO ALLOW BRUSH-OFF ABRASIVE BLASTING AND HIGH PRESSURE WATER CLEANING. • PARAGRAPH 631-5.2.6: REVISED TERM "PLASTIC SURFACES" TO ADDRESS GRP, FIBERGLASS AND NON-METALLIC COMPOSITE SURFACES. • PARAGRAPH 631-5.3.1: ADDED TEXT TO EMPHASIZE THAT USE OF ALL OTHER SSPC SURFACE PREPARATIONS STANDARDS REQUIRES SOLVENT CLEANING PER SSPC-SP 1 AS THE INITIAL STEP. • PARAGRAPH 631-5.3.3: CLARIFIED THAT MINIMUM REQUIRED PROFILE WHEN SSPC-SP 11 IS SPECIFIED IS 2.0 MILS. • PARAGRAPH 631-5.3.3.1: ADDED NEW PARAGRAPH REQUIRING SOLVENT CLEANING PRIOR TO POWER TOOL CLEANING, AND AGAIN AFTER POWER TOOL CLEANING, IF NECESSARY. • PARAGRAPH 631-5.3.3.2: STRENGTHENED REQUIREMENT TO PROHIBIT POLISHING OF METAL SURFACES WHEN USING POWER TOOL CLEANING, AND REQUIRED PROFILING USING NEEDLE GUNS IF POLISHING HAS OCCURRED. • PARAGRAPH 631-5.3.3.3: ADDED GUIDANCE ON USE OF POWER TOOLS. ADDED NOTE THAT 2 MM NEEDLES FOR NEEDLE GUNS CAN PRODUCE ACCEPTABLE PROFILE. • PARAGRAPH 631-5.3.4: ADDED NEW PARAGRAPH TO ALLOW USE OF SSPC-VIS 3 STANDARDS TO ASSESS CLEANLINESS OF HAND AND POWER TOOL CLEANED STEEL SURFACES. • PARAGRAPH 631-5.3.5: ADDED NEW PARAGRAPH OPTIONALLY ALLOWING THE USE OF SSPC-SP 6 OR SSPC-SP-12 WJ-2L INSTEAD OF SSPC-SP 11 WHEN POWER TOOL CLEANING IS SPECIFIED. • PARAGRAPH 631-5.3.6: NEW SECTION AND TABLE 631-5-2 ADDED TO DESCRIBE THE USE OF RUST CONVERTERS. • PARAGRAPH 631-5.4.1: DELETED REFERENCE TO USE OF INHIBITORS WHEN WET BLASTING. • PARAGRAPH 631-5.4.3: ADDED MATERIAL TO DESCRIBE USE OF ALUMINUM OXIDE, GARNET, AND WALNUT SHELL ABRASIVES. ADDED NEW PARAGRAPH 631-5.4.3.1 TO DESCRIBE DEGREASING REQUIRED WHEN ANY AGRICULTURAL MEDIA HAVE BEEN USED. • PARAGRAPH 631-5.4.3.2: ADDED NEW PARAGRAPH ALLOWING THE USE OF ABRASIVE SPONGE MEDIA FOR ABRASIVE BLASTING. • PARAGRAPH 631-5.4.4: ADDED ALLOWANCE TO PROCURE STEEL SHOT AND GRIT ABRASIVES PER SSPC-AB 3, AND WALNUT SHELL ABRASIVES PER A-A-1722. ADDED REQUIREMENT THAT RECYCLED ABRASIVES COMPLY WITH SSPC-AB 2. • PARAGRAPH 631-5.4.5: DELETED WARNING AND NOTE CONCERNING USE OF BLASTOX IN ABRASIVE BLAST MEDIA. ADDED TEXT TO STATE THAT DISPOSAL OF SPENT ABRASIVES MUST COMPLY WITH ALL REGULATIONS, AND THAT TESTING FOR LEAD MAY BE REQUIRED. • PARAGRAPH 631-5.4.6 THROUGH 5.4.6.2.2: PROHIBITED USE OF ANY INHIBITORS USED FOR WET BLASTING, AND DELETED ASSOCIATED TEXT. REVISED TEXT DESCRIBING WET ABRASIVE BLASTING (WAB).

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		• PARAGRAPH 631-5.4.7, 5.4.7.1, 5.4.7.2, 5.4.7.3, 5.4.7.4: REVISED WORDING OF DEFINITIONS OF ABRASIVE BLASTED STEEL SURFACES TO MATCH THOSE IN THE CURRENT APPLICABLE SSPC/NACE STANDARDS. ADDED REQUIREMENT FOR INITIAL SOLVENT CLEANING PER SSPC-SP 1. ADDED NEW PARAGRAPH 631-5.4.7.5 DESCRIBING CLEANLINESS STANDARDS FOR WET ABRASIVE BLASTING. ADDED NEW PARAGRAPH 631-5.4.7.6 PROVIDING WORDING FOR WHEN SSPC STANDARDS ARE SPECIFIED FOR ALUMINUM SURFACES. • PARAGRAPH 631-5.4.8: DELETED SNAME PUBLICATION. ADDED USE OF SSPC-VIS 5 FOR WET ABRASIVE BLASTING. • PARAGRAPH 631-5.5 AND SUBPARAGRAPHS: COMPLETELY REVISED TO REFLECT WATERJETTING VS. HYDROBLASTING TERMINOLOGY, TO MEET DEFINITIONS AND REQUIREMENTS OF CURRENT VERSION OF SSPC-SP 12 AND SSPC-VIS 4, AND TO REFLECT CURRENT POLICY. REMOVED TEXT DESCRIBING THE ADDITION OF ABRASIVE TO THE WATERJETTING, TO BE IN COMPLIANCE WITH THE STANDARD. • PARAGRAPH 631-5.9: REVISED TO PROHIBIT ALL USE OF CHEMICAL PAINT STRIPPERS AND REMOVERS UNLESS SPECIFIC APPROVAL IS GRANTED. • PARAGRAPH 631-5.10.5: DELETED ENTIRE SECTION ON USE OF METHYLENE CHLORIDE PAINT REMOVERS. • PARAGRAPH 631-5.11.5 AND TABLE 631-5-4: DELETED THIS SECTION AND TABLE DEALING WITH COLOR-CODING BARE STEEL, AS IT IS COVERED BY T9074-BD-GIB-010/300, "BASE MATERIALS FOR CRITICAL APPLICATIONS: REQUIREMENTS FOR LOW ALLOY STEEL PLATE, FORGINGS, CASTINGS, SHAPES, BARS, AND HEADS OF HY-80/100/130 AND HSLA-80/100". • PARAGRAPH 631-5.13 (OLD): CITRIC ACID CLEANING METHOD DELETED DUE TO NON-USE. • PARAGRAPH 631-5.14 (OLD)/5.13 (NEW): REVISED SECTION ON HAND CLEANING OF BILGES TO INCORPORATE REQUIREMENTS FOR SUBMARINE BILGES. • PARAGRAPH 631-5.15 (OLD): SURFACE PREPARATION OF AGED INORGANIC ZINC SURFACES DELETED DUE TO NON-USE. • PARAGRAPH 631-5.15 (OLD) FUEL TANK RIVETED LAP-PLATE SEAMS SURFACE PREPARATION: DELETED DUE TO NON-USE. • PARAGRAPH 5.14 (NEW)/5.17 (OLD): EXTENSIVELY REVISED TO REFLECT ALL OF THE SURFACE PREPARATION QA TESTS, INSPECTIONS, AND RECORDS REQUIREMENTS. CONTAINS TEXT MOVED FROM OTHER AREAS IN SECTION 5. ADDED REQUIREMENT TO VERIFY THAT THE PRE-SURFACE PREPARATION REQUIREMENTS OF 631-5.2.2 HAVE BEEN MET. ADDED REQUIREMENTS TO DETERMINE THE INITIAL SURFACE CONDITION OF PREPARED SURFACES, VERIFY THE CERTIFICATION OF THE BLAST MEDIA, AND INSPECT FOR THE REMOVAL OF RESIDUAL DUST AFTER SURFACE PREPARATION IAW ISO 8502-3. ADDED USE OF SSPC-VIS 3, SSPC-VIS 4, AND SSPC-VIS 5 FOR EVALUATING SURFACE CLEANLINESS COMPLIANCE. CLARIFIED SURFACE PROFILE REQUIREMENTS AND MEASUREMENTS. UPDATED SURFACE SALT TESTING REQUIREMENT AND CRITERIA TO ALLOW EITHER CHLORIDE OR CONDUCTIVITY TESTING. MODIFIED PARAGRAPH SO IT IS NOT EXCLUSIVE TO ABRASIVE BLASTING, SINCE SP-11 OR SP-12 ARE OTHER CLEANLINESS LEVELS APPROVED FOR SOME CRITICAL COATED AREAS. • FIGURE 631-5.1: NEW FIGURE ADDED TO PROVIDE SURFACE CONDUCTIVITY TEST METHOD. FIGURE ADAPTED FROM APPENDIX 8 OF CORE PPI 63101-000, REV. 12. • PARAGRAPH 631-6.2.2.5: ADDED NEW PARAGRAPH UNDER PAINTING DOCUMENTATION REQUIREMENTS DESCRIBING NEED TO UPDATE THE CCIMS DATABASE. • PARAGRAPH 631-6.3.2: EXEMPTED SPECIFIC SURFACE TOLERANT EPOXY COATINGS FROM DEW POINT AND RELATIVE HUMIDITY REQUIREMENTS. CLARIFIED MAXIMUM RELATIVE HUMIDITY REQUIREMENTS FOR LONG-LIFE COATING SYSTEMS IN TANKS AND VOIDS, AND FOR WHEN WATER-JETTING IS USED. • PARAGRAPH 631-6.3.3.2.2: NEW PARAGRAPH WITH REQUIREMENTS THAT PROHIBIT SUBDIVIDING AND MIXING 2-COMPONENT PAINTS, REGARDLESS OF THE MIX RATIO.

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		• PARAGRAPH 631-6.4.1: REVISED NOTE AND DELETED REQUIREMENT THAT PAINTING BEGIN WITHIN 6 HOURS OF BLASTING. INSTEAD, REQUIRED SPECIFIED CLEANLINESS TO STILL EXIST AT TIME OF PAINTING, REGARDLESS OF ELAPSED TIME BETWEEN SURFACE PREPARATION AND PAINTING. • PARAGRAPH 631-6.4.6: ENTIRE NEW SECTION AND SUB-PARAGRAPHS ADDED TO ADDRESS USE OF PLURAL COMPONENT SPRAYING EQUIPMENT. SECTION 631-6.4 PARAGRAPHS REORDERED AND RENUMBERED. • PARAGRAPH 631-6.4.5 (OLD)/631-6.4.7 (NEW): DELETED NOTE REFERRING TO HOT SPRAYING OF VINYL PAINTS, SINCE USE OF VINYL PAINTS HAS BEEN DELETED FROM THE NSTM. • PARAGRAPH 631-6.5 AND FIGURE 631-6-5: REVISED PHOTOGRAPHIC EXAMPLES AND DESCRIPTIONS OF TYPES OF PAINT FAILURES. ADDED REFERENCE TO SSPC PUBLICATION "VISUAL COMPARISON MANUAL: APPLICATION AND COATING DEFECTS". • PARAGRAPH 631-7.1.1: REVISED PARAGRAPH ON PRECEDENCE OF DOCUMENTS AND CONFLICT RESOLUTION. • PARAGRAPH 631-7.1.2: ADDED REQUIREMENT TO APPLY ALL PAINTS IAW NAVSEA-APPROVED ASTM F718 DATA SHEETS, EXCEPT FOR MIL-DTL-24441 PAINTS. • PARAGRAPH 631-7.1.3: ADDED NEW PARAGRAPH TO PROVIDE UNIVERSAL STRIPE COAT APPLICATION REQUIREMENTS. • PARAGRAPH 631-7.1.4: ADDED NEW PARAGRAPH AND SUBPARAGRAPHS PROVIDING DETAILED REQUIREMENTS FOR COATING APPLICATION QA TESTS, INSPECTIONS, AND RECORDS. NEW PARAGRAPH CONTAINS REQUIREMENTS FOR ENVIRONMENTAL CONDITIONS; TYPE, SHELF LIFE, STORAGE, AND RECEIPT INSPECTION OF COATINGS; PAINT MIXING, INDUCTION, CURE AND OVERCOAT TIMES; WFT AND DFT REQUIREMENTS; STRIPE COATS; WORKMANSHIP; AND VISUAL AND WET-SPONGE HOLIDAY INSPECTIONS. • PARAGRAPH 631-7.1.5: ADDED NEW PARAGRAPH ON COATINGS ON WELDS THAT ARE TO BE PRESSURE-TESTED. • PARAGRAPH 631-7.2.1.1: NEW PARAGRAPH FOR 90F MAXIMUM MIXING, APPLICATION, AND CURE TEMPERATURE (SURFACE AND AMBIENT) FOR MIL-DTL-24441 TYPE III AND IV COATINGS. TABLES 631-7-1 THROUGH 631-7-4 FOR INDUCTION TIME, POT LIFE, AND CURE TIMES ALSO EDITED TO REFER TO THIS PARAGRAPH FOR TEMPERATURE LIMITS. • PARAGRAPH 631-7.2.4.7.1: DELETED PARAGRAPH DEALING WITH THINNING OF MIL-DTL-24441 PAINTS. • PARAGRAPH 631-7.2.5.2: EDITED TO SHOW THAT TYPE IV MIL-DTL-24441 COATINGS DO NOT REQUIRE AN INDUCTION TIME. • TABLE 631-7-1: EDITED TABLE HEADER, AND CHANGED TEMPERATURE RANGES TO PREVENT OVERLAP, FOR MIL-DTL-24441 INDUCTION TIME. ADDED NOTE TO SHOW THAT TYPE IV COATINGS DO NOT REQUIRE AN INDUCTION TIME. • TABLE 631-7-2: CORRECTED TABLE HEADER TO INDICATE POT LIFE. • PARAGRAPH 631-7.2.5.6.2: CLARIFIED RELATIVE HUMIDITY REQUIREMENTS FOR LONG-LIFE COATING SYSTEMS IN TANKS AND VOIDS. • PARAGRAPH 631-7.2.5.6.4: ENTIRE PARAGRAPH ON RECORD-KEEPING SPECIFIC TO PAINTING WITH MIL-DTL-24441 PAINT DELETED, SINCE RECORD-KEEPING IS ONLY REQUIRED FOR DEFINED CRITICAL COATED AREAS, AND IS DESCRIBED IN 631-7.1.4 AND SECTION 11. • PARAGRAPH 631-7.2.6.1: DELETED PARAGRAPH DEALING WITH THINNING OF MIL-DTL-24441 PAINT. • PARAGRAPH 631-7.2.6.4 TO 7.2.6.7: REARRANGED PARAGRAPH ORDER AND CLARIFIED REQUIREMENTS FOR CURE TIMES BETWEEN COATS OF MIL-DTL-24441 COATINGS. CHANGED POLICY FOR OVERCOATING MIL-DTL-24441 EPOXY WITH NON-EPOXY TOPCOATS SUCH AS MIL-PRF-24635, SUCH THAT EPOXY MUST BE DRY TO TOUCH INSTEAD OF TACKY.

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• PARAGRAPH 631-7.3: REVISED WORDING OF PARAGRAPH DESCRIBING USE OF OBSOLETE FORMULA 117 PRE-TREATMENT PRIMERS, AND MOVED TO PARAGRAPH 631-7.4. INSERTED REVISED PARAGRAPH ON USE OF MIL-PRF-23236 COATINGS, MOVED FROM PARAGRAPH 631-8.7. ADD PARAGRAPH 631-7.3.2 ON ALLOWABLE RUNS, DRIPS, AND SAGS IN 100% SOLIDS COATINGS, AS TAKEN FROM NAVSEA STD. ITEM 009-32. ADD PARAGRAPH 631-7.3.3.1 FOR BRUSHABLE GRADES OF SELECT SHERWIN WILLIAMS MIL-PRF-23236 TYPE VII PAINTS. ADDED PARAGRAPH 631-7.3.4 FOR TOPCOATING MIL-PRF-23236 EPOXY PAINTS WITH NON-EPOXY PAINTS. ADDED NEW PARAGRAPH 631-7.3.5 ON MIL-PRF-23236 PAINTS APPROVED FOR INTERIOR SUBMARINE USE PER THE SUBMARINE ATMOSPHERE CONTROL PROGRAM. • PARAGRAPH 631-7.4: DISCUSSION OF VINYL ANTI-FOULING PAINT (FORMULAS 121 AND 129) APPLICATION DELETED, DUE TO OBSOLESCENCE AND NON-USE. • PARAGRAPH 631-7.6: MATERIAL FROM 631-3.2.9 ON METAL SPRAY COATINGS MOVED AND INTEGRATED HERE. NEW PARAGRAPH 631-7.6.5 ADDED TO REQUIRE USE OF TRAINED COATING INSPECTOR, AS DESCRIBED IN 631-11.6 AND 631-11.7, AND TO INVOKE THIS REQUIREMENT IF THE THERMAL SPRAY COATING WORK IS SUB-CONTRACTED. • PARAGRAPH 631-7.7: DELETED PARAGRAPHS 631-7.7.1 THROUGH 631-7.7.3.4, TABLES 631-7-5 THROUGH 631-7-7, AND FIGURE 631-7-1, ALL DEALING WITH POLYSULFIDE SEALANTS AND POLYURETHANE TOPCOATS USED AS SEALANTS FOR FUEL TANK RIVETED LAP PLATE SEAMS, DUE TO OBSOLESCENCE. RETAINED PARAGRAPH 631-7.7.4 DESCRIBING APPLICATION OF EROSION-RESISTANT 3M EC-2216 COATINGS. RENUMBERED PARAGRAPHS AND TABLES ACCORDINGLY. • PARAGRAPH 631-7.8: VERMICULITE REMOVED AS AN ANTI-SWEAT TREATMENT FOR NEW APPLICATIONS, AND REPLACED BY HEMPEL, TEMP-COAT, KEFA DRYTECH, AND DELTA-T MARINE PRODUCTS. REPAIR OF EXISTING VERMICULITE TREATMENTS WITH VERMICULITE IS PERMITTED. • PARAGRAPH 631-7.8.6 ON EPOXY REPAIR AND HULL SMOOTHING COMPOUNDS MOVED INTO NEW PARAGRAPH 631-7.12 . • PARAGRAPH 631-7.9: REVISED SECTION DESCRIBING POWDER COATINGS. ALLOWED SURFACE PREPARATION PRE-TREATMENTS FOR COSMETIC POWDER COATING TO BE CHEMICAL CLEANING OR PHOSPHATE PRE-TREATMENTS, IAW COMMERCIAL PRACTICE. • PARAGRAPH 631-7.10: NEW SECTION ADDED CONCERNING USE OF TT-P-28 HEAT RESISTANT COATINGS. • PARAGRAPH 631-7.11: NEW SECTION ON USE OF WATER-BASED COATINGS, MOVED FROM 631-8.23. • THIS REVISION ADDRESSES FOLLOWING TMDERS: N45404-02-4401, A00000-04-0225. • PARAGRAPH 631-8.2: REVISED EXTENSIVELY TO DISTINGUISH BETWEEN REQUIREMENTS AND GUIDANCE, AND CLARIFIED SAME FOR DIFFERENT TYPES OF METALLIC SURFACES. DELETED PARAGRAPH ON FORMULA 117 PRE-TREATMENT PRIMER; REFER TO PARAGRAPH 631-7.4. REVISED PAINTING PIPING IN SEAWATER AND FUEL OIL TANKS TO REFLECT VARIETY OF CORROSION RESISTANT PIPING SYSTEM MATERIALS THAT MAY BE FOUND IN TANKS. • TABLE 631-8-1 (OLD): DELETED THIS TABLE WITH REQUIREMENTS FOR PAINTING EXTERIOR AND INTERIOR STRUCTURAL ALUMINUM SURFACES, SINCE THESE REQUIREMENTS ARE CONTAINED IN PARAGRAPH 631-8.23 AND THE TABLES REFERENCED THEREIN. • PARAGRAPH 631-8.3: REVISED EXTENSIVELY TO DISTINGUISH BETWEEN REQUIREMENTS AND GUIDANCE, AND CLARIFIED SAME FOR DIFFERENT TYPE OF NON-METALLIC SURFACES. DELETED USE OF ALUMINUM PASTE AND VARNISH AS A TREATMENT FOR WOOD SURFACES, AND SUBSTITUTED MIL-DTL-24441 OR MIL-PRF-23236 TYPE VI EPOXY.		

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• PARAGRAPH 631-8.4 AND 631-8.6 DELETED OLD PARAGRAPHS 8.4.1 THROUGH 8.4.3, AND 8.6.1 THROUGH 8.6.3. REVISED PARAGRAPH TO APPLY TO SURFACE SHIP UNDERWATER HULL COATINGS FOR ALL TYPES OF HULL MATERIALS. MOVED RELATED TEXT FROM PARAGRAPHS 631-5.2.3.3 (NOTE), 631-8.23, AND TABLE 631-8-11 HERE. ADDED USE OF E-PAINT SN-1 GRAY AF COATING FOR EMBARKED ALUMINUM BOATS AND CRAFT. UPDATED GRAY AF COATINGS FOR USE ON EMBARKED BOATS IN ORDER TO MEET CAMOUFLAGE REQUIREMENTS, PER NAVSEA MESSAGE R040500Z OCT 03. OLD TABLES 631-8-2 AND 631-8-3 DELETED, AS NEW TABLE 631-8-2 SUPERCEDES THEM. NEW TABLE 631-8-2 REFLECTS NEW TYPE, GRADE, CLASS DESIGNATIONS IN PENDING REVISION TO MIL-PRF-24647. DELETED REFERENCES TO USE OF ORGANOTIN (TBT) PAINTS. ADDED NEW PARAGRAPH ON BASELINE HULL COATING SYSTEM DFT MEASUREMENTS, TO COMPLEMENT SIMILAR REQUIREMENT IN 009-32. ADDED PARAGRAPHS ON COATING PROPULSION SHAFT BEARING VOIDS, AND RUDDERS, STRUTS, AND OTHER EROSION-PRONE AREAS. MADE USE OF 3M EC-2216 COATING FOR EROSION-PRONE AREAS OPTIONAL AS DESIRED BY TYCOM. ADDED REQUIREMENT THAT SURFACE PREPARATION ON NEW WELDS ON HULL BE SSPC-SP 10. • PARAGRAPH 631-8.5 (NAVSEA-APPROVED COATINGS FROM PROPRIETARY SOURCES): MOVED PARAGRAPH TO PARAGRAPH 631-3.4.2, AS THIS IS A MORE APPROPRIATE LOCATION. • PARAGRAPH 631-8.7 (OLD): REVISED WORDING OF PARAGRAPH DESCRIBING USE OF MIL-PRF-23236 COATINGS, AND MOVED TO PARAGRAPH 631-7.3. • TABLE 631-8-2 (NEW): REVISED TABLE PROVIDING POTABLE WATER TANK COATING REQUIREMENTS. DELETED REFERENCES TO INTERGARD, DEVTRAN, AND VALSPAR COATINGS FOR POTABLE WATER TANKS. ADDED MIL-PRF-23236 COATINGS. REVISED MIL-DTL-24441 TYPE III SYSTEM TO INDICATE THE DEFAULT (PREFERRED) FORMULA NUMBER ORDER (150/152/151/150/152), AND SPECIFICALLY PROHIBITED USE OF F159. • PARAGRAPH 631-8.8 (NEW 631-8.5): REVISED VARIETY OF REQUIREMENTS FOR POTABLE WATER TANKS, TO REFLECT CURRENT POLICY AND STD. ITEM 009-32. RENUMBERED PARAGRAPHS ACCORDINGLY. CHANGES INCLUDE: CONTROL OF DFT; USE OF WFT GAGES BY PAINTERS; DELETED PARAGRAPH DESCRIBING MIL-DTL-24441 TYPE III AS THE PREFERRED COATING SYSTEM; DELETED PARAGRAPH ON USE OF OBSOLETE FORMULA 102, MIL-E-15145; ADDED 50% RELATIVE HUMIDITY LIMIT. • PARAGRAPH 631-8.9 (OLD)/631-8.6 (NEW) AND TABLE 631-8-5 (OLD)/631-8-3 (NEW): ADDED USE OF MIL-PRF-23236 TYPE VI OR VII, CLASS 11 COATINGS; DELETED APPROVAL FOR USE OF POTABLE WATER TANK COATINGS IN FEEDWATER TANKS; DELETED DEVTRAN AND SOVAPON COATINGS FOR FEEDWATER TANKS; ADDED FRESH WATER DRAIN COLLECTION TANKS. REVISED MIL-DTL-24441 TYPE III SYSTEM TO INDICATE THE DEFAULT (PREFERRED) FORMULA NUMBER ORDER (150/152/151/150/152), AND SPECIFICALLY PROHIBITED USE OF F159. • PARAGRAPH 631-8.10 (OLD)/631-8.7 (NEW): ADDED SURFACE PREPARATION REQUIREMENTS; MOVED TABLE NOTES INTO PARAGRAPH TEXT; ADDED INFORMATION ON USE OF HIGH-TEMPERATURE COATINGS; CLARIFIED TEMPERATURE RANGES FOR HEATED VS. UN-HEATED SYSTEMS; COMPLETELY REVISED TABLE FORMAT. • PARAGRAPH 631-8.11 (OLD)/631-8.8 (NEW): REVISED COATING SYSTEMS; ADDED SURFACE PREPARATION REQUIREMENTS; MOVED INFORMATION ON SWITCHBOARDS AND PANELS HERE. • PARAGRAPH 631-8.13 (OLD): MOVED SINGLE PARAGRAPH ON SWITCHGEAR AND PANELS TO NEW PARAGRAPH 631-8.8.2 UNDER ELECTRICAL EQUIPMENT. • PARAGRAPH 631-8.14 (OLD)/631-8.10 (NEW): DELETED USE OF OCEAN 634 AND OCEAN 9788 COATINGS FOR ELECTRICAL CABLES, AND SPECIFIED USE OF PAINTS PER MIL-PRF-24596, AND OTHER COATINGS AS PER 009-32. • PARAGRAPH 631-8.15 (OLD)/631-8.11 (NEW), AND TABLE 631-8-8 (OLD): REVISED REQUIREMENTS FOR COATING METAL ENCLOSURES USED INSIDE THE SHIP; ADDED SURFACE PREPARATION REQUIREMENTS; ADDED POWDER COATING OPTIONS; DELETED TABLE 631-8-8.		

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		• PARAGRAPH 631-8.15.2: ADDED NEW PARAGRAPH, AND ACCOMPANYING TABLE 631-8-6 FOR PAINTING OF SUBMARINE BOW DOMES. • PARAGRAPH 631-8.17: NEW ITEMS ADDED TO THE LIST OF COMPONENTS THAT SHALL NOT BE PAINTED, SUCH AS ALUMINUM ACCOMMODATION LADDER PARTS, PARTS OF DOORS, HATCHES AND SCUTTLES, LIFELINES, ETC. • PARAGRAPH 631-8.18: PARAGRAPH ON RADAR AND ACOUSTICAL EQUIPMENT AND SONAR DOMES DELETED, AS IT PROVIDED NO MEANINGFUL REQUIREMENTS. • PARAGRAPH 631-8.19 AND SUBPARAGRAPHS: DELETED REFERENCES TO OBSOLETE ANTENNAS AND REFERRED TO ANTENNA TECHNICAL MANUALS FOR REPRESENTATION PROCEDURES. UPDATED MIL-DTL-24441 PAINT SPECIFIED. UPDATED REFERENCE TO NIMB, NAVSEA SE000-01-IMB-010. • PARAGRAPH 631-8.21 (OLD)/631-8.16 (NEW) AND TABLE 631-8-9 (OLD)/631-8-6 (NEW): TABLE LAYOUT AND COATINGS SYSTEMS COMPLETELY REVISED; EXPANDED NOMENCLATURE FOR TERM "SMOKE PIPES"; DELETED USE OF INORGANIC ZINC PRIMERS; MOVED PAINTING OF VENTILATION DUCTS, TRUNKS, AND PLENUMS TO SECTION ON PAINTING INTERIOR STRUCTURE, AND ADDED NOTE REGARDING REPLACING RUSTED STEEL SHEET METAL DUCTING WITH CRES 316 IAW GSO SECTION 512. • PARAGRAPH 631-8.18 (NEW): COMPLETE REVISION OF THIS PARAGRAPH AND SUBPARAGRAPHS. PARAGRAPH NOW COVERS ALL SURFACE SHIP EXTERIOR AND INTERIOR STRUCTURAL PAINTING REQUIREMENTS. TABLES 631-8-7 THROUGH 631-8-11 ACCOMPANY THIS PARAGRAPH. TABLE LAYOUTS FOR COATING SYSTEM SELECTION REVISED TO USE COMMON FORMAT USED THROUGHOUT THE REVISED NSTM. SURFACE PREPARATION REQUIREMENTS FOR VARIOUS AREAS CLEARLY DEFINED. COATING SYSTEMS REVISED. DELETED USE OF INORGANIC ZINC COATINGS. DELETED ALUMINUM PASTE AND VARNISH FOR WOOD PRIMING. ADDED REQUIREMENT THAT SURFACE PREPARATION ON NEW WELDS ON FREEBOARD BE SSPC-SP 10. DELETED LIST OF COMPANIES THAT MADE PAINTS DESIGNATED AS FORMULA 25A, SINCE THAT PAINT IS NOW COVERED BY MIL-PRF-24596. (SIMILAR CHANGES WERE MADE THROUGHOUT WHERE F25A AND MIL-PRF-24596 WERE SEPARATELY REFERENCED.) CHANGED REQUIREMENT FOR PRIMING INTERIOR DECKS AND BULKHEADS WITH TT-P-645 F84 FROM ONE COAT TO TWO COATS TO ENSURE ADEQUATE COVERAGE. ADDED SECTIONS FOR WEAR RESISTANT AND AFFF STATION DECK PAINTS. MOVED PARAGRAPH ON GENERAL INFORMATION FOR USE OF WATER BASED PAINTS TO SECTION 7. MOVED TEXT OF MANY TABLE NOTES INTO MAIN BODY TEXT. DELETED USE OF INTUMESCENT PAINT FOR UNPAINTED SURFACE SHIP FIRE ZONE BULKHEADS. ADDED PARAGRAPH AND TABLE LINE FOR COATING EXTERIOR WATERTIGHT CLOSURES. REVISED SECTION DEALING WITH ANTI-SWEAT COATINGS. • PARAGRAPHS 631-8.18.4 AND 631-8.18.5: NEW PARAGRAPHS ADDED TO CLARIFY COATING REQUIREMENTS FOR HVAC INTAKE PLENUMS, TRUNKS, AND DUCTS, AND COMBUSTION AIR INTAKES AND UPTAKES, RESPECTIVELY. • PARAGRAPH 631-8.18.6 AND TABLE 631-8-11: COMPLETELY REVISED AND UPDATED COATING REQUIREMENTS FOR TANKS, VOIDS, BILGES, AND CHAIN LOCKERS, TO BE CONSISTENT WITH 009-32 FY07, AND OTHER CURRENT POLICY. SIGNIFICANT CHANGES INCLUDE: • A) MODIFIED RELATIVE HUMIDITY REQUIREMENTS; • B) MODIFIED REQUIREMENTS FOR EDGE RADIUS VS. EDGE BREAKING FOR 100% SOLIDS VS. OTHER TYPES OF COATINGS; • C) COMMON REQUIREMENTS FOR WELD SURFACE FINISHING IN ALL TYPES OF CRITICAL COATED AREAS MODIFIED AND MOVED TO SECTION 5 (REF. TMDER N45404-02-4401); TT-P-28. • D) MANY FORMER NOTES TO OLD TABLE 631-8-15 MOVED INTO TEXT; • E) MANY SURFACE PREPARATION QA REQUIREMENTS COMMON TO ALL CRITICAL COATED AREAS MOVED TO 631-5.14; REPLACED SURFACE SALT CHLORIDE TESTING BY BRESLE METHOD WITH CONDUCTIVITY METHOD AND LIMITS; • F) CLARIFIED REQUIREMENTS FOR COATING CORROSION RESISTANT METALS IN TANKS;

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		• G) DELETED OLD PARAGRAPH 631-8.23.10.8 ON USE OF PROPRIETARY COATINGS, AS IT IS NO LONGER NEEDED DUE TO REVISIONS TO THIS SECTION AND USE OF MIL-PRF-23236C COATING SYSTEMS; • H) DELETED ALL USE OF INORGANIC ZINC PRIMERS; • I) ADDED COATING REQUIREMENTS FOR MANHOLE COVERS. • PARAGRAPH 631-8.18.7: NEW PARAGRAPH ADDED FOR COATING REQUIREMENTS IN WET SPACES. • (OLD PARAGRAPH 631-8.25 ON SUBMARINE COATING REQUIREMENTS NOW NUMBERED PARAGRAPH 631-8.20.) • PARAGRAPH 631-8.20.1: ADDED NEW PARAGRAPH AND SUBPARAGRAPHS ADDRESSING COORDINATION WITH SUBMARINE URO MRC'S. RENUMBERED SUBSEQUENT PARAGRAPHS ACCORDINGLY. • PARAGRAPH 631-8.20.2: COMPLETELY REVISED THIS PARAGRAPH AND SUBPARAGRAPHS PERTAINING TO EXTERIOR SUBMARINE COATINGS. ADDRESSED COATINGS FOR SURFACES COVERED BY SHT AND MIP, AND COATING OF BOW DOMES AND FIBERGLASS FAIRINGS. • TABLE 631-8-13 (NEW)/631-8-12 (OLD): COMPLETELY REVISED TABLE FORMAT AND CONTENTS FOR SUBMARINE EXTERIOR COATINGS, TO COMPLEMENT NEW PARAGRAPH 631-8.20.2. • PARAGRAPH 631-8.20.3.1: DELETED LIST OF MANUFACTURERS FOR FORMULA 25A INTERIOR PAINT, AND REFERRED TO REVISED MIL-PRF-24596 AND ITS QPL INSTEAD. • PARAGRAPH 631-8.20.5: PREVIOUS TEXT CONCERNING TORPEDO TUBE PAINTING ON DECOMMISSIONED CLASSES OF SUBMARINES DELETED. NEW SECTION ON SUBMARINE POWDER COATINGS INSERTED. • PARAGRAPH 631-8.20.6.5: ADDED NEW PARAGRAPH ON PAINTING OF RUBBER PIPE HANGER COMPONENTS FOR SUBMARINES, IAW NAVSEA LTR 9631, SER 92T125/0352 OF 4 AUG 2000. CROSS-REFERENCES TO THIS PARAGRAPH ADDED TO 631-8.17.1 LIST OF ITEMS NOT TO BE PAINTED. • TABLE 631-8-15 (OLD TABLE 8-14): DELETED NOTE 13, AND ALL REFERENCES TO FORMULA 102 PAINTS. • PARAGRAPH 631-9.1.2 ADDED TO PROVIDE INFORMATION ON CAMOUFLAGE REQUIREMENTS OF BOATS AND SMALL CRAFT, AS PER NAVSEA MESSAGE R040500Z OCT 03. • PARAGRAPH 631-9.1.2 CHANGED PRIMER FOR WOOD SURFACES OF BOATS AND SMALL CRAFT FROM ALUMINUM PASTE AND VARNISH TO MIL-DTL-24441, F150 EPOXY. • PARAGRAPH 631-9.2.3.1: DELETED REFERENCES TO USE OF INORGANIC ZINC PRIMERS. • PARAGRAPH 631-9.3.2: DELETED OLD PARAGRAPH ON PRIMING STEEL BOATS AND CRAFT, AS IT IS NOW COVERED IN 631-8.4. • PARAGRAPH 631-9.9: DELETED OBSOLETE PARAGRAPH DEALING WITH AVR BOATS. • PARAGRAPH 631-10.4.1: REVISED REQUIREMENTS FOR DRAFT MARKS TO REFER TO NEW PARAGRAPH IN PARAGRAPH 631-8.4.1. • PARAGRAPH 631-10.7.2, 631-10-7-3: CHANGED ORDER OF FIGURES 631-10-3 AND 631-10-4, AS THEY WERE MENTIONED IN REVERSE ORDER. • SECTION 11: DELETED FREQUENT USE OF THE TERM "IN CRITICAL COATED AREAS" IN THE SUBPARAGRAPHS IN THIS SECTION, SINCE THE SECTION APPLIES TO CRITICAL COATED AREAS BY DEFINITION. • PARAGRAPH 631-11.1: CLARIFIED THAT SECTION 11 QA REQUIREMENTS APPLY TO CONTRACTORS AS WELL AS SHIPYARDS THAT PERFORM PAINTING OF CRITICAL COATED AREAS. • PARAGRAPH 631-11.2: REVISED TO PROVIDE SPECIFIC LISTING OF DEFINED CRITICAL COATED AREAS. (LIST COMPLEMENTS THAT IN 009-32, FY-06, PARAGRAPH 3.4.) • PARAGRAPH 631-11.3: REQUIRED PRIVATE SHIPYARDS AND CONTRACTORS ACTUALLY PERFORMING PRESERVATION OF CRITICAL COATED AREAS TO BE CERTIFIED IAW SSPC QP-1. BROKE OUT SEPARATE SUBPARAGRAPH 631-11.3.2 TO INDICATE THAT THERE ARE ADDITIONAL REQUIREMENTS FOR POTABLE WATER, FEEDWATER, AND HIGH PURITY WATER TANKS.

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• PARAGRAPH 631-11.4: CLARIFIED REQUIREMENT TO INCLUDE DRYDOCKING REPORT PAINTING RECORDS AS PART OF THE PAINTING RECORDS TO BE MAINTAINED FOR CRITICAL COATED AREAS. ADDED REQUIREMENT TO USE QA FORMS IN APPENDICES OF STD. ITEM 009-32 (PER FY-07CH1). • PARAGRAPH 631-11.5: ADDED REQUIREMENT THAT DRY ABRASIVE BLASTING PERSONNEL BE TRAINED PER SSPC C-7, AND THAT PLURAL COMPONENT PAINT APPLICATION PERSONNEL BE CERTIFIED PER THE SSPC C-14 M-PCAC PROGRAM, OR THEIR NAVSEA-APPROVED EQUIVALENTS. REQUIRED THAT A COPY OF THE NAVSEA APPROVAL LETTER BE MAINTAINED BY THE CONTRACTOR FOR EQUIVALENT CERTIFICATIONS. • PARAGRAPH 631-11.5.1: NEW PARAGRAPH ADDED TO DESCRIBE MINIMUM ACCEPTABLE ELEMENTS OF AN ALTERNATE ABRASIVE BLASTING TRAINING COURSE TO SSPC C-7. • PARAGRAPH 631-11.6: CLARIFIED COATING INSPECTOR CERTIFICATION REQUIREMENTS FOR CRITICAL COATED AREAS. MOVED REQUIREMENT FOR CERTIFIED INSPECTORS FOR THERMAL SPRAYED COATINGS TO PARAGRAPH 631-7.6.5. • PARAGRAPH 631-11.7: CLARIFIED COATING INSPECTOR RESPONSIBILITIES TO INCLUDE OTHER COATING PROCESS SPECIFICATIONS OR DOCUMENTS THAT ARE INVOKED IN THE SPECIFICATION FOR THE WORK BEING PERFORMED • PARAGRAPH 631-11.8: REVISED TO REFLECT PAINT STORAGE SHALL BE AS PER THE NAVSEA-APPROVED ASTM F718 DATA SHEETS. • PARAGRAPH 631-11.9: ADDED REQUIREMENT THAT THE COATING INSPECTOR SHALL BE INDEPENDENT OF THE SHOP OR CODE PERFORMING THE WORK. • PARAGRAPH 631-11.11: REVISED REQUIREMENTS FOR INSPECTION OF FINAL COATING SYSTEM. • TABLE 631-11-1: ADDED CROSS-REFERENCES TO KEY QA REQUIREMENTS PARAGRAPHS 631-5.2.2, 631-5.14, AND 631-7.1.4 TO SECTION HEADERS AND TABLE NOTES. CONDENSED AND REVISED NOTES TO DELETE TECHNICAL REQUIREMENTS AND TEST METHODS AND CRITERIA, SINCE THIS INFORMATION IS NOW CONTAINED IN SINGLE LOCATIONS 631-5.2.2, 631-5.14, AND 631-7.1.4, AS APPROPRIATE TO THE STAGE OF THE PRESERVATION PROCESS. • TABLE 631-11-1: ADDED NEW GENERAL NOTE REQUIREMENT TO SUBMIT ASTM F718 DATA SHEETS AS A PART OF THE DOCUMENTATION PACKAGE FOR EACH COATING USED. • TABLE 631-11-1 PART I, ROW 1.A: IN ADDITION TO MIL-A-22262, ADDED CERTIFICATION OF ABRASIVE BLASTING MEDIA PER SSPC-AB 3, AS REQUIRED BY THE JOB SPECIFICATION. • TABLE 631-11-1 PART I, ROWS 1.B AND 1.C: ADDED NEW REQUIREMENT TO OBTAIN A COPY OF THE ORIGINAL COATING MANUFACTURER'S CERTIFICATE OF COMPLIANCE TO THE PAINT MATERIAL SPECIFICATION. REVISED RECEIPT INSPECTION REQUIREMENTS TO CLARIFY THAT THEY APPLY TO ALL DEFINED CRITICAL COATED AREAS, NOT JUST TANKS, AND REVISED TABLE NOTE FOR RECEIPT INSPECTION TO REFLECT PAINT SPECIFICATION CONFORMANCE TESTS. CLARIFIED THAT DATE PAINT WAS RECEIVED BY COATING INSTALLER IS TO BE RECORDED. • TABLE 631-11-1 PART I, ROW 2.C: ADDED NEW REQUIREMENT TO MONITOR PAINT STORAGE TEMPERATURES FOR 24 HOURS PRIOR TO USE, AND TO RECORD THE MINIMUM AND MAXIMUM TEMPERATURES MEASURED. • TABLE 631-11-1 PART II, ROW 1.F: ADDED REQUIREMENT TO TEST FOR SURFACE CONDUCTIVITY AND RESIDUAL DUST. • TABLE 631-11-1 PART II, ROW 2.B: ADDED REQUIREMENT TO TEST FOR RESIDUAL DUST. • TABLE 631-11-1 PART III, ROW 2.A: MODIFIED TO STATE THAT PAINTS USED ARE AS PER THE APPLICABLE JOB SPECIFICATION, OR PER NSTM 631 OR STD. ITEM 009-32, INSTEAD OF A LIST OF SEVERAL OTHER DOCUMENT REFERENCES. • TABLE 631-11-1 PART III, ROW 4.A: CLARIFIED TIME RECORDING REQUIREMENTS FOR SURFACE PREPARATION AND PRIMING. • TABLE 631-11-1 PART IV, ROW 1.C: ADDED CONTRASTING COLOR REQUIREMENT FOR STRIPE COATS.		

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REVISION NO.	DATE	TITLE AND/OR BRIEF DESCRIPTION/PREPARING ACTIVITY
• TABLE 631-11-1 PART IV, ROW 1.D: ADDED REFERENCE TO PARAGRAPH 631-8.8.6 FOR DRYING AND CURING REQUIREMENTS IN POTABLE WATER TANKS. • TABLE 631-11-1 NOTE 10: APPLIED NOTE TO TABLE, IN ROW FOR DFT MEASUREMENTS, AS IT WAS NOT PREVIOUSLY CITED. MODIFIED NOTE, AND ADDED REFERENCE TO NEW TEXT ON USING WFT TO DETERMINE DFT IN 631-8.4. • PARAGRAPH 631-12.1: CHANGED TO INDICATE THAT PPI'S ARE INTENDED FOR SURFACE SHIP PAINTING, AND CLARIFIED THAT THE PPIS LISTED WILL REQUIRE TAILORING AND ADDITIONS IF USED FOR SUBMARINE PAINTING OPERATIONS. • PARAGRAPH 631-12.3 AND TABLE 631-12-1: REVISED TO REFLECT USE OF PPI'S VICE TGI'S, AND UPDATED LIST OF PPI'S. ADDED WEB PAGE LINK. • PARAGRAPH 631-12.5: CHANGE TO REFER TO NAVSEA STD. ITEM 009-32 AND HTTP://WWW.NSTCENTER.COM/NAVYRESOURCES.ASPX FOR THE QA INSPECTION FORMS.		

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CHAPTER 631

PRESERVATION OF SHIPS IN SERVICE GENERAL

SECTION 1

GENERAL INFORMATION

631-1.1 INTRODUCTION.

631-1.1.1 GENERAL. This chapter provides instructions, requirements, and information for prevention of corrosion and deterioration of ships, submarines, boats, and small craft in the naval service by means of surface preparation, painting, and application of other preventive measures. This document contains both mandatory requirements and guidance information. The mandatory requirements are indicated by the words "shall" or "is required." Guidance information is indicated either by the word "should" or "may".

631-1.1.2 ORGANIZATION. This chapter is organized into the following sections.

1. [Section 1](#) - General Information: Provides introductory information, overarching paint policy requirements, a list of reference documents, and coating requirements summary tables for surface ships and submarines, drawn from [Section 8](#).
2. [Section 2](#) - Safety Information: Provides requirements and guidance for safety precautions to be taken during surface preparation, painting, and related processes associated with preservation described in this manual. This material is largely based on information provided by the Naval Environmental Health Center (NEHC).
3. [Section 3](#) - Paint Equipment, Gages and Materials: Provides information on types of painting equipment, gages and instruments used in some of the in-process inspection check points, and paints, coatings, and preservatives referenced in this manual.
4. [Section 4](#) - Reconditioning Of Flooded And Smoke-Contaminated Equipment: The equipment, cleaning materials, and procedures used for reconditioning contaminated equipment to operational condition that was formerly contained in this section has been moved to NSTM Chapter 079, Volume 3 "Damage Control Engineering Casualty Control."
5. [Section 5](#) - Surface Preparation: Provides overarching paint policy requirements and guidance for the various types of surface preparation and cleaning methods required by [Sections 8](#) and [9](#). Also provides a summary of the quality assurance requirements associated with the surface preparation process.
6. [Section 6](#) - Paint Application Guidance and Requirements: Provides general guidance and requirements for the application of paints and coatings by brushing, rolling, spraying, and other methods. Also provides descriptions, color photographs, and suggested remedies for a variety of paint defects and failures.
7. [Section 7](#) - Paint Application Procedures: Provides specific requirements and guidance for the application of the paints on Naval vessels required by [Sections 8](#) and [9](#). Includes generally applicable requirements such as the use of stripe coats and NAVSEA-approved ASTM F718 data sheets, and a summary of the quality assurance requirements associated with the paint application process. Provides specific requirements for several of the types of coatings required in [Section 8](#).
8. [Section 8](#) - Shipboard Paint Application: Provides general and specific requirements and guidance for the surface preparation and coatings to be used on specific areas or components of ships and submarines. This section provides the basis for the summary tables in [Section 1](#).

9. [Section 9](#) - Boats And Small Craft: Provides general and specific requirements and guidance for the surface preparation and coatings to be used on specific areas or components of boats and small craft.
10. [Section 10](#) - Naval Ships' Marking And Awards: Provides guidance for the size, painting, and placement of naval ship and small craft names, identification markings, and awards.
11. [Section 11](#) - Quality Assurance For Critical Coated Areas: Defines critical coated areas, and provides the quality control and quality assurance requirements that a public or private shipyard or contractor must meet for those areas. At private shipyards and repair facilities, the local Naval Supervisor of Shipbuilding, Conversion and Repair, Regional Maintenance Center (RMC), or the classification society Surveyor, as appropriate to the contract, shall monitor the contractor's performance to ensure that these requirements are met in accordance with the applicable contracts.
12. [Section 12](#) - Preservation Process Instructions: Describes and lists the Preservation Process Procedures (PPIs) that NAVSEA has developed for coating specific shipboard areas or components. The CORE PPI (63101-000) provides the common requirements that are applicable to all of the other PPIs.

631-1.2 REFERENCE DOCUMENTS.

631-1.2.1 Reference documents are listed in [Table 631-1-1](#).

631-1.3 GENERAL PAINTING REQUIREMENTS.

631-1.3.1 GENERAL. Painting of the ships' surfaces, interior and exterior, shall be based on either a condition-based assessment of the specific area, or, for coating systems with service-life expectations as stated in this Technical Manual (e.g. underwater hull antifouling coatings), on a time-based schedule according to the age of the coating. Soiled surfaces should be cleaned rather than repainted. Painting for strictly cosmetic reasons is discouraged; refer to [paragraph 631-1.3.2.7](#) below. The repainting of surfaces shall be performed using the procedures and coatings specified in this Technical Manual. Refer to [Section 8](#), for detailed requirements and [Tables 631-1-2](#) through [631-1-6](#) for a general summary of coating requirements.

631-1.3.2 DEFINITIONS OF SCOPE OF PRESERVATION. The following definitions apply to the scope of preservation work being performed in a space or compartment, or, for exterior surfaces, a defined area, e.g. freeboard, underwater hull, mast, etc. Although full preservation, partial preservation and spot repair are different in the proportions of area being preserved, each shall meet the quality assurance requirements stated in this manual as if full preservation were being done. For surface ships (including aircraft carriers), the documentation requirements of [Section 11](#) are waived for touchup areas; the requirements of [paragraphs 631-5.2.2, 631-5.14, 631-7.1.3, and 631-7.1.4](#) shall be verified but do not require documentation for touchup areas. This waiver does not apply to potable or feedwater tanks; no requirements shall be waived for the touch up of surface ship potable or feedwater tanks. For submarines, the documentation requirements of [Section 11](#) are waived for touchup areas except for the requirements to provide the paint manufacturer's certificate of compliance and material conformance test data, as described in [Table 631-11-1, Section I](#), rows 1.b and 1.c; the requirements of [paragraphs 631-5.2.2, 631-5.14, 631-7.1.3, and 631-7.1.4](#) shall be verified but do not require documentation for touchup areas unless otherwise specified in Standard Item 009-32. This waiver does not apply to potable or feedwater tanks; no requirements shall be waived for the touch up of submarine potable or feedwater tanks.

631-1.3.2.1 Full Preservation. Full preservation is defined as preservation of an entire space or location.

631-1.3.2.2 Partial Preservation. Partial preservation is defined as preservation of a section of an entire space or location.

631-1.3.2.3 Spot Repair. Spot repair is defined as a small, localized area being preserved that is greater in size than what is defined as touchup.

631-1.3.2.4 Touchup For Surface Ships. Touchup is defined within this manual as preservation operations on cumulative surface areas less than one percent of the total area of the space (e.g. tank, compartment, etc.), location (e.g. bilge, superstructure area, etc.), or item of equipment being preserved, with no individual area greater than 10 square feet. Included under touchup operations are new and disturbed areas of less than 10 square feet.

631-1.3.2.5 Touchup For Submarines. Touchup is defined within this manual as preservation operations on cumulative surface areas less than one percent of the total area of the space (e.g. tank, compartment, etc.), location (e.g. bilge, sail area, etc.), or item of equipment being preserved, with no individual area greater than 4 square feet. Included under touchup operations are new and disturbed areas of less than 4 square feet.

631-1.3.2.6 Disturbed Areas. Disturbed areas are defined as any surface that requires cleaning and/or painting due to the existing paint finish being damaged in the accomplishment of work specified. Closure plates/hull accesses and their associated welds shall not be considered a disturbed surface and shall be cleaned, prepared, painted, and documented in accordance with the requirements for the paint system specified for the surrounding area. Deviations to this requirement may be authorized by the local Naval Supervisor of Shipbuilding or Regional Maintenance Center based on size, location, application, or severity of condition of the coating system being applied.

631-1.3.2.7 Cosmetic Painting. Cosmetic painting is defined as additional topcoats (i.e. not primer or anti-corrosion (AC) coats) applied to an existing system in order to improve the visual appearance of the ship, whether they are applied to an interior or exterior area. Cosmetic painting does not include any application of paint to bare metal or other materials, with the exception that small areas of coatings damage may be touched-up following the requirements and limitations for Touchup given above. As these additional topcoats are not being applied to correct functional coatings damage or ongoing corrosion issues, the requirements of [Section 11](#) and [paragraphs 631-5.2.2, 631-5.13, 631-7.1.3, and 631-7.1.4](#) do not apply. Application of multiple cosmetic coats can have a significant negative impact on the performance of the coating system, adds weight to the ship, and can increase the overall fuel load in the event of a fire. Specific issues to consider prior to authorizing cosmetic painting include:

631-1.3.2.7.1 Coating De-lamination and Blistering Risk. Additional topcoats increase the risk of a coating system failure by severe blistering or extensive peeling and flaking. This risk is significantly increased if proper cleaning and preparation steps aren't followed to remove any hydrocarbons or salts from the surface prior to painting.

631-1.3.2.7.2 Significant Weight Impact. Although it may seem that paints are applied so thinly that they do not affect the weight of the ship significantly, excessive cosmetic coats can add significant unplanned weight to a ship. For example, on an aircraft carrier freeboard (including catwalks, etc.), each extra mil of dry paint thickness adds 1.5 long-tons of weight. On other surface ships, this number is smaller in proportion to the affected surface area; however, since failure investigations have shown that on several ships there has been 80 mils or more of excess paint, the weight impact can be significant on all ship classes.

631-1.3.2.7.3 Decreased Service Life. Excessive additional layers of topcoats above the anti-corrosion coats impart additional stresses on the paint system as a whole, leading to an increased risk of a catastrophic coating system failure to bare metal, as the system pulls away from the substrate in sheets. Furthermore, cosmetic coatings can hide actual defects in the AC layers, which could be allowing corrosion to progress underneath the coating film.

631-1.3.2.7.4 Wasted Money and Time. Applying additional coats of paint to hide aesthetic issues such as running rust stains only covers over the issue. The rust stains will continue to develop (or even bleed through) the new layers, leading to application of more cosmetic layers. Cosmetic painting does not address or eliminate the root cause of the staining. In many cases, simply power washing to remove the staining, performing touchup on small damaged areas or installing pipe liners in overboard discharges to eliminate the source of the rust staining is far more cost effective than constant repainting in the long run.

631-1.3.2.7.5 Excess Paint as a Fuel Source for Fires. Almost all paints are organic materials, and organic materials can and will burn in a fire. Excess layers of paint can act as an additional fuel source for a fire in a compartment, possibly contributing to raising the temperature of the fire, adding more smoke, or causing it to burn longer.

631-1.3.3 MANDATORY COATING REPLACEMENT. For the critical coated areas defined in [paragraph 631-11.2](#), except for potable water, reserve feed water, and fresh water drain collection tanks on nuclear-powered vessels, when the accumulated damage to a coating system that would require repairs exceeds 10 percent of the total surface area in the space or designated area being coated, the coating shall be replaced as soon as practicable. This condition corresponds to an ASTM D610 rust grade rating of “3” or lower. For potable water, reserve feed water, and fresh water drain collection tanks in nuclear-powered vessels, coating replacement shall be directed as described in the general Specifications for Overhaul (GSO), nuclear supplement, Section 631. For all other areas, when the cumulative coating damage exceeds 20% of the total surface area, the coating system shall be replaced as soon as practicable.

631-1.3.4 CONDITION-BASED COATING ASSESSMENT REQUIREMENTS. Condition-based coating assessment inspections conducted in critical coated areas in accordance with this Technical Manual shall be made by trained and certified coating inspectors as described in [paragraph 631-11.6](#). The inspection should include the following elements appropriate to the area being inspected: an assessment of the coating system using visual inspections for degree of rusting, blisters, or other coating failures; dry film thickness (DFT); and, if deemed beneficial by the coating inspector and specifically authorized by the Type Commander, qualitative or quantitative adhesion tests. The coating inspector shall also review and evaluate the available quality assurance records from the prior coating installation work. In cases where the coating system has failed to the extent that structural loss resulting from corrosion is evident, a structural assessment shall be made by a qualified maintenance engineer or surveyor.

631-1.3.4.1 Condition-Based Inspection Periodicities For Critical Coated Areas (Except Tanks and Voids). Inspections shall be conducted far enough in advance of an availability to allow for availability planning, and shall be timed to minimize disruption to the ship’s crew. Tank and void coating inspection requirements are described in [paragraph 631-1.3.5](#) below. For all other critical coated areas defined in [paragraph 631-11.2](#), the following minimum requirements for inspection periodicities are established:

Surface Ship Bilges:	36 months	Combustion Uptakes, Trunks:	72 months
Well Deck Overheads:	72 months	HVAC Intakes, Plenums, Trunks:	72 months
Jet Blast Deflector Pits:	72 months	RAST, etc. Track Troughs	36 months

Underwater Hull:	Time-based per previous coating system applied
Rudders and Struts:	36 months (Diver inspections permitted)
ICCP Dielectric Shields:	Refer to NSTM Chapter 633
Non-Skid Decks:	Refer to NSTM Chapter 634

631-1.3.4.2 Submarine Unrestricted Operation Maintenance Requirement Cards. Preservation on submarines shall be coordinated with applicable Unrestricted Operation (URO) Maintenance Requirement Cards (MRC), as described in [paragraph 631-8.20.1](#).

631-1.3.5 TANK AND VOID COATING INSPECTIONS. Tank and void inspections shall be completed to facilitate condition-based maintenance. The periodicity of tank inspections is dependent on many factors that are affected by ship operations. Among the considerations that need to be evaluated are available time, funding, criticality of the tank from an operational standpoint, and acceptable risk. Tank inspection periodicity must also take into account the potential need to effect repairs to the tank coating or structure as a result of the inspection. This is especially pertinent in the case of drydocking, when the tank coating repair procedure can be accomplished with better environmental controls, and easier access, such as through hull cuts. In general, if a tank is opened for any reason, an inspection should be performed, with the data from the inspection collected and stored per [paragraph 631-1.3.6.1](#).

631-1.3.5.1 Tanks That Can Only Be Coated In Drydock. The following applies to tanks that can only be painted in drydock (e.g., certain aircraft carrier potable water and reserve feedwater tanks). When planning work for the next drydocking availability, if the installed coating systems' life expectancy will be reached before a subsequent drydocking, then re-preservation shall not be deferred.

631-1.3.5.2 Difficult To Access Tanks. Prior to or during scheduled drydocking availabilities, tanks and voids that cannot reasonably be represerved waterborne shall be inspected. The types of tanks that fall into this category differ according to ship class, but generally include ballast tanks, freshwater tanks, fuel tanks, voids and cofferdams located in the inner-bottom or in the double-bottom.

631-1.3.5.3 Tank and Void Inspection Periodicities. Tank and void inspections shall be timed to coincide with major availabilities to minimize the effects on the ship's crew. The Planned Maintenance System (PMS) is acceptable for scheduling these requirements. The following requirements for surface ships and craft and aircraft carrier tank and void inspection periodicities are established to perform condition based maintenance. The requirement for ballast tanks shall also apply to compensated fuel tanks, as these tanks contain seawater and fuel. See also [paragraph 631-8.5.2](#) for potable water tanks. For submarines, tank inspection periodicities are as specified in URO MRC 003 or the applicable submarine maintenance plan.

Ballast Tanks	72 months	JP5 Storage	120 months
CHT Tanks	48 months	JP5 Service	96 months
Potable Water	72 months	JP5 Drains and sumps	36 months
Reserve feed water tanks	72 months	Fuel Oil Storage	120 months
Sponson Voids	72 months	Fuel Oil Service	120 months
Catapult Trough Wing Voids	72 months	Lube Oil Tanks	120 months
Waste Water & Plumbing Waste Drain Tanks			72 months
JP5 Contaminated, Settling, and Purifier Drain Tanks			36 months
Voids (4th deck or below on aircraft carriers and 2nd deck or below for surface ships)			72 months.
Voids (above 4th deck on aircraft carriers and above 2nd deck on surface ships)			120 months

631-1.3.6 COATING REPAIR DECISIONS. The decision to conduct replacement or repairs to a coating system is dependent on many factors beyond the condition of the coating system. Considerations include the age of the coating system, the type of coating installed, the documentation of quality assurance measures used during the original coating installation, the presence and condition of sacrificial anodes, and the remaining service life of the ship. The Type Commander or their designated representatives (e.g. Port Engineers, Maintenance Planning Managers, etc.) are the initial decision authority for coating repair determinations.

631-1.3.6.1 Tank and Void Coating Replacement and Repair Protocol. The Corrosion Control Information Management System (CCIMS) shall be used as the repository for storage of in-service coating inspections and shall serve as the basis for making decisions that relate to the repair or replacement of tank and void coating systems. The CCIMS is described in NAVSEA Technical Publication T-9630-AB-MMD-010/ALL USN HULLS. The CCIMS can be located at the following web site link:

631-1.3.7 PERFORMANCE OF CONTRACTED PRESERVATION WORK ON SURFACE SHIPS. NAVSEA Standard Item 009-32 shall be invoked as the implementing contract document for the requirements specified herein, for all contracted preservation work. The work specification shall invoke the appropriate table(s) and line(s) of Standard Item 009-32 for the area, type of substrate, and scope of work being performed.

631-1.3.8 USE OF ASTM F718 DATA SHEETS. Unless otherwise specified herein, all paints and coatings that are qualified to performance specifications (MIL-PRF, see [paragraph 631-3.4.9](#)) are to be applied in accordance with the manufacturer's NAVSEA-approved ASTM F718 product/procedure data sheet submitted at the time of product qualification to the applicable specification, or other NAVSEA approval. NAVSEA-approved ASTM F718 data sheets have been prepared for all Naval vessel military specification paints. All coatings applied in designated critical coated areas (see [paragraph 631-11.2](#)) are to be applied in accordance with NAVSEA-approved ASTM F718 data sheets. NAVSEA-approved ASTM F718 data sheets refer to NAVSEA Standard Item 009-32 for dry film thickness (DFT) requirements. The DFT requirements stated in NAVSEA Standard Item 009-32 or this Technical Manual take precedence over any other manufacturer's coating data sheets. Copies of the NAVSEA-approved ASTM F718 data sheets are available from the National Surface Treatment Center (NST Center) web site, <http://www.nstcenter.com/>.

631-1.3.9 NAVSEA DIRECTIVE FOR CHANGING PAINTING PRACTICES. Whenever a directive is issued by NAVSEA effecting a change in painting practice, repainting to conform with the directive should be deferred until repainting is necessary, unless the directive specifies that repainting shall be done as soon as practical.

631-1.3.10 SPECIFICATION OF PAINT COLORS. Where five-digit paint colors are specified in this Technical Manual, this refers to the colors defined by FED-STD-595, "Colors Used in Government Procurement". All of these color numbers begin with either the digits 1, 2, or 3, indicative of the finish, or degree of gloss of the coating. A "1" indicates a glossy finish, a "2" indicates a semi-gloss finish, and a "3" indicates a flat or lusterless finish. When a text name is also given with the color number, it generally is the most commonly used name associated with that particular color number; in the event of any conflicts regarding color names, the FED-STD-595 color number takes precedence.

631-1.4 COATING SELECTION.

Coatings installed on Naval vessels shall be free of lead, chromates, asbestos, and cadmium, and shall comply with all Federal, state and local regulations which regulate the emission of volatile organic compounds (VOC) into the atmosphere, as described in NAVSEA paint specifications. Refer to [paragraph 631-3.4.8](#) and [Table 631-3-4](#).

NOTE

The paints and coatings, as well as the safety application information, listed in this manual have been reviewed for compliance with environmental and occupational safety and health compliance to the rules and regulations in effect on the date of the latest change. Fleet and shore activities procuring and using paints other than those listed herein have the responsibility of verifying that the paints comply with all such rules, regulations and laws.

631-1.5 NAVSEA COGNIZANT TECHNICAL AUTHORITY.

The Naval Sea Systems Command Corrosion Control Division, SEA 05P23, is the Cognizant Technical Authority (CTA) for all naval vessel preservation policy, and is responsible for the content of this Technical Manual. All requests for conflict resolution, clarification, or other preservation issues shall be referred to SEA 05P23.

631-1.6 DEPARTMENT OF DEFENSE CORROSION PREVENTION AND CONTROL PROGRAM.

631-1.6.1 ESTABLISHMENT OF POLICY. Section 1067 of the National Defense Authorization Act for Fiscal Year 2003 required the Department of Defense (DoD) to create policy to prevent and mitigate corrosion during the design, acquisition, and maintenance of military equipment. In response to this requirement, the Under Secretary of Defense for Acquisition, Technology, and Logistics (USD[AT&L]) established a DoD Corrosion Prevention and Control policy in a Memorandum dated 12 November 2003. This policy applies to the planning, design, and procurement of new systems (acquisition), as well as the maintenance and upgrade of existing systems. This Memorandum stated that the early stages of acquisition provide the best opportunity to make effective trade-offs among the many competing design criteria that will provide desired Defense capability. The Memorandum made corrosion planning a standard topic for Integrating Integrated Product Team reviews, and required corrosion prevention and control planning to be reviewed by the Overarching Integrated Product Team. On 17 September 2004, Change Notice 20040917 to the Defense Federal Acquisition Regulation Supplement (DFARS) formally implemented this requirement in acquisition programs.

631-1.6.2 CORROSION PREVENTION AND CONTROL PLANNING GUIDEBOOK. To supplement the DoD Corrosion Prevention and Control policy, a “Corrosion Prevention And Control Planning Guidebook” has been issued by the Director, Corrosion Policy and Oversight, PDUSD (AT&L). The current version of this guidebook is Spiral 2 - July 2004. The guidebook, and any subsequent revision, is available on the DoD Corrosion Exchange website:

www.DoDcorrosionexchange.org

The guidance and requirements in the Corrosion Prevention And Control Planning Guidebook primarily address new acquisition programs. The Guidebook provides detailed corrosion planning guidance and includes discussions on the following topics:

- a. DoD policy for making corrosion prevention and control planning an explicit part of performance-based acquisition.
- b. Implementation of best business practices and best-value decisions for corrosion prevention and control in system acquisition, sustainment, and utilization.
- c. Establishment of a Corrosion Prevention Advisory Team (CPAT) at program initiation, and involvement of the Technical Authority.

- d. Establishment of a Contractor Corrosion Team (CCT), and selection of members and responsibilities.
- e. Technical and design considerations.

Table 631-1-1 Reference Documents

DOCUMENT NUMBER	TITLE
ANSI Z358.1	Emergency Eyewash and Shower Equipment
ANSI Z87.1	Occupational and Educational Personal Eye and Face Protection Devices
ASTM D3363 ^{NOTE 6}	Standard Test Method for Film Hardness by Pencil Test
ASTM D441 ^{NOTE 6}	Standard Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel
ASTM F718 ^{NOTE 6}	Shipbuilders and Marine Paints and Coatings Product/Procedure Data Sheet
CFR Sections (Code of Federal Regulations) 29 CFR 1910.134	Respiratory Protection
DODINST 6055.1	DoD Occupational Safety and Health Program
FED-STD-595	Colors Used in Government Procurement
FED-STD-793	Depot Storage Standards
ISO 8502-3	Assessment Of Dust On Steel Surfaces Prepared For Painting (Pressure Sensitive Tape Method)
Master Painters Institute ^{NOTE 7} Reference Coatings	N/A
MIL-E-2036(SH)	Enclosure For Electric And Electronic Equipment, Naval Shipboard
MIL-STD-1689(SH)	Fabrication, Welding, And Inspection Of Ships Structure
MIL-STD-2138(SH)	Metal Sprayed Coating Systems for Corrosion Protection Aboard Naval Ships
MIL-STD-2199(SH)	Glass Reinforced Plastic Coverings For Propeller Shafting
MS 6310-081-015 ^{NOTE 5}	Submarine Maintenance Standard: Submarine Preservation
MS 6310-081-017 ^{NOTE 5}	Submarine Maintenance Standard: ASDS Preservation
MS 7650-081-091 ^{NOTE 5}	Submarine Maintenance Standard: Submarine Hull Inspection
NACE International Standard Recommended Practice RP0188 ^{NOTE 2}	Standard Recommended Practice – Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates
NACE International Standard Recommended Practice RP0178 ^{NOTE 2}	Fabrication Details, Surface Finish Requirements, and Proper Design Considerations for Tanks and Vessels to be Lined for Immersion Service
NAVMEDCOMINST 6260.5	Occupational Noise Control and Hearing Conservation
NAVSEA 0902-018-2010	General Overhaul Specifications For Deep Diving SSBN/SSN Submarines (DDGOS)
NAVSEA 0919-LP-008-8010/NAVAIR 51-5-30	Corrosion Control for Shipboard Launch and Recovery System
NAVSEA 0929-LP-002-7010	U.S. Navy Shipboard Color Coordination Guidance Manual
NAVSEA 0967-LP-412-3010	Sonar Dome Handbook, Vol. I, AN/SQS-4 Series and AN/SQS-23 Sonar Domes
NAVSEA 0967-LP-412-3020	Sonar Dome Handbook, Vol. II, AN/SQS-26 Steel and Rubber Sonar Domes
NAVSEA 0967-LP-412-3030	Sonar Dome Handbook, Vol. III, AN/SQS-38 GRP Sonar Domes
NAVSEA 0967-LP-412-3040	Sonar Dome Handbook, Vol. IV, AN/SQQ-23 Rubber Sonar Domes
NAVSEA 0989-LP-037-2000	Commissioned Submarine General Reactor Plant Overhaul and Repair Specifications
NAVSEA 0989-LP-043-0000	Commissioned Surface Ship General Reactor Plant Overhaul and Repair Specifications
NAVSEA S0400-AD-URM-010	Tag Out Users Manual (TUM)

Table 631-1-1 Reference Documents - Continued

DOCUMENT NUMBER	TITLE
NAVSEA S6360-AG-MAN-010	Camouflage Manual for Surface Ship Concealment
NAVSEA S6360-AD-HBK-010	Special Hull Treatment (SHT) Maintenance and Repair (for SSN688 Class and earlier)
NAVSEA S6360-AN-MMA-010/SHT	Submarine Mold-In-Place Special Hull Treatment Maintenance and Repair Manual (for SSN21 Class)
NAVSEA S6360-AV-MMA-010/SHT	Submarine Mold-In-Place Special Hull Treatment Maintenance and Repair Manual (for SSN774 Class)
NAVSEA S9AA0-AB-GOS-010/GSO	General Specifications for Overhaul of Surface Ships (GSO)
NAVSEA S9074-AQ-GIB-010/248	Requirements for Welding and Brazing Procedure and Performance Qualification
NAVSEA S9086-CH-STM-010	NSTM Chapter 074, Volume 1, Welding And Allied Processes
NAVSEA S9086-CH-STM-030	NSTM Chapter 074, Volume 3, Gas Free Engineering
NAVSEA S9086-CN-STM-030	NSTM Chapter 079, Volume 3, Damage Control Engineering Casualty Control
NAVSEA S9086-CQ-STM-010	NSTM Chapter 081, Waterborne Underwater Hull Cleaning of Navy Ships
NAVSEA S9086-DA-STM-010	NSTM Chapter 100, Hull Structures
NAVSEA S9086-KC-STM-010	NSTM Chapter 300, Electric Plant - General
NAVSEA S9086-KE-STM-010	NSTM Chapter 302, Electric Motors and Controllers
NAVSEA S9086-ND-STM-010	NSTM Chapter 400, Electronics
NAVSEA S9086-RK-STM-010	NSTM Chapter 505, Piping Systems
NAVSEA S9086-RQ-STM-010	NSTM Chapter 510, Heating, Ventilating, and Air-Conditioning Systems for Surface Ships
NAVSEA S9086-TV-STM-010	NSTM Chapter 581, Anchoring
NAVSEA S9086-TX-STM-010	NSTM Chapter 583, Boats and Small Craft
NAVSEA S9086-VF-STM-010	NSTM Chapter 633, Cathodic Protection
NAVSEA S9086-VG-STM-010	NSTM Chapter 634, Deck Coverings
NAVSEA S9086-VH-STM-010	NSTM Chapter 635, Thermal, Fire, and Acoustic Insulation
NAVSEA S9086-WK-STM-010	NSTM Chapter 670, Stowage, Handling, and Disposal of Hazardous General Use Consumables
NAVSEA S9165-AC-HBK-010	Submarine Sonar Dome Handbook (except Trident and SSN21 Class Submarines)
NAVSEA S9510-AB-ATM-010,	Nuclear Power Submarine Atmosphere Control Manual
NAVSEA SE000-01-IMB-010 (0910-LP-003-9770)	Navy Installation and Maintenance Book
NAVSEA SE110-DK-MMO-010	Procedures for Inspection, Repair and Painting of Fiberglass Mast Assemblies
NAVSEA SE300-AY-MMA-010/ SSBN726CL	Trident GRP Bow Sonar Dome Handbook
NAVSEA SE300-AZ-MMA-010	SSN21 Class Sonar Bow Dome Handbook
NAVSEA T9074-AD-GIB-010/1688	NAVSEA Technical Publication: Requirements For Fabrication, Welding, And Inspection Of Submarine Structure
NAVSEA T9074-AS-GIB-010/271	NAVSEA Technical Publication: Requirements For Nondestructive Testing Methods
NAVSEA T9630-AB-MMD-010/ALL USN HULLS	NAVSEA Technical Publication: Corrosion Control Information Management System (CCIMS)
NAVSEA Drawing 690-6520337	Special Hull Treatment/MIP Installation (SSN21 Class)
NAVSEA Drawing 690-7383660	Special Hull Treatment Installation (SSN774 Class)
NAVSEAINST 9210.36	Steam Plant Cleanliness Control
NAVSEA Standard Item 009-32 ^{NOTE 3}	Cleaning and Painting Requirements; Accomplish

Table 631-1-1 Reference Documents - Continued

DOCUMENT NUMBER	TITLE
NAVSUPPUB 4105	Navy Shelf Life Items
OPNAVINST 5100.19	Navy Occupational Safety and Health (NAVOSH) Program Manual for Forces Afloat
OPNAVINST 5100.23	Navy Occupational Safety and Health (NAVOSH) Program
SSPC-AB 2 ^{NOTE 1}	Specification for Cleanliness of Recycled Ferrous Metallic Abrasives
SSPC-AB 3 ^{NOTE 1}	Newly Manufactured or Re-Manufactured Steel Abrasives
SSPC-SP1 ^{NOTE 1}	Solvent Cleaning
SSPC-SP 2 ^{NOTE 1}	Hand Tool Cleaning
SSPC-SP 3 ^{NOTE 1}	Power Tool Cleaning
SSPC-SP 5/NACE No. 1 ^{NOTE 1}	White Metal Blast Cleaning
SSPC-SP-6/NACE No. 3 ^{NOTE 1}	Commercial Blast Cleaning
SSPC-SP-7/NACE No. 4 ^{NOTE 1}	Brush-Off Blast Cleaning
SSPC -SP-10/NACE No. 2 ^{NOTE 1}	Near White Blast Cleaning
SSPC-SP-11 ^{NOTE 1}	Power Tool Cleaning to Bare Metal
SSPC-SP 12/NACE No. 5 ^{NOTE 1}	Surface Preparation and Cleaning of Steel and Other Hard Materials by High- and Ultrahigh-Pressure Water Jetting Prior to Recoating
SSPC-VIS 1 ^{NOTE 1}	Guide and Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning
SSPC-VIS 3 ^{NOTE 1}	Guide and Reference Photographs for Steel Surfaces Prepared by Power and Hand Tool Cleaning
SSPC-VIS 4/NACE VIS 7 ^{NOTE 1}	Guide and Reference Photographs for Steel Surfaces Prepared by Waterjetting
SSPC-VIS 5/NACE VIS 9 ^{NOTE 1}	Guide and Reference Photographs for Steel Surfaces Prepared by Wet Abrasive Blast Cleaning
SSPC-PA 2 ^{NOTE 1}	Measurement of Dry Coating Thickness with Magnetic Gages
SSPC Publication ^{NOTE 1}	Visual Comparison Manual: Application and Coating Defects
UIPI 0631-901	Electrostatic Powder Spray
URO MRC 003	Unrestricted Operations (URO) Maintenance Requirement Card (MRC): Hull Structural Survey
NOTES FOR TABLE 631-1-1 1. Available from SSPC - The Society for Protective Coatings (SSPC), 40 24th Street, 6th Floor, Pittsburgh, PA 15222-4656. Tel: (412) 281-2331. The following publication is also available from SSPC: Document Number: "SSPC-PA Guide 3", Document Title: "A Guide to Safety in Paint Application". 2. Available from NACE International (NACE), 1440 South Creek Drive, Houston, TX 77094-4906. Tel: (281) 228-6200. 3. Available from the NAVSEA Standard Specification For Ship Repair And Alteration Committee (SSRAC), http://www.supship.navy.mil/ssrac4/standard.htm. 4. Available from American National Standards Institute, 11 West 42nd Street, New York, NY 10036. 5. Available from Submarine Maintenance Engineering, Planning & Procurement (SUBMEPP) Activity, P.O. Box 7002, Portsmouth, NH 03802-7002. 6. Available from ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA, 19428-2959. 7. Master Painters Institute (HQ), 4090 Graveley St., Burnaby, BC, Canada, V5C 3T6.	

Table 631-1-2 Summary Of Coating Requirements For Surface Ships-Exterior

Area or Compartment to be Finished	Surface Preparation for Full Preservation	Coating System for Full Preservation	Reference Paragraph/Table	Minimum Surface Preparation for Other Than Full Preservation.	Coating for Less Than Full Preservation	Remarks
Underwater hull (keel to lower boottop) including rudders, struts, and cavitation prone areas	SSPC-SP 10 or SSPC-SP 12, WJ-2L.	1	631-8.4 Table 631-8-1	631-8.4.1.1	1	Overhaul surface preparation may require only spot blasting to near white and will require inspection.
Lower boottop limit to 12" above the upper boottop limit	SSPC-SP 10 or SSPC-SP 12, WJ-2L.	1	631-8.4 Table 631-8-1	631-8.4.1.1	1	Touchup existing coatings with the same system. Do not put epoxy AC coatings over any type of AF coating.
Fin Stabilizers	SSPC-SP 7 or SSPC-SP 2	1	631-8.4 Table 631-8-1	631-8.4.1.1	1	SSPC-SP 7 shall be used for existing fin stabilizers, and SSPC-SP 2 shall be used for refurbished fin stabilizers.
Freeboard, Superstructure, and Masts (Exterior vertical or near-vertical ship structure surfaces from 12" above the boottop, except other structural surfaces listed below)	SSPC-SP 10 or SSPC-SP 12, WJ-2L.	2A or 2B or 3A or 3B	631-8.18.2 Table 631-8-8	SSPC-SP 10 or SSPC-SP 11	2A or 2B or 3A or 3B	When using System 2, MIL-PRF-24635 Grade C coatings with LSA and Anti-Stain are preferred. Do not put epoxy over alkyd or latex paints. Edges of repaired areas shall be feathered.
Exterior horizontal surfaces and waterways not receiving non-skid coatings	SSPC-SP 10 or SSPC-SP 12, WJ-2L.	4A or 4B	631-8.18.2 Table 631-8-8	SSPC-SP 10 or SSPC-SP 11	4A or 4B	Do not put epoxy over alkyd paints. Edges of repaired areas shall be feathered.
Flight Decks, Hanger Decks, Vertical Replenishment Decks, Exterior Walkways	--	--	--	--	--	Refer to NSTM Chapter 634 for non-skid coating system requirements.
Exterior fittings and piping	SSPC-SP 10	2A or 2B or 3A or 3B	631-8.18.2 Table 631-8-8	SSPC-SP 11	2A or 2B or 3A or 3B	When using System 2, MIL-PRF-24635 Grade C coatings with LSA and Anti-Stain are preferred.
Anchor	SSPC-SP 10	2A or 2B	631-8.16 Table 631-8-7	SSPC-SP 11	2A or 2B	Anchors that are normally stowed below the lower boottopping limit shall be painted the same as the underwater hull AC/AF system. Stripe coat may be omitted.
Anchor chains	SSPC-SP 6	9	631-8.16 Table 631-8-7	SSPC-SP 11	9	
Catapult launching valves and exhaust	SSPC-SP 10	7A or 7B or 8	631-8.16 Table 631-8-7	SSPC-SP 10 or SSPC-SP 11	5 or 7A or 7B or 8	Stripe coat may be omitted. SSPC-SP 11 for system 5 only.
Closures, Watertight (Doors, Hatches, Scuttles)	SSPC-SP 10	45A or 45B or 45C	631-8.18.2.3 Table 631-8-8	SSPC-SP 11	2A or 10	Systems 2A or 10 for use by Ship's Force; if System 2A is used, use MIL-PRF-23236 Type VI, Class 5.
Embarked Boats, Aluminum, Underwater Hulls	See Remarks	1 or 17	631-8.4.1.10 631-9.3	See Remarks	1 or 17	Refer to paragraph 631-8.4 and Section 631-9 Boats and Small Craft.
Exterior canvas lagging and life rafts	Detergent clean and rinse, dry	12	631-8.16 Table 631-8-7	Detergent clean and rinse, dry	12	

Table 631-1-2 Summary Of Coating Requirements For Surface Ships-Exterior - Continued

Area or Compartment to be Finished	Surface Preparation for Full Preservation	Coating System for Full Preservation	Reference Paragraph/Table	Minimum Surface Preparation for Other Than Full Preservation.	Coating for Less Than Full Preservation	Remarks
Fire plugs and foam discharge valves	SSPC-SP 10	13	631-8.16 Table 631-8-7	Hand or power tool clean	13	Use color number 11105 (Red).
Galvanized Steel Surfaces	SSPC-SP 7 or SSPC-SP 3	See remarks	631-8.16 Table 631-8-7	SSPC-SP 3	See remarks	Do not coat small items of galvanized outfitting hardware. Use care during surface preparation to minimize removal of the galvanizing. Components with large surface areas shall only be lightly brush-off blasted or power tool cleaned. Touchup damaged areas of galvanizing with one coat of MIL-DTL-24441 F150 or MIL-PRF-23236 epoxy at 2-4 mils DFT, and topcoat to match surrounding area.
Louvers, Removable (Bolted), for Intakes and Uptakes	SSCP-SP 10 or SSPC-SP 12 WJ-2L	7B or 25	631-8.18 Table 631-8-8	SSPC-SP 10 or SSPC-SP 11	7B or 25	
Messenger buoys	Detergent clean and rinse, dry		631-8.16 Table 631-8-7	Detergent clean and rinse, dry	13	Use color number 12197 (International Orange)
Passive Countermeasure System (PCMS)	See remarks	11, omit stripe coat	631-8.16 Table 631-8-7	See remarks	11, omit all MIL-DTL-24441 if only cosmetic recoat.	Refer to Table 631-8-7 for additional information.
Propellers (composition or corrosion resistant)	Clean and polish bright	N/A		N/A	N/A	
Propulsion shaft outboard bearing void (internal surfaces of strut and stern tube in way of outboard bearings)	SSPC-SP 10 (When shaft is removed)	7A or 7B, See Remarks	631-8.4 Table 631-8-7	SSPC-SP 10	7A or 7B, See Remarks	Fill bearing void with corrosion preventive compound MIL-C-11796 Class 1 after each bearing shell installation. Two coats of the under-water hull anti-corrosion (AC) coating system per MIL-PRF-24647 may be substituted for System 7A or 7B.
RAST Track Troughs	SSCP-SP 10 or SSPC-SP 12 WJ-2L	7A or 7B or 5	631-8.18.2 Table 631-8-8	SSPC-SP 11	5	For RAST Track Cover and Side Plates requiring non-skid, coat per NSTM CH. 634.
Rudder and skegs (internal surfaces)	--	14	631-8.16 Table 631-8-7	--	14	Ventilate after application to remove solvent vapors. Rudders may be filled and drained or float coated.
Shafting inboard	SSPC-SP 2	5	631-8.16 Table 631-8-7	SSPC-SP 2	5	SSPC-SP 2 hand clean to prevent damage to shaft. Stripe coat may be omitted.

Table 631-1-2 Summary Of Coating Requirements For Surface Ships-Exterior - Continued

Area or Compartment to be Finished	Surface Preparation for Full Preservation	Coating System for Full Preservation	Reference Paragraph/Table	Minimum Surface Preparation for Other Than Full Preservation.	Coating for Less Than Full Preservation	Remarks
Shafting outboard	--	--	631-8.16 Table 631-8-7	--	--	Resin-glass cloth coating per MIL-STD-2199, Glass Reinforced Plastic Coverings For Propeller Shafting This shall be followed by hand sanding, and application of the AC and AF coating system specified in Table 631-8-1 for fiber-glass/GRP surfaces, using the applicable "Desired Service Life" line for the ships under-water hull coating system. Nonferrous surfaces shall receive one coat of MIL-PRF-23236 Type V, VI or VII Class 5 epoxy paint.
Shaft tube (internal)	SSPC-SP 2	5	631-8.16 Table 631-8-7	SSPC-SP 2	5	SSPC-SP 2 hand clean to prevent damage to shaft. Stripe coat may be omitted. Shaft bearings and shaft must be pulled before this work can be accomplished.
Smoke Pipes, Exhaust Stacks, BLISS Caps, Exhaust Eductors, IR Suppressors; Exterior, high temperature surfaces	SSPC-SP 10	15	631-8.16 Table 631-8-7	SSPC-SP 3	15	Black coatings shall not be used on these components.
Smoke Pipes, Exhaust Stacks, BLISS Caps, Exhaust Eductors, IR Suppressors; Interior, high temperature surfaces	SSPC-SP 10	16	631-8.16 Table 631-8-7	SSPC-SP 3	16	Black coatings shall not be used on these components.
Sonar domes	--	--	631-8.15	--	--	Refer to 631-8.15 .
Well deck overheads	SSPC-SP 10	6	631-8.18.2 Table 631-8-8	SSPC-SP 10 and SSPC-SP 11	6	Well decks have specific surface preparation and coating requirements. Refer to 631-8.18.2 for details.
Well deck bulkheads and decks, and turntable pits	SSPC-SP 10	2A or 2B or 6	631-8.18.2 Table 631-8-8	SSPC-SP 10 and SSPC-SP 11	2A or 2B or 6	Well decks have specific surface preparation and coating requirements. Refer to 631-8.18.2 for details.
GENERAL NOTES: Table 631-1-4 lists the coating systems and their dry film thickness (DFT) requirements for the coating system numbers shown in this table. - Unless otherwise noted, the surface preparation standards shown in this table are those that apply to steel surfaces. Refer to Section 5 for equivalent surface preparation requirements for other types of substrate materials, or Section 8 for requirements for other materials specific to the type of shipboard location or equipment being painted. - For aluminum surfaces, abrasive blast media shall be garnet or aluminum oxide per MIL-A-22262, or black walnut shells per A-A-1722, Type 2, as specified in the applicable coatings reference paragraph in Section 8. Refer also to paragraphs 631-5.2.4.3 and 631-5.4.3.1. - Unless otherwise specified herein, the surface profile shall be 2-4 mils for all metallic surfaces prepared by abrasive blasting, abrasive sponge media blasting, slurry blasting, or waterjetting. - For surfaces where the surface preparation is specified as either SSPC-SP 10 or SSPC-SP 12 WJ-2L, waterjetting per SSPC-SP 12 may be used, provided that the 2-4 mil surface profile requirement is met. Refer to paragraph 631-5.5.1.						

Table 631-1-3 Summary Of Coating Requirements For Surface Ships - Interior

Area or Compartment to be Finished	Surface Preparation for Full Preservation	Coating System for Full Preservation	Reference Paragraph/Table	Minimum Surface Preparation for Other Than Full Preservation	Coating for Less Than Full Preservation	Remarks
PRIMARY SHIP STRUCTURE AND RELATED ITEMS						
AFFF Stations: Decks and Foundations located inside the coamings, and under proportioners.	SSPC-SP 11 SSPC-SP 11 shall be the surface preparation method used, even if the F718 data sheet has a more stringent requirement.	20	631-8.18.3.8.2	SSPC-SP 11 SSPC-SP 11 shall be the surface preparation method used, even if the F718 data sheet has a more stringent requirement.	20	Upon completion of surface preparation, pH measurements must be taken. The pH must be in the range of 6.5 to 7.5. If it is not, the surface must be washed with freshwater until the required pH is obtained.
Aircraft Electrical Servicing Stations (AESS) trunks.	SSPC-SP 10 or SSPC-SP 12 WJ-2L or SSPC-SP 11	5 or 46	631-8.18.6 Table 631-8-12	SSPC-SP 12 WJ-2L or SSPC-SP 11	5 or 46	
Bilges, Bilge Wells, Sumps: Structure and fittings below floor plates in machinery spaces, including bottoms and edges of steel floor plates.	SSPC-SP 10 or SSPC-SP 12 WJ-2L or SSPC-SP 11	7B or 5 or 46	631-8.18.6 Table 631-8-12	SSPC-SP 12 WJ-2L or SSPC-SP 11	5 or 46	SSPC-SP 11 and SSPC-SP 12 are for use with System 5 only.
Bilge Drain Wells .	SSPC-SP 11 SSPC-SP 11 shall be the surface preparation method used, even if the F718 data sheet has a more stringent requirement.	20	631-8.18.3.8	SSPC-SP 11 SSPC-SP 11 shall be the surface preparation method used, even if the F718 data sheet has a more stringent requirement.	20	Upon completion of surface preparation, pH measurements must be taken. The pH must be in the range of 6.5 to 7.5. If it is not, the surface must be washed with freshwater until the required pH is obtained.
Bilge Keels, Struts, Skegs, Internals (Internal Surfaces).	--	14	631-8.16 Table 631-8-7	--	14	Ventilate after application to remove solvent vapors.
Bulkheads or Side Shell, Uninsulated, adjacent to air conditioned space or sea.	SSPC-SP 11	37 A, B, C or D	631-8.18.3	SSPC-SP 11	37 A, B, C or D	Anti-condensation system.
Bulkheads and structure behind insulation.	SSPC-SP 10 or SSPC-SP 11	7A or 7B	631-8.18.3	SSPC-SP 11 or SSPC-SP 3	7A or 7B	Stripe coats can be omitted.
Bulkheads and Overheads, compartments not otherwise listed.	SSPC-SP 10 or SSPC-SP 11 or SSPC-SP 3 or SSPC-SP 2	32 or 28 or 40 or 42	631-8.18.3	SSPC-SP 11 or SSPC-SP 3 or SSPC-SP 2	32 or 28 or 40 or 42	Colors shown in Tables 631-8-10 and 631-8-11 shall be specified by TYCOM or ship's Commanding Officer in accordance with Chapter 631-8.18.3 . Restore each compartment marking in accordance with NSTM Chapters 079, Vol. 2 and 505.
Catapult jet blast deflector pits, barricade stanchions and wells, and associated void spaces.	SSPC-SP 10	7B or 46	631-8.18.6 Table 631-8-12	SSPC-SP 10 or SSPC-SP 11	7B or 46	Refer to Table 631-8-12 for service life projections of the coating system(s).
Catapult wing voids, exhaust blowdown trunks, and gravity tanks.	SSPC-SP 10	25 or 7B or 26 or 46	631-8.18.6 Table 631-8-12	SSPC-SP 10 or SSPC-SP 11	25 or 7B or 26 or 46	Refer to Table 631-8-12 for service life projections of the coating system(s). System 26 for less than 50F only.
Chain Lockers.	SSPC-SP 10	7A or 7B or 46	631-8.18.6 Table 631-8-12	SSPC-SP 10 or SSPC-SP 11	7A or 7B or 5 or 46	SSPC-SP 11 to be used with System 5 only.
Decks, High Traffic (Coatings other than non-skid, tile, etc.)	SSPC-SP 10 or SSPC-SP 11	34	631-8.18.3.8.1	SSPC-SP 10 or SSPC-SP 11	34	This system may also be invoked for preservation of decks in spaces that are prone to wear and do not receive deck covering IAW NSTM 634.

Table 631-1-3 Summary Of Coating Requirements For Surface Ships - Interior - Continued

Area or Compartment to be Finished	Surface Preparation for Full Preservation	Coating System for Full Preservation	Reference Paragraph/Table	Minimum Surface Preparation for Other Than Full Preservation	Coating for Less Than Full Preservation	Remarks
Decks and Walking Surfaces, Painted, Subject to Condensation.	SSPC-SP 11 or SSPC-SP 3 or SSPC-SP 2	7A or 7B	631-8.18.3.8.3	SSPC-SP 11 or SSPC-SP 3 or SSPC-SP 2	7A or 7B	Use topcoat color #26008 or #36231 for systems 7A or 7B.
Decks and Walking Surfaces, Painted, in compartments not otherwise listed.	SSPC-SP 11 or SSPC-SP 3 or SSPC-SP 2	28 or 32	631-8.18.3.8.3	SSPC-SP 11 or SSPC-SP 3 or SSPC-SP 2	28 or 32	
Fan Rooms	SSPC-SP 10 or SSPC-SP 12 WJ-2L or SSPC-SP 11	5	631-8.18.7	SSPC-SP 12 WJ-2L or SSPC-SP 11	5	
Intakes: Combustion Air, Dirty and Clean Sides	SSPC-SP 10 or SSPC-SP 12 WJ-2L or SSPC-SP 11	25 or 5	631-8.18.5	SSPC-SP 12 WJ-2L or SSPC-SP 11	25 or 5	Vertical surfaces of the clean sides of aluminum or CRES intakes do not require painting, except for 2-4 inch high borders above decks or other horizontal surfaces that can retain water. SSPC-SP 11 or SSPC-SP 12 shall be used with System 5 only.
Machinery Spaces, bulkheads and overheads above bilge area.	SSPC-SP 10 or SSPC-SP 12 WJ-2L or SSPC-SP 11	23 or 29	631-8.18.3	SSPC-SP 12 WJ-2L or SSPC-SP 11	23 or 29	SSPC-SP 11 or SSPC-SP 12 shall be used with System 29 only.
Sanitary Wet Spaces (Wash rooms, water closets, bath and shower spaces, sculleries, vegetable prep. spaces): Overheads and bulkheads.	SSPC-SP 10 or SSPC-SP 11	43 or 44 or 5	631-8.18.7	SSPC-SP 11	43 or 44 or 5	
Sanitary Wet Spaces (Wash rooms, water closets, bath and shower spaces, sculleries, vegetable prep. spaces): Painted decks and walkways.	SSPC-SP 10 or SSPC-SP 11	5	631-8.18.7	SSPC-SP 11	5	
Tanks: CHT, Sanitary.	SSPC-SP 10	24 or 46	631-8.18.6 Table 631-8-12	SSPC-SP 10 or SSPC-SP 11	24 or 46	
Tanks: Feedwater, Reserve Feed Innerbottom, Fresh Water Drain Collection.	SSPC-SP 10	22 or 21	631-8.6 Table 631-8-3	SSPC-SP 10 or SSPC-SP 11	22 or 21	
Tanks: Fuel- Jet/JP-5, MOGAS, Gasoline, Diesel, Fuel Oil Service, Contaminated Fuel, Compensated Fuel, Fuel Storage, Sumps.	SSPC-SP 10	7B or 46	631-8.18.6 Table 631-8-12	SSPC-SP 10 or SSPC-SP 11	7B or 46	Refer to Table 631-8-12 for service life projections of the coating system(s).
Tanks: Fuel, Diesel- Silicone Bronze.	SSPC-SP 10 or SSPC-SP 11	7B or 27	631-8.18.6 Table 631-8-12	N/A	N/A	
Tanks: Hydraulic fluid.	--	See remarks	631-8.18.6 Table 631-8-12	--	See remarks	MIL-PRF-3150 Medium Lube Oil Preservative, maintain preservation until filled.
Tanks: Locked in Fresh Water Ballast.	SSPC-SP 10	See remarks	631-8.18.6 Table 631-8-12	SSPC-SP 10 or SSPC-SP 11	See remarks	NAVSEA approved coatings for potable or feedwater tanks may be used. Refer to 631-8.18.6 for alternatives.
Tanks: Lubricating Oil.	--	See remarks	631-8.18.6 Table 631-8-12	--	See remarks	MIL-PRF-3150 Medium Lube Oil Preservative, maintain preservation until filled.

Table 631-1-3 Summary Of Coating Requirements For Surface Ships - Interior - Continued

Area or Compartment to be Finished	Surface Preparation for Full Preservation	Coating System for Full Preservation	Reference Paragraph/Table	Minimum Surface Preparation for Other Than Full Preservation	Coating for Less Than Full Preservation	Remarks
Tanks: Potable Water .	SSPC-SP 10	18 or 19 or 21	631-8.5 Table 631-8-2	SSPC-SP 10 or SSPC-SP 11	18 or 19 or 21	
Tanks: Seawater and Seawater Ballast, Peak Tanks.	SSPC-SP 10	25 or 7B or 26 or 46	631-8.18.6 Table 631-8-12	SSPC-SP 10 or SSPC-SP 11	25 or 7B or 26 or 46	Refer to Table 631-8-12 for service life projections of the coating systems. System 26 for use only when surface temperature cannot be maintained above 50F.
Uptake Spaces/Mixing Rooms With Vents Or Louvers To The Outside Atmosphere (Bulkheads & Decks).	SSPC-SP 10	7B	631-8.18.5	SSPC-SP 12 WJ-2L or SSPC-SP 11	5	
Ventilation Air (HVAC) Intake Plenums and Trunks: Interior, Non-Galvanized Steel Surfaces.	SSPC-SP 10 or SSPC-SP 12 WJ-2L	7B or 5	631-8.18.4	SSPC-SP 12 WJ-2L or SSPC-SP 11	7B or 5	SSPC-SP 11 or SSPC-SP 12 are to be used with System 5 only.
Voids: Floodable.	SSPC-SP 10	25 or 7B or 26 or 46	631-8.18.6 Table 631-8-12	SSPC-SP 10 or SSPC-SP 11	25 or 7B or 26 or 46	Refer to Table 631-8-12 for service life projections of the coating systems. System 26 for less than 50F only.
Voids: Non-Floodable.	SSPC-SP 10	25 or 7B or 46	631-8.18.6 Table 631-8-12	SSPC-SP 10 or SSPC-SP 11	25 or 7B or 46	
Voids: Small, Inaccessible.	SSPC-SP 1 or SSPC-SP 2	14	631-8.18.6 Table 631-8-12	SSPC-SP 1 or SSPC-SP 2	14	Clean if possible. Use MIL-PRF-16173 Grade 1.
Welding Bays and Light Traps: Bulkheads and Overheads.	SSPC-SP 11 or SSPC-SP 3 or SSPC-SP 2	7A or 7B	631-8.18.3 Table 631-8-10	SSPC-SP 11 or SSPC-SP 3 or SSPC-SP 2	7A or 7B	Stripe coats may be omitted. Use topcoat color #37038.
Welding Bays and Light Traps: Painted Decks.	SSPC-SP 11 or SSPC-SP 3 or SSPC-SP 2	7A or 7B or 34	631-8.18.3 Table 631-8-10	SSPC-SP 11 or SSPC-SP 3 or SSPC-SP 2	7A or 7B or 34	Stripe coats may be omitted. Use topcoat color #27038 for systems 7A or 7B.
SYSTEMS AND EQUIPMENT: MACHINERY, OUTFITTING, MISCELLANEOUS ITEMS						
Cable trays, supports, and hangers; steel or aluminum.	--	--	631-8.10	--	--	Clean and coat as required for surrounding area or compartment. CRES cable supports do not require painting.
Cable, Interior, Low Smoke PVC.	SSPC-SP 2	35	631-8.10	SSPC-SP 2	35	
Cable, Interior, Other Than Low Smoke PVC.	SSPC-SP 2	32 or 28	631-8.10	SSPC-SP 2	32 or 28	
Cable, Exterior, Other Than Low Smoke PVC.	SSPC-SP 2	13	631-8.10	SSPC-SP 2	13	Color 26270 Haze Gray for System 13.
Electric and electronic equipment (except as otherwise indicated).	SSPC-SP 2	30 or 13	631-8.8	SSPC-SP 2	30 or 13	Color 26307 for System 13.

Table 631-1-3 Summary Of Coating Requirements For Surface Ships - Interior - Continued

Area or Compartment to be Finished	Surface Preparation for Full Preservation	Coating System for Full Preservation	Reference Paragraph/Table	Minimum Surface Preparation for Other Than Full Preservation	Coating for Less Than Full Preservation	Remarks
Furniture and Joiner Doors.	--	See notes.	631-8.16 Table 631-8-7	--	--	New furniture is coated per MIL-PRF-32038. Unpainted aluminum (bright) surfaces shall be waxed. Furniture and joiner doors requiring recoating or touch-up in service may use MIL-PRF-24712 powder coatings applied in accordance with their NAVSEA-approved ASTM F718 data sheets, or paints MIL-DTL-15090 F-111 (light gray only), MIL-DTL-24607, or MIL-PRF-24596
Inaccessible Surfaces (Galvanized and Non-ferrous).	--	Unpainted	631-8.16 Table 631-8-7	--	--	
Inaccessible steel surfaces (not galvanized).	SSPC-SP 11	7A or 7B or 31	631-8.16 Table 631-8-7	SSPC-SP 11 or SSPC-SP 3	7A or 7B or 31	Stripe coat in System 7 can be omitted.
Interior Communication and Fire Control Equipment.	--	--	631-8.12	--	--	Clean and coat per MIL-E-2036 or MIL-F-18870 as applicable to equipment.
Items not painted.	--	--	631-8.17	--	--	Refer to 631-8.17 for a list of items not to be painted.
Lighting Systems.	--	--	631-8.13	--	--	See 631-8.13 . Do not paint light reflecting and light transmitting surfaces.
Louvers, Gas Turbine Intake and Exhaust, Bolted into structure.	--	--	See remarks	--	--	Zinc-rich powder coating system applied by fluidized bed process, for use on DDG51 Class; other uses require NAVSEA approval. See PPI 63125-001.
Machinery and sheet metal surfaces; ferrous; external; up to 125° F.	SSPC-SP 3	30 or 13	631-8.7 Table 631-8-4	SSPC-SP 3	30 or 13	Color 26307 for System 13.
Machinery Gageboards.	SSPC-SP 3	30 or 13	631-8.7 Table 631-8-4	SSPC-SP 3	30 or 13	Color 26307 for System 13.
Machinery Casings, Sheet Metal, Boilers and economizers (except parts used for heat transfer); steel; 125° F to 400° F.	SSPC-SP 11	15 or 27	631-8.7 Table 631-8-4	SSPC-SP 11	15 or 27	
Machinery Casings, Sheet Metal, Boilers and economizers (except parts used for heat transfer); steel; 400° F to 700° F.	SSPC-SP 11	15 or 16	631-8.7 Table 631-8-4	SSPC-SP 11	15 or 16	
Machinery Casings, Sheet Metal, Boilers and economizers (except parts used for heat transfer); steel; over 700° F.	SSPC-SP 11	16	631-8.7 Table 631-8-4	SSPC-SP 11	16	

Table 631-1-3 Summary Of Coating Requirements For Surface Ships - Interior - Continued

Area or Compartment to be Finished	Surface Preparation for Full Preservation	Coating System for Full Preservation	Reference Paragraph/Table	Minimum Surface Preparation for Other Than Full Preservation	Coating for Less Than Full Preservation	Remarks
Manhole Covers for Tanks.	SSPC-SP 10	36A or see remarks	631-8.18.6.8 631-7.9	SSPC-SP 11 or SSPC-SP 3 or SSPC-SP 2	See remarks	Coat with either powder coating, or same paint system specified for the tank. Powder coating shall not be used on covers for fresh water drain collection tanks aboard nuclear powered ships.
Metal Enclosures (Bare steel, Galvanized steel, and Aluminum)	SSPC-SP 2 or Chemical or detergent clean, or TT-C-490 zinc phosphate pre-treatment	30 or 28 or 32 or 36A	631-8.11	SSPC-SP 2	30 or 28 or 32 or 36A	Second coat of TT-P-645 in listed coating systems may be omitted. Epoxy primer shall be used on galvanized steel surfaces instead of TT-P-645 as described in 631-8.11 .
Miscellaneous Metal Parts.	SSPC-SP 10 or Chemical or detergent clean, or TT-C-490 zinc phosphate pre-treatment	36A	631-7.9	--	--	Powder coating per ASTM F718 data sheets.
Motors and Generators (Exterior).	SSPC-SP 2	30 or 13	631-8.9	SSPC-SP 2	30 or 13	Color 26307 for System 13.
Motors and Generators (Interior).	--	--	--	--	--	Refer to 631-8.9.3 .
Overboard Discharge Lining.	SSPC-SP 10	--	See remarks	N/A	N/A	See PPI 63101-009.
Piping and Piping System Fittings and Components; 125° F and Below.	SSPC-SP 2	28 or 13	631-8.7 631-8.18.6.6 631-8.17 Table 631-8-4	SSPC-SP 2	28 or 13	Steel, galvanized steel, and aluminum piping exposed to weather, in defined wet spaces, or below level of deck plates in bilges, shall be painted as per the surrounding structure. See 631-8.7.3(c) . Topcoat color: MIL-DTL-24607 Formula 124 for system 28, or select to match surroundings, or as needed to identify piping system.
Piping and Piping System Fittings and Components; 125° F to 400° F.	SSPC-SP 2	15 or 27	631-8.7 631-8.17 Table 631-8-4	SSPC-SP 2	15 or 27	
Piping and Piping System Fittings and Components; 400° F to 700° F.	SSPC-SP 2	15 or 16	631-8.7 631-8.17 Table 631-8-4	SSPC-SP 2	15 or 16	
Piping and Piping System Fittings and Components; over 700° F.	SSPC-SP 2 SSPC-SP 10	16 or 8	631-8.7 631-8.17 Table 631-8-4	SSPC-SP 2 or SSPC-SP 10	16 or 8	SSPC-SP 10 only required for System 8 on valves – see 631-7.6 .
Piping and Piping System Fittings and Components; Weather-Exposed Shore Steam Systems; Steel.	SSPC-SP 2 SSPC-SP 10	15 or 8	631-8.7 Table 631-8-4	SSPC-SP 2 SSPC-SP 10	15 or 8	SSPC-SP 10 only required for System 8 on valves – see 631-7.6 .
Radar, fire control, antennas and electronic equipment.	--	--	631-8.14	--	--	
Seamless coating for small objects.	--	Plastisol	631-8.16 Table 631-8-7	--	--	Refer to 631-7.5 for requirements for plastisol coatings.

Table 631-1-3 Summary Of Coating Requirements For Surface Ships - Interior - Continued

Area or Compartment to be Finished	Surface Preparation for Full Preservation	Coating System for Full Preservation	Reference Paragraph/Table	Minimum Surface Preparation for Other Than Full Preservation	Coating for Less Than Full Preservation	Remarks
Thermal Insulation, on Hull, HVAC & Ventilation Systems, and Piping.	Soap and water clean, hand sand	32 Omit F84 primer coats.	631-8.18.3	Soap and water clean, hand sand	32 Omit F84 primer coats.	Prior to painting, apply 3 coats of a vapor barrier coating compound, MIL-PRF-19565, in contrasting colors (white-orange-white), to insulation within laundries, sculleries, galleys, drying rooms, and to insulation on the warm side of refrigerated stores spaces.
GENERAL NOTES: Table 631-1-4 lists the coating systems and their dry film thickness (DFT) requirements for the coating system numbers shown in this table. - Unless otherwise noted, the surface preparation standards shown in this table are those that apply to steel surfaces. Refer to Section 5 for equivalent surface preparation requirements for other types of substrate materials, or Section 8 for requirements for other materials specific to the type of shipboard location or equipment being painted. - For aluminum surfaces, abrasive blast media shall be garnet or aluminum oxide per MIL-A-22262, or black walnut shells per A-A-1722, Type 2, as specified in the applicable coatings reference paragraph in Section 8. Refer also to paragraphs 631-5.2.4.3 and 631-5.4.3.1. - Unless otherwise specified herein, the surface profile shall be 2-4 mils for all metallic surfaces prepared by abrasive blasting, abrasive sponge media blasting, slurry blasting, or waterjetting. - For surfaces where the surface preparation is specified as either SSPC-SP 10 or SSPC-SP 12 WJ-2L, waterjetting per SSPC-SP 12 may be used, provided that the 2-4 mil surface profile requirement is met. refer to paragraph 631-5.5.1. - The coating systems shown in this table do not affect or modify non-deviational drawings.						

Table 631-1-4 Surface Ship Coating System Schedule Summary

System Number	Coating System Description and Dry Film Thickness (mils)	Remarks
1	NAVSEA approved underwater hull anti-corrosion (AC) and anti-fouling (AF) systems	Refer to paragraph 631-8.4 and Table 631-8-1 .
2A	MIL-PRF-23236 Type IV, V or VI Class 5/MIL-PRF-24635 Grade B or C Haze Gray Primer: 4-8 mils DFT MIL-PRF-23236 Type IV, V or VI Class 5, and Stripe: 4-8 mils DFT MIL-PRF-23236 Type IV, V or VI Class 5, and Topcoat: 4-8 mils DFT MIL-PRF-23236 Type IV, V or VI Class 5, and Topcoat: 2-3 mils DFT MIL-PRF-24635 Grade C, Haze Gray color 26270, or Topcoat: 2-3 mils DFT MIL-PRF-24635 Grade B, Haze Gray color 26270	1. MIL-PRF-24647 Anti-Corrosive (AC) epoxy being used on the underwater hull may be able to be substituted for MIL-PRF-23236. See Table 631-8-8 . 2. Designations and markings: Use MIL-PRF-24635 LSA. In lieu of white, use Light Gray, color 26373. In lieu of black, use Ocean Gray, color 26173.
2B	MIL-PRF-23236 Type VII Class 5/MIL-PRF-24635 Grade B or C Haze Gray Primer: 4-8 mils DFT MIL-PRF-23236 Type VII Class 5, and Stripe: 6-10 mils DFT MIL-PRF-23236 Type VII Class 5, and Topcoat: 10-12 mils DFT MIL-PRF-23236 Type VII Class 5, and Topcoat: 2-3 mils DFT MIL-PRF-24635 Grade C, Haze Gray color 26270, or Topcoat: 2-3 mils DFT MIL-PRF-24635 Grade B, Haze Gray color 26270	1. MIL-PRF-24647 Anti-Corrosive (AC) epoxy being used on the underwater hull may be able to be substituted for MIL-PRF-23236. See Table 631-8-8 . 2. See system 2A for painting designations and markings.
3A	MIL-PRF-23236 Type IV, V or VI Class 5/MIL-PRF-24763 Type II Class 2 Primer: 4-8 mils DFT MIL-PRF-23236 Type IV, V or VI Class 5, and Stripe: 4-8 mils DFT MIL-PRF-23236 Type IV, V or VI Class 5, and Topcoat: 4-8 mils DFT MIL-PRF-23236 Type IV, V or VI Class 5, and Topcoat: 2-4 mils DFT MIL-PRF-24763 Type II, Class 2, Haze Gray color 26270	1. MIL-PRF-24647 Anti-Corrosive (AC) epoxy being used on the underwater hull may be able to be substituted for MIL-PRF-23236. See Table 631-8-8 . 2. See system 2A for painting designations and markings.
3B	MIL-PRF-23236 Type VII Class 5/MIL-PRF-24763 Type II Class 2 Primer: 4-8 mils DFT MIL-PRF-23236 Type VII Class 5, and Stripe: 6-10 mils DFT MIL-PRF-23236 Type VII Class 5, and Topcoat: 10-12 mils DFT MIL-PRF-23236 Type VII Class 5, and Topcoat: 2-4 mils DFT MIL-PRF-24763 Type II, Class 2, Haze Gray color 26270	1. MIL-PRF-24647 Anti-Corrosive (AC) epoxy being used on the underwater hull may be able to be substituted for MIL-PRF-23236. See Table 631-8-8 . 2. See system 2A for painting designations and markings.
4A	MIL-PRF-23236 Type V or VI Class 5/MIL-PRF-24635 Grade B Deck Gray Primer: 4-8 mils DFT MIL-PRF-23236 Type V or VI Class 5, and Stripe: 4-8 mils DFT MIL-PRF-23236 Type V or VI Class 5, and Topcoat: 4-8 mils DFT MIL-PRF-23236 Type V or VI Class 5, and Topcoat: 2-3 mils DFT MIL-PRF-24635 Grade B, Deck Gray color 26008	1. MIL-PRF-24647 Anti-Corrosive (AC) epoxy being used on the underwater hull may be able to be substituted for MIL-PRF-23236. See Table 631-8-8 .
4B	MIL-PRF-23236 Type VII Class 5/MIL-PRF-24635 Grade B Deck Gray Primer: 4-8 mils DFT MIL-PRF-23236 Type VII Class 5, and Stripe: 6-10 mils DFT MIL-PRF-23236 Type VII Class 5, and Topcoat: 10-12 mils DFT MIL-PRF-23236 Type VII Class 5, and Topcoat: 2-3 mils DFT MIL-PRF-24635 Grade B, Deck Gray color 26008	1. MIL-PRF-24647 Anti-Corrosive (AC) epoxy being used on the underwater hull may be able to be substituted for MIL-PRF-23236. See Table 631-8-8 .
5	MIL-PRF-23236 Type VII, Class 17 Primer: 6-8 mils DFT MIL-PRF-23236, Type VII, Class 17, and Stripe: 6-8 mils DFT MIL-PRF-23236, Type VII, Class 17, and Topcoat: 6-8 mils DFT MIL-PRF-23236, Type VII, Class 17	Moisture Tolerant System.
6	MIL-PRF-23236, Type VII, Class 19 Primer: 4-8 mils DFT MIL-PRF-23236, Type VII, Class 19 (Cream or Buff), and Stripe: 6-10 mils DFT MIL-PRF-23236, Type VII, Class 19 (Gray), and Topcoat: 10-12 mils DFT MIL-PRF-23236, Type VII, Class 19 (White)	Chemical-resistant epoxy-novolac system for well deck overheads.
7A	MIL-PRF-23236 Type V or VI Class 5 Primer: 4-8 mils DFT MIL-PRF-23236 Type V or VI Class 5, and Stripe: 4-8 mils DFT MIL-PRF-23236 Type V or VI Class 5, and Topcoat: 4-8 mils DFT MIL-PRF-23236 Type V or VI Class 5	
7B	MIL-PRF-23236 Type VII Class 5 Primer: 4-8 mils DFT MIL-PRF-23236 Type VII Class 5, and Stripe: 6-10 mils DFT MIL-PRF-23236 Type VII Class 5, and Topcoat: 10-12 mils DFT MIL-PRF-23236 Type VII Class 5	Seawater ballast tank, floodable void, combustion air uptakes, exterior bolted louvers, and HVAC intake plenums and trunks coating. Add Topcoat: 2-3 mils MIL-PRF-24635 Grade B, Haze Gray color 26270 for exterior bolted louvers.
8	MIL-STD-2138 Thermal Spray Aluminum System Refer to paragraph 631-7.6 .	When MIL-STD-2138 thermal spray aluminum coatings are listed as a coating option, they should be used only on surfaces where the service temperature is 200°F or higher.

Table 631-1-4 Surface Ship Coating System Schedule Summary - Continued

System Number	Coating System Description and Dry Film Thickness (mils)	Remarks
9	PPG/Ameron PSX 700 Primer: 1-2 mils DFT PPG/Ameron PSX 700 (to hold the blast; see remarks), and Topcoat: 4-5 mils DFT PPG/Ameron PSX 700, and Topcoat: 4-5 mils DFT PPG/Ameron PSX 700	Apply one mist coat (1-2 mils) of PPG/Ameron PSX 700 after blast and prior to remaining coats where invoking Work Item requires anchor chain inspections prior to preservation.
10	MIL-DTL-24441 Type IV/MIL-PRF-24635 Grade B Primer: 4-6 mils DFT MIL-DTL-24441 Type IV, F150, and Stripe: 4-6 mils DFT MIL-DTL-24441 Type IV, F152, and Topcoat: 4-6 mils DFT MIL-DTL-24441 Type IV, F151, and Topcoat: 2-3 mils MIL-PRF-24635 Grade B, Haze Gray color 26270	Substitute deck gray color 26008 for color of final topcoat on horizontal surfaces and decks. See Note 1.
11	MIL-DTL-24441 Type IV/MIL-PRF-24763 Primer: 4-6 mils DFT MIL-DTL-24441 Type IV, F150, and Stripe: 4-6 mils DFT MIL-DTL-24441 Type IV, F152, and Topcoat: 4-6 mils DFT MIL-DTL-24441 Type IV, F151, and Topcoat: 2-4 mils MIL-PRF-24763 Type II, Class 2, Haze Gray color 26270	See Note 1.
12	TT-P-595 Gray canvas preservative Haze gray silicone alkyd paint (MIL-PRF-24635) shall be used instead of canvas preservative for canvas normally stowed in a vertical or near vertical position, where the color is visible, in accordance with the NAVSEA Surface Ship Camouflage Manual NAVSEA S6360-AG-MAN-010.	Preservation coating is not required where approved synthetic materials are used in place of canvas.
13	TT-P-645 Formula 84/MIL-PRF-24635 Primer: 1.5-3.0 mils DFT TT-P-645 F-84, and Topcoat: 1.5-3.0 mils DFT TT-P-645 F-84, and Topcoat: 2-3 mils DFT MIL-PRF-24635, Color and Grade As Specified, and Topcoat: 2-3 mils DFT MIL-PRF-24635, Color and Grade As Specified	Use MIL-PRF-24635 Grade B (LSA) if specified; otherwise use Grade A (Standard Pigment). Apply second topcoat of MIL-PRF-24635 only if required for hiding.
14	MIL-PRF-16173, Grade 1 or 3 rust preventive	Preservative for rudder internals, small inaccessible voids.
15	PPG Amercoat PSX 892HS 2-3 mils DFT PPG Amercoat PSX 892HS, Haze Gray	PPG Amercoat PSX 892HS shall not be used for surfaces that exceed 700°F degrees service temperature. If in-service surface temperature exceeds 700°F, use TT-P-28, System 16.
16	TT-P-28 Type I High-Temperature Paint Primer: 1.0-1.5 mils DFT TT-P-28 Type I, and Topcoat: 1.0-1.5 mils DFT TT-P-28 Type I	
17	E-Paint Corporation SN-1 Boat Bottom Coating System Primer: 4-6 mils DFT E-Paint EP Primer 1000, and Topcoat: 4-6 mils DFT E-Paint EP PRIMER 1000, and Topcoat: 5-7 mils WFT/3-4 mils DFT E-Paint SN-1 Gray, and Topcoat: 5-7 mils WFT/3-4 mils DFT E-Paint SN-1 Black, and Topcoat: 5-7 mils WFT/3-4 mils DFT E-Paint SN-1 Gray Draft Marks: 5-7 mils WFT/3-4 mils DFT E-Paint SN-1 Black	Underwater hull coating system for embarked boats.
18	MIL-PRF-23236 Type V or VI, Class 9 Primer: 4-8 mils DFT MIL-PRF-23236 Type V or VI, Class 9, and Stripe: 4-8 mils DFT MIL-PRF-23236 Type V or VI, Class 9, and Topcoat: 4-8 mils DFT MIL-PRF-23236 Type V or VI, Class 9	Potable water tank coating.
19	MIL-PRF-23236 Type VII, Class 9 Primer: 4-8 mils DFT MIL-PRF-23236 Type VII Class 9, and Stripe: 6-10 mils DFT MIL-PRF-23236 Type VII Class 9, and Topcoat: 10-12 mils DFT MIL-PRF-23236 Type VII Class 9	Potable water tank coating.
20	MIL-PRF-32171 Type IV, Class 1 or 2 Primer: 10-12 mils DFT MIL-PRF-32171, Type IV, Class 1 or 2, and Topcoat: 10-12 mils DFT MIL-PRF-32171, Type IV, Class 1 or 2	Decks in AFFF stations and under AFFF proportioning units; bilge drain wells. Qualified systems are: Belzona Ceramic Metal 4311; Chesterton ARC 855N; or Enecon Cermalloy CL+[AC].

Table 631-1-4 Surface Ship Coating System Schedule Summary - Continued

System Number	Coating System Description and Dry Film Thickness (mils)	Remarks
21	MIL-DTL-24441 Type III Primer: 2-4 mils DFT MIL-DTL-24441 Type III, F150, and Stripe: 2-4 mils DFT MIL-DTL-24441 Type III, F152, and Topcoat: 2-4 mils DFT MIL-DTL-24441 Type III, F151, and Stripe: 2-4 mils DFT MIL-DTL-24441 Type III, F150, and Topcoat: 2-4 mils DFT MIL-DTL-24441 Type III, F152 Total system 8-12 mils DFT in areas without stripe coats. Control the DFT of the final topcoat to meet the total system DFT requirement.	Potable water and feedwater tank coating. NOTE It is emphasized that MIL-DTL-24441 Type IV is not an authorized substitute for this system.
22	MIL-PRF-23236 Type VI or VII, Class 11 Primer: 4-8 mils DFT MIL-PRF-23236 Type VI or VII, Class 11, and Stripe: 4-8 mils DFT MIL-PRF-23236 Type VI or VII, Class 11, and Topcoat: 4-8 mils DFT MIL-PRF-23236 Type VI or VII, Class 11	Feedwater and freshwater drain collection tank coating.
23	MIL-PRF-23236 Type VII, Class 5/ MIL-DTL-24607 Formula 124 Primer: 4-8 mils DFT MIL-PRF-23236, Type VII, Class 5, and Topcoat: 10-12 mils DFT MIL-PRF-23236, Type VII, Class 5, and Topcoat: 1.5-3.0 mils DFT MIL-DTL-24607 F-124, and Topcoat: 1.5-3.0 mils DFT MIL-DTL-24607 F-124	Machinery space coating above bilge area; alternate coating for piping in bilge regions. Omit second coat of MIL-PRF-23236 for bulkheads and overheads above bilge areas.
24	MIL-PRF-23236, Type VII, Class 13 Primer: 4-8 mils DFT MIL-PRF-23236, Type VII, Class 13 (Cream or Buff), and Stripe: 6-10 mils DFT MIL-PRF-23236, Type VII, Class 13 (Gray), and Topcoat: 10-12 mils DFT MIL-PRF-23236, Type VII, Class 13 (White)	Chemical-resistant epoxy-novolac system for CHT/sanitary tanks.
25	MIL-PRF-23236, Type VII, Class 7 Primer: 4-8 mils DFT MIL-PRF-23236, Type VII, Class 7, and Stripe: 6-10 mils DFT MIL-PRF-23236, Type VII, Class 7, and Topcoat: 10-12 mils DFT MIL-PRF-23236, Type VII, Class 7	Seawater ballast tanks, floodable voids, combustion air intakes, and exterior bolted louvers coating. Add Topcoat: 2-3 mils MIL-PRF-24635 Grade B, Haze Gray color 26270 for exterior bolted louvers.
26	MIL-PRF-23236, Type V or VI, Class 5 or 7, Grade A or B Primer: 4-8 mils DFT MIL-PRF-23236, Type V or VI, Class 5 or 7, Grade A or B, and Stripe: 4-8 mils DFT MIL-PRF-23236, Type V or VI, Class 5 or 7, Grade A or B, and Topcoat: 4-8 mils DFT MIL-PRF-23236, Type V or VI, Class 5 or 7, Grade A or B	Seawater ballast tank and floodable void coating only to be used when substrate temperature cannot be maintained above 50° F.
27	MIL-DTL-24441 Type IV Primer: 4-6 mils DFT MIL-DTL-24441 Type IV, F150, and Stripe: 4-6 mils DFT MIL-DTL-24441 Type IV, F152, and Topcoat: 4-6 mils DFT MIL-DTL-24441 Type IV, F151	See Note 1. Topcoat formula number/color may vary according to location used, as specified. Stripe coat may be omitted for applications on piping and machinery.
28	TT-P-645 Formula 84/MIL-DTL-24607 Primer: 1.5-3.0 mils DFT TT-P-645 F-84, and Topcoat: 1.5-3.0 mils DFT TT-P-645 F-84, and Topcoat: 1.5-3.0 mils DFT MIL-DTL-24607, Color As Specified, and Topcoat: 1.5-3.0 mils DFT MIL-DTL-24607, Color As Specified	Apply second topcoat of MIL-DTL-24607 only if required for hiding.
29	MIL-PRF-23236 Type VII, Class 17/ MIL-DTL-24607 Formula 124 Primer: 6-8 mils DFT MIL-PRF-23236, Type VII, Class 17, and Topcoat: 6-8 mils DFT MIL-PRF-23236, Type VII, Class 17, and Topcoat: 1.5-3.0 mils DFT MIL-DTL-24607 F-124, and Topcoat: 1.5-3.0 mils DFT MIL-DTL-24607 F-124	Machinery space coating above bilge area; alternate coating for piping in bilge regions. Omit second coat of MIL-PRF-23236 for bulkheads and overheads above bilge areas.
30	TT-P-645 Formula 84/MIL-DTL-15090 Formula 111 Primer: 1.5-3.0 mils DFT TT-P-645 F-84, and Topcoat: 1.5-3.0 mils DFT TT-P-645 F-84, and Topcoat: 1.5-3.0 mils DFT MIL-DTL-15090 F-111, and Topcoat: 1.5-3.0 mils DFT MIL-DTL-15090 F-111	Machinery and interior equipment coating. Apply second topcoat only if required for hiding.
31	TT-P-645 Formula 84 Primer: 1.5-3.0 mils DFT TT-P-645 F-84, and Topcoat: 1.5-3.0 mils DFT TT-P-645 F-84	

Table 631-1-4 Surface Ship Coating System Schedule Summary - Continued

System Number	Coating System Description and Dry Film Thickness (mils)	Remarks
32	TT-P-645 Formula 84/MIL-PRF-24596 Primer: 1.5-3.0 mils DFT TT-P-645 F-84, and Topcoat: 1.5-3.0 mils DFT TT-P-645 F-84, and Topcoat: 2-4 mils DFT MIL-PRF-24596, and Topcoat: 2-4 mils DFT MIL-PRF-24596	When ambient and/or surface temperatures are less than 50°F, use Type I, Grade C, Class 1 or 2 of MIL-PRF-24596. Apply second topcoat only if required for hiding.
33	(Not used)	
34	MIL-PRF-32171 Type I, Class 1 or 2 Primer: 10-12 mils DFT MIL-PRF-32171, Type I, Class 1 or 2, and Topcoat: 10-12 mils DFT MIL-PRF-32171, Type I, Class 1 or 2	Interior space wear resistant deck coating for surface ships. Qualified systems are: PPG/Ameron Amercoat 238 and Sigma Sigmaguard CSF Glass Flake 7954.
35	MIL-PRF-24596/MIL-DTL-24607 Primer: 2-4 mils DFT MIL-PRF-24596, and Topcoat: 2-4 mils DFT MIL-PRF-24596, and Topcoat: 1.5-3.0 mils DFT MIL-DTL-24607, Color match as specified, and Topcoat: 1.5-3.0 mils DFT MIL-DTL-24607, Color match as specified	
36A	MIL-PRF-24712, or MIL-PRF-23236 Type VIII Powder Coating Powder coat as per NAVSEA-approved ASTM F718 data sheet, color as specified	Powder coating color selected to match surrounding space/area, as specified.
36B	TT-P-28 Type II Heat-Resistant Powder Coating	TT-P-28, Rev. H or later. For use in applications up to 700°F (372C).
37A	Hempel Anti-Condens System Primer: 4-6 mils DFT Hempadur 45150-50630, and Topcoat: 50-60 mils DFT Hempel Anti-Condens 617US-10000	Antisweat coating system
37B	Tempcoat 101 System Primer: 1.5-3.0 mils DFT TT-P-645 Formula 84, or Primer: 4-8 mils DFT MIL-PRF-23236 Type IV, V, VI, and Topcoat: 20-22 mils DFT Tempcoat 101, and Topcoat: 20-22 mils DFT Tempcoat 101, and Topcoat: 20-22 mils DFT Tempcoat 101	Antisweat coating system
37C	KEFA Airless 8125 System Primer: 1.5-3.0 mils DFT TT-P-645 Formula 84, or Primer: 4-8 mils DFT MIL-PRF-23236 Type IV, V, VI or VII, and Topcoat: 50-60 mils DFT KEFA Airless 8125	Antisweat coating system
37D	Mascoat Delta-T Marine System Primer: 1.5-3.0 mils DFT TT-P-645 Formula 84, or Primer: 4-8 mils DFT MIL-PRF-23236 Type IV, V, VI or VII, and Topcoat: 20-22 mils DFT Delta-T Marine, and Topcoat: 20-22 mils DFT Delta-T Marine, and Topcoat: 20-22 mils DFT Delta-T Marine	Antisweat coating system
38	(Not used)	
39	(Not used)	
40	MIL-PRF-23236 Type VI Class 5/MIL-PRF-24596 Primer: 4-8 mils DFT MIL-PRF-23236 Type VI Class 5, and Topcoat: 2-4 mils DFT MIL-PRF-24596, and Topcoat: 2-4 mils DFT MIL-PRF-24596	Single-coat epoxy primer system, for interior spaces. When ambient and/or surface temperatures are less than 50°F, use Type I, Grade C, Class 1 or 2 of MIL-PRF-24596. Apply second topcoat only if required for hiding.
41	(Not used)	
42	MIL-PRF-23236 Type VI Class 5/MIL-DTL-24607 Primer: 4-8 mils DFT MIL-PRF-23236 Type VI Class 5, and Topcoat: 1.5-3.0 mils DFT MIL-DTL-24607, Color match as specified, and Topcoat: 1.5-3.0 mils DFT MIL-DTL-24607, Color match as specified	Single-coat epoxy primer system, for interior spaces. Apply second topcoat only if required for hiding.

Table 631-1-4 Surface Ship Coating System Schedule Summary - Continued

System Number	Coating System Description and Dry Film Thickness (mils)	Remarks
43	Sigmatglaze 5492 Primer: 8-10 mils DFT Sigmaglaze 5492 White, and Stripe: 8-10 mils DFT Sigmaglaze 5492 non-white, and Topcoat: 8-10 mils DFT Sigmaglaze 5492 White	Wet sanitary space bulkhead and overhead system.
44	MIL-PRF-23236 Type VII Class 17/Sherwin-Williams Dura-Plate UHS Primer: 6-8 mils DFT MIL-PRF-23236, Type VII, Class 17, and Stripe: 6-10 mils DFT Sherwin-Williams Dura-Plate UHS, and Topcoat: 10-12 mils DFT Sherwin-Williams Dura-Plate UHS	Wet sanitary space bulkhead and overhead system.
45A	MIL-PRF-24712 Zn-Rich Epoxy Powder/ MIL-PRF-24712 Polyester Powder Primer: 6-8 mils DFT MIL-PRF-24712 Zinc Rich Epoxy Powder and Topcoat: 6-8 mils DFT MIL-PRF-24712 Polyester Powder	Exterior closure coating. MIL-PRF-24712 Zinc-rich epoxy powder is preferred as first coat, but epoxy powder may be substituted if necessary. MIL-PRF-23236 Type VIIa zinc-rich epoxy powder may also be substituted for MIL-PRF-24712 zinc-rich epoxy powder. For the interior side of exterior watertight closures, a final top coat may be applied to match the surrounding structure.
45B	MIL-PRF-24712 Zn-Rich Epoxy Powder/MIL-PRF-24635 Ty. II, Cl. 2, Gr. C Primer: 6-8 mils DFT MIL-PRF-24712 Zinc Rich Epoxy Powder and Topcoat: 2-3 mils DFT MIL-PRF-24635 Type II, Class 2, Grade C	Exterior closure coating. MIL-PRF-24712 Zinc-rich epoxy powder is preferred as first coat, but epoxy powder may be substituted if necessary. MIL-PRF-23236 Type VIIa zinc-rich epoxy powder may also be substituted for MIL-PRF-24712 zinc-rich epoxy powder. For the interior side of exterior watertight closures, a final top coat may be applied to match the surrounding structure.
45C	MIL-PRF-23236, Type VII, Class 5/MIL-PRF-24635 Type II, Class 2, Grade C Primer: 4-8 mils DFT MIL-PRF-23236, Type VII, Class 5 and Stripe: 6-10 mils DFT MIL-PRF-23236, Type VII, Class 5 and Topcoat: 2-3 mils DFT MIL-PRF-24635 Type II, Class 2, Grade C	Exterior closure coating. MIL-PRF-23236 Type VII Class 5 is preferred, but MIL-PRF-23236 Type VI Class 5 may be substituted, applied at 3-5 mils DFT for both the primer and stripe coats. For the interior side of exterior watertight closures, a final top coat may be applied to match the surrounding structure.
46	MIL-DTL-24441 Type IV Primer: 4-6 mils DFT MIL-DTL-24441, Type IV, F150, and Stripe: 4-6 mils DFT MIL-DTL-24441, Type IV, F151 or F152 or F156, and Topcoat: 4-6 mils DFT MIL-DTL-24441, Type IV, F151 or F156 or F157	Unless specified for particular applications, the stripe coat and topcoat may be F151, F152, or F156, provided that each successive coat is of a contrasting color.
GENERAL NOTES to Table 631-1-4: a. For touchup of Sherwin Williams "Duraplate" or "Novaplate" paints per MIL-PRF-23236 Type VII, Sherwin Williams "Brushplate" may be used, and shall be applied at 8-10 mils DFT per coat. b. For touchup of Sherwin Williams "Fast Clad ER" paint per MIL-PRF-23236 Type VII, Sherwin Williams "Fast Clad Brush Grade" may be used, and shall be applied at 8-10 mils DFT per coat. SPECIFIC NOTES to Table 631-1-4: 1. Except for potable water tanks and feedwater tanks, MIL-DTL-24441 epoxy paints may be applied as either a Type III three coat system (i.e., Formulas 150/151/152) or as a Type IV two coat system (i.e., Formulas 150/151 or 150/152). Unless otherwise stated in this technical manual or specified in work orders, total dry film thickness of the two coat Type IV system is to be the same as the thickness of the three coat Type III system.		

Table 631-1-5 Summary Of Coating Requirements For Submarines-Exterior

Area or Compartment to be Finished	Surface Preparation for Full Preservation	Coating System for Full Preservation	Reference Paragraph/Table	Minimum Surface Preparation for Other Than Full Preservation	Coating for Less Than Full Preservation	Remarks
Underwater Hull, Non-SHT surfaces below waterline requiring anti-fouling; Keel to upper boottop; rudders; struts; diving planes.	SSPC-SP 10 or SSPC-SP 12 WJ-2/L	1	631-8.20.2 Table 631-8-13	631-8.20.2.1	1	Hull inserts and sea chests must be coated with the preservation system applied to adjacent surfaces. Extend coating system a minimum 1/2" on to nonferrous liner or cladding. From the keel to max beam, alternating AF colors may be used, and the final coat may be red or black. From max beam to the upper boottop, all AF coats shall be black.
Non-SHT exterior surfaces above the waterline (includes DSRV/SRC seating surfaces)	SSPC-SP 10 or SSPC-SP 12 WJ-2/L	2 or 3 or 4	631-8.20.2 Table 631-8-13	631-8.20.2.1	2 or 3 or 4	Hull inserts and sea chests must be coated with the preservation system applied to adjacent surfaces. Extend coating system a minimum 1/2" on to nonferrous liner or cladding.
Non-SHT exterior foot traffic areas requiring non-skid. (All classes of submarines)	SSPC-SP 10 or SSPC-SP 12 WJ-2/L	5A or 5B or 5C	631-8.20.2 Table 631-8-13	631-8.20.2.1	5A or 5B or 5C	
Free-Flood Areas and Fairwaters	SSPC-SP 10	20	631-8.20.2.9	631-8.20.2.1	8 or 9	Hull inserts must be coated with the preservation system applied to adjacent surfaces. Extend coating system a minimum 1/2" on to nonferrous liner or cladding. Coating System 8 may be MIL-PRF-23236 Class 5 or 7. Coating System 9 topcoats may be F151 or F152 or F153 or F154.
Moored Training Ships only: exterior surfaces above the waterline (non-immersion surfaces only)	SSPC-SP 10 or SSPC-SP 12 WJ-2/L	6A or 6B	631-8.20.2 Table 631-8-13	631-8.20.2.1	6A or 6B	Hull inserts must be coated with the preservation system applied to adjacent surfaces. Extend coating system a minimum 1/2" on to nonferrous liner or cladding.
Steel Bow Domes: Interior Surfaces	SSPC-SP 12 WJ-2L or SSPC-SP 10	7 or 8 or 9	631-8.15.2 Table 631-8-6	SSPC-SP 12 WJ-2L or SSPC-SP 10	7 or 8 or 9	
Steel Bow Domes: Booted Exterior Surfaces Above Upper Boottop	Steel: SSPC-SP 12 WJ-2L or SSPC-SP 10 Rubber Boot: See 631-8.15.2.1	10 and 11	631-8.15.2 Table 631-8-6	Steel: SSPC-SP 12 WJ-2L or SSPC-SP 10 Rubber Boot: See 631-8.15.2.1	10 and 11	System 10 is paint on steel dome prior to installing boot. System 11 is paint on rubber boot.
Steel Bow Domes: Booted Exterior Surfaces Below Upper Boottop	Steel: SSPC-SP 12 WJ-2L or SSPC-SP 10 Rubber Boot: See 631-8.15.2.1	10 and 12	631-8.15.2 Table 631-8-6	Steel: SSPC-SP 12 WJ-2L or SSPC-SP 10 Rubber Boot: See 631-8.15.2.1	10 and 12	System 10 is paint on steel dome prior to installing boot. System 12 is paint on rubber boot.
Steel Bow Domes: Unbooted Exterior Surfaces Above Upper Boottop and GRP Bow Domes: Unbooted Exterior Surfaces Above Upper Boottop	Steel: SSPC-SP 12 WJ-2L or SSPC-SP 10 GRP: See 631-8.15.2.1	13 or 8 or 10	631-8.15.2 Table 631-8-6	Steel: SSPC-SP 12 WJ-2L or SSPC-SP 10 GRP: See 631-8.15.2.1	13 or 8 or 10	

Table 631-1-5 Summary Of Coating Requirements For Submarines-Exterior - Continued

Area or Compartment to be Finished	Surface Preparation for Full Preservation	Coating System for Full Preservation	Reference Paragraph/Table	Minimum Surface Preparation for Other Than Full Preservation	Coating for Less Than Full Preservation	Remarks
Steel Bow Domes: Unbooted Exterior Surfaces Below Upper Boottop	SSPC-SP 12 WJ-2L or SSPC-SP 10	14 or 15 or 16	631-8.15.2 Table 631-8-6	SSPC-SP 12 WJ-2L or SSPC-SP 10	14 or 15 or 16	
GRP Bow Domes: Interior Surfaces	- -	- -	- -	- -	- -	Painting not required.
GRP Bow Domes: Booted Exterior Surfaces Above Upper Boottop	See 631-8.15.2.1	17 and 11	631-8.15.2 Table 631-8-6	See 631-8.15.2.1	17 and 11	System 17 is paint on GRP dome prior to installing boot. System 11 is paint on rubber boot after boot installation.
GRP Bow Domes: Booted Exterior Surfaces Below Upper Boottop	See 631-8.15.2.1	17 and 12	631-8.15.2 Table 631-8-6	See 631-8.15.2.1	17 and 12	System 17 is paint on GRP dome prior to installing boot. System 12 is paint on rubber boot after boot installation.
GRP Bow Domes Unbooted Exterior Surfaces Below Upper Boottop	See 631-8.15.2.1	18 or 19	631-8.15.2 Table 631-8-6	See 631-8.15.2.1	18 or 19	
GENERAL NOTES: 1. Unless otherwise noted, the surface preparation standards shown in this table are those that apply to steel surfaces. Refer to Section 5 for equivalent surface preparation requirements for other types of substrate materials, or Section 8 for requirements for other materials specific to the type of shipboard location or equipment being painted. 2. Unless otherwise specified herein, the surface profile shall be 2-4 mils for all metallic surfaces prepared by abrasive blasting, abrasive sponge media blasting, slurry blasting, or waterjetting. 3. For surfaces where the surface preparation is specified as either SSPC-SP 10 or SSPC-SP 12 WJ-2L, waterjetting per SSPC-SP 12 may be used, provided that the 2-4 mil surface profile requirement is met. See paragraph 631-5.5.1 .						

1. MIL-PRF-24647, Type I or II Anti-Corrosion (AC) and Anti-Fouling (AF)

1 coat red AC, DFT 4-6 mils, and
1 coat gray AC, DFT 4-6 mils (Total AC DFT 10 mils minimum), and
1 coat AF, DFT 4-6 mils, and
1 coat AF, DFT 4-6 mils

2. MIL-PRF-23236, Type V, Class 5 or 7

Primer: 4-8 mils DFT MIL-PRF-23236 Type V, Class 5 or 7, and
Topcoat: 4-8 mils DFT MIL-PRF-23236 Type V, Class 5 or 7, Black

3. MIL-PRF-24647 Anti-Corrosive (AC), Type I or II

Primer: 4-6 mils DFT AC MIL-PRF-24647 Type I or II, and
Topcoat: 4-6 mils DFT AC MIL-PRF-24647 Type I or II, Black

4. MIL-DTL-24441 Type IV

Primer: 4-6 mils DFT MIL-DTL-24441 Type IV, F-150, and
Topcoat: 4-6 mils DFT MIL-DTL-24441 Type IV, F-153

5A. MIL-PRF-23236, Type V, Class 5 or 7/MIL-PRF-24667 Non-Skid

Primer: 4-8 mils DFT MIL-PRF-23236 Type V, Class 5 or 7, and
Topcoat: 4-8 mils DFT MIL-PRF-23236 Type V, Class 5 or 7, Black, and
Non-Skid: MIL-PRF-24667, Type I or X, Composition G

5B. MIL-PRF-24647 Anti-Corrosive (AC), Type I or II/MIL-PRF-24667 Non-Skid

Primer: 4-6 mils DFT AC MIL-PRF-24647 Type I or II, and
Topcoat: 4-6 mils DFT AC MIL-PRF-24647 Type I or II, Black, and
Non-Skid: MIL-PRF-24667, Type I or X, Composition G

5C. MIL-DTL-24441 Type IV/MIL-PRF-24667 Non-Skid

Primer: 4-6 mils DFT MIL-DTL-24441 Type IV, F-150, and
Topcoat: 4-6 mils DFT MIL-DTL-24441 Type IV, F-153, and
Non-Skid: MIL-PRF-24667, Type I or X, Composition G

6A. MIL-PRF-23236 Type V, Class 5 or 7/MIL-PRF-24635 Color 27038

Primer: 4-8 mils DFT MIL-PRF-23236 Type V, Class 5 or 7, and
Topcoat: 4-8 mils DFT MIL-PRF-23236 Type V, Class 5 or 7, and
Topcoat: 2-4 mils DFT MIL-PRF-24635 Color No. 27038

6B. MIL-DTL-24441 Type IV/MIL-PRF-24635 Color 27038

Primer: 4-6 mils DFT MIL-DTL-24441 Type IV, F-150, and

Topcoat: 4-6 mils DFT MIL-DTL-24441, Type IV, F-151 or F-150, and

Topcoat: 2-4 mils DFT MIL-PRF-24635 Color No. 27038

7. MIL-PRF-23236 Type VII Class 5

Primer: 4-8 mils DFT MIL-PRF-23236 Type VII Class 5, and

Stripe: 6-10 mils DFT MIL-PRF-23236 Type VII Class 5, and

Topcoat: 10-12 mils DFT MIL-PRF-23236 Type VII Class 5

8. MIL-PRF-23236 Type V or VI Class 5

Primer: 4-8 mils DFT MIL-PRF-23236 Type V or VI Class 5, and

Stripe: 4-8 mils DFT MIL-PRF-23236 Type V or VI Class 5, and

Topcoat: 4-8 mils DFT MIL-PRF-23236 Type V or VI Class 5

9. MIL-DTL-24441 Type IV

Primer: 4-6 mils DFT MIL-DTL-24441 Type IV, F150, and

Stripe: 4-6 mils DFT MIL-DTL-24441 Type IV, F151, and

Topcoat: 4-6 mils DFT MIL-DTL-24441 Type IV, F152

10. MIL-DTL-24441 Type IV

Primer: 4-6 mils DFT MIL-DTL-24441 Type IV, F150, and

Stripe: 4-6 mils DFT MIL-DTL-24441 Type IV, F151, and

Topcoat: 4-6 mils DFT MIL-DTL-24441 Type IV, F153 or F154

11. MIL-DTL-24631 Type II (Formula 187)

Topcoat: 2-3 mils DFT MIL-DTL-24631 Type II, F187

12. MIL-DTL-24631 Type I (Formula 184)/MIL-PRF-24647 Class 1 AF

Primer: 2-3 mils DFT MIL-DTL-24631 Type I, F184, and

Topcoat: 4-6 mils DFT MIL-PRF-24647 AF, Cl. 1, Appl. 2, Type I, II, or III, and

Topcoat: 4-6 mils DFT MIL-PRF-24647 AF, Cl. 1, Appl. 2, Type I, II, or III

13. MIL-PRF-24647 Class 1 AC

Primer: 4-6 mils DFT MIL-PRF-24647 Type I, II, or III AC, and

Stripe: 4-6 mils DFT MIL-PRF-24647 Type I, II, or III AC, and

Topcoat: 4-6 mils DFT MIL-PRF-24647 Type I, II, or III AC

14. MIL-PRF-24647 Class 1 AC/MIL-PRF-24647 Class 1 AF

Primer: 4-6 mils DFT MIL-PRF-24647 Type I, II, or III AC, and

Stripe: 4-6 mils DFT MIL-PRF-24647 Type I, II, or III AC, and

Topcoat: 4-6 mils DFT MIL-PRF-24647 Type I, II, or III AC, and

Topcoat: 4-6 mils DFT MIL-PRF-24647 AF, Cl. 1, Appl. 2, Type I, II, or III, and

Topcoat: 4-6 mils DFT MIL-PRF-24647 AF, Cl. 1, Appl. 2, Type I, II, or III

15. MIL-PRF-23236 Type V or VI Class 5/MIL-PRF-24647 Class 1 AF

Primer: 4-8 mils DFT MIL-PRF-23236 Type V or VI Class 5, and

Stripe: 4-8 mils DFT MIL-PRF-23236 Type V or VI Class 5, and

Topcoat: 4-8 mils MIL-PRF-23236 Type V or VI Class 5, and

Topcoat: 4-6 mils DFT MIL-PRF-24647 AF, Cl. 1, Appl. 2, Type I, II, or III, and

Topcoat: 4-6 mils DFT MIL-PRF-24647 AF, Cl. 1, Appl. 2, Type I, II, or III

16. MIL-DTL-24441 Type IV/MIL-PRF-24647 Class 1 AF

Primer: 4-6 mils DFT MIL-DTL-24441 Type IV, F150, and

Stripe: 4-6 mils DFT MIL-DTL-24441 Type IV, F151, and

Topcoat: 4-6 mils DFT MIL-DTL-24441 Type IV, F153 or F154, and

Topcoat: 4-6 mils DFT MIL-PRF-24647 AF, Cl. 1, Appl. 2, Type I, II, or III, and

Topcoat: 4-6 mils DFT MIL-PRF-24647 AF, Cl. 1, Appl. 2, Type I, II, or III

17. MIL-DTL-24441 Type IV

Primer: 4-6 mils DFT MIL-DTL-24441 Type IV, F150

18. MIL-PRF-24647 Class 1 AC/MIL-PRF-24647 Class 1 AF

Primer: 4-6 mils DFT MIL-PRF-24647 Type I, II, or III AC, and

Topcoat: 4-6 mils DFT MIL-PRF-24647 AF, Cl. 1, Appl. 2, Type I, II, or III, and

Topcoat: 4-6 mils DFT MIL-PRF-24647 AF, Cl. 1, Appl. 2, Type I, II, or III

19. MIL-DTL-24441 Type IV/MIL-PRF-24647 Class 1 AF

Primer: 4-6 mils DFT MIL-DTL-24441 Type IV, F150, and

Topcoat: 4-6 mils DFT MIL-PRF-24647 AF, Cl. 1, Appl. 2, Type I, II, or III, and

Topcoat: 4-6 mils DFT MIL-PRF-24647 AF, Cl. 1, Appl. 2, Type I, II, or III

20. **MIL-PRF-23236, Type VII, Class 5 or 7**

Primer: 4-8 mils DFT MIL-PRF-23236, Type VII, Class 5 or 7, and

Stripe: 6-10 mils DFT MIL-PRF-23236, Type VII, Class 5 or 7, and

Topcoat: 10-12 mils DFT MIL-PRF-23236, Type VII, Class 5 or 7

Table 631-1-6 Summary Of Coating Requirements For Submarines-Interior

Area or Compartment to be Finished	Initial or Overhaul Surface Preparation	Initial or Overhaul Coating System*	Coating NSTM 631 Para.	Minimum Dry Film Thickness of System (Mils)	Minimum Spot Repair Surface Preparation	Remarks
Auxiliary Tanks	SSPC-SP 10	2	631-8.20.8	8.0	SSPC-SP 10 or SSPC-SP 11	
Bilges	SSPC-SP 10	5 or 3	631-8.20.8	9.0	SSPC-SP 11 or SSPC-SP 2	See Table 631-8-16 .
Bilge Collecting Tanks/ Sumps	SSPC-SP 10	5 or 3	631-8.20.8	9.0	SSPC-SP 11 or SSPC-SP 2	
Bow Buoyancy Tanks	SSPC-SP 10	1	631-8.20.8	13.0	SSPC-SP 10 or SSPC-SP 11	
Bow Sonar Tank (SSN 688 Class)	SSPC-SP 10	1	631-8.20.8	8.0	SSPC-SP 10 or SSPC-SP 11	
Chain Locker	SSPC-SP 10	2	631-8.20.8	8.0	SSPC-SP 10 or SSPC-SP 11	
Clean Fuel Oil Tanks	SSPC-SP 10	2	631-8.20.8	8.0	SSPC-SP 10 or SSPC-SP 11	Tanks originally unpainted shall remain unpainted.
Collecting Fuel Oil Tanks	SSPC-SP 10	2	631-8.20.8	8.0	SSPC-SP 10 or SSPC-SP 11	Tanks originally unpainted shall remain unpainted.
Depth Control Tanks	SSPC-SP 10	2	631-8.20.8	8.0	SSPC-SP 10 or SSPC-SP 11	
Diesel Fuel Oil Seawater Expansion Tanks (SSN668 Class)	SSPC-SP 10	2	631-8.20.8	8.0	SSPC-SP 10 or SSPC-SP 11	
Diesel Generator Lubricating Oil Tank	SSPC-SP 10	None	631-8.20.8	8.0	SSPC-SP 11 or SSPC-SP 2	Maintain tanks in a cleaned and preserved state until used.
Dirty Drain Collecting Tanks	SSPC-SP 10	3 or 5	631-8.20.8	9.0	SSPC-SP 11 or SSPC-SP 2	
Drainage Trenches	SSPC-SP 10	5	631-8.20.8	9.0	SSPC-SP 11 or SSPC-SP 2	
Feedwater Tank	SSPC-SP 10	6	631-8.20.8 and 631-8.5	8.0	SSPC-SP 10 or SSPC-SP 11	
Freshwater Drain Collecting Tank	SSPC-SP 10	6	631-8.20.8	8.0	SSPC-SP 10 or SSPC-SP 11	
Fuel Oil Ballast Tanks	SSPC-SP 10	2	631-8.20.8	8.0	SSPC-SP 10 or SSPC-SP 11	
Fuel Oil Expansion Tanks	SSPC-SP 10	2	631-8.20.8	8.0	SSPC-SP 10 or SSPC-SP 11	

Table 631-1-6 Summary Of Coating Requirements For Submarines-Interior - Continued

Area or Compartment to be Finished	Initial or Overhaul Surface Preparation	Initial or Overhaul Coating System*	Coating NSTM 631 Para.	Minimum Dry Film Thickness of System (Mils)	Minimum Spot Repair Surface Preparation	Remarks
Fuel Oil Filter Sump Drain Tank (SSN688 Class)	SSPC-SP 10	2	631-8.20.8	8.0	SSPC-SP 10 or SSPC-SP 11	
Fuel Oil Overflow Tanks	SSPC-SP 10	2	631-8.20.8	8.0	SSPC-SP 10 or SSPC-SP 11	
Hovering Tanks	SSPC-SP 10	2	631-8.20.8	8.0	SSPC-SP 10 or SSPC-SP 11	
Hydraulic Oil Tanks	SSPC-SP 10	None	631-8.20.8	8.0	SSPC-SP 10 or SSPC-SP 11	CRES tanks are not painted.
Inaccessible Voids	SSPC-SP 10	7	631-8.20.8	Heavy Coat	SSPC-SP 2 if possible	
Lubricating Oil Collecting/Settling Tanks	SSPC-SP 10	None	631-8.20.8		SSPC-SP 10 or SSPC-SP 11	Maintain tanks in a cleaned and preserved state until used.
Lubricating Oil Sludge Tanks	SSPC-SP 10	None	631-8.20.8		SSPC-SP 10 or SSPC-SP 11	Maintain tanks in a cleaned and preserved state until used.
Lubricating Oil Stowage Tanks	SSPC-SP 10	None	631-8.20.8		SSPC-SP 10 or SSPC-SP 11	Maintain tanks in a cleaned and preserved state until used.
Lubricating Oil Sumps	SSPC-SP 10	None	631-8.20.8		SSPC-SP 10 or SSPC-SP 11	Maintain tanks in a cleaned and preserved state until used.
Main Ballast Tanks	SSPC-SP 10	1	631-8.20.8	13.0	SSPC-SP 10 or SSPC-SP 11	
Main Induction Sump Tanks	SSPC-SP 10	8	631-8.20.8	9.0	SSPC-SP 11 or SSPC-SP 2	
Missile Tube Eject Chamber and Missile Compensating Tanks	SSPC-SP 10	5	631-8.20.8	9.0	SSPC-SP 11 or SSPC-SP 2	
Negative Tanks	SSPC-SP 10	2	631-8.20.8	8.0		
Non-Floodable Voids	SSPC-SP 10	2 or 3	631-8.20.8	8.0	SSPC-SP 11 or SSPC-SP 2	
Non-Oily Bilge Collecting Tanks	SSPC-SP 10	3 or 5	631-8.20.8	9.0	SSPC-SP 11 or SSPC-SP 2	
Non-Oily Drain Collecting Tanks (other than freshwater)	SSPC-SP 10	3 or 5	631-8.20.8	9.0	SSPC-SP 11 or SSPC-SP 2	

Table 631-1-6 Summary Of Coating Requirements For Submarines-Interior - Continued

Area or Compartment to be Finished	Initial or Overhaul Surface Preparation	Initial or Overhaul Coating System*	Coating NSTM 631 Para.	Minimum Dry Film Thickness of System (Mils)	Minimum Spot Repair Surface Preparation	Remarks
Normal Fuel Oil Tanks	SSPC-SP 10	2	631-8.20.8	8.0	SSPC-SP 10 or SSPC-SP 11	Tanks originally unpainted shall remain unpainted.
Oily Bilge Collecting Tanks	SSPC-SP 10	3 or 5	631-8.20.8	9.0	SSPC-SP 10 or SSPC-SP 11	
Oily Drain Collecting Tanks	SSPC-SP 10	3 or 5	631-8.20.8	9.0	SSPC-SP 10 or SSPC-SP 11	
Poppet Valve Drain	SSPC-SP 10	2	631-8.20.8	8.0	SSPC-SP 10 or SSPC-SP 11	
Potable Water Tanks	SSPC-SP 10	6	631-8.20.8 and 631-8.5	8.0	SSPC-SP 11	Surface to be completely clean and not polished. Only white and red MIL-DTL-24441 are interchangeable. Feather edges.
Reserve Feedwater Inner Bottom Tank	SSPC-SP 10	6	631-8.20.8	8.0	SSPC-SP 10 or SSPC-SP 11	
Reserve Feedwater Tank	SSPC-SP 10	6	631-8.20.8	8.0	SSPC-SP 10 or SSPC-SP 11	
Safety Tanks	SSPC-SP 10	2	631-8.20.8	8.0	SSPC-SP 10 or SSPC-SP 11	
Sanitary Tanks	SSPC-SP 10	4	631-8.20.8	10.0	SSPC-SP 10 or SSPC-SP 11	
Seawater Expansion Tanks	SSPC-SP 10	2	631-8.20.8	8.0	SSPC-SP 10 or SSPC-SP 11	
Steam Plant Surge Tanks	SSPC-SP 10	9	631-8.20.8	4.0	SSPC-SP 10 or SSPC-SP 11	
Torpedo Impulse Tanks	SSPC-SP 10	2	631-8.20.8	8.0	SSPC-SP 10 or SSPC-SP 11	
Torpedo Tube Drain Tanks	SSPC-SP 10	2	631-8.20.8	8.0	SSPC-SP 10 or SSPC-SP 11	
Trim Tanks	SSPC-SP 10	2	631-8.20.8	8.0	SSPC-SP 10 or SSPC-SP 11	
Variable Fuel Oil Tanks	SSPC-SP 10	2	631-8.20.8	8.0	SSPC-SP 10 or SSPC-SP 11	

Table 631-1-6 Summary Of Coating Requirements For Submarines-Interior - Continued

Area or Compartment to be Finished	Initial or Overhaul Surface Preparation	Initial or Overhaul Coating System*	Coating NSTM 631 Para.	Minimum Dry Film Thickness of System (Mils)	Minimum Spot Repair Surface Preparation	Remarks
Waste Oil Collecting Tank (SSN 688 Class, SSBNs)	SSPC-SP 10	2	631-8.20.8	8.0	SSPC-SP 10 or SSPC-SP 11	
Water Round Torpedo Tanks	SSPC-SP 10	2	631-8.20.8	8.0	SSPC-SP 10 or SSPC-SP 11	
Ferrous machinery surfaces (unheated, external and internal)	SSPC-SP 10 or power tool clean	10 or 11	631-8.7	4.5	SSPC-SP 2 or SSPC-SP 11	
Ferrous sheet metal surfaces (unheated, external and internal)	SSPC-SP 10 or power tool clean	11	631-8.7	4.5	SSPC-SP 2 or SSPC-SP 11	
Ferrous sheet metal surfaces (heated, external and internal)	SSPC-SP 10 or power tool clean (SSPC-SP 5 if WSA)	12	631-8.7	1.0	SSPC-SP 2 or SSPC-SP 11	Unless wire sprayed aluminum (WSA) is specified. See section 2 for carbon monoxide (CO) monitoring.
Ferrous machinery surfaces (heated, external and interior)	SSPC-SP 10 or power tool clean (SSPC-SP 5 if WSA)	12	631-8.7	1.0	SSPC-SP 2 or SSPC-SP 11	Unless WSA is specified, see section 2 or carbon monoxide monitoring.
Machinery gage boards (including gages and clocks)	Power tool or hand clean	13	631-8.7	4.5	SSPC-SP 2	
Thermally insulated machinery, valves, and piping	SSPC-SP 10 or power tool clean	14	631-8.7	1.0 plus 1.5 finished	SSPC-SP 2	See section 2 for carbon monoxide monitoring.
Oxygen piping and valves (exterior)	SSPC-SP 10 or power tool clean	15	631-8.7	3.0	SSPC-SP 2 or SSPC-SP 11	
Piping, fittings, and valves (galvanized and ungalvanized steel, and aluminum)	SSPC-SP 10 or power tool clean	11	631-8.7	4.5	SSPC-SP 2	SSPC-SP 2 only allowed on 08 Cog. piping.
Nonferrous and corrosion resistant steel piping and valves, non-immersion areas	Unpainted	Unpainted			None	Hand cleaning only allowed on 08 Cog. piping.

Table 631-1-6 Summary Of Coating Requirements For Submarines-Interior - Continued

Area or Compartment to be Finished	Initial or Overhaul Surface Preparation	Initial or Overhaul Coating System*	Coating NSTM 631 Para.	Minimum Dry Film Thickness of System (Mils)	Minimum Spot Repair Surface Preparation	Remarks
Nonferrous and corrosion resistant steel piping and valves, immersion areas		Paint together with surrounding immersion areas				Hand cleaning only allowed on 08 Cog. piping. These surfaces in propulsion spaces of nuclear powered ships shall be left unpainted.
Electric and electronic Equipment (except as otherwise indicated)	SSPC-SP 2 or SSPC-SP 11	13	631-8.8	4.5	SSPC-SP 2	
Motors and Generators (Exterior)	SSPC-SP 2 or SSPC-SP 11	13	631-8.9	4.5	SSPC-SP 2	Except shafts and identification plate.
Motors and Generators (Interior)		15	631-8.9			
Electric Cables						See 631-8.10 .
Metal Enclosures (Galvanized)	SSPC-SP 2 or SSPC-SP 11	16	631-8.11	5	SSPC-SP 2	
Metal Enclosures (Bare Steel)	SSPC-SP 10 or power tool clean	17	631-8.11	5	SSPC-SP 2	
Metal Enclosures (Aluminum)	Hand clean or Power tool clean	11	631-8.11	5	Hand clean	
Metal Enclosures (Miscellaneous Metals)	Hand clean or Power tool clean	11	631-8.11	5	Hand clean	Brass, CRES, and nonferrous metals other than aluminum are not coated, except when required for appearance or camouflage.
Interior Communication and Fire Control Equipment		MIL-E-2036 MIL-E-18870	631-8.12	5	SSPC-SP 2	Brass, CRES, and nonferrous metals other than aluminum are not coated, except when required for appearance or camouflage.
Lighting Systems	See 631-8.17					Do not paint light-reflecting and light-transmitting surfaces.
Electronic Equipment	See 631-8.19		631-8.8		SSPC-SP 2	

Table 631-1-6 Summary Of Coating Requirements For Submarines-Interior - Continued

Area or Compartment to be Finished	Initial or Overhaul Surface Preparation	Initial or Overhaul Coating System*	Coating NSTM 631 Para.	Minimum Dry Film Thickness of System (Mils)	Minimum Spot Repair Surface Preparation	Remarks
Bilge Keels, Rudder Internals (Internal Surfaces)		7	Table 631-8-7	Heavy Coat		Rudders may be filled and drained or float coated.
Furniture and Joiner Doors	MIL-PRF-32038		Table 631-8-7			
Inaccessible Surfaces (Galvanized and Non-ferrous)	Unpainted	Unpainted	Table 631-8-7		Unpainted	
Ventilation Ducts and Trunks	SSPC-SP 10	1) 2 or 2) 18	Table 631-8-7	1) 9.0 or 2) 10.5	SSPC-SP 2 or SSPC-SP 11	
Seamless Coating for Small Objects	See 631-7.5 to 631-7.5.6.1	See 631-7.5 to 631-7.5.6.1		See 631-7.5.2		Refer to 631-7.5 through 631-7.5.6.1
Items Not Painted	See 631-8.17	See 631-8.17				631-8.17 is a list of shipboard items not to be painted.

GENERAL NOTES:

CAUTION

The requirements for submarine potable water tanks, feedwater tanks, and freshwater drain collecting tanks are current as of the date of issue of this NSTM revision. For the most current coating requirements for other interior areas of submarines, refer to the current edition of NAVSEA Standard Item 009-32, or Submarine Maintenance Standard MS 6310-081-015.

1. Refer to Section 2 for safety precautions for surface preparation and painting.
2. Refer to Section 5 for descriptions of surface preparation methods IAW SSPC/NACE standards.
3. MIL-DTL-24441 refers to Type IV unless otherwise noted.
4. Topcoat colors for items not specified are to match surrounding area.
5. Some items may be powder coated. See paragraphs 631-7.9 and 631-8.20.5 for requirements.

*COATING SYSTEMS for Table [631-1-6](#)

NOTE

Except for potable water tanks, feedwater tanks, and reserve feedwater tanks, MIL-DTL-24441 epoxy paints may be applied as either a Type III three coat system (i.e., 150/151/152) or as a Type IV two coat system (i.e., 150/151 or 150/152) or where any Type III, MIL-DTL-24441 paint is specified, the equivalent type IV MIL-DTL-24441 coating may be substituted. Unless otherwise stated in this technical manual or specified in work orders, total dry film thickness of the two coat Type IV system is to be the same as the thickness of the three coat Type III system. Potable water, feedwater, and reserve feedwater tank coating systems and application remain unchanged (see [631-8.5](#) and [631-8.6](#)).

- 1) MIL-DTL-24441 Type IV
Prime: 1 Coat F-150 DFT 3-5 mils
Topcoat: 1 Coat F-151 DFT 3-5 mils
Plus 2 coats 121 to 2 feet above tank opening
- 2) MIL-DTL-24441 Type IV
Prime: 1 Coat F-150 DFT 3-5
Topcoat: 1 Coat F-151 DFT 3-5
- 3) MIL-PRF-23236 if authorized by NAVSEA
- 4) 1 coat 150
1 coat 156
1 coat 151
1 coat 152
- 5) 1 coat 150
1 coat 151 or 156
1 coat 151 or 157 (Non-nuclear bilges only)
- 6) Prime: 1 coat MIL-DTL-24441 Type III, F150, 2-4 mils dft
Stripe: 1 coat MIL-DTL-24441 Type III, F152, 2-4 mils dft
Topcoat: 1 coat MIL-DTL-24441 Type III, F151, 2-4 mils dft
Stripe: 1 coat MIL-DTL-24441 Type III, F150, 2-4 mils dft
Topcoat: 1 coat MIL-DTL-24441 Type III, F152, 2-4 mils dft
Total system 8 mils dft minimum.
- 7) MIL-PRF-16173, Grade 1

- 8) 1 coat 150
1 coat 151 or 156
1 coat 151 or 156
- 9) 2 coats Apexior No. 1 (Dampney Co.)
- 10) Prime: 1 coat TT-P-645, F-84
Topcoat: MIL-E-15090, F-111
- 11) Prime: 1 coat TT-P-645, F-84
Topcoat: To match surrounding area
- 12) 2 coats TT-P-28 Type I or Wire Spray Aluminum (WSA) if specified
For WSA: High Temp applications (over 175° F) - Use Type I of MIL-STD-2138, 10 to 15 mils DFT plus 3 mils sealer coat. Low Temp applications (175° F and less) - Use Type II of MIL-STD-2138, 7 to 10 mils DFT plus 3 mils sealer coat.
- 13) Prime: 1 coat TT-P-645, F-84
Topcoat: 2 coats MIL-E-15090, F-111
- 14) 2 coats TT-P-28 Type I, plus one finish coat over insulation
- 15) Prime: 1 coat TT-P-645, F-84, or 1 coat MIL-DTL-24441, F150
Topcoat: 1 coat MIL-PRF-24635
- 16) Prime: 1 coat MIL-DTL-24441, F-150 (omit over miscellaneous metals)
Topcoat: 2 finish coats to match surrounding area
- 17) Prime: 1 coat TT-P-645, F-84
Topcoat: 2 finish coats to match surrounding area
- 18) MIL-STD-2138
For WSA: High Temp applications (over 175° F) - Use Type I of MIL-STD-2138, 10 to 15 mils DFT plus 3 mils sealer coat. Low Temp applications (175° F and less) - Use Type II of MIL-STD-2138, 7 to 10 mils DFT plus 3 mils sealer coat.

SECTION 2

SAFETY INFORMATION

631-2.1 GENERAL

631-2.1.1 This section contains safety precautions for all aspects of paint handling and operations except stowage. Stowage safety precautions are contained in **NSTM Chapter 670, Stowage, Handling and Disposal of Hazardous General Use Consumables** .

631-2.1.1.1 The Occupational Safety and Health Act of 1970 established regulations and standards which govern occupational safety and health (OSH) matters. Executive Order 12196 provides guidance to the Department of Defense concerning OSH matters. DOD OSH Program Instruction (DODINST 6055.1) and Navy Occupational Safety and Health (NAVOSH) Program Manual (OPNAVINST 5100.19 Series/OPNAVINST 5100.23 Series) provide overall guidance. OPNAVINST 5090.1 Series provides the requirements, responsibilities and policy for management of the environment and natural resources.

631-2.1.1.2 Information in this section provides policy and the minimum requirements for safety and health aspects of paint handling, surface preparation and paint application. It cannot cover all conceivable operations and conditions. All personnel involved must understand the intent so that unusual circumstances are treated appropriately to protect personnel. Consult supervisor for additional guidance.

631-2.1.1.3 Personnel shall be adequately informed of and understand hazardous material concerns and the necessary protective measures (hazard communication training), proper disposal techniques and procedures, and ready access to Material Safety Data Sheets (MSDSs) per OPNAVINST 5100.19 Series, OPNAVINST 5100.23 Series and OPNAVINST 5090.1 Series. Commensurate with their responsibilities and participation, all personnel connected with these operations shall be made aware of the hazards associated with the handling and use of hazardous and/or flammable materials, as well as the appropriate safety precautions prior to working with hazardous materials. This information shall be a part of each individual's initial and periodic job training.

631-2.1.1.4 SUPERVISORY RESPONSIBILITIES. The supervisor shall lay out the work and manage projects in such a manner as to produce the safest possible conditions. Personnel safety is the supervisor's prime responsibility. A safety checklist shall be used before a job gets underway. In addition, all supervisors shall adhere to the following:

- a. Always be aware of potential hazards in the area. Consult the local industrial hygienist for additional guidance.
- b. Be sure that each painter understands and accepts personal responsibility for safety and is informed of all safety rules.
- c. Be sure that all safety measures have been taken before each work shift or operation begins.
- d. Insist that crew-members work safely. Use disciplinary action in accordance with existing personnel directives, if necessary to ensure compliance.
- e. Be sure that all equipment meets safety standards. Use non-sparking tools and data collection equipment in fire or explosion hazardous areas. Anticipate possible risks with new types of equipment. Secure expert advice on potential hazards in advance from cognizant OSH personnel.

- f. Encourage personnel to discuss the hazards in their work during periodic safety meetings. No job shall proceed if any question about safety remains unanswered. Be receptive to their ideas and suggestions. Their field experience can be an important source of information that will help prevent accidents.
- g. Set a good example for the crew by demonstrating safety awareness in all personal work habits.

631-2.1.1.5 The following is an example of a supervisor's safety checklist:

1. NO SMOKING signs posted.
2. Warning tags and signs posted.
3. Required protective clothing, safety shoes, and hard hat available.
4. Required eye protection available.
5. Required respiratory protection available.
6. Buddy system setup if warranted.
7. Safety belts, harnesses, and tending lines on hand as required.
8. Hazardous material control as needed.
9. Burn hazards (chemical, hot pipes, other) are properly identified and appropriate control measures are in place.
10. Potential falling objects are properly secured or precautions are taken to minimize the hazard.
11. Moving objects, cranes, and other traffic hazards controlled.
12. Safety showers and eyewashes are properly located with easy access in the event of an accident.
13. Location of fire alarm station is known.
14. Fire extinguishers and fire blankets on hand as required and personnel are properly trained in their use.
15. Location of nearest telephone is known.
16. Barricades are installed as necessary.
17. Electrical hazards in vicinity taken into account.
18. Working electrical equipment properly grounded.
19. Spark proof tools are available and used as required.
20. Flammability or flashpoints of painting materials and solvents and nearby stowed materials are known.
21. Safety and fire permits obtained.
22. Gas Free Engineer's approval (if necessary) obtained for entry of personnel based on the specific operation.
23. Condition of ladders and scaffolding checked and found acceptable.
24. Safe walking/working surfaces provided for personnel.
25. Adequate ventilation is provided.
26. Fire retardant masking paper used as required.
27. Each worker shall be required to review and be familiar with potential health hazards and precautions for the materials involved in each operation. The DOD Hazardous Material Information Resource System (HMIRS), and Ships Hazardous Material List (SHML) provide guidance in this regard.

631-2.2 GENERAL HAZARDS.

631-2.2.1 GENERAL. Every painting operation exposes maintenance personnel and others in the area to conditions and situations that are potentially hazardous. Use of toxic and flammable materials, pressurized equipment, ladders, scaffolding, and rigging presents potential hazards. Hazards may also be inherent in working conditions or be caused by operator inexperience, lack of training, or carelessness. Awareness of all potential hazards is therefore essential because continuous and automatic observance of precautionary measures will minimize the danger and improve painting crew efficiency and morale. The degree of hazard along with the required control measures should be addressed on a case by case basis using MSDSs and Hazardous Chemical Warning Labels as reference sources. These references should be reviewed by each worker prior to the start of any operation. The following areas require alertness when painting operations are planned and executed:

- a. Paint and solvent materials
- b. Surface preparation materials and processes
- c. Equipment
- d. Work Environment
- e. Ventilation
- f. Painting crew training
- g. Degree of hazard

631-2.2.1.1 Paint and Solvent Materials. Most paint and solvent materials are hazardous to some degree. Paints and solvents may be flammable and many are toxic. Others can irritate the skin, eyes, and mucous membranes. All paints and solvents may be potentially hazardous based on their specific chemical composition, and manner of application or removal.

631-2.2.1.2 Surface Preparation Materials and Processes. Preparing a surface for painting often requires the use of solvents, acids, or alkaline cleaners (Refer to [paragraphs 631-2.5.6 through 631-2.5.7](#)). All of these will irritate the skin, eyes, and mucus membranes unless used with care. Some paint removers are highly toxic. The use of high-pressure abrasive or water blasting methods can be hazardous; water pressures as low as 10 to 15 lb/in² have been known to cause serious injuries. In addition, continued exposure to airborne particulates without respiratory protection during abrasive blasting operations may result in lung disease. Steam cleaning procedures employ both high heat and pressure that, if not properly handled, can cause serious burns and other injuries to the operator and nearby personnel.

631-2.2.1.3 Equipment. Ladders, scaffolding, and rigging shall be used for areas not readily accessible from the deck, pier, or dock. Fall protection shall be considered when working on ladders, scaffolding, or rigging. Pressure equipment is often used to prepare surfaces and to apply paint. All of this equipment can be hazardous if handled carelessly. More time may be required for proper equipment setup, dismantling and cleaning, required safety checks, and observance of basic equipment precautions than is required to prepare the surface or apply the protective coating. Nevertheless, precautions must never be omitted.

631-2.2.1.4 Work Environment. Working conditions will vary from job to job. In addition to the hazards inherent in the painting operation, the blaster or painter may encounter other hazards in the work area itself. For example, slippery decks or obstacles located on deck may cause falls; electrical or mechanical equipment may produce shocks or other serious injuries; un-insulated steam lines or hot pipes may cause severe burns, fire haz-

ards, or too rapid evaporation of solvent, thus creating a toxic atmosphere. Temperatures in the work environment should be kept at 18 to 24° C (65 to 75° F), if practical. Potential hazards in the work environment shall be considered before blasters or painters are sent into any work area: Hazards such as poor ventilation, noxious vapors, thermal stress, types of potentially hazardous material and how they are applied, and the space where the work is to be done shall be considered. Special action is required if any of the following conditions exist:

- a. If the space is considered oxygen deficient or enriched by the cognizant Gas Free Engineer (see NSTM Chapter 074, Volume 3, Gas Free Engineering; a space is considered deficient if the oxygen level by volume is less than 19.5% and is considered enriched if the oxygen level is greater than 22%);
- b. If combustible vapors or gases are present (see NSTM Chapter 074, Volume 3, Gas Free Engineering);
- c. If toxic or hazardous substances are present (see NSTM Chapter 074, Volume 3, Gas Free Engineering);
- d. If it is impractical, with available equipment, to properly test the workspace atmosphere for known or suspected toxic vapors or gases (such as bilge gases, distillate fuels, kerosene, or Navy standard fuel oil).

631-2.2.1.5 Ventilation. If ventilation is required, the basic ventilation requirements of NSTM Chapter 074 Volume 3 Gas-Free Engineering shall be followed. If such ventilation is not possible or ineffective, respiratory protective equipment shall be provided in accordance with the workspace conditions following the requirements of OPNAVINST 5100.19 or 5100.23 Series. When exhaust systems are used, the system shall remove vapors or gases from the space or bottom of the tank or area in which work is being done, as well as potentially stagnant areas in accordance with NSTM Chapter 074 Volume 3 Gas-Free Engineering. The hazard potential of stagnant areas and pockets shall be given special accommodation. A crewmember shall never work alone in a hazardous area. Discharge exhaust systems to weather so as to avoid re-circulation of exhaust vapors and presenting a potential hazard to personnel.

631-2.2.1.6 Painting Crew Training. To reduce the threat to the safety of the ship, crew and others, each blaster and painter shall have the training, experience, and knowledge of the process being used and the hazards present. Carelessness of any worker will also increase hazards. Shortcuts often produce unsafe working conditions resulting in accidents, personnel injuries, and loss of time and materials. Observance of all safety precautions at all times will reduce this risk to a minimum. Painting crews shall be composed of personnel who have a proper attitude toward safety and who are in good physical condition.

631-2.2.1.7 Degree of Hazard. Each supervisor is responsible for ensuring that all necessary precautions are taken, designating the equipment required, and advising the crew of the specific hazards of each job prior to the start of the operation. Ignoring these hazards will increase the odds that accidents will occur. Relaxing precautions in one job can lead to carelessness in subsequent jobs, regardless of the degree of hazard. The eventual result will be an increase in accident rates.

631-2.2.2 RESPIRATORY PROTECTION. Life or health may depend on proper respirator selection and implementation of a complete respirator program, including training, fit testing, maintenance, and use requirements. Always consult 29 CFR 1910.134, OPNAVINST 5100.23 and OPNAVINST 5100.19 Series for complete and up-to-date details on the elements of a proper respiratory protection program. General factors to be considered when selecting respirators for surface preparation and painting operations include the following:

1. Only NIOSH-approved respiratory protective equipment shall be utilized. Such equipment shall be utilized only for the purpose and exposures for which the equipment has been tested and approved.

2. All exposures or potential exposures must be carefully evaluated before proper respiratory protective devices can be selected. Such evaluation shall include, at a minimum:
 - a. Types of contaminants present or likely to be present or generated (mists, fumes or vapors).
 - b. Concentration of contaminants.
 - c. Appropriate exposure limits of contaminants: threshold limit value (TLV), permissible exposure limits (PEL), threshold limit value ceiling (TLVC).
 - d. Oxygen level.
 - e. Atmosphere as a whole, i.e., whether or not space is Immediately Dangerous to Life or Health (IDLH).

631-2.2.2.1 Respirator Care. Life or health may depend on availability and proper functioning of respiratory equipment. Equipment shall be cleaned immediately after use and shall be properly maintained and stored in clean, dry compartments. Filters, cartridges, and rubber parts shall be inspected before each use at regular intervals for any signs of deterioration. Any suspect filter or cartridge shall be replaced immediately. See OPNAVINST 5100.19.

631-2.2.3 EYE PROTECTION. Safety glasses with side shields, or safety goggles as necessary shall be worn in areas where there is a possibility of particulates, mists, or vapors entering eyes. Eyewear should fit well, contain unbreakable glass or plastic lenses, should conform to ANSI standards for safety glasses (Z87.1), and should allow adequate peripheral and straight-ahead vision. Safety eyewear shall be kept clean and available for use when required. Crew-members working with chemicals shall wear chemical worker's goggles. A full face respirator or ANSI-approved full length face shield may be necessary where protection of the eyes, face, and neck is required.

631-2.2.3.1 Emergency eyewash systems conforming to ANSI Z358.1 must be immediately available near the work area should their use be required. Portable eyewash fountains must also conform to ANSI design criteria if permanently installed systems are not available. Systems must be accessible within 10 seconds.

631-2.2.4 PROTECTIVE CLOTHING. Personnel shall wear adequate clean clothing and gloves to prevent skin contact with painting and cleaning materials. Clothing with cuffs, loose pockets or rips, and loose items and jewelry shall not be worn since they are potential causes of hangups. The following precautions shall be adhered to with regard to protective clothing:

- a. NIOSH/MSHA-approved abrasive blasting respirators shall be worn during abrasive blasting;
- b. Hardhats and steel-toed safety shoes shall be worn wherever there is possible danger from falling objects;
- c. Nonskid, nonsparking, rubber-soled shoes shall be worn for work in enclosed spaces or where flammable vapors may be present (spark prevention);
- d. Acid-proof clothing shall be worn when handling acid or caustic cleaning; and
- e. Acid/caustic resistant suits with hood along with a full-face air supplied respirator shall be worn when using acid or caustic cleaning materials in enclosed spaces.

631-2.2.5 OTHER PRECAUTIONS. Safety precautions that shall be taken to ensure personnel safety during inspection of tanks, voids, and other hazardous areas to be painted are described in the following paragraphs.

631-2.2.5.1 Buddy System. Personnel shall never work alone in hazardous areas. At least two crew members shall be assigned to such jobs, and each shall be in communication with the other at all times during operations in hazardous areas. If an accident occurs in a tank or other confined space, the crew member stationed on the outside must never enter the tank to give assistance alone, but shall seek help. Multiple deaths have occurred from failure to follow this basic precaution. Safety harnesses and tending lines shall be used in confined spaces. A supplied air respirator shall be available for each person working in a confined space. If an accident happens outside a confined space, the other crew member can seek help or come to the aid of the injured one. Based on the exposure of concern and the physical confines of the work space, a supplied air respirator may be required with an egress bottle.

631-2.2.5.2 Inspection Safety Precautions. The following are the safety precautions that shall be used to ensure personnel safety during inspection of tanks, voids, and other hazardous areas to be painted.

631-2.2.5.2.1 Pre-Entry Requirements. Do not enter any enclosed or poorly ventilated space until a Gas Free Engineer has tested and certified that the space is safe for entry. For pre-entry requirements see NSTM Chapter 074, Volume 3, Gas Free Engineering. Station a crew member outside before entering any confined space such as tank or void.

631-2.2.5.2.2 Safety Equipment. Use necessary safety equipment. Lifejackets shall be worn when working near or over water. Lifelines shall have no more than 2 feet of slack so that the jolt from a fall will not cause injury. Personnel fall protection systems may be required.

631-2.2.5.2.3 Personal Hygiene. Do not smoke, eat, or drink inside a tank or other hazardous area. Wash hands and face thoroughly before smoking, eating, drinking or using the toilet. Obtain medical attention immediately should significant respiratory system irritation occur, or other suspected adverse effect, and for any cuts, abrasions or symptoms of ill health (dizziness) that are incurred during the inspection of these spaces.

631-2.3 GENERAL PAINT/SOLVENT INFORMATION FOR FIRE/EXPLOSION.

631-2.3.1 FIRE PREVENTION PRECAUTIONS. Smoking, open flames (such as matches and torches), and hot work are prohibited in or near the area where paint, varnishes, lacquers, and their solvents are mixed, used or stored. Spilled paint or solvents shall be wiped up immediately to reduce fire and vapor hazards. Rags or other materials used for paint cleanup shall be placed in a closed-top metal container for disposal. Specific fire prevention precautions are described in the following paragraphs.

631-2.3.1.1 Electrical Equipment. In rooms where extensive paint mixing operations are carried on, electrical equipment shall be installed in accordance with Class I, Group D requirements of the National Electrical Code. Explosion-proof lamps with shatterproof lenses shall be used for lighting.

631-2.3.1.2 Firefighting. Authorized personnel, duty fire party, and damage control party using the mixing room shall be informed of the location and instructed in the use of the firefighting equipment and systems to be used on paint or paint-related fires. The firefighting equipment shall be readily accessible and escape routes from the area shall be prominently designated.

631-2.3.2 PAINT AND SOLVENT FLASHPOINTS. The definition of flashpoint is the lowest temperature at which vapors above a volatile combustible substance ignite in air when exposed to flame. Flashpoint is an indi-

cator of a fire hazard; the lower the flashpoint, the greater the fire hazard. If doubt exists about the flashpoint of a paint or thinner, read the label on the material or check the vendor's data sheet or Material Safety Data Sheet (MSDS).

631-2.3.2.1 Low Flashpoint. Paints and solvents with flashpoints (closed-cup) less than 35° C (95° F) shall not be used for compartment and tank painting because of potential fire and explosion hazards. If the use of low flashpoint materials is required in confined spaces, ventilation rates shall be maintained to provide an atmosphere below 10% of the lower explosive limit (LEL) at all times. See S9086-CH-STM-030/CH-074V3 for further ventilation information.

631-2.3.2.2 Paint and Solvent Flashpoint Listing. Flashpoints of paints and solvents shall be determined by the Pensky-Martens closed-cup method, the Tag closed-cup method, or the Setaflash closed-cup method. Flashpoints of common solvents used in paint are listed in [Table 631-2-1](#). The flashpoints of formulated paints generally parallel the flashpoints of the solvents used. However, many paints contain solvent blends and this table cannot be used as an accurate gage of flashpoint.

631-2.3.2.3 Highly Flammable Paints. Flashpoint labeling is a requirement for all paints and solvents. Personnel shall be instructed to read and understand container labels before using the paint product. Size of posted danger areas, amount of ventilation, and degree of other fire and explosion preventive procedures shall be revised and approved by the cognizant Gas Free Engineer prior to use of low-flashpoint paint materials.

631-2.3.2.4 Paint Flashpoints. Epoxy paints in accordance with MIL-DTL-24441, and most interior or tank paints, including MIL-PRF-23236, MIL-PRF-24607, MIL-DTL-15090, MIL-DTL-700, TT-P-645, and TT-P-28 have a minimum specified flashpoint of about 38° C (100° F). Current exterior topcoat paints, such as MIL-PRF-24635 and MIL-PRF-24596 also have a minimum specified flash point of 38° C (100° F). A few paints have lower flashpoints, some below 17° C (60° F), and present much greater fire and explosion hazards. Some paints have flashpoints that can only be determined only by reading warning labels on the cans or by consulting the manufacturer's literature or Material Safety Data Sheet (MSDS).

631-2.3.2.5 Paint Thinner Flashpoints. The most common shipboard paint thinner, Degreasing Solvent (Standard Solvent), MIL-PRF-680, Type I or ASTM D235 Type I, should be used for thinning or cleanup of alkyd and oil-based coatings. This thinner has a flashpoint above 38° C (100° F). Synthetic enamel thinner (CID A-A-3007) has a flashpoint of 10° C (50° F) minimum and should be used for thinning or cleanup of heat-resistant aluminum paint (FED-Spec. TT-P-28 Type I). Choice of thinners for commercial proprietary coatings depends upon the recommendations. Flashpoints can be found in the manufacturer's literature or printed on the can labels.

631-2.3.2.6 Minimum Flashpoint Specifications. Only coating materials having flashpoints of 35° C (95° F) minimum shall be used in spray booths, with the exception of synthetic enamel thinner. Where material with flashpoints less than 35° C (95° F) are specified in drawings and equipment specifications, NAVSEA shall be consulted for assistance in determining whether less flammable alternatives exist or a waiver to this requirement should be requested.

631-2.4 PAINT AND SOLVENT HEALTH HAZARDS.

631-2.4.1 PAINT COMPOSITION. Stock numbers and specification numbers for commonly used ship painting materials are covered in [Section 3](#). These specifications contain either a complete list of product ingredients or a generic description of the product, with performance requirements, which can be used to identify other com-

plying products. Approved proprietary products and their manufacturers may be found on the Qualified Products List (QPL), if applicable, for each military and federal specification. Material safety data sheets (MSDSs) furnished by manufacturers of hazardous materials shall be reviewed for additional information concerning material hazards and composition. Information concerning paint composition can also be obtained from manufacturers, the Hazardous Material Information Resource System (HMIRS), or from NAVSEA. Due to the performance oriented nature of many paint systems, the chemical nature of each paint cited should be carefully reviewed and verified.

631-2.4.2 GENERAL. A Navy Environmental and Preventive Medicine Unit (NAVENPVNTMEDU or a local medical treatment facility shall be consulted for guidance in acceptability and adequacy of personnel protective procedures for the process and specific materials being used.

631-2.4.3 HAZARDOUS PAINT INGREDIENTS.

631-2.4.3.1 The Navy has adopted the 1989 Occupational Safety and Health Administration's (OSHA) exposure standards for use throughout the agency. Personnel exposure to airborne contaminants without protection shall not exceed the Permissible Exposure Limits (PEL) specific for that substance

Table 631-2-1 Solvent Flashpoints

Solvent	Flashpoint (closed cup)	
	° C	° F
Amyl acetate	29	84
Butyl acetate	29	84
n-Butyl alcohol	35	95
Butyl carbitol (diethylene glycol monobutyl ether)	101	214
Butyl cellosolve (ethylene glycol monobutyl ether)	60	140
Carbitol (diethylene glycol monoethyl ether)	96	204
Cellosolve (ethylene glycol monoethyl ether)	42	108
Cellosolve acetate (ethylene glycol monoethyl ether acetate)	51	142
Cyclohexanone	44	111
Diacetone alcohol	47	117
Ethyl alcohol	13	55
Super high-flash naphtha	43	110
Isobutyl acetate	18	64
Isobutyl alcohol	28	82
Isophorone	82	179
Isopropyl alcohol	12	53
Methyl n-butyl ketone	23	73
Methyl cellosolve (ethylene glycol monomethyl ether)	42	107
Methyl cellosolve acetate (ethylene glycol monomethyl ether acetate)	49	121
Methyl ethyl ketone	-1	30
Methyl isobutyl ketone	16	60
Mineral spirits (paint thinner)	43	109
SOLVATONE solvent M	26	78
Dry cleaning solvent, type II	59	138
Styrene	32	90
Toluene	4	40

Table 631-2-1 Solvent Flashpoints - Continued

Solvent	Flashpoint (closed cup)	
	° C	° F
Turpentine	35	95
VM&P naphtha	-7	20
Xylene	17	63

NOTE

Some of the above solvents have been identified as toxic/hazardous materials. Use shall be in accordance with all OSHA/NAVOSH precautions. Some have potential to be a reproductive hazard - that is adversely affect the human reproduction process.

631-2.4.3.2 The Threshold Limit Value (TLV) is established by a committee of the American Conference of Governmental Industrial Hygienists (ACGIH). These values are reviewed by the Committee on a routine basis, but are not considered consensus standards

631-2.4.3.3 The "skin" designation indicates the contaminant can present a significant contribution to total exposure through the skin. Skin contact shall be prevented or reduced to the extent necessary by gloves, coveralls or other appropriate PPE/engineering controls.

631-2.4.3.4 A workplace assessment, as conducted by an industrial hygienist or by a qualified industrial hygiene technician, is necessary to assist in making recommendations regarding the protection of personnel. Training must provide personnel with sufficient knowledge for the effective participation in the OSH program, as required by OPNAVINST 5100.23 or 5100.19 Series.

631-2.4.3.5 Lacking specific industrial hygiene recommendations regarding protection of personnel, precautions related to hazardous paint ingredients are described in the MSDS or HMIRS for the paint in use along with guidance with regard to potential health hazards related to working with a specific coating.

631-2.4.4 PAINT TYPES AND INGREDIENTS.

631-2.4.4.1 Alkyd and Oil-Base Paints and Varnishes. These include MIL-E-1115 (Formula 30), TT-P-645 (Formula 84), MIL-DTL-15090 (Formula 111), and MIL-DTL-24607 (Formulas 124, 125, and 126), and coatings in accordance with DOD-P-21035 and MIL-PRF-24635. These contain hydrocarbon solvents such as paint thinner and vegetable oil resins which include glyceryl phthalate (alkyd) resin (FED Spec. TT-R-266). This category includes most interior compartment and passageway paints, as well as exterior enamel, silicone alkyd MIL-PRF-24635. Personnel shall wear chemical worker's goggles and impervious gloves during mixing operations. Personal respiratory protective equipment (NIOSH-approved chemical cartridge or air line respirator) shall be required if airborne solvent vapor concentrations cannot be controlled by ventilation. Skin that comes in contact with these paints shall be promptly cleaned with soap and water (not thinners).

631-2.4.4.2 Vinyl Paints. NAVSEA has cancelled all specifications for vinyl paints, and use of such paints are not authorized.

631-2.4.4.3 Epoxy Paints and Hull Repair Compounds. These include MIL-DTL-24441, MIL-PRF-23236, some NAVSEA approved proprietary paints, and DOD-PRF-24176 Hull Repair Compounds. These contain epoxy resins and amine, polyamine, or polyamide curing agents. Paints in accordance with MIL-DTL-24441 contain n-butyl alcohol (butanol) and naphtha. Butanol and naphtha are often used for thinning paint and cleaning equipment. The commercial epoxy paints are proprietary products which may contain the above solvents, as well as ketones, esters (for example, butyl acetate), and aromatic or aliphatic hydrocarbons (for example, xylene or paint thinner). Because of some ingredients used in epoxy paints, health hazards such as skin irritation and allergic reactions are greater than alkyds. If epoxy coatings contact the skin, prompt skin cleanup is mandatory. Soap and water, not solvents, shall be used, as solvents permits greater penetration of paint into the skin. Seek medical attention if skin reddening or rash appears.

631-2.4.4.4 Water Based Paints. These paints include those qualified to MIL-PRF-24596 Grades A or B, and MIL-PRF-24763. Water based paints that used to be separately designated as Formula 25A are now covered by MIL-PRF-24596. While mixing, application, and clean-up of these paints is considered to be non-hazardous and non-toxic, the precautions of [paragraph 631-2.2](#) shall be observed to prevent eye contact and inhalation of mists or vapors.

631-2.4.4.5 Coal Tar Epoxy Paints. Coal tar epoxy paints are recognized as having carcinogenic (cancer causing) properties and shall not be used.

631-2.4.4.6 Organotin Materials. Organotin materials contain toxic anti-fouling agents, such as bis-tributyltin oxide (TBTO) or tributyltin fluoride. These coatings are not authorized for use. (See [paragraph 631-2.8.3](#)).

631-2.4.4.7 Non-Skid Deck Coverings. Safety precautions for the application of nonskid deck coverings are presented in NSTM Chapter 634, Deck Coverings.

631-2.4.4.8 Polyurethane Coatings. Precautions concerning the use of polyurethane coatings are described in [paragraph 631-2.8.2](#).

631-2.4.4.9 N-Butyl Alcohol. Exposure to vapors produces irritation to nose, throat, and eyes. Butyl alcohol also causes contact dermatitis.

631-2.4.4.10 Cresol. This is a strong irritant which frequently causes dermatitis. Serious or even fatal poisoning may result if large areas of the skin are wet with cresol unless it is removed immediately. The use of any product containing cresol is prohibited.

631-2.4.4.11 Methylene Chloride (Dichloromethane). Methylene chloride and products containing methylene chloride shall not be used, as they are suspected carcinogens.

631-2.4.4.12 Ethylene Glycol Monobutyl Ether. This chemical is considered toxic and can be absorbed by the skin. Skin absorption through direct contact with the liquid contributes significantly to overall exposure and must be prevented.

631-2.4.4.13 Ethylene Glycol Monoethyl Ether and Ethylene Glycol Monomethyl Ether. These chemicals are considered toxic and can be absorbed through the skin. Skin absorption, if not prevented, can add significantly to overall exposure. They are considered to be reproductive toxins.

631-2.4.4.14 Formic Acid. This acid produces severe primary damage to skin, eyes, and mucous membranes. It is suspected that the presence of formic acid in paint remover could, through destruction of skin tissue, accelerate the absorption of phenol, cresol, and their toxic components.

631-2.4.4.15 Methyl Ethyl Ketone (MEK). This chemical can irritate eyes and mucous membranes. Repeated skin contact with the liquid may cause skin dryness and irritation.

631-2.4.4.16 Methyl Isobutyl Ketone (MIBK). Effects of this chemical are the same as those for methyl ethyl ketone.

631-2.4.4.17 Methyl Normal Butyl Ketone. Effects of this chemical are the same as those for methyl ethyl ketone.

631-2.4.4.18 Paint Thinner (Degreasing Solvent, Mineral Spirits, or Stoddard Solvent). MIL-PRF-680, Type I or ASTM D235 Type I. Paint thinner vapors are mildly irritating to mucous membranes. Repeated or prolonged skin contact with paint thinner will dry and de-fat the skin, resulting in irritation and dermatitis.

631-2.4.4.19 Phenol. This hazardous chemical is highly toxic when ingested, inhaled, or absorbed through the skin. It is readily absorbed through intact skin. Death has been reported to result from absorption of phenol through a skin area as small as 64 square inches. Death from acute exposure to phenol may occur within 30 minutes. The use of any product containing phenol is prohibited.

631-2.4.4.20 Polyamides and Polyamines. Polyamides and polyamines are skin irritants and some are skin sensitizers.

631-2.4.4.21 Super High-Flash Naphtha. This chemical contains up to 98 percent aromatic hydrocarbons. Some of the aromatics in super high-flash naphtha (for example, mesitylene) are highly toxic by inhalation. Inhalation of the concentrated vapors can cause headache, nausea, and coma.

631-2.4.5 PROHIBITED PAINT INGREDIENTS. There are paint ingredients that are strictly prohibited from marine paints used for Navy shipboard application and subsequent removal and disposal. Marine paints containing the ingredients discussed in [paragraphs 631-2.4.5.1 through 631-2.4.5.4.2](#) are never to be used. Alternate paints must be used. These prohibitions result from the ingredients being classified by authoritative agencies as carcinogens and/or as causing significant blood, nervous system and reproductive system disorders.

631-2.4.5.1 Chromates. Formulations containing hexavalent chromium (Chrome VI) should be regarded as materials that have the potential to cause cancer in exposed workers. Chromates may be present in Navy marine coatings as pigments or as trace contaminants. In current Navy marine specification paints, the maximum allowable amount of total chromates (as Chrome VI) is 50 parts per million (ppm) or 0.005 weight percent. The principal exposure to chromates occurs during surface preparation operations when chromate containing dust is generated by abrasive blasting, and the use of hand or power tools. Note that formulations containing hexavalent chromium (Cr VI) are still authorized for aircraft applications. However, use of chromate-bearing aircraft primers on ship structure and equipment is prohibited.

631-2.4.5.1.1 Assume paints being removed contain chromates and present an increased cancer risk unless it can be demonstrated either by laboratory analysis or survey of paint application logs or specifications that the exist-

ing paint does not contain chromates (as chromium) in excess of 50 parts per million (ppm) or 0.005 weight percent total metal in the dry film. Multiple layers of paint must be individually verified as to their chromate content.

631-2.4.5.2 Lead. Lead may be present in paints as a trace element in pigments or as a drying agent. In current Navy marine specification paints lead is restricted to a maximum of 50 parts per million (ppm), or 0.005 weight percent total metal in the dry film.

631-2.4.5.2.1 Paint being removed shall be considered to contain lead unless the procedures of [paragraph 631-2.4.5.1.1](#) are used to demonstrate the level of lead is below 0.005 weight percent in the dry film.

631-2.4.5.3 Cadmium. Cadmium compounds such as cadmium selenide (CdSe) and cadmium sulfide (CdS) have often been used as stabilizing red, yellow and orange paint pigments for paints frequently exposed to sunlight and high temperatures. The presence of cadmium in paints may not be readily evident if the constituent was not explicitly specified in the formula or material safety data sheet. Lung cancer and renal dysfunction (kidney disease) have resulted among workers and animals exposed to cadmium. The permissible exposure limit (PEL) of five micrograms of cadmium per cubic meter of air applies to all cadmium compounds, dust and fumes.

631-2.4.5.3.1 Cadmium exposure may occur during the application or removal of coatings containing cadmium. In addition to its inclusion in paints, cadmium is frequently used for electroplating steel and aluminum parts. Therefore, precautions similar to those for lead and chromium removal should be taken when preparing surfaces of equipment which contain cadmium plated parts (e.g., fasteners, springs, electrical connectors, etc.).

631-2.4.5.4 Crystalline Silica. Crystalline Silica, or Quartz Chemical Abstract Service (CAS) Number 14808-60-7 or Cristobalite CAS Number 14464-46-1 has been used in paints in the past as a low-cost extender pigment. Current requirements limit the amount of crystalline silica in Navy paints to a maximum of one-percent (1.0 %) by weight of paint.

631-2.4.5.4.1 The International Agency for Research on Cancer (IARC) has classified crystalline silica as a Group I Carcinogen, those substances known to be carcinogenic to humans. The National Toxicology Program (NTP) also considers crystalline silica Quartz (CAS Number 14808-60-7) (respirable size) and Cristobalite (CAS Number 14464-46-1) (respirable size) as reasonably anticipated to be human carcinogens.

631-2.4.5.4.2 Exposure to crystalline silica generally occurs when removing paint that contains crystalline silica. Therefore, precautions similar to those imposed for the removal of Lead and Chromate should be taken when removing paint containing crystalline silica. Unless the paint being removed can be shown by laboratory analysis or other specification requirement to have a maximum crystalline silica content of less than 1 percent or by calculations based on crystalline silica content of ingredients, the paint being removed should be considered to be hazardous.

631.2.4.6 MEDICAL EVALUATION AND SURVEILLANCE. Each command is responsible for ensuring that all painters are referred to the medical department for placement in the medical surveillance program in accordance with the requirements of the OPNAVINST 5100.23 or 5100.19 Series as recommended by an industrial hygiene assessment.

631.2.4.6.1 Personnel with signs or symptoms which may be caused by, or aggravated by, exposure to paint in the workplace shall be referred to the medical department for evaluation.

631.2.4.6.2 Showers provided in the shop shall be used by each work shift after spray painting. Also, personnel shall wash hands, arms, and face before eating, drinking, smoking, or using the toilet.

631-2.5 SURFACE PREPARATION/PAINT REMOVAL METHODS AND TOOLS.

631-2.5.1 GENERAL. To prevent injuries and property damage by improper use and handling of paint removal methods and tools, the following safety precautions and requirements shall be observed. Paint removal methods and tools covered here include abrasive blasting, water-jetting (formerly called hydroblasting), electrically operated power tools, pneumatic power tools, and solvent and chemical cleaning. The removal of surface coatings may involve methods which can liberate toxic components of the coating, base material and the removal media. Workers performing such operations shall be protected from exposure to these toxic components per OPNAVINST 5100.23 or 5100.19 Series. Consult previous sections of this chapter for health hazards of paint ingredients where applicable. A workplace assessment, as conducted by an industrial hygienist or by a qualified technician, is necessary to assist in making recommendations regarding the protection of personnel.

631-2.5.1.1 Consider hand and arm or body postures when working with power tools for ergonomic risk factors. This includes forceful exertions, excessive vibration and awkward postures. Attention to the selection and design of tools can minimize ergonomic stresses. Proper training is required for workers exposed to ergonomic risk factors. See OPNAVINST 5100.23 Series. Personnel with arthritis, neuritis, or circulatory disease shall be examined by a Medical Officer to determine if their medical condition might be aggravated if they were to operate vibrating tools such as pneumatic hammers, chisels, grinders or other peening tools.

631-2.5.2 SAFETY PRECAUTIONS AND REQUIREMENTS FOR ABRASIVE BLASTING. The safety precautions and requirements that shall be taken to prevent introduction of abrasive-blasting materials into ship spaces and unprotected equipment, and to prevent injury to personnel and property damage, are described in the following paragraphs. These precautions apply to all abrasive blasting operations on or within the vicinity of naval ships undergoing any type of availability. The Commissioned Submarine and the Commissioned Surface Ship General Reactor Plant Overhaul and Repair Specifications (NAVSEA 0989-LP-037-2000 and 0989-LP-043-0000), respectively, shall be consulted for additional precautions before areas outboard of the reactor compartment or machinery spaces of nuclear powered ships are blasted with abrasives.

631-2.5.2.1 Preoperational Requirements. Abrasive blasting shall not be undertaken until positive steps have been taken to prevent contamination and spread of abrasives and dust to adjacent compartments, machinery, and equipment. Abrasives and dust can enter ships through open sea valves, hatches, ventilation systems, temporary openings, normal entryways frequently opened and closed, and entryways which must remain open to accommodate other work. If there is any possibility that abrasives can enter a ship or ship's compartment in spite of all possible precautions, critical machinery surfaces and parts, and electric and electronic equipment, shall be positively sealed or otherwise protected. Machinery components, such as reduction gears, open boilers, hotwells, and turbines in various stages of disassembly, are especially subject to damage from contamination. When abrasive blasting in-hull is required late in an availability and most adjacent areas are nearly complete, consideration shall be given to locating the source of blasting media in-hull near the site to be blasted, to minimize the length of hose containing high pressure air and grit. This will reduce the chance for a hose leak to cause damage to nearby equipment.

631-2.5.2.2 Prior to blasting operations, the responsible shop shall notify the ship force, and all other ships in the vicinity, of time and location of proposed abrasive blasting operations. All shops and the ship force shall take the following precautions to protect equipment and structures:

- a. Drop cloths and masking shall be used to prevent damage from the abrasive material.
- b. Temporary shields and other sealing or closing-off measures shall be used to prevent abrasives from entering machinery, pipes, seawater inlets, and pump wells through ventilation intakes and other openings.
- c. Where remote service connections provide water or ventilation, such as seawater from the auxiliary seawater system while the ship is in drydock, the inlet to the connection shall be positioned and measures taken to prevent the entry of blasting contaminants.
- d. Additional precautions shall be taken to the extent necessary to protect adjacent ships, buildings, and stores.

631-2.5.2.3 Personnel in or near the blasting area shall be warned of blasting operations. In all circumstances, close cooperation between ship and shipyard personnel is required.

631-2.5.2.4 The entire area to be blasted shall be visually inspected. Heavily rusted or corroded areas, damaged metal, and holes in the structure or piping shall be checked to determine if technical examination is warranted, and for possible repair prior to blasting. Abrasive blasting hoses routed through compartments shall be identified by an appropriately marked sign posted in each compartment, warning against damaging the hoses.

631-2.5.2.5 Post-Operational Requirements. After any blasting or contamination of ship interior, the equipment or components blasted or contaminated by abrasive dust shall be cleaned and tested in accordance with the applicable NSTM chapter prior to being put into service. The entire area shall be visually inspected for pits, scabs, and scars. Suspected wall thickness reductions shall be reported for further technical examination in accordance with NSTM Chapter 100, Hull Structures, and NSTM Chapter 505, Piping Systems.

631-2.5.2.6 Blasting Unit Operational and Maintenance Safety Precautions. Each abrasive-blasting hose and its control line shall be color-coded at both ends to avoid cross-connecting hoses or lines. Hoses shall be equipped with deadman controls, audio-visual signaling devices, and manually operated air supply choke valves. The deadman control shall be the type that requires continuous pressure by the blast operator, and secures the air pressure to the nozzle automatically in the event the nozzle becomes unattended. The high-pressure air supply choke valve shall be kept closed by the machine operator or pot tender at all times except during actual blasting.

631-2.5.2.7 Operational and maintenance procedures and safety precautions shall be developed and posted on each blasting unit and shall include the following requirements.

- a. Hoses and nozzles have been inspected and are in satisfactory operating condition.
- b. Color codes on both ends of each blasting hose match those on the control lines for that hose.
- c. Deadman controls are attached to the hoses prior to positioning aboard ship.
- d. Deadman control, horn, and light operate correctly prior to positioning aboard ship. Check prior to each blasting operation.
- e. Blast equipment operators shall not circumvent the deadman control by tying down the deadman lever.
- f. Choke valve is closed until the blast operator signals readiness to commence blasting.

- g. Blast equipment operators shall not overblast, pit, or scar the surface being blasted. Follow surface preparation requirements in [Section 5](#) of this Chapter.
- h. Noise hazard areas are posted in accordance with OPNAVINST 5100.19 or 5100.23 Series.

631-2.5.2.8 Audio-Visual Operating Signals. The supervisor shall review audio-visual signals, operating procedures, and safety precautions weekly with all personnel directly involved in blasting operations. A signal horn (or buzzer) and a light mounted on the machine shall be used to establish positive communication from each blast operator to the machine operator or pot tender where there is no visual contact. Hand signals may be used when there is visual contact. Audio and visual signals shall be standardized and posted on each blasting unit, including signals for close choke valve, open choke valve, more abrasive, and emergency.

631-2.5.2.9 Protective Equipment. For open or walk-in blasting operations, all operators shall wear a complete blasting ensemble including abrasive blasting respirators (Type CE). Other mandatory clothing includes rubber or leather gauntlet gloves, safety shoes, and coveralls. The blast operator shall wear a fall prevention system when working on staging or other elevated places.

631-2.5.2.10 Personnel other than blast equipment operators, including machine operators, personnel doing chipping, needle-gunning, grinding, scaling, and personnel engaged in work in the vicinity of abrasive blasting operations, shall wear full eye protection and NIOSH approved respirators. Per OPNAVINST 5100.19 or 5100.23 Series, approved ear protectors shall be worn wherever the noise level is greater than 84 dBA. Both earplugs and earmuffs (double protection) shall be worn if the noise level exceeds 104 dBA.

631-2.5.2.11 Staging shall be stable and correctly positioned for the safety, convenience, and comfort of the blast operator.

631-2.5.2.12 Operating Safety Precautions. The nozzle shall never be pointed in the direction or ricochet line of another person, even with the air and abrasive stream shut off. The blast operator shall always keep hands and other parts of the body away from the discharge nozzle, and shall never try to adjust the nozzle while the abrasive stream is flowing.

631-2.5.2.13 Hoses shall be secured, leaving only enough free length to be handled safely by the blast operator. All hoses, fittings, and so forth shall be inspected before blasting begins; worn parts shall be discarded.

631-2.5.2.14 When couplings are located where sudden parting would be hazardous, both coupled hoses shall be secured to a strong support or to each other.

631-2.5.2.15 Abrasive-blasting equipment shall be properly maintained because operation of damaged or poorly maintained equipment at high pressures is dangerous.

631-2.5.2.16 Whenever practical, hoppers and hopper tenders should be located on top of drydock walls rather than in the basin. This improves housekeeping and permits grit flow to be aided by gravity. Minimizing the number of people who must be in the dock basin reduces the risk of injury if a hose or connection should break, causing the hoses to whip.

631-2.5.3 PRECAUTIONS FOR WATERJETTING (HYDROBLASTING). Although not considered to be as hazardous as abrasive blasting, waterjetting uses water at high pressure which can cut through a body, causing

serious injury or death. The precautions and protective personnel equipment described for abrasive blasting, and the special precautions given in the following paragraphs shall apply.

631-2.5.3.1 Visual Operating Signals. Prearranged visual signals shall include: Start, Stop, Increase Pressure, Decrease Pressure (for the pump), Shut Down Engine, and Bleed Pressure.

631-2.5.3.2 Pump Operator. One person shall be stationed at the pump at all times to monitor running condition, control reserve water level, make pressure adjustments, handle emergencies (such as a ruptured hose), perform emergency procedures (stop engine, bleed pressure), and clear hoses at ground or pump location. The pump operator shall maintain visual contact with the gun operator and his assistant, and respond immediately to their signals. Where this is not possible, audio signals shall be used, similar to those specified in see [paragraph 631-2.5.2.8](#). Pump operators exposed to noise levels greater than 84 dBA or above shall wear approved earplugs or ear muffs. If the noise level exceeds 104 dBA, then both earplugs and ear muffs (double protection) shall be worn.

631-2.5.3.3 Gun Operator. Two workers shall be assigned to each gun being operated and shall relieve each other as required. The assistant shall keep hoses clear of all obstructions, assist the operator as required by supporting the hose weight, be alert to potential hazards which may be encountered by the operator, and take corrective action as required. The assistant shall also observe work done by the pump operator, point out missed areas, and provide visual signals to the pump operator as necessary. The gun operator and assistant shall wear wet-weather gear, face shield or goggles, work gloves, shoes with antiskid soles, and, when working from a scaffold or other elevated position, a safety harness.

631-2.5.3.4 Equipment and Operating Precautions. Waterjetting equipment shall be properly maintained because operation of damaged equipment at high pressure is dangerous. Staging shall be stable and correctly positioned so that the worker can hold the gun at a 60-degree angle with the tip approximately 8 to 12 inches from the surface being blasted.

631-2.5.3.5 Medical Alert Card. The waterjetting gun or lance shall never be pointed at other personnel. The water stream is capable of severing an arm or leg. Bacteria and other organisms may be injected under a persons' skin as a result of an accidental high pressure waterjetting contact. Injuries caused by high pressure water coming in contact with human skin can be life-threatening. Every operator shall be given a medical alert card and must present this card to medical personnel prior to treatment. The card shall have the following information on it:

"This person has been water jetting at pressures up to 40,000 psi and/or a water jet velocity up to 2,850 ft/sec. People injured by direct contact with high or ultra-high pressure water typically experience unusual infections with microaerophilic organisms. These may be gram-negative pathogens, such as those found in sewage. Before administering treatment, the attending physician shall immediately contact a local poison control center for appropriate treatment information."

631-2.5.3.6 The straight jet nozzle shall be used only in special cases such as cleaning weld seams or crevices. Caution shall be used, because the water stream will rapidly cut through paint to bare metal.

631-2.5.4 SAFETY PRECAUTIONS FOR ELECTRICALLY OPERATED POWER TOOLS. Portable power tools shall be equipped (by manufacturer or modification) with a safety throttle/lock-off device or a protected

throttle switch to prevent inadvertent startup caused by tools being dropped, bumped, or stepped on. Precautions for power tools are described in the following paragraphs.

631-2.5.4.1 Inspection. Portable power tools shall be kept clean, oiled, and repaired. Tools shall be carefully inspected before use; switches shall operate, cords shall be clean and free from defects, and plugs shall be clean and sound. The switch on a tool shall be in OFF position at the time the tool is plugged into a receptacle. Tools shall be stored in a clean, dry place.

631-2.5.4.2 Grounds. Metal-cased portable tools shall be fitted with three pronged grounding plugs. Portable tools with double-insulated plastic cases are designed to be electrically safe without the use of a three-pronged grounding plug. A two conductor flexible cable and two-pronged plug suitable for use with grounded type receptacles may be used for all such equipment. Double-insulated tools with metal gearing, and housings with two-pronged converter are also acceptable. Great care shall be used when overhauling these double-insulated tools to be sure they are properly wired.

631-2.5.4.3 Fire Hazards. Portable electric tools with brushes can cause sparking, and shall not be used where flammable vapors, gases, liquids, or explosives are present.

631-2.5.4.4 Cord Care. Cords should not be allowed to kink, nor be left where they might be run over. Cords shall not come in contact with sharp edges, hot surfaces, oil, grease, water, or chemicals. Damaged cords shall be replaced, not repaired. Patching cords with tape is prohibited. Tools shall be stored with cords loosely coiled.

631-2.5.4.5 Extension Cords. Only three-wire extension cords with three-pronged grounding plugs and three-slot receptacles shall be used. Personnel using a portable electric device connected to an extension cord shall plug the device into the extension cord before the extension cord is inserted into a live bulkhead receptacle. Likewise, the extension cord shall be unplugged from the bulkhead receptacle before the device is unplugged from the extension cord.

631-2.5.5 SAFETY PRECAUTIONS FOR PNEUMATIC TOOLS. Safety precautions for pneumatic tools are described in the following paragraphs.

631-2.5.5.1 Personnel. Only authorized and trained personnel shall operate pneumatic tools. Operators using pneumatic tools shall wear and use necessary protective devices, including hearing protection.

631-2.5.5.2 Inspection. Pneumatic tools shall be thoroughly inspected at regular intervals. These tools shall be kept in good operating condition, and particular attention should be given to valves, hose connections, guide clips on hammers, and chucks of reamers and drills during the inspection. All pneumatic tools should be labeled as hazardous noise sources.

631-2.5.5.2.1 All other types of explosion-proof fixtures shall have underwriter approval for Class I, Group D atmospheres, in accordance with the National Electrical Code. Fixtures shall not be repaired nor lamps replaced within the danger area. Fixtures shall be completely and properly assembled prior the start of work.

631-2.5.5.3 Disconnection. The tools should be fitted with a quick-disconnect fitting and, when the tool is not in use, it shall be disconnected from its supply hose. For tools without quick-disconnect fittings (threaded to air hose), pressure shall be shut off and bled from the line before a pneumatic tool is disconnected.

631-2.5.5.4 Air Hose. The air hose shall be rated for the pressure required for the tool. Leaking or defective hoses shall be removed from service. Hoses shall be routed to avoid creating a tripping hazard, particularly on ladders, steps, scaffolds, and walkways. Hoses that are run through doorways shall be protected against damage caused by the door edge. An air hose shall never be pointed at any person.

631-2.5.5.5 Compressed Air. Compressed air shall not be used to clean clothing being worn, nor shall it be used to blow off the body. Compressed air shall never be used as a power source for a projectile or to clean the deck or space where the pneumatic tool was used.

631-2.5.5.6 Safety Lock-Off Devices. Information concerning safety lock-off devices for pneumatic tools is contained in the following paragraphs.

631-2.5.5.6.1 Tool Procurement Policy. It is NAVSEA policy to replace existing stocks of portable pneumatic grinders and reciprocating saws with those having a safety lock-off device which provides protection against accidental startup and to prohibit purchase of portable pneumatic grinders and reciprocating saws lacking a safety lock-off device.

631-2.5.5.6.2 Definition. A safety lock-off device is any operating control which requires positive action by the operator before the tool can be turned on. The lock-off device shall automatically positively lock the throttle in the OFF position when the throttle is released. Two consecutive operations by the same hand shall be required, first to disengage the lock-off device and then to turn on the throttle. The lock-off device shall be integral with the tool, shall not adversely affect the safety or operating characteristics of the tool, and shall not be easily removable. Devices such as a deadman control or quick disconnect, which do not automatically and positively lock the throttle in the OFF position when the throttle is released, are not safety lock-off devices.

631-2.5.6 SAFETY PRECAUTIONS FOR SOLVENT AND CHEMICAL CLEANING. These safety precautions apply to chemicals used to clean painted surfaces.

631-2.5.6.1 Solvent Cleaning. Personnel protection, fire prevention, and ventilation requirements for solvent cleaning are the same as those specified for mixing and applying paint.

631-2.5.6.2 Chemical Cleaning. A method for cleaning ferrous metal surfaces of surface ship bilges is given in [Section 5](#). It is approved for use only on surface ships at shipyards and shall not be used on submarines or at locations other than shipyards. This method shall not be used on or near aluminum.

631-2.5.6.3 Chemical Cleaning Materials. Chemical cleaning materials include sodium hydroxide (lye), sodium gluconate, and detergent. Alkaline powders and solutions constitute an extreme personnel hazard if improperly handled. Concentrating or heating solutions is ordinarily prohibited because it compounds the danger. These solutions may permanently damage or burn the eyes, severely burn skin and damage tissue, and cause death or severe injury if swallowed. Mists and dusts may severely irritate the eyes, nose, and throat.

631-2.5.6.4 Caustic Solutions. Caustic solutions shall not be prepared or stored in wide-open steel tanks. The tanks used for storage shall have a small tank opening and shall be closed during storage. Caustic solutions shall be transferred through alkali-resistant pumps and lines.

631-2.5.6.5 Entry into bilges or any other area containing caustic solutions is prohibited. If entry is imperative, the caustic solution shall first be removed.

631-2.5.6.6 Personnel Safety Precautions. Personnel shall be thoroughly instructed regarding the hazards of using chemical cleaning materials. Consult OPNAVINST 5100.19 or 5100.23 Series regarding hazardous materials training programs. Personnel working in areas where chemical solutions are being used, prepared, or transferred shall be dressed in clothing impervious to the chemicals of concern. This includes chemical workers goggles. Safety showers and eyewash fountains shall be provided near the work areas where caustic solutions are prepared, used, or stored. These should be accessible within 10 seconds should their use be required.

631-2.5.7 SAFETY PRECAUTIONS FOR PAINT STRIPPERS AND REMOVERS. The use of chemical paint strippers or removers is no longer authorized by this NSTM. Requests to use chemical paint strippers and removers on specific pieces of equipment shall be referred to the cognizant engineering or maintenance activity for that equipment, and personnel protective guidance for the specific proposed shall be obtained from the command safety office, an NAVENPVNTMEDU, or the medical treatment facility's industrial hygienist. In no case shall paint strippers or removers be used on fiberglass-reinforced plastic laminates (FRP or GRP) or other composite materials, other plastics, electrical insulators, or other materials which may be damaged by the stripper. In no case shall caustic strippers be used on aluminum, magnesium, or zinc or their alloys.

631-2.6 PAINT MIXING.

631-2.6.1 Shore Facilities. The mixing area shall be adequately ventilated to prevent personnel overexposure to solvents and other toxic materials. Contact the local industrial hygienist for detailed guidance. If possible, detached shops or temporary structures shall be provided for paint mixing and for storing paint buckets, brushes, solvents, and rags. Permanent structures created for paint mixing and storage shall be equipped with automatic sprinklers. Signs reading NO SMOKING IN OR AROUND THIS BUILDING shall be posted conspicuously inside and outside of each paint shop or other building in which paint is used, mixed, or stored. Only the quantity of solvent and paint needed for one workday shall be taken into the mixing area.

631-2.6.2 Forces Afloat. Paint shall not be stowed in the mixing area. For stowage requirements, refer to NSTM Chapter 670, Stowage, Handling, and Disposal of Hazardous General Use Consumables. Mixing of paints, varnishes, lacquers, and their solvents shall be confined to the paint mixing room or other designated compartments. Paint products shall not be mixed in a closed compartment without adequate ventilation. Posted barricades or other suitable measures shall be provided to ensure that there is no smoking, open flame, or hot work within mixing compartments or in adjacent passageways.

631-2.6.3 Personnel Protective Precautions For Paint Mixing. These precautions apply to paints in general. Skin contact, eye contact, ingestion, and breathing mists or vapors in excess of the Permissible Exposure Limit (PEL) shall be avoided. A Navy Environmental and Preventive Medicine Unit (NAVENPVNTMEDU) or a local medical treatment facility (MTF) shall be consulted for direction if doubt exists concerning adequacy or acceptability of personnel protective procedures. The precautions necessary to protect personnel health and ensure safety during paint mixing are described in the following paragraphs.

631-2.6.3.1 Persons handling paint materials shall avoid contact of material with skin and eyes, and inhalation of mists or vapors. No food, drink, or smoking materials shall be allowed in the paint area. When painting materials are handled, care shall be exercised to wash hands before eating, drinking, smoking, or using toilets.

631-2.6.3.2 Accidental Ignition. Extreme care shall be taken by persons mixing solvent-based paints to remove from their person all possible sources of ignition, such as matches, cigarette lighters, and steel buckles. Personnel shall wear nonskid, non-sparking, rubber-soled shoes (or canvas boots over their shoes) when working in an enclosed space or where flammable vapors may be present. Plastic clothing shall not be worn except when specifically approved by the safety department.

631-2.7 PAINT APPLICATION.

631-2.7.1 SAFETY PRECAUTIONS FOR PAINT APPLICATION. Safety precautions for paint mixing apply also to paint application. Safety precautions applicable to shipboard paint spray booths are discussed in [paragraph 631-2.7.8](#).

631-2.7.2 Danger Area. For brush or roller painting operation, the local activity shall define and clearly delineate, by signs, those areas where there is a possibility of vapors which may pose a hazard to the painting personnel and operation. For spray application, the danger area shall extend a minimum of 25 feet from the painting operation. Refer to [paragraphs 631-2.7.6 through 631-2.7.7](#).

631-2.7.3 Paint Application. Precautions to be observed when paints are applied by brush, roller, or spray are the same as those for mixing paints. For spraying the potential hazards from flammable or toxic solvents are greater. Additional ventilation in confined spaces is needed to comply with the requirements for flammable material control. Depending upon location of the painting operation and type of paints used, respirators and protective clothing may also be needed to comply with personnel protective requirements.

631-2.7.4 Ignition Sources. Steps shall be taken to ensure the absence of ignition sources within the same area or compartment where paint is being applied. Prohibited activities include open flame or heat-producing work such as welding, cutting, or brazing and the energizing of non-explosion-proof electrical circuits. Areas such as fire, engine, and pump rooms shall be in cold-iron condition before and during paint application. Spark or heat-producing work areas adjacent to where brush/roller application of paint is being performed may be considered outside the danger area provided that:

- a. The painting operation involves only minor (touchup type) applications.
- b. The painting and hot work operations are separated by a watertight bulkhead.
- c. Neither operation is conducted on the adjacent (common) bulkhead.
- d. There are provisions for continuous monitoring of the atmosphere during the painting evolution. This may be accomplished by the use of an automatic gas testing instrument set to alarm when the percentage of explosive vapors at the periphery of the established danger zone exceeds 5 percent of the Lower Explosive Limit (LEL). Deenergizing of non-explosion-proof electrical circuits would be required if the level of explosive vapors/gases approaches 10% of the LEL. The gas free engineer should then investigate and resolve the cause of the increase in explosive vapors during paint application.

631-2.7.5 APPLICATION OF PAINT IN CONFINED SPACES. Provisions for adequate ventilation, gas free testing, and accidental ignition precautions are major factors in controlling the hazards inherent in the application of flammable coatings in enclosed spaces. The many variables in each situation prohibit complete reliance on standardized tables or guidelines. Refer to NSTM Chapter 074, Volume 3, Gas Free Engineering for requirements

and guidance for working in confined spaces. Additional factors and supplemental information for the hazards requiring control when coatings are applied in enclosed spaces, and the precautions to be observed, are described in the following paragraphs.

631-2.7.5.1 Explosion-Proof Lamps and Blowers. Explosion-proof lamps with shatterproof lenses, such as Crouse-Hinds Model RCDE-6 or RCDE-6 or equal, shall be installed. Lights shall be completely and properly assembled and in operable condition prior to installation in the danger area. Bulbs shall not be replaced nor lights repaired within the danger area. Portable lights shall be hung, using spark-proof hooks, and shall never be wrapped around nor draped over supports. Fans, blowers, motors and other such equipment utilized to ventilate atmospheres containing flammable or explosive vapors, fumes, mists or dusts shall be approved, explosion-proof equipment.

631-2.7.5.2 Gas Free Testing. Periodic tests shall be conducted to ensure safe, gas free working conditions. The Gas Free Engineer should conduct the initial test, with monitors conducting the follow-up tests under his supervision. Testing shall begin concurrently with the painting operation and shall continue until all areas involved are tested and certified "safe for entry". Periodic tests shall be made throughout the space being painted, at the exhaust areas, at the air intake areas, and in all other areas, drydocks, adjacent tanks, mixing areas, and storage areas where explosive vapors may collect.

631-2.7.5.3 Ventilation. During paint operations, all tanks and enclosed areas shall be properly ventilated. Always ventilate exhaust carrying flammable vapors to the exterior of the ship in a manner preventing recirculation. Prohibit placement of outlets where exhaust air could contaminate adjacent spaces. The placement of ducts, blowers, and other ventilation aids will vary according to the shape, size, and number of openings in a tank or enclosed space. Frequent testing of a space may be necessary because the amount of ventilation required for a space will vary, even though obvious controlling factors (the number of blowers and painters) remain constant. Field tests have shown that exhaust fans hooked in parallel or series often fall short of their rated or theoretical delivery capacities. The size, type, and amount of duct work are generally the controlling factors for the ventilation system rated capacity.

631-2.7.5.3.1 Field tests have shown that during spray painting of ballast tanks, high vapor concentrations in the tank occur most frequently when the painter is in the upper half of the tank. Venting a tank by blowing air through a bottom opening is not a good practice because of the tendency for vapors from solvents used in flammable coatings to collect in pockets. These pockets can readily form in the space being painted, in adjacent areas open to solvent vapors, and in drydock areas. Small blowers of various types have been used to circulate the air in areas where regular blowers are ineffective. Flooding of dry dock sumps has been used to reduce the amount of mechanical ventilation needed.

631-2.7.5.3.2 Adequate ventilation does not preclude accumulation of explosive concentrations within limited areas adjacent to a spray nozzle. The actual size and shape of these areas will depend upon several factors: air movement rate, air movement direction, and space/tank configuration. Based on test results, this explosive concentration area probably does not extend more than 5 feet from the nozzle. In these tests, samples were taken above the nozzle only; however, the 5-foot distance applies in all directions from the nozzle.

631-2.7.5.3.3 As few painters as practical should be permitted to work in the tank or space at any one time to keep vapor concentrations as low as possible. Personnel shall be informed that solvent vapors collect more readily in humid, foggy, and rainy weather, and of the need for extra precaution.

631-2.7.5.3.4 Ignition Prevention Precautions. In addition to observing good housekeeping practices, the following precautions in the following paragraphs shall be observed to prevent accidental ignition of solvent vapors.

- a. Danger Area. A danger area for each painting operation shall be defined by the local activity and clearly identified and marked by signs. A danger area is that area in which explosive mixtures may collect.
- b. Electrical Grounds. Ships being painted in drydock shall be electrically grounded and painting operations shall be suspended during electrical storms.
- c. Solvent storage tanks and transfer lines shall be grounded. Metal containers such as buckets used to transfer solvents shall make metal-to-metal contact with the equipment when filling and emptying. Metal-to-metal contact shall also be made when pouring solvent from one bucket to another (as in mixing).
- d. Electrical Equipment. Electrical equipment and circuits within the danger area shall be de-energized, with the exception of explosion-proof equipment and associated power cables. Connections for necessary electrical services shall be made outside the danger area. Only electrical leads with intact insulation shall be used within the danger area. Coating QA inspection personnel using battery-powered electronic instruments should review the equipment documentation for any warnings concerning usage in areas with high solvent vapor concentrations.
- e. To prevent sparks, personnel engaged in handling or applying these coats shall wear rubber-soled shoes. They shall not wear plastic protective clothing (see [paragraph 631-2.2.4.9](#)), and shall remove from their persons all sources of ignition (for example, matches, cigarette lighter, and steel buckles).
- f. All material and equipment (for example, blowers, duct work, spray guns, power tools, paint brushes, and buckets) shall be of such material and construction that the possibility of a spark being generated is precluded. If metal staging is used, it shall be installed with wooden or nonferrous plugs or fittings to eliminate the possibility of sparks. A periodic check system shall be established to ensure that explosion-proof light fixtures, spray gun assemblies, and other equipment used during painting operations have no exposed ferrous metal parts which could strike a spark on contact.

631-2.7.6 APPLICATION BY SPRAY. The application of paints, varnishes, lacquers, enamels, and other flammable liquids by the spray process is more hazardous than brush application because of the volume of material which can be applied, and because spraying deposits a flammable residue which is subject to spontaneous ignition, refer to see [paragraph 631-2.7.8.4.8](#). Potentially harmful mists created by paint spraying operations add to health hazard. Precautions for paint spraying include those for mixing and paint application, as well as the requirements described in the following paragraphs.

631-2.7.6.1 Personnel Protective Precautions. Spray painting requires all the precautions of brush painting, with additional measures to protect personnel from airborne paint mist.

631-2.7.6.2 Fire Prevention Precautions. During spray painting, precautions in addition to those for brushing or mixing are necessary to prevent static sparking and excessive flammable solvent concentrations. Danger areas shall extend at least 25 feet from the painting operation and may include an entire dry dock in cases of extensive painting with highly flammable paints. Rope off and post DANGER AREA signs in the vicinity of the painting operation to alert personnel to the hazard. These signs shall designate the danger area and prohibit smoking, hot work, and open flame. All energized electrical circuits in the danger area shall be explosion-proof (Class I, Group D or better) and all equipments requiring grounding shall have a common ground. During spray painting operations, fire extinguishing equipment shall be in the ready condition.

631-2.7.6.3 Protective Clothing and Gear. Spray painters shall wear gloves and protective garments that fit snugly at ankles, neck and wrists. They shall wear approved respirators while spraying, mixing, or handling any materials with the potential to exceed the permissible exposure limits.

631-2.7.6.4 Showers. If paint spraying operations are extensive, showers should be available and operators should shower after every shift.

631-2.7.6.5 Cleaning Spray Guns. Spray guns, paint containers, and hoses shall be thoroughly cleaned after use, but shall never be cleaned in confined areas.

631-2.7.6.6 Epoxy Paints. Personnel spray painting with epoxy paints, in accordance with MIL-DTL-24441, MIL-PRF-23236, and other epoxy paints in other than approved spray booths shall wear coveralls, gloves and NIOSH-approved air line respirators which provide full-face coverage. See OPNAVINST 5100.19 or 5100.23 Series for breathing air specifications. Exposed skin areas shall be covered. Chemical workers goggles shall be worn except when eye protection is provided by full-face respirators or hoods. When these coatings are applied overhead or on surfaces above waist level of the workers, approved hoods which completely protect the head, face, and neck shall be worn. Contact the local industrial hygienist for detailed guidance.

631-2.7.7 AIRLESS AND PLURAL COMPONENT SPRAY, ADDITIONAL SAFETY PRECAUTIONS. Additional precautions are necessary for airless and plural component paint spraying. Personnel shall receive complete instructions in the proper use of airless and plural component spray equipment before being permitted to operate the equipment or to assist the operators. Training shall stress the potential dangers associated with handling of the equipment, as well as the built-in safety features designed to minimize these dangers. The airless and plural component spray methods uses a pump to deliver high-pressure fluid to the small, spray-tip orifice. This high-pressure (up to 4,500 lb/in²) system is potentially hazardous. Amputations, paint injections, and deaths have resulted from careless use of this equipment, particularly when spray tips are removed for cleaning. Before a spray tip is removed or adjusted and when spray operations are shut down for an extended period, it is mandatory that pumps be shut off, and that the gun trigger has been depressed to bleed line pressure.

631-2.7.7.1 Painters using airless or plural component spray shall comply with the following precautions:

- a. Do not use airless spray equipment unless properly trained.
- b. Never allow an untrained person to use the equipment.
- c. Never put hands or fingers in front of the spray gun.
- d. Never point the gun at a person.
- e. Never work on or attempt to repair pressurized equipment. The equipment shall be shut off, the pressure released, and the trigger safety engaged before disassembly. **SHUTTING OFF THE POWER DOES NOT RELEASE THE PRESSURE .**
- f. Always secure connections to prevent leaks.
- g. When cleaning spray equipment, never spray a flammable solvent through the gun tip at high pressure or to cause a spray at high velocity. Static electricity could be generated which would cause a fire or explosion.
- h. Before use, check hoses for leaks, cuts, and wear. Replace any damaged hose. Never plug hose leaks with fingers.
- i. Wear protective gloves and goggles at all times.

- j. Use the trigger lock at all times when not actually spray painting (for example, before wiping the tip). Remove the tip guard only if spraying with it in place is impossible.
- k. Never leave pressurized units unattended.
- l. Always remove the gun from the hose after flushing and when storing.
- m. The airless spray gun is a dangerous device. Keep the trigger safety engaged when not in use.
- n. Obtain immediate medical attention for injuries. Report the nature of injury and the type of fluid or solvent being used.

631-2.7.8 PAINT SPRAY BOOTHS.

631-2.7.8.1 General. A paint spray booth is a ventilated structure which provides an enclosed space for spraying operations. It confines and limits the escape of sprays, vapors, and residues and directs them safely to an exhaust system. Proper operation and maintenance of paint spray booth equipment is essential to avoid the risk of a potentially catastrophic fire.

631-2.7.8.2 Safety Precautions. Two types of paint spray booths are installed aboard naval ships. These are the waterwash type and dry filter type. Both have open frontal access. Paint spray booths and their safety precautions are described in the following paragraphs.

631-2.7.8.2.1 Exhaust System. Each booth has its own independent exhaust system which is equipped with explosion-proof fan motors. For safe operation of these booths, the filtering medium shall be maintained. If paint spray is not filtered out, it will collect in the exhaust fan and ducting, creating a potential fire hazard. Depending upon the type of spray method, the minimum air velocity within the spray booth should be 100 feet per minute. For very large walk-in booths, 50-75 feet per minute is recommended, again depending on spray type. Consult the local industrial hygienist for additional guidance.

631-2.7.8.2.2 Filter System. In the dry filter booth, filter pads shall be replaced when examination indicates filters are paint-loaded. Visible gages or pressure activated devices shall be installed to indicate or insure the required air velocity is maintained. In the waterwash booth, the baffle plates and nozzles shall be examined and stripped of paint as necessary. When the filters or baffles show evidence of paint-loading, further inspection of the exhaust system is required, including the exhaust fan. For both types of paint spray booths, where touchup painting is involved, the filtering mechanisms shall be inspected for accumulation of paint residues every 3 months, more frequently if necessary.

631-2.7.8.2.3 Waterwash Paint Spray Booth. The waterwash paint spray booth is equipped with a waterspray system that is designed to minimize residue entering the exhaust system. The system uses baffle plates and nozzles to maintain a waterspray curtain between the spray paint and the exhaust system. It is important that the baffle plates and nozzles do not become covered or plugged with residue accumulations which will decrease the collection efficiency and create open areas in the waterspray curtain.

631-2.7.8.2.4 The waterwash system also permits the recovery of overspray finishing material in a settling tank. This tank is normally installed with horizontal and vertical screens to collect paint residue and sludge. Chemical additives are used in the water to precipitate the residues so that they may be skimmed off the water surface. Paint residue and sludge shall not be allowed to accumulate. As this material is highly flammable, it shall be promptly collected and stored in a closed metal container for proper disposal.

631-2.7.8.2.5 Dry Filter Paint Spray Booth. A typical dry filter paint spray booth is equipped with disposable dry filters to minimize residues entering the exhaust system. The filter area is approximately 40 inches by 40 inches and has 4 dry filters, each 20 inches by 20 inches. Should the dry filters become paint-loaded, spray paint may be forced back onto the operator and out from the booth.

631-2.7.8.2.6 Dry Filter Paint Booth Air Filter Gage. The dry filter paint spray booth is equipped with a flex tube manometer which serves as an air filter gage. Newly purchased spray booths are supplied with green and red stick-on markers which are arrowhead in shape. Follow the local industrial hygienist's recommendation in the placement of these markers after acceptance testing of the booth.

631-2.7.8.2.7 Unauthorized Spray Booths. Forces afloat are cautioned against using spray booths of a type not corresponding to those described in [paragraphs 631-2.7.8.2.3 through 631-2.7.8.2.6](#).

631-2.7.8.3 Flammable Hazards Associated With Paint Spray Booths. Refer to [paragraph 631-2.3.2](#) for detailed guidance related to paint flashpoints. Refer to [paragraph 631-2.3.2.5](#) for detailed guidance related to paint thinner flashpoints.

631-2.7.8.4 Paint Spray Booth Operation Safety Procedures And Precautions. Safe operation of paint spray booths is described in the following paragraphs.

631-2.7.8.4.1 Physical Layout. No open flame, spark-producing equipment, incandescent lamps, nor electrical receptacles shall be used or installed in the space extending 10 feet horizontally from the open front of the spray booth and vertically from the deck to 3 feet above the top of the booth, unless the equipment is explosion-proof (Class I - Group D). For a graphic layout of the restricted space, refer to the National Electrical Code.

631-2.7.8.4.2 Portable Equipment Restrictions. The use of portable equipment is restricted during spraying operations, which include preparation and mixing of material, spraying, and the prescribed drying or exhaust time.

631-2.7.8.4.3 Electrical Grounds. All metal parts of the spray booth, including exhaust ducts and spray, shall be electrically grounded.

631-2.7.8.4.4 Flammable Liquids. Only a one-day or one-shift supply of flammable liquids may be present in the booth when the booth is in use.

631-2.7.8.4.5 Drying Spaces. Drying spaces shall be adequately ventilated; otherwise they will be regulated as spraying areas.

631-2.7.8.4.6 Exhaust Fan. When paint spraying operations are completed, the exhaust fan should be run for at least an additional 3 minutes more to purge vapors from the booth and ducting.

631-2.7.8.4.7 Fire Extinguisher. An 18-pound portable potassium bicarbonate (PKP) fire extinguisher shall be maintained within 5 feet of the booth opening. PKP fire extinguishers are intended for fighting Class B (flammable liquid) fires.

631-2.7.8.4.8 Lacquer Spraying. Booths used for spraying lacquers shall not be used for spraying other coatings unless thoroughly cleaned. Otherwise, the residue buildup of alternative deposits of lacquer and other paint or stain finishes may be subject to spontaneous heating. Also, booths shall not be used for hot-air drying of coated objects. Such use can increase booth surface temperature, adding to the spontaneous heating hazard.

631-2.7.9 EXPLOSION HAZARD IN SPRAY PAINTING EQUIPMENT CONTAINING ALUMINUM PARTS IN CONTACT WITH HALOGENATED HYDROCARBONS. The National Spray Equipment Manufacturer's Association has reported explosions involving high pressure fluid handling equipment. This investigation indicated that the explosions were caused by a violent reaction between aluminum and halogenated hydrocarbon solvents within the confined, pressure-coating sections of high pressure pumps or heaters. Severe corrosion in other fluid handling equipment has also been attributed to this reaction. Concern centers upon aluminum, zinc, or galvanized fluid handling equipment used for processing or application of paints, coatings, cleaning agents, adhesives, or other fluids containing halogenated hydrocarbons. This type of equipment includes pumps, heaters, filters, valves, spray guns, and pressure tanks. The hazard can be avoided by ensuring that halogenated hydrocarbon solvents are used only in compatible equipment. Suitable materials for compatible equipment include steel and stainless steel. Where doubt exists as to the presence of halogenated hydrocarbon solvents in any formulation, container labels, material safety data sheets, or the manufacturer should be consulted.

631-2.7.9.1 The chemical reaction associated with the hazard appears to involve a chemical process capable of progressing rapidly and producing enormous energy. The hazard involves more than the simple hydrostatic rupture of a pressurized component. The reaction is unpredictable. The reaction may proceed only to the point of causing corrosion, or it may continue and cause an explosion. Prior use of halogenated hydrocarbon solvents in aluminum-bearing equipment without incident does not mean such use is safe.

631-2.7.9.2 Chemical suppliers are adding inhibitors to their halogenated hydrocarbon solvents to prevent the reaction. However, these inhibitors may be rendered ineffective when combined with water or diluted by the addition of a traditional solvent to thin a compliant coating material, therefore, no known inhibitor will be effective under all circumstances.

631-2.7.9.3 If a halogenated hydrocarbon solvent has ever been used in equipment with aluminum or galvanized parts, the following procedure shall be followed:

- a. Empty system, shut down all equipment, relieve pressure.
- b. Disassemble all equipment, including pumps, heaters, spray guns, and pressure tanks and clean all parts with non-halogenated solvent. (Equipment supplier may be consulted for cleaning solvent recommendations.)
- c. Check all parts for corrosion and wear, replace damaged parts as necessary before reassembly.
- d. Flush the entire system with non-halogenated solvent.
- e. Make certain that the equipment is not used with halogenated hydrocarbons in the future.

631-2.8 SPECIFIC COATING SYSTEM CONCERNS.

631-2.8.1 MIL-E-1115 FORMULA 30 AND CERTAIN HEAT-RESISTANT PAINTS IN ENCLOSED SPACES. Requirements and precautions are given in the following paragraphs for use of white enamel (MIL-E-1115, Formula 30), and heat-resistant paint (TT-P-28), in enclosed spaces on surface ships and submarines.

631-2.8.1.1 Specified Uses. On submarines and some surface ships, Formula 30 and/or heat-resistant paints are specified, in various compartments and spaces for surfaces exposed to temperatures above 149° C (300° F) in unmanned spaces and 52° C (125° F) in manned spaces. Air samples taken from an enclosed compartment on a submarine, after application of Formula 30 enamel, showed a high level of carbon monoxide (CO). The general data for all paints tested indicated that CO levels increased with temperature and decreased with time. However, only testing can reveal whether the atmosphere is acceptable.

631-2.8.1.2 Monitoring Protection from Potentially Toxic Vapors. Acrolein and other harmful vapors may be generated by the curing of Formula 30 and TT-P-28 paints when the system temperatures of painted surfaces (engine room, auxiliary machine room, etc.) are elevated during hot evolutions/operations (Hot-Ops).

631-2.8.1.3 Acrolein and other harmful vapor levels in each affected space should be monitored during high temperature evolutions. Monitoring results dictate fresh air ventilation (non-recirculated) and/or respiratory protection requirements. Ensure that the affected personnel are advised of the potential for an acrolein problem and that appropriate personnel are trained and medically qualified in accordance with OPNAVINST 5100.19 or 5100.23 Series for respiratory protection. The appropriate respiratory protection for use by personnel who may enter the affected spaces during periods when acrolein levels may exceed the PEL is shown in [Table 631-2-2](#).

Table 631-2-2 Acrolein Levels And Respirator Requirements

Acrolein Level	Respirator
0.1 - 2.5 ppm	Full face air purifying with organic vapor cartridges or full face air supplied or air fed hood.
Greater than 2.5 ppm	Full face air supplied operated in pressure demand mode or self-contained breathing apparatus.

631-2.8.1.4 White Enamel (MIL-E-1115) (Formula 30). When subject to a temperature of 38° C (100° F) after a 1-day drying period, white enamel emitted CO in excess of the permissible exposure limit value established by the OSHA. However, this level was not exceeded after a 10-day drying period. Although these tests were not conducted at ambient temperatures of 24-27° C (75-80° F), it is expected that the results at ambient temperatures would be similar.

631-2.8.1.5 Heat-Resistant Paint (TT-P-28). At 121° C (250° F) and 204° C (400° F), heat-resistant aluminum paint per TT-P-28 gave excessively high levels of CO, even after a 10-day drying period. Because heat is required to cure TT-P-28 paints, the paints emit CO and other hazardous vapors only after the component reaches its operating temperature.

631-2.8.1.6 Ventilation and Entry Requirements. Compartments or spaces in which surfaces are painted with Formula 30 shall not be closed until ventilated for an adequate period. Periodic checks for CO levels will be made to determine whether the period of ventilation is adequate and compartments are safe for personnel entry. If an entire compartment is painted, ventilating for approximately 10 days may be required to obtain a safe level. If painting is minimal, the ventilation period may be reduced to 1 or 2 days, depending upon emission levels produced. Consult the local industrial hygienist for detailed guidance.

631-2.8.1.7 There are no other tested and approved alternative heat-resistant paints. Therefore, when these types of paints are used, the painted compartment shall be ventilated and CO emission levels tested, before and after surfaces are exposed to high temperatures. Heat-resistant aluminum paint may not give off high levels of CO until

subjected to temperatures of 121° C (250° F) or higher. When systems painted with TT-P-28 are later subjected to such temperature, the CO level shall be checked before compartments are entered.

631-2.8.1.8 Carbon Monoxide (CO) Monitoring. The CO shall be monitored following any painting operations in enclosed spaces to ensure that the air is acceptable. Additional tests, including flammability and oxygen level, shall be performed. A Gas Free Engineer or designated qualified representative shall conduct tests for CO.

631-2.8.1.9 Formula 30 and heat resistant paint shall not be applied in interior spaces unless the requirements for ventilation and determining CO emission levels are carried out. Local painting instructions shall specify ventilation and monitoring requirements.

631-2.8.2 POLYURETHANE COATINGS.

631-2.8.2.1 GENERAL. Once cured, polyurethane coatings generally present no special hazards to health. However, during the mixing, application, and curing of polyurethane coatings, isocyanate vapors can be released. In the workplace, vapors or aerosols containing isocyanates are most commonly produced when polyurethane coatings are sprayed. These compounds may be called isocyanate monomers (i.e., hexamethylene diisocyanate [HDI]), isocyanurates or polyisocyanates. These isocyanate vapors can cause sensitization of workers, irritation of skin, eyes, and respiratory tract. For sensitized personnel, subsequent exposure to very small amounts of isocyanates can cause severe allergic reactions and may produce asthma-type symptoms. If sensitization occurs, it tends to be permanent and generally precludes further exposure of that person to isocyanates. The potential for overexposure is a function of the materials in use, as well as the magnitude, duration, and location of the operation. It is advisable to consult the applicable Material Safety Data Sheet (MSDS), Product Information Sheets, Container Labels, and Safety and Occupational Health professionals for additional specific guidance and precautions needed to perform the operation safely. The DOD Hazardous Material Information Resource System (HMIRS) also serves as an additional source of hazardous materials information which may be of benefit.

631-2.8.2.2 Polyurethane Coating Requirements And Precautions. Special requirements and precautions for polyurethane coatings, which include aircraft coatings, are given in the following paragraphs.

631-2.8.2.2.1 Commander Responsibilities. Commanders of activities where polyurethane paints or other substances containing isocyanates are used shall ensure that the following steps are completed.

- a. Step 1. Ensure that an industrial hygiene survey of the work area or process has been conducted that will evaluate exposure risks. Industrial hygiene assistance may be needed to plan any large-scale operation. If adequately assessed by an industrial hygienist, operations may be safely conducted using the recommended protective equipment and process controls.
- b. Step 2. Ensure that the polyurethane coatings and related substances issued are used only for authorized applications. Materials shall be used in accordance with the precautionary measures recommended as the result of on-site industrial hygiene surveys.
- c. Step 3. Ensure that medical evaluation and surveillance of all personnel exposed to isocyanates are conducted as recommended through industrial hygiene surveys.

631-2.8.2.2.2 Restrictions on Issue and Use. Polyurethane paints and other substances containing unreacted isocyanates shall be restricted to use in the following situations:

- a. Production type mixing and spray painting operations employing standard vibrator, air-supply, or airless type spray guns.
- b. Touchup of small, localized areas, refer to [paragraph 631-2.8.2.2.3.2](#).
- c. Application of polyurethane coatings is considered to be depot level maintenance work and use of more than one (1) quart per individual per 24-hour period is not ships' force activity.

631-2.8.2.2.3 Environmental Control Measures. Polyurethane paints and related substances shall be prepared and used in accordance with the environmental controls specified in the following paragraphs.

631-2.8.2.2.3.1 Production-type operations shall be performed only in specifically designated areas with local exhaust ventilation and such other environmental control measures as may be recommended on the basis of an on-site industrial hygiene survey.

631-2.8.2.2.3.2 Touchup operations shall be performed only in areas with good general ventilation, such as the hangar deck of an aircraft carrier or in a shore hangar with the doors open. Unprotected personnel in adjacent areas shall not be exposed to mist, spray, or vapor. Application shall be restricted to brush, roller, or self-pressurized aerosol spray kits. No individual shall apply more than one quart of polyurethane paint by self-pressurized spray kit in any 24-hour period.

631-2.8.2.2.3.3 Other specifically authorized uses shall include observance of specified environmental controls.

631-2.8.2.3 Personal Protective Equipment. Personnel preparing or applying polyurethane paints or related materials shall be equipped with appropriate personal protective equipment (PPE) as described below. Each worksite should be evaluated in an industrial hygiene survey to determine the actual or potential exposure to physical or chemical hazards based on the process being performed. Evaluate the process for potential skin contact and/or splash hazards. An example of a full set of PPE includes:

- a. Full body coveralls, cloth or disposable such as Tyvek® or equivalent.
- b. Gloves (butyl rubber, nitrile, or Viton®). (Solvent resistant gloves are covered by specification MIL-DTL-32066, Type III.)
- c. Eye or face protection (chemical goggles/face shield if full face respirator is not required as based on air sampling assessments)
- d. Rubber shoes or shoe covers whenever there is a chance of footwear contamination from spillage or splashing.
- e. A supplied air respirator or an organic vapor respirator with fresh cartridges changed daily (or as needed) provided that concentrations are within limitations of the air-purifying respirator (as determined by airborne exposure assessments of isocyanate and other organic vapor components of the paint system). See OPNAVINST 5100.19 or 5100.23 Series.

631-2.8.2.3.1 Other Equipment and Measures. Other equipment and hazard control measures should be as specified by the cognizant BUMED industrial hygienist, based on a specific site survey of actual operations to be performed.

631-2.8.2.3.2 Substitute Protective Equipment. Substitution of other items for those listed in [paragraph 631-2.8.2.3](#) is explicitly prohibited unless such substitution has been specifically approved in writing by the Cognizant BUMED industrial hygienist or by the appropriate safety organization. Military unique gas masks, such as the MARK V or MCU-2/P shall not be used in polyurethane painting operations or in work involving related materials.

631-2.8.2.4 Medical Evaluation And Surveillance. Placement in the medical surveillance program shall be based on industrial hygiene assessments in accordance with the requirements of the OPNAVINST 5100.19 or 5100.23 Series.

631-2.8.2.4.1 Persons occupationally exposed to polyurethane paints or other substances containing un-reacted isocyanates who develop symptoms of cardiorespiratory disease, skin irritation, or eye irritation shall be promptly referred to a physician for evaluation.

631-2.8.3 ORGANOTIN (TBT) ANTI-FOULING MATERIALS. Organotin (tri-butyltin, TBT) antifouling paints are no longer authorized for use on Navy ships. See [Table 631-8-1](#) for non-TBT, non-toxic paints authorized for use on underwater hull areas, particularly aluminum. Consult NAVSEA for any changes to NAVSEA policy and/or updates to [Table 631-8-1](#).

SECTION 3

PAINT EQUIPMENT, GAUGES, AND MATERIALS

631-3.1 INTRODUCTION.

631-3.1.1 The selection of the proper equipment and materials for any painting job requires a general knowledge of the equipment and materials needed to do the job correctly. This section describes the different tools that are available for the application of paints and the tools that are used for testing. Also, this section provides information on the requisition, storage, and testing of paints.

631-3.2 PAINT EQUIPMENT.

631-3.2.1 GENERAL. Tools used for the application of paint shall be of first quality and maintained in perfect working condition at all times. The types of tools and their care and maintenance are described in the following paragraphs.

631-3.2.2 PAINT BRUSHES. Brushes are identified by the type of bristle used; natural, synthetic, or a mixture of each. The types of brushes available through the National Supply System are listed in [Table 631-3-1](#). The various types of bristles, their uses, and their advantages and disadvantages are described in the following paragraphs.

Table 631-3-1 Brushes And Rollers

Identification	Applicator Width (in.)	NSN
Flat paintbrush	1	8020-00-899-7920
Flat paintbrush	3	8020-00-597-4770
Flat paintbrush	4	8020-00-597-4784
Flat paintbrush	5	8020-00-597-4781
Paint applicator	7	8020-00-597-4759
Paint applicator	9	8020-00-689-5379
Paint roller tray	N/A	8020-00-753-4911
Paint roller, replacement	7	8020-00-753-4914
Paint roller, replacement	9	8020-00-753-4915
Roller covers	7	8020-00-682-6489
Roller covers	9	8020-00-682-6491
Roller grid for 5-gallon pails	N/A	8020-00-721-9360

NOTE

Some brushes contain a mixture of hog bristle and horsehair and their quality depends upon the percentage of each type used.

631-3.2.2.1 Chinese Hog Bristles. Chinese hog bristles are the finest of the natural bristles because of their length, durability, and resiliency. Hog bristle has a unique characteristic in that the bristle end forks out (flags) like a tree branch and permits more paint to be carried on the brush. In addition, the hog bristle flagging leaves finer brush marks which flow together readily and result in a smooth finish.

631-3.2.2.2 Horsehair Bristles. Horsehair bristles are used in inexpensive brushes and are an unsatisfactory substitute for hog bristles. The ends of the horsehair bristles do not flag and quickly become limp. They also hold far less paint and do not spread the paint as well. Brush marks left in the applied coating tend to be coarse and do not level as smoothly.

631-3.2.2.3 Other Animal Hair Brushes. Animal hair is used in fine brushes for special purposes. Badger hair, for example, is used for a particularly good varnish brush. Squirrel and sable are ideal for striping, lining, lettering, and freehand art brushes.

631-3.2.2.4 Nylon Brushes. Nylon is the most common synthetic used in paint brushes. By artificially fraying the ends and kinking the fibers, manufacturers have increased the paint load nylon can carry and have reduced the coarseness of nylon brush marks. Nylon is almost always superior to horsehair. Nylon brushes are recommended for use with latex paint because water does not cause any appreciable swelling of nylon bristles. Since nylon is a synthetic polymer material, it may be softened or dissolved in some strong solvents used in non-latex paints or used for clean-up.

631-3.2.3 BRUSH CARE AND MAINTENANCE. Before using, rinse brushes with paint thinner. Brushes that are to be reused the following day need to be marked for white, light colors, or dark colors. Brushes should be suspended by the handle in a closed container, with the bristles immersed in paint thinner or linseed oil to just below the bottom ferrule. The weight of the brush should not rest upon the bristles.

631-3.2.3.1 Brushes that are not to be reused immediately shall be cleaned with thinner or some other solvent (at least three cleanings), and then washed with detergent and water. Brushes shall be stored suspended from racks by the handle or wrapped in paper and stored in a flat position.

631-3.2.4 PAINT ROLLERS. The selection of a paint roller for a job depends upon the type of paint being used and the surface to be coated. Paint rollers and their covers are described in the following paragraphs.

631-3.2.4.1 Roller Description. A paint roller is a cylindrical sleeve or cover which slips onto a rotatable cage. The inside diameter of the cover is 1-1/2 to 2-1/4 inches. In length, covers are 3, 4, 7, and 9 inches. Special rollers are available in lengths from 1-1/2 to 18 inches. The types of rollers that are available through the National Supply System are listed in [Table 631-3-1](#).

631-3.2.4.2 Types of Roller Covers. Proper paint application depends upon the selection of a cover with the desired fabric and fabric thickness (nap length). Selection is based on the type of paint to be used and the smoothness or roughness of the surface to be painted. The fabrics used in roller covers are:

- a. Lambs wool (pelt) is the most solvent-resistant type of material used and is available in nap length up to 1-1/4 inches. Lambs wools is recommended for application on semi-smooth and rough surfaces; it mats badly in water and is not recommended for water-base paints.
- b. Mohair is made primarily of angora hair. It is solvent-resistant and is supplied in 3/16- to 1/4-inch nap lengths. Mohair is recommended for synthetic enamels and for use on smooth surfaces, and can be used with water-base paints.
- c. Dynel is a modified acrylic fiber which has excellent resistance to water. It is best for application of conventional water-base paints and solvent-base paints, except those which contain strong solvents such as ketones. Dynel is available in a range of nap lengths from 1/4- to 1-1/4 inches.

- d. Dacron is a synthetic fiber which is somewhat softer than Dynel. It is best suited for exterior oil or latex paints. Dacron is available in nap lengths ranging from 5/16- to 1/2-inch.
- e. Rayon roller covers are not recommended because of poor results generally obtained. In addition to other disadvantages, rayon mats badly in water.
- f. Napless or rubber rollers are used to apply non-skid coatings.

631-3.2.5 PAINT SPRAY GUN. A conventional paint spray gun is a mechanical means of bringing air and paint together. The mixing of air with the paint atomizes (breaks up) the paint into a spray either before or after it is propelled through the air cap. The spray equipment authorized for each ship is contained in the Revised Master Allowances List.

631-3.2.5.1 General. Each spray gun consists of the gun body assembly and the removable spray head assembly.

631-3.2.5.2 Spray Gun Body Assembly. The principal parts of a conventional spray gun are illustrated in [Figure 631-3-1](#) and described in the following listing:

631-3.2.5.3 Types of Spray Guns. Most types of conventional spray guns that are available to shipyards and ships are assembled with a pressure tank equipped for separate control of paint, and with adjustable atomizing air pressures to obtain a satisfactory spray pattern. Some nozzle combinations will perform better than others. Some assemblies clog at the air cap during continuous spraying of fast-drying paints (for example, vinyls) and may require cleaning too frequently. Clogging may produce too small a spray pattern or may require spraying too close to the surface.

631-3.2.5.3.1 Information regarding recommended air cap and fluid tip combination for specific paints can be found in equipment manufacturer's literature. NAVSEA should be contacted for assistance with any problems that cannot be resolved locally.

631-3.2.6 CONVENTIONAL SPRAY PAINTING EQUIPMENT CARE AND MAINTENANCE. Spray painting equipment must be carefully maintained to achieve optimum performance and life. Spray guns, paint containers, and hoses shall be thoroughly cleaned after use.

The principal parts of a conventional spray gun are illustrated in [Figure 631-3-1](#) and described in the following listing:

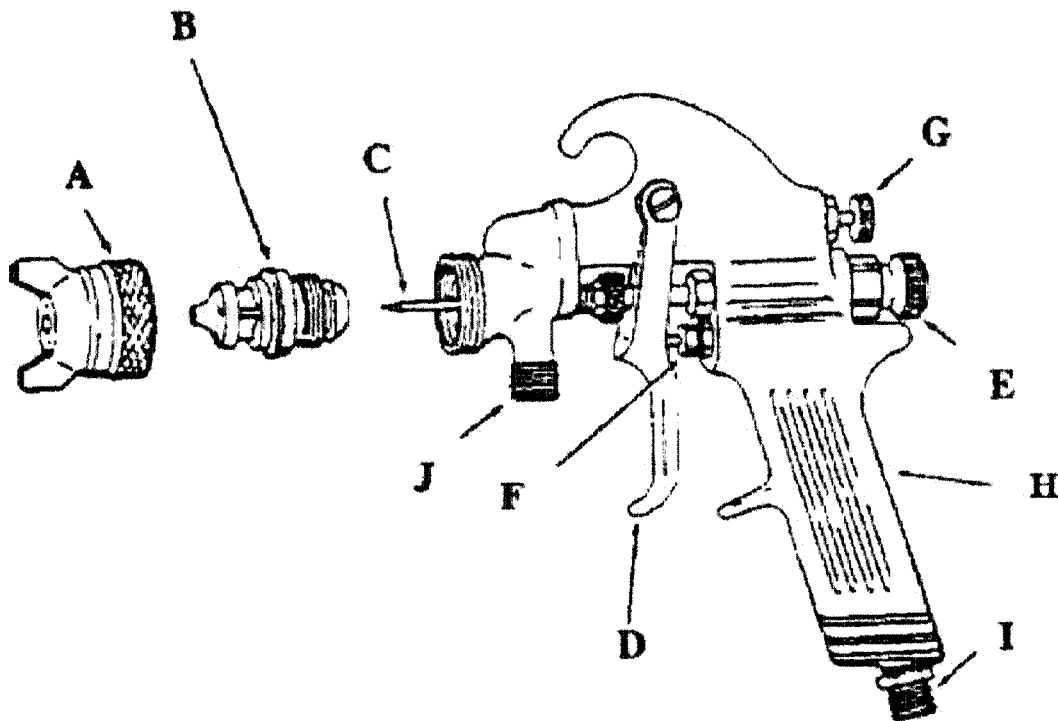


Figure 631-3-1 Conventional Spray Gun

- A. **Air nozzle or cap:** The air nozzle directs the compressed air into the stream of paint. The air atomizes the paint at this point and directs the flow of particles onto the surface.
- B. **Fluid nozzle or tip:** The fluid nozzle regulates the amount of paint released and directs the paint into the stream of compressed air.
- C. **Fluid needle:** The needle starts or shuts off the fluid flow through the fluid nozzle. Select the fluid nozzles and needles in pairs, as they shall be the same size to operate correctly.
- D. **Trigger:** The trigger operates the air valve and the fluid needle.
- E. **Fluid adjustment screw:** The fluid adjustment screw controls the fluid needle to allow more or less paint to get to the fluid tip.
- F. **Air valve:** The air valve controls the rate of airflow through the gun to the nozzle.
- G. **Side port control:** The side port control regulates the supply of air to the air nozzle and it determines the size and shape of the spray pattern.
- H. **Gun body and handle:** The gun body is the part of the equipment the painter holds to operate the spray gun.
- I. **Air inlet:** The air inlet is at the bottom of the handle and is connected to the airhose.
- J. **Fluid inlet:** The fluid inlet is an opening below the fluid needle and is connected to the fluid hose.

CAUTION

Never soak the assembled gun in paint thinner because it has a detrimental effect upon the packing around the fluid valve, as well as on the grease and oil in the trigger action. Do not use caustic alkaline solutions for cleaning spray guns. They destroy aluminum alloys used in gun bodies and parts.

631-3.2.6.1 Spray Gun Cleaning. When using a pressure feed tank, release the pressure from the tank, hold a cloth over the air cap, and pull the trigger. This forces the material back into the tank. Then remove the paint hose from the gun and run solvent through the hose. Dry out the hose with air. Spray some solvent through the gun. Remove air cap and wash off the fluid tip with solvent. Repeat until all paint residuals are removed from the cup and spray gun. Clean air cap and replace on gun. Clean out tank and reassemble for future use. When using a cup gun, remove the cup, then hold a cloth over the openings in the air cap, reduce the pressure to 1-15 lb/in², direct the gun siphon tube toward the paint container and pull the trigger. This forces paint back into the container. Empty cup of paint and replace with small quantity of solvent. Spray solvent in the usual way, remove air cap, and wash off fluid tip with solvent. Repeat until all paint residuals are removed from the cup and spray gun. Clean air cup and replace on gun.

631-3.2.6.2 Air Cap Cleaning. Clean air cap by immersing in solvent. If small holes become clogged, soak in solvent. If reaming is still necessary, use a match stick, broom straw, or any other soft implement. Digging out the holes with a wire or nail may permanently damage the cap.

631-3.2.6.3 Spray Gun Lubrication. Spray guns require occasional lubrication. The fluid needle packing should be removed and softened with oil, and fluid needle shank should be coated with grease or petrolatum. Use a few drops of light oil on all moving parts. Most spray guns are provided with oil holes for these parts.

631-3.2.7 AIRLESS SPRAY PAINTING. Airless spray painting is done with the use of hydraulic pressure. The equipment operates on a different principle than conventional equipment. An air compressor operates a hydraulic pump which causes paint atomization by forcing it through a specially shaped orifice at pressures up to 4,500 lb/in². NEVER attempt to clean an airless fluid hose as you would a conventional air atomized system. The extremely high working pressures will drive paint through the skin into the bloodstream and cause serious bodily injury or even death with some materials.

631-3.2.7.1 Airless spraying usually permits the use of products with a higher viscosity; less thinning is required, better film build is obtained, and production is increased. The need for a single hose leading into the gun makes airless spray equipment lighter to handle and less fatiguing. The reduction of overspray offers two other advantages, cleanup is easier and masking is minimized.

631-3.2.8 AIRLESS SPRAY EQUIPMENT CARE AND MAINTENANCE. All fluid connections should be tightened before starting the hydraulic pump. High-pressure fluid hose shall be checked for possible damage through kinking, bending, or abrasion. Avoid careless handling of the spray gun, especially when the nozzle has been removed. Relieve the fluid pressure before disconnecting the hose to the airless spray gun.

631-3.3 PAINT THICKNESS GAUGES

631-3.3.1 GENERAL. Paint thickness is measured in terms of wet film thickness (WFT) and dry film thickness (DFT). The WFT measurements are useful in monitoring in-process paint applications, and may be required in some applications, described below. DFT measurements are used to determine whether the individual coats of a multi-coat system, and the total applied system meet the DFT requirements specified herein. A variety of WFT and DFT gages are available from industrial paint equipment supply companies. Use of the gages shall be as described in the manufacturer's instructions, as supplemented by the requirements of SSPC-PA 2 for DFT gages used on magnetic (steel) substrates, when SSPC-PA 2 is invoked herein. See [paragraph 631-7.1.4](#) for the required use of WFT and DFT gages.

631-3.3.2 MEASUREMENTS ON NON-MAGNETIC AND NON-METALLIC SUBSTRATES. SSPC-PA 2 is only directly applicable to non-magnetic coatings applied to magnetic substrates. However, commercial gages are available and shall be used for aluminum, stainless steel (CRES), and other non-magnetic metallic substrates. For non-metallic substrates, in-process WFT measurements are used to determine the DFT, as described below. In

addition, when a large non-metallic area such as the underwater hull of a composite or Glass Reinforced Plastic (GRP) ship or craft is being painted, and it contains metallic parts (such as sea chests or other fittings) that are painted at the same time, DFT measurements on the metallic parts may be able to be used to provide an estimation of the DFT on the non-metallic surfaces.

631-3.3.3 ESTIMATING DFT FROM WFT MEASUREMENTS. The DFT that results from applying a wet coat of paint is related to the volume percentage of the paint that is volatile, and the volume percentage that is considered “solids”. (Together, these two percentages add up to 100%.) For example, if a paint that is listed as 50% solids on the data sheet is applied at a WFT of 6 mils, then once the paint has dried and cured, the DFT will be 3 mils. For a 100% solids paint, the DFT will equal the WFT, since there are no volatiles. The equation below shows this relationship. In the equation, the percent solids by volume is expressed as the decimal form, i.e. 60% is 0.60, 100% is 1.00. The percent solids by volume is stated on the paint manufacturer’s NAVSEA-approved ASTM F718 data sheet. If it is not available, contact the paint manufacturer, or NAVSEA to obtain this figure.

$$\text{DFT} = (\text{WFT}) \times (\% \text{ solids by volume})$$

631-3.4 PAINTS AND PAINT MATERIALS

631-3.4.1 GENERAL. Only paints and paint materials that are in accordance with Navy standard formulas and specifications, or approved by NAVSEA, shall be used on board naval ships. The Revised Master Allowance List contains the paint allowances for all naval ships. Paints and paint materials covered by formula designations are listed in [Table 631-3-2](#). Included in this table are National Stock Numbers (NSN) and specifications. Paints and paint materials covered by specifications, but not by formula designations, are listed in [Table 631-3-3](#). **ONLY PAINT THAT COMPLIES WITH ALL LOCAL, STATE AND FEDERAL ENVIRONMENTAL REGULATIONS SHALL BE PROCURED AND APPLIED .**

Table 631-3-2 Materials With Formula Designations

Formula Number	Coating	NSN's and Container Size	Specification
20L	Gray alkyd deck enamel		MIL-DTL-700
25A (Note 3)	Non-Flaming Fire Protective Coating, Water Based		MIL-PRF-24596, Type I, Class 1, Grades A and B
30	White enamel	8010-00-286-7744 (1 gal) 8010-00-286-7745 (5 gal)	MIL-E-1115
38 (Note 1)	Black striping 17038		
39 (Note 1)	Green striping 14062		
40 (Note 1)	Red striping 11105		
41 (Note 1)	Brown striping 10075		
42 (Note 1)	Yellow striping 13538		
43 (Note 1)	Blue striping 15123		
49 (Note 2)	Cherry stain		
50 (Note 2)	Dark mahogany stain		
51 (Note 2)	Dark oak stain		
52 (Note 2)	Light oak stain		
54 (Note 2)	Walnut stain		
84	Zinc molybdate primer	8010-01-285-1329 (1 gal) 8010-01-285-1328 (5 gal)	TT-P-645

Table 631-3-2 Materials With Formula Designations - Continued

Formula Number	Coating	NSN's and Container Size	Specification
111	Light gray enamel	8010-00-285-4858 (1 qt) 8010-00-285-4868 (1 gal) 8010-00-285-4869 (5 gal)	MIL-DTL-15090
124 (Soft white semi-gloss)	Non-Flaming Chlorinated Alkyd Enamel	8010-01-344-5089 (1 gal) 8010-01-344-5100 (5 gal)	MIL-DTL-24607 Color #26307
125 Pastel green semi-gloss)	Non-Flaming Chlorinated Alkyd Enamel	8010-01-344-5090 (1 gal) 8010-01-344-5101 (5 gal)	MIL-DTL-24607
126 (Bulkhead gray semi-gloss)	Non-Flaming Chlorinated Alkyd Enamel	8010-01-344-5091 (1 gal) 8010-01-344-5102 (5 gal)	MIL-DTL-24607 Color #26307
127 (Green-gray semi-gloss)	Non-Flaming Chlorinated Alkyd Enamel	8010-01-290-1949 (1 gal) 8010-01-290-1935 (5 gal)	MIL-DTL-24607 Color #26496
128 (Yellow-gray semigloss)	Non-Flaming Chlorinated Alkyd Enamel	8010-01-290-1936 (1 gal) 8010-01-290-1937 (5 gal)	MIL-DTL-24607 Color #26400
130 (Pearl gray semi-gloss)	Non-Flaming Chlorinated Alkyd Enamel	8010-01-290-1938 (1 gal) 8010-01-290-1939 (5 gal)	MIL-DTL-24607 Color #26493
131 (Pastel blue semi-gloss)	Non-Flaming Chlorinated Alkyd Enamel	8010-00-290-1940 (1 gal) 8010-01-290-1941 (5 gal)	MIL-DTL-24607 Color #25526
150	Green primer	8010-01-487-0723 (1 pt) 8010-01-380-2362 (2 gal kit) 8010-01-380-2389 (10 gal kit)	MIL-DTL-24441/29 Type IV
151	Haze gray	8010-01-487-0724 (1 pt) 8010-01-380-2435 (2 gal kit) 8010-01-380-2388 (10 gal kit)	MIL-DTL-24441/30 Type IV
152	White	8010-01-380-2448 (2 gal kit) 8010-01-380-2343 (10 gal kit)	MIL-DTL-24441/31 Type IV
153	Black, R ₀ 1.8	8010-01-380-2375 (2 gal kit) 8010-01-380-2456 (10 gal kit)	MIL-DTL-24441/32 Type IV
154	Black, R ₀ 3.6	8010-01-380-2359 (2 gal kit) 8010-01-380-2390 (10 gal kit)	MIL-DTL-24441/33 Type IV
155	Black, R ₀ 6.0	8010-01-380-2414 (2 gal kit) 8010-01-380-2441 (10 gal kit)	MIL-DTL-24441/34 Type IV
156	Red	8010-01-380-2345 (2 gal kit) 8010-01-380-2383 (10 gal kit)	MIL-DTL-24441/35 Type IV
157	Gray No. 50	8010-01-380-2408 (2 gal kit) 8010-01-380-2434 (10 gal kit)	MIL-DTL-24441/36 Type IV
158	Yellow	8010-01-380-2407 (2 gal kit)	MIL-DTL-24441/37 Type IV
160	Black	8010-01-380-2337 (2 gal kit)	MIL-DTL-24441/38 Type IV
161	Yellow	8010-01-380-2391 (2 gal kit)	MIL-DTL-24441/39 Type IV
162	Red	8010-01-380-2415 (2 gal kit)	MIL-DTL-24441/40 Type IV
150 Ty III	Green primer	8010-01-347-0916 (2 qt) 8010-01-350-4742 (2 gal) 8010-01-302-3608 (10 gal)	MIL-DTL-24441/20 Type III
151 Ty III	Haze gray	8010-01-350-4741 (2 gal) 8010-01-302-6838 (10 gal)	MIL-DTL-24441/21 Type III
152 Ty III	White	8010-01-350-4743 (2 gal) 8010-01-302-3606 (10 gal)	MIL-DTL-24441/22 Type III
153 Ty III	Black R ₀ 1.8	8010-01-350-4744 (2 gal) 8010-01-302-3604 (10 gal)	MIL-DTL-24441/23 Type III

Table 631-3-2 Materials With Formula Designations - Continued

Formula Number	Coating	NSN's and Container Size	Specification
154 Ty III	Dark gray R _o 3.6	8010-01-350-6256 (2 gal) 8010-01-302-3605 (10 gal)	MIL-DTL-24441/24 Type III
155 Ty III	Dark gray R _o 6.0 topcoat	8010-01-302-7058 (10 gal)	MIL-DTL-24441/25 Type III
156 Ty III	Red topcoat	8010-01-350-4745 (2 gal) 8010-01-302-3607 (10 gal)	MIL-DTL-24441/26 Type III
157 Ty III	Light gray topcoat	8010-01-302-3609 (10 gal)	MIL-DTL-24441/27 Type III
158 Ty III	Yellow (23695)	8010-01-380-3285 (2 gal) 8010-01-365-8841 (10 gal)	MIL-DTL-24441/28 Type III
159 Ty III		Zinc-rich epoxy primer	MIL-DTL-24441/19Type III
184	Black R _o 1.8 epoxy	8010-01-349-4757 (2 gal) 8010-01-212-5493 (5 gal)	MIL-DTL-24631/1
185	Dark gray R _o 3.6 epoxy	8010-01-212-7518 (2 gal) 8010-01-349-4756 (5 gal)	MIL-DTL-24631/2
186	White	8010-01-349-4758 (5 gal)	MIL-DTL-24631/3
187	Black R _o 1.8 Topcoat	8010-01-380-3280 (1.5 qt kit) 8010-01-380-3257 (1.25 gal kit)	MIL-DTL-24631/7
EC 2216	Flexible Epoxy Cavitation Resistant	8010-00-145-0530 (1 qt kit) 8010-00-145-0432 (1 pt kit)	3M Company (Proprietary)
MSTS-3 (Beach sand semi-gloss)	Non-Flaming Chlorinated Alkyd Enamel	8010-01-290-1942 (1 gal)	MIL-DTL-24607 Color #22563
MSTS-8 (Rosewood semi-gloss)	Non-Flaming Chlorinated Alkyd Enamel	8010-01-290-1944 (1 gal) 8010-01-290-1945 (5 gal)	MIL-DTL-24607 Color #22519
MSTS-9 (Clipper blue semi-gloss)	Non-Flaming Chlorinated Alkyd Enamel	8010-01-290-1946 (1 gal) 8010-01-290-1947 (5 gal)	MIL-DTL-24607 Color #24516
MSTS-15 Sunglow semi-gloss)	Non-Flaming Chlorinated Alkyd Enamel	8010-01-290-1948 (1 gal)	MIL-DTL-24607 Color #23697
NOTES to Table 631-3-2. General: Where F-150 series paints are indicated, this refers to coatings covered by specification MIL-DTL-24441. Unless otherwise directed by NAVSEA, MIL-DTL-24441, Type IV paints are to be applied to the same dry film thickness as Type III paints, but in two coats (i.e., If three coats of Type III are applied to 10 mils total dry film thickness, Type IV would be applied in two coats at 10 mils total dry film thickness.) MIL-DTL-24441 Type IV paints shall not be substituted for MIL-DTL-24441 Type III paints in potable water or feedwater tanks. 1. Formulas 38, 39, 40, 41, 42 and 43 have been superseded by high gloss enamels qualified to MIL-PRF-24635 Class 1 in the required Fed Std No. 595 colors. See Table 631-3-3 for their NSN's. 2. Stains previously designated as Formulas 49, 50, 51, 52, and 54 were procured under specification TT-S-711. This specification has been cancelled. Use locally procured, environmentally compliant commercial stains. 3. Water based paints that used to be separately designated as Formula 25A are now covered by MIL-PRF-24596 and QPL-24596. See Table 631-3-3.			

Table 631-3-3 Materials Without Formula Designations

Material	Specification	NSN's
Anti-sweat (anti-condensation) compound	Hempels Anti Condens 617US	8010-01-385-7578 (5 gal)
	Temp-Coat 101 (White)	8030-01-387-1027 (5 gal)
	KEFA Airless 8125	- - -
	Mascoat Delta-T Marine	- - -

Table 631-3-3 Materials Without Formula Designations - Continued

Material	Specification	NSN's
Anchor chain paint	PPG/Ameron PSX 700 or equal	Safety yellow 8010-01-432-2614 (5 gal kit) Red 8010-01-432-2615 (1 gal kit) Blue 8010-01-432-1206 (1 gal kit) Black 8010-01-432-2617 (5 gal kit) White 8010-01-432-2616 (1 gal kit)
Caulking compounds, for metal and wood seams.	A-A-272 Type III Butyl Rubber (Paintable)	8030-00-160-6899 (1 pt can) 8030-00-243-0956 (1 gal can) 8030-01-309-9834 (10 oz. cartridge, gray) 8030-01-309-9833 (10 oz. cartridge, white) 8030-00-577-4740 (10 oz. cartridge, black)
	Type IV 100% Silicone (Not Paintable)	8030-00-180-6339 (10 oz. cartridge, clear)
Canvas Preservative:	TT-P-595	8030-00-281-2347 (1 gal deck gray) 8030-00-281-2346 (5 gal olive drab) 8030-00-290-4382 (1 gal olive drab) 8030-00-550-8017 (1 gal white)
Cleaning compound, solvent emulsion cleaner	MIL-C-22230	6850-00-965-2360 (55 gal)
Cleaning compound, steam	A-A-59133	6850-00-965-2087 (25 lb) 6850-00-256-0157 (125 lb) 6850-00-965-2329 (400 lb)
Coating compound, fire protective, Ocean 634 and Ocean 9788		Ocean 634 Primers: 8010-01-220-5971 (1 gal) 8010-01-322-4356 (1 gal, brick red) 8010-01-334-4251 (1 gal, burnt orange) 8010-01-322-4355 (1 gal, haze gray) 8010-01-334-7475 (1 gal, mushroom) 8010-01-334-4252 (1 gal, pastel green) 8010-01-322-4357 (1 gal, tile red) 8010-01-334-4253 (1 gal, white) Ocean 9788 Topcoats: 8010-01-220-5968 (1 gal) 8010-01-322-6855 (1 gal, gray 36373) 8010-01-322-6870 (1 gal, mushroom) 8010-01-322-6856 (1 gal, soft white, 27880)
Corrosion preventive compounds: Solvent cutback, cold application, thin film	MIL-PRF-16173, Grade 1 (hard film)	8030-00-231-2345 (1 gal) 8030-00-244-1299 (5 gal) 8030-00-244-1300 (55 gal)
Petrolatum, hot application	MIL-PRF-16173, Grade 2 (soft film)	8030-00-244-1297 (1 gal) 8030-00-244-1298 (1 gal) 8030-00-244-1295 (55 gal)
	MIL-PRF-16173, Grade 3 (soft film, water displacing)	8030-00-244-1296 (1 gal) 8030-00-244-1293 (5 gal) 8030-00-244-1294 (55 gal)

Table 631-3-3 Materials Without Formula Designations - Continued

Material	Specification	NSN's
	MIL-PRF-16173, Grade 4 (transparent, nontacky film)	8030-00-062-5866 (1 gal) 8030-00-526-1605 (5 gal) 8030-00-526-1604 (55 gal)
	MIL-PRF-16173, Grade 5 (removable film)	8030-00-137-1671 (5 gal)
	MIL-C-11796, Class 1 (hard film)	8030-00-231-2354 (1 lb) 8030-00-597-3288 (35 lb) 8030-00-231-2352 (400 lb)
Corrosion preventive compounds: Petrolatum, hot application	MIL-PRF-11796, Class 1A (hard film, non-stick)	8030-00-514-1843 (400 lb)
Deck covering compound, non-slip	MIL-PRF-24667	Refer to NSTM Chapter 634.
Detergent, general purpose water soluble	MIL-D-16791, Type I	7930-00-282-9699 (1 gal) 7930-00-985-6911 (5 gal)
Diammonium phosphate	Tech. Grade	6810-00-174-1821 (100 lb)
Enamel, Acrylic, Water-Based Emulsion	MIL-E-24763 Type I (Max. VOC = 340 g/l) FED-STD-595 Color Numbers	
Class 1 High Gloss		
Gray	16187	8010-01-344-6683 (5 gal)
Gray	16307	8010-01-344-6688 (5 gal)
Class 2 Medium Gloss		
Brown	20109	8010-01-344-5107 (5 gal)
Dark Gray	26008	8010-01-344-5108 (5 gal)
Gray	26173	8010-01-344-5109 (5 gal)
Gray	26231	8010-01-344-6689 (5 gal)
Haze Gray	26270	8010-01-344-5110 (5 gal)
Equipment Gray	26307	8010-01-344-5111 (5 gal)
Ocean Gray	26373	8010-01-344-5112 (5 gal)
Light Gray	26492	8010-01-344-5113 (5 gal)
Olive Drab	24084	8010-01-344-6686 (5 gal)
Blue White	27875	8010-01-344-5115 (5 gal)
Yellow	23578	8010-01-344-6682 (5 gal)
Yellow	23594	8010-01-344-6684 (5 gal)
Class 4 Flat Gloss		
Black	37038	8010-01-344-6687 (5 gal)
Gray	36118	8010-01-344-5117 (5 gal)
Gray	36231	8010-01-344-5118 (5 gal)
Haze Gray	36270	8010-01-344-6685 (5 gal)
Green	34097	8010-01-344-5116 (5 gal)
Enamel, Silicone Alkyd Max. VOC 340 g/L (2.8 Lb/gal) Gloss, Standard Pigments	MIL-PRF-24635, Type II, Class 1, Grade A Fed Std 595 color number:	

Table 631-3-3 Materials Without Formula Designations - Continued

Material	Specification	NSN's
Off-white	17886	8010-01-433-8385 1 qt 8010-01-433-8380 1 gal 8010-01-433-8391 5 gal
Gray white	17875	8010-01-360-8067 1 gal 8010-01-344-6699 5 gal
Blue white	17877	8010-01-361-3079 1 gal
Bright white	17925	8010-01-397-3935 1 gal
Purple	17142	8010-01-433-8375 1 qt 8010-01-433-8388 1 gal
Grey	16076	8010-01-375-2174 1 gal 8010-01-374-8955 5 gal
Gray	16307	8010-01-368-7793 1 gal 8010-01-344-6704 5 gal
Gray	16187	8010-01-356-2940 1 gal 8010-01-344-6692 5 gal
Grey	16099	8010-01-874-8954 5 gal 8010-01-360-8068 1 gal
Light gray	16376	8010-01-375-2175 1 gal
Dark gray	16081	8010-01-433-8384 1 qt 8010-01-433-8379 1 gal
Green	14193	8010-01-396-6802 1 gal
Light green	14449	8010-01-433-8370 1 qt 8010-01-433-8369 1 gal
Medium green	14110	8010-01-433-8364 1 qt 8010-01-433-8366 1 gal
Dark green	14062	8010-01-349-9007 5 gal
Blue	15182	8010-01-396-6796 1 qt 8010-01-360-9304 1 gal
Light blue	15200	8010-01-433-8382 1 qt 8010-01-433-8373 1 gal

Table 631-3-3 Materials Without Formula Designations - Continued

Material	Specification	NSN's
Dark blue	15044	8010-01-433-8371 1 qt 8010-01-433-8374 1 gal
Clear blue	15177	8010-01-433-8372 1 qt 8101-01-433-8377 1 gal
Blue striping	15123	8010-01-396-6797 1 qt 8010-01-349-9009 5 gal
Buff	10371	8010-01-396-6804 1 qt 8010-01-360-9307 5 gal
High-light buff	13578	8010-01-433-8363 1 qt 8010-01-433-8368 1 gal
Tan	10324	8010-01-433-8367 1 qt 8010-01-433-8365 1 gal
Brown striping	10075	8010-01-433-7737 1 qt 8010-01-433-8376 1 gal
Brown	10059	8010-01-365-8833 1 gal
Yellow	13538	8010-01-396-6805 1 gal 8010-01-349-9005 5 gal
Yellow	13695	8010-01-365-7738 1 gal
Yellow	23655	8010-01-396-6800 1 gal
Red	11105	8010-01-396-6803 1 qt 8010-01-396-6798 1 gal 8010-01-349-9006 5 gal
Red	21105	8010-01-396-6801 1 gal
Red, Coast Guard	12199	8010-01-360-9305 1 gal
Orange	12246	8010-01-433-8361 1 qt 8010-01-433-8381 1 gal
International orange	12197	8010-01-360-9306 1 gal
Black	17038	8010-01-350-5239 1 gal 8010-01-344-6695 5 gal
Gold	17043	8010-01-468-3267 1 qt 8010-01-467-8995 1 gal

Table 631-3-3 Materials Without Formula Designations - Continued

Material	Specification	NSN's
Enamel, Silicone Alkyd Max. VOC 340 g/L (2.8 Lb/gal) Semi-Gloss, Standard Pigments	MIL-PRF-24635, Type II, Class 2, Grade A Fed Std 595 color number:	
Off White	27886	8010-01-344-6690 5 gal 8010-01-382-1810 1 gal
White	27875	8010-01-344-5322 5 gal 8010-01-344-5321 1 gal
Light Grey	26373	8010-01-344-5318 1 gal
Light Grey	26492	8010-01-344-5319 1 gal
Dark Grey	26008	8010-01-344-5314 1 gal
Grey	26231	8010-01-356-2941 1 gal 8010-01-344-5309 5 gal
Grey	26492	8010-01-356-9906 5 gal
Grey	26187	8010-01-374-8952 5 gal 8010-01-374-8953 1 gal
Ocean Grey	26173	8010-01-344-5316 1 gal
Haze gray	26270	8010-01-344-5311 1 gal 8010-01-344-5309 5 gal
Equipment Grey	26307	8010-01-344-5311 1 gal 8010-01-353-9055 5 gal
Dark Grey	26008	8010-01-350-4727 5 gal
Black	27038	8010-01-344-5320 1 gal 8010-01-344-6701 5 gal
Brown	20109	8010-01-334-6700 5 gal
Brown	20059	8010-01-365-8832 1 gal
Brown	20117	8010-01-344-6693 5 gal 8010-01-382-1896 1 gal
Brown	20109	8010-01-344-5312 1 gal
Yellow	23695	8010-01-365-8834 1 gal

Table 631-3-3 Materials Without Formula Designations - Continued

Material	Specification	NSN's
Yellow	23594	8010-01-344-6694 5 gal 8010-01-356-2939 1 gal
Yellow	23695	8010-01-344-6697 5 gal
Yellow	23578	8010-01-356-3685 1 gal 8010-01-344-6691 5 gal
Blue	25440	8010-01-374-4343 5 gal
Blue	25530	8010-01-374-4342 5 gal
Olive Drab	24084	8010-01-344-6698 5 gal
Enamel, Silicone Alkyd Max. VOC 340 g/L (2.8 Lb/gal) Semi-Gloss, Low Solar Absorbent (LSA) Pigments	MIL-PRF-24635, Type II, Class 2, Grade B Fed Std 595 color number:	
Grey	26173	8010-01-441-6145 1 gal
Haze Gray	26270	8010-01-441-6146 1 gal 8010-01-441-6147 5 gal
Light Grey	26373	8010-01-356-9905 5 gal 8010-01-441-6144 1 gal
Enamel, Silicone Alkyd Max. VOC 340 g/L (2.8 Lb/gal) Semi-Gloss, Low Solar Absorbent (LSA) and Anti-Stain Pigments	MIL-PRF-24635, Type II, Class 2, Grade C Fed Std 595 color number:	
Grey	26173	8010-01-441-6148 1 gal
Grey	26373	8010-01-441-6149 1 gal
Haze Gray	26270	8010-01-441-6150 1 gal 8010-01-441-6151 5 gal
Enamel, Silicone Alkyd Max. VOC 340 g/L (2.8 Lb/gal) Low Gloss, Standard Pigments	MIL-PRF-24635, Type II, Class 3, Grade A Fed Std 595 color number:	
Grey	36231	8010-01-356-9908 5 gal 8010-01-344-5310 1 gal
Grey	36118	8010-01-356-9907 5 gal 8010-01-344-5315 1 gal

Table 631-3-3 Materials Without Formula Designations - Continued

Material	Specification	NSN's
Haze Grey	36270	8010-01-382-1864 1 gal 8010-01-344-6696 5 gal
Blue White	37875	8010-01-349-8493 5 gal
Black	37038	8010-01-344-6703 5 gal 8010-01-356-2938 1 gal
Red	31350	8010-01-396-6799 1 gal
Dark Green	34097	8010-01-356-3811 5 gal 8010-01-344-5313 1 gal
Linseed oil (raw)	ASTM D234	8010-00-221-0611 (1 gal) 8010-00-656-1639 (5 gal)
Non-flaming Coatings, Non-Intumecent, Surface Ships Use	MIL-PRF-24596, Type I, Class 1 Fed Std 595 color numbers	
Rosewood	22519	8010-01-208-5832 (1 gal) 8010-01-208-1774 (5 gal)
Beach Sand	22563	8010-01-206-4712 (1 gal) 8010-01-208-7772 (5 gal)
Yellow	23697	8010-01-209-1153 (1 gal) 8010-01-208-7774 (5 gal)
Green	24585	8010-01-208-1779 (1 gal) 8010-01-208-1780 (5 gal)
Blue	25526	8010-01-208-7776 (1 gal) 8010-01-209-1155 (5 gal)
Blue	25530	8010-01-374-4345 (5 gal)
Equipment Gray	26307	8010-01-208-1781 (1 gal) 8010-01-208-7778 (5 gal)
Yellow-Gray	26400	8010-01-208-1777 (1 gal) 8010-01-208-7775 (5 gal)
Light Gray	26493	8010-01-208-1782 (1 gal) 8010-01-209-3195 (5 gal)
Green-Gray	26494	8010-01-209-1154 (1 gal) 8010-01-208-1776 (5 gal)

Table 631-3-3 Materials Without Formula Designations - Continued

Material	Specification	NSN's
White	27880	8010-01-208-1778 (1 gal) 8010-01-208-7777 (5 gal)
Galvanizing Repair Paint	MIL-P-21035	8010-01-501-5798 (16 oz) 8010-01-360-3369 (1 gal)
Oakum, marine	T-O-56, Class 1	5330-00-191-5679 (50 ft/lb)
Paint, heat resistant	TT-P-28 (NOTE 1)	8010-00-664-7468 (1 qt) 8010-00-815-2692 (1 gal) 8010-00-857-1938 (5 gal)
VOC 340 g/L		8010-01-344-5121 (1 gal) 8010-01-344-5122 (5 gal)
VOC 420 g/L		8010-01-344-5119 (1 gal) 8010-01-344-5120 (5 gal)
Powder coatings:		
Interior Use: Immersion and Wet Spaces	MIL-PRF-23236, Type VIII	- - -
Interior/Exterior Use: Immersion and Wet Spaces, Zinc-Rich	MIL-PRF-23236, Type VIIIa	- - -
Exterior Use	MIL-PRF-24712, Types I, II, III, and IV; Classes 1, 2, and 3	- - -
Interior Use, Dry Space/Cosmetic	MIL-PRF-24712, Types I, II, III, and IV; Class 4	- - -
Heat Resistant, Aluminum Pigmented (Up to 700F/372C)	TT-P-28, Type II	- - -
Repair kit, glass reinforced plastic laminate	MIL-R-19907	2090-00-372-6064
Sealant 3M Scotch-weld 2216 B/A gray		8040-00-145-0019 (1 pint kit) 8040-00-145-0530 (1 quart kit)
Sealing compound, wood bedding	MIL-S-19653	
	Type 1 (use without fabric)	8030-00-579-8890 (1 gal) 8030-00-579-8891 (5 gal)
	Type 2 (use with fabric)	.
Sodium hydroxide	ASTM D456	6810-00-270-8177 (500 grams) 6810-00-174-6581 (100 lb)
Solvents:		
Ethyl alcohol (denatured)	A-A-59342	6810-00-264-6614 (1 gal) 6810-00-810-1044 (5 gal)
Ethylene glycol monoethyl ether (EGME)	A-A-59106	6810-00-285-4309 (1 gal) 6810-00-222-2751 (5 gal)

Table 631-3-3 Materials Without Formula Designations - Continued

Material	Specification	NSN's
Mineral Spirits (Stoddard Solvent)	MIL-PRF-680, Type I or ASTM D235 Type I	6850-01-474-2302 (1 gal) 6850-01-474-2309 (5 gal) 6850-01-474-2313 (55 gal)
Synthetic Enamel thinner	A-A-3007	8010-01-441-5938 (1 quart) 8010-01-441-5940 (1 gal) 8010-01-441-5941 (5 gal)
Vapor Barrier Coating, Interior, Cold Piping	MIL-C-19565 (white)	8030-00-174-2588 (1 gal) 8030-00-174-2589 (5 gal)
Varnish, Spar	Master Painters Institute (MPI) Reference Coating #28	
Wood preservative, oil soluble: Copper naphthanate	MIL-W-18142 Type A	8030-00-281-2724 (55 gal)
NOTES to Table 631-3-3: 1. NCP Coating Company (formerly NILES Chemical Coatings Company) product N6974 is qualified to TT-P-28G and has the unique property of drying to touch at ambient temperature in one-half hour or less if applied at the wet film thickness of 2.0 mils (resultant DFT is 1.0 mil). The NCP coating product is preferred for use for all surface ship applications.		

631-3.4.2 PAINT REQUISITION. Paint requisitions shall be submitted only for paints presented in this Technical Manual. The formula or specification numbers, types, grades, and classes, etc., or the NSN(s) of the paints to be ordered shall be stated on the requisition.

631-3.4.2.1 Ships Hazardous Material List (SHML). Prior to Ship's Force ordering paint for shipboard use or storage, consult the ship's SHML to determine whether the paint is permitted to be used on the ship. Many paints are not intended for use by Ship's Force, or for shipboard storage, due to:

- a. Requirements for industrial-level environmental, health, or safety protection equipment or procedures; or
- b. Requirements for specialized industrial-level surface preparation or paint application equipment; or
- c. Requirements for increased levels of environmental condition controls (temperature and humidity controls, containment structures, etc.) and in-process quality assurance.

Contact NSWCCD-SSES Code 631 for questions concerning the SHML.

631-3.4.3 RECEIPT INSPECTION FOR COATINGS. Receipt inspection of contractor furnished coatings for non-critical areas (areas other than those defined in [paragraph 631-11.2](#)) shall be based on supplier performance history and one of the following: certificate of compliance or vendor material test certification data. Receipt inspection tests and their criteria may be found as the conformance tests in the applicable specification for the paint or coating. Receipt inspection requirements for coatings used in critical coated areas are described in [Section 11](#).

631-3.4.3.1 Receipt Of Unsatisfactory Paint. Ships or shipyards receiving a standard paint that is unsatisfactory in quality or quantity should immediately determine the defects and their extent. If possible, the cause of the defects should be determined and the findings reported to NAVSEA. In the case of quality defects, an original

unopened container of the material should be submitted for laboratory examination with the report of findings. For identification, the invoice number under which the paint was received should be stated in the correspondence. The manufacture date of each kind of ready-mixed paint is stamped on the paint container and shall be referred to in reporting unsatisfactory paint.

631-3.4.4 RECEIPT OF SPECIAL PAINT. Ships receiving special paint (paints other than those presented in this section) should, if practical, compare it with a standard paint intended for the same purpose and submit a complete report to NAVSEA covering the results obtained. Refer to [Section 6](#) for reporting requirements.

631-3.4.5 PAINT STORAGE. Paints on board Navy ships shall be stored in a storeroom designated for flammable liquids (paint locker). The paint storeroom on all Navy vessels, public and private shipyards, or any other preservation facility shall be clean, cool, and dry, and shall prevent the paint from being exposed to freezing temperatures or direct sunlight. The ambient temperature of the paint storage facility shall be maintained between 65 and 85 degrees Fahrenheit. Any special storage requirements on the NAVSEA-approved ASTM F718 paint data sheet, or, for those paints that do not require NAVSEA-approved F718 data sheets, the manufacturer's data sheet, shall also be met. Paint whose shelf life has expired shall be segregated from paint whose shelf life has not expired.

631-3.4.5.1 Paint Can Marking and Rotation of Stock. Paints shall be stored in tightly sealed cans and marked with the name, formula number, and manufacture date. When new stock is obtained, it should be stored so that the oldest paint will be used first.

631-3.4.5.2 Paint Inspections. The contents of any paint container more than 2 years old shall be inspected. If uncertain as to whether the paint is suitable for use, particularly where large quantities are involved, send representative samples to a Navy laboratory as designated by NAVSEA.

631-3.4.6 PAINT SHELF LIFE CODES. Paint, varnish, and lacquer supplies are generally classed for shelf life under the codes listed in NAVSUPPUB 4105, Navy Shelf Life Items. The shelf life codes are defined in the following paragraphs.

631-3.4.6.1 Code 4: Initial Shelf Life. Code 4 means 12 months initial shelf life from manufacture date.

631-3.4.6.2 Code T4: Shelf Life Extension. Code T4 means to test the paint and, if it is found acceptable, to extend the shelf life for an additional 12 months. The code T should be interpreted as usability testing, which can be carried out at the storage site, rather than specification testing, which requires instrumentation found only in a chemical laboratory.

631-3.4.6.3 Code L: Laboratory Analysis. Code L means to perform laboratory analysis of paint products (to meet original specification requirements) only when questionable properties are observed during usability testing.

631-3.4.6.4 Code RD: Additional Shelf Life Extension. Code RD means to replace any deteriorated paint container and repackage the paint product. Perform laboratory analysis to see if the paint meets original specification requirements and, if found acceptable, return the paint to stock as RFI (ready for issue).

631-3.4.6.5 Code X: Termination of Shelf Life Extension. Code X means that the item is no longer usable and is surveyed; this shelf life code is rarely encountered with paint products.

631-3.4.7 PAINT USABILITY TESTING. As the explanations of the shelf life codes indicate, paint and powder coating products require frequent extensions of shelf life, using simple on-site methods of usability testing such as drying time, color, gloss, leveling, and uniformity of film and resorting to laboratory analysis only in instances where questionable paint properties are encountered.

631-3.4.7.1 Test Procedure. The procedure used for testing the paint and powder coating for shelf life extension is as follows:

1. Open one container from each separate batch number. For liquid paint, stir the paint product. The stirred paint product should result in a uniform mixture free of abnormal clumping, jelling, skinning, or other objectionable properties, and comply with procurement documents as described in FED-STD-793, Appendix S - FSC 8010. Acceptable quality level and length of time for shelf extension shall be in accordance with FED-STD-793, Appendix S. For powder coatings, the powder coating shall be free of solvent, water, and free flowing.
2. For liquid paints, apply a coating of the test paint on a small panel. It should dry in accordance with the material purchase document (see FED-STD-793) to give a uniform film. Two component paints should be mixed in the appropriate proportions and similarly tested. For powder coatings, apply a coating of the powder coating to a small panel and check for compliance to military specification MIL-C-24712, MIL-PRF-23236, or TT-P-28 as applicable to the specific coating. Consult NAVSEA for the extent of allowable deviation from the purchase document.
3. Documentation of shelf life extension of paint products at an industrial activity shall be retained by the Supply Department and by the Laboratory Division of the Quality Assurance Office.

631-3.4.8 COATING SELECTION. Since previous editions of NSTM Chapter 631, health, safety and environmental considerations have resulted in reformulation of many paints. Also, some paint specifications have been cancelled and replaced with safe and environmentally compliant materials. [Table 631-3-4](#) identifies new coatings that are specified in this manual and the materials they are replacing. In some cases the replacement coating is a reformulation of the previous material and in other cases specifications have been cancelled and replaced with alternate compliant materials. The new materials are lead and chromate free (lead and chromate <0.005% in the dry film) and comply with Federal, state and local regulations restricting the emission of volatile organic compounds (VOC) to the atmosphere.

631-3.4.9 GUIDANCE ON COATING SPECIFICATION DESIGNATIONS. Most Navy vessel coating specifications are either Military or Department of Defense (DOD) specifications, and begin with “MIL” or “DOD”, respectively. MIL-PRF-23236 is an example. Federal coatings specifications are used for some applications, and these begin with a two-letter designation, such as TT-P-645, or single letters such as T-O-56. Coating specifications are periodically revised to reflect new materials, processes, and the impact of environmental regulation changes. Previously, military paint specifications had a format such as “MIL-P-24441”. To comply with government acquisition reform initiatives and changing policy, many MIL specifications have been converted to either detail specifications (MIL-DTL-24441 for example) or to performance specifications (MIL-PRF-24635 for example). A detail paint specification provides specific formulas for how paint manufacturers are to make the paint, whereas performance specifications give the paint manufacturers more leeway in formulating the paints, but provides very specific performance tests and criteria that the paint must meet. In places where stringent control of chemical composition is required, such as in spaces associated with nuclear propulsion equipment, detail specifications are required.

631-3.4.9.1 Qualified Products Database. The Defense Standardization Program Office (DPSO) is in the process of converting from paper Qualified Products Lists (QPLs) to an online qualified products database. All indi-

viduals involved in planning or ordering materials are highly encouraged to apply for a free account to ASSIST Online (assist.daps.dla.mil). The Qualified Products Database (QPD), implemented on April 3, 2006, will eventually supersede all QPLs and Qualified Manufacturers List (QML) documents. While in the transition phase, either a QPL or QML, or a corresponding Qualification Data Set (QDS), will be available for each specification requiring qualification. Once a QDS is published, the Adobe Acrobat Portable Document Format (PDF) file for the former QPL or QML will be replaced in ASSIST by a transformation notice describing how to access the qualification information in the QPD. Future changes to the qualification information for that specification will be maintained directly in the QPD by the cognizant Qualifying Activity. Besides providing ASSIST account holders with improved search capabilities when trying to locate a part or a source, the QPD will ensure users always have access to current information.

Table 631-3-4 Lead And Chromate Free/VOC Compliant Materials

OLD MATERIAL	NEW MATERIAL	NOTES
TT-P-28	TT-P-28 (Low VOC)	Available through GSA
TT-E-489	MIL-PRF-24635 Class 1	Use Gloss Colors
TT-E-490	MIL-PRF-24635 Class 2	Use Semi-gloss Colors
TT-P-645A	TT-P-645 Rev. B or later	Note use of "B" revision
DOD-E-698	MIL-PRF-24635	Use old spec. in 08 areas
DOD-E-699	MIL-PRF-24635	Use old spec. in 08 areas
DOD-E-700 (Formula 20L)	MIL-DTL-700	
DOD-E-1115	MIL-E-1115D	Use only in 08 areas
DOD-E-1265	MIL-PRF-24635	
TT-P-1757	TT-P-645 Rev. B or later	Can also use MIL-DTL-24441
MIL-E-15090	MIL-DTL-15090	
MIL-E-15129	MIL-PRF-24635	
DOD-P-15146	MIL-PRF-24635	
MIL-P-15183	MIL-E-24535	
DOD-P-15328	TT-P-645 Rev. B or later	Can also use MIL-DTL-24441
MIL-P-15929	MIL-DTL-24441	
MIL-P-15931	MIL-PRF-24647	
MIL-E-15935	MIL-PRF-24635	
MIL-E-15936	MIL-PRF-24635	
MIL-C-16173		Use MIL-PRF-16173
MIL-E-16188	MIL-PRF-24635	
MIL-P-16738	MIL-PRF-24635	
MIL-P-17545	TT-P-645 Rev. B or later	Can also use MIL-DTL-24441
MIL-E-17970	MIL-DTL-24607	Can also use MIL-PRF-24596 except in SEA 08 areas.
MIL-E-17971	MIL-DTL-24607	Can also use MIL-PRF-24596 except in SEA 08 areas.
MIL-E-17972	MIL-DTL-24607	Can also use MIL-PRF-24596 except in SEA 08 areas.
MIL-E-17973	MIL-DTL-24607	Can also use MIL-PRF-24596 except in SEA 08 areas.
MIL-E-17974	MIL-DTL-24607	Can also use MIL-PRF-24596 except in SEA 08 areas.
DOD-E-18210	MIL-PRF-24635	
DOD-E-18214	MIL-PRF-24635	
MIL-P-19451	MIL-PRF-24647	
MIL-P-19452	MIL-PRF-24647	

Table 631-3-4 Lead And Chromate Free/VOC Compliant Materials -

Continued

OLD MATERIAL	NEW MATERIAL	NOTES
MIL-P-19453	MIL-DTL-24441	
MIL-E-20090	MIL-PRF-24635	
MIL-P-22298	MIL-DTL-24631	
MIL-P-22299	MIL-DTL-24631	
MIL-P-23316	TT-P-645 Rev. B or later	
MIL-P-23377	MIL-DTL-24441	Use MIL-DTL-24441, Formula 150
MIL-E-24292	MIL-DTL-24441	
MIL-E-24306	MIL-DTL-24441	
MIL-E-24307	MIL-DTL-24441	
DOD-P-24588	MIL-PRF-24647	
DOD-P-24655	MIL-PRF-24647	

631-3.4.10 NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANTS (NESHAP). The Federal Environmental Protection Agency (EPA) has issued a federal regulation entitled “National Emissions Standards for Hazardous Air Pollutants (NESHAP) for Shipbuilding and Ship Repair Operations”, effective November 15, 1996. This particular NESHAP limits the amounts of hazardous air pollutants (HAPS) in marine coatings. The NESHAP allowable limits for HAPS are equal to the Volatile Organic Compound (VOC) of the coating (paint). Fleet and shore activity compliance to the NESHAP may be attained by utilizing the low VOC, low lead, low chromate, and low HAPS paints listed in [Table 631-3-4](#) and maintaining records of batch-specific VOC certifications, as required by 40 CFR 63, Appendix A, Subpart II data sheet. The NESHAP also requires improved worker practices to reduce the release of paint vapors into the air: (1) personnel applying marine coatings are required to reduce paint solvent emissions by maintaining tight-fitting covers on paint containers when the paint is not being used, (2) solvent-soaked cleaning rags shall be kept in bags or containers that are normally closed when not in use, 3) the handling transfer and storage of coatings or solvents shall be accomplished in such a manner so as to minimize spills, and (4) cleaning of equipment shall be conducted in a manner to minimize vapor release and to capture cleaning solvents in normally closed containers. In addition to improved work practices, the NESHAP will also require general record keeping and reporting of coating usage compiled each calendar month.

631-3.4.10.1 NESHAP VOC Limits for Marine Coatings. [Table 631-3-5](#) gives the limits for volatile organic hazardous air pollutants (VOHAP) in marine coatings according to their category of use. These limits are taken from Environmental Protection Agency (EPA) regulations published in the U.S. Code of Federal Regulations, 40CFR, Part 63, Subpart II. VOC levels in coatings are expressed as either grams per liter (g/l) or pounds per gallon (lb/gal), but the units used to determine compliance with the legal regulations are the metric units g/l. To convert from g/l to lbs/gal, multiply by 1/120, or 0.00833. The VOC content of a coating can usually be found on both its data sheet and on the label of the can. [Table 631-3-6](#) lists the commonly used Navy paint specifications, their maximum VOC contents, and their matching usage categories from [Table 631-3-5](#).

Table 631-3-5 Volatile Organic HAP (VOHAP) Limits For Marine Coatings

Coating Category		Maximum VOC grams/liter
G:	General use	340
S1:	Air flask	340

Table 631-3-5 Volatile Organic HAP (VOHAP) Limits For Marine Coatings -

Continued

Coating Category		Maximum VOC grams/liter
S2:	Antenna	530
S3:	Antifoulant	400
S4:	Heat resistant	420
S5:	High-gloss	420
S6:	High-temperature	500
S7:	Inorganic zinc high-build	340
S8:	Military exterior	340
S9:	Mist	610
S10:	Navigational aids	550
S11:	Nonskid	340
S12:	Nuclear	420
S13:	Organic zinc	360
S14:	Pretreatment wash primer	780
S15:	Repair and maintenance of thermoplastics	550
S16:	Rubber camouflage	340
S17:	Sealant for thermal spray aluminum	610
S18:	Special marking	490
S19:	Specialty interior	340
S20:	Tack coat	610
S21:	Undersea weapons systems	340
S22:	Weld-through preconstruction primer	650

Table 631-3-6 Maximum VOC Contents And NESHAP Use Categories Of Navy Coatings

Specification	Max. VOC (grams/liter)	NESHAP Use Categories
MIL-DTL-24441 Types III and IV	340	G, S9, S12, S17, S20
MIL-PRF-23236 Types IV, V	340	G, S9, S20
MIL-PRF-23236 Type VI	250	G, S9, S20
MIL-PRF-23236 Type VII	150	G, S9, S20
MIL-PRF-23236 Type VIII, VIIIa	75gm/kg (Powder Coatings)	G, S5, S8, S19
MIL-PRF-23236 Inorganic binder shop primers used with Types IV, V, VI, VII	650	S22
MIL-PRF-24635 Type II	340	S5, S8, S18
MIL-PRF-24635 Type III	250	S5, S8, S18
MIL-PRF-24667	340	S8, S11
TT-P-645	340	G
MIL-PRF-24647 Grade A	400	S3
MIL-PRF-24647 Grade B	340	S3
MIL-PRF-24647 Grade C	275	S3
MIL-PRF-24647 Grade D	0	S3
MIL-DTL-15090	340	S12, S19

Table 631-3-6 Maximum VOC Contents And NESHAP Use Categories Of
Navy Coatings - Continued

Specification	Max. VOC (grams/liter)	NESHAP Use Categories
MIL-E-1115	340	S12, S19
MIL-DTL-24607	340	S19
TT-P-28, Type I	250	S4, S6, S17
MIL-DTL-24631	340	S8, S16
MIL-E-24763	340	S5, S8, S18
MIL-PRF-24596 Grade A	120	S19
MIL-PRF-24596 Grade B	275	S19
MIL-PRF-24596 Grade C	340	S19
MIL-PRF-24596 Grade D	420	S19
MIL-PRF-24596 Grade E	275	S19
MIL-C-19565	340	G, S19
MIL-PRF-24712	340	G, S1, S8, S15, S19
Anti-Sweat (Ant-condensation) Paints	340	G
Anchor Chain Paint (PPG/Ameron PSX 700)	340	G

SECTION 4**RECONDITIONING OF FLOODED AND SMOKE-CONTAMINATED EQUIPMENT****631-4.1 GENERAL**

Shipboard electronic, electrical, and mechanical equipment may become flooded with fresh water, seawater, fuel, lubricating oil, or a combination of these contaminants; or may be contaminated by smoke during fire or other casualty. The equipment, cleaning materials, and procedures used for reconditioning contaminated equipment to operational condition that was formerly contained in this section has been moved to NSTM Chapter 079, Volume III "Damage Control Engineering Casualty Control."

SECTION 5

SURFACE PREPARATION

631-5.1 GENERAL.

631-5.1.1 Paint will perform effectively only if applied to a surface that has been properly prepared. The initial cost of adequate surface preparation is justified because the intended coating service life can only be achieved if the paint is applied over a properly prepared surface.

631-5.2 SURFACE PREPARATION.

631-5.2.1 GENERAL. The materials and surface preparation requirements in this section have been reviewed for compliance with environmental and occupational safety and health compliance to the applicable rules and regulations in effect on the date of the latest change notice for the paints and coatings listed in Reference A. Fleet and shore activities procuring and using materials or surface preparation methods other than those listed herein have the responsibility of verifying that such materials and surface preparation complies with all such rules, regulations and laws. Selection of surface preparation methods shall be based on:

- a. Nature of substrate.
- b. Existing condition of surface to be painted.
- c. Type of exposure.
- d. Past history of the surface to be preserved.
- e. Whenever liquid penetrant testing is scheduled or foreseen.

NOTE

In accordance with NAVSEA T9074-AS-GIB-010/271, peening, shot, abrasive, grit, and vapor blasting shall not be performed on surfaces before liquid penetrant testing. This requirement shall not be waived unless specific prior approval has been obtained from Naval Sea Systems Command (NAVSEA).

- f. Practical limitations such as time, location, space, and equipment availability.
- g. Economic considerations.
- h. Type of paint to be applied.
- i. Safety factors.

631-5.2.2 PREPARATORY REQUIREMENTS FOR CRITICAL COATED AREAS. Critical coated areas are defined in [paragraph 631-11.2](#). The following preparatory surface preparation requirements apply to critical coated areas.

631-5.2.2.1 Surface Finishing of Welds. Prior to surface preparation for painting, all welds (new or pre-existing) shall have been prepared for painting to NACE weld preparation designation “D” in accordance with Appendix C of NACE International Standard Recommended Practice RP0178, “Fabrication Details, Surface Finish Requirements, and Proper Design Considerations for Tanks and Vessels to be Lined for Immersion Service”.

This finish condition allows minor imperfections to exist, but all weld spatter and slag shall be removed and weld metal protrusions, projections, and spikes shall be ground even with the weld profile. Note that this does not require butt welds to be ground flush with the plate surface. This weld dressing shall be performed by personnel qualified to perform this work prior to the surface preparation steps otherwise done for painting. Refer to NAVSEA S9074-AQ-GIB-010/248, Requirements for Welding and Brazing Procedure and Performance Qualification. In general, blasters and painters should not perform this weld finishing. For new weldments made as a part of repairs or alterations, this weld dressing shall be performed at an appropriate time in the sequence of work to allow for any required non-destructive examination (NDE) and repairs of the new welds. For additional weld surface finish criteria and process controls, including allowable weld undercutting, refer to NSTM Chapter 074 Volume 1, and to MIL-STD-1689 for surface ships and NAVSEA Technical Publication T9074-AD-GIB-010/1688 for submarines. In the event of a conflict between these requirements, refer to NAVSEA for resolution.

631-5.2.2.1.1 A molded plastic visual comparator of the weld surface conditions described in Appendix C of NACE RP0178 is available from NACE International. This comparator may be used by coating inspectors to assess compliance with the above requirement. In the event of disagreements between parties, the written descriptions of the weld finishing in RP0178 shall take precedence over the graphics and the plastic visual comparator.

631-5.2.2.2 Preparation of Edges. All edges shall be broken, ground, or chamfered. See also [paragraph 631-8.18.6.3](#) for requirements for tanks.

631-5.2.2.3 Freshwater Washing. For all types of substrate materials, before surface preparation to the specified cleanliness level using any method other than waterjetting or wet abrasive blasting, the area to be cleaned shall be washed with low pressure freshwater to remove any residual soluble salts. The freshwater washing pressure shall be maintained between 2,000 and 3,000 PSI and shall not contain corrosion inhibitors. Freshwater washdown shall be followed by an adequate period of time to allow the surface to dry prior to blasting. For best efficiency in removing surface salts, the freshwater used for washing should have a maximum conductivity of 200 micro siemens/cm.

631-5.2.3 PAINTED SURFACES. Preparation of painted surfaces includes the removal of surface contaminants, corrosion, old paint, moisture, blending (touch-up paint), and roughening the surface (old paint in good condition). After surface preparation and prior to painting previously painted surfaces, critical coated areas shall meet the requirements of [paragraph 631-5.14](#).

WARNING

Most surface preparation methods generate noise levels in excess of 85 dB. Precautionary measures specified in NAVMEDCOM 6260.5, Occupational Noise Control and Hearing Conservation shall be taken in these circumstances. Personnel working on surface preparation shall wear approved hearing protective devices and shall be given periodic audiometric examinations. All noise hazard areas shall be posted with appropriate warning signs.

631-5.2.3.1 Removing Surface Contaminants. Surface contaminants shall be removed to ensure coating adhesion and minimize the possibility of defects such as blistering, peeling, flaking, and under-film rusting. Surfaces to be painted for preservation shall be completely free of mill scale, corrosion, loose paint, dirt, oil, grease, salt

deposits, and moisture. To prevent embedding contaminants during surface preparation, oil or grease shall be removed before using hand tool, power tool, or abrasive blasting surface preparation using solvent cleaning as described in SSPC-SP 1. Rusted surfaces shall be freshwater rinsed, where practicable, to remove water soluble contaminants before abrasive blasting or additional surface preparation by other means. For non-critical coated surfaces, weld spatter and flux compounds should be removed by grinding or chipping in order to prevent premature paint failure on the welds.

631-5.2.3.1.1 The freshwater washing requirements to remove residual salts, in [paragraph 631-5.2.2.3](#), shall also apply to all exterior topside (i.e. weather-exposed) surfaces.

631-5.2.3.2 Removing Old Paints. When less than full re-preservation is being performed (see [paragraph 631-1.3](#)), removal of old paint shall go beyond the visibly defective areas until an area of completely intact and adhering paint film is reached, with no rust or blisters underneath. The edges of tightly adherent old paint remaining around the area shall be tapered (feathered) to allow proper blending and prevent laying new paint over loose or cracked paint. Power tool cleaning per SSPC-SP 11 shall be used to establish a profile on bare metal areas.

631-5.2.3.3 Preparing Old Paint in Good Condition. Old paint in good condition provides an excellent base for repainting. When a surface is to be repainted and the old paint is not to be removed, the surface shall be roughened with an abrasive and cleaned and dried before new paint is applied. Refer to [paragraph 631-8.4](#) for special surface preparation requirements when over-coating existing ablative copper anti-fouling (AF) hull coatings.

631-5.2.4 METALLIC SURFACES. Blast-cleaning is the most effective and the preferred method of preparing metallic surfaces for painting. If abrasive blasting is not specified or permitted, mechanical means shall be used. If the surface to be painted is subject to flash rusting, blast-clean only the area that can be coated with paint immediately, before flash rusting can occur. The surface temperature of the substrate shall be 5° F (2° C) or more above the dew point to eliminate the possibility of damp surfaces being blasted or coated.

631-5.2.4.1 Steel Surfaces. When blasting to bare steel is specified or required or whenever new steel is used, surfaces shall be cleaned to meet the requirements of SSPC-SP 10, Near White Blast Cleaning, Steel Structures Painting Council (SSPC). Unless otherwise specified herein, the average surface profile of abrasive blasted surfaces shall be between 2-4 mils. (See [paragraph 631-5.14](#).) Prepared surfaces which do not meet the specified surface preparation standard shall be re-blasted to meet the surface preparation standard as originally specified.

631-5.2.4.1.1 Blasting with large particle size abrasives may produce a profile (anchor pattern) that is too deep for the coating system being applied.

631-5.2.4.1.2 Once blasting is completed, the entire surface shall be blown down with clean, oil-free and dry compressed air or vacuumed to remove all traces of blasting dust and debris prior to painting. Where only spot blasting or mechanical cleaning is required for touch-up, all deteriorated coating should be removed to sound, intact coating or to bare steel if required. Bare steel surfaces should be suitably roughened for the coating system being applied. Excessive use of power wire brushing or disk sanders is to be avoided because a polished surface will result, which will not be suitable for paint adhesion. Any broken edges of sound, adhering paint shall be tapered (feathered) by sanding.

631-5.2.4.1.3 Abrasive blast facility shall comply with all local, state and federal regulations regarding the proper storage, use, collection and disposal of all abrasive materials. Compliance with the requirements of the Clean Air

Act and Clean Water Act and their amendments are the responsibility of the operator of the abrasive blast facility. Water from wet abrasive blasting debris or operations shall meet Clean Water Act requirements before being discharged to surface waters or publicly owned treatment plants.

631-5.2.4.2 Galvanized Steel Surfaces. Galvanized surfaces shall be roughened with a light abrasive sweeping or by mechanical means.

631-5.2.4.3 Aluminum Surfaces. Aluminum surfaces shall be cleaned free of corrosion products, dirt, and other contaminants by light abrasive blasting. Use of 80-grit aluminum oxide or garnet abrasive at 65 lb/in² pressure has resulted in satisfactory aluminum surface preparation with minimum metal removal. Coal slag media shall not be used on aluminum surfaces. Spot cleaning after blasting can be done by power brushing or orbital sanding followed by needle gun or rotopeen for establishing a profile. For cleaning aluminum, only stainless steel wire brushes, stainless steel pads, or abrasive sanding discs (CID A-A-1016) shall be used.

NOTE

The abrasive sanding discs used on aluminum shall not have been used previously on other metals or to remove copper pigmented paints (e.g. anti-fouling paints).

631-5.2.4.3.1 If the abrasive blasted and cleaned aluminum surface becomes contaminated with oil or grease, the surface shall be washed with an aqueous solution of liquid detergent cleaner (MIL-C-85570, Type II), rinsed with freshwater and allowed to dry completely before paint is applied. The aluminum surface shall be inspected for dirt and foreign matter. If dirt or foreign matter is observed, the surface shall be blown down with clean, dry, oil-free compressed air or rinsed until the contaminants are removed. Persistent contamination shall be removed by brush blasting comparable to SSPC-SP 7. The surface shall dry completely before paint is applied. A check for soluble salt contamination shall be accomplished in accordance with [paragraph 631-5.14](#).

631-5.2.5 WOOD SURFACES. Before wood surfaces are prepared for painting, ensure that all required structural repairs have been completed in accordance with NSTM Chapter 100, Hull Structures, and Chapter 583, Boats and Small Craft. Wooden deck surfaces shall be prepared in accordance with NSTM Chapter 634, Deck Coverings. All dents, holes, and cracks shall be filled with butyl rubber putty per A-A-272, Type III. Surfaces should be sanded or planed smooth. Use of double planking cement, in accordance with MIL-S-19653, is required on frame ends and stern head and between all faying surfaces where watertight integrity is mandatory. Aluminum paint shall not be used where watertight integrity is required.

631-5.2.5.1 Wood Preservation. After the wood has been shaped, bored, and cut, it shall be soaked, except where varnish is specified, for 10 minutes in wood preservative (MIL-W-18142, Type A or B). For wood requiring varnish, only those surfaces adjacent to moldings, coamings, and in locations subject to dampness and decay need be treated. Lumber, where varnish is specified, shall be treated only with Type B preservative to which no coloring ingredients have been added. If fairing, boring, or trimming is necessary after preservative treatment, the reworked surfaces shall be submerged for 15 minutes in, or liberally brushed with, the preservative used originally. Re-treatment of the outer hull is required after sanding only adjacent to guards. Treated lumber shall dry a minimum of 72 hours before it is painted, caulked, or glued.

631-5.2.5.2 Seams Caulking. All seams shall be fair and continuous before caulking, and shall be watertight when caulked. Seams in hull planking shall be caulked with treated cotton and oakum. The caulking compound shall be worked well into the fibrous caulking material. Allowance shall be made for shrinking and swelling.

631-5.2.5.3 Surface Preparation. Hand-tool or power-tool cleaning, solvent cleaning, milling of surface, application of paint and varnish removers, or a combination of these techniques may be used to prepare a wood surface for repainting. Light brush-off abrasive blasting using non-metallic or agricultural abrasives may also be used for preparing wood surfaces. When preparing wood underwater hull surfaces for repainting, either brush off abrasive blasting, or high pressure water washing shall be used to remove all marine growth and loose or deteriorated coatings.

631-5.2.6 GRP, FIBERGLASS, AND COMPOSITE SURFACES. Glass reinforced plastic (GRP), fiberglass, and other non-metallic composite material surfaces requiring painting shall be lightly roughened. All extraneous matter shall be removed by washing with detergent, rinsing, wiping with a solvent, or by other suitable means. Glazed surfaces shall be sanded to promote adhesion. Specific requirements for the surface preparation of GRP submarine bow domes are given in [paragraph 631-8.15.2](#).

631-5.3 SURFACE CLEANING METHODS.

631-5.3.1 GENERAL. The goal of surface cleaning is to provide a roughened surface that is free of contamination, gouges, or sharp projections. Roughening is necessary to attain the necessary anchor pattern for good paint adhesion. Surface cleaning methods vary with the type of surface preparation needed, location, and size of the area being cleaned. These different cleaning methods are described in the following paragraphs. Where SSPC surface cleanliness standards are required in this Technical Manual, note that all of these standards require performing solvent cleaning per SSPC-SP 1 (see [paragraph 631-5.7](#)) to remove all visible oil, grease, and dirt prior to the specified surface preparation. This step is required to prevent embedding contaminants that will degrade paint performance in the surface. Any residual oil, grease, or dirt on a surface will not only degrade paint performance, but will also contaminate tools and cause additional problems with future work.

631-5.3.2 HAND CLEANING. Hand cleaning will remove only loose or loosely adherent surface contaminants, including rust, loose mill scale, and loosely adhering paint. Hand cleaning is not to be considered an appropriate procedure for removing tight mill scale or all traces of rust; it is primarily recommended for spot cleaning in areas where corrosion is not a serious factor. Surface preparation accomplished by hand cleaning shall meet the requirements of SSPC-SP-2, Hand Tool Cleaning.

CAUTION

Removal of contaminants by hand cleaning shall be done carefully to avoid deep tool marks or gouges on the surface.

631-5.3.2.1 Before hand cleaning, the surface shall be free of oil, grease, dirt, chemicals, and water soluble contaminants, all of which may be removed with solvent cleaners and fresh-water rinsing. Impact tools, such as chipping hammers, chisels, and scalers shall be used to remove rust scale and any heavy buildup of old coatings. Use vacuum or other removal methods to clean the area of dust and debris. Start painting as soon as possible after cleaning.

631-5.3.2.2 In those situations where areas are not accessible to power tools, hand cleaning methods may have to be used. Since hand cleaning will remove only the loosest contamination, careful application of primers is required, preferably by brushing, to thoroughly wet the surface. To achieve satisfactory results, all applied coats shall be capable of overcoming the interference of contaminants left behind after hand cleaning.

631-5.3.3 POWER TOOL CLEANING TO BARE METAL. When power tool cleaning to bare metal is specified herein, the surface cleanliness shall meet the requirements of SSPC-SP 11, Power Tool Cleaning to Bare Metal. Metallic surfaces that are prepared according to SSPC-SP 11, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, mill scale, rust, paint, oxide, corrosion products, and other foreign matter. Slight residues of rust and paint may be left in the lower portion of pits if the original surface is pitted. Although the SSPC-SP 11 standard requires a minimum of a one (1) mil profile, unless otherwise specified herein, the minimum required profile when SSPC-SP 11 is specified for critical coated areas defined in paragraph 631-11.2 is 2 mils. (See [paragraph 631-5.14.](#))

631-5.3.3.1 Solvent Cleaning. Solvent Cleaning. Before power-tool cleaning, the surface shall be free of visible oil, grease, dirt, chemicals, and water-soluble contaminants, using the solvent cleaning methods in SSPC-SP 1. If oil residue is detected after power-tool cleaning, solvent cleaning per SSPC-SP 1 shall be repeated. In addition, all dust and debris that resulted from power-tool cleaning shall be removed.

631-5.3.3.1.1 Requirements for Types of Power Tools. As described in SSPC-SP 11, the types of power tools that can be used in preparing a surface for painting include those that are suited for surface cleaning to remove rust and old paint, but that may destroy an existing profile, and those that are suitable for producing a suitable, uniform profile. Power driven abrasive wheels and disks, grinders, sanding pads, and wire brushes are suitable for initial surface cleaning, but not for producing the required profile. Power wire brushes and sanders tend to produce a polished metal surface, which is unacceptable for coating. If a polished surface is produced, it shall be profiled using appropriate power tools. Needle guns and rotary impact flap assemblies have been found to be able to produce the required profile, and shall be used as the final cleaning method when SSPC-SP 11 is specified. Refer to SSPC-SP 11 for more information. Power impact tools shall not be used on wood, plastic, fiberglass, GRP, or other types of composite materials, as they will cause structural damage.

631-5.3.3.2 Master Allowance List. The Master Allowance List, Part II, Group S92-1 contains the basic allowance of power preservation tools for all ships. Changes in shipboard allowance may be implemented by direction of the Type Commanders. The power tools common to most ships are listed in [Table 631-5-1.](#)

Table 631-5-1 Shipboard Cleaning Power Tools

Tool	NSN or Commercial Source	Shipboard Use
ERS portable rotary scaling and chipping tool w/cutter bundles, 115 VAC or VDC	5130-00-288-6577	Remove rust, paint, scale
ERS cutter bundles (replacement)	5130-00-287-5199	
Tennant Model K dc deck scaling machine, 220 VAC, 440 VAC, 550 VAC	4940-00-595-9735 G.H. Tennant Company Minneapolis, MN	Scaling, wire brushing, or sanding deck (large areas)
Tennant Model C dc deck scaling machine (portable), 230 VDC, 220 VAC, 440 VAC	G.H. Tennant Company Minneapolis, MN	Scaling, wire-brushing, or sanding deck (large areas)
ES portable disk sander w/three disks, universal motor 115V	5130-00-203-4857 (7 inch) 5130-00-203-4856 (9-1/8 inch)	Adaptable, used w/wirecup or wheel wire brush

Table 631-5-1 Shipboard Cleaning Power Tools - Continued

Tool	NSN or Commercial Source	Shipboard Use
EG portable aerial grinder w/abrasive wheel, universal motor 115V	5130-00-224-6504 (5 inch) 5130-00-540-0120 (6 inch)	Adaptable, used w/cup or wheel wire brush
PWG pneumatic vertical grinder w/o wheels or brushes	5130-00-184-0090 (6 inch)	Adaptable, used w/cup wheels and cup-type wire brushes
PG pneumatic horizontal aerial grinder w/o wheels or brushes	5130-00-242-0581 (6 inch) 5130-00-190-6434 (8 inch)	Adaptable, used w/radial-type or cup-type wire brushes
EHS portable scaling hammer w/o accessories, universal motor 115V	5130-00-294-9509	Remove rust and paint (0.495-inch shank diameter)
PHS portable pneumatic scaling hammer	5130-00-190-6442	Remove rust and paint
PSC pneumatic hammer w/three chisels, CLECO SC-3 scaler	Open purchase from: Cleco Pneumatic, P.O. Box 40430, Houston, TX 77040	Remove rust and paint
Scaler , Needle Type, Pneumatic Powered (Needle Gun)	- - -	Remove rust and paint

631-5.3.4 VISUAL AIDS FOR HAND AND POWER TOOL CLEANING. Photographic or visual standards showing the degrees of hand and power tool cleaning for steel surfaces may be used by coatings inspectors to assess the degree of cleanliness of a blasted surface. They are available in the following publication. In any dispute, the written SSPC standards shall take precedence.

- a. SSPC-VIS 3, Guide and Reference Photographs for Steel Surfaces Prepared by Power and Hand Tool Cleaning.

631-5.3.5 USE OF HIGHER CLEANLINESS STANDARDS AND METHODS. When power-tool cleaning per SSPC-SP 11 is specified, the shipyard or contractor may substitute dry or wet abrasive blasting, or abrasive sponge media blasting to a minimum of an SSPC-SP 6 cleanliness (see [paragraph 631-5.4](#)), or waterjetting to an SSPC-SP 12 WJ-2L cleanliness (see [paragraph 631-5.5](#)). The required 2-mil minimum surface profile shall still be achieved.

631-5.3.6 RUST CONVERTERS.

631-5.3.6.1 GENERAL. Rust converters are a broad class of commercial products intended for use on rusted steel to chemically convert the surface rust layer to a more tightly adherent oxide. The resulting surface is usually black or near-black in color. When a quality rust converter is properly applied, the resulting surface film can provide a limited amount of short-term corrosion protection, preventing further rusting until proper surface preparation and coating can be performed. Rust converters are usually based on phosphoric acid or tannic acid, and are generally not intended for use on non-ferrous metals. In particular, they shall not be used on aluminum alloys, where they can cause accelerated corrosion.

631-5.3.6.2 LIMITATIONS. The use of rust converters shall be limited to preventive measures taken by a ship's crew while a ship or submarine is underway and no other corrosion control procedure is available. The use of rust converter products shall not be substituted for standard NAVSEA-approved corrosion control practices for ship's Hull, Mechanical, and Electrical (HM&E) preservation, but shall serve as a temporary measure only until proper corrosion control procedures can be employed. Rust converters are not authorized as a pretreatment for

any coating system and shall be removed prior to the use of a NAVSEA-standard corrosion control system. Rust converters shall never be over-coated with any coating system. Rust converters are water based products and should not be used on wetted surfaces or on surfaces subject to continuous immersion. Immersion service represents a severe environment for which these products were not designed.

631-5.3.6.3 SAFETY PRECAUTIONS AND APPROVALS. All rust converter products purchased by ship's personnel shall be accompanied by a Material Safety Data Sheet (MSDS) and published user instructions. Products not possessing this legally-required documentation shall not be employed. Naval Environmental Health Center (NEHC) approval should be obtained for each specific product used. Specific rust converters must also be approved for shipboard use via the Ships Hazardous Material List (SHML); refer to [paragraph 631-3.4.2.1](#). Use all Personal Protective Equipment (PPE) recommended by the NEHC approval letter and the MSDS when handling or applying rust converters.

631-5.3.6.4 SURFACE PREPARATION AND APPLICATION GUIDANCE. The following is general guidance for the effective use of rust converters. Thick rust scale, and loose rust will prevent proper penetration of the rust converter to the sound steel surface, and must therefore be removed. Solvent degreasing or detergent cleaning is also required for maximum benefit.

- a. Loose rust, scale, and other contaminants are to be removed using hand tool (SSPC-SP 2) and power tool (SSPC-SP 3) cleaning methods.
- b. Solvents or detergents must be used to remove as much oil and grease as possible followed by a freshwater wash/rinse to remove any residual detergent and soluble salts. (Solvents shall not be used for submarine applications.)
- c. Allow surface to dry prior to applying rust converter.
- d. Water-based rust converters shall be applied on a dry surface by brush only. Spraying shall not be used, in order to prevent accidental contact with metals or other materials that may be damaged by the chemical rust converters.
- e. Rust converters should be applied in one or more treatments, according to the manufacturer's directions.

631-5.3.6.5 LIMITATIONS AND REQUIREMENTS FOR SUBMARINE USE. Specific rust converter products are approved for use on all classes of submarines. The rust converters listed in [Table 631-5-2](#) are approved for underway use on non-nuclear surfaces coated with NAVSEA-approved epoxy (MIL-DTL-24441 or MIL-PRF-23236) and enamel (MIL-DTL-15090 Formula 111) paints. This authorization does not apply to components that are governed by Reactor Plant Paint Schedules. These rust converters are approved under the Submarine Atmosphere Control Program in the LIMITED usage category. These materials can be used interchangeably, with the following restrictions, provided the temperature constraints below are not violated:

- a. Rust converters authorized for use on reactor compartment components which are governed by the Reactor Plant or Propulsion Plant Paint Schedules are provided by separate correspondence.
- b. Rust converters may be applied to fasteners that are permitted to be painted.
- c. Rust converter usage shall not to exceed 10 square feet of treated surface area per day.
- d. VACTAN shall not be applied to surfaces that experience a service temperature of 150° F or greater. TRIUMPH can be used on surfaces with service temperatures up to 200° F. The minimum surface temperature during application of TRIUMPH and VACTAN is 38° F and 50° F, respectively. Both products shall not be applied when surface temperatures exceed 78° F.

- e. The maximum quantity to be stored onboard while underway is 2 gallons.

Table 631-5-2 Rust Converters Approved For Submarine Underway Use

Rust Converter	National Stock Number (NSN)	Vendor
VACTAN	1H6850-01-432-8277	RAYCO Services, Inc. 2512 Broad Bay Road Virginia Beach, VA 23451 Tel: (757) 481-0373
TRIUMPH UNITED 303	1H6850-01-463-8446	United Laboratories 320 37th Avenue St. Charles, IL 60174-5414 Tel: (800) 323-2594

631-5.4 ABRASIVE BLASTING.

631-5.4.1 GENERAL. Abrasive blasting is the preferred method for preparing metal surfaces. Blast cleaning abrades and cleans the substrate through high-velocity impact of metal shot, mineral media or synthetic grit, or other abrasive particles. The abrasive is discharged, either wet or dry, under pressure. The wet system differs from the dry in that water is incorporated with the blast abrasive. The water is either introduced into the blast stream just behind or just in front of the blast nozzle. All blasted metal surfaces should be primed as soon as practical to prevent degradation (corrosion and contamination) of the blasted steel surfaces. The prepared surface shall meet the requirements of the specified surface preparation standard (e.g., SSPC-SP 10), immediately prior to coating. Prepared surfaces that do not meet the specified surface preparation standard shall be re-blasted to meet the surface preparation standard as originally specified. Heating, dehumidification and ventilation techniques for enclosed spaces such as tanks may afford extended intervals between surface preparation and coating while being able to retain the as-blasted cleanliness level.

631-5.4.2 ABRASIVE BLASTING SAFETY PRECAUTIONS. Abrasive blasting carries a high probability of injury to personnel or damage to ship components unless NAVSEA requirements are fully met. Specific safety precautions that shall be taken are listed in [Section 2](#).

631-5.4.2.1 Weld areas are often irregular and will require directing the abrasive blasting nozzle in all directions to assure a near-white blast and to obtain a surface profile in all areas.

631-5.4.3 ABRASIVE MATERIALS. Metal or synthetic shot or grit, or similar abrasives are used where recovery and reuse of the abrasive is possible as, for example, in closed cycle abrasive blasting units. Coal slag, copper slag, nickel slag, and other relatively low cost materials are used when the abrasive agent is expendable. Non-metallic, mineral abrasives, such as aluminum oxide and garnet, are used on aluminum, stainless steels, or other non-ferrous metals in order to avoid contamination of these surfaces by dissimilar metals from slag-type media that could cause accelerated corrosion or staining. Coal slag media shall not be used on aluminum surfaces. Abrasives made from hard agricultural products, such as walnut shells, are sometimes used on aluminum or other soft materials to remove old paint, corrosion products, or other debris with minimum damage to the substrate. The abrasive particle size shall be sufficient to remove surface contamination and to provide only that profile depth recommended. Controlling the profile is dependent on the size of the particle in relation to the speed of the blasting machine. Excessive depth of profile can cause problems with poor coating performance. A greater than recommended surface profile requires a paint film be applied to totally cover the profile to prevent pinhead or flash corrosion. The increase in paint film thickness also increases the susceptibility of solvent entrapment, causing blistering and premature failure of the coating.

631-5.4.3.1 Surfaces Blasted With Agricultural Media. When walnut shells or other agricultural-based abrasive media have been specified for use, the blasted surface shall be degreased to remove traces of agricultural oils inherently present in these materials. Even traces of residual oil will degrade coating adhesion. Appropriate safety precautions for working with flammable solvents must be enforced. An acceptable alternate to using hydrocarbon solvents is to use a vigorous soap and water wash followed by pressurized freshwater rinsing.

631-5.4.3.2 Use of Abrasive Sponge Media. Abrasive sponge media, using appropriate blasting equipment, may be used in new construction and repair to obtain the specified abrasive blast surface cleanliness levels and profiles specified herein. This media may be recycled according to the manufacturer's instructions. If this method is employed and the profile is insufficient to meet the requirements, the shipyard or contractor will still be required to establish the specified profile.

631-5.4.4 ABRASIVE MATERIAL ACQUISITION. Acquisition of blasting abrasives shall be in accordance with MIL-A-22262 or SSPC-AB 3. Walnut shells shall be in accordance with CID A-A-1722, Type II. Abrasive sponge media shall be procured from the manufacturer or their authorized licensee. MIL-A-22262 abrasives are inorganic materials (for example, minerals, slags, aluminum oxide, and garnet) which have set limits for metal content and radioactivity and meet Environmental Protection Agency (EPA) hazardous waste requirements. Abrasives are typically used to remove coatings to bare metal. Recycling techniques or other methods can be used to restore the abrasive material to be used again provided that the recycled materials meet the requirements of SSPC-AB 2.

NOTE

Local pollution abatement and health regulations may place additional restrictions on the selection of abrasive.

631-5.4.5 DRYBLASTING. The three dry blasting methods of surface cleaning are described in the following paragraphs. For all three methods, spent blasting media shall be collected and disposed of in accordance with Federal, state, and local environmental regulations. Testing for total leachable heavy metals may be required by these regulations to determine the required disposal method.

631-5.4.5.1 Open Blasting. Open blasting is a term used to designate the usual method of field blasting, in which no effort is made to alleviate the dust hazard nor recycle the blasting abrasive. Conventional blasting does not require special rinsing, as is required for wet blasting, but it does require that health precautions be taken to protect the operator and other personnel in the area from the fine, abrasive dust. Machinery in the vicinity shall also be shielded from the dust. After blasting, the surface shall be brushed, vacuumed, or air cleaned to remove residues or trapped grit.

631-5.4.5.2 Vacuum Blasting. Vacuum blasting is a surface cleaning method that minimizes the dust hazard and reclaims the blast abrasive. Vacuum blasting allows practically no dust to escape to contaminate the atmosphere. On highly irregular surfaces, the vacuum method of blasting is less efficient than conventional blasting methods because of the poor vacuum on such surfaces. When the blasting cone is held firmly against the surface to prevent abrasive loss and the surface is heavily contaminated with rust, marine fouling, or other foreign matter, the machine may become clogged after operating only a short time. When clogging occurs, the vacuum blaster is used as a semi-open blasting device and the cone containing the nozzle is held at a slight distance away from the surface. A considerable amount of dust is created (workers shall wear respirators), but not as much as that cre-

ated by conventional blasting. Vacuum blasting is efficient and economical for cleaning repetitive, small-scale surfaces in a shop. The process results in considerable savings in abrasive costs and also reduces the dust and the health hazard.

631-5.4.5.3 Closed Cycle Blasting. Closed cycle blasting is used during the initial surface preparation of steel plates and shapes or for open shipboard areas with portable units. This method consists of an enclosed cabinet containing rotating wheels with vanes that propel steel abrasive in accordance with SSPC-AB 3 onto the surface to remove corrosion products, mill scale, coatings, and other contaminants, and to establish a surface profile for coating adhesion. Abrasives used in this type of operation are continuously recycled until they are removed as fines in a dust collection system. This system is the most economical and cost effective method for removing mill scale while reducing dust and health hazards associated with conventional abrasive blasting.

631-5.4.6 WET ABRASIVE BLASTING (SLURRY BLASTING). Wet abrasive blasting (WAB), also termed slurry blasting, is when water is added to abrasive blasting. Wet blasting reduces the dust associated with dry blasting, and is more effective in removing residual surface salts than dry blasting. While WAB helps to remove oil and grease from a surface, its use does not preclude the need for performing degreasing per SSPC-SP 1 prior to WAB cleaning. Two types of WAB cleaning are commonly used: systems that use compressed air to propel the abrasive and water, and systems that use pressurized water to propel the abrasive. When the surface preparation specified herein requires an SSPC-standard cleanliness level, wet abrasive blasting may be used as an alternative to dry blasting. Refer to [paragraph 631-5.4.7.5](#).

NOTE

The use of corrosion inhibitors in conjunction with wet (slurry) blasting is prohibited.

631-5.4.6.1 Wet Blasting Disadvantages. Wet abrasives tend to stick to wet blasted surfaces and may promote flash rusting of the clean steel. When blasting is used on steel structures having many ledges formed by upturned angles or on horizontal girders, a considerable amount of cleanup work is required. Wet abrasive and other blast residues trapped on these ledges are more difficult to remove than dry materials. Some sludge will adhere to wet-blasted surfaces, requiring removal by rinsing, brushing, or compressed air. The blasted surface shall be thoroughly dry and all abrasives removed before coatings are applied.

631-5.4.7 DEGREES OF BLASTING CLEANING. Several degrees of blast cleaning for steel are defined in the joint standards of SSPC and NACE International. Those invoked in this NSTM are described in the following paragraphs. Note that each of these standards requires that visible deposits of oil, grease, or other contaminants be removed by solvent cleaning in accordance with SSPC-SP 1 (see [631-5.7](#)) prior to blasting. This step prevents the oil and grease from becoming embedded in the surface and contaminating the blast media, which is especially important if the blast media is to be recycled. The surfaces to be painted shall comply with the specified degree of cleanliness at the time immediately prior to coating application.

631-5.4.7.1 SSPC-SP 5/NACE No. 1 White-Metal Blast. Blasting to a white-metal surface finish is the highest degree of blasting cleanliness and is often specified for the metal spray coating process and for coatings that must withstand exposure to very corrosive atmospheres, or where the high cost of this degree of blasting is considered to be warranted. Surfaces that are to have been blast cleaned to white metal shall, when viewed without magnification, be free of all visible oil, grease, dirt, paint, rust, mill scale, dust, oxides, corrosion products, and other foreign matter.

631-5.4.7.2 SSPC-SP 10/NACE No. 2 Near-White Metal Blast. Blasting to a white-metal surface finish is the highest degree of blasting cleanliness and is often specified for the metal spray coating process and for coatings that must withstand exposure to very corrosive atmospheres, or where the high cost of this degree of blasting is considered to be warranted. Surfaces that are to have been blast cleaned to white metal shall, when viewed without magnification, be free of all visible oil, grease, dirt, paint, rust, mill scale, dust, oxides, corrosion products, and other foreign matter.

631-5.4.7.3 SSPC-SP 6/NACE No. 3 Commercial Blast. Commercial blasting requires the removal of all oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, when viewed without magnification. Light shadows, slight streaks or discolorations caused by stains of mill scale, rust stain, or stains of previously applied paint may remain on no more than 33 percent of each 3-inch by 3-inch (76 mm x 76 mm) square of surface area.

631-5.4.7.4 SSPC-SP 7/NACE No. 4 Brush-Off Blast. A brush-off blast cleaned surface, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, loose mill scale, loose rust, and loose paint. Tightly adherent mill scale, rust, and paint may remain on the surface. Mill scale, rust, and paint are considered tightly adherent if they cannot be removed by lifting with a dull putty knife after abrasive blasting has been performed. Brush-off blasting is not intended for use where severe corrosion is prevalent.

631-5.4.7.5 Wet Abrasive Blasting Cleanliness Standards. Wet Abrasive Blasting Cleanliness Standards. When wet abrasive blasting is used as an alternative to dry blasting, the required surface cleanliness shall designated as shown below. The “L” designation indicates light flash rusting, as defined in [paragraph 631-5.5.7](#). No flash rusting is permitted for tanks and floodable voids, or when white metal blasting per SSPC-SP 5/WAB-5 has been specified.

<u>Dry Blast Standard</u>	<u>Wet Blast Standard and Terminology</u>
SSPC-SP 5	WAB-5 Wet White Metal Blast Cleaning
SSPC-SP 10	WAB-10L Wet Near-White Metal Blast Cleaning
SSPC-SP 6	WAB-6L Wet Commercial Blast Cleaning
SSPC-SP 7	WAB-7L Wet Brush-Off Blast Cleaning

631-5.4.7.6 Abrasive Blasting Surface Cleanliness Requirements for Non-Ferrous Metals. Abrasive Blasting Surface Cleanliness Requirements for Non-Ferrous Metals. When Navy specifications call for SSPC standard abrasive blasting cleanliness requirements as the surface preparation method for aluminum and other non-ferrous metallic surfaces, the surface cleanliness requirements at the time of application of the coating shall be the same as that stated in the applicable SSPC standard, except that the words “corrosion products” shall be substituted for the word “rust”, and the colors of corrosion products shall be considered. (e.g. aluminum corrosion products are typically gray, while iron and steel corrosion products are varied shades of brown, red/orange, and black.).

631-5.4.8 VISUAL AIDS FOR BLAST CLEANING. Photographic or visual standards showing the degrees of blast cleaning for steel surfaces may be used by coatings inspectors to assess the degree of cleanliness of a blasted surface. They are available in the following publication. In any dispute, the written SSPC standards shall take precedence:

- a. SSPC-VIS 1, Guide and Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning.
- b. SSPC-VIS 5 Guide and Reference Photographs for Steel Surfaces Prepared by Wet Abrasive Blast Cleaning .

631-5.5 WATERJETTING AND WATER CLEANING.

631-5.5.1 GENERAL. Waterjetting (formerly called hydroblasting) of steel surfaces is described in SSPC-SP 12/NACE No. 5. This standard provides basic definitions of waterjetting and water cleaning according to the pressures used. The water used in waterjetting and water cleaning shall be freshwater of sufficient purity and quality so that it does not impose additional contaminants, such as salt or chlorides, on the surface being cleaned. The water should also not contain sediments or other impurities that are destructive to the proper functioning of waterjetting equipment. Waterjetting will not produce a profile on a steel surface; it can only expose the profile that was present under the old coating system. If the existing profile is not in the range of the current requirements, then abrasive blasting shall be used to produce the required 2-4 mil profile. Dry abrasive blasting per SSPC-SP 10 represents the lowest technical risk surface preparation method. SSPC-SP 12 is not equivalent to SSPC-SP 10. Waterjetting per SSPC-SP 12 carries a higher technical risk of excessive flash rusting, and rework with abrasive to produce an acceptable profile.

NOTE

Corrosion inhibitors shall not be added to the water used in waterjetting or water cleaning.

631-5.5.2 LOW PRESSURE WATER CLEANING. Low pressure water cleaning (LPWC) is performed at pressures less than 5,000 pounds per square inch (PSI) (34 MPa). This method may be used prior to or after other surface preparation cleaning methods to help remove salts and contaminants from the surface, in order to meet surface chloride or conductivity limits for specified areas. This is also called “power washing” or “pressure washing”.

631-5.5.3 HIGH PRESSURE WATER CLEANING. High Pressure Water Cleaning (HPWC) is fresh water blasting at pressures from 5,000 to 10,000 PSI (34 to 70 MPa). This cleaning method can be used to remove surface contaminants, light marine fouling, loose paint, and mild chalking or dusting. The HPWC waterjetting method is generally used for cleaning good surfaces with less than 10 percent marine fouling, paint defects, or corrosion.

631-5.5.4 HIGH PRESSURE WATER JETTING. High pressure waterjetting (HPWJ) operates at pressures between 10,000-30,000 PSI (70 to 210 MPa) HPWJ has been demonstrated to be effective in removing loose paint, loose rust, mill scale, and some, but not all, tightly adherent epoxy paint. Surfaces shall be dry before painting; and crevices and corners shall be carefully inspected for moisture. Isolated areas with paint defects shall be further prepared by the methods described in [paragraph 631-5.2.3.2](#).

631-5.5.5 ULTRAHIGH PRESSURE WATERJETTING. Ultrahigh pressure waterjetting is performed at pressures above 30,000 PSI (210 MPa). UHPWJ has been demonstrated to completely remove all paint from a substrate. This method is generally required in order for the resulting surface cleanliness to meet the requirements described in [paragraph 631-5.5.7](#).

631-5.5.6 FLASH RUSTING AND WATERJETTING. Waterjetting can lead to flash rusting depending upon surface contaminants, humidity, temperatures, operator technique, and time of contact with the jetting water. Control of flash rust is important to avoid creating enough flash rust to degrade the service life of primer systems. Excessive flash rust will cause blistering of primers and premature coating failure. If the degree of flash

rusting exceeds the specified level, it shall be removed prior to coating using sweep blasting or other approved methods. Refer to SSPC-SP 12 for additional information on flash rusting.

631-5.5.7 SURFACE CLEANLINESS REQUIREMENTS FOR STEEL. When waterjetting is specified as the surface preparation method for steel surfaces, the surface cleanliness requirement at the time of application of the coating shall be SSPC-SP 12/NACE No. 5, WJ-2L. The definitions are provided below.

WJ-2: A WJ-2 surface shall be cleaned to a matte (dull, mottled) finish which, when viewed without magnification, is free of all visible oil, grease, dirt, and rust except for randomly dispersed stains of rust, tightly adherent thin coatings, and other tightly adherent foreign matter. The staining or tightly adherent matter is limited to a maximum of 5% of the surface.

L: A surface which, when viewed without magnification, exhibits small quantities of a yellow-brown rust layer through which the steel substrate may be observed. The rust or discoloration may be evenly distributed or present in patches, but it is tightly adherent and not easily removed by lightly wiping with a cloth.

631-5.5.8 SURFACE CLEANLINESS REQUIREMENTS FOR ALUMINUM. When Navy specifications call for SSPC-SP 12/NACE No. 5 waterjetting to a cleanliness level of WJ-2L as the surface preparation method for aluminum surfaces, the surface cleanliness requirements at the time of application of the coating shall be the same as that stated in SSPC-SP 12, except that:

- a. The words “corrosion products” shall be substituted for the word “rust”; and
- b. The light flash rusting “L” requirement does not apply.

631-5.5.9 VISUAL REFERENCE STANDARDS. For steel surfaces only, the SSPC-VIS 4/NACE VIS 7 visual standard photographs may be used by coatings inspectors to assess the degree of cleanliness of a waterjetted surface. In any dispute, the written standards of SSPC-SP 12/NACE No. 5 shall take precedence.

631-5.6 UNDERWATER HULL CLEANING.

631-5.6.1 Specific instructions on underwater hull cleaning of surface ships are given in NSTM Chapter 081, Waterborne Underwater Hull Cleaning of Navy Ships. Underwater hull cleaning is indicated for a reported fouling rating of 50 over 20% of the hull excluding keel block areas and appendages. Divers using rotary brushes shall clean underwater surfaces of waterborne naval ships to achieve the purposes listed:

- a. To maintain the effective toxic leaching rate by periodically cleaning the surface of antifouling paint.
- b. To improve fuel economy through reduction of hull frictional resistance by removing heavy marine fouling from ship bottom.
- c. To restore the acoustical capability of sonar devices.
- d. To prepare damaged or abraded surfaces for application of underwater curing compounds.

631-5.7 SOLVENT CLEANING SSPC-SP-1.

631-5.7.1 GENERAL. Solvent cleaning prepares surfaces by removing oil, grease, dirt, chemical paint stripper residues, and other foreign matter prior to painting or mechanical treatment. Solvents clean by dissolving and diluting to permit contaminants to be wiped or washed off the surface.

631-5.7.2 PROCEDURES. The simplest procedure is to first remove soil and other dry materials with a wire brush. The surface is then scrubbed with brushes or rags saturated with solvent, and clean rags are used to rinse and wipe dry. Immersing the work in the solvent or spraying solvent over the surface is a more effective method. With either method, the solvent quickly becomes contaminated, so it is essential that several clean solvent rinses be applied. An effective solvent for cleaning under normal conditions is mineral spirits (Degreasing Solvent, MIL-PRF-680, Type I (Stoddard Solvent) or ASTM D235 Type I). For surfaces to be coated with paints other than alkyds, see paragraph 631-5.7.4b for cleaning. Solvent cleaning shall only be accomplished when allowed by local air quality regulations.

631-5.7.3 SOLVENT SAFETY PRECAUTIONS. Toxic solvents and solvents with low flashpoints present serious hazards to health and safety. Solvents shall not be used for cleaning if their flashpoints are below 38° C (100° F), or their Maximum Allowable Concentrations (MAC) are less than 100 p/m. Safety precautions for painting apply when solvents are used for cleaning (see [Section 2](#)).

631-5.7.4 RECOMMENDED SOLVENTS. Solvents recommended for cleaning surfaces prior to painting are:

- a. Degreasing Solvent (Stoddard Solvent), MIL-PRF-680, Type I, or ASTM D235 Type I, NSN 6850-01-474-2309 (5 gallons).
- b. Super high-flash naphtha.

631-5.8 ACID CLEANING.

CAUTION

Do not use acid cleaning on aluminum, magnesium, or stainless steel.

631-5.8.1 GENERAL. Acid cleaning is the method used to clean iron and steel by treating these metals with an acid solution. Acid cleaning is generally a shipyard practice, and Ship's Force should not attempt it without proper authorization.

631-5.8.2 ACID CLEANING USES. Acid cleaning removes surface contaminants by treating the surfaces with a phosphoric acid solution containing small amounts of solvent, detergent, and a wetting agent. Unlike alkaline cleaners, acid removes light rust and slightly etches the surface to ensure better coating adhesion. Many types of phosphoric acid metal cleaners and rust removers are available and each is formulated to perform a specific cleaning job.

631-5.8.3 CLEANING METHODS. Four basic acid cleaning methods are in use and each requires a variation in the phosphoric acid concentration, as well as a different detergent system.

631-5.8.3.1 Wash-Off Method. The wash-off method involves the application of the acid cleaner, a time allowance for the cleaner to act, a thorough rinsing, and a drying period before painting.

631-5.8.3.2 Wipe-Off Method. The wipe-off method is used when rinsing is impractical. It involves the application of the acid cleaner, a time allowance for the cleaner to act, wiping the surface with clean damp cloths, a final wiping with clean dry cloths, and a drying period prior to painting.

631-5.8.3.3 Hot-Dip Method. The hot-dip method involves the immersion of the work in hot acid cleaner, a rinse in hot or cold water after the surface is cleaned, and a second rinse in a weak (e.g. 5 percent) acid solution. A drying period is required before painting.

631-5.8.3.4 Spray Method. The spray method involves the same steps as the wash-off method, but requires pressurized spray equipment.

631-5.9 PAINT REMOVERS.

631-5.9.1 GENERAL. The use of chemical paint removers or strippers is no longer authorized by this NSTM. Requests to use chemical paint strippers and removers on specific pieces of equipment shall be referred to the cognizant engineering or maintenance activity for that equipment. Also refer to [paragraph 631-2.5.7](#). In no case shall paint strippers or removers be used on fiberglass-reinforced plastic laminates (FRP or GRP) or other composite materials, other plastics, electrical insulators, or other materials which may be damaged by the stripper. In no case shall caustic strippers be used on aluminum, magnesium, or zinc or their alloys. NAVSEA approval is required for the use of paint strippers by Ship's Force.

631-5.10 STEAM CLEANING.

631-5.10.1 GENERAL. The steam cleaning method of preparing surfaces for painting involves using steam or hot water under pressure. Steam cleaning compound P-C-437 can be included for added effectiveness. The steam or hot-water jet removes oil and grease by liquefying these contaminants (because of the high temperature), then emulsifying and diluting them with water. When steam cleaning is used on some types of old paint, the old paint becomes swollen and loosened. Steam cleaning is commonly used to remove heavy dirt deposits, soot, and grime. Wire brushing or brush-off blast cleaning may be necessary to complete the residue removal. Information on steam cleaning of tanks may be found in NSTM Chapter 074, Volume 3, Gas Free Engineering.

631-5.10.2 REMOVAL OF THIN FILM RUST-PREVENTIVE COMPOUND. Steam should be used to remove thin film corrosion preventive compound, MIL-PRF-16173, Grade 1, where large surface areas are involved, or where the rust-preventive compound hardened with age. For small areas it can be effectively removed with an aromatic hydrocarbon solvent of high-flash naphtha.

631-5.10.3 REMOVAL OF METAL CONDITIONING AND THIN FILM RUST-PREVENTIVE COMPOUNDS. Whenever practical, mixtures of Grade 1 thin film rust-preventive compound and metal-conditioning compound shall be removed by steaming. When straight steaming is not successful, the procedures described in the following paragraphs are recommended.

631-5.10.4 NAPHTHA-ROSIN SOAP. Mix Hercules Powder Dresinate 87 (a liquid sodium rosin soap) and high-flash naphtha in 1:2 weight ratio. Stir until a homogenous mixture is obtained. A person should clean

approximately 30-square feet of surface at one time. Allow the material to penetrate into the preservative film for about 5 minutes. If the cleaner appears to be drying, reapply a small amount.

631-5.10.4.1 Rinse the surface with a stream of hot water at about 90- to 100-pounds pressure. (A Seller Type B Hi-Pressure Jet Cleaner, 1,000-gallons per hour capacity, with nozzle number 2351, is suitable for this purpose.) Repeat the cleaning cycle over the same area, if necessary. Two cleaning cycles should be sufficient.

CAUTION

The naphtha-rosin soap mixture has a flashpoint of 41° C (105° F) and its use requires fire precautions equivalent to those observed when spray painting (see Section 2).

631-5.11 PICKLING.

631-5.11.1 GENERAL. Pickling is a method used in the shop to completely remove mill scale, rust, and rust scale by using sulfuric, hydrochloric, nitric, hydrofluoric, and phosphoric acids, individually or in combination. Sulfuric acid is the most frequently used because of its low cost, high boiling point, and general suitability. Pickling is a low-cost procedure if there is sufficient work to keep the equipment in regular use.

CAUTION

Do not use the pickling method on aluminum, magnesium, or stainless steel.

631-5.11.2 BASIC PICKLING PROCEDURES. The material to be pickled shall be solvent or alkali-cleaned to remove oil and grease before pickling, because pickling will not suitably remove these contaminants.

631-5.11.2.1 Pickling is usually done by immersing the work in tanks, but the same principles apply if the solution is sprayed or washed over the contaminated surface. Because mill scale itself is not chemically consistent throughout its composition, the outer layer tends to resist the acid solution, but the lower layers are soluble in the acid. Thus, the diluted acid penetrates cracks in the outer scale layer, dissolves some of the scale beneath, penetrates to the lowest layers, dissolves them rapidly, and causes all the scale to flake off the surface eventually.

631-5.11.2.2 During this process, any rust or rust scale is completely dissolved in the acid solution because these contaminants have low resistance to the acid action. Inhibitors are added to the solution to minimize acid action on base metal exposed in those portions of the surface that have cleaned faster than others.

631-5.11.2.3 Following pickling, several rinses are necessary to remove acids and salts, with a final rinse in an inhibitor solution to retard rusting.

631-5.11.3 ACID PICKLING STEEL PLATES. A four-step method used to remove rust, mill scale, and other contaminants from steel plates prior to fabrication is described in the following paragraphs.

631-5.11.3.1 Precleaning. Solvent cleaning is the best method for removing waxes from metal surfaces. Oil and grease applied to the steel by suppliers, or present for other reasons, may be removed by using 1 to 2 ounces of steam cleaning compound (FED Spec P-C-437) for each gallon of water, in a steam-cleaning machine, or applied with a simple aspirating type steam gun.

631-5.11.3.1.1 Where the volume of steel requiring pre-cleaning is large, and tank space permits, a cleaning tank containing an alkaline solution (for old paint films) or steam-cleaning compound (for oil, grease, or wax) is recommended. When alkali is used, steel shall be thoroughly rinsed between pre-cleaning and pickling. This is best accomplished by using a rinse tank or neutralizer tank. Heavy rust may be removed by mechanical means to break up heavy mill scale prior to pickling. This procedure decreases acid bath immersion time.

631-5.11.3.2 Bath 1 Pickling Solution. Bath 1 is composed of a sulfuric acid solution. The acid concentration shall be maintained between 3-1/2 and 5 percent by volume. Initially, each 100 gallons of solution shall be composed of 5 gallons of concentrated sulfuric acid (1.835 specific gravity) and 95 gallons of water. The bath shall be inhibited with pickling inhibitor, FED Spec. 0-I-501, Type II, Class A. Pickling inhibitor shall be used at the concentration recommended by the manufacturer. The bath shall be maintained between 77 and 82 ° C (170 and 180 °F).

NOTE

Because these inhibitors tend to lose their inhibiting properties in approximately 18 months, acquisition should be limited to a 12-month supply.

631-5.11.3.3 Testing of Bath 1 Pickling Solution. The pickling solution acid concentration and iron content shall be determined as frequently as necessary, but not less than once a week. When the sulfuric acid is replenished, proportional quantities of the pickling inhibitor shall be added. When the weight of iron in the solution reaches 5 percent of the total bath weight, the entire bath shall be discarded in accordance with environmental regulations.

631-5.11.3.4 Special Bath 1 Pickling Solution. When acid pickling is used for special treatment and high strength steels, sodium chloride shall be added to the pickling solution to make a 1-1/2 percent solution. (Sodium chloride shall be added as required to maintain this concentration.) This modified solution also may be used for medium- and high-tensile steels. Pickled and primed special treatment and high-strength steels shall be aged a minimum of 24 hours before fabricating or welding.

631-5.11.3.5 Bath 1 Timing. Pickling time shall be sufficient to remove the rust and mill scale completely. Timing will vary from 10 to 75 minutes, depending upon scale thickness, continuity, tightness, and the bath acid strength. Plates shall be withdrawn from the bath after no more than 30 minutes of pickling and examined for scale presence. Plates may be withdrawn sooner if experience indicates complete scale removal in less than 30 minutes, which may be the case for medium- and high-tensile steels. If complete scale removal has not been achieved after 30 minutes, plates shall be re-immersed for successive 15-minute periods.

631-5.11.3.6 Bath 1 Completion. An ohmmeter test may be used to confirm a visual estimation of completeness of scale removal. Medium- and high-tensile steel usually appear a clear uniform gray upon removal from the pickling bath. Special treatment and high-strength steels will probably have slight to extensive soft, dark smut deposits not removed by the acid bath. On visual examination these smut deposits may be confused with mill scale.

631-5.11.3.6.1 After pickling, the plates shall be withdrawn slowly from the acid and allowed to drain over the pickling tank for at least 1/2 minute to conserve acid and prevent carry-over of acid to the rinse tank. The smut on the special treatment and high-strength steels shall be removed by wiping with burlap or with a stiff bristle brush prior to, or just after, rinsing. If smut is to be removed prior to rinsing, necessary precautions should be taken to protect operator from acid splatter.

631-5.11.3.7 Ohmmeter Test. The ohmmeter test determines mill scale presence or absence. The test is conducted by using an ohmmeter (0 to 10 ohms, full scale) which is fitted with test prongs. Press one prong firmly against the plate surface. With moderate pressure, slowly draw the other prong along the plate surface for a distance of at least 2 inches. In the absence of mill scale the needle will not fluctuate and will remain below 0.5 ohms. Mill scale presence is indicated by needle fluctuations and resistance above 0.5 ohms.

631-5.11.3.7.1 Alternatively, the meter may be replaced by a suitably housed 2-cell flashlight with the test prongs in the bulb circuit. Flickering, dimming, or no light at all will indicate mill scale presence; a bright steady light will indicate mill scale absence. Sufficient individual checks shall be made on each plate to ensure that all mill scale has been removed, especially on dark areas remaining after smut removal. At least one ohmmeter test shall be made for each 100-square feet of surface.

631-5.11.3.8 Bath 2 Water Rinse. The next step used in steel plate pickling is the water rinse, or bath 2. This bath shall consist of freshwater maintained above 85° C (190° F). It is important that the rinse water be kept free from excessive contamination. Combined concentrations of sulfuric acid and ferrous concentration shall not exceed 2.0 grams per gallon. The water shall be tested for acid and iron concentration as frequently as necessary, but not less than once a week. When impurities exceed the maximum limit, the water shall be discarded, the sludge removed from the tank, and the tank refilled with freshwater. The steel shall be immersed in the water rinse for about 2 minutes. Repeated dips with a short drain period between dips are recommended to ensure ample rinsing.

631-5.11.3.8.1 A powdery coating on the pickled steel indicates improper conditions in the pickling operation. Further pickling shall cease until test samples indicate the immersion times, bath concentrations, or temperatures have been corrected. Any powdery coating shall be removed by brushing or wiping before painting. If copper deposits are observed on a steel plate after pickling and rinsing, 0.1 percent by weight of diethylthiourea shall be added to the sulfuric acid pickling solution. A similar addition of diethylthiourea shall be made if deposits reappear.

631-5.11.3.9 Bath 3 Corrosion Inhibiting Solution. This bath shall be maintained between 88 to 95 °C (190 to 205° F). Its ingredients shall be in accordance with the following formula for a 1,000 gallon, full-strength bath. Sixty-three pounds of sodium dichromate (technical grade) and 56 pounds (4.2 gallons) of phosphoric acid (75-percent grade) shall be mixed with fresh tap water to fill a 1,000-gallon volume bath. Steel shall be immersed in this bath for not less than 2, nor more than 5 minutes. When removed from the bath, the steel shall have a typical clean, gray appearance. The steel shall be allowed to dry after removal from the corrosion inhibiting bath.

631-5.11.3.9.1 An analysis of the bath shall be made as frequently as necessary, but not less than once a week. Sodium dichromate concentration shall not be allowed to drop below 50 percent of its full strength. To increase the bath concentration, proportional quantities of the chemicals specified shall be added. Regardless of the concentration of chemicals, the bath shall be discarded when the steel comes out dirty because of accumulated iron and sediment in the solution.

631-5.11.4 PICKLING ANALYTICAL CONTROL METHOD. Pickling procedures specify that determination of bath concentrations shall be made as frequently as necessary, but at least once a week. The technical assistance of a shipyard chemical laboratory is recommended until the depletion rate of the components of the three baths is determined from local experience. Where practical, frequent field tests, in addition to weekly laboratory checks, are recommended. If desired, simple test sets are available for personnel unfamiliar with standard laboratory practice. The test sets, which can be used to test for acid and iron in the pickling baths, may be obtained from the American Chemical Paint Co., Ambler, PA.

631-5.11.4.1 General. If the solution contains sludge or sediment, it shall be allowed to settle and a clear sample shall be decanted for analysis. As an alternate procedure, the solution may be filtered through a dry filter and funnel. The first 50 mL of filtrate shall be discarded and the remainder shall be used for analysis. Test methods, which may be used by a chemical laboratory, are described in the following paragraphs.

631-5.11.4.2 Test of Pickling Solution Specific Gravity. Test of Pickling Solution Specific Gravity. To determine the pickling solution specific gravity, a reading shall be taken with a hydrometer that reads specific gravity directly. If a Twadell or Baume type of hydrometer is used, the reading shall be converted in accordance with the following formula:

$$\text{Specific Gravity} = \frac{1 + \text{Twadell reading}}{200}$$

$$\text{Specific Gravity} = \frac{145}{145 - \text{Baume reading}}$$

631-5.11.4.3 Test of Pickling Solution Acid Concentration. To test the acid concentration of the pickling solution, dilute 5 mL of the pickling solution with 50 mL of water in a porcelain dish. Add 2 grams of unadjusted sodium hexametaphosphate and stir the mixture until dissolved. Add three drops of methyl purple indicator and titrate the mixture with a standard 0.5 normal sodium hydroxide (NaOH) solution until it becomes gray-green in color.

631-5.11.4.4 Test of Percentage of Iron in Pickling Solution. To test the percentage of iron in the pickling solution, place 5 mL of the pickling solution in a porcelain dish and add 50 mL of water and 5 mL of diluted phosphoric acid. Titrate with standard 0.2 normal potassium permanganate (KMnO₄) until a faint pink color appears.

$$\text{Percent Iron (by weight)} = \frac{1.117 \times \text{mL KMnO}_4 \times \text{normality}}{\text{Specific Gravity}}$$

631-5.11.4.5 Test of Water Rinse. Methods of analysis used for testing the pickling solution (bath 1) may be used to test the water rinse (bath 2).

631-5.11.4.6 Test of Sodium Dichromate Concentrate in Corrosion Inhibiting Solution. Rapid control tests of the sodium dichromate concentration in the corrosion-inhibiting solution (bath 3) may be made with the Klett-Summerson (or similar) colorimeters. Mix known concentrations of sodium dichromate and phosphoric acid and compare the colorimeter data with curves obtained by measuring the mixtures. For control purposes, it may not be necessary to measure the concentration of phosphoric acid because phosphoric acid is depleted at approximately the same rate as the sodium dichromate.

631-5.12 ALKALINE CLEANING.

631-5.12.1 GENERAL. Alkaline cleaning is more efficient and less costly than solvent cleaning, but is a more difficult cleaning method to carry out. Alkaline solutions emulsify oils and greases, converting them into soapy solutions that wash away with water. The ingredients contained in the Alkaline cleaners aid in removing surface dirt and other contaminants. Alkaline cleaners are effective in removing some types of old paints by softening or lifting them from the surface. These cleaners are dissolved in water and are used at a relatively high temperature, 66° C (150° F), because cleaning efficiency increases with the water temperature.

CAUTION

Do not use alkaline cleaners on aluminum, magnesium stainless or galvanized steel.

631-5.12.2 TYPES OF ALKALINE CLEANERS. The most commonly used alkaline cleaners are trisodium phosphate, caustic soda, and silicated alkalies. They can be applied by brushing, scrubbing, spraying, or by immersion of the surface in soak tanks. Thorough water rinses are necessary to remove the soapy residue, as well as all traces of alkali, to avoid their harmful reaction with the applied paint. If the rinsing is not complete, cleaning may do more harm than good. Rinse water should be hot and, preferably, applied under pressure.

631-5.12.3 PRECAUTIONS FOR USE WITH STEEL. If used on steel, alkaline cleaners shall contain 0.1 percent potassium dichromate to prevent corrosion. After rinsing, check for the presence of free alkali by placing universal pH test paper against the wet steel.

631-5.12.4 CHEMICALS USED FOR TESTING ALKALINE CLEANING SOLUTION. The chemicals used in the testing of the alkaline cleaning solution used in bilge cleaning are described in the following paragraphs.

631-5.12.4.1 Methyl Orange Indicator. Dissolve 1 gram of methyl orange in 1 liter of water.

631-5.12.4.2 0.5 Normal Solution of Sulfuric Acid. Add 14 mL of reagent grade concentrated sulfuric acid to approximately 800 mL of distilled water in a 1-liter volumetric flask. Fill the flask to the 1-liter mark with distilled water, mix well, and cool to room temperature. Standardize with primary standard grade sodium carbonate using methyl orange indicator.

631-5.12.4.3 Orange-G Indicator. Dissolve 0.5 grams of Orange-G in 100 mL of distilled water. Orange-G indicator is available from the National Analine Division, Allied Chemical Corporation.

631-5.12.4.4 0.1 Molar Solution of Copper Sulfate. Weigh 25 grams of reagent grade copper sulfate and transfer to a 1-liter volumetric flask. Add 500 mL of distilled water and dissolve the salts. Fill the flask to the 1-liter mark with distilled water and mix thoroughly.

631-5.12.4.5 2.5 Normal Solution of Sodium Hydroxide. Weigh 100 grams of reagent grade sodium hydroxide and transfer to a 1-liter volumetric flask. Add 800 mL of distilled water, dissolve, and cool to room temperature. Fill the flask to the 1-liter mark with distilled water and mix thoroughly.

631-5.12.5 TESTING OF ALKALINE CLEANING SOLUTION. The testing of the chemicals that comprise the alkaline cleaning solution is described in the following paragraphs.

631-5.12.5.1 Determination of Sodium Hydroxide. Pipette 2 mL of the sample solution into a 250-mL Erlenmeyer flask. Add 50 mL of distilled water and 10 drops of Orange-G indicator. Titrate rapidly with 0.5N sulfuric acid to the color of a control, which is prepared by adding a slight excess of sulfuric acid titrant to a blank prepared as described at the beginning of this paragraph. The formula is NaOH ounces per gallon x normality x 2.668.

631-5.12.5.2 Determination of Sodium Gluconate. Pipette 2 mL of sample solution into a 150-mL beaker. Add 10 mL of 2.5N sodium hydroxide and 10 mL of distilled water. While stirring, slowly add 0.1M copper sulfate until the precipitate formed will not re-dissolve when the solution is stirred.

631-5.12.5.2.1 Dilute to approximately 80 mL with distilled water. Heat just below boiling point for 5 minutes. Cool to room temperature and transfer to a 100-mL volumetric flask. Fill to the 100-mL mark with distilled water and mix thoroughly. Transfer to a 100-mL centrifuge tube and centrifuge for 15 minutes at 1,500 rpm. Determine the transmittance of the clear solution at the wavelength of maximum absorption (620-680 nm). Use distilled water to determine a blank. The concentration of sodium gluconate is determined by referring the difference between the blank and the sample solution readings to a curve prepared by plotting the spectrophotometric readings of known concentrations of sodium gluconate.

631-5.12.6 ALKALINE CLEANING OF SHIPS' BILGES. Metal surfaces of ships' bilges can be cleaned with alkaline substances before repainting, except in submarines, and in surface ships constructed with aluminum hulls. If chemical cleaning is to be done by the Ship's Force, it shall be done only under the technical supervision of qualified and experienced shipyard or industry representatives. Arrangements shall also include plans for procuring needed chemicals and obtaining necessary equipment and other materials. Chemical cleaning of propulsion equipment spaces in nuclear-powered ships may only be performed if specifically approved by NAVSEA. Alkaline cleaning of bilges can degrade the effectiveness of shipboard oil/water separation systems; therefore, alkaline cleaning solutions shall not be processed through a ship's oily/water separator.

631-5.12.6.1 Required Materials. Materials required for alkaline cleaning of ships' bilges are given in [Table 631-5-3](#).

Table 631-5-3 Alkaline Bilge Cleaners

Cleaner	Purpose	NSN
Solvent cleaning compound, solution type, MIL-C-22230	For cleaning fuel oil tanks and machinery space bilges	6850-00-965-2359 (5-gal drum) 6850-00-965-2360 (55-gal drum)
Sodium hydroxide ASTM D456, flake	Technical	6810-00-174-6581 (100-1b drum) 6810-00-270-8177 (500 gram container)
Sodium gluconate, local purchase	Technical	None
Detergent, liquid, nonionic, MIL-D-16791, Type 1	General purpose	7930-00-985-6911 (5-gal pail)

631-5.12.6.2 Required Equipment. Equipment required for alkaline cleaning of ships' bilges includes:

- a. A portable, closed-top carbon steel tank of sufficient capacity, and fitted with a caustic-resistant recirculating pump and a chemical injection system.
- b. Wheeler machine.
- c. Caustic-resistant hose.
- d. Pneumatic motor agitator fitted with steel paddle for agitating hot caustic solution (motor available from Ingersoll-Rand).
- e. Steam-heating coils of 1-1/4-inch steel tubing, formed into 2-foot diameter coils of a variety of sizes and shapes to conform to space configurations.
- f. Temporary air, steam, and water, with suitable lines, manifolds, and connections.
- g. Exhaust ventilation blowers and ducts.
- h. Remote-reading thermometers.
- i. Safety clothing.
- j. Portable shower.
- k. Hydrogen detector.

631-5.12.6.3 Safety Precautions. Alkaline powders and solutions constitute an extreme personnel hazard if improperly handled. Safety precautions that shall be observed when using alkaline substances to clean ships' bilges are listed in [Section 2](#).

631-5.12.6.4 Alkaline Solution Preparation. Materials required to prepare 1,000 gallons of caustic sequestrant solution are shown in [Table 631-5-4](#) to the cold water, with continuous mechanical agitation. When all the lye has dissolved, slowly add the sodium gluconate while continuing the mechanical agitation. When the sodium gluconate has completely dissolved, add the detergent. Add water to the 1,000-gallon level and stir until thoroughly mixed.

Table 631-5-4 Materials For 1,000 Gallons Of Caustic Sequestrant Solution

Quantity	Material	Explanation
1,200 lbs	Sodium hydroxide (lye)	Approximately 19 oz/gal
800 lbs	Sodium gluconate	Approximately 13 oz/gal
1 gal	Nonionic, water-soluble, liquid detergent	

631-5.12.6.5 Bilge Preparation. Remove deck plates to provide access to the bilge area. Install plywood planking. Drain all piping in the bilge and blank-off the open ends of the piping. Remove electrical equipment and cables, pipe lagging, aluminum handwheels, and all other material and equipment susceptible to damage by the caustic solution. Cover any equipment which cannot be removed to prevent splashing by the chemical solution and damage from vapor. Air test tanks and voids below the bilge at 2 lb/in² to ensure watertight integrity of the system, including any access covers for freshwater or feedwater tanks which may be in the bilge areas. Provide ventilation and connections for air, steam, and water. Provide facilities for pumping solutions from bilge.

631-5.12.6.6 Oil and Scale Removal. Spray all bilge surfaces with solvent cleaning compound (MIL-C-22230). Permit the surfaces to soak for 30 minutes. Wash down the bilge with a high-velocity stream of water warmed to 49° C (120° F). Pump out bilge. Inspect for oil and grime removal and reclean as necessary. Inspect bilge surfaces, particularly the tank top, for heavy iron oxide scale. Oil impregnated corrosion products or thick scale will not be adequately removed by the method described in this paragraph. If necessary, remove heavy scale and other debris from the bilge before introducing the caustic solution.

631-5.12.6.7 Equipment Installation. Install the quantity of heat exchanger coils necessary to maintain a uniform solution temperature of 88° C (190° F) in all parts of the bilge. The heat exchangers shall be fitted so they may be used as heating coils by the introduction of steam, or as coolers by circulation of cold water. Install the quantity of solution agitators necessary to produce vigorous stirring of the solution in all parts of the bilge. Install ventilation exhaust blowers and ducting. Install necessary piping and connections for air, steam, and water.

WARNING

During chemical treatment of the bilge, check for the evolution of hydrogen by periodically using the hydrogen detector. If hydrogen is detected, smoking, welding, burning, and all other ignition sources shall be prohibited.

631-5.12.6.8 Bilge Cleaning. Pump cold caustic-sequestrant solution into the bilge to fill to the top of the deck plate supports. Heat the solution to 88° C (190° F) and agitate the solution during the entire treatment period. Maintain temperature at 88° C (190° F) for 24 hours.

631-5.12.6.8.1 As an optional step, to prolong the useful life of the caustic-sequestrant solution, pretreat the bilge with a hot caustic soda solution. This removes undesirable types of paint that may be present. The caustic-sequestrant treatment is then used to remove rust. A spent caustic-sequestrant solution may be used for this purpose if it is refortified with caustic soda. A 12-hour treatment with 16 ounces per gallon caustic soda solution at 82° C (180° F) removes paint effectively.

631-5.12.6.9 Removal of Alkaline Solution. Cool the solution by circulating cold water through the heat exchangers. When it is cold, pump the caustic-sequestrant solution from the bilge. Collect the used solution in a storage tank or barge for refortification or disposal, or pump the solution directly into an adjacent bilge. Disposal shall be in accordance with local regulations.

631-5.12.6.10 Detergent and Freshwater Rinse. Fill bilge with freshwater. Add 1 gallon of nonionic, water soluble, liquid detergent, MIL-D-16791, Type 1, for each 1,000 gallons of water. Heat the detergent solution to 82° C (180° F). Agitate solution vigorously while maintaining temperature for 30 minutes. While continuing agitation, pump out the hot solution. Disposal shall be in accordance with local regulations.

631-5.12.6.10.1 Immediately after removal of the detergent solution, wash all surfaces with a high-velocity stream of warm freshwater to remove residual scum and corrosion. Dry bilge surfaces with a combination of air blast, exhaust ventilation, and hand drying.

631-5.12.6.11 Bilge Inspection. Inspect the bilge to determine if the surfaces are suitable for paint application, according to the specified cleanliness level for the job. Any remaining loose or damaged coating or rust shall be removed before paint application. Apply paint as soon as possible, since surfaces will develop flash rusting if exposed to water or high humidity.

631-5.12.7 CLEANING SOLUTION RECLAMATION. The bilge cleaning solution may be reclaimed for the next use by physical separation of the insoluble material, followed by chemical refortification. On settling, the contaminated solution separates into three layers. The top layer is a scum consisting largely of insoluble soaps; the middle layer is a clear solution; and the bottom layer is principally paint pigments and magnetite. Settling may be accomplished by pumping the solution to a settling tank and letting it stand long enough for separation, after which the clear solution is pumped to a holding tank. The solution shall not be discharged through a ship-board oil/water separator.

631-5.12.7.1 The solution may then be refortified by additions of sodium hydroxide and sodium gluconate in the quantities that tests indicate will restore the solution to its original strength. A nonionic wetting agent should be added at the rate of 1 quart per 1,000 gallons of solution. The cleaning solution can be used indefinitely. Experience has shown no discernible reduction in cleaning efficiency after six uses.

631-5.13 HAND CLEANING OF SHIPS' BILGES.

631-5.13.1 GENERAL. The hand-cleaning method is used solely to prepare bilge surfaces for repainting, as some routine methods of cleaning bilges for other purposes are inadequate for paint preparation. When cleaning of the bilges is required to facilitate inspections of the condition of existing paint or structure, washing with freshwater, washing with detergent, hand cleaning, and/or using the emulsifiable solvent described below may be used. The hand cleaning method is described in the following paragraphs.

631-5.13.1.1 Submarine Condition Assessment. For submarine bilges, after soils have been removed by pre-cleaning, surfaces showing evidence of corrosion, pitting, rust, scaling, or general paint failure must be evaluated in accordance with Unrestricted Operations (URO) MRC 003 when the URO MRC is scheduled for accomplishment, or Maintenance Standard (MS) No. 7650-081-091 when the URO MRC is not scheduled for accomplishment.

631-5.13.2 HAND CLEANING PROCEDURES. When hand cleaning procedures are implemented, work sections no larger than 200 to 300 square feet should be cleaned at a time. Longitudinal and transverse structural members can be used as boundaries to define the work sections. Each section should be fully cleaned and primed before work is started on the next section. The procedure is essentially hand cleaning, with the assistance of detergent solutions to aid in soil removal.

WARNING

Bilge cleaning compound is flammable. Do not smoke in the area where it is used. Do not pour or spray the solution on hot surfaces. Do not use atomizing spray equipment to apply the emulsified solvent solution; this will create an explosion hazard.

CAUTION

Exercise care during the cleaning process to prevent damage to intact paint surfaces, wireways, piping, damping tiles, transducers, etc.

CAUTION

Ensure all machinery and electronics are protected from contamination due to dust, paint overspray, cleaning solutions, and other forms of contamination that might compromise the equipment.

631-5.13.3 CLEANING SOLUTIONS APPLICATION. The two chemical solutions used in the hand cleaning procedure are an emulsifiable solvent and an alkaline water-base cleaner.

631-5.13.3.1 Emulsifiable Solvent. The emulsifiable solvent is used to penetrate and loosen oil-saturated soils which are then emulsified and washed away in a high-velocity stream of freshwater. After solvent cleaning, any rust, loose paint, or oily incrustations are removed from the surfaces by brushing or scraping. This is essential because new paint will bond only to clean metal or to clean, sound, existing paint. Do not discharge these solutions through a shipboard oil/water separator.

631-5.13.3.2 Alkaline Solution. Solvent cleaning, although effective for removal of oil, grease, and grime, leaves an oily film on the surface that will interfere with paint adhesion. To remove this film, the surfaces shall be recleaned with the alkaline solution. Permit the alkaline solution to remain on the surface for a minimum of 30 minutes. Scrub the sprayed surfaces with a stiff-bristle brush to remove heavy soil and permit better penetration. Use a paintbrush to reapply the solution where needed. Do not discharge these solutions through a shipboard oil/water separator.

631-5.13.4 DETAILED PROCEDURE. Specific steps for bilge cleaning are specified in the following paragraphs.

631-5.13.4.1 Solvent Application. Remove all debris from the bilge. Use pressurized, non-atomizing spray equipment to apply the MIL-C-22230 solvent bilge cleaning compound (NSN 6850-00-965-2359, 5 gallons). Permit the solvent to remain on the surface for at least 30 minutes.

631-5.13.4.1.1 Scrub the sprayed surfaces with a stiff-bristle brush to remove heavy soil and permit better solvent penetration. Use a paintbrush to reapply solvent where needed.

631-5.13.4.2 Initial Rinsing. Power-rinse all surfaces with a high-velocity stream of warm, freshwater.

CAUTION

For SSN-21 and SSN-774 Class submarines, excessive use of mechanical tools (grinders, sanders, chippers, etc.) must be minimized to avoid metal loss due to lack of corrosion allowance. Any areas where excessive metal

Caution - precedes

thickness loss by corrosion or mechanical cleaning is suspected must be assessed in accordance with URO MRC 003.

631-5.13.4.3 Hand and Power Tool Cleaning. Remove emulsified soil by continuous vacuum stripping while rinsing. Remove all remaining loose paint, corrosion products, or other soil by hand or power tool cleaning. Prior to re-painting, surfaces that were required to be cleaned down to bare metal due to failed or damaged paint shall meet the cleanliness requirements of SSPC-SP 11, with a minimum surface profile of 2 mils, as described in [631-5.3.3](#). The edges of existing tightly adherent paint surrounding areas that have been cleaned to bare metal must be cleaned and feathered to a tapered edge to provide a smooth transition to the bare metal. The overlap for touchup painting should be approximately 1" to 2".

631-5.13.4.4 Application of Alkaline Solution. Spray all surfaces with an alkaline water-base cleaning solution prepared by dissolving the following ingredients in 50 gallons of freshwater:

Three pounds of sodium metasilicate pentahydrate (NSN 6810- 00-664-7062).

Three pounds of sodium phosphate tri-basic dodecahydrate (NSN 6810-00-151-6080).

Three pints of water-soluble nonionic detergent (NSN 7930- 00-985-6911).

631-5.13.4.5 Final Rinse. Rinse all surfaces with freshwater. Vacuum strip while rinsing. Continue rinsing and stripping until the rinse waters are no longer alkaline (for example: when tested with red litmus paper, the paper remains red). Do not discharge alkaline solutions through a shipboard oil/water separator.

631-5.13.4.5.1 Dry all surfaces immediately to prevent rusting. Prime surfaces as soon as dry.

631-5.14 PREPARATION QUALITY ASSURANCE TESTS, INSPECTIONS AND RECORDS.

631-5.14.1 GENERAL REQUIREMENTS. Unless otherwise specified herein, the Quality Assurance (QA) test and inspection methods, and criteria associated with the preparation of surfaces to be coated shall be as described in the following paragraphs. For critical coated areas, defined in [paragraph 631-11.2](#), the performance of these tests and inspections, and the preparation and submittal of records of these tests and inspections, shall be as described in [Section 11](#).

631-5.14.2 PREPARATORY REQUIREMENTS FOR CRITICAL COATED AREAS. For defined critical coated areas, the requirements for preparatory measures to be taken before surface preparation for coating in [paragraph 631-5.2.2](#) shall be met.

631-5.14.3 ENVIRONMENTAL CONDITIONS. Before abrasive blasting or waterjetting is initiated, the air temperature and surface temperature shall be measured in close proximity to the surface to be cleaned, and the dew point shall be determined. The surface temperature shall be a minimum of 5° F above the dew point before and during the abrasive blasting or waterjetting operation. For potable water and feedwater tanks, environmental readings shall be taken a minimum of every four hours from the start of surface preparation to seven (7) days after application of the final coat. (Refer to [paragraph 631-8.5.5](#).)

631-5.14.3.1 Environmental Conditions for Coating Application. Requirements for the continuance or performance of measurements of environmental conditions, with the addition of relative humidity, for coating application and curing, are described in [paragraph 631-7.1.4](#). If adverse environmental conditions lead to condensation, surface rusting, or other deterioration of the prepared surface between the completion of surface preparation and the start of coating application, then the surface shall be restored to the specified cleanliness level prior to paint application.

631-5.14.4 SURFACE CLEANLINESS. Unless otherwise specified herein, all surface preparation shall meet the cleanliness requirements of the latest revision of the appropriate SSPC specification designated. Unless otherwise specified, the minimum requirement is abrasive blasting to Near White Metal, SSPC-SP 10. For surface preparation of steel surfaces, the SSPC visual standard publications SSPC-VIS 1, SSPC-VIS 3, SSPC-VIS 4, and SSPC-VIS 5 may be used to supplement the written requirements of the SSPC cleanliness standard to evaluate the degree of cleanliness. For metallic surfaces other than steel, refer to the applicable sections of [paragraphs 631-5.4](#) for abrasive blasting, and [631-5.5](#) for waterjetting.

631-5.14.4.1 Determination of Initial Surface Condition. When using the SSPC visual guides to assess the cleanliness of prepared steel surfaces, prior to hand and power tool cleaning and abrasive blasting, the condition of the metal surface shall be determined as indicated in those visual guides. This is done because the initial surface condition affects the resulting visual appearance of the prepared surface.

631-5.14.5 CERTIFICATION OF ABRASIVE BLAST MEDIA. Abrasive blast media shall be certified as being in conformance with the applicable specification for the media, as described in [paragraph 631-5.4.4](#).

631-5.14.6 RESIDUAL DUST AFTER SURFACE PREPARATION. All prepared surfaces shall be free of dust prior to priming. Surfaces shall be inspected in accordance with ISO 8502-3, Assessment of Dust on Steel Surfaces Prepared for Painting (Pressure Sensitive Tape Method), and shall meet Rating 2, Class 2. Five individual readings shall be taken for the first 1,000 square feet (with a minimum of five tape readings taken for areas less than 1,000 square feet); for each additional 1,000 square feet, two tape readings shall be taken. Surfaces that do not meet this criterion shall be vacuumed or otherwise cleaned until this criterion is met. The tape reading requirement is waived if the surface was prepared using only SSPC-SP 12 UHP (ultra high pressure) waterjetting and the primer is applied within 6 hours of completion of UHP waterjetting.

631-5.14.7 SURFACE PROFILE. After the surface is prepared and dirt, dust, and abrasive media are removed, surface profile measurements shall be made in accordance with ASTM D 4417, Method C ("Press-O-Film" compressible tape), except that the number of tape measurements shall be determined as stated below. The grade of profile tape used (i.e. its range of measurement) shall be appropriate for the specified and actual profile. Tapes used to measure the profile shall become a part of the record. In determining compliance with the profile requirement, three (3) **individual tape measurements** shall be made and averaged to produce one (1) profile **reading**. One profile **reading** shall be taken for every 200 square feet for the first 1,000 square feet; for each additional 1,000 square feet, 2 profile **readings** shall be taken; the average of the **readings** in each 1,000 square feet shall then be determined. If areas are found to be greater than 5 mils, i.e. beyond the measuring ability of the commonly available extra coarse profile tape, use ASTM D4417 Method B (fine pointed probe, or profilometer gage) in those areas to determine the profile. The sampling locations shall accurately characterize the complex geometries that have been prepared. If a non-conforming area is found, additional profile tests shall be conducted in order to bound the non-conforming area, and the area shall be re-prepared to achieve the required profile. Electronic profile measurement devices may be used as an alternative to the profile tape test, provided that they have been approved by NAVSEA.

631-5.14.7.1 Surface Profile for Blasted Surfaces. Unless otherwise specified herein, the average surface profile required after dry or wet abrasive blasting, abrasive sponge media blasting, or waterjetting shall be between 2.0 and 4.0 mils, with no individual tape reading being less than 1 mil, nor more than 5 mils.

631-5.14.7.2 Surface Profile for SSPC-SP 11 Power Tool Cleaned Surfaces. Unless otherwise specified herein, the average surface profile after power tool cleaning to SSPC-SP 11 shall be at least 2 mils for critical coated areas defined in [paragraph 631-11.2](#), and one (1) mil minimum for all other areas where accessible, with no individual tape reading being less than 1 mil nor more than 5 mils. Inaccessible areas must be determined by inspection and agreed to by the responsible authority (e.g. the Supervisor, the certified coatings inspector authorized to represent NAVSEA, etc.)

631-5.14.7.3 Profile Conflict With Coating Manufacturer's Data Sheet. When surface profile requirements of the coating manufacturer's data sheets are greater (higher numeric values) than those specified herein, the manufacturer's surface profile requirements shall take precedence over this NSTM.

631-5.14.8 SOLUBLE SALTS. For all types of substrates in defined critical coated areas, before painting the cleaned area shall be tested for the presence of non-visible soluble salts. Either surface conductivity testing or chloride testing shall be used, in accordance with the procedures and criteria below. Take five (5) measurements every 1,000 ft (90m²). Areas less than 1,000 ft² (90m²) shall have 5 measurements made. Measurements shall be made randomly over the prepared surface.

631-5.14.8.1 Conductivity Testing and Criteria. Conductivity testing shall follow the procedure illustrated in [Figure 631-5-1](#). The maximum surface conductivity levels shall be 30 microsiemens/cm for surfaces that are immersed in service (tanks, underwater hull, and bilges), or 70 microsiemens/cm for all other non-immersed or topside surfaces.

631-5.14.8.2 Chloride Testing and Criteria. Chloride samples shall be collected using steps 1 through 6 of [Figure 631-5-1](#), and the collected samples shall be tested using the Bresle titration method, or other approved field or laboratory test method. The maximum surface chloride levels shall be 3 micrograms per square centimeter (3 µg/cm²) for surfaces that are immersed in service (such as tanks, underwater hull, and bilges), or 5 micrograms per square centimeter (5 µg/cm²) for all other non-immersed or topside surfaces. Electronic chloride measurement devices may be used as an alternative to the Bresle titration method test, provided that they have been approved by NAVSEA.

631-5.14.8.3 Non-Compliant Soluble Salt Test Results. Conductivity testing provides a measure of all water-soluble ionic contaminants on a surface, including chlorides. Therefore, if conductivity testing is initially performed and fails to meet the above criteria, then a confirmatory chloride test may be performed. If the chloride level measured in the confirmatory test meet the above criteria, then the surface shall be considered to pass the soluble salts test. If a conductivity test fails, and the confirmatory chloride test is not conducted, or if the chloride test fails, pressure wash the affected area(s) with freshwater at 3,000-5,000 PSI, dry the area(s), and repeat the testing until satisfactory levels are obtained. The freshwater should have a maximum conductivity of 200 microsiemens/cm. If, as a result of water washing, flash rusting occurs on steel surfaces to a degree beyond that specified for the area being painted, the surface must be re-cleaned to the originally specified visual cleanliness level.

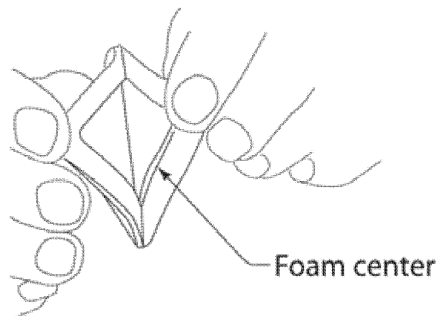
SURFACE CONDUCTIVITY TESTING

BEFORE TESTING: Assure that the conductivity meter has been calibrated according to manufacturer's directions. Because of the extreme sensitivity of the test, it is important to wear clean latex or nitrile gloves during the extraction of soluble salts to prevent contamination of the surface.

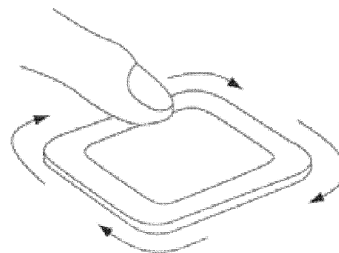
AFTER TESTING: clean conductivity cell with deionized (DI) water *after each test*. Do NOT store a contaminated cell for long periods.

STEP 1: Remove the protective backing and foam center from the Bresle patch.

Note: Patch center may be round or square.



STEP 2: Apply patch to surface. Press firmly around perimeter of patch to ensure a complete seal.

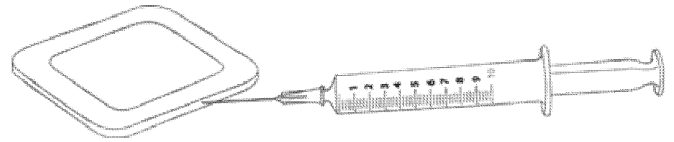


STEP 3: Fill syringe with 3 milliliters (ml) of deionized (DI) water.

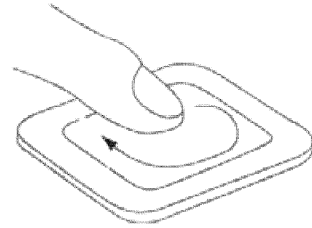


Figure 631-5-1 Surface Conductivity Testing Procedure. (Page 1 of 3)

STEP 4: Insert syringe into patch through the spongy foam perimeter and inject 1.5 ml of the DI water into the patch. With the syringe still in the patch, reposition the needle and evacuate (suck out) any air in the patch. Once the air has been removed, inject the remaining 1.5 ml of DI water.



STEP 5: Remove syringe from the patch and gently rub the surface of the patch for 10-15 seconds to allow the water to dissolve surface contaminants. Reinsert syringe through foam perimeter of patch, and extract solution. Remove syringe from patch.



STEP 6: Empty the contents of the syringe into a clean container. (See step 7b for alternative.)

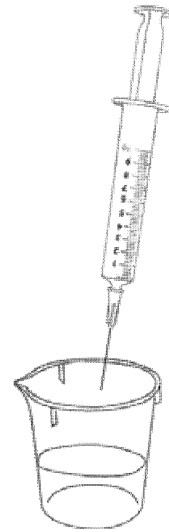
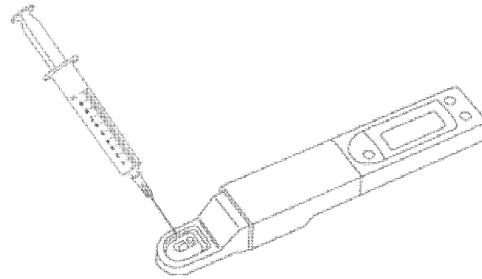
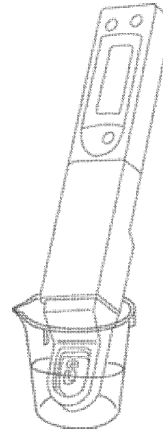


Figure 631-5.1 Surface Conductivity Testing Procedure. (Page 2 of 3)

STEP 7a: Measure the conductivity of the water using a digital conductivity meter.

-OR-

STEP 7b: Inject sample directly into conductivity cell. Rinse cell several times with the test solution to be measured before taking reading.



STEP 8: (This step can be performed after Step 5 if desired.) Remove patch from surface. Be sure to remove any residual adhesive before painting, using solvent if necessary.

Figure 631-5.1 Surface Conductivity Testing Procedure. (Page 3 of 3)

SECTION 6

PAINT APPLICATION GUIDANCE AND REQUIREMENTS

631-6.1 GENERAL.

631-6.1.1 There are basic requirements that shall be met whenever significant painting is accomplished aboard a Navy ship. This section covers basic paint application techniques that should be followed.

631-6.1.2 When painting schedules conflict with the requirements given in this chapter, guidance on paint compatibility and touch-up procedures shall be obtained from NAVSEA or a designated NAVSEA representative. For nuclear-powered vessels, if there is a conflict between this chapter and the propulsion plant or reactor plant paint schedules, then the paint schedules shall take precedence. Should doubt arise on paint identification, laboratory testing shall be used as the basis for verification. Consult NAVSEA or a designated NAVSEA representative for assistance.

631-6.2 PAINTING RECORDS, REPORTS, AND DOCUMENTATION.

631-6.2.1 RECORDS. Records of significant ship-board paint application shall be maintained. These include routine maintenance that requires painting, regular overhauls docking, and major alterations.

631-6.2.2 PAINTING SCHEDULES, CCIMS DATABASE, AND DOCKING REPORTS. The painting schedules and docking reports that shall be consulted and updated are described in the following paragraphs.

631-6.2.2.1 New Construction Painting Schedule. The new construction painting schedule should be referred to in accomplishing touch-up painting prior to ship delivery. In addition, ships with non-deviation new construction paint schedules should use these schedules for all painting following ship delivery unless otherwise specifically approved by NAVSEA. Following ship delivery, and where non-deviation paint schedules do not exist, the coatings and application procedures specified in this chapter shall be used when known to be compatible with existing coatings, or when surfaces are cleaned to bare metal or other substrate.

631-6.2.2.2 Ship Painting Schedule. The individual ship painting schedule should be revised and updated at each regular overhaul to reflect current painting requirements.

631-6.2.2.3 Overhaul Painting Schedules. Overhaul painting schedules may be used to update new construction painting schedules and should be used when available.

631-6.2.2.4 Docking Reports. Docking reports shall contain supplemental preservation data sheets for all tanks, voids, and shipbottoms. The sheets shall include:

- a. Method and extent of surface preparation.
- b. Coating applied (trade name and numerical designation shall be used in listing commercial coatings).
- c. Method and extent of paint application.

631-6.2.2.5 CCIMS. The Corrosion Control Information Management System (CCIMS) shall be updated for tanks, voids and other applicable systems whenever coatings systems are replaced. This database is more easily updated than the Painting Schedules and should be utilized when planning for determining existing coatings installed.

631-6.2.3 SPECIALIZED EQUIPMENT PAINTING REQUIREMENTS. Painting requirements for specialized shipboard equipment, compartments, and spaces (especially in the electronics, weapons, and concealment categories) are found in separate specifications and publications. Painting requirements contained in these documents shall be followed unless specific changes are approved by NAVSEA or the Type Commander. Requests for changes to these painting requirements should be initiated when:

- a. Documents are outdated, specifying either coatings no longer available or procedures found impractical in the field.
- b. Equivalent products are available in the National Supply System to replace specified commercial coatings.

631-6.3 BASIC PREPARATIONS.

631-6.3.1 GENERAL. To obtain optimum performance from a coating, certain basic procedures shall be followed, regardless of the type of equipment selected for paint application.

631-6.3.2 TEMPERATURE, WIND, AND HUMIDITY REQUIREMENTS. It is essential for surface and surrounding temperature to be between 10 and 32° C (50 and 90° F) for water-based coatings, and between 2 and 35° C (35 and 95° F) for other coatings, unless the manufacturer specifies otherwise. For potable water and feed water tanks, more stringent requirements apply; refer to [paragraphs 631-8.5 and 631-8.6](#). Except for the specific moisture tolerant paints per MIL-PRF-23236, Type VII, Class 17, paint shall be applied only when surfaces are completely dry and surface temperature is at least 2° C (5° F) above the dew point. The paint material should be maintained at a temperature of 18 to 29° C (65 to 85° F) at all times. Paint is not to be applied when the temperature is expected to drop to freezing before the paint has dried. Wind velocity should be less than 15 miles per hour for exterior painting, unless suitable protective enclosures or containment is used. Except for all types of tanks and floodable voids where the service life of the coating system being applied is intended to be 15 years or more, the relative humidity at the specific location where the work is being performed (either exterior area or shop, or interior shipboard space) shall be a maximum of 85% from the start of surface preparation through the cure of the final topcoat. For all types of tanks and floodable voids where the service life of the coating system being applied is intended to be 15 years or more, the relative humidity in the tank or void shall be maintained at a maximum of 50% from the start of surface preparation through cure of the final topcoat. For surface preparation of any area by waterjetting, the relative humidity requirements apply from the time that the surface is dry through the cure of the final topcoat.

NOTE

Tank and floodable void coating systems with intended service lives of 15 years or more are described in [Table 631-8-12](#). These are currently the ultra-high solids (UHS) edge-retentive MIL-PRF-23236 Type VII, Class 5 and 7 coatings.

631-6.3.3 PAINT MIXING. Paints shall not be used until they are thoroughly mixed. Improper mixing is one of the principal reasons for poor paint performance. Tinting pastes, if used, shall be mixed in a similar manner before they are added to the paint. Pastes shall be measured carefully, and stirred in until no streaking occurs and the desired color is obtained.

631-6.3.3.1 Single-Component Paints. Mechanical paint agitators (shakers) shall be used whenever possible. If a shaker is not available, the paint shall be stirred until all lumps, cakes, and sediments are completely dispersed. Stirring should be done in accordance with the following procedure:

1. Open the paint can. If a skin has formed on the paint surface, it should be carefully removed and discarded.
2. Pour the top 2/3 of the paint into another can.
3. Stir the pigment and liquid left in the first can until the paint is smooth. A paint mixing attachment for use with an electric or pneumatic drill is suitable. See [Section 2](#) for applicable safety precautions.
4. Gradually add contents of the second can to the first can, continuing to stir.
5. Continue to mix by pouring the paint back and forth from one can to the other (boxing) until uniformly smooth.

631-6.3.3.2 Two-Part Paints. Two part paints cure by chemical reaction of one component with the other. The two components shall be kept separated until the paint is ready for application. The two packages are generally designated as component A and component B with one containing the resin (generally A) and one containing the curing agent or hardener (generally B). Neither component can be used alone. Failure to mix components in accordance with required mix ratios will result in products that fail to cure properly. Mixing involves the following steps:

1. Stir the A and B components individually to disperse any lumps and obtain a consistent mixture.
2. While continuing agitation of the A component, slowly add all of the B component.
3. Agitate until a smooth, uniform, consistent mixture is obtained.

631-6.3.3.2.1 Because these products cure by chemical reaction, the reactions will be slowed or even stopped at low temperatures and accelerated at high temperatures. Once the chemical cross-linking proceeds, the product will reach a stage where the viscosity (consistency) increases to such a high degree that the product is no longer applicable. This stage is referred to (in increments of time) as pot life.

631-6.3.3.2.2 Paint manufacturers normally package two-part products (Part A/Part B) such that all of Part A and all of Part B are to be mixed together and used at one time. The prepackaged mix ratios are 1:1, 2:1, 3:1 or 4:1 and the maintenance of these ratios is critical - under no circumstances shall the Parts A and B be subdivided and the resultant partial kits be used.

631-6.3.3.3 Paint Straining. Strain the paint through a wire screen or cheese cloth to remove any particles or skins that remain un-dissolved after stirring.

631-6.3.4 MULTICOATING APPLICATIONS. When successive coats of the same paint are used, each coat shall be a contrasting color to aid in determining proper application and to ensure complete coverage. Sufficient time shall be allowed for each coat to dry thoroughly before topcoating or subjecting the painted surface to ser-

vice conditions such as immersion. To ensure removal of solvents and to avoid blistering of layer coats, when paint is applied in a confined area such as a tank, proper ventilation shall be used. Air exhaust shall be from bottom of a tank and from any pockets.

631-6.4 BASIC PAINTING PROCEDURES.

631-6.4.1 GENERAL. The basic techniques, procedures, and methods used in the application of paints are described in the following paragraphs.

NOTE

Before starting any painting job, ensure that surface preparation has been completed as directed in [Section 5](#) of this chapter. Apply the first coat of paint as soon as practicable after surface preparation has been accomplished, but in no case shall more than 6 hours elapse from the time abrasive blasting is completed until the first coat of paint is applied.

631-6.4.2 PAINTBRUSH TECHNIQUES. The techniques used in the application of paint with a brush are described in the following paragraphs.

631-6.4.2.1 Painting Procedure. Start major work on overhead areas first, then work downward. Begin painting at a corner or some other logical vertical division. Cover only that area which can be easily reached without moving ladders. Work downward, painting progressive sections to the deck level, then start at the top of the adjacent area and work down again. Paint trim, doors, or similar areas after bulkheads and other major surfaces are completed.

631-6.4.2.2 Coating Application. Dip the brush into the paint up to 1/2 the bristle length. Withdraw the brush and tap it against the inside of the bucket to remove excess paint. Hold the brush at an angle of 45 degrees to the work. Make several light strokes in the area to be painted. This will transfer much of the paint to the surface. Then spread the paint evenly and uniformly. Do not bear down on the brush.

631-6.4.2.2.1 When one section of the surface is painted, adjacent areas should be painted so that the brush strokes are completed by sweeping the brush into the wet edge of the paint previously applied. This helps eliminate lap marks and provides a more even coating.

631-6.4.2.2.2 Finally, cross-brush lightly to smooth the painted surface and to eliminate brush or sag marks. Very fast drying finishes will not permit much brushing and cross-lapping; in such cases, the paint shall be applied, spread rapidly, then allowed to dry undisturbed. Going back over a fast-drying paint will cause piling up of the coating.

631-6.4.3 PAINT ROLLER TECHNIQUE. The technique used in the application of paint with a roller is described in the following paragraphs.

631-6.4.3.1 Paint to Roller Procedure. To apply paint with a roller, pour the premixed paint into the tray to about 1/2 the tray depth. Immerse the roller completely, then roll it back and forth along the ramp to coat the cover completely. Remove any excess paint. As an alternative to using the tray, place the specially designed gal-

vanized wire screen (grid) into a 5-gallon can of the paint. This screen attaches to the can and remains at the correct angle to load and spread paint onto the roller. The first load of paint on a roller should be worked out on newspaper to remove entrapped air from the roller cover. It is then ready to apply to a surface.

631-6.4.3.2 Paint Application. When a roller is passed over a surface, thousands of tiny fibers continually compress and expand, releasing the coating and wetting the surface. This application of paint is in sharp contrast to other application methods which depend upon the skill and technique of the painter. The uniformity of application by roller is less susceptible to variance because of painter ability than other methods.

631-6.4.3.2.1 Always roll paint onto the surface, working from the dry area into the just painted area. Never roll completely in the same or one direction. One good technique is to roll the paint onto the surface in a W pattern and then fill in the area inside the W using horizontal or vertical strokes. Don't roll too fast. Avoid spinning the roller at the end of the stroke. Always feather out final strokes to pick up any excess paint on the surface. Feathering is done by rolling out the final stroke with minimal pressure.

631-6.4.4 CONVENTIONAL SPRAY PAINTING TECHNIQUES. Conventional spray painting techniques are described in the following paragraphs.

631-6.4.4.1 Spray Painting Preparation. Before spray painting starts, ensure that the following steps are completed.

1. Mix the paint thoroughly.
2. Strain the paint through a wire screen or cloth to remove skin and coarse or foreign particles.
3. Ensure that the air filter is connected to the main air supply line to prevent moisture and oil particles from mixing with the paint.

631-6.4.4.2 Spray Pattern Adjustment. After making initial adjustments to the air and liquid pressures (see [Figures 631-6-1](#) and [631-6-2](#)), make the final spray gun adjustment by observing the spray pattern. A normal spray pattern will appear as illustrated in [Figure 631-6-3](#), A and B.

631-6.4.4.3 Spray Gun Paint Application. The spray gun shall be held 6 to 12 inches from the surface being painted. Begin the strokes before pulling the trigger and release the trigger before ending the stroke (see [Figure 631-6-4](#)). This prevents piling up paint at the beginning and end of each stroke. Always keep the gun at a right angle to the surface being painted. Swinging the gun in an arc results in uneven application and excessive overspray at the end of the stroke.

631-6.4.4.3.1 When painting corners, first spray the adjoining bulkheads or surfaces to within a 1 to 2 inch margin from the corner. Then holding the gun sideways, spray the corner so that both sides of the corner are sprayed at the same time. Speed of application depends upon the material being sprayed, rate of paint flow, and surface to be coated.

631-6.4.5 AIRLESS SPRAY TECHNIQUE. Airless spraying is a high-production method of coating application. Material can be applied to surfaces as fast as the painter can move the gun. Since the degree of atomization with airless spray is not sufficiently fine, this method should not be used for fine finishing.

WARNING

Considerable care shall be exercised in operating airless spray paint equipment because of the high pressure used. Refer to [Section 2](#) for safety precautions.

631-6.4.5.1 The high rate of speed, plus the release of pressure, causes atomization without compressed air. There is no air turbulence to deflect the paint, which is the usual cause of overspray in the conventional method. The absence of air also reduces rebounding of the paint in crevices and corners, providing more uniform coverage.

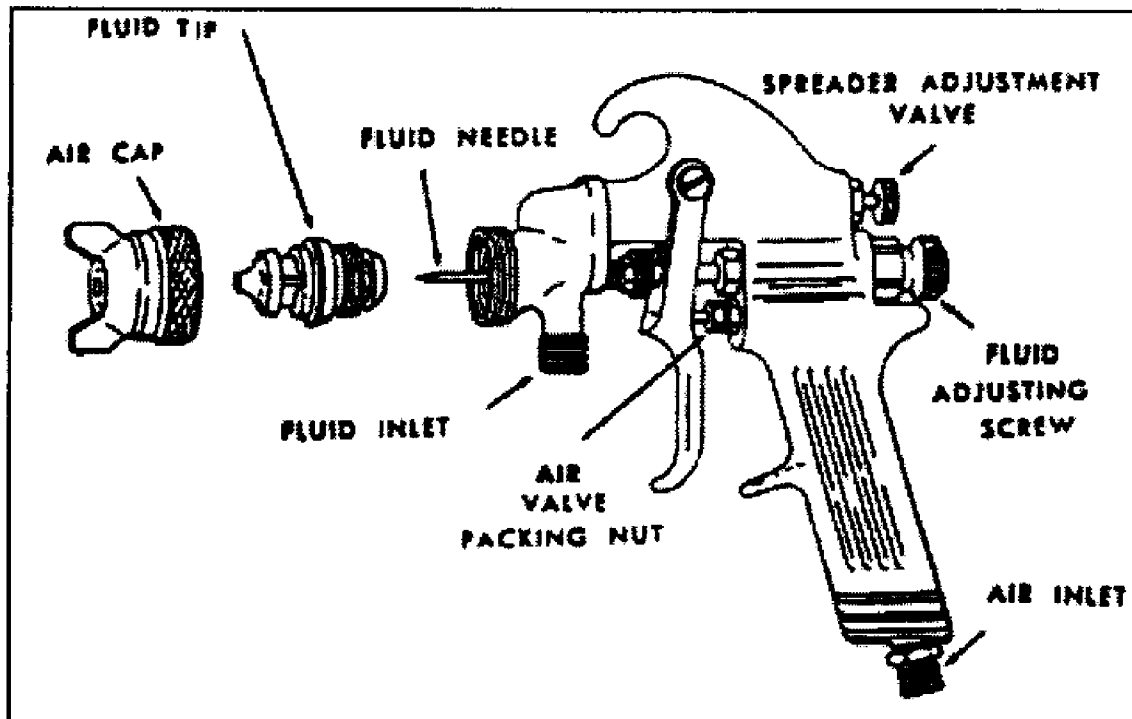


Figure 631-6-1 Spray Gun Adjustments

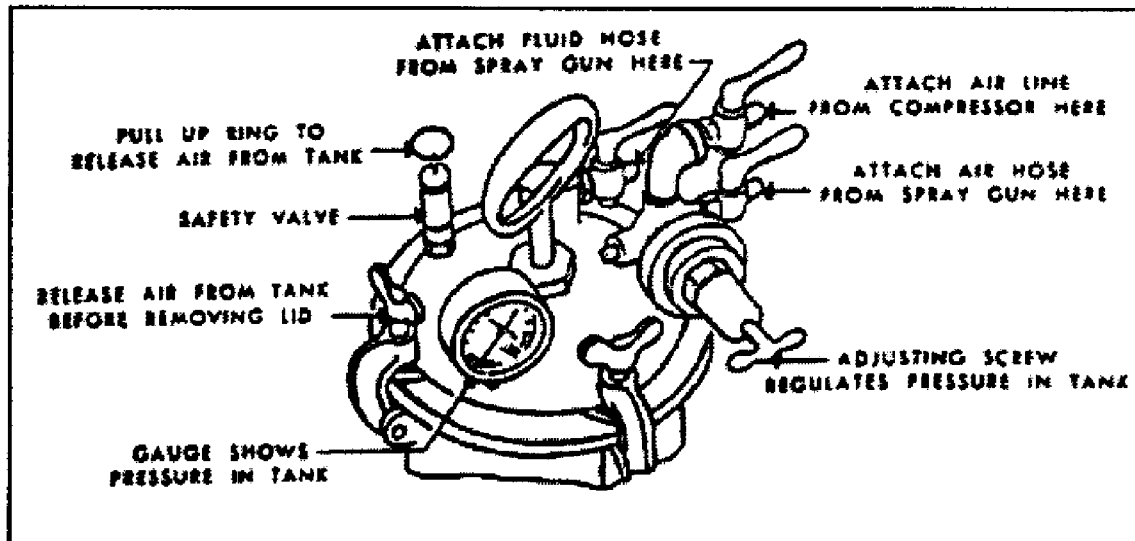


Figure 631-6-2 Typical Pressure Pot Fittings

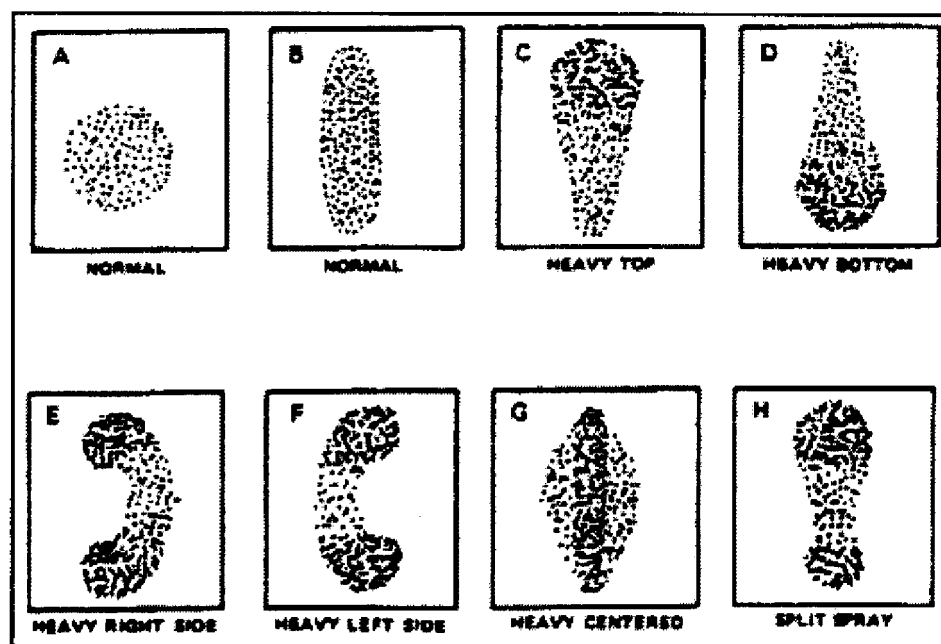
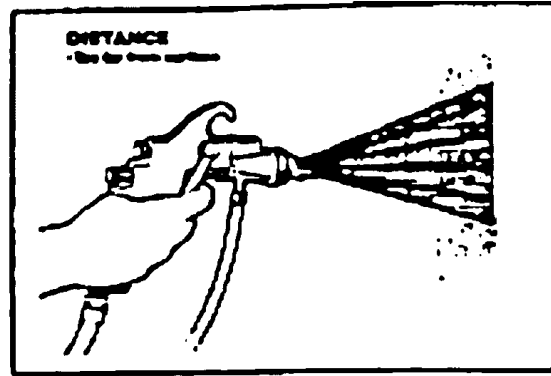
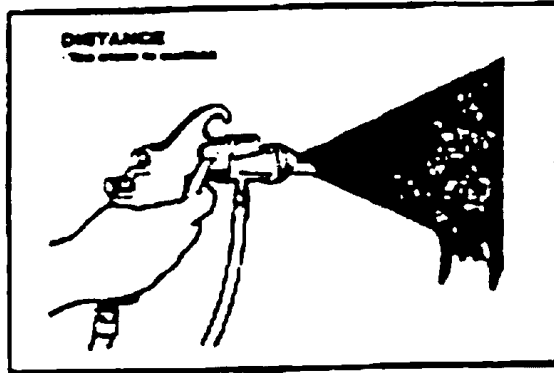
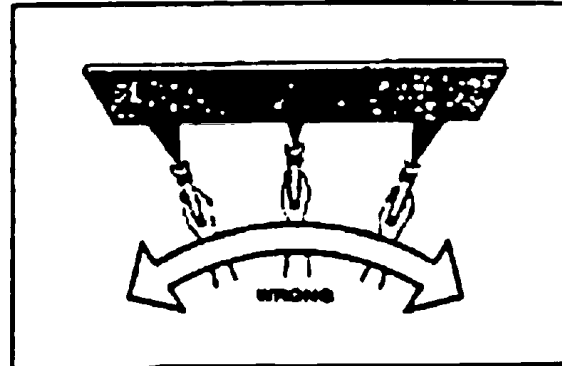
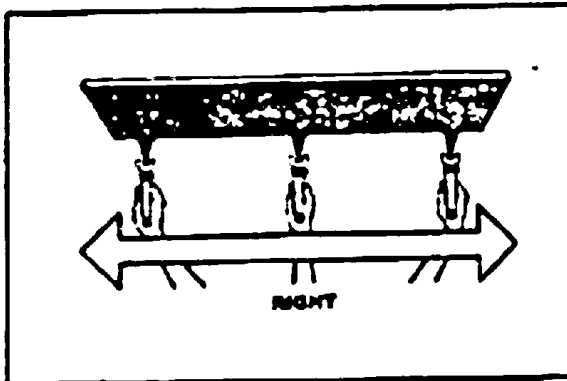


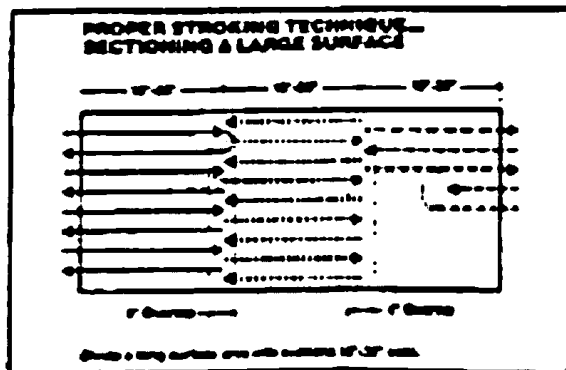
Figure 631-6-3 Spray Paint Patterns



Distance. The material and atomization pressure determine the proper distance from the surface. It may vary from 6 to 12 inches for conventional spraying and 12 to 15 inches for airless, which gives a wetter spray. The paint should always go on evenly and wet.

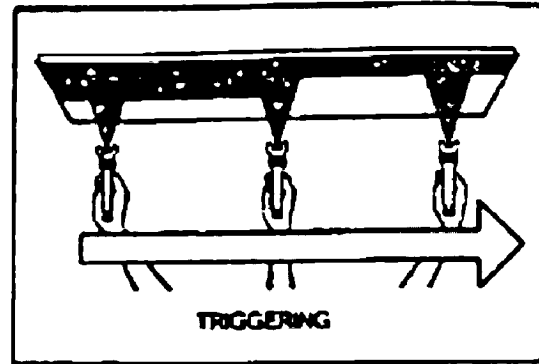
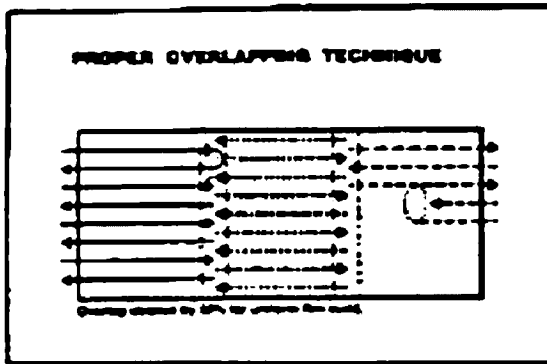


Stroking. While holding the spray gun at a right angle to the work, move the arm and shoulder as well as the wrist parallel to the surface. This prevents "arcing" which gives an uneven coat. The arm must remain at right angles to the surface.



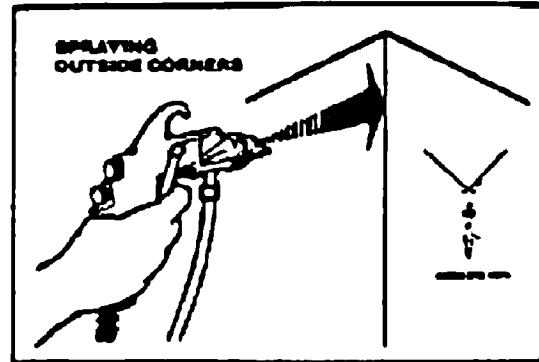
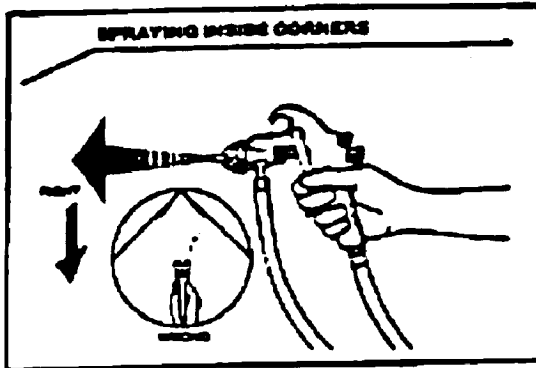
An ideal stroke length is 18 to 36 inches. When a surface area is too long to be sprayed with one stroke, it is divided into separate sections. The basic triggering and horizontal stroking technique is used on each section. Each area slightly overlaps the previous one to give an even and continuous film.

Figure 631-6-4 Spraying Techniques (Sheet 1 of 2)



Each stroke should overlap the previous stroke by 50%. If uniform overlapping is maintained, the film thickness will be uniform.

Triggering. The spray gun should be triggered at the beginning and end of each stroke. The gun should be in motion before triggering and before releasing at the end of a stroke. This method helps to give accurate control of the spray gun and the materials.



Each side of an inside corner should be sprayed separately. If the spray gun is aimed directly into the corner, the coating will not be uniform. It will go on too thin in the corner and too heavy at the sides. To get an even coating, a vertical stroke is used at one side, followed by a short horizontal stroke applied in the direction away from the corner.

When spraying an outside corner, the gun is aimed directly at the corner. One stroke coats the corner and the adjoining sides at the same time. Each side is then sprayed separately.

Speed. Spraying should always be done at a consistent rate of speed. The proper speed deposits a full, wet coat with each stroke. A slow stroke deposits a thick film and a faster stroke applies a thinner paint film. If quick stroking is needed to avoid flooding, then the fluid nozzle is too large or the fluid pressure is too high. If slow stroking is necessary to get a wet coat, increase the fluid pressure or the size of the fluid nozzle. Speed and rhythm are developed with experience.

Figure 631-6-4 Spraying Techniques (Sheet 2 of 2)

631-6.4.6 PLURAL COMPONENT PAINT APPLICATION. The use of plural component paint application equipment is gaining popularity, especially when newer high-solids and ultra-high solids (UHS) 2-part epoxy paint systems with shorter pot lives than prior paints are being applied. Figure 631-6-5 shows a schematic of the plural component paint system application equipment. The system components include the feed system for parts A and B of the paint, a proportioning and pumping system, a mixing manifold system, heating system, hoses, and spray guns. A means to provide solvent flushing through the mix manifold is also required. In plural component application systems, components A and B of the paint are power stirred and agitated separately, heated to reduce their viscosities, and then pumped to a proportioning unit, which in turn separately pumps the Parts A and B in the specified mix ratios in heated high-pressure hoses to a mixing unit, where the two components are mixed together and immediately sent on to the spraying guns. Since the two components of the paint are mixed “on-demand” just prior to reaching the spray guns, applying short pot life paints can be managed more efficiently. In addition, the original components can be stored separately in large containers, such as the 55-gallon drums shown in the figure, minimizing waste

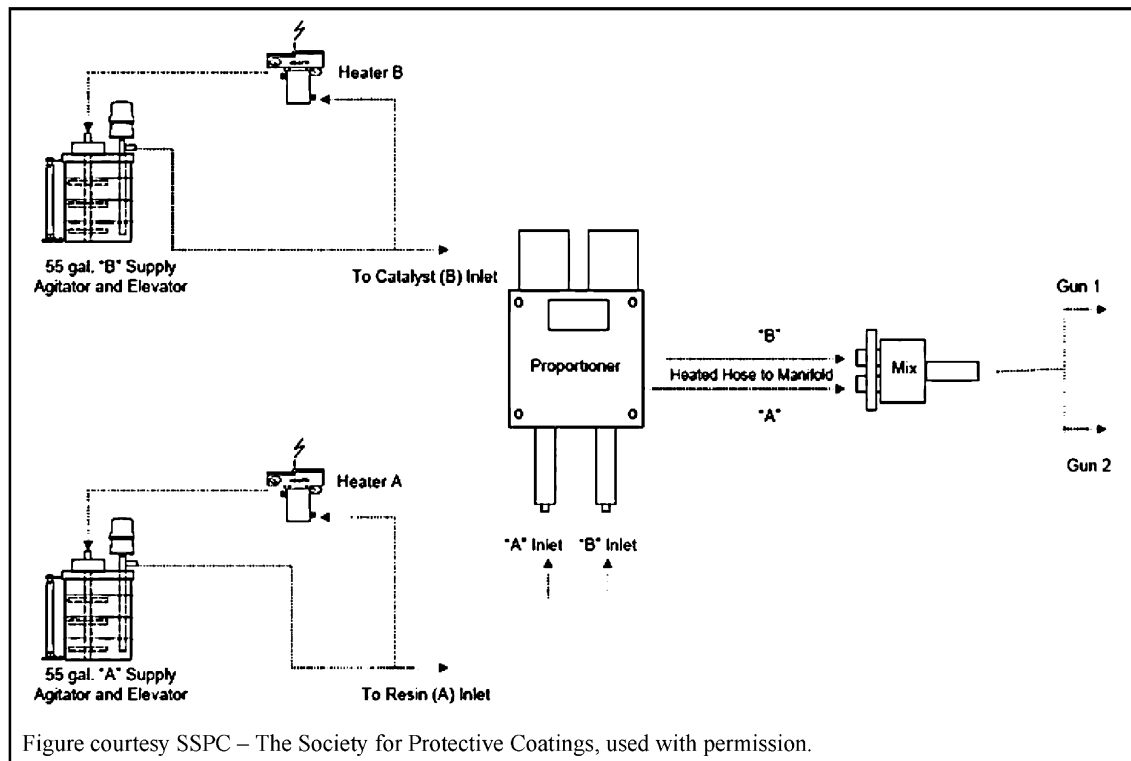


Figure 631-6-5 Plural Component Equipment Schematic

631-6.4.6.1 Importance of Correct Mixing Ratio . Obtaining the correct mixing ratios of multi-component paints like epoxies is always critical to achieve proper curing, which in turn affects the performance of the paint and the process time. Like other multi-part paint application techniques, when using plural component painting equipment, the mix ratio must always be checked before beginning work and after stoppages. The mix ratio should not vary from that specified by the paint manufacturers’ data sheet by more than 3%. Since the plural component process equipment is more complex than conventional air spray and airless equipment, it is important to understand where in the process and system components the mix ratio can be affected. Most commercial plural component equipment systems provide a monitoring system for the mixing ratio, as well as the temperatures and pressures at various points in the system. It is the responsibility of both tender and applicator to ensure the ratios are correct during spraying operations.

631-6.4.6.2 Feed System. The feed system sends the stirred and heated part A and B paint material through heated hoses to the proportioning pump. Filters are generally used to remove coarse clots or particles of paint that may clog the tips of spray guns. The feed pumps must be of a sufficient capacity to supply the proportion-

ing unit when it is operated at its maximum volume output. Most of these systems are pressure feed systems; the pressures of the feed systems should be well below those of the spraying system, so as not to overpower the intakes and valves in the downstream proportioning pump and create an incorrect mixing ratio. In this part of the system, it is important that the equipment is designed and operated to prevent air from being introduced or trapped in the system, since it can cause incorrect mixing ratios and excess wear of the proportioning pump.

631-6.4.6.3 Proportioning and Mixing Units. The proportioning unit takes the heated Part A and B paint material and pumps it to the mixing unit (sometimes called the mixing manifold) in the specific ratio for the paint being applied. The proportioners may be fixed, variable, or adjustable ratio units depending on the manufacturer and model; common fixed ratio units operate at 1-to-1 or 4-to-1 ratios. The mixing units or manifolds are where the Part A and B resin and catalyst are first brought together and mixed. They may be mounted on the proportioner or located separately and joined by heated hoses. The material is brought up to the mix valves and held there until the mixing unit is switched to spray. Once the mix manifold is turned to spray the materials are introduced into the mix chamber and into the static mixer. This is the point where the designated pot life begins, and equipment operators must be acutely aware of these time limits to avoid damage to the equipment. The solvent flushing system for cleaning and purging the mixer and lines is connected at this point. From the mixing unit, the mixed paint is connected to one or more spray guns via hoses; most units use airless spray guns.

631-6.4.6.4 Solvent Purge System. The solvent purge system is used to flush the mixed paint from the manifold, spray hose, and guns. The purged material must be collected for proper disposal per applicable regulations. Mixed components must be solvent purged or flushed from the system whenever the paint application is interrupted for several minutes, as determined from the paint manufacturer's recommendations.

WARNING

Most plural component paint spraying systems use high pressures (2,500-5,000 PSI) from the proportioning unit pump to the spray gun, which is generally an airless style. The safety precautions associated with high pressure airless paint spraying must be observed. Refer to Section 2 for safety precautions.

631-6.4.6.5 Heaters, Hoses, and Spray Guns. Unlike other types of paints, the UHS epoxy paints generally require that each component of the paint be heated in order to keep the viscosity down and the material freely flowing up to the mixing unit. The paint manufacturer's data sheets should provide information on the temperatures that should be used. Commercial plural component spray equipment meets these requirements by providing a heating system for the Part A and B material in the drums, and heated and insulated hoses from the drums to the mixing units. The paint materials should be brought up to the desired temperatures in the drums, as the heated hoses are intended just to maintain that temperature. Long hose runs and low ambient temperatures will make it more difficult to maintain the desired paint temperature. The temperature should be monitored throughout the application. For many units, the paint pressure from the mixing unit to the spray gun is in the range of 2,500- 5,000 PSI, so high pressure hoses and airless style spray guns are generally used. Note that high solids coatings tend to wear spray gun tips more rapidly than traditional solvent borne coatings.

631-6.4.6.6 Control of Paint Film Thickness. Theoretically, the wet film thickness of near-100% solids (UHS) coatings is the same as the dry film thickness. This and the high viscosity of the mixed paint can lead inexperienced applicators to have excessive film builds. Applicator training programs for UHS paints and plural component equipment and the use of smaller tips and guns when practical may be needed to control film thickness to within the specified limits.

631-6.4.7 CONVENTIONAL HOT SPRAY PROCESS. Hot spray is an industrial term for warming paint with special equipment before spraying with conventional spray equipment. Warm spray is often a better term to use in describing this process because most Navy paints, when warmed, do not exceed 49° C (120° F). Paints that are heated have reduced viscosity. Benefits of the hot spray process are:

- a. Elimination or reduction of gaps (holidays) in the film.
- b. Smoother and less porous finishes with fewer dimpled areas (orange peels), sags, or runs.
- c. Reduction in paint waste from overspray or fogging (misting).
- d. Elimination of need to add paint thinner to reduce paint to spraying consistency.
- e. Reduction of atomizing air pressures.
- f. Reduction of cleanup time where paint is recirculated overnight.
- g. Application of heavier coats, thereby reducing the number of coats required for a multiple-coat system, and total application time.
- h. Only minor gun adjustments are required over a wide range of weather conditions because paint viscosities are controlled by maintaining a constant spraying temperature, thereby achieving more consistent results.

631-6.4.8 IMPERFECT SPRAY PATTERNS SPRAY. Imperfect spray patterns are caused by clogging of the gun's paint or air passages, or improper balancing of the air or fluid pressures.

631-6.4.8.1 Clogged Passages. Imperfect spray patterns caused by clogged passages will take the forms illustrated in [Figure 631-6-3](#) and listed below:

- a. Heavy top pattern ([Figure 6-3](#), View C).
- b. Heavy bottom pattern ([Figure 6-3](#), View D).
- c. Heavy right-side pattern ([Figure 6-3](#), View E).
- d. Heavy left-side pattern ([Figure 6-3](#), View F).

631-6.4.8.2 Improper Air and Fluid Pressures. Imperfect spray patterns caused by improper balance of air and fluid pressures will take one of the following forms:

- a. Heavy center pattern ([Figure 6-3](#), View G) caused by:
 - 1. Spreader adjustment valve set too low.
 - 2. Excessive fluid pressure.
 - 3. Viscosity of paint too high (too thick).
- b. Split spray pattern ([Figure 6-3](#), View H) caused by:
 - 1. Spreader adjustment valve set too high:
 - 2. Spreader adjustment valve set too high.
 - 3. Viscosity of paint too low (too thin).

631-6.4.9 COMMON SPRAY PAINT DEFECTS. Some of the common causes of paint faults and how to remedy them are detailed in [Table 631-6-1](#). This table is reprinted with permission of SSPC – The Society for Protective Coatings (SSPC) from the 1966 edition of Volume 1, Good Painting Practice.

631-6.4.10 DIP PAINTING TECHNIQUES. Dip painting involves dipping an article to be painted into a tank filled with paint. The tank should be just large enough to permit convenient dipping of the article. An agitation method shall be provided to keep the paint uniformly mixed.

631-6.4.10.1 Give careful consideration to the type and amount of thinner used in the operation of a dip tank. The optimum consistency is that which provides coverage at the highest point, yet allows the paint to draw off well from the lowest point of the article being coated. Suspend the article in a manner that provides the shortest drain without creating paint pockets. Dip the article in the paint, remove slowly and regularly, and allow to drain. When it is apparent that dipping operations will be interrupted for several hours, remove the paint and place it in sealed containers.

Table 631-6-1 SPRAY PAINTING FAULTS AND HOW TO REMEDY THEM

Trouble	Possible Causes	Suggested Remedies
SAGS	1. Dirty air cap and fluid tip (distorted spray pattern). 2. Guns stroked too close to the surface. 3. Trigger not released at end of stroke (when stroke does not go beyond object). 4. Gun stroked at wrong angle to surface. 5. Paint too cold. 6. Paint piled on too heavy. 7. Paint thinned out too much.	1. Remove air cap and clean tip and air cap carefully. 2. Stroke the gun 6 to 10 in. from surface. 3. Operator should release the trigger after every stroke. 4. Gun should be stroked at right angles to surface. 5. Heat paint in an approved paint heater. 6. Learn to calculate depth of wet film of paint. 7. Add the correct amount of solvent by measure.
STREAKS	1. Dirty air cap and fluid tip (distorted spray pattern). 2. Insufficient or incorrect overlapping of strokes. 3. Gun stroked too rapidly (dusting of the paint). 4. Gun stroked at wrong angle to surface. 5. Stroking too far from surface. 6. Too much air pressure. 7. Split spray. 8. Paint too cold.	1. Remove air cap and clean tip and air cap carefully. 2. Follow the previous stroke accurately. Deposit a wet coat. 3. Avoid whipping. Take deliberate slow stroke. 4. Gun should be stroked at right angles to surface. 5. Stroke 6 to 10 in. from surface. 6. Use least air pressure necessary. 7. Clean the fluid tip and air cap. 8. Heat paint to get good flow out.
ORANGE PEEL	1. Paint not thinned out sufficiently. 2. Paint too cold. 3. Not depositing a wet coat. 4. Gun stroked too rapidly (dusting the paint). 5. Insufficient air pressure. 6. Using wrong air cap or fluid nozzle. 7. Gun stroked too far from the surface. 8. Overspray striking a previously sprayed surface.	1. Add the correct amount of solvent by measure. 2. Heat paint to get good flow out. 3. Check solvent. Use correct speed and overlap of stroke. 4. Avoid whipping. Take deliberate slow strokes. 5. Increase air pressure or reduce fluid pressure. 6. Select correct air cap and nozzle for the material and feed. 7. Stroke the gun 6 to 10 in. from surface. 8. Spray detail parts first. End with a wet coat.

Table 631-6-1 SPRAY PAINTING FAULTS AND HOW TO REMEDY

THEM - Continued

Trouble	Possible Causes	Suggested Remedies
EXCESSIVE PAINT LOSS	1. Not triggering the gun at each stroke. 2. Stroking at wrong angle to surface. 3. Stroking gun too far from the surface. 4. Wrong air cap or fluid tip. 5. Depositing a paint film of irregular thickness. 6. Air pressure too high. 7. Fluid pressure too high. 8. Paint too cold.	1. It should be a habit to release trigger after every stroke. 2. Gun should be stroked at right angles to surface. 3. Stroke the gun 6 to 10 in. from the surface. 4. Ascertain and use correct setup. 5. Learn to calculate the depth of wet film of finish. 6. Use the least amount of air necessary. 7. Reduce pressure. If pressure keeps climbing, clean regulator on pressure tank. 8. Heat paint to reduce air pressure.
EXCESSIVE SPRAY FOG	1. Too high air pressure. 2. Spraying past surface of the product. 3. Wrong air cap or fluid tip. 4. Gun stroked too far from the surface. 5. Material thinned out too much.	1. Use least amount of compressed air necessary. 2. Release trigger when gun passes target. 3. Ascertain and use correct setup. 4. Stroke the gun 6 to 10 in. from surface. 5. Add the correct amount of solvent by measure.
PAINT WON'T COME FROM SPRAY GUN	1. Out of paint (gun begins to sputter). 2. Settled, caked pigment blocking gun tip. 3. Grit, dirt, paint skins, and so forth, blocking gun tip, fluid valve or strainer.	1. Add paint, correctly thinned out and strained. 2. Remove obstruction; stir paint thoroughly. 3. Clean your spray gun thoroughly, and strain the paint. Always strain paint before using it.
PAINT WON'T COME FROM PRESSURE TANK	1. Lack of proper air pressure in the pressure tank. 2. Air intake opening, inside of pressure tank lid, clogged by dried up paint. 3. Leaking gaskets on tank cover.	1. Check for leaks or lack of air entry. 2. This is a common trouble. Clean the opening periodically. 3. Replace with a new gasket.
PAINT WON'T COME FROM SUCTION CUP	1. Dirty fluid tip and air cap. 2. Clogged air vent on cup cover. 3. You may be using the wrong air cap. 4. Leaky connections on fluid tube or nozzle.	1. Remove air cap and clean tip and air cap carefully. 2. Remove the obstruction. 3. Ascertain and use correct setup. 4. Check for leaks under water, and repair.
GUN SPUTTERS CONSTANTLY	1. Fluid nozzle not tightened to spray gun. 2. Leaky connection on fluid tube or needle packing suction gun. 3. Fluid pipe not tightened to the pressure tank lid.	1. Tighten securely, using a good gasket. 2. Tighten connections; lubricate packing. 3. Tighten. Check for defective threads.
PAINT LEAKS FROM SPRAY GUN	1. Fluid needle packing nut too tight. 2. Packing for fluid needle dry. 3. Foreign particle blocks fluid tip. 4. Damaged fluid tip or needle.	1. Loosen nut, lubricate packing. 2. Lubricate this part daily. 3. Remove tip and clean. 4. Replace both tip and needle.

631-6.5 PAINT FAILURES.

631-6.5.1 GENERAL. The types of common paint failures to look for when inspecting a surface before or after

an application of paint are described in the following paragraphs. Other failures, causes and remedies are shown in [Table 631-6-2](#). Many of these photographs are from the SSPC publication “Visual Comparison Manual: Application and Coating Defects” (book or CDROM format), used with permission of SSPC and the author..

631-6.5.2 ALLIGATORING OR CHECKING. Alligatoring, or checking, exists when the outer layer of paint is broken and underlying paint coats are visible, often presenting an appearance similar to alligator hide. This may be caused by applying paint:

- a. To unseasoned wood.
- b. Over a relatively soft undercoat.
- c. Over previous coats before they have dried.
- d. Of a hard drying non-elastic type over a more elastic paint.

631-6.5.3 CRACKING. Cracking exists when a break extends through to the substrate. Paints that lack elasticity because of aging or other causes can no longer contract or expand with moisture and temperature changes and, therefore, crack.

Table 631-6-2 Paint Failures, Causes, and Remedies.

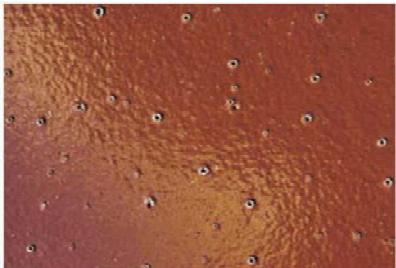
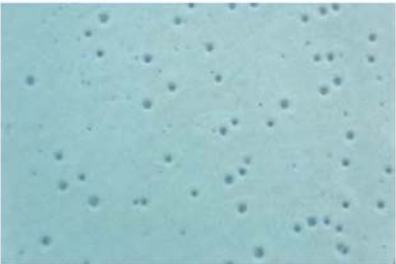
	CRATERS: Small round pock-marks or indentations in a spray-applied film caused by air bubbles that were trapped in the wet coating that burst after the coating had dried to the point that it could no longer re-cover them. Sand or blast the affected area to a smooth finish and apply additional coats to rebuild the film.
	PINHOLES: Tiny voids or holes in a film that penetrate to the substrate or previous layer. Caused by insufficient atomization, settling pigment, or improper solvent balance. Can also occur during drying due to burst air or gas bubbles, especially over porous substrates or prior coatings. If the paint has not cured, brush out the pinholes and apply an additional coat. If the paint has cured, apply an additional coat.
	FISHEYES: Film separation that exposes the previous coating or the substrate. Caused by oil, dirt, grease, or silicone on the surface, or by an incompatible coating. Sand or blast affected area and reapply coating system.

Table 631-6-2 Paint Failures, Causes, and Remedies. - Continued

	RUNS, SAGS, CURTAINS: Excessive flow or slippage of a coating caused by excess thinner, excess thickness, spray gun too close to surface, previous film too hard or glossy, or surface too cold. Brush out if uncured, or sand and reapply coating if cured
	WRINKLING: A rough or crinkled surface caused by excess coating thickness, high surface temperature, or a hard coating applied over a soft coating. It can also be caused by the solvent in an alkyd topcoat affecting an underlying coat that is not yet fully cured. Scrape wrinkles off and reapply thin coats to rebuild system.
	OVERSPRAY, DRY SPRAY: A flat, dry, pebbly appearance on the surface caused by too rapid solvent evaporation, or spray gun being too far from the surface. Before cure, remove by solvent wiping. After cure, sand and reapply system.
	BLISTERS: Bubbles in the film caused by solvent entrapment, or a surface contaminated with oil, moisture, or salt. Solvent entrapment blisters caused by application on top of an uncured film, and broken blisters smell of solvent. Osmotic blisters occur in service, often in water tanks, and blisters contain water. Remove solvent entrapment blisters by sanding, and apply new coat.
	ORANGE PEEL: Small hills and valleys in a film causing the surface to resemble the skin of an orange. Caused by improper atomization, material too viscous, gun too close to surface, or solvent evaporating too fast. Sand the affected area and reapply the coating.

Table 631-6-2 Paint Failures, Causes, and Remedies. - Continued

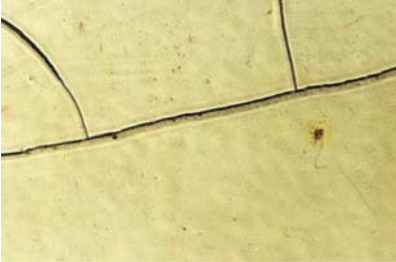
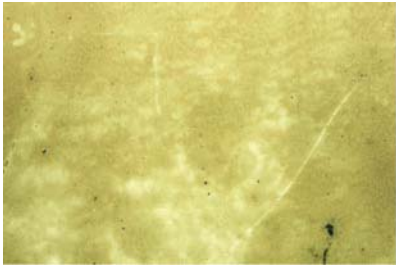
	CHECKING: Short narrow breaks in the dried film that does not penetrate to the substrate. Caused by excess thickness, high temperature during application, or loss of elasticity in film. Sand to remove checks and reapply coating. Checking of anti-fouling paints that have been in service, on a ship that is in drydock, is not unusual and is not a source of concern unless cracking, flaking, or mudcracking is also present.
	CRACKING: Breaks in the dried coating that penetrate to the substrate. Caused by excess thickness, high temperature during application, or shrinkage of the film. Remove coating and reapply.
	CRACKING/FLAKING: Breaks in the coating that penetrate to the substrate, with edge curling and loss of adhesion. Caused by excess thickness, excess thinner, or too rapid drying. Remove coating and reapply.
	MUDCRACKING: Network of cracks in the coating that penetrate to the substrate, resembling cracked mud in a dried pond or puddle. Caused by excess thickness of inorganic zinc or water-based coatings. Remove all old coating and reapply.
	DIRT ON SURFACE: Blast media, dirt, or other contaminants left on a surface prior to painting, caused by inadequate cleaning. Sand or blast area clean and recoat.

Table 631-6-2 Paint Failures, Causes, and Remedies. - Continued

	BLOOM OR BLUSH: Oily deposit on the surface of a film, resulting in loss of gloss and dull color. Caused by coating being exposed to moisture or high humidity during curing. Also called amine bloom, since amine-cured epoxies are prone to this if the recommended environmental conditions are not maintained during application and cure. Remove with clean cloth or suitable solvent.
	CHALKING: Powdery layer on surface of paint film, accompanied by color fading. Common for epoxy coatings exposed to sunlight. Powdery deposits must be removed by abrasion or very light sweep blasting, and a chalk-resistant topcoat applied.

631-6.5.4 FLAKING, SCALING, AND PEELING. Flaking, scaling, and peeling are characterized by the detachment of pieces of paint, generally irregular in shape. When pieces are small, it is termed flaking; when pieces average over 1/4 inch, it is termed scaling; when pieces are larger (over 1 inch), it is termed peeling. Flaking and scaling usually follow cracking and have the same causes. Peeling is often caused by the presence of moisture behind the film or by incompatibility of paint films.

631-6.5.5 BLEEDING. Bleeding exists when the color of a previous coat is absorbed into the topcoat. Bleeding is usually caused by the solubility of the color ingredient of the undercoat in the vehicle of the new coat.

631-6.5.6 BLISTERING. Blistering occurs when a coat of paint detaches from an underlying coat of paint or from the base substrate in unbroken dome-shaped projections as a result of gases or liquid forming beneath or between coats.

631-6.5.7 CHALKING. Chalking is characterized by the presence of a loose powder evolved from the paint film, at or just beneath the surface. Chalking may be detected by rubbing the film under the fingertips. Slight chalking is desirable for some applications because the surface becomes self-cleaning. The degree of chalking is determined by the composition of the paint. It is most commonly observed on epoxy paints and coatings that are exposed to sunlight for extended periods.

631-6.5.8 DISCOLORATION. Discoloration is an alteration in the original color and includes yellowing, darkening, fading, and mottling.

SECTION 7

PAINT APPLICATION PROCEDURES

631-7.1 GENERAL REQUIREMENTS.

631-7.1.1 PRECEDENCE AND CONFLICT RESOLUTION. Detailed paint application procedures are frequently presented in system or equipment-specific Technical Manuals, military or Federal specifications and standards, and other NSTM chapters. In general, the requirements specified herein take precedence over other documents, unless those documents are specifically cited in this manual. Requirements in non-deviational drawings (e.g., propulsion plant paint schedules) take precedence over requirements contained herein. Whenever these painting procedures are in conflict, NAVSEA shall be consulted for resolution.

631-7.1.2 USE OF ASTM F718 DATA SHEETS. Unless otherwise specified herein, all paints and coatings that are qualified to performance specifications (MIL-PRF-23236,) see [paragraph 631-3.4.9](#) are to be applied in accordance with the manufacturer's NAVSEA-approved ASTM F718 product/procedure data sheet submitted at the time of product qualification to the applicable specification, or other NAVSEA approval. NAVSEA-approved ASTM F718 data sheets also have been prepared for coatings per specifications MIL-DTL-24441, MIL-E-24763, and TT-P-28. All coatings applied in designated critical coated areas (see [paragraph 631-11.2](#)) are to be applied in accordance with NAVSEA-approved ASTM F718 data sheets. NAVSEA-approved ASTM F718 data sheets refer to NAVSEA Standard Item 009-32 for dry film thickness (DFT) requirements. The DFT requirements stated in NAVSEA Standard Item 009-32 or this Technical Manual take precedence over any other manufacturer's coating data sheets. Copies of the NAVSEA-approved ASTM F718 data sheets are available from the National Surface Treatment Center (NST Center) web site, <http://www.nstcenter.com/>.

631-7.1.3 APPLICATION OF STRIPE COATS. For all areas where stripe coating is required herein, the stripe coat shall be applied to edges, weld seams, welds of attachments and appendages, cutouts, corners, butts, foot/handholds, and other mounting hardware (non-flat surfaces). The stripe coating requirement also applies to difficult-to-access areas such as the back side of piping and the underside of Tee and I-beam stiffeners. Unless otherwise specified herein, stripe coats shall be applied in accordance with the NAVSEA-approved ASTM F718 coating data sheets, except that the stripe coat DFT requirements shall be as specified herein. The paint used to perform stripe coating shall be not be thinned. Stripe coating shall be applied after the primer coat has dried. Stripe coats shall be neat in appearance, and shall have minimal runs, drips, or sags. Stripe coats may be brushed, rolled, or sprayed. The stripe coat shall encompass all edges and welds, as well as at least a one-inch border on each side of the edge or weld. Each stripe coat shall be of the specified paint system and shall be a different color from both the paint over which it is being applied and the next coat in the system. If a product only comes in two colors, the stripe coat shall contrast with the color of the previous coat. Inspections of the primer coat shall be conducted prior to stripe coat application. When measuring intermediate or total system DFT to determine compliance with the specified thickness, DFT readings shall not be taken in areas where stripe coatings have been applied. Stripe coat DFT requirements specified herein shall be checked by the painter in-process, using WFT measurements. Stripe coat DFT requirements are provided for each coating system table in [Section 8](#), and are summarized in [Table 631-1-4](#).

631-7.1.4 COATING APPLICATION REQUIREMENTS AND QUALITY ASSURANCE TESTS, INSPECTIONS AND RECORDS. Unless otherwise specified herein, the Quality Assurance (QA) test and inspection methods, and criteria associated with the application of coatings to prepared surfaces shall be as described in the following paragraphs. For critical coated areas, defined in [paragraph 631-11.2](#), the performance of these tests and inspections, and the preparation and submittal of records of these tests and inspections, shall be as described in [Section 11](#).

631-7.1.4.1 Environmental Conditions. Ambient and substrate surface temperatures, relative humidity, and dew point shall be measured and recorded in close proximity to the structure being coated. Environmental readings shall be taken from 12 hours prior to, to 48 hours after, the application of a coat of paint. For potable and feed-water tanks, environmental readings shall be taken from the start of surface preparation to 7 days after application of the final coat. The frequency of measurements of the environmental conditions shall be one of the options described below

- a. Use a continuous automatic data-logger that takes readings approximately every 5 minutes, installed in the space or area being cleaned, and manually verify the readings from the data-logger every 12 hours, and at every process step involving (G)-points as described in NAVSEA Standard Item 009-32. “Coating System Environment Recorder” made by Veriteq Instruments, Inc., Model no. KT-2000-NEI, (Veriteq web information: www.veriteq.com/navy) or equivalent may be used.
- b. Manually take measurements at 4-hour intervals during the time period required above, and at every process step involving (G)-points as described in NAVSEA Standard Item 009-32. :

NOTE

(G)-points are designated in a Work Item by the symbol (G), and establish a point in the sequence of accomplishment of work at which time the SUPERVISOR shall be notified to permit observation of a specific test or inspection by the government.

Unless otherwise specified herein, the surface temperature shall be maintained at a minimum of 5°F above the dew point, and in defined critical coated areas, shall be greater than 50 degrees Fahrenheit. In addition, unless otherwise specified herein, the ambient and substrate surface temperatures, and the relative humidity, shall be maintained in accordance with the NAVSEA-approved ASTM F718 data sheets. See [paragraph 631-8.5](#) for relative humidity and temperature requirements in potable and reserve feed water tanks, and [paragraph 631-8.18](#) for relative humidity requirements in all other tanks, voids, bilges and chain lockers. MIL-PRF-23236, Type VII, Class 17 products are exempt from dew point and relative humidity requirements; for these products, dew point and relative humidity do not need to be recorded on QA Checklist Forms.

631-7.1.4.2 Type of Paint, Shelf Life, Storage, and Receipt Inspection. Verify that the correct paint is being used in accordance with the specification; that the paint being used has not exceeded its shelf life; and that paint has been stored in accordance with [paragraph 631-3.4.5](#). Monitor the storage temperature of paint over a 24 hour period prior to use, and document the minimum and maximum temperatures. Verify receipt inspection requirements have been met for paint used in non-critical coated areas as per [paragraph 631-3.4.3](#), or per [Section 11](#) for paint used in critical coated areas.

631-7.1.4.3 Paint Mixing, Induction Times, and Cure and Overcoat Times. The following items shall be verified in accordance with the NAVSEA-approved ASTM F718 data sheets.

- a. Verify that the paint has been properly mixed.
- b. Verify that painters have allowed adequate induction time for multi-component paints, if applicable.
- c. Verify that painters have applied multi-coat paint systems within the allowable overcoat time windows (minimum and maximum recoat times).
- d. Verify that the dry time to immersion service, if applicable, has been met.

631-7.1.4.4 Film Thickness (WFT) Measurements. Wet A WFT gage shall be used to verify the application of proper paint thickness for the primer coat of all coating systems. Readings shall be taken to confirm this, but need not be recorded.

631-7.1.4.4.1 WFT readings shall be made in lieu of DFT readings for any coat that must be in a tacky state when the next coat is applied. The NAVSEA-approved ASTM F718 data sheets, or paragraph 7.2 and follow or [Section 8](#) of this NSTM will define when a coat must be in a tacky state prior to application of the next coat.

631-7.1.4.4.2 When required by [paragraphs 631-7.1.4.4.1](#) or [631-7.1.4.5.2](#), the DFT shall be calculated by measuring the WFT, as shown in the equation below. For non-metallic surfaces, if WFT readings are used to determine DFT in this manner, the sampling frequency, distribution, and acceptance criteria shall be the same as described in SSPC-PA 2, except that only one WFT reading is required to represent a “spot measurement” instead of the three “gage readings” defined in SSPC-PA 2. For metallic surfaces, the number of WFT spot readings shall be 2 readings per 1,000 sq ft. In the equation below, the percent solids by volume is expressed as the decimal form, i.e. 60% is 0.60, 100% is 1.00. The percent solids by volume is stated on the paint manufacturer’s NAVSEA-approved ASTM F718 data sheet. If it is not available, contact the paint manufacturer, or NAVSEA to obtain this figure.

$$\text{DFT} = (\text{WFT}) \times (\% \text{ solids by volume})$$

631-7.1.4.5 Dry Film Thickness (DFT) Measurements. DFT measurements made in accordance with SSPC-PA 2 shall be used to determine the compliance to the DFT requirements specified herein for all critical coated areas defined in [Section 11](#). SSPC-PA 2 may also be invoked for non-critical coated areas, either as described herein, or in the applicable work specification. The DFT gages used shall be certified or tested as accurate as described in SSPC-PA 2. Unless otherwise specified herein, the procedures for usage, calibration and adjustment, sampling rates per painted area, and determination of conformance to the specified thickness shall be in accordance with SSPC-PA 2.

NOTE

Observe the requirements of SSPC-PA 2 regarding access to the prepared bare metal substrate and the adjustment and measurement of both Type 1 (pull-off) and Type 2 (electronic) gages. In particular for Type 1 gages, the base metal reading (BMR) shall be obtained and recorded, and subtracted from the gage readings obtained on the coated surface.

NOTE

Type 2 DFT gages shall be required for all readings in the near future in order to comply with the NAVSEA “Paperless QA” initiative.

631-7.1.4.5.1 DFT Measurements On Non-Magnetic Substrates. SSPC-PA 2 is only directly applicable to non-magnetic coatings applied to magnetic substrates. However, commercial gages are available and shall be used for aluminum, stainless steel (CRES), and other non-magnetic metallic substrates. For these substrates, the sampling rates and determination of conformance to the specified thickness shall be in accordance with the methods described in SSPC-PA 2.

631-7.1.4.5.2 DFT Compliance For Non-Metallic Substrates. Unless otherwise specified herein or in the applicable work specification, in-process WFT measurements shall be used to determine compliance with the specified coating DFT ranges on non-metallic substrates, as described in [paragraph 631-7.1.4.4.2](#). When recording this coating application data under the Paperless QA initiative, WFT data, and the conversions based on the equation in [paragraph 631-7.1.4.4.2](#), shall be manually entered into a computer in a format compatible with the initiative.

631-7.1.4.6 Stripe Coats. When stripe coating is specified, verify that it has been performed in accordance with [paragraph 631-7.1.3](#).

631-7.1.4.7 Workmanship and Visual Holiday Inspection. A visual inspection for holidays (any small voids, skips, or other defects exposing bare metal) or other defects (runs, drips and sags) shall be performed after the primer has been applied, using adequate lighting, and any defects shall be identified by location and repaired. Visual inspections shall be conducted to standardized acceptance criteria to the extent practicable. Visual aids, such as SSPC publication “Visual Comparison Manual: Application and Coating Defects”, or “Pictorial Standards of Coating Defects” obtained from ASTM and the ASTM standards for evaluating the degree of checking, cracking, flaking, blistering, chalking, etc., may be used to ensure that quality standards are met.

631-7.1.4.8 Low-Voltage Wet Sponge Holiday Test. A holiday inspection using a low voltage, wet sponge holiday detector may be performed on metallic surfaces at the request of the coating inspector as a referee method in the case of disputes, or if specifically called for in a particular job specification. When used, low-voltage, wet sponge holiday testing shall be performed as described in NACE Standard RP0188-99, “Standard Recommended Practice – Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates”. Low-voltage, wet sponge holiday testing can only be used where the coating on the metal surface is 20 mils or less thick. The coating inspector or responsible QA activity shall ensure that a holiday detector is readily available during coating inspections in the event that its use is required, in order to minimize work disruptions or delays.

631-7.1.5 COATINGS ON WELDS THAT ARE TO BE PRESSURE-TESTED. Unless otherwise specified (e.g. reactor plant painting schedules, etc.), when post-fabrication or repair compartment air-tightness testing or piping system hydrostatic testing is required by the work specification, this testing should be performed after any required surface preparation, cleaning or flushing but prior to coating or any required disinfection. Joints, including new welds and weld repairs, shall be left un-insulated, unpainted, and exposed for examination during the test, unless they have been previously satisfactorily tested to the required pressure. Ideally all welding and testing of welds should occur before any coating is applied. If this cannot be avoided, or if a coating was previously applied and then subsequent welding or repairs were performed that require pressure testing, the coating must be removed for the testing, and the disturbed area repaired upon completion of the testing.

631-7.2 EPOXY-POLYAMIDE COATINGS (MIL-DTL-24441).

631-7.2.1 GENERAL. Epoxy-polyamide coatings are similar to other epoxy coatings in that they consist of a twocomponent system that includes a pigmented polyamide resin (component A) and an epoxy resin (component B). Once they are mixed together and applied as a paint film, the coating cures to a hard film by chemical conversion. During this curing period, the solvents used to reduce film viscosity and promote paint film leveling evaporate from the coating.

631-7.2.1.1 Mixing, Application, and Curing Temperature Limits. For proper curing, the maximum ambient and surface temperatures for the mixing, application, and curing of MIL-DTL-24441 Type III and IV products shall be 90 degrees Fahrenheit (32 degrees Celsius).

631-7.2.2 AVAILABILITY. Epoxy-polyamide coating (MIL-DTL-24441) is the Navy epoxy which consists of several individual formulations numbered from 150 through 162. Consult the latest issue of the specification for applicable formula numbers. These coatings are suitable for use in tanks, bilges, wet spaces, and on interior or exterior surfaces. Epoxy-polyamide coatings are available in 10-gallon, 2-gallon, and 2-quart kits.

631-7.2.3 HAZARDS. All MIL-DTL-24441 formulations have a minimum flashpoint of 35°C (95°F). Since solvent fumes from epoxy paint systems are potentially hazardous, suitable precautions shall be taken to prevent fires and to protect personnel from fumes and fume inhalation (particularly in confined spaces). Precautions against such hazards are contained in [Chapter 2](#) and NSTM Chapter 074, Volume 3, Gas Free Engineering.

631-7.2.3.1 In addition to fire and vapor hazards, these epoxy coatings can cause allergic reactions when allowed to come in contact with the skin. Prompt skin cleanup is recommended using soap and water, not solvent. Solvent will thin and spread the paint over the skin, permitting deeper penetration and increasing the hazard of a delayed allergic reaction. (Refer to [Chapter 2](#).)

631-7.2.4 SURFACE PREPARATION. The single factor most affecting the performance of the MIL-DTL-24441 epoxy-polyamide coatings is the preparation of the surface to be coated, both as to method and to degree of care. Surfaces to be coated shall be completely free from rust, loose paint, dirt, scale, oil, grease, salt deposits, moisture, and other contaminants. Surface preparation procedures detailed in [Chapter 5](#) apply and are supplemented by requirements given in this section. (Refer to [Chapter 2](#).)

631-7.2.4.1 Bare Surfaces. When painted surfaces show evidence of corrosion, peeling, blistering, checking, or general disintegration, the old paint shall be removed down to bare metal prior to repainting. Surfaces to be painted with the epoxy-polyamide system shall be abrasive-blasted to near-white metal in accordance with SSPCSP- 10. In areas where abrasive blasting is not permitted, the surfaces shall be cleaned to bare metal by mechanical means (e.g. disc sanding, chipping tools, or pneumatic descender or “needle gun”) to remove all loose paint film and foreign matter in accordance with SSPC-SP 11. Since abrasive blasting will not adequately clean surfaces contaminated with oil or grease, such areas shall be cleaned with solvent as specified in [paragraph 631-5.7](#).

631-7.2.4.2 Galvanized Steel. Galvanized steel shall be roughened by a light abrasive blast or by mechanical means to provide a suitable clean substrate for paint application.

631-7.2.4.3 Aluminum Surfaces. Aluminum shall be cleaned by light abrasive blasting, power wire brushing, or orbital sanding. Only stainless steel wire brushes, scouring pads, or aluminum oxide abrasive sanding disks shall be used. None of these materials shall have been previously used on other metal, or for the removal of copigmented paint, prior to being used on aluminum.

631-7.2.4.4 Surface Preparation of Coated Metal. Brush-off blasting (SSPC-SP 7) may be used instead of blasting to bare metal in those instances where an epoxy coating is in good condition and has been applied over a wellprepared surface. This method should result in a surface retaining all paint films, but free from all corrosion products, scale, and foreign matter.

631-7.2.4.5 Touch-up Painting. When only localized areas or spots require painting, it is essential that removal of the old paint be carried back to an area of completely intact and adhering paint film. Edges of tightly adhering paint remaining around the area to be recoated shall be sanded to a smooth tapered edge (feathered) from the

intact paint film to the bare metal area. Areas of intact paint to be over-coated shall first be roughened. A tack coat shall then be applied as described in [paragraph 631-7.2.6.5](#).

631-7.2.4.6 Bilges and Sumps. Structures and fittings below floor plates in machinery spaces (e.g. bilges, bilge wells, and sumps) may require special cleaning methods. A cleaning method for bilges on surface ships at shipyards is described in [paragraph 631-5.12.6](#). A hand-cleaning method for bilges on surface ships or submarines is described in [paragraph 631-5.13](#).

631-7.2.4.7 Coating Over Inorganic Zinc Coatings. If epoxy coatings are to be applied over aged, inorganic zinc coatings, or if the topcoat over an inorganic zinc coating has been removed by mechanical damage, the inorganic zinc coating should be scrubbed and washed with a detergent solution. This solution is prepared by mixing 8 pounds of sodium metasilicate, and 1 gallon of detergent (MIL-D-16791, Type 1) with sufficient freshwater to make 30 gallons of solution. Flush the cleaned surface with freshwater to remove the loosened dirt, grime, and cleaning solution. Allow surface to dry. Lightly roughen the dry surface by mechanical means, feathering the edges of the intact topcoat. Reapply the topcoat system. Apply the first coat of the topcoat system as a thin film coating the inorganic zinc and allow to dry. This fills the pores and seals the surface of the inorganic zinc coating. Follow this procedure with the complete topcoat system.

631-7.2.4.8 Wet Spaces. In wet spaces and shower stalls, remove corrosion products and cracked or loose paint by mechanical means. Retain tightly adhering paint. Edges of the sound, adherent paint film around the area to be recoated shall be feathered. Remove stains on old paint by solvent cleaning (SSPC-SP 1), detergent cleaning, or both. Rinse with clean freshwater and dry before repainting. Apply primer on the bare metal areas so it overlaps the intact paint. Apply topcoats over the spot-primed bare areas and the remaining intact painted surfaces. Intact painted areas do not require priming.

631-7.2.5 MIXING EPOXY-POLYAMIDE COATINGS. Epoxy-polyamide coatings are in measured amounts that shall be mixed together in exact proportions to ensure the correct chemical reaction.

631-7.2.5.1 Mixing Ratio. The mixing ratios of the MIL-DTL-24441 coatings are all 1:1 by volume; for example, 5 gallons of component A to 5 gallons of component B.

NOTE

The individual components of the various formulas are not interchangeable.

631-7.2.5.2 Mixing Procedure. Each component shall be thoroughly stirred prior to mixing the components together. After mixing equal volumes of the two components, this mixture shall again be thoroughly stirred until well blended. The induction or stand-in times given in [Table 631-7-1](#), shall be adhered to for Type III coatings. Type IV coatings do not require an induction time prior to application. Induction time is defined as that time immediately following the mixing together of components A and B during which the critical chemical reaction period of these components is initiated. This reaction period is essential to ensure the complete curing of the coating

Table 631-7-1 MIL-DTL-24441 TYPE III JOB SITE AMBIENT TEMPERATURE AND INDUCTION TIME

Job Site Ambient Temperature °C (°F)	Induction Time, Hours (In Location at 21°C (70°F) minimum)
2 to 10 (35 to 50)	2
11 to 16 (51 to 60)	1-1/2 to 2
16 to 21 (61 to 70)	1 to 1-1/2
22 to 32 (71 to 90)	1/2 to 1
GENERAL NOTES: 1. Type IV paints per MIL-DTL-24441 do not require an induction time after mixing. 2. Refer to paragraph 631-7.2.1.1 for general temperature limits.	

631-7.2.5.3 MIL-DTL-24441 Type III Induction Times. (This paragraph shall be considered mandatory for potable water tank painting; see [Table 631-8-2](#).) The approximate temperature of the paint components in storage should be estimated to judge the amount of induction time and the pot life that might be expected. The job site application temperature will affect the time required for the paint to cure, and shall be considered in estimating induction time, cure time, and the effect of batch size on these functions.

631-7.2.5.3.1 The induction times listed in [Table 631-7-1](#) are based on a 10-gallon batch. Smaller batches require a longer induction time. When these paints are to be applied at a job site having temperatures in the range of 2 to 10° C (35 to 50° F), it is essential that induction occur in a warm area that has a minimum temperature of 21° C (70°F). This ensures that the coating will fully cure. When the induction period is completed, the paint is carried to the job site. To ensure that the reaction proceeds uniformly, the paint should be stirred every 20 minutes during its induction period. This action prevents localized overheating or hot spots within the paint mixture.

631-7.2.5.4 Practical Pot Life of MIL-DTL-24441. [Table 631-7-2](#) gives the practical pot life for MIL-DTL-24441 after mixing components A and B. The listed pot life includes induction time. Pot life is the length of time that any two component mixture remains usable. Also refer to paragraph 631-7.2.1.1 for general temperature limits.

Table 631-7-2 MIL-DTL-24441 POT LIFE

Ambient Temperature °C (°F)	Pot Life (in hours)
4 to 16 (40 to 60)	7
16 to 27 (61 to 80)	6
27 to 38 (81 to 100)	3
38 to 49 (101 to 120)	0.5 to 1

631-7.2.5.4.1 When either ambient or steel surface temperature is at 2 to 10°C (35 to 50°F), it is essential that the induction period be in a warm area before the paint is carried to the job site. In addition to the mixing area being above 21°C (70°F), the paint itself should be at a minimum temperature of 21°C (70°F). To avoid the application of cold paint, below 10°C (50°F) only that quantity of paint should be carried to the job site which can be used within a practical time frame. To ensure that the reaction continues uniformly, the mixed components shall be stirred occasionally to avoid overheating (hot spots) within the paint mixture before transferring the paint mixture to the pressure pot. The requirements for occasional stirring of the blended components of the epoxy mixture are mandatory for both the commercially supplied epoxies and the MIL-DTL-24441 epoxy, regardless of ambient temperatures.

631-7.2.5.4.2 Where winter temperature conditions exist, the application of MIL-DTL-24441 epoxy paint at temperatures below 2° C (35° F) can be approved, provided that controlled application and temperature conditions are utilized which have been previously approved by NAVSEA. Wherever and whenever possible, the exterior winter application of epoxy should be avoided and preplanning and production scheduling prepared accordingly. Paint to be used at temperatures below 10°C (50°F) shall be stored for 24 hours at 21°C (70°F).

631-7.2.5.5 General Precautions When Using Epoxy Paints.

1. Always follow recommended mixing instructions and proportions.
2. Do not mix more paint than can be used within the estimated pot life.
3. Do not mix components of different paint formulas.
4. Do not use paint which has large un-dispersed pigment particles, or lumps, without first straining the paint. If more than a half-pint of solids per 5 gallons are retained in the strainer, do not use the paint.
5. Do not mix components, or paints, from different manufacturers.
6. Do not store unopened containers of epoxy in direct sunlight.
7. Do not thin paints unless there is a specific need that has been defined by the manufacturers instructions or other application.
8. Do not store unopened containers of epoxy paints at temperatures above 38°C (100°F).

631-7.2.5.6 General Guidance in Coating Applications. Always check the ambient (air) temperature and the temperature of the surface to be painted. Surface temperature is critical at the lower temperatures. This is especially so in relation to the dew point. To avoid condensation, the surface temperature shall be at least 2°C (5°F) higher than the dew point.

631-7.2.5.6.1 The use of surface temperature thermometers in colder climate locations is strongly recommended as a means of improved quality control in determining go/no go painting conditions. Ambient and surface temperature measurements are critical in relation to dew point and condensation or ice or frost formation.

631-7.2.5.6.2 Do not paint when the Relative Humidity (RH) is greater than 85 percent. For potable water, feed-water, and freshwater drain collecting tanks, the maximum relative humidity shall be 50% (see [paragraphs 631-8.5](#) and [631-8.6](#)).

631-7.2.5.6.3 Applicators should be issued wet film thickness gauges and trained in their use. A target wet film thickness expressed in mils for each individual coat of paint should be calculated and issued to the applicator so that he can stay within a specified range to assure a specified dry film thickness per coat. It is recommended that wet film thicknesses be periodically checked for accuracy by a responsible supervisor.

631-7.2.5.6.4 Records of key parameters from paint application in defined critical coated areas shall be as described in [paragraphs 631-7.1.4](#) and [631-11](#), and retained as described in [paragraph 631-11.4](#).

631-7.2.5.6.5 A pressure pot equipped with air-driven or spark-proof electrically powered agitator/stirrer shall be used when applying an epoxy coating system. Adequately mixing paint is essential to uniform appearance and cure rate.

631-7.2.5.6.6 Cross-hatch spraying of the primer coat is recommended to avoid holidays and failure to completely fill the valleys in the clean anchor pattern in the steel surface. This is a source of blistering if the valley is not fully coated and should be an area of close quality control inspection to avoid premature film failures. Quality control: existing quality control procedures which cover the surface preparation, paint processing/ preparation and paint application should be reviewed and upgraded, as necessary. Quality control inspections and sign-off approval should be invoked preceding and following each step in the total painting process. Defective work or a defective product shall be repaired, or replaced, before proceeding further in the painting process. Quality control requirements should be implemented through a standard painting process instruction.

631-7.2.6 EPOXY-POLYAMIDE COATING APPLICATION. Epoxy-polyamide coatings (MIL-DTL-24441) may be applied by brushing, spraying, and rolling or dip coating.

631-7.2.6.1 Application Thickness. Unless otherwise specified, apply each coat of paint to produce approximately 3 mils Dry Film Thickness (DFT). Applications that yield in excess of 4.0 mils DFT should be avoided.

631-7.2.6.2 Brush Application. During maintenance painting, brush application is recommended for the first coat of paint over mechanically cleaned surfaces and hand-cleaned bilges. The brushing effort forces the paint into the surface profile and displaces any traces of surface contaminants.

631-7.2.6.3 Spray Application. MIL-DTL-24441 paints should be sprayed with normal spray guns and normal spray pot pressures. The spray gun should be equipped with a middle-size (D) needle and nozzle setup. Both conventional and airless spray equipment are suitable for use.

631-7.2.6.4 Curing Time Between Coats of Epoxy. The minimum drying times between coats of MIL-DTL-24441 epoxy are shown in [Table 631-7-3](#). Where a different type of epoxy anticorrosive coating is used, the minimum and maximum overcoat time windows between coats, and contingency procedures, shall be as shown on the coating's NAVSEA-approved ASTM F718 data sheet

631-7.2.6.4.1 If more than seven days elapse between coats of MIL-DTL-24441 epoxy, the surface shall be cleaned with water and detergent and rinsed clean with freshwater and allowed to dry. If required, use solvents for grease and oil removal. If local air quality regulations do not allow the use of solvents for cleaning, use a soap and water solution followed by a liberal freshwater rinse. The surface shall be dry before painting. Then a tack coat (1 to 2 mils WFT) of the last coat applied, or Formula 150, shall be applied to the hard epoxy coat. It shall be allowed to dry approximately 4 hours before application of the next full coat of the epoxy. This same procedure applies to aged epoxy paint systems after service, except that surface preparation methods specified in [paragraphs 631-5.2.3.1](#) through [631-5.2.3.3](#) apply. Formula 150 shall be used as the tack coat when applying MIL-DTL- 24441 paints over proprietary epoxy coatings. Where it is compatible with ship scheduling requirements, epoxy paint drying times should be extended to 24 hours minimum between coats and seven days minimum before the coated surface is exposed to its service environment. This permits time for curing the epoxy and release of solvent. For potable water, reserve feed water, and freshwater drain collecting tanks, the requirements of [paragraphs 631-8.5](#) and [631-8.6](#) shall be strictly adhered to.

631-7.2.6.4.2 If more than 30 days has elapsed, any cured MIL-DTL-24441 epoxy coatings shall be thoroughly cleaned free of dirt, oil, grease, and other contaminants and then lightly roughened by a light sweep blasting. Blasting dust shall be removed by an air blow down. The final coat of MIL-DTL-24441 epoxy anticorrosive shall then reapplied over this roughened surface. This shall be allowed to cure to its final tacky stage before applying the first coat of any non-epoxy coating.

631-7.2.6.5 Application of Non-Epoxy Topcoat Paints. When MIL-PRF-24635 silicone alkyd, and other solventbased non-epoxy topcoats are applied over MIL-DTL-24441 epoxy paints, the epoxy paint shall be at least dry to touch and no longer tacky. When MIL-PRF-24596 and other water-based non-epoxy topcoats are applied over MIL-DTL-24441 epoxy paints, the epoxy paint shall have been allowed to dry at least 16 hours. This is because if the epoxy is still tacky when the non-epoxy topcoat is applied, it can greatly extend the time it takes for the non-epoxy topcoat to cure.

631-7.2.6.6 Curing Time for Touch-Up. The curing times for final coat touch-up shown in Table 631-7-4 are acceptable for minor touch-up involving less than 1% percent of the total area of painted surfaces, provided that they are augmented by Notes 1 through 4. These times apply to the paint system after application of the final touch-up coat. For touch-up, individual paint coats can be over-coated as soon as they are dry to the fingernail. For touch-up coatings in potable water, reserve feed water, and freshwater drain collecting tanks in nuclear-powered vessels, the requirements of Sections 631-8.5 and 631-8.6 shall be strictly adhered to.

631-7.2.6.7 Equipment Cleanup. Since epoxy paints cure with time, due to an internal chemical reaction, the paint should not be allowed to remain in spray equipment for an extended period, especially in the sun or a warm area. Increasing temperature cures the paint more rapidly. When components A and B are mixed together, the pot life of the mixture (including the induction time for Type III paints) is 6 hours at 21°C (70°F). Pot life is longer at lower temperatures and shorter at temperatures above 21°C (70°F). After use, spray equipment should be cleaned by flushing and washing with a mixture (1:1) of N-Butyl Alcohol and super high-flash naphtha. General clean-up is also done by using a mixture (1:1) of N-Butyl Alcohol and super high-flash naphtha. Brushes and rollers should be given a final cleaning in warm soapy water, rinsed clean with warm freshwater, and hung to dry. Solvents shall be recycled in accordance with local procedures and regulations.

Table 631-7-3 MINIMUM DRYING TIMES BETWEEN COATS OF MIL-DTL-24441 EPOXY

Ambient Temperature °C (°F)	Time (in hours)
2 to 4 (35 to 40)	24
5 to 16 (41 to 60)	18
16 to 27 (61 to 80)	12
27 to 38 (81 to 100)	8
38 to 49 (101 to 120)	6
NOTES: 1. For potable water, reserve feedwater, and freshwater drain collecting tanks, the drying time requirements of paragraph 631-8.5 apply. 2. Refer to paragraph 631-7.2.1.1 for general temperature limit requirement of 32°C (90°F) maximum; higher temperatures are reflected in this table for information only.	

Table 631-7-4 FINAL COAT CURING TIME FOR TOUCH-UP OF POLYAMIDE COATING SYSTEMS (MIL-DTL-24441)

Ambient Temperature °C (°F)	Curing Time (in hours)
4 to 16 (40 to 60)	7
16 to 27 (61 to 80)	6
27 to 38 (81 to 100)	3
38 to 49 (101 to 120)	0.5 to 1

NOTES:

1. Mixing and application of paints shall be in accordance with requirements of [Sections 6](#) and [Section 7](#).
2. Any surfaces that are artificially heated shall not exceed 27°C (80°F) during application of paint.
3. Air used for ventilation during application or curing of paint coats and whenever personnel are present in a confined space shall not be heated to a point where a potential safety hazard would be created. Acceptability of any heating procedures shall be evaluated locally on a case basis after review of the specific materials and conditions involved.
4. Gas free engineering services shall be provided during all phases of tank coating and curing (see [Section 2](#)), with particular attention to requirements for use of explosion-proof blowers, lamps, and other equipment.
5. Refer to [paragraph 631-7.2.1.1](#) for general temperature limit requirement of 32°C (90°F) maximum; higher temperatures are reflected in this table for information only.

631-7.3 MIL-PRF-23236 COATINGS.

631-7.3.1 MIL-PRF-23236 APPLICATION. Unless otherwise specified herein, the requirements for environmental conditions, surface preparation, mixing, application, and drying times of MIL-PRF-23236 coatings shall be as specified in the NAVSEA-approved ASTM F718 marine coating data sheets supplied by the coating manufacturer at the time of qualification testing to the current edition of the Qualified Products List (QPL-23236), except that the per coat and total system dry film thickness (DFT) shall be as shown in this Technical Manual. For potable water, feedwater, and freshwater drain collection tanks (see sections [631-8.5](#) and [631-8.6](#)), and for any tanks or floodable voids where 15 year or longer life MIL-PRF-23236 coating systems are being applied, the maximum relative humidity shall be 50%.

NOTE

MIL-PRF-23236 tank and floodable void coating systems with intended service lives of 15 years or more are described in [Table 631-8-12](#). These are currently the ultra-high solids (UHS) edge-retentive MIL-PRF-23236 Type VII, Class 5 and 7 coatings.

631-7.3.2 RUNS, DRIPS, AND SAGS IN TYPE VII COATINGS. Runs, drips, and sags may appear in MIL-PRF-23236 Type VII ultra-high solids (approximately equal to 100% solids) coatings due to their solvent-free nature and application properties. Runs, drips, and sags generally cause the coating thickness to exceed the specified maximums. If the total area of the runs, drips, and sags in any coat exceeds 5% of the surface area being coated, it shall be removed. For a wet run, drip, or sag on a dry surface, brush out the defect, and if necessary, reapply a new coat directly over the brushed out area. If the defect has dried, then the affected area shall be scraped or mechanically removed and the coat shall be reapplied.

631-7.3.3 TOUCH-UP PAINTING. For touch-up painting of MIL-PRF-23236 liquid epoxy coatings, in order to ensure compatibility between the coats, the new paint should be the same manufacturer and brand name designation as the existing paint. If non-epoxy topcoats (e.g. alkyds) have already been applied, they must be

removed from the borders of the area being touched-up by feathering the coating with a sander, in order for the epoxy coatings to properly adhere. Epoxy coatings in MIL-DTL-24441 are considered to be compatible topcoats for touch-up painting over the epoxy coatings in MIL-PRF-23236.

631-7.3.3.1 Touch-up of Sherwin Williams MIL-PRF-23236 Type VII Coatings. For touch-up of Sherwin Williams “Duraplate” or “Novaplate” paints per MIL-PRF-23236 Type VII, Sherwin Williams “Brushplate” may be used, and shall be applied at 8-10 mils DFT per coat. For touch-up of Sherwin Williams “Fast Clad ER” paint per MIL-PRF-23236 Type VII, Sherwin Williams “Fast Clad Brush Grade” may be used, and shall be applied at 8-10 mils DFT per coat.

631-7.3.4 APPLICATION OF NON-EPOXY TOPCOATS. When MIL-PRF-24635 silicone alkyd, and other solvent-based non-epoxy topcoats are applied over MIL-PRF-23236 epoxy paints, the epoxy paint shall be at least dry to touch and no longer tacky. When MIL-PRF-24596 and other water-based non-epoxy topcoats are applied over MIL-PRF-23236 epoxy paints, the epoxy paint shall have been allowed to dry at least 16 hours. This is because if the epoxy is still tacky when the non-epoxy topcoat is applied, it can greatly extend the time it takes for the non-epoxy topcoat to cure.

631-7.3.5 MIL-PRF-23236 COATINGS FOR INTERIOR SUBMARINE USE. When MIL-PRF-23236 coatings are specified for the interior of submarines in areas subject to the Submarine Atmosphere Control program, only coatings that have been specifically approved under that program shall be used. The MIL-PRF-23236 Type VII coatings currently approved for interior spaces of submarines under the Submarine Atmosphere Control Program are listed below.

MIL-PRF-23236 Type VII, Class 5:

FAST CLAD ER (The Sherwin Williams Co.)
NOVAPLATE UHS (The Sherwin Williams Co.)
SIGMA EDGEGUARD (SIGMA Coatings)

MIL-PRF-23236 Type VII, Class 7:

SIGMAGUARD BT (SIGMA coatings)
DURAPLATE UHS (The Sherwin Williams Co.)
INTERGARD 143 (International Paint, Inc.)
AMERCOAT 133 (PPG/Ameron USA)
AMERCOAT 333 (PPG/Ameron USA)
FAST CLAD ER (The Sherwin Williams Co.)

MIL-PRF-23236 Type VII, Class 9:

SIGMAGUARD CSF 85 (SIGMA Coatings)

MIL-PRF-23236 Type VII, Class 13:

SIGMA EDGEGUARD (SIGMA Coatings)
NOVAPLATE UHS (The Sherwin Williams Co.)

MIL-PRF-23236 Type VII, Class 17:

INTERBOND 998 (International Paint, Inc.)
EURONAVY ES301K or EURONAVY ES301L (Euronavy)

631-7.4 PRETREATMENT WASH PRIMER (FORMULA 117).

631-7.4.1 Wash primer, Formula 117, MIL-P-15328, is no longer approved for shipboard application. Formula 117 contains unacceptable levels of hazardous chromates and excessive volatile organic compounds (VOC) that

make Formula 117 environmentally unacceptable. Where Formula 117 is specified in older ship paint schedules or equipment specifications or drawings, either TT-P-645, Formula 84 zinc molybdate primer, or MIL-PRF-23236 or MIL-DTL-24441 epoxy coatings shall be substituted, as described for the type of surface or area to be painted as described herein.

631-7.5 VINYL PLASTISOL COATINGS.

631-7.5.1 GENERAL. Vinyl plastisol, A-A-59464, is a liquid paste consisting of polyvinyl chloride resins in a plasticizer. It is termed a plastisol because the liquid plasticizer replaces a solvent.

631-7.5.2 USES. Plastisols have many uses and are particularly adapted for application in thicknesses of 10 to 100 mils on complex shapes that can be accommodated in a dipping operation. They are particularly useful in covering intricately shaped surfaces where heavy, impervious, seamless coatings are desired. Plastisols have been used for coating tool handles, washers, metal O-rings, drums, valve handwheels, steel racks, hooks, pipe sections (exterior surface), strainers, panel knobs, duct work, strongback, stowage clips, and many other items..

631-7.5.2.1 Plastisols form tough, flexible, abrasion-resistant coatings that retain their physical properties after immersion in aliphatic hydrocarbons such as paraffin, acids, and alkalis. If a plastisol-coated item is immersed in an aromatic hydrocarbon or a ketone, however, the plasticizer will dissolve (leach) out of the plastisol. Because of thermal-decomposition products which are emitted by plastisols when exposed to elevated temperatures, the use of plastisols shall be limited to relatively small areas. Proposals for application of plastisol to extensive areas shall be referred to NAVSEA for approval.

631-7.5.3 SURFACE PREPARATION. Surfaces to be coated with plastisol shall be free from all traces of oil, corrosion products, scale, and dirt. All welds shall be chipped and all soldering or brazing flux shall be removed. All loose joints, small holes, and porous welds shall be eliminated because they trap air that will cause the coat to blister during cure. Plastisol will assume the contour of the metal and, to some degree, will fill in and smooth over a rough surface.

631-7.5.3.1 Metal surfaces should be cleaned by abrasive blasting to achieve a surface for maximum bond strength. For soft metals such as aluminum, chemical cleaning may be used instead of abrasive blasting. Chemical residues shall be removed by hot water rinse. After abrasive blasting or chemical cleaning, and immediately prior to primer application, the surfaces should be degreased by solvent washing.

631-7.5.4 SOLDER JOINT PRECAUTIONS. Soft solder (50 percent tin and 50 percent lead) cannot be used on a joint that is to be coated with a plastisol unless a mechanical fastener is used. Soft solder joints lose strength at the plastisol baking temperature, 177 to 191°C (350 to 375°F). Solder that contains 10 to 20 percent tin and 80 to 90 percent lead can be used unsupported on a joint.

CAUTION

Primers contain flammable solvents. Refer to section 2 for safety precautions.

631-7.5.5 SURFACE PRIMING. When applied to bare metal, plastisol has little or no adhesion and can be stripped off easily. When plastisol is applied over an approved primer specified by the plastisol manufacturer, it has excellent adhesion. Primer should not be applied to surfaces from which the plastisol coating is to be removed (such as the cores of valve handwheels).

631-7.5.5.1 Plastisol primer can be applied by brushing, spraying, or dipping. After abrasive blasting or chemical cleaning, apply one coat of plastisol primer and air-dry for at least 20 minutes, but not more than 16 hours

631-7.5.6 VINYL PLASTISOL COATING APPLICATION. To apply vinyl plastisol by the dipping method, proceed as follows:

1. Suspend primed article in a forced-draft-air oven at 177 to 191°C (350 to 375°F) for 10 to 20 minutes or until the metal reaches the oven temperature.
2. Remove the article from the oven and immediately immerse it in the plastisol, leaving it completely immersed for 30 to 60 seconds, depending upon desired coating thickness.
3. Slowly withdraw the article from the plastisol tank in such a manner that the excess plastisol fluid can run off at a single point which will not be readily visible on the finished article.
4. Allow the article to drain until all dripping has stopped.
5. Return the article to the oven at 177 to 191°C (350 to 375°F) for 10 to 20 minutes, or until dense fumes are emitted from the coated article, indicating complete fusion.

NOTE

During heating, the plastisol is converted into a solid in which the resin and plasticizer combine.

6. Remove the article from the oven and suspend it on a rack until it cools to room temperature.
7. Trim drip marks. Remove excess plastisol from areas that were not primed.
8. If damaged, plastisol coatings can be patched with a heat-curing putty or an air-drying vinyl putty which is available from plastisol manufacturers.

631-7.5.6.1 The coating procedure is appropriate for most articles. For some articles, however, the plastisol dip-coating must be precisely tailored to the article. Separate, specific instructions should be obtained for special products because of differences in specific reaction to heat, in cooling rates, or mass.

631-7.6 THERMAL SPRAY COATINGS.

631-7.6.1 TYPES OF COATINGS. Thermal spraying is a process in which a metallic, ceramic, or ceramic-metallic material is deposited on a selected surface in a plasma, molten, or semi-molten state to form a coating. Ceramic and ceramic-metallic (Cermet) coatings are generally used to provide very wear-resistant surfaces, and all three types of materials can be used to provide corrosion resistance in specialized applications. Thermal spray coating systems using aluminum, zinc, or a combination of aluminum and zinc are only used to provide enhanced corrosion protection. The application of a sealer or topcoat over the thermal sprayed coating provides the total coating system longer life. These coatings provide corrosion protection to steel by acting as a barrier to the environment, and once damaged, by providing sacrificial (cathodic) protection, particularly during exposure to an aggressive marine atmosphere.

631-7.6.2 THERMAL SPRAY APPLICATION PROCESSES. Aluminum thermal spray coatings shall be applied and used as described in MIL-STD-2138. These coatings have also been termed Metal Spray Coatings (MSC), Flame Spray Aluminum (FSA), and Wire Sprayed Aluminum (WSA) at various times during their use by the Navy. Flame sprayed coatings, which use aluminum powder melted by a high-temperature flame, are seldom used on Navy ships, as they produced the lowest quality coating. Wire sprayed coatings use aluminum wire melted by an electric arc, and are more commonly used on Navy ships. This process produces a more dense coating with less porosity than the flame spraying process. Other processes are available that produce higher quality, even less dense coatings.

631-7.6.3 HIGH AND LOW TEMPERATURE SERVICE. High-temperature applications are those where the service temperature of the surface or component being coated will be over 175°F. These coatings are Type I of MIL-STD-2138, and are applied at 10-15 mils DFT plus 3 mils of a sealer coat. Low temperature applications are those where the service temperature of the surface or component being coated will be 175°F and less. These are Type II of MIL-STD-2138, and are applied at 7 to 10 mils DFT plus 3 mils of a sealer coat.

631-7.6.4 WIRE SPRAYED ALUMINUM (WSA). WSA has been used for many years by the Navy for corrosion control. The following information applies.

631-7.6.4.1 WSA with the appropriate paint system can last much longer than the paint system alone if the total application process, from surface preparation through topcoat application, is tightly controlled. If the topcoat paint system is damaged, the WSA will corrode sacrificially and therefore preserve the substrate. How much additional protection the WSA will provide has not been determined and is probably dependant on the conditions and the specific application. Sharp corners, drilled holes, dissimilar metals, contact with salt water, etc will accelerate corrosion.

631-7.6.4.2 If WSA is applied incorrectly, the problem is usually that the surface to which it is being applied has not been properly prepared. Applying WSA is a labor intensive, exacting process. It requires a abrasive blasting to an SSPC-SP 5 white-metal level of cleanliness, which often requires that the surface be blasted with conventional steel or mineral abrasives then re-blasted with aluminum oxide grit. The required anchor tooth surface profile is 2-3 mils. Once blasted, no flash rusting of the steel is permitted, so WSA must be applied quickly or the climate must be very well controlled. This process usually costs between two and three times more than applying epoxy paint systems alone. For these reasons the process is best applied on new components or in the shop where access and conditions can be controlled.

631-7.6.4.3 Another consideration is that WSA is not as hard as the steel substrate and so is more easily damaged. For this reason WSA should not be used in applications where it will be subject to mechanical damage, such as on deck plates.

631-7.6.4.4 An appropriate topcoat must be maintained whether or not WSA is used. While the combined WSA and topcoat system can last much longer than paint alone, if paint system fails, moisture can get into the porosity in the WSA coating at it will begin to corrode. While this sacrificial corrosion protects the steel substrate, the voluminous white aluminum corrosion product expands and can cause spreading blistering and flaking of the paint system from the point of original damage, which may not be aesthetically acceptable.

631-7.6.4.5 If the paint system fails and the aluminum starts to corrode, the loose aluminum corrosion products and blistered paint must be removed to sound aluminum coating. The surface should then be repainted in accor-

dance with procedures established in this technical manual for the particular ship area. If there is extensive corrosion of the WSA coating and failing topcoat, then the surface should be completely re-blasted and a new coating system applied.

631-7.6.4.6 Examples of the Proper Use of WSA. These examples are by no means a complete list of the potential uses of WSA, but rather are intended to illustrate applications where WSA has been used effectively in Navy service.

631-7.6.4.6.1 Two Inch and Larger Steam Valves. WSA must be applied in the shop. The valves are inaccessible once lagged and the valves are used in a highly corrosive environment.

631-7.6.4.6.2 Various Gun Mounts, Winch, Capstan And Antenna Foundations. They are used in a corrosive environment, and depending on the precise location and configuration, access and maintenance of conventional paint systems is difficult. However, due to limited accessibility, there is little chance of topcoat damage from foot traffic.

631-7.6.4.6.3 Foundations And Equipment Removed To The Shop For Represervation. Access to the equipment and ability to control the environment make application cost effective.

631-7.6.4.6.4 Other Areas. Areas that will receive little or no maintenance and which do not have to maintain an aesthetically pleasing appearance in service.

631-7.6.4.7 Examples of Poor Applications for WSA. The following are examples of poor applications for WSA, as determined from past Navy experience.

631-7.6.4.7.1 Helicopter Deck and Cargo Deck Tie Downs. The surrounding nonskid on the deck does not adhere well to the WSA coating border around the tie-down, and the WSA is subject to frequent mechanical damage and traffic.

631-7.6.4.7.2 Preservation Of Ships Bilges. These are not cost effective due to the extensive surface preparation required and the cost of protecting installed ships equipment.

631-7.6.4.7.3 CHT (Sewage) Tanks. Experience shows that the environment is too corrosive for WSA to be effective.

631-7.6.4.7.4 Submerged Applications. WSA is not recommended in applications where the WSA will be completely submerged for any extended length of time, especially in salt water or chemical environments.

631-7.6.5 THERMAL SPRAY COATING INSPECTOR CERTIFICATION. Shipyards using thermal spray coating processes for corrosion prevention shall have a coating inspector certified as described in [paragraph 631-11.6](#) monitor, oversee, and record the surface preparation and coating application process requirements described above and in MIL-STD-2138. The responsibilities of the coating inspector described in [paragraph 631-11.7](#) shall apply. If the thermal spray coating work is sub-contracted, this requirement shall be included in the contract specification.

631-7.7 EROSION-RESISTANT EPOXY COATING (EC-2216B/A).

631-7.7.1 SPRAYABLE EPOXY COATING (EC-2216B/A). Erosion-resistant epoxy adhesive coating (3M Company EC-2216B/A, NSN 8040-01-080-1490) is a gray, flexible, two-part compound used as an optional additional coating with MIL-PRF-24647 underwater hull coating systems for areas prone to erosion from turbulent water flow patterns, such as the rudders and struts on some classes of ships. When used, this coating is to be applied between underwater hull anti-corrosive (AC) and anti-fouling (AF) coatings, as described in [paragraph 631-8.4.3.2](#). It is composed entirely of nonvolatile material (solids) but shall be diluted with solvent for application with specified spray equipment. It is a modified epoxy sealant that cures at room temperature and has high shear and peel strengths. Use of these coatings is optional; NAVSEA does not require or prohibit the use of these products.

631-7.7.2 TOOLS AND MATERIALS. Tools used in the application of EC-2216B/A shall be explosion-proof, including correctly grounded motors and non-sparking tools. The tools and materials required for the application of EC-2216B/A are:

- a. Explosion-proof ventilation equipment.
- b. Jiffy Mixer, 4120 Tigris Way, Riverside, CA 92503-4843 phone (909) 272-0838.
- c. Bristle brush, FED Spec H-B-1490, NSN 7920-00-240-7174.
- d. Paintbrush, 3- or 4-inch.
- e. Buckets.
- f. Clean rags.

CAUTION

MIBK has a flashpoint of 25°C (74°F).

- g. Cleanup MIBK solvent, NSN 6810-00-281-2761 (55-gallon).
- h. Epoxy Sealant, EC-2216B/A gray, manufactured and supplied by 3M Company, St. Paul, MN 55144-1000.
- i. Binks Spray Gun, No. 18, with No. 68 Fluid Tip, No. 68 PB Air Cap, or equivalent.
- j. Solvent thinner, Ethyl Cellosolve (FED Spec TT-E-781).
- k. Solvent thinner, n-Butanol (ASTM D 304).

631-7.7.3 MIXING. The EC-2216B/A coating is presently supplied in gallon kit form or full 5-gallon pails. The gallon kit works well when using only one spray gun. Both the base and accelerator are pre-measured, and only the solvent shall be measured at the time of mixing. The recommended application procedure requires solvent dilution to attain about 70 percent solids in the mixed coating. For this dilution, the solvent is used at the same amount by volume as the base component. The materials in the kit, diluted and mixed, provide approximately 2-1/3 gallons of sealer. When more than one person is spraying and larger quantities of coating are desirable, use the 5-gallon pail.

631-7.7.3.1 Thinner Preparation. To prepare the thinner for use with EC-2216B/A, mix one part ethyl cellosolve (FED Spec TT-E-781) to one part n-butanol (ASTM D 304). The thinner may be refrigerated to extend the pot life of thinned coating. Prepare 3 quarts of thinner for each gallon kit.

631-7.7.3.2 EC-2216B/A Pot Life. EC-2216B/A accelerator (gray component) may be refrigerated to extend the pot life of the coating.

NOTE

Do not refrigerate EC-2216B/A base (white component will become too thick to mix).

631-7.7.3.3 Mixing Procedure. When mixing the coating, limit the batch size to ensure that the mixed material will be applied within the estimated work life (based on ambient temperatures). Mix the refrigerated EC-2216A accelerator with the room temperature EC-2216B base, using a paddle or non-sparking explosion-proof power mixer (Jiffy Mixer or equivalent) until the mixture is streak-free and has a uniform color and consistency. If larger quantities of the coating are used, the mix ratio shall be:

- a. One gallon EC-2216B (white colored base component).
- b. One and one-half gallons EC-2216A (gray colored accelerator component).
- c. One gallon thinner mixture.

The mixed material should be used as soon as possible. Once mixed, it has a limited application time. The higher the temperature or the larger the batch mixed, the shorter the application time or work life.

631-7.7.3.4 Work Life. The work life of the EC-2216B/A epoxy coating is affected mainly by the percentage of solids, batch size, and temperature. After mixing, the two components begin reacting and initiating the cure process. This reaction is heat-releasing (exothermic) and the temperature of the mixed batch increases until the material gels and finally cures.

631-7.7.3.4.1 Data on work life and curing times of EC-2216B/A epoxy coating are contained in [Table 631-7-5](#) and [Table 631-7-6](#). This information has been obtained by testing in the laboratory and should be used as a guide in mixing and application.

631-7.7.4 APPLICATION. For underwater hull applications on rudders and struts, apply the first coat at 6 mils WFT/4-5 mils DFT, and three successive coats at 8 mils WFT/5-6 mils DFT per coat. Guidance on the type of spray equipment to be used is given in [Table 631-7-7](#).

Table 631-7-5 EC-2216B/A WORK LIFE

Coating Volume	Work (hours)	Coating Temperature at End of Work Life °C(°F)	Notes
3-1/2 pints	2	52 (125)	1
3-1/2 quarts	1-1/2	74 (165)	1
3-1/2 gallons	1-1/2	74 (165)	1
2-3/4 pints	1-1/4	68 (155)	2
2-3/4 gallons	1	82 (180)	2
2-3/4 gallons	1	88 (190)	2

NOTES:

1. Batches mixed to 71 percent solids by volume at room temperature 24°C (75°F) (1 volume EC-2216B, 1 volume solvent A, 1-1/2 volumes EC-2216A)
2. Batches mixed to 91 percent solids by volume at room temperature 24°C (75°F) (1 volume EC-2216B, 1/4 volume solvent, 1-1/2 volumes EC-2216A)

Table 631-7-6 EC-2216B/A OVERCOATING TIMES

Minimum Time (in hours)	Ambient Temperature °C(°F)
2	38 (100)
3	32 (90)
4-1/2	27 (80)
7	21 (70)
10	16 (60)
22	10 (50)
70	4 (40)

Table 631-7-7 SPRAY EQUIPMENT FOR EC-2216B/A

Solids by Volume (Percent)	Ambient Temperature °C(°F)			
70	4 (40) E	16 (60) E	27 (80) E	38 (100) E

Key: E - Use external mix type spray gun

631-7.7.4.1 Spray Equipment. The use of nylon- or Teflon-lined hose is recommended. Teflon packings, glands, and other Teflon parts shall also be used. If the hoses or pressure pot containing the mixed coating becomes hot to the touch, immediately dilute the coating with additional solvent and empty the pot, lines, and gun before the coating cures to a solid state.

631-7.7.4.2 Minimum Application Temperature. EC-2216B/A shall be applied at temperatures above 10°C (50°F). If application is required at lower temperatures, the ambient temperature shall be raised to 10°C (50°F) or higher with hot-air ventilation or strip heaters.

631-7.7.4.3 Procedures. Epoxy coating EC-2216B/A should be sprayed at about 70 percent solids by volume in a temperature range of 10 to 38°C (50 to 100°F). The recommended equipment is a standard external air atomizing spray gun such as a Binks No. 18 or No. 62 gun with a No. 68 fluid tip and a No. 68 PB air cap. This equipment, with an atomizing pressure of 60 to 90 PSI, will give a flow rate of up to 30 fluid oz/min and pro-

duces a DFT of 8 to 10 mils for each coat. Sags or runs will result if heavier applications are made using this method. At 70 percent solids by volume, EC-2216B/A has a coverage of approximately 70 ft² /gal at a theoretical DFT of 16 mils.

631-7.7.4.3.1 The second coat can be applied as soon as the first coat has set and is tack-free to the touch. For guidance, the set-time needed before applying the second coat at various ambient temperatures in laboratory tests is given in [Table 631-7-6](#). The second coat should always be applied the same day (24 hours or less after the first coat) and, for best results, by the same sprayer during the normal work shift. Similar guidelines apply for any successive coats.

631-7.7.4.4 Spray Equipment Cleanup. Spray equipment can be cleaned by using methyl isobutyl ketone or some other ketone-type solvent. Ensure compliance with ventilation and other safety requirements.

631-7.7.4.5 Quality Assurance. The epoxy coating shall be inspected after each application. Complete coverage shall be verified and any discrepancies shall be corrected.

631-7.7.4.5.1 Defective areas of coating should be prepared for recoating by abrading the affected surface and washing it with the thinner specified for mixing. If an area needing repair is small, a brush coat of EC-2216B/A, diluted to about 90 percent solids (1 part EC-2216B, 1/4 part solvent, and 1-1/2 parts EC-2216A) by volume is the easiest method of repair. If the defective area is large, re-spraying is more effective and can be done after abrading and cleaning. For re-spraying, use the same techniques used for original application.

631-7.8 ANTISWEAT TREATMENT AND COMPOUND.

631-7.8.1 GENERAL. Compartment surfaces which are subject to sweating should receive antisweat treatment or compound. Surfaces to receive antisweat treatment are specified in NSTM Chapter 635, Thermal, Fire, and Acoustic Insulation. Antisweat treatment should be applied to the warm side of the uninsulated surface to be coated.

631-7.8.2 ANTISWEAT COMPOUNDS. Approved antisweat coating compounds for surface ships are listed below. Other anti-sweat coatings may be approved by NAVSEA. These antisweat coating compounds are not approved for use on submarines. Unlike vermiculite antisweat paints that were previously used, these coating compounds are based on resin systems that may not be readily over-coated with standard paints. Where the white color of these compounds is not acceptable, only overcoats recommended by the manufacturer of the specific antisweat compound shall be used. Refer to [paragraph 631-8.18.3.5](#) for coating system details, including primers.

- a. Anti-Condens 617US
Hempels Marine Coatings, USA (713-672-6641)
- b. Temp-Coat 101
Temp-Coat Products LLC, LaPlace, LA (985-651-2911)
- c. Mascoat Delta-T Marine
Mascoat Products, Houston, TX (800 549-0043)
- d. KEFA Airless 8125
USA Distributor: Select Mill Products Inc., McIntyre GA (478 946-1150)

631-7.8.2.1 Selection of Treatments. The Anti-Condens 617US and AB Grafotherm materials perform on the principle of absorption and evaporation. Water condenses on the coating surface and is absorbed. This process continues until the coating becomes saturated (at which time sweating will appear) or until the ambient conditions change, permitting re-evaporation of the moisture back into the air. Therefore, overcoating these products with standard paints will interfere with moisture absorption and evaporation, and will degrade coating performance. Because the Temp-Coat 101 and Delta-T marine products do not absorb appreciable amounts of moisture, these products are more appropriate for spaces that experience frequent or continuous condensation. Examples are passageways that are frequently open to the outside environment and have one or more bulkheads adjacent to air-conditioned combat systems spaces or refrigerated spaces. None of these antisweat coating compounds shall be considered an acceptable replacement for any conventional foam or fiberglass insulation used on pipes, bulkheads, or overheads as described in NSTM 635, unless specifically tested and approved for those applications by NAVSEA.

631-7.8.2.2 Installation Considerations. Since these materials will absorb fluids, they shall not be installed in areas subject to oil spills or sprays. Oil will contaminate the materials, impair their effectiveness, and eventually create a fire hazard. These compounds shall not be used in flooded areas or locations that are subject to severe abrasion, because flooding and abrasion will also result in failure of the materials to perform satisfactorily. Surface preparation and application procedures are to be in accordance with the manufacturer's instructions.

631-7.8.3 REPAIR OF EXISTING VERMICULITE-BASED ANTISWEAT TREATMENT. Vermiculite-based anti-sweat treatment shall not be used for new installations. However, surfaces with existing vermiculite-based anti-sweat treatments may be locally touched-up or repaired using vermiculite-based treatments. The application of vermiculite-based anti-sweat treatment shall be followed by application of the specified finish treatment. Sufficient drying time shall be allowed prior to application of a chlorinated alkyd-base paint to eliminate wrinkling.

631-7.8.3.1 Primers. At least one coat of the anticorrosive primer specified for the finish paints in the compartment shall be applied. Use at least one coat of MIL-DTL-24441 Formula 150 or TT-P-645 Formula 84 as a primer as specified where maximum corrosion resistance is desired. Before recoating previously painted areas that are subjected to continuous moisture, scrape the surface with a knife to determine whether corrosion is occurring beneath the old paint film.

631-7.8.3.2 Application. Application. The application of vermiculite anti-sweat treatment is a two-step process. First, apply one heavy spray or brush coat of MIL-DTL-24607 enamel to the primed surface. This coating should have a wet film thickness of 5 mils. Do not thin. The second step is the application of vermiculite ASTM C 516, Type I, Grade 4 to the binder coating with compressed air. Instructions for this application are:

- a. Particle velocity should be at maximum with a minimum air discharge to prevent premature setting of the binder by the air blast.
- b. Vermiculite should be entirely free of dust and fine particles to maintain anti-sweat properties.
- c. Rate of flow should be even (to achieve a uniform surface).

NOTE

A compressed-air gun for drawing up the vermiculite and blowing it into the binder may be designed and used for applying anti-sweat coatings.

631-7.8.3.3 Composite Vermiculite-Binder Mixture. Vermiculite anti-sweat treatment may be applied as a composite vermiculite-paint mixture if acceptable application equipment is available.

631-7.9 POWDER COATINGS.

631-7.9.1 GENERAL. Powder coatings selected shall be in accordance with MIL-PRF-24712, MIL-PRF-23236 Type VIII or VIIIa as indicated below, or other as approved by NAVSEA, and shall be applied by either electrostatic spray or fluidized bed methods in accordance with their NAVSEA-approved ASTM F718 data sheets. Epoxy powder coatings shall not be used on exterior surfaces exposed to sunlight:

- a. For exterior applications and interior dry applications of removable parts, MIL-PRF-24712 powder coatings shall be used.
- b. For interior wet or immersion areas, MIL-PRF-23236 Type VIII powder coatings shall be used.
- c. Powder coatings are not practical for use on large components or ship structure, and any large-scale applications to ship structure requires approval by NAVSEA. The largest parts currently practical are the DDG51 Class gas turbine intake louvers.
- d. Powder coating shall not be used on components, covers, or any parts to be installed in feedwater or fresh-water drain collection tanks aboard nuclear powered ships.

Powder coating application may be used if designated in this NSTM, or if approved by the Type Commander (TYCOM); otherwise use the applicable paints and coatings specified in this NSTM. TYCOM approval shall denote specific items or classes of items and applications. Powder coatings may match the color of the surrounding area or, if needed, may be over-coated with liquid paints. The applicable Quality Assurance (QA) requirements of [paragraphs 631-5.14](#) and [631-7.1.4](#) are still required when powder coatings are used.

631-7.9.2 TYPES OF POWDER COATINGS. There are two general categories of powder coatings based on the type of resin or polymers that they are manufactured from. Thermoplastic powder coatings, such as vinyls, nylons, polyethylenes, and polypropylenes, melt and flow when heated during the curing process, but maintain the same chemical composition when they cool and solidify. Thermoplastics can re-melt and flow when exposed to temperatures above their melting point. The other category of powder coatings are thermosets. Thermoset powder coatings include epoxies, acrylics, polyesters, epoxy-polyester hybrids, and urethane polyesters. During the curing process, thermosetting powder coatings melt, flow, and chemically crosslink or polymerize to form the coating film. The cured coatings are heat stable and will not re-melt when exposed to heat up to their curing temperature. However, they are still organic polymers, and will degrade or char at higher temperatures, depending on the type of polymer resin. Maximum service temperatures for cured thermosetting powder coatings vary, but are typically in the range of 225°F to 350°F. Refer to the coating manufacturer's data sheet for specific service temperature limits.

631-7.9.2.1 Advantages and Limitations of Powder Coatings.

1. The advantages of powder coating when compared to liquid solvent based coatings include:
 - a. Elimination of reportable Volatile Organic Compound (VOC) emissions, because there are no liquid solvents in the coatings.
 - b. Potential for reduced labor costs and schedule times due to the elimination of mixing, thinning, and multiple cycles of coating and drying.

- c. Potential for lower material and handling costs due to the elimination of solvents, and a high transfer efficiency of powder coatings.
- d. Potential for longer expected coating service life for components.

2. Limitations of powder coatings when compared to conventional paints include:

- a. Components to be coated must not be adversely affected by heating to process temperatures or by other process conditions. Items that are powder coated are heated in an oven at 275°F to 450°F to facilitate cure of the powder resin. This may require disassembly (and re-assembly) of components that would not otherwise be required if they were to be coated with liquid paints, in order to remove heat-sensitive parts.
- b. Specialized equipment and facility requirements.
- c. Items to be coated must be able to be removed from ship, which increases handling, and has the potential for damage to newly applied coatings during transportation back to the ship and reinstallation.
- d. Components must be small enough to fit inside the curing oven.

631-7.9.3 APPLICATION INFORMATION. Powder coating is a dry finishing process that produces a uniform, durable, high quality finish that is most often applied in a single coat. The term “dry” means that there are no solvents used during any part of the finishing process. These coatings are usually applied using specialized equipment by either electrostatic spray or by fluidized bed. When using electrostatic spray, the powder particles are charged in the spray gun and directed at the grounded article to be coated. The powder particles are attracted uniformly to the ground and form a fusion bonded coating when the article is passed through a curing oven. The fluidized bed can be utilized as an electrically charged system similar to the electrostatic spray or the article to be coated can be heated and dipped into the fluidized bed to cause fusion of a uniform coating onto the surface. Thicker layers of powder coating can be obtained by heating the component to be coated prior to electrostatic spraying or fluidized bed immersion. Because of the heat fusion of powder particles, the film formed is very tough, durable, uniform, and highly resistant. Stripe coats are not required for items preserved by powder coatings.

631-7.9.4 PRE-TREATMENTS AND SURFACE PREPARATION. Surface preparation for MIL-PRF-24712 cosmetic powder coatings may include combinations of chemical cleaning, iron phosphate, zinc phosphate or other pretreatments, or abrasive blasting to near white metal, NACE 2/SSPC-SP 10, as per the ASTM F718 data sheet. Surface preparation requirements for high-performance functional powder coatings per MIL-PRF-23236 shall be abrasive blasting to a cleanliness level and surface profile as defined on the product ASTM F718 data sheet; near-white metal blasting per NACE 2/SSPC-SP 10 shall be used as the minimum cleanliness if not otherwise specified.

631-7.9.5 SUBMARINE POWDER COATING APPLICATION. All powder coatings for submarine use shall be applied in accordance with UIPI 0631-901 for the electrostatic spray method on steel. Quality Assurance shall be documented and shall be at a level at least equivalent to UIPI 0631-901. Refer to [paragraph 631-8.20.5](#).

631-7.9.6 HIGH TEMPERATURE TT-P-28 TYPE II POWDER COATINGS. Heat-resistant aluminum pigmented powder coatings for service up to a maximum of 372 °C (700 °F) are being qualified to specification TT-P-28, Type II. Service applications and coating requirements are being developed for future inclusion in this NSTM. In the interim, refer to NAVSEA for information regarding these coatings.

631-7.10 TT-P-28 HEAT RESISTANT COATINGS.

631-7.10.1 GENERAL. The following requirements apply to the use of TT-P-28 Type I heat resistant coatings. Refer to [paragraph 631-7.9.6](#) for TT-P-28 Type II heat resistant powder coatings

- a. Heat resistant paint is highly flammable during application and shall not be applied to surfaces whose temperature at the time of application exceeds 29°C (85°F). Safety precautions specified in [Section 2](#) apply. Apply two thin coats (1.0-1.5 mils DFT) to properly-prepared dry metal surfaces. Surface preparation shall consist of removing as much corrosion, dirt, oil, grease, deteriorated paint, and other contaminants as possible, in a manner that will not mar, gouge, or otherwise damage the substrate.
- b. NCP Coating Company (formerly NILES Chemical Coatings Company) product N6974 is qualified to TT-P-28G and has the unique property of drying to touch at ambient temperature in one-half hour or less if applied at the wet film thickness of 2.0 mils (resultant DFT is 1.0 mil). The NCP coating product is preferred for use for all surface ship applications.

631-7.11 WATER-BASED COATINGS MIL-PRF-24596.

631-7.11.1 GENERAL. MIL-PRF-24596 water-based coatings require ambient air and substrate temperatures above 50°F, in order for the water to evaporate completely and form a continuous coating. Where specific manufacturers allow use of their water-based paint below 50°F, the manufacturer's instructions may be followed. Waterbased coatings require storage above 32°F. If water-based paints are used, exercise special care to ensure the surface preparation, primer application, primer cure, and water-based top coat application are properly performed. Water-based coatings may only be used over fully primed or painted steel substrates. Aluminum substrates do not require priming. Water-based coatings will not dry at relative humidity above 80 percent. Adequate ventilation or dehumidification will aid drying of water-based paints. Water-based coatings shall not be used where water condensation will occur before the paint dries.

631-7.12 EPOXY REPAIR AND HULL SMOOTHING COMPOUNDS.

631-7.12.1 GENERAL. For surface ships, epoxy hull repair and smoothing compounds qualified under DOD-PRF-24176, Type I, are approved for filling and repairing minor pits or corrosion in metal or minor damage in wood. The epoxy hull-repair compounds are not approved for repair of severe deterioration, as defined in NSTM Chapter 100, Hull Structures. For making repairs of this nature, the procedures outlined in NSTM Chapter 100 shall be followed. For submarines, epoxy hull smoothing/fairing compounds qualified under DOD-PRF-24176, Type I, are approved only for smoothing and fairing purposes as allowed by NAVSEA 0902-018-2010 (DDGOS) Section 9110-0-C. DOD-PRF-24176, Type I, repair compounds are suitable for general use and for surfaces in way of cathodic protection. Specific approved materials are listed on Qualified Products List, QPL-24176.

631-7.12.2 SURFACE PREPARATION AND APPLICATION. Epoxy repair compounds shall be applied to clean, dry, and roughened surfaces in accordance with the manufacturer's instructions. Surface preparation shall include removal of paint, corrosion products, scale, and grease. Repair compounds may also be used over freshly applied, tack-free MIL-PRF-24647 anti-corrosive primers or MIL-DTL-24441 Formula 150 primer when the particular product from QPL-24176 is known to be compatible. For guidance on compatibility, consult NAVSEA.

631-7.12.3 CURING. Repaired areas should be fully cured before sanding smooth and painting, as required. Epoxy repair compounds are two-component systems that harden by chemical curing. Curing time is affected by

temperature. It is recommended that at temperatures below 10°C (50°F) the epoxy compound be mixed indoors, and that the hull plating be warmed prior to application, where practical. Warming the repair area with hot-air guns or infrared heat should accelerate the curing. At 21°C (70°F), the compounds will cure in approximately 24 hours.

631-7.12.4 CLEAN-UP. Good housekeeping is very important. Avoid spilling. Promptly clean up all drippings, waste, and deposits on tools. Wash all protective clothing and equipment if contaminated. Place waste matter in covered waste cans. Keep chemical containers clearly labeled and tightly covered when not in use.

631-7.12.5 SAFETY. Safety precautions specified in [Section 2](#) for proprietary epoxy paints are also required for epoxy repair compounds. Ventilation and personnel protection shall comply with [Section 2](#). Depending on the situation this may include protective clothing, skin creams, gloves, goggles, and respirators. Exhaust ventilation may be required for interior applications of repair compounds.

SECTION 8

SHIPBOARD PAINT APPLICATION

631-8.1 GENERAL.

631-8.1.1 OVERVIEW. The application of paints to shipboard equipment, bilges, tanks, and interior and exterior surfaces of naval surface ships, boats, and small craft and submarines is covered in this section.

631-8.2 GENERAL REQUIREMENTS AND GUIDANCE FOR METAL SURFACES.

631-8.2.1 GENERAL. The following paragraphs provide both requirements and guidance for the painting of metal surfaces. Where guidance is provided, specific requirements for surface preparation and painting are provided elsewhere in this Technical Manual according to the location being painted or type of coating being used.

631-8.2.2 GUIDANCE FOR PRIMING. Metal surfaces should be primed as soon as practical after surface preparation, especially if there is no form of containment or other protection from the weather, humidity, condensation, fluid leaks, sea spray, or other sources of surface contamination. This prevents corrosion and maintains the state of preservation until the finish coat can be applied. However, be aware that epoxy coatings have defined periods of time, termed overcoat windows, during which topcoats can be applied without any additional surface treatments. If these overcoat windows are exceeded, then additional surface treatments of the epoxy primer may be required to promote adhesion of the subsequent coat. In general, the surface cleanliness, profile, and environmental conditions specified herein shall be met at the time of primer application. After priming, a “stripe coat” of the coating system in a contrasting color is often specified for all edges, weld beads, rivet heads, and other protruding objects, as described in [paragraph 631-7.1.3](#).

631-8.2.3 GUIDANCE FOR STEEL SURFACES. Both exterior and interior structural steel surfaces are generally coated with at least two coats of epoxy paint to protect the surface from corrosion. Various types of topcoats (alkyds, silicone alkyds, polyurethanes, water-based, etc.) are used according to the service location to provide the required color or other functional property, such as anti-fouling, camouflage, anti-stain, etc., or to protect the epoxy from degradation in sunlight.

631-8.2.4 GUIDANCE FOR GALVANIZED STEEL. Paint all galvanized steel unless painting is specifically excluded elsewhere in this chapter. This is known as a duplex coating system. Epoxy paints are generally used, with topcoats if necessary for the intended service. When welding has damaged the galvanizing on steel surfaces, the welds must be cleaned prior to painting, and two coats of galvanizing repair paint (DOD-P-21035) should be applied. Unless otherwise specified herein, alkyd paints shall not be used directly on galvanized surfaces, due to the risk of premature paint failure by a mechanism known as saponification.

631-8.2.5 GUIDANCE FOR ALUMINUM SURFACES. Exterior structural aluminum surfaces are generally coated with epoxy primers and top-coated similarly to steel. Interior aluminum may have either epoxy or alkyd primers specified, depending on the type of service.

631-8.2.6 REQUIREMENTS FOR ALUMINUM TANKS AND VOIDS. Surface preparation and coating requirements for tanks and voids made of aluminum shall be the same as those for steel tanks and voids, except that garnet or aluminum oxide abrasive blast media shall be used, the surface profile shall be 1.5-3.0 mils, and the surface cleanliness shall be the equivalent to SSPC-SP 10 modified as described in [paragraph 631-5.4.7.6](#).

631-8.2.7 REQUIREMENTS FOR ALUMINUM FAYING SURFACES. Aluminum alloys are prone to accelerated corrosion in the crevices and joints formed by faying surfaces, whether the mating surfaces are both aluminum, or are of dissimilar materials, including non-metals. Prior to assembly of the mating surfaces, both sides of the faying surfaces shall be painted as specified for the structure or equipment being mated. Coat wood surfaces in contact with aluminum with one coat of MIL-DTL-24441 epoxy, Type III or IV, or MIL-PRF-23236 epoxy, Type V, VI or VII.

631-8.2.7.1 Requirements for Sealing Aluminum Faying Surfaces. Aluminum faying surfaces in contact with other metals that require sealing from moisture shall be treated as specified. All joints shall be sealed with caulking compound MIL-C-18255. For water-tightness, horizontal joints exposed to the weather shall be sealed with caulking compound. This is not required where butyl or neoprene rubber tape has been used.

631-8.2.7.1.1 Insulation tape, non-metallic/non-wicking sheet gasket material, or other suitable type of non-metallic insulating material shall be installed between aluminum faying surfaces where one or both sides of a joint are exposed to seawater, weather, or dampness. The tape or material shall be of sufficient width to extend beyond the joint edge. Pressure-sensitive tape may be difficult to apply where insulating material will be inserted after final drilling and cleaning of faying surfaces. Wetting pressure sensitive tape with kerosene or dusting lightly with talc before installing usually facilitates installation.

631-8.2.7.1.2 Install label plates on aluminum surfaces in the weather or in wet spaces in accordance with NAVSEA hull type drawing S2803-980208, or other applicable NAVSEA Standard Drawings or corrosion prevention and control manuals.

631-8.2.8 GUIDANCE FOR MISCELLANEOUS METALS. In interior compartments, other than tanks, voids, and bilges, corrosion-resistant steel (CRES), titanium alloys, brass, nickel copper alloys, and copper-nickel alloys are not required to be painted except to provide color-coding regarding system service (e.g. purple piping for JP-5 fuel) or to match the surrounding color scheme.

631-8.2.9 GUIDANCE FOR DISSIMILAR METAL SURFACES. The most effective methods for preventing bimetallic corrosion are careful design to eliminate bimetallic interfaces and correct assembly. Quality workmanship is required to insulate dissimilar metals from each other effectively. Properly applied films of specified paints and insulation tapes, gaskets, or caulks or sealants may increase durability and prevent corrosion.

631-8.2.9.1 Requirements for Dissimilar Metal Insulation. For insulation material to function effectively, it shall be installed so that all joints are closed. This ensures that water cannot collect and form a bridge at the bimetallic interfaces. For ships in service where no insulating tape appears to have been used, or where existing tape has deteriorated, joints exposed to the weather shall be sealed with caulking or sealing compound.

631-8.3 GENERAL REQUIREMENTS AND GUIDANCE FOR NON-METALLIC SURFACES.

631-8.3.1 GENERAL. The following paragraphs provide both requirements and guidance for the painting of non-metallic surfaces, e.g. wood, plastic, rubber, fiberglass (glass-reinforced plastic, or GRP), and other non-metallic composite materials. Where guidance is provided, specific requirements for surface preparation and painting are provided elsewhere in this Technical Manual according to the location being painted or type of coating being used.

631-8.3.2 REQUIREMENTS FOR WOOD SURFACES. Wood surfaces shall be preserved as specified in the following paragraphs and [Section 9](#).

631-8.3.2.1 Varnished Surfaces. Fill defects in wood that is to be varnished with wood filler, specification TT-F-336. Stain the wood to the desired shade with one of the following stains: Formula 49, 50, 51, 52 or 54. Coat the stained wood with three coats of spar varnish, Master Painters Institute (MPI) reference coating #28.

631-8.3.2.2 Painted Interior Surfaces. Apply one of the following coating systems. For the TT-P-645 alkyd-based systems, apply the last topcoat only if required for hiding.

MIL-DTL-24441 Type IV

Primer: 4-6 mils DFT MIL-DTL-24441 Type IV, F150, and

Topcoat: 4-6 mils DFT MIL-DTL-24441 Type IV, F151

TT-P-645 Formula 84/MIL-DTL-24607

Primer: 1.5-3.0 mils DFT TT-P-645 F-84, and

Topcoat: 1.5-3.0 mils DFT TT-P-645 F-84, and

Topcoat: 1.5-3.0 mils DFT MIL-DTL-24607, Color As Specified, and

Topcoat: 1.5-3.0 mils DFT MIL-DTL-24607, Color As Specified

TT-P-645 Formula 84/MIL-PRF-24596

Primer: 1.5-3.0 mils DFT TT-P-645 F-84, and

Topcoat: 1.5-3.0 mils DFT TT-P-645 F-84, and

Topcoat: 2-4 mils DFT MIL-PRF-24596, and

Topcoat: 2-4 mils DFT MIL-PRF-24596

631-8.3.2.3 Underwater Surfaces. For underwater surfaces other than the hull, treat the wood with wood preservative, MIL-W-18142, then prime the wood with two coats of MIL-DTL-24441, Type IV, Formula 150, or MIL-PRF-23236, Type VI epoxy. Prepare and coat underwater hull surfaces as described in [paragraph 631-8.4](#). Treat chain lockers and bilges with a heavy coat of wood preservative, MIL-W-18142.

631-8.3.3 REQUIREMENTS FOR FIBERGLASS AND GRP STRUCTURES AND EQUIPMENT. Unless otherwise specified herein, clean fiberglass or GRP boards, panels, or other surfaces in interior compartments with soap and water, and very light hand sanding if necessary, and coat as follows:

- a. One coat of TT-P-645 Formula 84 at 1.5-3.0 mils DFT, and
- b. Two coats of MIL-PRF-24596 at 2-4 mils DFT each, or
- c. Two coats of chlorinated alkyd paint MIL-DTL-24607 at 1.5-3.0 mils DFT.

Unless otherwise specified herein, GRP and other non-metallic composite material sonar domes, radomes, and special equipment shall be painted as specified in the applicable manual, drawing, or other document.

631-8.3.4 REQUIREMENTS FOR RUBBER ITEMS. Rubber items (such as gaskets and expansion joint components) in contact with painted or cemented surfaces shall not be clamped in place under pressure until paints or cements have dried sufficiently. Allow painted surfaces to dry tack-free. Apply paint to rubber surfaces only

when specified. Before putting rubber items in place, allow solvent to evaporate from applied cement until surfaces are only slightly tacky. Allow an additional 3-hour drying period before applying pressure.

631-8.3.5 REQUIREMENTS FOR PLASTIC SURFACES. Unless otherwise specified herein, plastic surfaces that are to be painted shall be pretreated with a coat of epoxy primer per MIL-PRF-23236, Type VI, or MIL-DTL-24441, Type IV, Formula 150.

631-8.4 SURFACE SHIP AND CRAFT UNDERWATER HULL COATINGS .

631-8.4.1 HULL COATING SYSTEMS. Underwater hull anti-corrosion (AC) and anti-fouling (AF) coating systems for surface ships, boats, and craft made from all types of materials shall be as shown in [Table 631-8-1](#). In addition to the requirements in [Table 631-8-1](#), the following paragraphs apply to underwater hull coating systems and draft markings.

631-8.4.1.1 Over-Coating of Ablative Copper AF. An ablatative copper AF coating system shall not be removed by blasting prior to its specified service life unless it is blistered, peeling, or otherwise damaged beyond repair, or if the next scheduled drydocking exceeds the expected remaining service life. Stable and intact ablatative AF coatings shall be retained and over-coated. The total film thickness of the combined retained and freshly applied paint shall comply with [Table 631-8-1](#). When the work specification calls for over-coating of retained intact ablatative copper AF coating, ship and boat AF surfaces shall be washed down with fresh water at 2000 psi as the vessel comes out of the water, in order to prevent slime and oxidized paint from drying on the hull and inhibiting leaching of the paint when the ship is returned to the water. Any AC paint in need of repairs shall be touched-up and then overcoated with the identical AF system.

631-8.4.1.2 Preparation for Steel. Surface Surface preparation required for all steel surfaces shall be abrasive blasting to near-white metal, SSPC-SP 10/NACE #2. For previously painted steel surfaces, surface preparation shall be either SSPC-SP 10/NACE #2, or waterjetting to SSPC-SP 12/NACE #5, Condition WJ-2L. See [paragraphs 631-5.4](#) and [631-5.5](#). The surface profile shall be 2-4 mils. New welds resulting from hull cuts or other work performed on the hull in an availability shall be prepared as described in [paragraph 631-5.2.2](#), and shall be abrasive blasted to SSPC-SP 10; hand and power tool cleaning is insufficient.

631-8.4.1.3 Preparation for Aluminum. Surface Surface preparation required for all aluminum surfaces is abrasive blasting to a cleanliness level equivalent to the near-white level required for steel surfaces. See [paragraph 631-5.4.7.5](#). The abrasive blasting media shall be either garnet or aluminum oxide in accordance with MIL-A-22262. For previously painted aluminum surfaces, surface preparation shall be either abrasive blasting as described above, or waterjetting to a cleanliness level equivalent to SSPC-SP 12/NACE #5, Condition WJ-2. (See [paragraph 631-5.5.8](#).) The surface profile shall be 1.5-3 mils. Surface preparation requirements for aluminum in special situations are described below

- a. For touch-up paint repairs where the hull paint system is to be removed only down to sound and intact primer, light abrasive blasting using black walnut shells in accordance with [paragraph 631-5.4.3](#), and spot power tool cleaning per [paragraph 631-5.2.4.3](#) may be used.

631-8.4.1.4 Preparation for Composite Materials. Surface Surface preparation required for all composite, glass-reinforced plastic (GRP), and fiberglass surfaces is high pressure water washing to remove all marine growth and loose paint. For touch-up purposes, or when removal of only the anti-fouling coating down to sound and intact primer is required, then light abrasive blasting using black walnut shells in accordance with [paragraph 631-5.4.3](#)

may be used, along with spot cleaning as described in [paragraph 631-5.2.6](#). The surface preparation of steel or aluminum underwater hull components (struts and rudders, etc.) on composite, GRP, and fiberglass hulls shall be as described for those materials above. Care must be taken to prevent damage to the non-metallic hull during surface preparation of these components.

631-8.4.1.5 Preparation for Wood. Surface Surface preparation required for all wood surfaces is described in [paragraph 631-5.2.5.3](#). Prior to painting of wooden underwater hulls, allow the hull to dry to a maximum moisture content of 15 percent. Readings shall be taken with an electronic moisture meter, Sovereign Moisture Master or equal. Cover any grounding plates and sacrificial anodes prior to painting. The surface preparation of steel or aluminum underwater hull components (struts and rudders, etc.) on wood hulls shall be as described for those materials above. Care must be taken to prevent damage to the wood hull during surface preparation of these components.

631-8.4.1.6 Soluble Salts Testing. Prior to the application of the first coat of the AC coating, surfaces shall be tested for the presence of soluble salts, and shall meet the requirements of [paragraph 631-5.14](#).

631-8.4.1.7 Anti-Corrosive and Anti-Fouling Paint. Anti-corrosive and anti-fouling paint shall be applied in alternating colors to ensure coverage and to aid in performing in-service inspections and failure analyses. Anti-fouling paint shall be applied in the order described in [Table 631-8-1](#), such that the final coat in the area from the keel to the boottop for surface ships is red. The boottop is defined as the area from the minimum load waterline at which the ship is expected to operate to 12 inches above the maximum load waterline. Ocean gray or black anti-fouling paint shall be used in the boottop area. The Ocean Gray color is preferred to improve ships' camouflage appearance. However, not all qualified vendor anti-fouling paint systems are available in Ocean Gray, and as such, black is authorized. Haze gray paint on the freeboard shall be carried to the Ocean Gray or black anti-fouling paint that marks the upper boottop paint. Do not apply the anti-fouling paint over haze gray MIL-PRF-24635.

631-8.4.1.7.1 The following provides general guidance in the application sequence of AC and AF coatings.

- a. Apply first coat of the AC system to weld seams, directing spray gun or brush from more than one position or angle if needed to obtain complete coverage. Follow promptly with a full coat of the AC primer system, applied to the entire prepared and cleaned area, including pre-coated seams.
- b. Apply the next coat of AC paint, first to the weld seams, then to the entire primed area, including pre-coated seams.
- c. Touch-up areas, including those masked to protect sonar windows and Prairie Maskers, should receive special attention to assure adequate surface preparation (cleaning and roughening) and adequate thickness of anticorrosive or barrier and antifouling coatings.

631-8.4.1.7.2 For AF coatings that are required to be applied while the last coat of AC coating is still tacky, the applied dry film thickness (DFT) of the last coat of AC paint may be determined by measuring the wet film thickness (WFT) as described in [paragraph 631-7.1.4](#).

631-8.4.1.7.3 The copper-bearing anti-fouling coatings used on steel, GRP/fiberglass, and wood hulls shall not be used on aluminum hulls of ships, boats, or craft. Copper can cause accelerated dissimilar metal corrosion of the aluminum. Low surface energy anti-fouling coatings, also termed foul-release coatings, shall be used on aluminum hulls. These coatings act as non-stick coatings, and do not allow bio-fouling organisms to adhere strongly

to the hull. This enables marine growth on the coating to be dislodged at ship's operational speeds (18 knots and up), and allows the hull to be easily cleaned. Other non-copper-bearing AF paints may also be used on aluminum hulls as shown in [Table 631-8-1](#).

631-8.4.1.8 Anti-Corrosive and Anti-Fouling Paint Drying Time. The minimum drying time requirements before undocking and subjecting the AF coatings to immersion shall be as described in the NAVSEA-approved ASTM F718 data sheet for the product applied, taking into account the appropriate ambient temperature. The first full coat of AC paint shall have cured a minimum of seven days prior to immersion. A minimum of 24 hours drying time prior to undocking shall be allowed after the last coat of anti-fouling paint has been applied.

631-8.4.1.9 Wood Hull Boats and Small Craft. Caulking After the application of the AC coatings on wood hulls, and before the application of any AF coating, apply caulking compound A-A-272, Type III to any screw heads where the caulking is missing.

631-8.4.1.10 Anti-Fouling on Boats and Craft. AF paint need not be applied to boats and craft that are dry-berthed, or wet-berthed in non-fouling waters, or subject to frequent beaching. The Type Commander has the responsibility for deciding whether to apply AF paint under these conditions. If the Type Commander requires that AF coating is to be applied to steel, composite, GRP/fiberglass, or wood hulled boats or craft, it shall be as shown in [Table 631-8-1](#). If the Type Commander requires that AF coating is needed for embarked aluminum hull boats or craft, it shall be either E-Paint Corporation SN-1 Boat Bottom Coating System, Ocean Gray, Color 26173, or the International Paint Intersleek 425 3-year system shown in [Table 631-8-1](#). The number of coats and DFT requirements for the E-Paint SN-1 Boat Bottom Coating are as described below.

Primer: 4-6 mils DFT E-Paint EP Primer 1000, and
 Topcoat: 4-6 mils DFT E-Paint EP PRIMER 1000, and
 Topcoat: 5-7 mils WFT/3-4 mils DFT E-Paint SN-1 Gray, and
 Topcoat: 5-7 mils WFT/3-4 mils DFT E-Paint SN-1 Black, and
 Topcoat: 5-7 mils WFT/3-4 mils DFT E-Paint SN-1 Gray
 Draft Marks: 5-7 mils WFT/3-4 mils DFT E-Paint SN-1 Black

631-8.4.1.10.1 Gray AF paint is preferred for use on embarked boats and craft in order to meet surface ship camouflage requirements. Application of AF paints to embarked boats and craft by ship's force is not authorized, but they may be applied or repaired by shore-based intermediate and depot maintenance activities.

631-8.4.1.10.2 Fleet Commanders and Force Commanders have the responsibility for specifying the desired AF paint colors for aluminum boats or craft in their Commands, and for new aluminum ships or crafts scheduled to join their Commands.

631-8.4.1.11 Non-Antifouling Finish Coats. Finish coats for boats and craft not subject to fouling shall be as specified in [paragraph 631-9.3.2](#) through [631-9.3.3](#)

631-8.4.1.12 Hull Coating System DFT Readings. Baseline Record a minimum of 30 DFT readings per 1,000 square feet. Baseline DFT readings of underwater hull paint system shall be taken after the final coat is applied and quality assurance specification compliance DFT measurements in accordance with SSPC-PA 2 are completed. This data shall be included in the docking reports for the availability and uploaded in electronic form to the CCIMS database, described in [paragraph 631-1.3.6](#).

631-8.4.1.13 Draft Marks. For other than MIL-PRF-24647 Type III foul-release hull coating systems, draft marks in the boottop and below shall consist of one coat of MIL-PRF-24635 Grade B (Low Solar Absorption, LSA) silicone alkyd, light gray, FED-STD-595 color number 26373, 2-3 mils DFT. Draft marks above the boottop shall consist of one coat of MIL-PRF-24635 Grade B LSA silicone alkyd, ocean gray, FED-STD-595 color number 26173, 2-3 mils DFT. For foul-release hull coatings systems (e.g., International Intersleek or others), conventional alkyd or other anti-fouling paints will not adhere to them, and draft mark paints shall be a compatible paint as specified by the foul-release hull coating manufacturer.

631-8.4.1.14 Dielectric Shield. ICCP The dielectric shield coating surrounding impressed current cathodic protection (ICCP) anodes on the underwater hull shall be as described below and in NSTM Chapter 633 – Cathodic Protection. Note that the dielectric shield area is considered a critical coated area along with the rest of the underwater hull as defined in [paragraph 631-11.2](#):

- a. Surface preparation shall be abrasive blasting to white metal, SSPC-SP 5/NACE #1, with a surface profile of 2-4 mils.
- b. The inner shield coating shall be one coat of U.S. Filter Electrocatalytic “Capastic”™, Part No. 35524, applied to a minimum DFT of 100 mils, or other product as approved by NAVSEA. The inner shield is defined as the portion of the dielectric shield that extends 3 feet from the anode in all directions.
- c. The outer shield coating shall be one coat of U.S. Filter Electrocatalytic “Capastic”™, Part No. 35524, applied to a minimum DFT of 22 mils, or other product as approved by NAVSEA. The outer shield is defined as the portion of the dielectric shield from the inner shield to a distance of 6 feet from the anode.
- d. The full underwater hull anti-corrosion and anti-fouling paint systems described in [Table 631-8-1](#) shall be applied on top of the dielectric shield coating
- e. Refer to NSTM Chapter 633 - Cathodic Protection for criteria for repairing or replacing deteriorated or damaged dielectric shields, and for more detailed repair and replacement procedures.

631-8.4.2 PROPULSION SHAFT OUTBOARD BEARING VOIDS. Propulsion shaft outboard bearing voids are the internal surfaces of struts and stern tubes in way of the outboard shaft bearings. Surface preparation and painting shall be the same as the underwater hull AC coating system. The bearing void shall be filled with corrosion preventive compound MIL-C-11796 Class 1 after each bearing shell installation.

631-8.4.3 RUDDERS, STRUTS, AND EROSION-PRONE AREAS. The exterior surfaces of rudders, struts, and other erosion prone areas shall be prepared and coated with the same anti-corrosion (AC) and anti-fouling (AF) coating system, at the same DFT and number of coats, that will be used on the rest of the underwater hull, as described in [paragraph 631-8.4.1](#) and [Table 631-8-1](#). The AF system shall be that described for the keel to the bottom of the boottop. The internal surfaces of rudders shall be coated as described in [paragraph 631-8.16](#) and [Table 631-8-7](#),

631-8.4.3.1 Coating Service Life. Expected The target service life goals shown in [Table 631-8-1](#) may not be achieved in erosion-prone areas, especially on the rudders and struts of surface combatant ships with a history of erosion and accelerated coating damage.

631-8.4.3.2 Erosion-Resistant Coating. At the option of the Type Commander, the following erosion-resistant coating is recommended as a mid-coat to be applied between the AC and AF coatings on rudders, struts, and other underwater hull erosion-prone surfaces.

- a. 3M Company EC-2216B/A Gray Epoxy Adhesive. Apply first coat at 6 mils WFT/4-5 mils DFT, and three successive coats at 8 mils WFT/5-6 mils DFT per coat. Refer to [paragraph 631-7.7](#) for mixing and application guidance. The first coat of EC-2216 shall be applied when the last coat of epoxy anti-corrosive paint is in its final tacky cure stage. The first coat of the MIL-PRF-24647 AF coating shall be applied to the EC-2216 while the EC-2216 is still tacky.

631-8.4.4 FIN STABILIZERS. Surface preparation for existing fin stabilizers shall be brush-off blasting, SSPC-SP 7 (see [paragraph 631-5.4.7.4](#)), taking care to ensure that adjacent polymer fairing compounds are not damaged or removed during blasting. Equipment, shafts, and openings shall be blanked, wrapped, covered or masked as appropriate prior to blasting to prevent damage and contamination. Protective coverings shall be removed upon completion of preservation operations. Surface preparation for refurbished fin stabilizers shall be hand tool cleaning to per SSPC-SP 2. Fin stabilizers shall be coated with the same anti-corrosion (AC) and anti-fouling (AF) coating system, at the same DFT and number of coats, that will be used on the rest of the underwater hull, as described in [paragraph 631-8.4.1](#) and [Table 631-8-1](#). The AF system shall be that described for the keel to the bottom of the boottop.

Table 631-8-1 SURFACE SHIP AND CRAFT UNDERWATER HULL COATING SYSTEMS

Desired Service Life	Anti-Corrosion (AC) Coating or Primer(s) (Note 1)	Keel to Bottom of Boottop Anti-Fouling (AF) Coating	Boottop Anti-Fouling (AF) Coating
STEEL, FIBERGLASS/GRP, AND WOOD SURFACES (MIL-PRF-24647 CLASS 1) (NOTE 2)			
3 years or less (MIL-PRF-24647 Application 1)	MIL-PRF-24647 Type I, II, or III 1 coat red AC and 1 coat gray AC, DFT 4-6 mils per coat, total AC DFT 10 mils minimum	MIL-PRF-24647 Type I, II, or III 1 coat red AF, DFT 4-6 mils	MIL-PRF-24647 Type I, II, or III 1 coat black AF, DFT 4-6 mils
STEEL, FIBERGLASS/GRP, AND WOOD SURFACES (MIL-PRF-24647 CLASS 1) (NOTE 2)			
7 years or less (MIL-PRF-24647 Application 2)	MIL-PRF-24647 Type I, II, or III 1 coat red AC and 1 coat gray AC, DFT 4-6 mils per coat. Total AC DFT 10 mils minimum	MIL-PRF-24647 Type I, II, or III 1 coat black and 1 coat red AF, DFT 4-6 mils per coat. Total AF DFT 10 mils minimum	MIL-PRF-24647 Type I, II, or III 2 coats black AF, DFT 4-6 mils per coat. Total AF DFT 10 mils minimum
STEEL, FIBERGLASS/GRP, AND WOOD SURFACES (MIL-PRF-24647 CLASS 1) (NOTE 2)			
12 years or less (MIL-PRF-24647 Application 3)	MIL-PRF-24647 Type I or II 1 coat red AC and 1 coat gray AC, DFT 4-6 mils per coat. Total AC DFT 10 mils minimum	MIL-PRF-24647 Type I or II 1 coat red, 1 coat black, and 1 coat red AF, DFT 4-6 mils per coat. Total AF DFT 15 mils minimum	MIL-PRF-24647 Type I or II 3 coats black AF, DFT 4-6 mils per coat. Total AF DFT 15 mils minimum
STEEL, FIBERGLASS/GRP, AND WOOD SURFACES (MIL-PRF-24647 CLASS 1) (NOTE 2)			
High-Speed Vessels, 2 years mini- mum (MIL-PRF-24647 Application 4) (Note 3)	MIL-PRF-24647 Type I, II, or III 1 coat red AC and 1 coat gray AC, DFT 4-6 mils per coat. Total AC DFT 10 mils minimum	MIL-PRF-24647 Type I, II, or III Contact NAVSEA for qualified prod- ucts, number of coats, and DFT.	MIL-PRF-24647 Type I, II, or III Contact NAVSEA for qualified prod- ucts, number of coats, and DFT.
ALUMINUM SURFACES (MIL-PRF-24647 CLASS 2)			
3 years or less (MIL-PRF-24647 Application 1)	MIL-PRF-24647 Type I, III, or IV 1 coat red AC and 1 coat gray AC, DFT 4-6 mils per coat. Total AC DFT 10 mils minimum (Note 4)	MIL-PRF-24647 Type I, III, or IV Contact NAVSEA for qualified prod- ucts, number of coats, and DFT. (Note 4)	MIL-PRF-24647 Type I, III, or IV Contact NAVSEA for qualified prod- ucts, number of coats, and DFT. (Note 4)
7 years or less (MIL-PRF-24647 Application 2)	MIL-PRF-24647 Type I or III 1 coat red AC and 1 coat gray AC, DFT 4-6 mils per coat. Total AC DFT 10 mils minimum	MIL-PRF-24647 Type I or III Contact NAVSEA for qualified prod- ucts, number of coats, and DFT.	MIL-PRF-24647 Type I or III Contact NAVSEA for qualified prod- ucts, number of coats, and DFT.

Table 631-8-1 SURFACE SHIP AND CRAFT UNDERWATER HULL COATING SYSTEMS - Continued

Desired Service Life	Anti-Corrosion (AC) Coating or Primer(s) (Note 1)	Keel to Bottom of Boottop Anti-Fouling (AF) Coating	Boottop Anti-Fouling (AF) Coating
12 years or less (MIL-PRF-24647 Application 3)	MIL-PRF-24647 Type I 1 coat red AC and 1 coat gray AC, DFT 4-6 mils per coat. Total AC DFT 10 mils minimum	MIL-PRF-24647 Type I Contact NAVSEA for qualified products, number of coats, and DFT.	MIL-PRF-24647 Type I Contact NAVSEA for qualified products, number of coats, and DFT.
High-Speed Vessels, 2 years minimum (MIL-PRF-24647 Application 4) (Note 3)	MIL-PRF-24647 Type I or III 1 coat red AC and 1 coat gray AC, DFT 4-6 mils per coat. Total AC DFT 10 mils minimum	MIL-PRF-24647 Type I or III Contact NAVSEA for qualified products, number of coats, and DFT.	MIL-PRF-24647 Type I or III Contact NAVSEA for qualified products, number of coats, and DFT.
ELASTOMERIC SURFACES (MIL-PRF-24647 CLASS 3)			
---	MIL-PRF-24647 Type I, II, III, or IV Contact NAVSEA for qualified products, number of coats, and DFT.	MIL-PRF-24647 Type I, II, III, or IV Contact NAVSEA for qualified products, number of coats, and DFT.	MIL-PRF-24647 Type I, II, III, or IV Contact NAVSEA for qualified products, number of coats, and DFT.
General Notes: a. All references to MIL-PRF-24647 coatings are Revision "D" or later. MIL-PRF-24647 anti-corrosion (AC) and anti-fouling (AF) coatings are qualified as a system, and each coat of the system must be from a single qualified manufacturer's system as defined on the Qualified Products List (QPL-24647) or otherwise designated by NAVSEA 05P23 as an approved system. Grades A, B, and C of MIL-PRF-24647 are for qualified systems whose anti-corrosion (AC) coatings have maximum volatile organic contents (VOC) of 340 g/L (2.8 lb/gal), 250 g/L (2.1 lb/gal), and 100 g/L (0.8 lb/gal), respectively. The use of any Grade is acceptable based on local environmental regulations. b. In the boottop area, Ocean Gray boottop antifouling paint, FED-STD-595 Color Number 26173, may be applied for camouflage purposes. Note that most copper-based AF coatings are not color-stable over time, and tend to turn green. Contact NAVSEA for currently approved Ocean Gray boottop antifouling paint. Camouflage painting shall be in accordance with NAVSEA S6360-AG-MAN-010. c. The desired service life goals for ablative or self-polishing AF coatings per MIL-PRF-24647 Type II are based on a nominal in-service wear rate of 1 mil per year. More frequent hull cleanings and high ship operational tempos will accelerate the wear of these coatings and shorten their expected life. Specific Notes: 1. For cold weather applications below 40 degrees Fahrenheit requiring low-temperature cure epoxy AC coatings, MIL-PRF-23236 Type IV, V, or VI, Class 5 or 7, Grade A or B shall be used in lieu of MIL-PRF-24647 coatings; however, each coat of the system must be from a single qualified manufacturer's system as defined on the Qualified Products List (QPL-24647) or otherwise designated by NAVSEA 05M1 as an approved system. Do not apply coating below 35 degrees Fahrenheit without approval of NAVSEA. 2. For fiberglass/GRP and wood surfaces of ships, only 1 coat of red AC primer is required; omit the second gray coat. For fiberglass/GRP and wood hulls of boats and small craft, one coat of MIL-PRF-24441 Formula 150 may be substituted for the AC coating, applied at 4-6 mils DFT.			

Table 631-8-1 SURFACE SHIP AND CRAFT UNDERWATER HULL COATING SYSTEMS - Continued

Desired Service Life	Anti-Corrosion (AC) Coating or Primer(s) (Note 1)	Keel to Bottom of Boottop Anti-Fouling (AF) Coating	Boottop Anti-Fouling (AF) Coating
3. High speed vessels are defined as those that generally operate at a sustained speed of 35 knots or higher.			
4. MIL-PRF-24647 Type II and IV coating systems that contain copper shall not be used on aluminum hulls or surfaces.			

631-8.5 POTABLE WATER TANK COATING SYSTEMS.

631-8.5.1 GENERAL. Potable water tank coatings that are applied too thick or that are inadequately cured will adversely impact the crew's well-being and morale because they make food and beverages unpalatable. Improperly applied potable water tank coatings have adversely affected ship operating schedules, and in extreme cases required ships to return to port for recoating.

631-8.5.2 IN-SERVICE INSPECTION OF POTABLE WATER TANKS. It is required that the condition of the coating in all potable water tanks be inspected by a trained coating inspector (see [paragraph 631-11.6](#)) at specific intervals to coincide with work planning for major availabilities. For all types of surface ships, craft, and aircraft carriers, this interval is six years; for submarines, this interval is eight years, concurrent with entry into the tanks to perform URO MRC 003. If recoating is required, unless otherwise authorized by NAVSEA or the Type Commander, potable water tanks shall be painted by a depot-level activity to minimize the extent of potable water tank preservation required out of major availabilities, when the time available for proper paint curing may be marginal or inadequate.

631-8.5.3 APPROVED COATING SYSTEMS. [Table 631-8-2](#) lists the approved coatings systems for potable water tanks. Stripe coats shall be applied as described in [paragraph 631-7.1.3](#). Use of coating systems other than MIL-DTL-24441 Type III in potable water tanks on nuclear powered ships requires NAVSEA approval.

NOTE

The paints and coatings listed in [Table 631-8-2](#) and their use criteria have been reviewed by NAVSEA and the Naval Environmental Health Center (NEHC) for compliance with Navy and National Sanitary Foundation (NSF) drinking water quality and safety requirements, as well as for environmental, occupational safety and health compliance to the rules and regulations in effect on the date of the latest change notice.

631-8.5.4 CONTROL OF COATING THICKNESS. For MIL-DTL-24441 Type III coatings, and MIL-PRF-23236 Types V and VI coatings, the total DFT specified in [Table 631-8-2](#) shall not be exceeded except in isolated, difficult-to-coat areas adjacent to shapes and stiffeners, and when a maximum system DFT is specified, in no case shall it be exceeded by more than 2 mils. The total of the isolated areas where the system thickness has been exceeded shall be less than 2 percent of the total area coated. For 100% solids coatings per MIL-PRF-23236, Type VII, runs, sags, and drips may appear in the coating due to its solvent-free nature and application properties. If runs, sags, or drips in a wet coat of a MIL-PRF-23236 Type VII coating exceed 15 mils WFT, immediate action shall be taken to correct the coating system by brushing out the wet run, sag, or drip. If the runs, sags, or drips have dried, and the total system DFT in the affected area exceeds 30 mils, then the affected area shall be scraped or mechanically removed and the coating shall be reapplied. Coating inspectors shall perform DFT measurements in excess of those required by SSPC-PA 2 in order to verify that these requirements have been met.

631-8.5.4.1 Thickness Control for Over-Coating and Touch-Up. Coating For touch-up or over-coating intact aged paint in good condition, the above requirements also apply, and the total film thickness maximum requirement may be corrected to allow for the thickness of the underlying aged paint. The intent of this requirement is to avoid excess thickness in individual coats in coatings where solvents are released upon curing. High DFT resulting from the application of extra coats of paint is not considered to be a problem below 15 mils DFT for the MIL-DTL-24441 Type III system, 20 mils DFT for the MIL-PRF-23236 Types V or VI systems, or 35 mils total DFT for the MIL-PRF-23236 Type VII system. Submit a DFS request if these limits are exceeded.

631-8.5.4.2 In-Process Control of Coating Thickness. Wet Film Thickness (WFT) to DFT ratios shall be locally determined for the selected coating. See [paragraphs 631-3.3.3](#) and [631-7.1.4.5](#). Painters shall be instructed to apply paint within a WFT range that will result in the required DFT. All potable water tank painters shall be supplied with WFT gauges and instructed on their proper use.

Table 631-8-2 POTABLE WATER TANK COATING SYSTEMS

Paint Systems and DFTs	Notes
MIL-PRF-23236 Type V or VI, Class 9 Primer: 4-8 mils DFT MIL-PRF-23236 Type V or VI, Class 9 Stripe: 4-8 mils DFT MIL-PRF-23236 Type V or VI, Class 9 Topcoat: 4-8 mils DFT MIL-PRF-23236 Type V or VI, Class 9	2
MIL-PRF-23236 Type VII, Class 9 Primer: 4-8 mils DFT MIL-PRF-23236 Type VII Class 9 Stripe: 6-10 mils DFT MIL-PRF-23236 Type VII Class 9 Topcoat: 10-12 mils DFT MIL-PRF-23236 Type VII Class 9	2
MIL-DTL-24441 Type III Primer: 2-4 mils DFT MIL-DTL-24441 Type III, F150 Stripe: 2-4 mils DFT MIL-DTL-24441 Type III, F152 Topcoat: 2-4 mils DFT MIL-DTL-24441 Type III, F151 Stripe: 2-4 mils DFT MIL-DTL-24441 Type III, F150 Topcoat: 2-4 mils DFT MIL-DTL-24441 Type III, F152 Total system 8-12 mils DFT in areas without stripe coats. Control the DFT of the final topcoat to meet the total system DFT requirement.	1,2
NOTES for Table 631-8-2: 1. MIL-DTL-24441 Type IV shall not be substituted for Type III coatings in potable water tanks. Alternate formula numbers (colors) of Type III coatings may be used, provided that each coat, including the stripe coats, contrast with the prior coat; however, Formula 159 zinc-rich paint shall not be used. The induction (stand-in) times of paragraph 631-7.2.5.3 shall be met after mixing MIL-DTL-24441 Type III paint. 2. Use of coating systems other than MIL-DTL-24441 Type III in potable water tanks on nuclear powered ships requires NAVSEA approval.	

631-8.5.5 COATING REQUIREMENTS. The following requirements apply to all coating work performed in potable water, feedwater, and fresh water drain collection tanks.

- a. Maintain the relative humidity in the tank at a maximum of 50 percent from the start of abrasive blasting through cure of the topcoat to the dry to recoat time shown on the NAVSEA-approved ASTM F718 data sheet. Drying time between coats (including between the stripe coat and subsequent full coat) shall be no less than 48 hours, at a minimum ambient and substrate temperature of 21°C (70°F). Heated air shall be used if necessary to maintain the proper temperature.
- b. Surfaces shall be blasted to achieve a cleanliness standard of SSPC-SP 10, near white metal, with an average surface profile between 2.0 and 4.0 mils.
- c. Following complete system coating application and prior to filling with water, ventilation shall be provided continuously for at least 7 consecutive days at a minimum ambient and substrate temperature of 21°C (70°F), with a minimum of one complete air change every 4 hours. Verify and document daily that ventilation is properly installed and running. Refer to [Section 2](#) for ventilation requirements guidance.
- d. Fully coated tanks shall be cured for a minimum of 7 days under the same conditions stated in (a) and (b) above before being filled. Environmental readings shall be taken from the start of surface preparation to 7 days after application of the final coat.
- e (Potable Water Tanks Only) Freshly painted potable water tanks shall be rinsed at least twice with potable water before being disinfected and put into service

631-8.5.5.1 Accelerated Touch-Up Procedure. The following accelerated drying procedure for touch-up coating is allowed in potable water and feedwater tanks on non-nuclear powered vessels only. This procedure is only permitted for the final

topcoat, and shall not be used for the primer or any intermediate coats. Accelerated touchup is not authorized for potable water, feedwater, or fresh water drain collecting tanks in nuclear powered vessels. Use of this procedure imposes a higher risk of in-service coating failures, and therefore must be documented and locally approved via the Departure From Specification (DFS) process when this procedure is implemented. No other requirements shall be waived for the touch up of potable water or feedwater tanks:

- a. Two days wait after final coat, if the largest single touch-up area is less than one square foot and the total touch-up area is less than four square feet.
- b. Three days wait after the final coat, if the largest single area is between one and two square feet or the total touch-up area is less than ten square feet.
- c. Wait the full seven days if any single area is over two square feet.

631-8.5.5.2 Approval Authority. Any deviation to the above accelerated paint drying or curing requirements should be referred to NAVSEA for approval (specific Reactor Plant Planning Yard approval is required for reactor plant tanks), including proposed resolution such as using heat to shorten drying and curing times.

631-8.5.6 POTABLE WATER CONTAMINATION. For any suspected case of potable water contamination, the Navy Environmental Preventive Medicine Unit (NAVENPVNTMEDU) should be requested to determine the degree of personnel hazard. They should also be requested to recommend proper water treatment procedures, including sampling procedures. For assistance with corrective action and to enact preventive measures for other ships, NAVSEA should be advised of all cases where paint is the suspected cause of contamination.

631-8.5.7 QUALITY ASSURANCE. Potable water tanks are defined as a critical coated area, and the quality assurance requirements of NSTM 631, [Section 11](#) apply. In addition, the following quality assurance inspections for potable water tank coatings shall include:

- a. Measure and record the DFT of any remaining aged coating.
- b. Test the scratch hardness of each coat of paint to ensure that it has cured thoroughly. This test shall be conducted using the pencil hardness test in accordance with the method described in ASTM D3363, except that only the designated hardness pencil shall be used, in order to avoid needlessly damaging the coating. A coating shall be considered to be cured for the purpose of this test if it is not scratched by a number 4H pencil.

631-8.6 FEEDWATER AND FRESH WATER DRAIN COLLECTION TANK COATING SYSTEMS.

631-8.6.1 APPROVED TANK COATINGS. Coatings that shall be used in feedwater and fresh water drain collection tanks, except for those tanks used in nuclear-propelled ships, are listed in [Table 631-8-3](#) MIL-DTL-24441, Type IV paints shall not be used in feedwater tanks. Stripe coats shall be applied as described in [paragraph 631-7.1.3](#).

631-8.6.1.1 Nuclear Powered Vessels. Propulsion plant tanks aboard nuclear powered ships covered by paint schedules shall use the paints identified in the paint schedule. Painting requirements in the paint schedule must be followed in addition those of the NSTM. In the event of a conflict between a paint schedule and the NSTM, the paint schedule takes precedence.

631-8.6.2 FEEDWATER WATER TANK COATING PROCEDURES. The control of coating thickness and coating application and ventilation requirements for potable water tanks in [paragraphs 631-8.5.4](#) and [631-8.5.5](#) shall apply for feedwater and fresh water drain collection tank coating systems.

Table 631-8-3 FEEDWATER AND FRESH WATER DRAIN TANK COATING SYSTEMS (NON-NUCLEAR VESSELS ONLY)

Paint Systems and DFTs	Notes
MIL-PRF-23236 Type VI or VII, Class 11 Primer: 4-8 mils DFT Type VI or VII, Class 11 Stripe: 4-8 mils DFT MIL-PRF-23236 Type VI or VII, Class 11 Topcoat: 4-8 mils DFT MIL-PRF-23236 Type VI or VII, Class 11	
MIL-DTL-24441 Type III Primer: 2-4 mils DFT MIL-DTL-24441 Type III, F150 Stripe: 2-4 mils DFT MIL-DTL-24441 Type III, F152 Topcoat: 2-4 mils DFT MIL-DTL-24441 Type III, F151 Stripe: 2-4 mils DFT MIL-DTL-24441 Type III, F150 Topcoat: 2-4 mils DFT MIL-DTL-24441 Type III, F152 Total system 8-12 mils DFT in areas without stripe coats. Control the DFT of the final topcoat to meet the total system DFT requirement.	1
NOTES for Table 631-8-3: 1. MIL-DTL-24441 Type IV shall not be substituted for Type III coatings in feedwater water tanks. Alternate formula numbers (colors) of Type III coatings may be used, provided that each coat, including the stripe coats, contrast with the prior coat; however, Formula 159 zinc-rich paint shall not be used.	

631-8.7 MACHINERY AND PIPING.

631-8.7.1 GENERAL REQUIREMENTS. Equipment on surface ships and submarines is usually supplied painted and preserved as required by either the individual purchase specifications or the equipment operating or technical manual. If the equipment is received in an unpainted condition or if the coating is damaged before or during installation, or during the equipment service life, painting and preservation shall be done as specified in [Table 631-8-4](#) and the following paragraphs.

631-8.7.2 SURFACE PREPARATION REQUIREMENTS. The surface preparation for the coatings specified in [Table 631-8-4](#) shall be as follows:

- a. SSPC-SP 2 for piping systems, except that SSPC-SP 5 is required for the application of thermal sprayed metal coatings in accordance with MIL-STD-2138 and [631-7.6](#). Steel piping in tanks shall be prepared and painted using the same requirements specified for the tank; see [paragraph 631-8.18.6](#).
- b. SSPC-SP 3 for unheated ferrous machinery, sheet metal, and gageboards
- c. SSPC-SP 11 for high-temperature (e.g. >125°F) machinery and sheet metal.

631-8.7.3 PAINTING PIPING SYSTEMS. The following requirements apply to painting piping, valves, and piping system components:

- a. Apply coatings as specified in [Table 631-8-4](#). For insulated piping and piping system fittings and components, apply coatings directly to the piping, under the insulation.
- b. For piping systems with operating temperatures 200°F and below, when color-coding is required, use MIL-PRF-24635 topcoat in a color specified per NSTM Chapter 505, either directly on the primed piping, or on any insulation or lagging. Identify valves by painting a section of the handwheel or by painting a band on the operating levers, or other method as specified in NSTM Chapter 505. Where no color is specified, the same color as the surrounding structure shall be used. Do not paint valve stems or other moving parts on valves, as specified in NSTM Chapter 505.
- c. In bilge regions below the deck plates, defined “wet spaces” (see [631-8.18.7](#)), and where exposed to the weather, steel,

galvanized steel, and aluminum piping and piping system components with operating temperatures of 200°F or below shall be painted the same as the surrounding epoxy paint system used on the ship structure.

- d. Painting of copper-nickel or other corrosion-resistant piping materials in non-immersed areas is neither required nor prohibited. The requirements of [paragraph 631-8.18.6.6](#) apply to piping in immersed areas. For nonferrous and CRES piping and valves in immersion areas of reactor and propulsion plant in nuclear powered ships, see [paragraph 631-8.17.2](#).

631-8.7.4 USE OF HIGH TEMPERATURE COATINGS. TT-P-28H Type I heat resistant paint will dry to the touch in ambient temperature conditions, but will not fully cure unless the surface temperature reaches at least 400°F in service. Therefore, it shall not be used on machinery or equipment with operating surface temperatures below 400°F. Between 125°F and 400°F, MIL-DTL-24441 Type IV epoxy or PPG Amercoat PSX 892HS shall be used. Amercoat 892HS shall only be used on surfaces with an operating temperature of 700°F or less; use TT-P-28 Type I or metal spray coating per MIL-STD-2138 where the operating surface temperature will be over 700°F.

631-8.7.5 ALTERNATE COLORS. As an alternate to machinery gray (MIL-DTL-15090 Formula 111), the use of the paints listed in [Table 631-8-5](#) is approved for equipment installed in machine shops and engine rooms on surface ships when directed by the Type Commander.

Table 631-8-4 SURFACE SHIP MACHINERY AND PIPING COATINGS

Equipment or Surface	Paint Systems and DFTs	Notes
Machinery and sheet metal surfaces; ferrous; external; up to 125°F	TT-P-645 Formula 84/MIL-DTL-15090 Formula 111 Primer: 1.5-3.0 mils DFT TT-P-645 F-84, and Topcoat: 1.5-3.0 mils DFT MIL-DTL-15090 F-111, and Topcoat: 1.5-3.0 mils DFT MIL-DTL-15090 F-111	1,2
and Machinery Gageboards	or TT-P-645 Formula 84/MIL-PRF-24635 Primer: 1.5-3.0 mils DFT TT-P-645 F-84, and Topcoat: 2-3 mils DFT MIL-PRF-24635, Color 26307, and Topcoat: 2-3 mils DFT MIL-PRF-24635, Color 26307	1,2
Machinery Casings, Sheet Metal, Boilers and economizers (except parts used for heat transfer); steel; 125°F to 400°F	PPG Amercoat PSX 892HS Primer/Topcoat: 2-3 mils DFT PPG Amercoat PSX 892HS, Haze Gray or MIL-DTL-24441 Type IV Primer: 4-6 mils DFT MIL-DTL-24441 Type IV, F150, and Topcoat: 4-6 mils DFT MIL-DTL-24441 Type IV, F151	
Machinery Casings, Sheet Metal, Boilers and economizers (except parts used for heat transfer); steel; 400°F to 700°F	PPG Amercoat PSX 892HS Primer/Topcoat: 2-3 mils DFT PPG Amercoat PSX 892HS, Haze Gray or TT-P-28 Type I High-Temperature Paint Primer: 1.0-1.5 mils DFT TT-P-28 Type I, and Topcoat: 1.0-1.5 mils DFT TT-P-28 Type I	
Machinery Casings, Sheet Metal, Boilers and economizers (except parts used for heat transfer); steel; over 700°F	TT-P-28 Type I High-Temperature Paint Primer: 1.0-1.5 mils DFT TT-P-28 Type I, and Topcoat: 1.0-1.5 mils DFT TT-P-28 Type I	

Table 631-8-4 SURFACE SHIP MACHINERY AND PIPING COATINGS -

Continued

Equipment or Surface	Paint Systems and DFTs	Notes
Piping and Piping System Fittings and Components; 125°F and Below	TT-P-645 Formula 84/MIL-DTL-24607 Formula 124 Primer: 1.5-3.0 mils DFT TT-P-645 F-84, and Topcoat: 1.5-3.0 mils DFT TT-P-645 F-84, and Topcoat: 1.5-3.0 mils DFT MIL-DTL-24607 F-124, and Topcoat: 1.5-3.0 mils DFT MIL-DTL-24607 F-124 or TT-P-645 Formula 84/MIL-PRF-24635 Primer: 1.5-3.0 mils DFT TT-P-645 F-84, and Topcoat: 1.5-3.0 mils DFT TT-P-645 F-84, and Topcoat: 2-3 mils DFT MIL-PRF-24635, Color As Specified, and Topcoat: 2-3 mils DFT MIL-PRF-24635, Color As Specified or Epoxy paint system as per surrounding structure may be used on surfaces up to 200°F, see paragraph 631-8.7.3(c).	1 1
Piping and Piping System Fittings and Components; 125°F to 400°F	PPG Amercoat PSX 892HS Primer/Topcoat: 2-3 mils DFT PPG Amercoat PSX 892HS, Haze Gray or MIL-DTL-24441 Type IV Primer: 4-6 mils DFT MIL-DTL-24441 Type IV, F150, and Topcoat: 4-6 mils DFT MIL-DTL-24441 Type IV, F151	
Piping and Piping System Fittings and Components; 400°F to 700°F	PPG Amercoat PSX 892HS Primer/Topcoat: 2-3 mils DFT PPG Amercoat PSX 892HS, Haze Gray or TT-P-28 Type I High-Temperature Paint Primer: 1.0-1.5 mils DFT TT-P-28 Type I, and Topcoat: 1.0-1.5 mils DFT TT-P-28 Type I	
Piping and Piping System Fittings and Components; over 700°F	TT-P-28 Type I High-Temperature Paint Primer: 1.0-1.5 mils DFT TT-P-28 Type I, and Topcoat: 1.0-1.5 mils DFT TT-P-28 Type I or MIL-STD-2138 Thermal Spray Aluminum System Refer to paragraph 631-7.6	

Table 631-8-4 SURFACE SHIP MACHINERY AND PIPING COATINGS -

Continued

Equipment or Surface	Paint Systems and DFTs	Notes
Piping and Piping System Fittings and Components; Weather-Exposed Shore Steam Systems; Steel	PPG Amercoat PSX 892HS Primer/Topcoat: 2-3 mils DFT PPG Amercoat PSX 892HS, Haze Gray or MIL-STD-2138 Thermal Spray Aluminum System Refer to paragraph 631-7.6	
NOTES for Table 631-8-4 : 1. Apply final coat of specified paint system only if required to completely hide the underlying color of the primer. 2. See paragraph 631-8.7.5 .		

Table 631-8-5 ALTERNATE MACHINE SHOP AND ENGINE ROOM PAINT COLORS

Coating	FED-STD-595 Color No.	Coating	Uses
Brilliant yellow	13538	MIL-PRF-24635	Crane hooks and pulleys
Vivid orange	12246	MIL-PRF-24635	Exposed hazards
Clear blue	15177	MIL-PRF-24635	Switch box control panels
Highlight buff	13578	MIL-PRF-24635	Highlight areas to concentrate attention
Machinery gray	To match Formula 111	MIL-DTL-15090 Formula 111	Body of machinery

631-8.8 ELECTRICAL AND ELECTRONIC EQUIPMENT.

631-8.8.1 PAINTING ELECTRICAL AND ELECTRONIC EQUIPMENT. Electrical and electronic equipment will usually be supplied painted and preserved as required by either the individual purchase specifications or the operating manual. Painting and preservation may be necessary if the equipment is received in an unpainted condition or if the coating has been damaged before or during installation or in service. In addition, painting and preservation are necessary for finishing after installation. Surface preparation shall be SSPC-SP 2. Except as otherwise specified in MIL-E-2036(SH), the painting and preservation of electric and electronic equipment shall comprise:

TT-P-645 Formula 84/MIL-DTL-15090 Formula 111

Primer: 1.5-3.0 mils DFT TT-P-645 F-84, and

Topcoat: 1.5-3.0 mils DFT MIL-DTL-15090 F-111, and

Topcoat: 1.5-3.0 mils DFT MIL-DTL-15090 F-111

or

TT-P-645 Formula 84/MIL-PRF-24635

Primer: 1.5-3.0 mils DFT TT-P-645 F-84, and

Topcoat: 2-3 mils DFT MIL-PRF-24635, Color 26307

631-8.8.2 Switchboards and dead-front type panels for control, power, lighting applications, and for electric propulsion shall be given an additional finish coat only if cleaning and touch-up will not give the desired result.

631-8.9 MOTORS AND GENERATORS.

631-8.9.1 PAINTING MOTORS AND GENERATORS. Motors and generators shall be painted according to the following paragraphs.

631-8.9.2 EXTERIOR PARTS. Except for shafts and identification plates, paint exterior parts in accordance with [paragraph 631-8.8.1](#).

631-8.9.3 INTERIOR PARTS. Electrical insulation of all types and surfaces in contact with lubricating oil or grease, commutators, collector rings, brushes, bearings, and bearing surfaces shall not be painted. Do not paint peripheries of armatures and rotors or any other rotating part of a machine from which centrifugal force may cause the paint to be thrown on to the windings when the machine is operated at rated load and rated ambient temperature. Insulation varnish conforming to MIL-I-24092, instead of paint, may be applied to such parts. Paint other corrosion-resistant parts in accordance with [paragraph 631-8.8.1](#).

631-8.9.3.1 Inside Ends of Motors and Generators. Apply one coat of primer (MIL-DTL-24441 Type III or IV Formula 150) or primer (TT-P-645 Formula 84) followed by one coat of white enamel (MIL-PRF-24635) to the inside of both ends of the enclosure of water-or air-cooled motors and generators.

631-8.9.3.2 Reduce Wear of Motor and Generator Brushes. To reduce wear of carbon brushes, paints which contain silicon resins, such as TT-P-28 Type I shall not be used on, or in close proximity to, motors and generators. Consult NAVSEA for guidance to resolve any conflicts. Motor generators on submarines also require protection when using all types of epoxy paints.

631-8.10 ELECTRIC CABLES AND SUPPORTS.

631-8.10.1 GENERAL REQUIREMENTS. Steel or aluminum supporting structure for cable shall be cleaned and primed before installation of cable in accordance with the paint system required for the bulkheads or overheads of the compartment or space. Stainless steel (CRES) cable supports do not require painting. After being secured in position, primed armored cable and supporting structure and unpainted unarmored cable shall be coated as described below. Surface preparation for unarmored cables shall be soap and water cleaning, or gentle hand tool cleaning to remove previously existing damaged paint. Surface preparation for armored cables shall be SSPC-SP 2.

a. Cable, Interior, Low Smoke PVC

MIL-PRF-24596/MIL-DTL-24607

Primer: 2-4 mils DFT MIL-PRF-24596, and

Topcoat: 2-4 mils DFT MIL-PRF-24596, and

Topcoat: 1.5-3.0 mils DFT MIL-DTL-24607, Color match as specified, and

Topcoat: 1.5-3.0 mils DFT MIL-DTL-24607, Color match as specified

b. Cable, Interior, Other Than Low Smoke PVC

TT-P-645 Formula 84/MIL-PRF-24596

Primer: 1.5-3.0 mils DFT TT-P-645 F-84, and

Topcoat: 2-4 mils DFT MIL-PRF-24596, and

Topcoat: 2-4 mils DFT MIL-PRF-24596

or

TT-P-645 Formula 84/MIL-DTL-24607

Primer: 1.5-3.0 mils DFT TT-P-645 F-84, and

Topcoat: 1.5-3.0 mils DFT MIL-DTL-24607, Color match as specified, and

Topcoat: 1.5-3.0 mils DFT MIL-DTL-24607, Color match as specified

c. Cable, Exterior, Other Than Low Smoke PVC

TT-P-645 Formula 84/MIL-PRF-24635 Grade B

Primer: 1.5-3.0 mils DFT TT-P-645 F-84, and

Topcoat: 2-3 mils DFT MIL-PRF-24635 Grade B, Haze Gray color 26270

The color of the topcoats shall match the surrounding area, as specified. For surface ships, a fire protective coating shall be applied to fire zone penetrations (collars, multiple cable penetrators and stuffing tubes) as a fire stop method where PVC jacketed cable is installed. If bare, unarmored cables are to be painted, the first coat shall be a water base paint qualified to MIL-PRF-24596.

631-8.11 METAL ENCLOSURES.

631-8.11.1 GENERAL. Steel, galvanized steel, and aluminum sheet metal enclosures for motor controllers, electric panels, wiring boxes, fittings, fixtures (including those complying with NAVSEA standard plans), and enclosures for electric equipment in general (except electronic interior communication, and fire control equipment) for which painting is not otherwise specified in purchase specifications, shall be coated as described below. For equipment received with pretreatment and primer only, apply finish coats as appropriate for the surrounding area. Finish paint matching the surrounding area may be applied over MIL-DTL-15090 Formula 111 to avoid masking enclosures when painting surrounding structure. Powder coating may be used as an alternative to conventional liquid painting in order to refurbish an empty enclosure, where the internal equipment has been removed to prevent damage from the heating involved in the powder coating process. (Refer to [paragraph 631-7.9.](#)) Touch up any damaged coatings as required.

631-8.11.2 SURFACE PREPARATION AND PRETREATMENT FOR PAINTS. New bare steel enclosures shall be chemically cleaned and pre-treated with a zinc or iron phosphate treatment per TT-C-490. New galvanized steel enclosures shall be detergent cleaned. New aluminum enclosures shall be chemically cleaned or detergent cleaned to be free of all visible oil, grease, dirt, or other debris. Refurbished enclosures shall be detergent cleaned and hand tool cleaned (SSPC-SP 2 for steel) to remove all dirt, soils, loose paint and corrosion products. If a previously painted and rusted steel sheet metal enclosure is being refurbished, and the internal equipment has been removed, it may be lightly abrasive blasted to remove old paint and rust.

631-8.11.3 COATING REQUIREMENTS.

TT-P-645/Interior Space Topcoat

Primer: 1.5-3.0 mils DFT TT-P-645 F-84, and

Topcoat: 2 coats of MIL-DTL-15090, F-111 at 1.5-3.0 mils DFT each, or

Topcoat: 2 coats of MIL-DTL-24607, at 1.5-3.0 mils DFT each, color to match, or

Topcoat: 2 coats of MIL-PRF-24596, at 2-4 mils DFT each, color to match

(One coat of epoxy paint per MIL-DTL-24441 Type IV Formula 150, or MIL-PRF-23236 Types IV, V, or VI Class 5 or 7, shall be substituted for TT-P-645 primer on galvanized steel enclosures.)

or

MIL-PRF-24712, or MIL-PRF-23236 Type VIII Powder Coating

Surface preparation, cleaning, pre-treatment and powder coat as per NAVSEA-approved ASTM F718 data sheet.

631-8.11.4 BRASS, STAINLESS STEEL, AND NONFERROUS METALS. Brass, stainless steel (CRES), and nonferrous metals other than aluminum shall not be coated except where painting is required for marking, safety or topside camouflage.

631-8.12 INTERIOR COMMUNICATION AND FIRE CONTROL EQUIPMENT.

631-8.12.1 COATING REQUIREMENTS. Manufacturers usually supply Interior Communication (IC) and Fire Control (FC) switchboards, amplifiers, panels, and equipment components finished according to MIL-E-2036(SH) or MIL-F-18870; no additional painting is required in these cases. Touch-up painting, as required, shall use the topcoats as described in [paragraph 631-8.11](#).

631-8.13 LIGHTING SYSTEMS.

631-8.13.1 Do not paint light-reflecting and light-transmitting surfaces of lighting fixtures and gaskets, rubber packing, or watertight work.

631-8.14 EXTERIOR RADAR, FIRE CONTROL, ANTENNAS AND ELECTRONIC EQUIPMENT.

631-8.14.1 GENERAL. Antennas generally should not be painted by Ship's Force. Radar antennas shall be coated as per their applicable Technical Manuals. For antennas (receivers and transmitters) and covers that do not have painting requirements in their Technical Manuals, use MIL-DTL-24441 Type IV, Formula 151 epoxy applied in accordance with MIL-E-2036(SH) at a facility that is capable of applying epoxy polyamide coatings in a controlled environment.

631-8.14.2 ALUMINUM ALLOY TRANSMITTING AND RECEIVING ANTENNA. Aluminum alloy transmitting and receiving antenna whips shall be coated with two coats of MIL-DTL-24441 Type IV Formula 150. Follow these with one coat of MIL-PRF-24635 (haze gray) paint on stack-mounted whip antennas.

631-8.14.3 WAVEGUIDES. Waveguides shall be protected and preserved on interior and exterior surfaces according to installation standards of NAVSEA SE000-01-IMB-010, 0910-LP-003-9770, Navy Installation and Maintenance Book (NIMB). Waveguide preservation may be performed before or after installation.

631-8.14.4 SHOCK MOUNTS. Care shall be taken to avoid painting electrical contact points, ceramic insulators, rubber insulation mounts (shock or noise mounts), and insulation materials of all kinds. Mask all such parts before painting. Finish-paint submarine antennas, except for insulators, as required by applicable antenna technical manuals.

631-8.14.5 RADOMES. Coat specialized radomes and other similar housings in accordance with the specific equipment Technical Manual. No other coatings shall be applied.

631-8.15 SONAR DOMES.

631-8.15.1 SURFACE SHIP SONAR DOMES. Acoustical surfaces of sonar components (exterior to the hull of the ship) not supplied finished by the manufacturer shall be painted in accordance with the instructions in the appropriate volumes of the Sonar Dome Handbook as listed below:

- a. NAVSEA 0967-LP-412-3010, Volume I, AN/SPS-4 Series and AN/SQS-23 Sonar Domes
- b. NAVSEA 0967-LP-412-3020, Volume II, AN/SQS-26 Steel and Rubber Sonar Domes.
- c. NAVSEA 0967-LP-412-3030, Volume III, AN/SQS-38 GRP Sonar Domes.

d. NAVSEA 0967-LP-412-3040, Volume IV, AN/SQQ-23 Rubber Sonar Domes.

631-8.15.2 SUBMARINE SONAR BOW DOMES. Submarine bow domes are either made of steel or Glass Reinforced Plastic (GRP) material, and either of these materials may or may not have rubber “boots” installed on the exterior surfaces. Submarine bow domes shall be painted as described in [Table 631-8-6](#) and per the requirements in the applicable bow dome technical manuals. Applicable submarine bow dome technical manuals are: NAVSEA S9165-AC-HBK-010 “Submarine Sonar Dome Handbook (except Trident and SSN21 Class Submarines)”; NAVSEA SE300-AY-MMA-010/SSBN726CL “Trident GRP Bow Sonar Dome Handbook”; and NAVSEA SE300-AZ-MMA-010 “SSN21 Class Sonar Bow Dome Handbook”. In general, epoxy anti-corrosion (AC) coatings are applied to all surfaces except the interior surfaces of GRP domes, and anti-fouling (AF) topcoats are applied to all exterior surfaces from the keel to the upper boottop; above the boottop, a polyurethane topcoat is to be applied.

631-8.15.2.1 Surface Preparation for Submarine Bow Domes. The surface preparation requirements for submarine bow domes vary according to whether the substrate being prepared is the steel dome, GRP dome, or the rubber boot.

- a. Steel Domes: Steel domes shall be prepared by either water jetting or abrasive blasting. Water jetting shall be per SSPC-SP 12/NACE No. 5, to obtain a WJ-2L surface cleanliness; refer to [paragraph 631-5.5](#). Abrasive blasting shall be to near-white metal cleanliness, SSPC-SP 10, and the surface profile shall be 3-4 mils; refer to [paragraph 631-5.4](#).
- b. GRP Domes: GRP domes shall be prepared either by Low Pressure Water Jetting (LPWJ) or wet abrasive blasting (WAB); refer to [paragraphs 631-5.5](#) or [631-5.4.6](#), respectively. LPWJ shall be performed with a fan spray starting at a pressure of 1,000 psi. Keep the cleaning lance nozzle tip perpendicular to and at least 4” from the surface, and increase the pressure, if needed, in increments of 500 psi up to a maximum of 5,000 psi. Perform WAB (or slurry blasting) carefully with 80 to 120 mesh grit and fresh water at 50 to 60 psig with the nozzle perpendicular to the surface. For either method, remove all paints down to sound grey or green anti-corrosive paint (MIL-DTL-24441 F-151 or F-150) or bare GRP, as specified. Remove any remaining barnacle particles or other foreign objects with wood or plastic scrapers, or by hand sanding. Do not use wire brushes or other abrasive tools. The surface finish of the bare GRP dome is to 180 microinches Ra or smoother.

CAUTION

Observe extreme caution when water jetting (LPWJ) rubber boots on bow domes. Measure stand-off distance and control nozzle pressure to assure that the boot is not damaged during the cleaning process.

- c. Rubber Boots: If the boot has an existing paint system, remove all marine growth and existing paint from the boot surface by Low Pressure Water Jetting (LPWJ), or by sanding with soft back dual action or soft back random orbital sanders and 60 grit paper. LPWJ shall be performed using fresh water with a starting pressure of 1000 psi. Increase the pressure in 500 psi increments as needed until the desired results are obtained. Scuff the entire boot surface using 60 grit paper or equivalent coarseness Scotchbrite pad to remove any remaining paint and provide an adequately prepared surface for paint application. Clean the bare boot surface with PF-145HP degreaser (NSN 6850-01-378-0044) or mineral spirits per Commercial Item Description A-A-2904 Grade 1.

NOTE

MIL-DTL-24631 Type I Formula 184 epoxy paint (also known as DTRC 2844-1118), had been used in the past for topside painting of rubber booted bow domes; however, it fades and chalks when exposed to sunlight. MIL-DTL-24631 Type II Formula 187 polyurethane paint is recommended instead because of its good flexibility and comparatively good UV stability. Formula 187 can only be applied if the Formula 184 is completely removed to a clean, buffed, bare rubber surface.

Table 631-8-6 SUBMARINE BOW DOME COATINGS

Location(s)	Paint Systems and DFTs	Notes
Steel Bow Domes: Interior Surfaces	MIL-PRF-23236 Type VII Class 5 Primer: 4-8 mils DFT MIL-PRF-23236 Type VII Class 5, and Stripe: 6-10 mils DFT MIL-PRF-23236 Type VII Class 5, and Topcoat: 10-12 mils DFT MIL-PRF-23236 Type VII Class 5 or MIL-PRF-23236 Type V or VI Class 5 Primer: 4-8 mils DFT MIL-PRF-23236 Type V or VI Class 5, and Stripe: 4-8 mils DFT MIL-PRF-23236 Type V or VI Class 5, and Topcoat: 4-8 mils DFT MIL-PRF-23236 Type V or VI Class 5 or MIL-DTL-24441 Type IV Primer: 4-6 mils DFT MIL-DTL-24441 Type IV, F150, and Stripe: 4-6 mils DFT MIL-DTL-24441 Type IV, F151, and Topcoat: 4-6 mils DFT MIL-DTL-24441 Type IV, F152	1
Steel Bow Domes: Booted Exterior Surfaces Above Upper Boottop	Prior to installing boot - paint on steel dome: MIL-DTL-24441 Type IV Primer: 4-6 mils DFT MIL-DTL-24441 Type IV, F150, and Stripe: 4-6 mils DFT MIL-DTL-24441 Type IV, F151, and Topcoat: 4-6 mils DFT MIL-DTL-24441 Type IV, F153 or F154 After boot installation - paint on rubber boot: MIL-DTL-24631 Type I (Formula 187) Topcoat: 2-3 mils DFT MIL-DTL-24631 Type II, F187	1 2
Steel Bow Domes: Booted Exterior Surfaces Below Upper Boottop	Prior to installing boot - paint on steel dome: MIL-DTL-24441 Type IV Primer: 4-6 mils DFT MIL-DTL-24441 Type IV, F150, and Stripe: 4-6 mils DFT MIL-DTL-24441 Type IV, F151, and Topcoat: 4-6 mils DFT MIL-DTL-24441 Type IV, F153 or F154 After boot installation – paint on rubber boot: MIL-DTL-24631 Type I (Formula 184)/MIL-PRF-24647 Class 1 AF Primer: 2-3 mils DFT MIL-DTL-24631 Type I, F184, and Topcoat: 4-6 mils DFT MIL-PRF-24647 AF, Cl. 1, Appl. 2, Type I, II, or III, and Topcoat: 4-6 mils DFT MIL-PRF-24647 AF, Cl. 1, Appl. 2, Type I, II, or III	1 3
Steel Bow Domes: Unbooted Exterior Surfaces Above Upper Boottop and	MIL-PRF-24647 Class 1 AC Primer: 4-6 mils DFT MIL-PRF-24647 Type I, II, or III AC, and Stripe: 4-6 mils DFT MIL-PRF-24647 Type I, II, or III AC, and Topcoat: 4-6 mils DFT MIL-PRF-24647 Type I, II, or III AC or	4

Table 631-8-6 SUBMARINE BOW DOME COATINGS - Continued

[illegible]

Table 631-8-6 SUBMARINE BOW DOME COATINGS - Continued

Location(s)	Paint Systems and DFTs	Notes
GRP Bow Domes: Booted Exterior Surfaces Below Upper Boottop	Prior to installing boot - paint on GRP dome: MIL-DTL-24441 Type IV Primer: 4-6 mils DFT MIL-DTL-24441 Type IV, F150 After boot installation - paint on rubber boot: MIL-DTL-24631 Type I (Formula 184)/MIL-PRF-24647 Class 1 AF Primer: 2-3 mils DFT MIL-DTL-24631 Type I, F184, and Topcoat: 4-6 mils DFT MIL-PRF-24647 AF, Cl. 1, Appl. 2, Type I, II, or III, and Topcoat: 4-6 mils DFT MIL-PRF-24647 AF, Cl. 1, Appl. 2, Type I, II, or III	3
GRP Bow Domes: Unbooted Exterior Surfaces Below Upper Boottop	MIL-PRF-24647 Class 1 AC/MIL-PRF-24647 Class 1 AF Primer: 4-6 mils DFT MIL-PRF-24647 Type I, II, or III AC, and Topcoat: 4-6 mils DFT MIL-PRF-24647 AF, Cl. 1, Appl. 2, Type I, II, or III, and Topcoat: 4-6 mils DFT MIL-PRF-24647 AF, Cl. 1, Appl. 2, Type I, II, or III or MIL-DTL-24441 Type IV/MIL-PRF-24647 Class 1 AF Primer: 4-6 mils DFT MIL-DTL-24441 Type IV, F150, and Topcoat: 4-6 mils DFT MIL-PRF-24647 AF, Cl. 1, Appl. 2, Type I, II, or III, and Topcoat: 4-6 mils DFT MIL-PRF-24647 AF, Cl. 1, Appl. 2, Type I, II, or III	3 3

NOTES for Table 631-8-6:

- Stripe and topcoat colors for MIL-DTL-24441 may vary, provided that they are of contrasting colors and that the top-coat color matches the existing surrounding paint on visible exterior surfaces.
- MIL-DTL-24631 Type II (F187) polyurethane paint can not be applied over previously existing MIL-DTL-24631 Type I (F184) epoxy paint. Previously existing F184 epoxy paint must be completely removed prior to the application of F187.
- MIL-PRF-24647 Anti-fouling (AF) color shall be black from the maximum beam up through the upper boottop, and may be black or red from the keel up to the maximum beam. The total AF DFT shall be a minimum of 10 mils.
- MIL-PRF-24647 Anti-corrosive (AC) colors should be of contrasting colors, and the topcoat shall be black. The total AC system DFT shall be 10 mils minimum.

631-8.16 MISCELLANEOUS EQUIPMENT.

631-8.16.1 GENERAL. Paint miscellaneous shipboard equipment as described in [Table 631-8-7](#).

Table 631-8-7 MISCELLANEOUS EQUIPMENT COATINGS

Location(s)	Paint Systems and DFTs	Notes
Anchor, Bow	MIL-PRF-23236 Type V or VI Class 5/MIL-PRF-24635 Grade B Haze Gray Primer: 4-8 mils DFT MIL-PRF-23236 Type V or VI Class 5, and Topcoat: 4-8 mils DFT MIL-PRF-23236 Type V or VI Class 5, and Topcoat: 2-3 mils DFT MIL-PRF-24635 Grade B, Haze Gray color 26270 or MIL-PRF-23236 Type VII Class 5/MIL-PRF-24635 Grade B Haze Gray Primer: 4-8 mils DFT MIL-PRF-23236 Type VII Class 5, and Topcoat: 10-12 mils DFT MIL-PRF-23236 Type VII Class 5, and Topcoat: 2-3 mils DFT MIL-PRF-24635 Grade B, Haze Gray color 26270	9
Anchor, Keel	— — —	1
Anchor chain	PPG/Ameron PSX-700 Primer: 1-2 mils DFT PPG/Ameron PSX-700 (to hold the blast; see note 2) Topcoat: 4-5 mils DFT PPG/Ameron PSX-700 Topcoat: 4-5 mils DFT PPG/Ameron PSX-700	2, 3
Bilge keels: Internal Surfaces	MIL-PRF-16173, Grade 1 or 3 rust preventive	6
Catapult launching valves and exhaust	MIL-STD-2138 Thermal Spray Aluminum System Refer to paragraph 631-7.6 or MIL-PRF-23236 Type V or VI Class 5 Primer: 3-5 mils DFT MIL-PRF-23236 Type V or VI Class 5, and Topcoat: 3-5 mils DFT MIL-PRF-23236 Type V or VI Class 5 or MIL-PRF-23236 Type VII Class 5 Primer: 4-8 mils DFT MIL-PRF-23236 Type VII Class 5, and Topcoat: 10-12 mils DFT MIL-PRF-23236 Type VII Class 5	4
Exterior canvas lagging and canvas life rafts	TT-P-595 Gray canvas preservative	5
Fireplugs and foam discharge valves	TT-P-645 Formula 84/MIL-PRF-24635 Primer: 1.5-3.0 mils DFT TT-P-645 F-84, and Topcoat: 1.5-3.0 mils DFT TT-P-645 F-84, and Topcoat: 2-3 mils DFT MIL-PRF-24635, Color Number 11105 (Red)	
Furniture and joiner doors	As specified in MIL-PRF-32038.	11

Table 631-8-7 MISCELLANEOUS EQUIPMENT COATINGS - Continued

Location(s)	Paint Systems and DFTs	Notes
Inaccessible steel surfaces (Not galvanized)	MIL-PRF-23236 Type V or VI Class 5 Primer: 4-8 mils DFT MIL-PRF-23236 Type V or VI Class 5, and Topcoat: 4-8 mils DFT MIL-PRF-23236 Type V or VI Class 5 or MIL-PRF-23236 Type VII Class 5 Primer: 4-8 mils DFT MIL-PRF-23236 Type VII Class 5, and Topcoat: 10-12 mils DFT MIL-PRF-23236 Type VII Class 5 or TT-P-645 Formula 84 Primer: 1.5-3.0 mils DFT TT-P-645 F-84, and Topcoat: 1.5-3.0 mils DFT TT-P-645 F-84	12
Messenger buoys	MIL-DTL-24441/MIL-PRF-24635 Primer: 4-6 mils DFT MIL-DTL-24441 Type IV, F150, and Topcoat: 4-6 mils DFT MIL-DTL-24441 Type IV, F151, and Topcoat: 2-3 mils DFT MIL-PRF-24635, Color Number 12197 (International Orange)	
Lockers, ordnance and pyrotechnic, exterior (weather)	The topcoats for ordnance and pyrotechnic locker sun shields shall be painted white (FED STD 595, Color No. 17875) or as directed by NAVSEA.	
Propellers (bronze or corrosion-resistant)	Unless otherwise specified, clean and polish bright.	
Rudders, shaft struts and skegs: Internal Surfaces)	MIL-PRF-16173, Grade 1 or 3 rust preventive	6
Seamless coating for small objects	Plastisol coating as per paragraph 631-7.5 .	
Shafting, inboard	MIL-PRF-23236 Type VII, Class 17 Primer: 6-8 mils DFT MIL-PRF-23236, Type VII, Class 17, and Topcoat: 6-8 mils DFT MIL-PRF-23236, Type VII, Class 17	9
Shafting, outboard	Resin-glass cloth coating per MIL-STD-2199, Glass Reinforced Plastic Coverings For Propeller Shafting. This shall be followed by hand sanding, and application of the MIL-PRF-24647 AC and AF coating system specified in Table 631-8-1 for fiberglass/GRP surfaces, using the applicable "Desired Service Life" line for the ships underwater hull coating system. Nonferrous surfaces shall receive one coat of MIL-PRF-23236 Type V, VI or VII Class 5 epoxy paint.	
Shaft tube (internal)	MIL-PRF-23236 Type VII, Class 17 Primer: 6-8 mils DFT MIL-PRF-23236, Type VII, Class 17, and Topcoat: 6-8 mils DFT MIL-PRF-23236, Type VII, Class 17	9, 14

Table 631-8-7 MISCELLANEOUS EQUIPMENT COATINGS - Continued

Location(s)	Paint Systems and DFTs	Notes
Propulsion shaft outboard bearing void (internal surfaces of strut and stern tube in way of outboard bearings)	MIL-PRF-23236 Type V or VI Class 5 Primer: 4-8 mils DFT MIL-PRF-23236 Type V or VI Class 5, and Stripe: 4-8 mils DFT MIL-PRF-23236 Type V or VI Class 5, and Topcoat: 4-8 mils DFT MIL-PRF-23236 Type V or VI Class 5 or MIL-PRF-23236 Type VII Class 5 Primer 4-8 mils DFT MIL-PRF-23236 Type VII Class 5, and Stripe: 6-10 mils DFT MIL-PRF-23236 Type VII Class 5, and Topcoat: 10-12 mils DFT MIL-PRF-23236 Type VII Class 5	9, 10
Smoke Pipes, Exhaust Stacks, BLISS Caps, Exhaust Eductors; Exterior, high temperature surfaces	2-3 mils DFT PPG Amercoat PSX 892HS, Haze Gray	7
Smoke Pipes, Exhaust Stacks, BLISS Caps, Exhaust Eductors; Interior, high temperature surfaces	TT-P-28 Type I High-Temperature Paint Primer: 1.0-1.5 mils DFT TT-P-28 Type I, and Topcoat: 1.0-1.5 mils DFT TT-P-28 Type I	8
Ventilation ducts, trunks, and plenums (HVAC)	— —	13
NOTES for Table 631-8-7: 1. Keel anchors or other anchors that are normally stowed below the lower boottopping limit shall be painted the same as the underwater hull AC/AF system. 2. Anchor chains shall be coated with PPG/Ameron PSX 700 or equal. PPG/Ameron PSX 700 is a 90% solids epoxy with a VOC of 120 grams per liter and has demonstrated superior performance as an anchor chain coating when compared to currently approved materials. PPG/Ameron PSX 700 is available in yellow, red, blue, black and white colors. Surface preparation and application shall be in accordance with NAVSEA-approved ASTM F718 data sheets. Absent F718 data sheets, prepare surface to a SSPC-SP 6 Commercial Blast finish. If an after-blast hold coat is desired to facilitate inspection, apply 1-2 mils DFT PSX 700. 3. Anchor chain and detachable links shall be marked and color coated in accordance with NSTM Chapter 581 unless otherwise directed by the Work Item. 4. When MIL-STD-2138 thermal spray aluminum coatings are listed as a coating option, they should be used only on surfaces where the service temperature is 300°F or higher. 5. Preservation coating is not required where approved synthetic materials are used in place of canvas. Haze gray silicone alkyd paint (MIL-PRF-24635) shall be used instead of canvas preservative for canvas normally stowed in a vertical or near vertical position, where the color is visible, in accordance with the NAVSEA Surface Ship Camouflage Manual NAVSEA S6360-AG-MAN-010. 6. Ventilate after application to remove solvent vapors. If desired, rudders may be coated by floating corrosion preventive on water, filling rudder and allowing to drain. External surfaces shall be coated as described in paragraph 631-8.4.3.		

Table 631-8-7 MISCELLANEOUS EQUIPMENT COATINGS - Continued

Location(s)	Paint Systems and DFTs	Notes
7. Exterior surface shall be painted with one coat of PPG Amercoat PSX 892HS over bare surfaces. No other heat resistant paints that are haze gray are acceptable on exterior uptakes and bliss eductor caps. Heat resistant paints other than Amercoat 892HS require NAVSEA approval. PPG Amercoat PSX 892HS shall not be used for surfaces that exceed 700 degrees Fahrenheit service temperature. If in-service surface temperature exceeds 700°F, use TT-P-28 Type I.		
8. The inner surface of the stack shall be painted with two coats of heat resistant paint, TT-P-28 Type I, over bare steel. Heat resistant paints other than TT-P-28 Type I require NAVSEA approval.		
9. Two coats of the underwater hull anti-corrosion (AC) coating system per MIL-PRF-24647 may be substituted for MIL-PRF-23236 epoxy coating. See paragraph 631-8.4 and Table 631-8-1 .		
10. Fill bearing void with corrosion preventive compound MIL-C-11796 Class 1 after each bearing shell installation.		
11. New furniture is coated per MIL-PRF-32038. Unpainted aluminum (bright) surfaces shall be waxed. Furniture and joiner doors requiring recoating or touch-up in service may use MIL-PRF-24712 powder coatings applied in accordance with their NAVSEA-approved ASTM F718 data sheets, or paints MIL-DTL-15090 F-111 (light gray only), MIL-DTL-24607, or MIL-PRF-24596.		
12. For inaccessible portions of steel joiner work and surfaces of areas under built-in furniture.		
13. See paragraph 631-8.18.4 for painting requirements for structural and non-structural ventilation (HVAC) air ducts, plenums and trunks. If there is no moisture separator installed at the weather opening/skin of the skip on supply ducts, existing corroded steel or galvanized steel ducts (sheet metal) should be replaced with CRES 316, from the weather opening to at least the first in-line HVAC component. Refer to the General Specifications for Overhaul (GSO), Section 512. Internal surfaces of aluminum, galvanized steel, or CRES ducts do not require painting. External surfaces shall be painted as specified for the surrounding structure.		
14. Shaft bearings and shaft must be pulled before this work can be accomplished.		

631-8.17 SHIPBOARD ITEMS NOT TO BE PAINTED.

631-8.17.1 ITEMS NOT TO PAINT. The following Navy shipboard items are not to be painted:

- a. Stainless steel (CRES) decks, CRES galley equipment, and CRES bulkheads in wet spaces. CRES and nonferrous piping in dry bilges.
- b. Decorative plastic surfaces such as those on bulkheads and table tops.
- c. The following items associated with doors, hatches and scuttles: dogs, wedges, nuts, spindles and CRES linkages on watertight and airtight doors; gasket-sealing knife edges on closures or closure frames; hinge pin hardware; hatch and scuttle brace links; hatch and scuttle hand wheels; hatch and scuttle counterbalance springs; dog bolts and nuts on individually dogged hatches; operating mechanisms on quick-acting hatches and scuttles; Collective Protection System (CPS) and dogging assist door latch assemblies; label plates on watertight closures.
- d. Watertight closure gaskets, including fixed light gaskets.
- e. Sight glasses, gauge faces, and identification plates and other markings which, if painted, would be illegible.
- f. Insulators.
- g. Submarine snorkel mast exterior stainless steel (CRES) surfaces.

- h. Porcelainized surfaces.
- i. Threaded parts, such as adjusting threads and take-up threads which, if painted, would not function properly.

NOTE

Paint applied to these fasteners need not be removed unless excess paint interferes with threaded fastener adjustments. Previously painted adjustable threaded fasteners shall not be repainted.

- j. Sacrificial anodes and impressed current cathodic protection (ICCP) anodes.
- k. The following interior aluminum surfaces:
 - 1. Bins, shelves, dressers, cabinets, battens, and fittings.
 - 2. Interior gratings, handrails, and floor plates.
 - 3. Internal ventilation duct surfaces.
- l. Electrical outlets, terminals, activating mechanisms of electrical safety devices, and control switchboards on machinery elevators.
- m. Bell pulls, sheaves, annunciator chains, and other mechanical communication devices.
- n. Bronze water ends of pumps.
- o. Condenser heads and outside surfaces of condensers when made of bronze.
- p. Within magazines, dry sprinkling piping with holes drilled in the pipe top.
- q. Exposed bronze part of any machinery.
- r. Valve stems, packing glands, gland threaded fasteners, and internal surfaces.

NOTE

Paint that was already applied to packing glands and gland threaded fasteners need not be removed unless there is excess paint that is interfering with valve packing adjustment. Previously painted packing glands and gland threaded fasteners shall not be repainted.

- s. Heat exchange surfaces of heating or cooling equipment.
- t. Joint faces of gaskets and packing surfaces.
- u. Lubricating gear, such as oil holes, oil or grease fittings and oil or grease cups, and lubricators and surfaces in contact with lubricating oil.
- v. Lubricating oil reservoirs.
- w. Machined metal surfaces of reciprocating engines, pumps, weapons, or other machinery, and all oil-wetted surfaces of internal combustion engines.
- x. Metal lagging.
- y. Rods, gears, universal joints, and couplings of valve operating gear.
- z. Expansion joints, nonferrous parts of pipe hangers, flexible hose connections, items partially fabricated of rubber, and resilient elements of isolation mounts. (See [631-8.20.6.5](#) for special submarine requirements.)
- aa. Sliding feet of turbines and boilers.
- bb. Springs.
- cc. Strainers
- dd. Turbine casing joints, nuts, and bolts.

- ee. Working surfaces, benches, or tables.
- ff. Deck fittings and joiner hardware on plastic boats.
- gg. Light-reflecting and light-transmitting surfaces of items such as light fixtures, ports, and windows.
- hh. Faces of sonar transducers, hydrophones, NOFOUL rubber sheeting, sonar dome rubber windows, rubber sonar domes, and AN/SQS-38 glass-reinforced plastic domes, except when otherwise specified in documents such as equipment manuals.
- ii. Rubber surfaces, except when specified. (See [631-8.20.6.5](#) for special submarine requirements.)
- jj. Grounding contact surface.
- kk. Label plates.
- ll. The following parts of aluminum alloy accommodation ladders: rotating platforms (upper & intermediate), including stanchions and safety chains; feathering and fixed tread ladder assemblies including handrails and safety chains; lower platforms, including handrails, safety chains, shell bumpers and H-frames.
- mm. Applies to LPD 17 Class Only: 1) The following components associated with the Retractable Accommodation Ladder Assembly: Compound-filled ladder treads, gratings, rotating connections, proximity switch contact points, hydraulic hose couplings/fittings, grease fittings, gasket seal, dog and wedge surfaces. 2) The following components associated with the AEMS Ladder System (Forward & Aft): Extension ladder, folding ladder, sectional ladder, and trapeze ladder treads.
- nn. Lifeline assemblies complete with end fittings.
- oo. Guard chain assemblies, including shackles and snap hooks.
- pp. Toggle bolts.
- qq. Vertical ladder tread surfaces.
- rr. Inclined ladder tread surfaces.
- ss. GRP surfaces that are already gray.

631-8.17.2 SPECIAL ITEMS NOT TO BE PAINTED. Corrosion resistant reactor plant and propulsion plant systems in nuclear-powered ships are not to be painted, except as identified in the surface ship and submarine general reactor plant overhaul and repair specifications (NAVSEA 0989-LP-043-0000 and 0989-LP-037-2000, respectively).

631-8.18 SURFACE SHIPS.

631-8.18.1 GENERAL. The preservation and coating of the interior and exterior surfaces of Navy surface ships are described in the following paragraphs. These paragraphs specify coatings for exterior and interior structural surfaces. If a coating system for a specific type of system, machinery, equipment, or outfitting cannot be identified in the preceding paragraphs, then use requirements below for coating the structure in the area the equipment is located, or contact NAVSEA for guidance.

631-8.18.2 EXTERIOR STRUCTURAL SURFACES. Exterior metallic surfaces above the waterline of all surface ships and craft, including the well decks of amphibious ships, and exterior watertight closures, shall be coated in accordance with the requirements in [Table 631-8-8](#) and the following paragraphs. Unless otherwise specified, surface preparation shall be abrasive blasting to SSPC-SP 10. All wood exterior surfaces shall be coated in accordance with the requirements in [Table 631-8-9](#) and the following paragraphs.

631-8.18.2.1 Freeboard, Masts, and Superstructure Decks and Bulkheads. The following special requirements apply to the surface preparation and coating of these areas:

- a. New welds resulting from hull cuts or other work performed on the freeboard in an availability shall be prepared as described in [paragraph 631-5.2.2](#), and shall be abrasive blasted to SSPC-SP 10; hand or power tool cleaning is insufficient.
- b. Surface preparation required for all composite, glass-reinforced plastic (GRP), and fiberglass surfaces is high pressure water washing to remove all staining and loose paint. For touch-up purposes, or when removal of only the topcoat down to sound and intact primer is required, then light abrasive blasting using black walnut shells in accordance with [paragraph 631-5.4.3](#) may be used, along with spot cleaning as described in [paragraph 631-5.2.6](#).
- c. Except for overheads and undersides of horizontal surfaces where white is specified, the paints specified are those required by NAVSEA S6360-AG-MAN-010, Camouflage Manual for Surface Ship Concealment. Haze gray, FED-STD-595, color No. 26270, shall be used on all exterior vertical, and near vertical surface above the upper boot-topping limit including the masts and the watch caps of the stacks. Exceptions are for overheads and undersides of horizontal surfaces where white is specified and decks where deck gray is specified. Examples of exceptions that are authorized are:
 1. Exhaust stacks, BLISS caps, IR suppressors, exhaust air eductors, smoke pipes, etc. shall be painted as specified in [Table 631-8-7](#).
 2. Contrasting colors (For example, FED-STD-595 color no. 12199, international orange) shall be used on tips of cargo booms and similar projection near landing areas for greater visibility.
 3. Letters and numbers used for designations and markings may be painted light gray (FED-STD-595, color 26373) and blackout lines dark gray (color no. 26173).
- d. To ensure a continuous primer base, deck areas adjacent to those being coated with proprietary primer and non-skid listed on QPLs for MIL-PRF-24667 shall be coated with the same primer and compatible topcoat. Peripheral deck edging and areas not receiving non-skid may substitute the non-skid manufacturer's color topping for MIL-PRF-24635. Refer to NSTM Chapter 634.

631-8.18.2.2 Well Decks. The following requirements apply to the surface preparation and coating of well deck areas.

- a. Prior to surface preparation, a low pressure (3000 to 5000 psi) fresh water wash-down of the well deck area shall be performed before either abrasive blasting or power tool cleaning, in order to remove all dirt, oil, grease, salts and loosely adherent coatings. (Note that this is a standard requirement for the well deck overhead, which is a defined critical coated area. However, this requirement is extended to other surfaces within the well deck area.).
- b. Abrasive blasting to SSPC-SP 10 shall be used for surface preparation of all well deck overheads, bulkheads, and decks, wherever possible, especially overhead areas exposed to LCAC exhaust. Where abrasive blasting is not possible, power tool cleaning to SSPC-SP 11 shall be used.

631-8.18.2.3 Exterior Watertight Closures. Watertight closures include doors, hatches, and scuttles. The following requirements apply to the surface preparation and coating of exterior watertight closures.

- a. Surface preparation of new or existing closures that are being coated by activities other than ship's force shall include the removal of all weld spatter and weld slag, followed by SSPC-SP 1 solvent cleaning, and abrasive blasting to SSPC-SP 10 near white metal with a 2-4 mil surface profile. Particular attention must be paid to welds, crevices, the gasket channel, and stiffener areas. If liquid paint coatings are used instead of powder coatings, stripe coating of welds and hard to reach areas is required.
- b. Surface preparation of in-service closures by ship's force shall first be SSPC-SP 1 solvent cleaning to remove all oil, grease and salts (see [paragraph 631-5.7](#)) and then power tool cleaned to bare metal SSPC-SP 11 (see [paragraph 631-5.3.3](#)).
- c. For touch-up repairs of painted or powder coated in-service closures by Ship's Force, either MIL-PRF-23236 Type V or VI, Class 5, Grade C, or MIL-DTL-24441 Type IV epoxy paints may be used, using 3-coat systems consisting of a primer, stripe coat on welds and edges, and an intermediate topcoat. The final topcoat for these touch-up repairs should be a single coat of exterior haze gray paint per MIL-PRF-24635 Type II, Class 2, Grade C.

- d. For the interior side of exterior watertight closures, a final top coat may be applied to match the surrounding structure.

Table 631-8-8 PAINT SYSTEMS FOR EXTERIOR SURFACES ABOVE WATERLINE

Location(s)	Paint Systems and DFTs	Notes
Freeboard, Masts, and Super-structure: All exterior vertical and near vertical surfaces from the upper boot-topping limit, except other structural areas listed below;	MIL-PRF-23236 Type IV, V or VI Class 5/MIL-PRF-24635 Grade B or C Haze Gray Primer: 4-8 mils DFT MIL-PRF-23236 Type IV, V or VI Class 5, and Stripe: 4-8 mils DFT MIL-PRF-23236 Type IV, V or VI Class 5, and Topcoat: 4-8 mils DFT MIL-PRF-23236 Type IV, V or VI Class 5, and Topcoat: 2-3 mils DFT MIL-PRF-24635 Grade C, Haze Gray color 26270, or Topcoat: 2-3 mils DFT MIL-PRF-24635 Grade B, Haze Gray color 26270	1, 2, 3
and	or	
Exterior Fittings and Piping	MIL-PRF-23236 Type VII Class 5/MIL-PRF-24635 Grade B or C Haze Gray Primer: 4-8 mils DFT MIL-PRF-23236 Type VII Class 5, and Stripe: 6-10 mils DFT MIL-PRF-23236 Type VII Class 5, and Topcoat: 10-12 mils DFT MIL-PRF-23236 Type VII Class 5, and Topcoat: 2-3 mils DFT MIL-PRF-24635 Grade C, Haze Gray color 26270, or Topcoat: 2-3 mils DFT MIL-PRF-24635 Grade B, Haze Gray color 26270	6
	or	
	MIL-PRF-23236 Type IV, V or VI Class 5/MIL-PRF-24763 Type II Class 2 Primer: 4-8 mils DFT MIL-PRF-23236 Type IV, V or VI Class 5, and Stripe: 4-8 mils DFT MIL-PRF-23236 Type IV, V or VI Class 5, and Topcoat: 4-8 mils DFT MIL-PRF-23236 Type IV, V or VI Class 5, and Topcoat: 2-4 mils DFT MIL-PRF-24763 Type II, Class 2, Haze Gray color 26270	
	or	
	MIL-PRF-23236 Type VII Class 5/MIL-PRF-24763 Type II Class 2 Primer: 4-8 mils DFT MIL-PRF-23236 Type VII Class 5, and Stripe: 6-10 mils DFT MIL-PRF-23236 Type VII Class 5, and Topcoat: 10-12 mils DFT MIL-PRF-23236 Type VII Class 5, and Topcoat: 2-4 mils DFT MIL-PRF-24763 Type II, Class 2, Haze Gray color 26270	6

**Table 631-8-8 PAINT SYSTEMS FOR EXTERIOR SURFACES ABOVE
WATERLINE - Continued**

Location(s)	Paint Systems and DFTs	Notes
Exterior horizontal surfaces and waterways not receiving non-skid coatings	MIL-PRF-23236 Type V or VI Class 5/MIL-PRF-24635 Grade B Deck Gray Primer: 4-8 mils DFT MIL-PRF-23236 Type V or VI Class 5, and Stripe: 4-8 mils DFT MIL-PRF-23236 Type V or VI Class 5, and Topcoat: 4-8 mils DFT MIL-PRF-23236 Type V or VI Class 5, and Topcoat: 2-3 mils DFT MIL-PRF-24635 Grade B, Deck Gray color 26008 or MIL-PRF-23236 Type VII Class 5/MIL-PRF-24635 Grade B Deck Gray Primer: 4-8 mils DFT MIL-PRF-23236 Type VII Class 5, and Stripe: 6-10 mils DFT MIL-PRF-23236 Type VII Class 5, and Topcoat: 10-12 mils DFT MIL-PRF-23236 Type VII Class 5, and Topcoat: 2-3 mils DFT MIL-PRF-24635 Grade B, Deck Gray color 26008	1
		6
Flight Decks, Hanger Decks, Vertical Replenishment Decks, Exterior Walkways	Refer to NSTM Chapter 634 for non-skid coating system requirements	
Galvanized steel surfaces	— —	4
Louvers, Removable (Bolted), for Intakes and Uptakes	MIL-PRF-23236 Type VII Class 5 Primer: 4-8 mils DFT MIL-PRF-23236 Type VII Class 5, and Stripe: 6-10 mils DFT MIL-PRF-23236 Type VII Class 5, and Topcoat: 10-12 mils DFT MIL-PRF-23236 Type VII Class 5, and Topcoat: 2-3 mils DFT MIL-PRF-24635 Grade B, Haze Gray color 26270 or MIL-PRF-23236, Type VII, Class 7 Primer: 4-8 mils DFT MIL-PRF-23236, Type VII, Class 7, and Stripe: 6-10 mils DFT MIL-PRF-23236, Type VII, Class 7, and Topcoat: 10-12 mils DFT MIL-PRF-23236, Type VII, Class 7, and Topcoat: 2-3 mils DFT MIL-PRF-24635 Grade B, Haze Gray color 26270	
Passive Countermeasure System (PCMS): Initial Installation Topcoat	MIL-DTL-24441 Type IV/MIL-PRF-24763 Primer: 4-6 mils DFT MIL-DTL-24441 Type IV, F150, and Topcoat: 4-6 mils DFT MIL-DTL-24441 Type IV, F151, and Topcoat: 2-4 mils DFT MIL-PRF-24763 Type II, Class 2, Haze Gray color 26270	5
Passive Countermeasure System (PCMS): Touch-Up/Repair Topcoat	Topcoat: 2-4 mils DFT MIL-PRF-24763 Type II, Class 2, Haze Gray color 26270	5
RAST Track Troughs	MIL-PRF-23236 Type VII, Class 17 Primer: 6-8 mils DFT MIL-PRF-23236, Type VII, Class 17 Stripe: 6-8 mils DFT MIL-PRF-23236, Type VII, Class 17 Topcoat: 6-8 mils DFT MIL-PRF-23236, Type VII, Class 17	7

**Table 631-8-8 PAINT SYSTEMS FOR EXTERIOR SURFACES ABOVE
WATERLINE - Continued**

Location(s)	Paint Systems and DFTs	Notes
Well Deck Overheads	MIL-PRF-23236, Type VII, Class 19 Primer: 4-8 mils DFT MIL-PRF-23236, Type VII, Class 19 (Cream or Buff) Stripe: 6-10 mils DFT MIL-PRF-23236, Type VII, Class 19 (Gray) Topcoat: 10-12 mils DFT MIL-PRF-23236, Type VII, Class 19 (White)	8
Well Deck bulkheads and decks, Turntable Pits	MIL-PRF-23236 Type V or VI Class 5/MIL-PRF-24635 Grade B or C Haze Gray Primer: 4-8 mils DFT MIL-PRF-23236 Type V or VI Class 5, and Stripe: 4-8 mils DFT MIL-PRF-23236 Type V or VI Class 5, and Topcoat: 4-8 mils DFT MIL-PRF-23236 Type V or VI Class 5, and Topcoat: 2-3 mils DFT MIL-PRF-24635 Grade C, Haze Gray color 26270, or Topcoat: 2-3 mils DFT MIL-PRF-24635 Grade B, Haze Gray color 26270 or	6
	MIL-PRF-23236 Type VII Class 5/MIL-PRF-24635 Grade B or C Haze Gray Primer: 4-8 mils DFT MIL-PRF-23236 Type VII Class 5, and Stripe: 6-10 mils DFT MIL-PRF-23236 Type VII Class 5, and Topcoat: 10-12 mils DFT MIL-PRF-23236 Type VII Class 5, and Topcoat: 2-3 mils DFT MIL-PRF-24635 Grade C, Haze Gray color 26270, or Topcoat: 2-3 mils DFT MIL-PRF-24635 Grade B, Haze Gray color 26270 or	8
	MIL-PRF-23236, Type VII, Class 19 Primer: 4-8 mils DFT MIL-PRF-23236, Type VII, Class 19 (Cream or Buff) Stripe: 6-10 mils DFT MIL-PRF-23236, Type VII, Class 19 (Gray) Topcoat: 10-12 mils DFT MIL-PRF-23236, Type VII, Class 19 (White)	8
Watertight Closures (Doors, Hatches, Scuttles)	MIL-PRF-24712 Zn-Rich Epoxy Powder/ MIL-PRF-24712 Polyester Powder Primer: 6-8 mils DFT MIL-PRF-24712 Zinc Rich Epoxy Powder and Topcoat: 6-8 mils DFT MIL-PRF-24712 Polyester Powder or	9
	MIL-PRF-24712 Zn-Rich Epoxy Powder/MIL-PRF-24635 Ty. II, Cl. 2, Gr. C Primer: 6-8 mils DFT MIL-PRF-24712 Zinc Rich Epoxy Powder and Topcoat: 2-3 mils DFT MIL-PRF-24635 Type II, Class 2, Grade C or	9

**Table 631-8-8 PAINT SYSTEMS FOR EXTERIOR SURFACES ABOVE
WATERLINE - Continued**

Location(s)	Paint Systems and DFTs	Notes
	MIL-PRF-23236, Type VII, Class 5/MIL-PRF-24635 Ty. II, Cl. 2, Gr. C Primer: 4-8 mils DFT MIL-PRF-23236, Type VII, Class 5 and Stripe: 6-10 mils DFT MIL-PRF-23236, Type VII, Class 5 and Topcoat: 2-3 mils DFT MIL-PRF-24635 Type II, Class 2, Grade C	10
NOTES for Table 631-8-8: - The 12-year MIL-PRF-24647 Anti-Corrosive (AC) underwater hull epoxy (Types I or II, Class 1, Application 3) being used on the underwater hull may be substituted for MIL-PRF-23236 in these areas if the underwater hull is being painted during the same availability. See paragraph 631-8.4 and Table 631-8-1 for requirements for use of MIL-PRF-24647 coatings. - Corrosion resistant fittings need not be painted. - The topcoats for ordnance and pyrotechnic locker sun shields shall be painted white (FED STD 595, Color No. 17875) or as directed by NAVSEA. - Prepare galvanized steel surfaces by very light abrasive blasting per SSPC-SP 7, using garnet or aluminum oxide blast media. Take care only to clean soils and corrosion products, and to minimize removal of zinc galvanizing. Do not coat small items of galvanized outfitting hardware. Apply one coat of MIL-PRF-24763 at 2-4 mils DFT, and topcoat to match surrounding area. - PCMS topcoats shall be applied, repaired, and touched-up in accordance with the PCMS Repair and Installation Methods publication RIM 05T1-99. When previous PCMS topcoats must be removed prior to repainting, they shall be removed using "Peel-Away 7" paint stripper, or plastic media blasting, or sodium bicarbonate media blasting as described in RIM 05T1-99. PCMS tile on the bow flares shall be painted with the same topcoat as the freeboard. - This coating system has a projected service life of 6-8 years for the epoxy and 2-3 years for the topcoat, when applied to a surface that has been prepared to SSPC-SP 10 or SSPC-SP 12 WJ-2L. - This coating system has a projected service life of 6 years when applied to a surface that has been prepared to SSPC-SP 10 or SSPC-SP 12 WJ-2L. - This coating system has a projected service life of 10 years for the epoxy and 2-3 years for the topcoat, when applied to a surface that has been prepared to SSPC-SP 10. - Zinc-rich epoxy powder is preferred as first coat, but epoxy powder may be substituted if necessary. MIL-PRF-23236 zinc-rich epoxy and epoxy powders may also be substituted for the similar type of MIL-PRF-24712 powders. - MIL-PRF-23236 Type VII Class 5 is preferred, but MIL-PRF-23236 Type VI Class 5 may be substituted, applied at 3-5 mils DFT for both the primer and stripe coats.		

**Table 631-8-9 PAINT SYSTEMS FOR EXTERIOR WOOD SURFACES ON
SURFACE SHIPS**

Location(s)	Paint Systems and DFTs	Notes
Keel to upper boottopping	See Table 631-8-1 .	

**Table 631-8-9 PAINT SYSTEMS FOR EXTERIOR WOOD SURFACES ON
SURFACE SHIPS - Continued**

Location(s)	Paint Systems and DFTs	Notes
From the upper boottopping limit to main deck and all vertical and near vertical surfaces Exterior piping and fittings	MIL-DTL-24441 Type IV/MIL-PRF-24635 Grade B Primer: 4-6 mils DFT MIL-DTL-24441 Type IV, F150, and Topcoat: 2-3 mils DFT MIL-PRF-24635 Grade B, Haze Gray color 26270	1, 2, 3
Exterior horizontal surfaces and waterways; masts and spars	MIL-DTL-24441 Type IV/MIL-PRF-24635 Grade B Primer: 4-6 mils DFT MIL-DTL-24441 Type IV, F150, and Topcoat: 2-3 mils DFT MIL-PRF-24635 Grade B, Deck Gray color 26008, or Topcoat: 2-3 mils DFT MIL-PRF-24635 Grade B, color 37038	1
Accommodation ladders	4 coats of spar varnish, Master Painters Institute Ref. #28.	
NOTES for Table 631-8-9: 1. One coat of MIL-DTL-24441, Type III at 3-4 mils per coat can be substituted for one coat of MIL-DTL-24441, Type IV, at 4-6 mils per coat. 2. Corrosion resistant fittings need not be painted. 3. The topcoats for ordnance and pyrotechnic locker sun shields shall be painted white (FED STD 595, Color No. 17875) or as directed by NAVSEA.		

631-8.18.3 INTERIOR STRUCTURAL SURFACES OF COMPARTMENTS. This paragraph provides coating requirements for painting interior structural surfaces (bulkheads, overheads, decks, foundations, etc.) in all types of compartments or spaces, except for the specific types of compartments or spaces described in [paragraphs 631-8.18.4](#) and follow. Deck painting requirements, including special wear-resistant deck paints, are defined herein. The requirements for all other types of deck covering treatments, including all types of non-skid coatings and treatments, are contained in NSTM Chapter 634 – Deck Coverings.

WARNING

Use a minimum number of thin coats of fire retardant coatings when repainting, and restrict repainting to those occasions when cleaning alone is inadequate. Even fire retardant coatings can contribute to fire spread when used in excessive thickness. This limit is exceeded at thicknesses in excess of 17 mils for MIL-DTL-24607 paints, and in excess of 21 mils for the MIL-PRF-24596 water-based fire retardant paints, which includes paints formerly designated as Navy Formula 25A. Excessive thickness can also increase smoke and fume generation during a fire.

631-8.18.3.1 Re-Painting Bulkheads and Overheads. Unless otherwise specified in [paragraph 631-8.18.3.3](#), MIL-DTL-24607 and MIL-PRF-24596 paints are approved for use in painting bulkheads and overheads of interior compartments that are considered manned spaces. The finish paint for interior compartments shall be water-based unless otherwise specified. Refer to [paragraph 631-1.3](#) when making coating repair/replace decisions.

631-8.18.3.2 Color Schemes. Interior Type Commanders may specify uniform painting schemes for ships under their Command or may permit each ship to adopt its own color schemes. The choice of colors for living, messing, recreation,

commissary, sanitary spaces, and adjacent passageways shall be restricted to those specified for decks, bulkheads, and overheads. A list of suggested color schemes is contained in NAVSEA 0929- LP-002-7010, U.S. Navy Shipboard Color Coordination Guidance Manual. The minimum reflectance of 70 percent is mandatory for overheads, except light traps. Reflectance may be determined by ASTM E97. MIL-DTL-24607 Formula 124 and MIL-PRF-24596 paints have a reflectance of 70% or more.

631-8.18.3.3 Application Of Fire Retardant Paints. Water-based fire-retardant coatings, qualified to MIL-PRF-24596 (including paints formerly designated as Navy Formula 25A), are to be used for all applications where the ambient air and substrate temperatures are at or above 50°F, and relative humidity is less than 80 percent and in all normally manned spaces within the ships air conditioning boundaries. Spaces with bulkhead and overhead surfaces subject to condensation due to temperature differentials such as main machinery rooms, auxiliary boiler room, shaft alleys, pump rooms, catapult machinery rooms, piping trunks and ventilation ducting when condensing conditions exist on ducting surfaces during periods of paint out and curing, shall be painted with chlorinated alkyd-base paints, MIL-DTL-24607. Although MIL-DTL-24607 is preferred for areas with substrate temperatures below 50°F, MIL-PRF-24596, Type I, Grade C, Class 1 or 2 may also be used if the surface or ambient temperature is below 50°F.

- a. For other bulkheads and overheads, apply two coats of TT-P-645 Formula 84 on steel or aluminum. Use two finish-coats of chlorinated alkyd-base paint ([Table 631-8-10](#)) or two finish coats of MIL-PRF-24596 fire retardant water-based paint, or two finish coats of other NAVSEA approved fire retardant water-based paints on bulkheads and overheads. Chlorinated alkyd-base paints are applied in the same way as conventional alkyd-base paint. The second finish coat need only be applied if necessary to completely cover and hide the underlying surface.

631-8.18.3.4 Structure Behind Thermal Insulation. Bulkheads and other structures that will be covered with thermal insulation shall be coated as below:

MIL-PRF-23236 Type V or VI Class 5

Primer: 4-8 mils DFT MIL-PRF-23236 Type V or VI Class 5, and

Topcoat: 4-8 mils DFT MIL-PRF-23236 Type V or VI Class 5

or

MIL-PRF-23236 Type VII Class 5

Primer: 4-8 mils DFT MIL-PRF-23236 Type VII Class 5, and

Topcoat: 10-12 mils DFT MIL-PRF-23236 Type VII Class 5

631-8.18.3.5 Anti-Sweat Coatings. In interior compartments (other than tanks, voids, chain lockers, and machinery space bilges) when an un-insulated side of a bulkhead is adjacent to an air conditioned compartment, or the un-insulated hull side shell is adjacent to the sea, an anti-sweat coating shall be applied. See [paragraph 631-7.8](#). Surface preparation shall be per SSPC-SP 11. The following coating systems are approved for use, and shall be applied according to their NAVSEA-approved ASTM F718 data sheets; other coating systems may be approved by NAVSEA.

Hempel Anti-Condens System

Primer: 4-6 mils DFT Hempadur 45150-50630, and

Topcoat: 50-60 mils DFT Hempel Anti-Condens 617US-10000

or

KEFA Airless 8125 System

Primer: 1.5-3.0 mils DFT TT-P-645 Formula 84, or

Primer: 4-8 mils DFT MIL-PRF-23236 Type IV, V, VI or VII, and
 Topcoat: 50-60 mils DFT KEFA Airless 8125

or

Tempcoat 101 System

Primer: 1.5-3.0 mils DFT TT-P-645 Formula 84, or
 Primer: 4-8 mils DFT MIL-PRF-23236 Type IV, V, VI or VII, and
 Topcoat: 20-22 mils DFT Tempcoat 101, and
 Topcoat: 20-22 mils DFT Tempcoat 101, and
 Topcoat: 20-22 mils DFT Tempcoat 101

or

Mascoat Delta-T Marine System

Primer: 1.5-3.0 mils DFT TT-P-645 Formula 84, or
 Primer: 4-8 mils DFT MIL-PRF-23236 Type IV, V, VI or VII, and
 Topcoat: 20-22 mils DFT Delta-T Marine, and
 Topcoat: 20-22 mils DFT Delta-T Marine, and
 Topcoat: 20-22 mils DFT Delta-T Marine

Table 631-8-10 INTERIOR-FINISH PAINTS FOR SURFACE SHIPS AND
 SUBMARINES

Color ¹	Formula	FED-STD-595 Color No.	Specification	Notes
CHLORINATED-ALKYD BASE				
White	124	27880	MIL-DTL-24607	2
Pastel green	125	24585	MIL-DTL-24607	2
Bulkhead gray	126	26307	MIL-DTL-24607	2
Rosewood		22519	MIL-DTL-24607	
Beach sand		22563	MIL-DTL-24607	
Yellow gray		26400	MIL-DTL-24607	
Green gray		26496	MIL-DTL-24607	
Pearl gray		26493	MIL-DTL-24607	
Sun glow		23697	MIL-DTL-24607	
Clipper blue		24516	MIL-DTL-24607	
Pastel blue		25526	MIL-DTL-24607	
WATER-BASE				
Pastel green		24585	MIL-PRF-24596	
Bulkhead gray		26307	MIL-PRF-24596	
White		27880	MIL-PRF-24596	
Beach sand		22563	MIL-PRF-24596	
Clipper blue		24516	MIL-PRF-24596	
Green gray		26496	MIL-PRF-24596	
Rosewood		22519	MIL-PRF-24596	
Sun glow		23697	MIL-PRF-24596	
Yellow gray		26400	MIL-PRF-24596	
Pearl gray		26493	MIL-PRF-24596	
Pastel blue		25526	MIL-PRF-24596	
NOTES for Table 631-8-10:				

Table 631-8-10 INTERIOR-FINISH PAINTS FOR SURFACE SHIPS AND
SUBMARINES - Continued

Color ¹	Formula	FED-STD-595 Color No.	Specification	Notes
1. The specific color for each compartment is listed on the ship's paint schedule.				
2. These coatings shall be used in engineering spaces on nuclear-powered ships.				

631-8.18.3.6 Bulkheads And Overheads. Use water-base, MIL-PRF-24596 paint (which includes paints formerly designated as Formula 25A), chlorinated alkyd-based MIL-DTL-24607, or other NAVSEA approved fire-retardant water-based paints for overheads and bulkheads of living, messing, and recreation spaces, and their connecting passageways. Paint fibrous glass board to match surrounding structure. Use interior finish water-based coatings as specified for interior compartments, bulkhead, and overheads. Finish-paint all other compartments according to [Table 631-8-11](#), in which space and station names are segregated into functional groups as designated in the general specifications.

Table 631-8-11 SURFACE SHIP COMPARTMENT FINISHES

Compartment	Bulkheads (B) Overhead (O)	Notes
Air control and associated spaces:		
1. Air operations	Green, (B,O)	8, 15
2. Air radio room	Green, (B) White, (O)	3, 15 3
3. Carrier control, approach room	Gray, (B,O)	15
4. Other spaces	White, (B,O)	15
Commissary spaces	White, (B,O)	15
Damage control spaces:		
1. Central control station	Green, (B) White, (O)	15
2. Other spaces	White, (B,O)	15
Electronic spaces:		
1. Radar control room	Gray, (B,O)	2, 15
2. Sonar control room	Pastel Blue, (B)	2, 15
3. Outboard Ops. and Comms	Insignia Blue, (O)	9
4. Other spaces	Green, (B) White, (O)	9
Machinery and associated spaces	White, (B,O)	5, 15
Fire control and gunnery spaces:		
1. Gun mount enclosure	White, Formula 30 (B,O)	4, 15 7
2. Powder test room	Green, (B)	15

Table 631-8-11 SURFACE SHIP COMPARTMENT FINISHES - Continued

Compartment	Bulkheads (B) Overhead (O)	Notes
3. Surface battery plot	White, (O) Green, (B) White, (O)	15
4. Underwater battery plot	Green, (B) White, (O)	15
5. Other spaces	White, (B,O)	15
Flag spaces:		
1. Flag planning center	Gray, (B,O)	2, 15
2. Flag plot	Gray, (B,O)	2, 15
3. Flag radio center	Green, (B) White, (O)	15
4. Secondary flag planning	Green, (B,O)	15
5. Support control room	Green, (B,O)	15
6. Supporting arms coordination center	Gray, (B,O)	2, 15
Medical and dental spaces	Green, (B,O)	13, 15, 16
Offices	Green, (B) White, (O)	15
Ship control and associated spaces:		
1. Captain plot	Gray, (B,O)	2, 15
2. Captain tactical message center	Gray, (B,O)	2, 15
3. Chart room	Green, (B,O)	2, 15
4. Combat Information Center (CIC)	Gray, (B,O)	2,9,15
5. Pilot house	Green, (B,O)	10,15
6. Secondary conn	Green, (B,O)	15
7. Other spaces	Green, (B) White, (O)	15
Workshops:		
1. Aviation photographic laboratory	Green, (B,O)	8, 15 3, 15
2. Welding bay	Black, (B) White, (O)	3

Table 631-8-11 SURFACE SHIP COMPARTMENT FINISHES - Continued

Compartment	Bulkheads (B) Overhead (O)	Notes
3. Print shop photographic darkroom	Green, (B) White, (O)	15
4. Other spaces	White, (B,O)	15
Storerooms, issue rooms, and lockers	White (B,O)	15
Utility spaces:		
1. Light traps	Black, (B,O)	6
2. Other spaces	White, (B,O)	15
Sanitary spaces	White, (B,O)	11, 15
Collective Protection System (CPS) filter rooms, decontamination stations, and air locks	White, (B,O)	11, 15
NOTES for Table 631-8-11: 1. Hanger deck areas not covered with deck-covering should be painted with gray paint, MIL-PRF-24635, color number 36231. Bulkheads of hanger bay areas should be finish-painted with gray paint, MIL-PRF-24635, color number 36231, to 4 feet above the deck. 2. The area directly behind the vertical plotting boards and status guards, plus a margin determined by a plane passing through the edges of the board at 45° to the bulkhead, shall be painted dull black, MIL-PRF-24635, color number 37038. Bulkheads shall be painted green and over-heads white, in spaces containing electronic equipment in which scopes, dials, meters, and gauges are not read frequently (that is not normally-manned spaces and spaces where electronic equipment is not monitored continuously). 3. Spaces in which electric arc welding is performed on a regular basis, such as welding bays, shall be finish-painted dull black, FED-STD-595 color number 37038. 4. Decks of magazines, ammunition stowage, and handling spaces should be finish-painted with MIL-PRF-24635, white, color number 27875, or gray, color number 36231. 5. Gratings and handrails shall not be painted. Decks and bulkheads in the bilge areas of machinery spaces shall be finish-painted with red, MIL-PRF-24635, color number 20109 or with epoxy paints specified in Table 631-8-12, for up to 2 feet above the lower grating level. The epoxy primer coating on bulkheads and overheads in machinery spaces above the bilge areas shall be top-coated with two coats of Formula 124, MIL-DTL-24607 at 1.5 to 3.0 mils DFT per coat. In wooden ship (e.g. MCM-class) generator and engine rooms, if practical, one heavy brush coat of wood preservative MIL-W-18142 shall be used over bare wood in place of painting. 6. Deck should be finish-painted black, MIL-PRF-24635, color number 37038. 7. Deck should be finish-painted gray, MIL-PRF-24635, color number 36231 or Formula 151. 8. Deck should be finish-painted red, MIL-PRF-24635, color number 20109 or Formula 156. 9. Pastel blue, color number 25526, MIL-DTL-24607 shall be used on bulkheads in CIC spaces and outboard operations and communications spaces with Broad Band Blue Operation Lighting systems. Overheads shall be insignia blue, color number 35044. 10. For pilothouse overhead, dull black (MIL-PRF-24635, color number 37038) may be used.		

Table 631-8-11 SURFACE SHIP COMPARTMENT FINISHES - Continued

Compartment	Bulkheads (B) Overhead (O)	Notes
11. For wet areas of sanitary spaces, CPS filter rooms, decontamination, or airlocks, see paragraph 631-8.18.3.3 and 631-8.18.7. 12. (Deleted) 13. See Table 631-8-10 for color number designations. 14. For all compartment finish coats, see paragraphs 631-8.18.3.1 through 631-8.18.3.9. 15. The preferred coating for compartment finishes is MIL-PRF-24596. However, MIL-DTL-24607 may be used as an alternative coating. 16. For Eye Examining Range Rooms Only. Walls shall be painted with pearl gray, color number 26492 of MIL-PRF-24635 (reflectivity 46 percent). Walls must not be black. Ceilings shall be painted white in order to approximate 75 percent of reflection. It is important that the trim, frame, or panel on which the charts maybe mounted be painted a gray that is not darker than the walls. The general room trim, casings, etc., shall be painted with semi-gloss Navy number 19 light Navy gray (reflectively 28 percent) paint. The standard Navy number paints referred to in this paragraph are those listed in the Navy Departmental manual, "The Application of Color to Shore Establishment". Windows and glass doors shall be completely covered or curtained with material that does not contrast with the color of the walls.		

631-8.18.3.6.1 Interior Colors. Interior deck colors may be carried up onto the bulkhead, adjacent to the deck, to a height of approximately 6 inches. Where interior decks are tiled and corresponding bulkheads are light colored, a dark border to a height of approximately 6 inches or as defined by a natural border may be used to reduce the effect of bulkhead scuff marks. If tile is dark, color should approximate that of the tile. If tile is light-colored, a black border shall be used. Paints listed in [Table 631-8-11](#) may also be used for deck borders in spaces where rugs are installed. Interiors of weather doors may be finish-painted to match the surrounding bulkhead. Overhead colors may be carried down onto the adjacent bulkhead to a line at the level of the bottom of the overhead framing.

631-8.18.3.7 Behind Electronics Equipment. Painting Before installation of front-serviced electrical or electronics equipment, the bulkhead shall be painted with two coats of TT-P-645 Formula 84 primer.

631-8.18.3.8 Decks And Walking Surfaces. Decks for which deck coverings are specified do not require finish painting except where the deck covering consists of false decking, gratings, rugs, or portable material. Deck painting requirements, including special wear-resistant deck paints, are defined herein. The requirements for all other types of deck covering treatments, including all types of non-skid coatings and treatments, are contained in NSTM Chapter 634 – Deck Coverings.

631-8.18.3.8.1 High Traffic Painted Decks. Painted deck areas that are subject to continuous foot traffic and show wear through the currently specified paint to the deck substrate in six months or less shall be painted as described below. The surface preparation required is SSPC-SP 10. SSPC-SP 11, SSPC-SP 3, or SSPC-SP 2 may be used for spot repairs and touch-up.

MIL-PRF-32171 Type I, Class 1 or 2

Primer: 10-12 mils DFT MIL-PRF-32171, Type I, Class 1 or 2, and

Topcoat: 10-12 mils DFT MIL-PRF-32171, Type I, Class 1 or 2

631-8.18.3.8.2 Aqueous Film Forming Foam (AFFF) Station Decks. Decks and foundations located inside the AFFF station coaming shall be coated as described below. SSPC-SP 11 shall be the surface preparation method used, even if the manufacturers' or NAVSEA-approved ASTM F718 data sheet has a more stringent requirement. Upon completion of surface preparation, pH measurements must be taken. The pH must be in the range of 6.5 to 7.5. If it is not, the surface must be washed with fresh water until the required pH is obtained.

MIL-PRF-32171 Type IV, Class 1 or 2

Primer: 10-12 mils DFT MIL-PRF-32171, Type IV, Class 1 or 2, and

Topcoat: 10-12 mils DFT MIL-PRF-32171, Type IV, Class 1 or 2

631-8.18.3.8.3 Other Painted Decks. All other decks not otherwise specified, including decks under electronic, habitability, machinery and other equipment, shall be coated as shown below. Unless otherwise specified, finish-paint decks with gray or dark gray, FED-STD-595 color numbers 36231 or 26008.

- a. Decks subject to condensation, including machinery rooms, boiler rooms, shaft alleys, pump rooms, catapult machinery rooms, and any recesses or decks that are tank tops:

MIL-PRF-23236 Type V or VI Class 5

Primer: 4-8 mils DFT MIL-PRF-23236 Type V or VI Class 5, and

Stripe: 4-8 mils DFT MIL-PRF-23236 Type V or VI Class 5, and

Topcoat: 4-8 mils DFT MIL-PRF-23236 Type V or VI Class 5

or

MIL-PRF-23236 Type VII Class 5

Primer: 4-8 mils DFT MIL-PRF-23236 Type VII Class 5, and

Stripe: 6-10 mils DFT MIL-PRF-23236 Type VII Class 5, and

Topcoat: 10-12 mils DFT MIL-PRF-23236 Type VII Class 5

- b. All other decks; apply second topcoat only if required for hiding.:

TT-P-645 Formula 84/MIL-DTL-24607

Primer: 1.5-3.0 mils DFT TT-P-645 F-84, and

Topcoat: 1.5-3.0 mils DFT TT-P-645 F-84, and

Topcoat: 1.5-3.0 mils DFT MIL-DTL-24607, Color As Specified, and

Topcoat: 1.5-3.0 mils DFT MIL-DTL-24607, Color As Specified

or

TT-P-645 Formula 84/MIL-PRF-24596

Primer: 1.5-3.0 mils DFT TT-P-645 F-84, and
 Topcoat: 1.5-3.0 mils DFT TT-P-645 F-84, and
 Topcoat: 2-4 mils DFT MIL-PRF-24596, and
 Topcoat: 2-4 mils DFT MIL-PRF-24596

631-8.18.3.9 Acoustic-Absorptive Treated Surfaces. Surfaces treated with acoustical absorptive material shall be painted with one coat of paint (unless two coats are required to achieve hiding) to match surrounding structure. The paint shall be sprayed in a thin coat and care shall be taken to prevent the paint from bridging or sealing the perforations in the acoustical treatment.

631-8.18.4 HEATING, VENTILATION AND AIR CONDITIONING (HVAC) INTAKE (SUPPLY) PLENUMS, TRUNKS, AND DUCTS. For the purposes of this manual, an air handling intake plenum is defined as a space or compartment where exterior ventilation air is drawn into the ship, prior to entering one or more fans and their associated ducts or trunks. Intake plenums may also exist for natural supply ventilation systems with no fans. A trunk is defined as an air handling passage where one or more sides are structural steel, other than sheet metal. Steel sheet metal ducts shall also be coated as described in this paragraph, provided that they are of sufficient thickness to be abrasive blasted, and of sufficient cross-sectional size to allow entry for surface preparation and painting. Surface preparation required for HVAC air intake trunks, and plenums is either SSPC-SP 10, SSPC-SP 12 WJ-2L, or SSPC-SP 11. When SSPC-SP 11 or SSPC-SP 12 is used, only the MIL-PRF-23236, Type VII, Class 17 coating system may be used. The following coating systems shall be used on the interior surfaces of steel intake trunks and plenums:

MIL-PRF-23236, Type VII, Class 5

Primer: 4-8 mils DFT MIL-PRF-23236, Type VII, Class 5, and
 Stripe: 6-10 mils DFT MIL-PRF-23236, Type VII, Class 5, and
 Topcoat: 10-12 mils DFT MIL-PRF-23236, Type VII, Class 5

or

MIL-PRF-23236 Type VII, Class 17

Primer: 6-8 mils DFT MIL-PRF-23236, Type VII, Class 17, and
 Stripe: 6-8 mils DFT MIL-PRF-23236, Type VII, Class 17, and
 Topcoat: 6-8 mils DFT MIL-PRF-23236, Type VII, Class 17

631-8.18.5 COMBUSTION AIR INTAKES AND UPTAKES. Combustion air intakes are generally divided into “clean” and “dirty” sides. The dirty side is defined as any space or compartment inside the ship prior to the intake air passing through a moisture separation and filtration assembly. The clean side is any space or compartment inside the ship after the intake air has passed through this assembly. Vertical surfaces of the clean sides of aluminum or CRES intakes do not require painting, except for 2-4 inch high borders above painted decks or other horizontal surfaces that can retain water. Combustion air uptakes also include spaces known as “mixing rooms.” Since corrosive exhaust gases mix with the ambient air in uptakes and mixing rooms, the more chemically-resistant MIL-PRF-23236 Class 5 coating system is required. Surface preparation required for combustion air intakes and uptakes is either SSPC-SP 10, SSPC-SP 12 WJ-2L, or SSPC-SP 11. When SSPC-SP 11 or SSPC-SP 12 is used, only the MIL-PRF-23236, Type VII, Class 17 coating system may be used. The following coating systems shall be used:

Intakes:

MIL-PRF-23236, Type VII, Class 7

Primer: 4-8 mils DFT MIL-PRF-23236, Type VII, Class 7, and
 Stripe: 6-10 mils DFT MIL-PRF-23236, Type VII, Class 7, and
 Topcoat: 10-12 mils DFT MIL-PRF-23236, Type VII, Class 7

or

MIL-PRF-23236 Type VII, Class 17

Primer: 6-8 mils DFT MIL-PRF-23236, Type VII, Class 17, and

Stripe: 6-8 mils DFT MIL-PRF-23236, Type VII, Class 17, and

Topcoat: 6-8 mils DFT MIL-PRF-23236, Type VII, Class 17

Uptakes:

MIL-PRF-23236, Type VII, Class 5

Primer: 4-8 mils DFT MIL-PRF-23236, Type VII, Class 5, and

Stripe: 6-10 mils DFT MIL-PRF-23236, Type VII, Class 5, and

Topcoat: 10-12 mils DFT MIL-PRF-23236, Type VII, Class 5

or

MIL-PRF-23236 Type VII, Class 17

Primer: 6-8 mils DFT MIL-PRF-23236, Type VII, Class 17, and

Stripe: 6-8 mils DFT MIL-PRF-23236, Type VII, Class 17, and

Topcoat: 6-8 mils DFT MIL-PRF-23236, Type VII, Class 17

631-8.18.5.1 Painting by Ship's Force. Ship's Force may perform touch-up or repair painting of steel or aluminum combustion air intakes and uptakes as described in the applicable ship class Planned Maintenance System (PMS) Maintenance Index Pages (MIP), MIP 2513/Various or MIP 3431/Various. Surface preparation by Ship's Force should be hand tool cleaning and/or power tool cleaning per SSPC-SP 2 or SSPC-SP 3, respectively. Note that both of these cleaning methods call for the use of solvent or detergent cleaning per SSPC-SP 1. For best results, surface preparation should be preceded by washing with fresh water to remove surface salts. A two-coat epoxy paint system, using either MIL-PRF-23236 Type VI or VII, Class 17 (preferred), or MIL-DTL-24441 Type IV, should be used.

631-8.18.6 TANKS, VOIDS, CHAIN LOCKERS, AND BILGES. Painting requirements for potable water tanks, and feedwater, reserve feedwater, and freshwater drain collection tanks, are described in [paragraphs 631-8.5](#) and [631-8.6](#), respectively. All other tanks, bilges, chain lockers, and voids shall be painted in accordance with [Table 631-8-12](#) and the paragraphs below. Treat wooden structures as specified in [paragraph 631-8.3.2](#) and [Section 9](#). Tanks covered by reactor plant painting schedules are not described herein, and the requirements in the reactor plant paint schedules shall apply.

631-8.18.6.1 Definitions of Voids. Floodable, but normally empty voids, are those flooded only for damage control purposes or piped for small amounts of drainage. Tanks normally void, but piped for use as freshwater tanks, shall be considered as fresh water drain collection tanks (see [paragraph 631-8.6](#)). Non-floodable voids (dry voids) are defined as cofferdams and inner-bottom compartments, not piped for flooding

631-8.18.6.2 Relative Humidity And Dew Point Requirements. For tanks and floodable voids, dehumidification equipment shall be used to maintain a maximum 50% relative humidity in the tank or void from prior to abrasive blasting through final cure of the topcoat to the dry to recoat time shown on the NAVSEA-approved ASTM F718 data sheet. For bilges and chain lockers, the maximum relative humidity shall be 85%. Blasted surfaces shall be maintained at a temperature that is at least 5°F above the dew point. Specified MIL-PRF-23236, Type VII, Class 17 moisture tolerant epoxy coating systems used in bilges are exempt from the relative humidity and dew point requirements. When conflicts exist between NAVSEA-approved ASTM F718 data sheets and this document, coatings shall be applied in accordance with the conditions required in this manual.

631-8.18.6.3 Preparations Before Abrasive Blasting. Before abrasive blast preparation, all welds shall have been prepared for painting, and fresh water washing shall have been performed to remove surface salts, loose rust or corrosion products,

mud, and marine growth, as described in [paragraph 631-5.2.2](#). In tanks and floodable voids where (approximately equal) 100% solids edge-retentive coatings per MIL-PRF-23236, Type VII are to be used, the edges of all stiffeners, flanges, cut-outs, angles, pipe hangers, and foot/hand holds shall be inspected, and any sharp edges on newly installed or previously existing material shall be broken. If low-temperature cure coatings per MIL-PRF-23236 Types V or VI, Grades A or B must be used, then all edges should be radiused to a minimum of 3 mm.

631-8.18.6.4 Abrasive Blasting, Surface Cleanliness, and Profile. The surfaces to be coated shall be abrasive blasted with an approved abrasive blast medium qualified to the requirements of MIL-A-22262 for non-metallic abrasives, or SSPC-AB 3 for metallic abrasives. All types of pre-construction primers, after blast primers, shop primers or pre-erection primers shall be removed by blasting, except for small inaccessible dry voids and floodable but normally dry voids. Surface preparation for complete repainting shall be done by abrasive blasting. Surfaces shall be blasted to achieve a cleanliness standard of SSPC-SP 10, near white metal, with an average surface profile between 2.0 and 4.0 mils. Abrasive sponge media and wet blasting methods may also be used to produce the required cleanliness level and profile, as described in [Section 5](#). After blasting, all spent blast media paint residue, and dust shall be removed from all surfaces. Special attention shall be given to horizontal surfaces in difficult to reach areas. Surfaces should be vacuumed to remove all dust. Prepared surfaces shall be dust-free prior to priming, as described in [paragraph 631-5.14](#). After all preparation, blast cleaning, and clean-up are complete, including any re-blasting required to meet the surface salt requirements specified below, the surface profile shall be tested as described in [paragraph 631-5.14](#). Once the required surface cleanliness and profile have been achieved, personnel entering the prepared spaces shall wear coveralls and clean, disposable booties to minimize contamination of the surfaces to be painted, as well as to protect the in-process painted surfaces.

631-8.18.6.4.1 Surfaces of bronze diesel fuel tanks shall be clean, dry, and free of all corrosion, paint, oil, grease, and other foreign matter prior to painting. Sanding, wire brushing, or other mechanical means should be used to obtain as clean a surface as practical. Abrasive blasting is recommended but should be used only when economically justified; for example, when extensive removal of machinery is done for reasons other than painting.

631-8.18.6.5 Soluble Salt Measurements. After all preparation, blast cleaning, and clean-up are complete, prepared surfaces shall be tested for residual soluble salt contamination using the surface conductivity method and criteria described in [paragraph 631-5.14](#). If water-washed surfaces in tanks and floodable voids develop any flash rusting, they shall be re-blasted to near-white metal SSPC-SP 10 cleanliness.

631-8.18.6.6 Painting Corrosion-Resistant Metals In Tanks, Voids and Bilges. In steel and aluminum tanks, floodable voids, and immersed areas of bilges, corrosion resistant metal (e.g. stainless steel (CRES), titanium, Inconel, Monel and other nickel-based alloys, copper alloys, etc.) piping, piping system components, the underside of manhole cover bolting rings, or other structures shall be completely painted (except where specifically prohibited in [paragraph 631-8.17](#)) to minimize the effect of galvanic corrosion at any defects in the coated tank surfaces. Corrosion-resistant metallic piping and components shall be painted only after adequate masking of rubber items, gaskets, filters, heat exchange surfaces, and critical sealing surfaces. These metals act as strong cathodes in immersion conditions, causing galvanic corrosion to take place at gaps (holidays) in the painted steel or aluminum tank surfaces that act as anodes in the galvanic couple. Deep pits occur at paint holidays since small anodic steel or aluminum surfaces are exposed to relatively large cathodes of more electrochemically cathodic metals.

631-8.18.6.7 Aircraft Carrier Unique Tanks and Voids. For aircraft carrier catapult wing voids, exhaust blowdown trunks, and gravity tanks, NAVSEA 0919-LP-008-8010/NAVAIR 51-5-30, Corrosion Control for Shipboard Launch and Recovery System, applies. Paint H2-1, H4C and H8 catapult gravity tanks, and the H4-1 and H4B gravity tanks, if they are accessible.

631-8.18.6.8 Tank Manhole Covers. Covers being completely re-preserved shall be prepared to near-white metal per SSPC-SP 10. Surface preparation for touch-up painting using epoxy paint may be power or hand tool cleaning. Coat with either powder coating (see [paragraph 631-7.9](#)), or the same paint system specified for the type of tank. Powder coating shall not be used on covers for fresh water drain collection tanks aboard nuclear powered ships. Powder coatings shall not be used on covers for potable water, fresh water drain collecting tanks and reserve feedwater tanks on nuclear submarines.

Table 631-8-12 PAINT SYSTEMS FOR TANKS, VOIDS, CHAIN LOCKERS, AND BILGES

Location(s)	Paint Systems and DFTs	Notes
Bilges, Bilge Wells, Sumps: Structure and fittings below floor plates in machinery spaces, including bottoms and edges of steel floor plates And Aircraft Electrical Servicing Stations (AESS) trunks	MIL-PRF-23236 Type VII Class 5 Primer: 4-8 mils DFT MIL-PRF-23236 Type VII Class 5, and Stripe: 6-10 mils DFT MIL-PRF-23236 Type VII Class 5, and Topcoat: 10-12 mils DFT MIL-PRF-23236 Type VII Class 5 or MIL-PRF-23236 Type VII, Class 17 Primer: 6-8 mils DFT MIL-PRF-23236, Type VII, Class 17, and Stripe: 6-8 mils DFT MIL-PRF-23236, Type VII, Class 17, and Topcoat: 6-8 mils DFT MIL-PRF-23236, Type VII, Class 17 or MIL-DTL-24441 Type IV Primer: 4-6 mils DFT MIL-DTL-24441, Type IV, F150, and Stripe: 4-6 mils DFT MIL-DTL-24441, Type IV, F151 or F152 or F156, and Topcoat: 4-6 mils DFT MIL-DTL-24441, Type IV, F151 or F156 or F157	6
Chain Lockers	MIL-PRF-23236 Type V or VI Class 5 Primer: 4-8 mils DFT MIL-PRF-23236 Type V or VI Class 5, and Stripe: 4-8 mils DFT MIL-PRF-23236 Type V or VI Class 5, and Topcoat: 4-8 mils DFT MIL-PRF-23236 Type V or VI Class 5 or MIL-PRF-23236 Type VII Class 5 Primer: 4-8 mils DFT MIL-PRF-23236 Type VII Class 5, and Stripe: 6-10 mils DFT MIL-PRF-23236 Type VII Class 5, and Topcoat: 10-12 mils DFT MIL-PRF-23236 Type VII Class 5 or MIL-DTL-24441 Type IV Primer: 4-6 mils DFT MIL-DTL-24441, Type IV, F150, and Stripe: 4-6 mils DFT MIL-DTL-24441, Type IV, F151 or F152 or F156, and Topcoat: 4-6 mils DFT MIL-DTL-24441, Type IV, F151 or F156 or F157	

**Table 631-8-12 PAINT SYSTEMS FOR TANKS, VOIDS, CHAIN
LOCKERS, AND BILGES - Continued**

Location(s)	Paint Systems and DFTs	Notes
Tanks: CHT (Collection, Holding, and Transfer), Sanitary	MIL-PRF-23236, Type VII, Class 13 Primer: 4-8 mils DFT MIL-PRF-23236, Type VII, Class 13, and Stripe: 6-10 mils DFT MIL-PRF-23236, Type VII, Class 13, and Topcoat: 10-12 mils DFT MIL-PRF-23236, Type VII, Class 13 or MIL-DTL-24441 Type IV Primer: 4-6 mils DFT MIL-DTL-24441, Type IV, F150, and Stripe: 4-6 mils DFT MIL-DTL-24441, Type IV, F151 or F152 or F156, and Topcoat: 4-6 mils DFT MIL-DTL-24441, Type IV, F151 or F156 or F157	
Tanks: Fuel- Jet/JP-5, MOGAS, Gasoline, Diesel, Fuel Oil Service, Contaminated Fuel, Compensated Fuel , Fuel Storage, Sumps and Barricade stanchions and wells, catapult jet blast deflector pits, and their associated void spaces	MIL-PRF-23236, Type VII, Class 5 Primer: 4-8 mils DFT MIL-PRF-23236, Type VII, Class 5, and Stripe: 6-10 mils DFT MIL-PRF-23236, Type VII, Class 5, and Topcoat: 10-12 mils DFT MIL-PRF-23236, Type VII, Class 5 or MIL-DTL-24441 Type IV Primer: 4-6 mils DFT MIL-DTL-24441, Type IV, F150, and Stripe: 4-6 mils DFT MIL-DTL-24441, Type IV, F151 or F152 or F156, and Topcoat: 4-6 mils DFT MIL-DTL-24441, Type IV, F151 or F156 or F157	1
Tanks: Hydraulic fluid	MIL-PRF-3150 Medium Lube Oil Preservative (Maintain preservation until filled with hydraulic oil.)	
Tanks: Locked-in freshwater ballast	NAVSEA approved coatings for potable or feedwater tanks may be used. See paragraphs 631-8.5 and 631-8.6 .	3
Tanks: Lubricating Oil	MIL-PRF-3150 Medium Lube Oil Preservative (Maintain preservation until filled with lube oil.)	
Tanks: Seawater Ballast, Peak and Floodable Voids and	MIL-PRF-23236, Type VII, Class 5 or 7 Primer: 4-8 mils DFT MIL-PRF-23236, Type VII, Class 5 or 7, and Stripe: 6-10 mils DFT MIL-PRF-23236, Type VII, Class 5 or 7, and Topcoat: 10-12 mils DFT MIL-PRF-23236, Type VII, Class 5 or 7 or	1

**Table 631-8-12 PAINT SYSTEMS FOR TANKS, VOIDS, CHAIN
LOCKERS, AND BILGES - Continued**

Location(s)	Paint Systems and DFTs	Notes
Catapult wing voids, exhaust blowdown trunks, and gravity tanks	MIL-PRF-23236, Type V or VI, Class 5 or 7, Grade A or B Primer: 4-8 mils DFT MIL-PRF-23236, Type V or VI, Class 5 or 7, Grade A or B, and Stripe: 4-8 mils DFT MIL-PRF-23236, Type V or VI, Class 5 or 7, Grade A or B, and Topcoat: 4-8 mils DFT MIL-PRF-23236, Type V or VI, Class 5 or 7, Grade A or B or MIL-DTL-24441 Type IV Primer: 4-6 mils DFT MIL-DTL-24441, Type IV, F150, and Stripe: 4-6 mils DFT MIL-DTL-24441, Type IV, F151 or F152 or F156, and Topcoat: 4-6 mils DFT MIL-DTL-24441, Type IV, F151 or F156 or F157	2
Tanks: Silicon Bronze Diesel Fuel	MIL-PRF-23236, Type VII, Class 5 Primer: 4-8 mils DFT MIL-PRF-23236, Type VII, Class 5, and Stripe: 6-10 mils DFT MIL-PRF-23236, Type VII, Class 5, and Topcoat: 10-12 mils DFT MIL-PRF-23236, Type VII, Class 5 or MIL-DTL-24441, Type IV Primer: 4-6 mils DFT MIL-DTL-24441 Type IV, F150, and Stripe: 4-6 mils DFT MIL-DTL-24441 Type IV, F152, and Topcoat: 4-6 mils DFT MIL-DTL-24441 Type IV, F151	
Voids: Non-Floodable	MIL-PRF-23236, Type VII, Class 5 or 7 Primer: 4-8 mils DFT MIL-PRF-23236, Type VII, Class 5 or 7, and Stripe: 6-10 mils DFT MIL-PRF-23236, Type VII, Class 5 or 7, and Topcoat: 10-12 mils DFT MIL-PRF-23236, Type VII, Class 5 or 7 or MIL-DTL-24441 Type IV Primer: 4-6 mils DFT MIL-DTL-24441, Type IV, F150, and Stripe: 4-6 mils DFT MIL-DTL-24441, Type IV, F151 or F152 or F156, and Topcoat: 4-6 mils DFT MIL-DTL-24441, Type IV, F151 or F156 or F157	5
Voids: Small, Inaccessible	MIL-PRF-16173, Grade 1	4
NOTES for Table 631-8-12: 1. In the service applications where noted, MIL-PRF-23236 Type VII, Class 5 or 7 is an edge-retentive coating system with a projected service life of 15-20 years when applied under conditions where the relative humidity is controlled at a maximum of 50° from surface preparation through final coating cure as described in the text.		

**Table 631-8-12 PAINT SYSTEMS FOR TANKS, VOIDS, CHAIN
LOCKERS, AND BILGES - Continued**

Location(s)	Paint Systems and DFTs	Notes
	2. In the service applications where noted, the MIL-PRF-23236, Type V or VI, Class 5 or 7, Grade A or B coating system shall be used only when the substrate temperature cannot be maintained above 50°F. This is an edge-retentive coating system with a projected service life of 5-7 years when applied under conditions where the relative humidity is controlled at a maximum of 85% from surface preparation through final coating cure as described in the text. 3. Coating systems for potable water or feedwater tanks may be used to preserve surfaces which lock in freshwater ballast; see paragraphs 631-8.5 and 631-8.6. Alternately, locked-in fresh water ballast may be preserved with the following corrosion inhibitors. a. Sodium silicate - N-Brand sodium silicate manufactured by Philadelphia Quartz Co., 1123 Public Ledger Bldg., Philadelphia, PA or equal 0.25 gallon/1,000 gallons of fresh water to give a concentration of 100 parts per million. b. Since corrosion inhibitors are effective only below the level of the water, MIL-PRF-16173, Grade 1, Thin Film Rust Preventive shall be applied to all areas above anticipated water line and about 2 feet below, if tank is not completely filled. 4. For small inaccessible voids, MIL-PRF-16173, Grade 1 preservative treatment shall not be required within welded, watertight, airtight, and small inaccessible voids whose boundaries are not exposed to the sea or to standing water. 5. See NSTM Chapter 510, Heating, Ventilating, and Air-Conditioning Systems for Surface Ships, for static dehumidification of voids using desiccants. 6. Bilge drain wells shall be prepared and coated the same as AFFF station decks and described in paragraph 631-8.18.3.8.2.	

631-8.18.7 WET SPACES. When the term “wet spaces” is used herein to provide coating requirements, it refers to fan rooms, decontamination stations and airlocks, CPS filter rooms (dirty sides), and wet sanitary spaces (wash rooms, water closets, shower stalls, galleys, sculleries and storerooms where heavy condensation is common). Nuclear propulsion decontamination stations are excluded from this definition. Sanitary wet space coatings shall be as shown below. The surface preparation required is SSPC-SP 10 or SSPC-SP 11.

Sigmatlaze 5492

Primer: 8-10 mils DFT Sigmatlaze 5492 White, and
 Stripe: 8-10 mils DFT Sigmatlaze 5492 non-white, and
 Topcoat: 8-10 mils DFT Sigmatlaze 5492 White

or

MIL-PRF-23236 Type VII Class 17/Sherwin-Williams Dura-Plate UHS

Primer: 6-8 mils DFT MIL-PRF-23236, Type VII, Class 17, and
 Stripe: 6-10 mils DFT Sherwin-Williams Dura-Plate UHS, and
 Topcoat: 10-12 mils DFT Sherwin-Williams Dura-Plate UHS

or

MIL-PRF-23236 Type VII Class 17

Primer: 6-8 mils DFT MIL-PRF-23236, Type VII, Class 17, and

Stripe: 6-8 mils DFT MIL-PRF-23236, Type VII, Class 17, and

Topcoat: 6-8 mils DFT MIL-PRF-23236, Type VII, Class 17

Fan rooms, decontamination stations and airlocks, CPS filter rooms (dirty sides) shall be coated with the system below. Decontamination station and air lock decks shall not be painted, see **NSTM Chapter 634, Deck Coverings**. The surface preparation required is SSPC-SP 10, SSPC-SP 12 WJ-2L, or SSPC-SP 11

MIL-PRF-23236 Type VII, Class 17

Primer: 6-8 mils DFT MIL-PRF-23236, Type VII, Class 17, and

Stripe: 6-8 mils DFT MIL-PRF-23236, Type VII, Class 17, and

Topcoat: 6-8 mils DFT MIL-PRF-23236, Type VII, Class 17

631-8.19 HOSPITAL SHIPS.

631-8.19.1 GENERAL. Hospital ship exterior vertical surfaces above the waterline shall have two finish-coats of white, MIL-PRF-24635, except areas designated for identifying ship name ([paragraph 631-10.8.3](#)). Weather decks covered with wood shall be unpainted, except for a square white area to be painted around the red crosses. Steel weather decks outside of walking areas shall have two finish-coats of white MIL-PRF-24635 Grade B, and walking areas of weather decks shall have two finish-coats of gray, MIL-PRF-24635 Grade B, color number 26008. Outer smoke pipe casing, booms, masts, and boats shall have two finish-coats of white, MIL-PRF-24635 Grade C. A black band, MIL-PRF-24635 Grade C, shall be painted around the smoke pipe from the top to a depth of 1/3 of the fore-and-aft pipe dimensions.

631-8.20 SUBMARINES.

631-8.20.1 UNRESTRICTED OPERATIONS MAINTENANCE REQUIREMENT CARDS. Preservation system repairs are an Unrestricted Operations (URO) Maintenance Requirement Cards (MRC) program attribute. The URO MRC program was developed by NAVSEA to monitor specific submarine areas of interest to determine if the conditions of these areas are suitable for continued unrestricted operations. Maintaining the protective coating system is critical to maintaining structural integrity during the periods between inspections. For this reason, complying with requirements for coating system application for all aspects of the preservation process is essential. Other systems that impact the URO MRC program are Special Hull Treatment (SHT) application process, including Mold-In-Place (MIP), maintenance of cathodic protection systems (i.e. the Impressed Current Cathodic Protection (ICCP) system and sacrificial anodes) and installation of various types of tiles (acoustic, damping, etc).

631-8.20.1.1 Surface Preparation Restrictions. Substrate preparation is not authorized/covered in this NSTM for damping tile, acoustic tile, Special Hull Treatment (SHT), and Mold-In-Place (MIP), vertical launch system (VLS) bathtub area, thin line towed array (TLTA), bow domes, and retractable bow plane recesses on submarines.

631-8.20.1.2 Coordination With URO MRC Inspections. Preservation work in submarine tanks and enclosed spaces is usually scheduled to occur when the tanks are opened and entered to perform URO MRC structural inspections. Any time a submarine tank is entered, if the scheduled URO MRC 003 structural inspection is not being performed, the government will perform a structural visual examination. Any URO MRC item being blasted and painted will have a URO MRC hull survey inspection performed by the government prior to blasting and again prior to repainting.

631-8.20.2 EXTERIOR SURFACES. Coat the exterior surfaces of submarines in accordance with [Table 631-8-13](#). The final coat of all exterior coating systems above the waterline shall be black. In addition to the requirements in [Table 631-8-13](#), the following paragraphs apply to exterior coating systems and draft markings. Unless otherwise indicated, the requirements below apply to steel surfaces that are not covered with Special Hull Treatment (SHT) tiles or Mold-In-Place

(MIP) treatment; refer to [paragraph 631-8.20.2.6](#) for coating requirements for SHT and MIP treated surfaces. Coating requirements for areas inside the sail and superstructure (fairwater) and other free-flood areas are described under [paragraph 631-8.20.2.9](#).

631-8.20.2.1 Surface Preparation for Steel. Surface preparation required for all exterior steel surfaces shall be abrasive blasting to near-white metal, SSPC-SP 10/NACE No. 2. For previously painted steel surfaces, surface preparation shall be either SSPC-SP 10/NACE No. 2, or waterjetting to SSPC-SP 12/NACE No. 5, Condition WJ-2L. See [paragraphs 631-5.4](#) and [631-5.5](#). The surface profile shall be 2-4 mils. New welds resulting from hull cuts or other work performed on the hull in an availability shall be prepared as described in [paragraph 631-5.2.2](#), and shall be abrasive blasted to SSPC-SP 10; hand and power tool cleaning is insufficient.

631-8.20.2.2 Antifouling (AF) Coatings. MIL-PRF-24647 AF coatings are applied on exterior surfaces over anti-corrosive coatings, SHT tiles, and bow dome rubber boots on areas of the ship that are below 12" above the waterline. (For AF paint purposes, the upper boottop limit is extended to 12" above the maximum condition diving trim waterline.) Other areas that receive AF top coats are free flooding surfaces subject to fouling, such as: the interior of the aft free flood area (mud tank), the secondary propulsion motor (SPM) recess, torpedo tube shutter recesses, the anchor recess, the retractable bow plane (RBP) recess, and interior main ballast tank (MBT) surfaces from bottom centerline to a height of 2 vertical feet above the highest flood louver in the tank.

631-8.20.2.2.1 The preferred AF topcoat color on exterior hull surfaces below maximum beam is black; however, red may be specified by the local activity because visual inspections of the underwater hull while pierside are easier with red anti-fouling paint. Topcoat color is a local decision. Red anti-fouling paint is applied in free flood recesses below the waterline to provide improved visibility for inspection.

631-8.20.2.2.2 AF coatings may be repaired, touched-up, and/or overcoated with any other approved ablative AF system. For AF coatings that are required to be applied while the last coat of AC coating is still tacky, the applied dry film thickness (DFT) of the last coat of AC paint may be determined by measuring the wet film thickness (WFT) as described in [paragraph 631-7.1.4](#).

631-8.20.2.2.3 The minimum drying time requirements before undocking and subjecting the AF coatings to immersion shall be as described in the NAVSEA-approved ASTM F718 data sheet for the product applied, taking into account the appropriate ambient temperature. The cure to immersion time for the AC paint may be different than the cure to immersion time for the AF paint. The longer cure to immersion time shall be used. Tack coats are not included when determining cure to immersion times.

631-8.20.2.2.4 The type of AF paints and number of coats used on bow domes varies depending on the class of submarine and whether the dome is booted or not. See [631-8.20.2.8](#) for details concerning bow dome painting.

631-8.20.2.3 Draft Marks. Draft marks shall be applied directly to the MIL-PRF-24647 anti-corrosion (AC) coat; they shall not be applied to anti-fouling (AF). Draft marks shall be made using one of the following coatings:

- a. MIL-DTL-24631, Formula 186, one coat 3-4 mils DFT, or
- b. MIL-DTL-24441, Type IV, Formula 152 one coat 3-4 mils DFT, or
- c. MIL-PRF-24647, Type I or II AC, White, one coat 3-4 mils DFT

631-8.20.2.4 Exterior Use of MIL-PRF-23236 Type VII Coatings. While MIL-PRF-23236 Type VII ultra-high solids coatings are not intended for use on exterior surfaces, they may be applied on Main Ballast Tank (MBT) flood grates and the non-pressure hull around the flood grates for an approximate distance of 24 inches in order to provide increased corrosion protection to the edges and flood grate contact surfaces. For submarines with SHT installed, the ultra-high solids coatings

can be extended onto the non-pressure hull to the SHT fairing strips. The transition between the ultra-high solids coating system and other paint systems applied to exterior surfaces shall be smooth. Specific approval from NAVSEA is required to apply ultra-high solids coatings to any other exterior surfaces.

631-8.20.2.5 Exterior Non-Skid Coatings. Exterior non-skid coatings shall be applied where indicated in [Table 631-8-13](#). NSTM Chapter 634, Deck Coverings, provides information on the installation and maintenance of non-skid coatings in non-SHT and non-MIP applications. Refer to NAVSEA drawing 606-5005466 Rev E or later for non-skid painting requirements for SSN-688 Class submarines. Deck areas covered with SHT or MIP have special non-skid paint systems; see [paragraph 631-8.20.2.6](#). Non-skid shall not be applied to fairwater planes, hatches or their components, Deep Submergence Rescue Vehicle (DSRV) seating surfaces (including an approximately 1-inch border around their perimeter), Advanced SEAL Delivery System (ASDS) seating surfaces, safety tracks, lifeline sockets, deck fittings and gear, faying surfaces of DSRV seating surfaces, contact or bearing surfaces, cleats, and access covers.

631-8.20.2.6 SHT and MIP Surfaces. Painting requirements for both AC and AF coatings associated with surfaces that are covered with SHT tiles or MIP material are contained in the technical manuals and NAVSEA drawings described below

- a. Surfaces to be covered with SHT tiles are preserved prior to tile installation with two coats of epoxy anti-corrosive paint as required by NAVSEA S6360-AD-HBK-010. These paints are DTRC 2844-1110, yellow primer coat, and DTRC 2844-1109, black top coat.
- b. For SSN-688 class submarines, SHT tiles above the upper boottop are overcoated with either an epoxy paint, MIL-DTL-24631A, Navy Formula 184 (formerly DTRC 2844-1118) or a polyurethane paint, MIL-DTL-24631, Navy Formula 187, as required by NAVSEA S6360-AD-HBK-010. Where non-skid is required, SHT tiled deck areas receive a non-skid paint system prepared with MIL-DTL-24631 Formula 184, and an abrasive blasting grit material. The abrasive grit material (MIL-A-22262) is cast uniformly on a freshly painted surface (intended DFT 3-4 mils) while the paint is wet. Two additional coats of Formula 184 are applied over the abrasive grit as sealer coats. Polyurethane paint, MIL-DTL-24631 Formula 187 may be substituted as the sealer topcoat in order to provide improved protection against chalking and fading. Specific guidance on the application and repair of non-skid deck paint applied over SHT on SSN-688 Class submarines is contained in the SHT Handbook, NAVSEA S6360-AD-HBK-010
- c. For SSN-21 Class submarines, SHT tiles and Mold-In-Place (MIP) SHT above the upper boottop are overcoated with polyurethane paint, MIL-DTL-24631A, Navy Formula 187, as required by NAVSEA S6360-AN-MMA-010/SHT. See NAVSEA Drawing 690-6520337 for initial installation requirements. Where non-skid is required, a coat of either MIL-DTL-24631 Formula 184 or Amercoat 3273 is applied. Abrasive grit per MIL-A-22262 is then cast uniformly on the freshly (still wet) painted surface at an approximate rate of 18 pounds per 250 square feet. After curing, this is then top-coated with a single coat of MIL-DTL-24631 Formula 187. Specific guidance on the application and repair of non-skid deck paint applied over SHT/MIP-SHT on SSN21 Class submarines is contained in the MIP-SHT Manual, NAVSEA S6360-AN-MMA-010/SHT.
- d. For SSN-774 Class submarines, SHT tiles and Mold-In-Place (MIP) SHT above the upper boottop are overcoated with polyurethane paint, MIL-DTL-24631A, Navy Formula 187, as required by NAVSEA S6360-AV-MMA-010/SHT. See NAVSEA Drawing 690-7383660 for initial installation requirements. Navy formula 187 paint is not required to be applied to SHT tiles under BQQ-5 fairing covers. These tiles are to be left unpainted above the waterline or be painted with anti-fouling paint below the waterline. Where non-skid is required, the application is the same as above for SSN-21 Class submarines. Refer to the MIP-SHT Manual, NAVSEA S6360-AV-MMA-010/SHT for specific guidance.

631-8.20.2.7 Fiberglass Fairings. The painting of submarine fiberglass faired masts and radomes shall be done in accordance with NAVSEA SE110-DK-MMO-010, Procedures for Inspection, Repair, and Painting of Fiberglass Mast Assemblies.

631-8.20.2.8 Bow Domes. Submarine bow domes are either made of steel or Glass Reinforced Plastic (GRP) material, and either of these materials may or may not have rubber “boots” installed on the exterior surfaces. Refer to [paragraph 631-8.15](#) for painting requirements for submarine bow domes.

631-8.20.2.9 Free-Flood Areas and Fairwaters. Fairwaters include the inside surfaces of the sail and superstructure. Surface preparation shall be abrasive blasting to near-white metal, SSPC-SP 10/NACE No. 2. The relative humidity in these areas shall be maintained at a maximum of 50 percent from the start of surface preparation to cure of the topcoat. Areas visible from above shall be topcoated either gray or black. Touch-up painting of these areas may be performed using one of the coating systems listed below; the topcoat of the touch-up paint system should match the color of the existing paint in the area.

MIL-PRF-23236, Type V or VI, Class 5 or 7, Grade A or B

Primer: 4-8 mils DFT MIL-PRF-23236, Type V or VI, Class 5 or 7, Grade A or B, and

Stripe: 4-8 mils DFT MIL-PRF-23236, Type V or VI, Class 5 or 7, Grade A or B, and

Topcoat: 4-8 mils DFT MIL-PRF-23236, Type V or VI, Class 5 or 7, Grade A or B

or

MIL-DTL-24441 Type IV

Primer: 4-6 mils DFT MIL-DTL-24441, Type IV, F150, and

Stripe: 4-6 mils DFT MIL-DTL-24441, Type IV, F151 or F152 or F156, and

Topcoat: 4-6 mils DFT MIL-DTL-24441, Type IV, F151 or F152 or F153 or F154

Table 631-8-13 PAINT SYSTEMS FOR SUBMARINE EXTERIOR

Location(s)	Paint Systems and DFTs	Notes
Underwater Hull, Non-SHT surfaces below waterline requiring anti-fouling; Keel to upper boottop; rudders; struts; diving planes	MIL-PRF-24647, Type I or II Anti-Corrosion (AC) and Anti-Fouling (AF) 1 coat red AC, 4-6 mils DFT, and 1 coat gray AC, 4-6 mils DFT (Total AC 10 mils DFT minimum), and 1 coat AF, 4-6 mils DFT, and 1 coat AF, 4-6 mils DFT	1, 2
Non-SHT exterior surfaces above the waterline (includes DSRV/ SRC seating surfaces)	MIL-PRF-23236, Type V, Class 5 or 7 Primer: 4-8 mils DFT MIL-PRF-23236 Type V, Class 5 or 7, and Topcoat: 4-8 mils DFT MIL-PRF-23236 Type V, Class 5 or 7, Black or MIL-PRF-24647 Anti-Corrosive (AC), Type I or II Primer: 4-6 mils DFT AC MIL-PRF-24647 Type I or II, and Topcoat: 4-6 mils DFT AC MIL-PRF-24647 Type I or II, Black or MIL-DTL-24441 Type IV Primer: 4-6 mils DFT MIL-DTL-24441 Type IV, F-150, and Topcoat: 4-6 mils DFT MIL-DTL-24441 Type IV, F-153	1

Table 631-8-13 PAINT SYSTEMS FOR SUBMARINE EXTERIOR -

Continued

Location(s)	Paint Systems and DFTs	Notes
Non-SHT exterior foot traffic areas requiring non-skid. (All classes of submarines)	MIL-PRF-23236, Type V, Class 5 or 7/MIL-PRF-24667 Non-Skid Primer: 4-8 mils DFT MIL-PRF-23236 Type V, Class 5 or 7, and Topcoat: 4-8 mils DFT MIL-PRF-23236 Type V, Class 5 or 7, Black, and Non-Skid: MIL-PRF-24667, Type I or X, Composition G or MIL-PRF-24647 Anti-Corrosive (AC), Type I or II/MIL-PRF-24667 Non-Skid Primer: 4-6 mils DFT AC MIL-PRF-24647 Type I or II, and Topcoat: 4-6 mils DFT AC MIL-PRF-24647 Type I or II, Black, and Non-Skid: MIL-PRF-24667, Type I or X, Composition G or MIL-DTL-24441 Type IV/MIL-PRF-24667 Non-Skid Primer: 4-6 mils DFT MIL-DTL-24441 Type IV, F-150, and Topcoat: 4-6 mils DFT MIL-DTL-24441 Type IV, F-153, and Non-Skid: MIL-PRF-24667, Type I or X, Composition G	
Free-Flood Areas and Recesses; Fairwaters (Inside Surfaces of Sail and Superstructure)	MIL-PRF-23236, Type VII, Class 5 or 7 Primer: 4-8 mils DFT MIL-PRF-23236, Type VII, Class 5 or 7, and Stripe: 6-10 mils DFT MIL-PRF-23236, Type VII, Class 5 or 7, and Topcoat: 10-12 mils DFT MIL-PRF-23236, Type VII, Class 5 or 7	1
Moored Training Ships only: exterior surfaces above the water-line (non-immersion surfaces only)	MIL-PRF-23236 Type V, Class 5 or 7/MIL-PRF-24635 Color 27038 Primer: 4-8 mils DFT MIL-PRF-23236 Type V, Class 5 or 7, and Topcoat: 4-8 mils DFT MIL-PRF-23236 Type V, Class 5 or 7, and Topcoat: 2-4 mils DFT MIL-PRF-24635 Color Number 27038 or MIL-DTL-24441 Type IV/MIL-PRF-24635 Color 27038 Primer: 4-6 mils DFT MIL-DTL-24441 Type IV, F-150, and Topcoat: 4-6 mils DFT MIL-DTL-24441, Type IV, F-151 or F-150, and Topcoat: 2-4 mils DFT MIL-PRF-24635 Color Number. 27038	1
SHT and MIP surfaces	See paragraph 631-8.20.2.6.	1
Exterior fiberglass faired masts and radomes	See paragraph 631-8.20.2.7.	
Bow domes, steel and GRP, booted and unbooted	Refer to paragraph 631-8.15.	
NOTES for Table 631-8-13: 1. Hull inserts and sea chests must be coated with the preservation system applied to adjacent surfaces. Extend coating system a minimum 1/2-inch on to nonferrous liner or cladding. 2. From the keel to max beam, alternating AF colors may be used, and the final coat may be red or black. From max beam to the upper boottop, all AF coats shall be black.		

CAUTION

The requirements for submarine potable water tanks, feedwater tanks, and fresh water drain collecting tanks are current as of the date of issue of this NSTM revision. For the most current coating requirements for other interior areas of submarines, refer to the current edition of NAVSEA Standard Item 009-32, or Submarine Maintenance Standard MS 6310-081-015.

631-8.20.3 INTERIOR SURFACES. Interior painting (except tanks and bilges) is not necessary when existing paints meet the requirements of this chapter and can be cleaned to the satisfaction of the ship's Commanding Officer. Chlorinated alkyd base paints (see [Table 631-8-10](#)) shall be used as finish paints for overheads and bulkheads in engineering spaces such as engine rooms and machinery rooms. Surfaces behind insulation, which have the opposite side in contact with water or exposed to weather and where heavy condensation is common, shall be coated with one coat each of MIL-DTL-24441 Formulas 150, 151, and 152 (8 to 12 mils minimum DFT) prior to installation of insulation. Un-insulated areas of steel structure, which have the opposite side in contact with water or exposed to weather and where heavy condensation is common, shall be coated with one coat of Formulas 150, 151, and 152 or one coat of Formula 150 and top coated with MIL-DTL-24607. If the existing coatings show excessive film defects such as cracking, peeling, and flaking, clean the entire surface to bare metal and repaint, using the appropriate procedure. Water-based, fire-retardant coatings, MIL-PRF-24596 (which includes paints formerly designated as Formula 25A, are to be used for all applications, other than engineering spaces, where the ambient air and substrate temperatures are at or above 50°F and relative humidity is less than 80 percent and areas as specified in [paragraph 631-8.20.3.2](#). Chlorinated alkyd-base coatings, MIL-DTL-24607, may be used at ambient air temperatures below 50°F in accordance with [paragraph 631-8.20.3.2](#). When MIL-PRF-23236 coatings are specified for the interior of submarines in areas subject to the Submarine Atmosphere Control program, only coatings that have been specifically approved under that program shall be used; see [paragraph 631-7.3.5](#).

WARNING

Use a minimum number of thin coats of fire retardant coatings when repainting, and restrict repainting to those occasions when cleaning alone is inadequate. Even fire retardant coatings can contribute to fire spread when used in excessive thickness. This limit is exceeded at thicknesses in excess of 17 mils for MIL-DTL-24607 paints, and in excess of 21 mils for the MIL-PRF-24596 water-based fire retardant paints, which includes paints formerly designated as Navy Formula 25A. Excessive thickness can also increase smoke and fume generation during a fire.

631-8.20.3.1 Paint Suppliers. MIL-DTL-24607 and MIL-PRF-24596 paints are approved for use in painting bulkheads and overheads of interior compartments (outside of engineering spaces) that are considered manned spaces.

631-8.20.3.2 Water-Based Coatings. Water-based coatings may only be applied when ambient air and substrate temperatures are above 50°F, in order for the water to evaporate completely and form a continuous coating. Where specific manufacturers allow use of their water-based paint below 50°F, the manufacturer's instructions may be followed. Water-based coatings require storage above 32°F. If water-based paints are used, exercise special care to ensure the surface preparation, primer application, primer cure and water-based topcoat application are properly performed. Water-based coatings may only be used over fully primed or painted steel substrates; do not apply to bare steel substrates. Aluminum substrates do not require priming when painting with water-based paints. Water-based coatings will not dry at relative humidity above 80 percent. Adequate ventilation or dehumidification will aid drying of water-based paints. Water-based coatings shall not be used where condensation will occur before the paint dries.

CAUTION

To minimize premature yellowing, chlorinated alkyd-based paints shall not be applied within 4 weeks before and after the application of amine-cured epoxy paints. The vapors from the epoxies can come in contact with the chlorinated alkyd paints and cause yellowing. Amine-cured paints include DTRC 2844-1118 and MIL-PRF-23236 tank and bilge coatings.

- a. Apply one coat of TT-P-645 Formula 84. Use two finish-coats of chlorinated alkyd-base paint or fire-retardant waterbased paint on bulkheads and overheads. Chlorinated alkyd-base paints and fire-retardant water-based paints are listed in [Table 631-8-10](#) and are applied in the same way as conventional alkyd-base paints or water-based paints.
- b. Apply one coat of TT-P-645 Formula 84 and two finish-coats on decks. Where topcoat color is satisfactory (for example, Formula 156 on a red deck), deck surfaces prepared to bare metal may be coated with Formula 150 primer and Formula 156 topcoat for improved durability. For special precautions when Formula 150-series coating applications may vent to a space containing motor generators, see [paragraph 631-8.20.7](#).
- c. Hull insulation shall be applied according to NSTM Chapter 635, Thermal, Fire, and Acoustic Insulation. Metal surfaces shall be primed with one coat (3 mils minimum DFT) of Formula 150, before installation of insulation. Cork and polyvinyl chloride (PVC) hull insulation, MIL-P-15280, shall be painted with the OCEAN 634/9788 (Ocean Chemical Co., Savannah, GA) coating system in accordance with the manufacturer's instructions. The three-coat OCEAN 634/9788 system consists of the following coatings: (1) one coat of OCEAN 634 Prime Coat, with a minimum of 2 mils DFT. (2) two coats of OCEAN 9788 Intumescent Fire-Retardant Paint with a minimum of 10 mils DFT (5 mils minimum DFT per coat).

NOTE

Use of any alternative to the OCEAN 634/9788 system requires specific NAVSEA approval.

- d. Apply one coat each of Formula 150 and 152 to wet spaces; for example, washrooms, water closets, bath and shower spaces, sculleries, and vegetable preparation spaces. Apply as specified in [Section 7](#) to achieve at least 5 mils DFT. For special precautions when Formula 150-series coating applications may vent to a space containing motor generators, see [paragraph 631-8.20.7](#).

631-8.20.4 COMPARTMENT FINISH. Compartments shall be finish-painted in accordance with these specifications:

1. Paints listed in [Table 631-8-10](#) shall be used for bulkheads and overheads, unless other materials are approved by NAVSEA.
2. Type Commanders may specify uniform painting schemes for ships under their Command or may permit each ship to adopt its own scheme.
3. Decks for which coverings are specified do not require finish-painting, except where the deck covering consists of false decking, gratings, rugs, or portable material. Epoxy finish paints shall not be applied over previously applied non-epoxy paints.
4. Finish-paints for built-in steel furniture shall match the surrounding structure.
5. Finish-paint battery compartments with two coats of white, MIL-DTL-24607 Formula 124, except for the rubber lining (NSTM Chapter 634, Deck Coverings).
6. Unless otherwise permitted by Type Commanders, finish-paint radio room yellow-gray on overhead bulkheads and furniture surfaces, and green-gray on apparatus panels, cabinets, and racks.

7. As an alternative to MIL-DTL-15090 Formula 111 machinery gray, the use of the paints listed in [Table 631-8-14](#) is approved for specified surfaces in submarine engine rooms when prescribed by the Type Commander.

Table 631-8-14 SUBMARINE ENGINE ROOM PAINTS

Color	FED-STD-595 Color No.	Surfaces
Clear Blue, FED Spec. TT-E-489	15177	Switch boxes, distribution panels, electric starting panels, and start-stop switches
Vivid orange, FED Spec. TT-E-489	12246	Purifier belt covers and other rotating machinery
Brilliant yellow, FED Spec. TT-E-489	13538	Underside or deck access hatches
Machinery gray, MIL-DTL-15090 Formula 111	To match Formula 111	Other equipment including engines, generators, coolers, and purifiers

631-8.20.5 SUBMARINE POWDER COATING REQUIREMENTS. Powder coating is an approved process for corrosion control for many submarine interior and exterior miscellaneous parts. Powder coatings shall not be used for components or other coating applications governed by reactor plant paint schedules unless specifically approved on those paint schedules. General requirements for powder coating are contained in section [631-7.9](#). Specific powder coating requirements for submarine applications are given below; in the event of a conflict between section [631-7.9](#) and this section, the requirements of this section take precedence.

631-8.20.5.1 Approved Powder Coatings. [Table 631-8-15](#) lists the powder coatings that are approved for use on submarines, in both exterior and interior applications. Unless otherwise specified, all powder coating materials for submarine interior applications shall be MIL-PRF-24712.

631-8.20.5.2 Approved Applications for Use of Powder Coatings. Uniform Industrial Process Instruction (UIPI) 0631-901, "Electrostatic Powder Coating", Enclosure (1) contains a list (although not all inclusive) of components that are candidates for submarine powder coating. Interior and exterior miscellaneous metal components to be powder coated must meet the following criteria:

- The component shall not be a reactor plant miscellaneous component, and the current specified coating system shall be either MIL-DTL-24441 epoxy, MIL-PRF-23236 epoxy, or MIL-DTL-15090 (Formula 111) machinery enamel.
- The component must not be adversely affected by heating to process temperature or by other process conditions.
- The component must be small enough to fit in the curing oven to be used.
- Powder coating of fasteners is not authorized.
- The powder coating material used shall comply with the requirements mandated by NAVSEA S9510-AB-ATM-010, Nuclear Power Submarine Atmosphere Control Manual. .

631-8.20.5.2.1 Specific approved submarine powder coating applications includes those listed below.

- Tank manhole covers can be powder coated, except that powder coating shall not be used on reserve feedwater, potable water, fresh water drain collecting, and steam plant surge tank manhole covers. When manhole covers are powder coated, the entire cover shall be coated, unless the fabrication drawing shows specific areas that are to be left uncoated. On flat plate manhole covers, the gasket seating surface is to be coated. For boiler type manhole covers, any clad surface and the manhole cover gasket grooves shall be left uncoated. Tank manhole covers are critical coated items as defined in [631-11.2](#). They are to be coated using the same environmental and QA/QC controls as tanks.

WARNING

Prior to surface preparation, air flasks must be depressurized. Barrier protection must be in accordance with NAVSEA S0400-AD-URM-010, Tag Out Users Manual (TUM), Appendix G

- b. Exterior surfaces of high-pressure air and emergency main ballast tank (EMBT) air flasks located in main ballast tanks may be preserved using either the same paint system used in the tanks or a powder coating. Powder coating of flask interior surfaces is authorized but facilities to handle the larger flasks are not available.
- c. Powder coatings are authorized on surfaces in way of damping or acoustic tiles when specifically approved by NAVSEA. Before adhering damping or acoustic tiles over powder coating, the surface of the coating shall be abraded using a non-metallic abrasive pad (3M Scotch-Brite or equivalent) and then cleaned with a solvent wipe.
- d. Pipe hangers in bilge areas may be powder coated as an alternative to painting. The color must match the surrounding area for visible exterior surfaces.
- e. VLS Components: Removable steel subassemblies in the VLS “Bathtub Area” (e.g., pipe hangers, switch brackets) may be powder coated. The T-bar Muzzle Hatch Lock Mechanism (SSN-719 and SSN-720 only, Items 1, 2, and 31 of NAVSEA Drawing 704-5765851) shall be powder coated in accordance with UIPI 0631-901 on all surfaces except bearing surfaces, contact surfaces, pinholes, sliding surfaces, internal surfaces, and threads. Powder coating shall be MIL-PRF-23236 Type VIII and shall be gray in color.

631-8.20.5.2.2 General Guidance For Selecting Components To Be Powder Coated. The first consideration for selecting items for powder coating is that they must be removable items (not requiring welding or brazing in order to re-install them) that are subject to an adverse environment such as the bilge, and have a demonstrated history of conventional paint coating failures. The powder coating of non-color coded aluminum lockers in upper levels and items subject to frequent mechanical abuse (chipping) is discouraged. While the primary use of powder coatings should be protection from corrosion, the comparative ease of surface cleaning and general appearance compared to conventional painted surfaces is also valid justification, provided that preservation requirements are met. Another consideration is that spot repair of thermosetting powder coatings can only be done by touchup painting, which will likely result in a mis-match or color and gloss, and therefore degrade the appearance of the item.

631-8.20.5.2.3 Powder Coating Procedure Requirements. Application of thermoset powder coatings to approved components using the electrostatic spray method shall be accomplished in accordance with Uniform Industrial Process Instruction (UIPI) 0631-901, “Electrostatic Powder Coating”. Unless otherwise specified, surface preparation of steel components shall be abrasive blasting to near white metal (SSPC-SP 10, see [paragraph 631-5.4](#)). Interior components/parts must be powder coated in a facility off the ship and returned to the ship only after the powder coating is completely cured.

Table 631-8-15 POWDER COATINGS APPROVED FOR SUBMARINE USE

Vendor	Brand name of Powder	Product Designation	Application Area (Interior/Exterior)
International Coatings	Interpon	Epoxy Coatings: Interpon 100 AA005U White Epoxy Interpon 100 AA007U White Epoxy Interpon 100 AA019U White Epoxy Interpon 100 AL104U Grey Epoxy Interpon 100 AL106U Grey Epoxy Interpon 100 AL113U Grey Epoxy Interpon 100 AN104U Black Epoxy Interpon 100 AN105U Black Epoxy Interpon 100 AN005U Black Epoxy Polyester Coatings: Interpon 600 JL111U Grey Polyester	Interior Only
International Coatings	Interpon	Interpon AG101U Red Interpon AE101U Yellow Interpon AN205U Flat Black	Interior and Exterior
3M Corporation	Skotchkote	3M Corporation 206 N F.B. Blue-Green	Interior Only
3M Corporation	Skotchkote	134 F.B. Blue-Green 135 F.B. Gray 136 F.B. Green	Interior and Exterior
Morton	Corvel	Corvel Gray 30-7241	Interior and Exterior
Dupont	Dupont	ELW-505-S9 Appliance White EFH-400-S9 ASA 61 Grey EFB-552-S9 Oil Black PFW-510-S9 Sky White PFR-400-S9 Red Baron PFK-604-S9 Blue Streak II PFH-502-S8 ASA 70 Gray PFB-400-S9 Bumper Black PFS-500-S8 Safety Orange PFG-500-S9 Evergreen EFT-604-S9 Tan Epoxy	Interior and Exterior Note: Manufacturer name "Dupont" was formerly sold under "Herberts O'Brien" and "Fuller O'Brien" product names. These products and identification codes are the same, only the company names have been changed.
Protech Chemicals, Ltd.	Protech	Protech PS311G190 Polyester Green Protech PC-6598 Polyester Mushroom Protech ES512R20 Bilge Red	Interior and Exterior
GENERAL NOTES: 1. This table lists specific approved submarine powder coatings, and shall be used pending the issuance of a Qualified Products List (QPL) for MIL-PRF-24712. 2. All of the coatings listed in this table are thermosetting powder coatings. Thermoplastic powder coatings, other than those incidentally supplied by the original equipment manufacturer (OEM) on parts of other assemblies (e.g. valve handles, locker brackets, etc.) shall not be used for submarine applications.			

Table 631-8-16 SUBMARINE TANK, BILGES AND VOID COATINGS

Location	Paint System (Number of Coats and Formula No.)	DFT (mils) Minimum	Notes
Bow buoyancy and main ballast tanks	1 coat of MIL-DTL-24441, F150 1 coat of MIL-DTL-24441, F151 1 coat of MIL-DTL-24441, F152 plus 2 coats of 121 to 2 feet above tank opening	2 to 4 2 to 4 2 to 4 (8 min total) 2 min/coat	2,3,5,7,14,15
Fuel oil ballast and expansion tanks; negative tank and safety tank	1 coat of MIL-DTL-24441, F150 1 coat of MIL-DTL-24441, F151 1 coat of MIL-DTL-24441, F152	2 to 4 2 to 4 2 to 4 (8 min total)	1,2,5,7,15
Fuel oil filter sump drain tank (SSN-688 class)	1 coat of MIL-DTL-24441, F150 1 coat of MIL-DTL-24441, F151 1 coat of MIL-DTL-24441, F152	2 to 4 2 to 4 2 to 4 (8 min total)	1,2,5,7,15
Chain locker	1 coat of MIL-DTL-24441, F150 1 coat of MIL-DTL-24441, F151 1 coat of MIL-DTL-24441, F152	2 to 4 2 to 4 2 to 4 (8 min total)	2
Clean fuel tanks, normal fuel tanks	1 coat of MIL-DTL-24441, F150 1 coat of MIL-DTL-24441, F151 1 coat of MIL-DTL-24441, F152	2 to 4 2 to 4 2 to 4 (8 min total)	2,16
Water round torpedo, trim, auxiliary, depth control, torpedo impulse, and torpedo tube drain tanks	1 coat of MIL-DTL-24441, F150 1 coat of MIL-DTL-24441, F151 1 coat of MIL-DTL-24441, F152	2 to 4 2 to 4 2 to 4 (8 min total)	1,2,5,7,15
Collecting fuel oil, and variable fuel oil tanks; poppet valve drain tank, fuel oil overflow tank	1 coat of MIL-DTL-24441, F150 1 coat of MIL-DTL-24441, F151 1 coat of MIL-DTL-24441, F152	2 to 4 2 to 4 2 to 4 (8 min total)	1,2,7,15,16
Lubricating oil sumps, lubricating oil stowage tanks, hydraulic oil tanks, lubricating oil collecting/ settling tank, and lubricating oil sludge tank	None	— — —	— — —
Sanitary tanks	1 coat of MIL-DTL-24441, F150 1 coat of MIL-DTL-24441, F156 1 coat of MIL-DTL-24441, F151 1 coat of MIL-DTL-24441, F152	2 to 4 2 to 4 2 to 4 2 to 4 (10 min total)	1,2,7
Potable water	See Table 631-8-2	— — —	1,2,7,11,13
Surge tanks	2 coats of Apexior No. 1 (Dampney Co.)	3	— — —
Hovering tank	1 coat of MIL-DTL-24441, F150 1 coat of MIL-DTL-24441, F151 1 coat of MIL-DTL-24441, F152	2 to 4 2 to 4 2 to 4	— — —

Table 631-8-16 SUBMARINE TANK, BILGES AND VOID COATINGS -

Continued

Location	Paint System (Number of Coats and Formula No.)	DFT (mils) Minimum	Notes
Bilges, drainage trenches, missile tube eject chamber, and missile compensating tanks	1 coat of MIL-DTL-24441, F150	3	1,4,7,8,9,10,15
	1 coat of MIL-DTL-24441, F151 or F156	3	
	1 coat of MIL-DTL-24441, F151 or F157	3	
Bilge collecting tanks/sumps, dirty drain collecting tanks, non-oily drain collecting tanks, oily drain collecting tanks, waste oil collecting tanks, non-oily bilge collecting tanks, and oily bilge collecting tanks	1 coat of MIL-DTL-24441, F150	3	1,4,7,8,9,15
	1 coat of MIL-DTL-24441, F151 or F156	3	
	1 coat of MIL-DTL-24441, F157 or F151	3	
Reserve feedwater tanks, fresh water drain collecting tanks	1 coat of MIL-DTL-24441, F150	2 to 4	1,2,7,10, 11,12, 13
	1 stripe coat of MIL-DTL-24441, F152	2 to 4	
	1 coat of MIL-DTL-24441, F151	2 to 4	
	1 stripe coat of MIL-DTL-24441, F150	2 to 4	
	1 coat of MIL-DTL-24441, F152	2 to 4 (8 min total)	
Inaccessible voids	MIL-C-16173	Heavy	Safety Precautions: Paragraphs 631-2.2, 631-2.2.1.4, and 631-2.5 , and See Section 2

NOTES for Table 631-8-16:

1. See [paragraph 631-8.20.7](#) for special procedures when applying or curing these paints while venting in a space containing motor generators.
2. Remove pre-construction primer by blasting. Surface preparation for complete repainting shall be done by abrasive blasting. Abrasive blasting shall be in accordance with this manual and with NAVSEAINST 9210.36.
3. Repainting relatively inaccessible areas on non-pressure structure such as the shell behind air flasks, may be deferred until a more appropriate time, provided coating is in good condition.
4. Clean areas of paint failure to bare steel by suitable means when touch-up is to be performed, except do not blast in machinery spaces. Tank interiors are not considered machinery spaces for purposes of this restriction. Blasting is permitted and often required in tanks.
5. After specified painting of tanks, lead bins and adjacent bulkheads and hull plating which will be in contact with lead ballast, shall be lined with either one layer of 1/8 inch thick rubber conforming to MIL-G-1149 or with two layers of 1/16 inch thick rubber conforming to MIL-S-2912, Type II. The rubber lining shall be installed using adhesive meeting the requirements of MIL-A-24456.
6. Coatings shall be applied as recommended by the manufacturer or stated in the paint specification, except that minimum surface preparation standards for MIL-DTL-24441 coatings govern when they conflict with less thorough requirements in manufacturer's instructions (See [Section 7](#)). NAVSEA should be consulted for assistance with resolution of any other conflicts or ambiguities.

Table 631-8-16 SUBMARINE TANK, BILGES AND VOID COATINGS -

Continued

Location	Paint System (Number of Coats and Formula No.)	DFT (mils) Minimum	Notes
7. Coat all nonferrous corrosion-resistant steel piping, underside of manhole, and coaming around the manhole opening and under the gasket, as described in paragraph 631-8.18.6.6. CRES tanks are not painted. 8. The finish coating of bilges shall be MIL-DTL-24441 Formula 151 or Formula 157. 9. Potential alternative high performance coating systems are prohibited without prior NAVSEA approval of performance, safety, and submarine atmosphere interactions. 10. Apply a stripe coating per Section 631-7.1.3 with a DFT of 2 to 4 mils. Apply a stripe coat between each coat specified in the table. The minimum total coating thickness specified in the table pertains to areas where stripe coats have not been applied. 11. Use mixing, application, and drying guidance specified for potable water tanks in paragraphs 631-8.5. For Formula 151, use guidance for Formulas 152 and 156. The requirements of this table govern where they differ from potable water tank instructions. Reduced touch-up paint curing procedures of paragraph 631-7.2 do not apply to these surfaces. Mixing of epoxy polyamide paints conforming to MIL-DTL-24441 is covered in paragraph 631-7.2. 12. For these tanks, NAVSEA approval shall be obtained for use of coatings or coating application procedures which differ from those specified in this table. 13. Additional coating requirements for potable water, feedwater, and fresh water drain collecting tanks are specified in paragraphs 631-8.5 through 631-8.6. Reduced touch-up paint curing procedures of Section 7 do not apply to these surfaces. 14. For tanks not listed in Table 631-8-16, see Table 631-1-6. 15. MIL-PRF-23236 (two or three coats) may be used if authorized by NAVSEA and the Type Commanders. 16. Tanks originally unpainted shall remain unpainted.			

631-8.20.6 SPECIAL SUBMARINE PAINTING REQUIREMENTS. The special requirements covered in the following paragraphs shall be observed when painting the interior of a submarine. Coating systems different than those required by non-deviation drawings shall have specific NAVSEA approval before application.

631-8.20.6.1 Paint Application. All painting with specified organic solvent-thinned oil based or epoxy paints that exceeds 1 quart of paint per day for the entire ship shall be completed at least five days before departure. For additional requirements for Formula 30 white enamel, MIL-E-1115, and TT-P-28 Type I heat-resistant paint, see [paragraph 631-2.8.1](#).

NOTE

The date of departure, as it relates to painting, shall be the date of the first dive after departure for a period of operation. The Commanding Officer of the submarine shall determine the date of departure whenever the question arises.

631-8.20.6.1.1 Painting shall be done at sea only after the last dive on return from patrol.

631-8.20.6.2 Touch-Up Painting. When touch-up painting or other small amounts of painting shall be completed within five days before departure, it shall be done with the specified solvent-base paint, not exceeding one quart of paint per day for the entire ship and exhausting to the weather. Where this procedure is not practical and painting is considered necessary, MIL-PRF-24596 water-base paints may be used instead of chlorinated alkyd paints (MIL-DTL-24607 Formula 124).

631-8.20.6.3 Painting of High Temperature Surfaces. After painting of any piping or lagging subject to heating during system operation, that system should (whenever practical) be activated (heated) at dockside or before submerging, while exhausting to the weather.

631-8.20.6.4 Ventilation. Exhaust ventilation to the weather, with a rate of at least 20 air changes per hour, shall be maintained during all painting (except for limited touch-up, as described in [paragraph 631-8.20.6.2](#)). When painting is completed, any compartment in which painting was done shall be ventilated to the weather for at least 24 hours. Change carbon filters before departure.

631-8.20.6.5 Painting of Rubber Pipe Hanger Components. Painting of rubber piece parts of pipe hangers are permitted in the following areas: main ballast tanks (MBT's), free flood areas outside of the pressure hull, and internal tanks which are normally painted. This allowance does not include internal tanks under nuclear cognizance or potable water tanks. The rubber piece parts include the liners, grommets, and inserts found in steel strap and steel block type pipe hangers. Also included is the block rubber in rubber block type pipe hangers.

631-8.20.7 PROTECTION OF MOTOR GENERATORS DURING PAINTING. Motor generators require protection from paints conforming to MIL-DTL-24441 (Navy epoxy Formula 150 series), MIL-PRF-23236, or NAVSEA fresh-water tank coatings during application and curing of the paint. When these paints are being applied or cured while venting in a space containing motor generators, the motor generators shall be protected using a NAVSEA approved procedure. For 300-kW and 500-kW motor generators, a positive pressure unit, according to the latest revision of Life Cycle Engineering Drawing 53711-307-5390492, shall be used. Consult NAVSEA to resolve any questions about adequacy of protective procedures for motor generators.

631-8.20.8 SUBMARINE TANKS, BILGES, AND VOIDS. Paint submarine tanks, bilges, and voids using the surface preparation and coating application requirements in [paragraph 631-8.18.6](#), and the coatings schedule and notes in [Table 631-8-16](#). Provisions in the table do not apply to tanks covered by reactor plant painting schedules of nuclear powered ships.

631-8.20.9 SSBN MISSILE LAUNCH TUBES AND AIR-EJECT PIPING. Before leaving the shipyard, all missile tubes, eject piping, and eject changers shall be inspected to ensure that they are clean, dry, and free of corrosion. Preserve as necessary with specified coatings.

631-8.20.9.1 Fresh-Water Cleaning. Immediately after draining tubes that were flooded with seawater, flush tubes and eject piping with fresh water (potable water is satisfactory) to remove salt deposits. In eject piping, use hose without metal fittings (or with fittings adequately protected) to prevent coating abrasion, and insert the hose from the eject changer up to the launch valve to flush the entire pipe. Pressurize the valve dome during flush operations to prevent water entry into the launch valve. Personnel should use rubber-soled shoes to prevent coating damage in the eject chamber.

631-8.20.9.2 Tube And Eject Piping Drying. Dry tube and eject piping surfaces thoroughly by swabbing, followed preferably by circulating dry air heated from 38° to 60°C (100° to 140°F). If shore compressors are used, fit the compressed air system with water-removing traps and filters, dehumidifiers, and heaters. Air from submarine flasks is also considered satisfactory. Circulation of a fresh supply of unheated air will also reduce drying time.

631-8.20.9.3 Inspection And Maintenance. Inspect tubes and eject piping for corrosion and loss of coating adhesion. If extensive corrosion exists, mechanically clean as necessary, and vacuum. Apply a thin film of corrosion preventive MIL-C-16173 (NSN 8030-00-244-1298) in eject pipe to maximum practical extent. A flexible shaft is recommended, using a wire brush for cleaning and a swab for coating the eject pipe.

631-8.20.9.3.1 Touch Up Painting. Touch up eject chamber and torus ring with previously applied coating type. Ventilate to the weather, if required, to remove solvent. In view of the comparatively small area involved, any solvent retained in the film after drying 4 hours with ventilation should not cause significant atmospheric contamination. If the corrosion or loose paint is minor, to the point that the possibility of damage from dislodgment would be negligible, the eject piping may be swabbed with metal conditioning compound (MIL-C-22235) without prior cleaning and subsequent ventilation.

631-8.20.9.3.2 Protect Sensitive Parts. In flushing, drying, and preserving the air eject piping system, a positive means of protecting first-stage jetevators and missile components from dust and mechanical damage shall be provided. During subsequent maintenance, the eject piping shall be inspected, flushed, and dried as specified in paragraphs [631-8.20.9.1](#) through [631-8.20.9.2](#).

SECTION 9

BOATS AND SMALL CRAFT

631-9.1 GENERAL.

631-9.1.1 OVERVIEW. After adequate surface preparation, surfaces of boats and small craft, except inflatable boats as described in NSTM Chapter 583, Boats and Small Craft, shall be coated according to one of the procedures described in this section.

631-9.1.2 GENERAL CAMOUFLAGE REQUIREMENTS. Boats and small craft that are embarked on surface ships or otherwise deployed should meet the camouflage requirements of NAVSEA TM S6360-AG-MAN-010, Camouflage Manual for Surface Ship Concealment. Bare metal surfaces of stainless steel, brass, or other corrosion-resistant hardware should be allowed to dull through natural weathering, and should not be polished, buffed, waxed, or otherwise brightened. When high-contrast black and white colored equipment or areas are present on the boats, gray canvas should be used to cover these areas. Care in the rigging and maintenance of canvas covers is required to avoid trapping moisture under the cover and causing corrosion of boat hardware.

631-9.2 ABOVE-WATER SURFACES.

631-9.2.1 PAINTED WOOD. Wood surfaces shall be primed with one coat of MIL-DTL-24441 Formula 150 epoxy paint. Apply two coats of the appropriate colored finish paint.

631-9.2.2 UNPAINTED WOOD. To unpainted wood, apply any necessary wood filler, TT-F-336, stain with either Formulas 49, 50, 51, 52, or 54, if desired, and finish with four coats of spar varnish, Master Painters Institute (MPI) reference coating Number 28. Surfaces below the floor or walking flat levels, forepeaks, and transom compartments should not be painted, but should be treated with a heavy coat of wood preservative, MIL-W-18142.

631-9.2.3 METAL. On metal surfaces, use two coats of primer, TT-P-645 Formula 84, and two coats of finish paint. Only one priming coat and one finishing coat are required for surfaces not exposed to the weather.

631-9.2.3.1 Surface Preparations. Ferrous surfaces on topsides of should be abrasive blasted and coated as specified in [Table 631-8-11](#) with a suitable color.

631-9.2.3.2 Corrosion Prevention. Inner surfaces of voids of small steel boats and landing craft (where surface preparation and paint application are difficult) should be coated with thin-film corrosion preventive, MIL-PRF-16173, Grade 1.

631-9.2.4 PLASTIC. Where finish paint is required for color, plastic surfaces shall receive one coat of Formula 150 and two coats of finish paint. Painting is not required where the color of plastic is satisfactory.

631-9.2.5 ALUMINUM. Detailed painting instructions for aluminum boats and small craft are presented in **NSTM Chapter 583**.

631-9.3 UNDERWATER SURFACES.

631-9.3.1 The surface preparation, primers and anti-corrosion (AC) coatings, and anti-fouling (AF) coatings requirements of [paragraph 631-8.4](#) and [Table 631-8-1](#) shall be used for steel, aluminum, GRP/fiberglass, or wood hull boats and craft.

631-9.3.2 FINISH COATS. Prime steel and wood surfaces as specified. Apply finish coats for underwater surfaces according to information given in the following paragraphs:

631-9.3.2.1 Boats Dry-Berthed on Shore. The bottoms of metal or plastic boats that are dry-berthed on shore shall be appropriately finish-coated with an anti-fouling (AF) topcoat if needed when placed in service. Wood boats, dry-berthed on shore, shall receive two coats of black paint, MIL-PRF-24635.

631-9.3.2.2 Boats Wet-Berthed in Fouling Waters. Apply AF paint to the bottoms of boats that are wet-berthed in fouling waters as per [paragraph 631-8.4](#) and [Table 631-8-1](#).

631-9.3.2.3 Issued for Individual Use of Flag-Rank Officers and Boats Issued to Hospital Ships. Boats Two coats of medium green paint MIL-PRF-24635 shall be applied to the bottoms of small boats that are issued for the individual use of flag-rank officers and boats that are issued to hospital ships.

631-9.3.2.4 Operating in Non-Fouling Waters. Boats Two coats of black paint MIL-PRF-24635 shall be applied to the bottoms of boats that are operating in non-fouling waters.

631-9.3.3 EXTENT OF BOTTOM FINISH COAT. The bottom finish coat should extend from the keel to the painted waterline that is scribed in the hull or 12 inches above the normal waterline. The normal waterline is defined as the waterline at which the boats will float under the following loading:

- a. Pulling boats. Full outfit and carrying maximum number of persons permitted.
- b. Power boats. Full outfit, fuel, and carrying 1/2 the maximum number of persons permitted.

631-9.3.3.1 Painting Around Fenders. Where a structural fender is approximately tangent to the upper limit of the bottom paint, the bottom paint system may be modified. It may be carried up to and may follow the lower side of the fender if modifying the bottom paint in such a manner improves the appearance of the boat.

631-9.4 MISCELLANEOUS EQUIPMENT.

631-9.4.1 HOOKS, OARS, AND STAFFS. Boat hooks, oars, and boat flag and pennant staffs should be varnished in natural wood as per [paragraph 631-9.2.2](#).

631-9.4.2 CANVAS CANOPIES. Canvas canopies shall be painted on the outside with canvas preservative, TTP-595. The undersides of canvas canopies should not be painted. All other canvas, such as curtains for cockpits and gangway, should not be painted.

631-9.4.3 **RUNNING-LIGHT BOXES.** Side running-light boxes shall be finish-painted black MIL-PRF-24635, on their inner surfaces. Outer surfaces should be painted to match the surrounding structure.

631-9.4.4 **FIRE EXTINGUISHING SYSTEM.** Carbon dioxide fire extinguisher cylinders shall be finished with red striping, MIL-PRF-24635. All operating parts should be left bright, especially the valve and the distant control gear on built-in units. Piping (except nozzles) should be painted to conform with the colors of adjacent bulkheads. Special care shall be taken to keep discharge nozzles free of paint.

631-9.5 OPEN BOATS.

631-9.5.1 **PAINTED SURFACES.** Surfaces other than the underwater bodies of pulling boats, motor launches, utility boats, and motor whaleboats shall receive a finish coat of haze gray, silicone alkyd enamel MIL-PRF-24635, except as otherwise specified.

631-9.5.2 **VARNISHED SURFACES.** The parts of pulling boats, motor launches, utility boats, and motor whaleboats that shall be given four coats of spar varnish (Master Painters Institute (MPI) reference coating #28) are:

- a. Wood awning stanchions.
- b. Backboards.
- c. Capping and clamp at gunwale (except clamps made of yellow pine, which should be painted according to [paragraph 631-9.5.1](#)).
- d. Decks and flats at level of gunwales.
- e. Flagstaffs.
- f. Platforms on level of thwarts.
- g. Stretchers.
- h. Structural fenders on gunwale (half-round or built-up).
- i. Thwarts.
- j. Tillers.
- k. Tops of rudders above lower edge of fender at gunwale.
- l. Towing posts.

631-9.5.3 **UNPAINTED SURFACES.** Unpainted surfaces such as bitts, chocks, cleats, cutwater, brass fender facings, transom angles, frame clips, breasthooks, caps for shaft logs, lifting pads, and engine exhaust pipes shall be left bright.

631-9.6 CABIN BOATS.

631-9.6.1 **PAINTED SURFACES.** The outside hulls of cabin boats, between the level of the deck and the upper waterline, shall receive a finish coat of haze gray, silicone alkyd enamel, MIL-PRF-24635, except as otherwise specified.

631-9.6.1.1 Motorboats for Flag Officers. Motorboats assigned for the individual use of flag-rank officers shall be finish-painted black (MIL-PRF-24635) on the outside of the hulls between the level of the decks and the upper waterline.

631-9.6.1.2 Internal Painting. Closed-in compartments that are not exposed to view from the outside shall be finished with white (MIL-E-1115 Formula 30) down to the level of the floors or walking flats.

631-9.6.2 UNPAINTED SURFACES. Surfaces below the level of the floors or walking flats, forepeaks, and transom compartments shall not be painted, but shall be treated with a heavy brush coat of wood preservative, MIL-W-18142.

631-9.6.3 VARNISHED SURFACES. The cabin boat parts that shall be given four coats of varnish (Master Painters Institute (MPI) reference coating #28) are:

- a. Benches.
- b. Coamings.
- c. Cockpits.
- d. Decks.
- e. Gunwales.
- f. Locker tops.
- g. Waterways.
- h. Woodwork above deck level.
- i. Main bulkheads which can be seen at a distance from the outside, except those already coated with paint.

631-9.6.4 BRASS SURFACES. Brass fittings, such as rails, port rims, voice tubes, cleats, bells and bell brackets, and the steering wheel shall be left bright.

631-9.6.4.1 Painting of Brass and Copper. The exterior of brass and copper ventilator cowls on motorboats assigned to flag-rank officers shall be left bright. Brass ventilator cowls on other motorboats should be painted on the outside, but the rim should be polished. The ventilator cowls on the inside should be finish-painted red, MIL-PRF-24635.

631-9.6.5 ALUMINUM SURFACES. Aluminum canopies and fittings shall be painted as described in NSTM Chapter 583. Metal hoods and spray shields should be finish-painted on the outside with haze gray, silicone alkyd enamel, MIL-PRF-24635, except on flag-rank boats used as barges and gigs and hospital ship boats, where they should be white (MIL-E-1115 Formula 30). The inside of all hoods should be finish-painted with white (Formula 30).

631-9.7 BOATS FOR HOSPITAL SHIPS.

631-9.7.1 PAINTING BOATS FOR HOSPITAL SHIPS. Boats on hospital ships shall be finish-painted white (MIL-E-1115 Formula 30). The white area shall include the side planking (except the underwater body which is painted according to [paragraph 631-8.4](#)), the transom, and the inside of the hull down to the footings or walking

flats. On closed motorboats, the interior shall be painted with white (MIL-E-1115 Formula 30). The cockpits and other parts ordinarily finished bright on other boats shall be finished bright on boats for hospital ships. Surfaces below the level of floors or walking flats shall not be painted, but shall be treated with a heavy brush coat of wood preservative, MIL-W-18142. Identification shall be as specified in [paragraph 631-10.8.3](#).

631-9.8 IDENTIFICATION MARKINGS.

631-9.8.1 NSTM CHAPTER 583. NSTM Chapter 583 gives instructions for proper identification markings.

631-9.9 PLASTIC BOATS.

631-9.9.1 SURFACE PREPARATIONS AND PAINTING. Prepare plastic boat surfaces for painting by removing contaminants and abrading the surface to ensure paint adhesion. Care should be taken so that none of the fiberglass underlay is damaged. Apply one coat of MIL-DTL-24441 Formula 150, and two finish coats, as specified for the boat type. Underwater surfaces shall be painted according to [paragraph 631-9.3](#) except that anti-corrosive (AC) paint is not required.

SECTION 10

NAVAL SHIPS' MARKING AND AWARDS

631-10.1 GENERAL.

631-10.1.1 OVERVIEW. The contents of this section shall be used as a guide for the size, painting, placement of naval ship and small craft names, identification markings, and awards.

631-10.2 SHIP NAMES.

631-10.2.1 SHIP NAME LOCATION. Ship names shall be painted in black (MIL-PRF-24635 Grade B) as prescribed by the Force Commanders. If practical, it is recommended that the name be painted in 12-inch letters directly on the stern at the centerline in a suitable location below the main deck. NAVSEA drawing No. S2804-0860347 may be used as a guide for letter style. On ships with sharp sterns, or interferences in the stern area, the name should appear on each quarter.

631-10.3 SHIP NAMEBOARD.

631-10.3.1 NAMEBOARD LETTERS. Nameboard letters shall be 6 inches high and 3/16 inch thick according to NAVSEA drawing No. 220598. Letters should be secured with brass wood screws. Letters may be procured locally through open purchase.

631-10.3.2 NAMEBOARDS. Nameboards shall be varnished mahogany, and shall be approximately 9 inches wide and 1-1/4 inches thick. They shall be attached port and starboard in a suitable location on the side of the bridge or at the rail.

631-10.4 DRAFT MARKS.

631-10.4.1 COLOR AND LOCATION. Requirements for draft marks are described in [paragraph 631-8.4.1](#).

631-10.5 DISTINGUISHING NUMERALS AND LETTERS.

631-10.5.1 EXCEPT AIRCRAFT CARRIERS. Distinguishing numerals and letters shall be painted as required by the NAVSEA drawing number listed in [Table 631-10-1](#), except as modified for aircraft carriers.

631-10.5.1.1 Aircraft Carriers. Flight deck markings on aircraft carriers shall be according to the applicable Visual Landing Aids General Service Bulletin. The area within a boundary of 24 inches adjacent to each high-thrust tiedown shall be painted with red striping paint (Formula 40) and stenciled FOR HIGH THRUST ENGINE TURN-UP.

Table 631-10-1 DISTINGUISHING NUMERALS AND LETTERS

Title	NAVSEA Drawing Number
Distinguishing figures for battleships and cruisers	S-2804-921791
Distinguishing figures for destroyers, frigates, and type conversions	S-2804-860345
Figures for distinguishing marks on submarines	S-2804-860346
Distinguishing figures for mine craft	S-2804-921769
Distinguishing figures for landing craft	S-2804-921783
Distinguishing figures for miscellaneous ships	S-2804-921819

631-10.6 LETTER AWARDS.

631-10.6.1 GENERAL. Letters awarded the ship shall be painted on as prescribed by Fleet Commanders, who will also designate the locations and sizes. If desired, the locations and sizes in [Table 631-10-2](#) may be used as a guide. Letters should be block type, shaded on the left side and lower edges with black MIL-PRF-24635, color 17038 as shown on NAVSEA drawing S2804-921819.

Table 631-10-2 LETTER AWARDS SPECIFICATIONS

Award	Insignia	Size	Location
Winner of Intra-type battle efficiency competition	White E	20" by 16"	Bridge bulwark (fwd, port, and starboard) or sail of submarines.
Electronic warfare department	White EW	E-15" by 10"	Port and starboard bridge bulwarks abaft the battle efficiency E. See Note 1.
Engineering	Red	Note 2	Note 2
Gunnery: 16", 8", 6" turrets	White E	15" by 12"	Center, each side of gun turret.
5" gun mounts	White E	10" by 8"	Center, each side of gun mount.
3" and 40 mm mounts	White E	10" by 8"	Center of splinter shield, outboard (on each side of centerline mounts). See Note 3.
Main battery and 5" directors	White E	15" by 12"	In appropriate position on each side director shield
3" and 40 mm directors	White E	10" by 8"	Center of splinter shield, outboard (on each side of centerline director). See Note 3.
Guided missiles	White E	15" by 12"	In appropriate position on each side of director tower
CIC	Green E	12" by 12"	Bridge bulwark (aft, port and starboard)
Communications	Green C	15" by 12"	Signal bridge bulwark (port and starboard)
Assault	Assault boat insignia	15" by 15" or 21" by 21"	On hull or superstructure in immediate vicinity of forward Welin davit.
Minesweeping	White M	15" by 18"	Each side of ship slightly forward of bridge.
ASW	White A	15" by 12"	In appropriate position on or adjacent to main ASW armament (port and starboard)
Safety	Green	16" by 21"	Bridge bulwark, aft of "Battle E" (port and starboard)
Weapons department	Black W	15" by 18"	Bridge bulwark (port and starboard)
Air department	Yellow E	15" by 12"	Near area of primary flight control station
Supply department	Blue E	15" by 12"	Bridge bulwark (aft, port, and starboard)

Table 631-10-2 LETTER AWARDS SPECIFICATIONS - Continued

Award	Insignia	Size	Location
NOTES 1. There shall be a 2-inch separation between the two letters. 2. See paragraph 631-10.6.2 for size and location of the engineering E. 3. If no splinter shield installed, E will be painted on the hull or superstructure in the immediate vicinity of the mount.			

631-10.6.2 ENGINEERING AWARD. When the ship receives an engineering award, it is recommended that the award letter be painted on each side of the forward stack. It shall be located with the top edge of the letter 1/2 the stack diameter below the top of the stack and the center of the letter on the centerline, and with the same rake as the stack. The height of the letters shall be 1/2 the stack diameter.

631-10.6.3 THE NAVY E. For battle efficiency awards, it is recommended that the E be located on the bridge wing bulwark, port and starboard if practical. Otherwise, the E should be placed in the general vicinity of painted campaign ribbons.

631-10.6.3.1 Subsequent Navy E's. For the second and each consecutive award of the Navy E, one service stripe shall be painted under the E. The distance between the shading on the bottom of the E and the upper corner of the strip and between stripes shall equal half the stripe width. When facing the E, the stripe shall slant downward from the upper right to the lower left, regardless on which side it is displayed.

631-10.6.3.2 More Than 5 Navy E's. Instead of the letter and four service stripes for winning the Navy E award five consecutive times, a gold insignia shall be displayed with one silver star above the insignia. Silver stars shall be added for each five successive awards shown in [Figure 631-10-1](#). Interim years will be indicated by gold stripes, to a maximum of four.

631-10.6.4 DAMAGE CONTROL AND DECK SEAMANSHIP DEPARTMENTAL AWARD. The Damage Control and Deck Seamanship Departmental Award is a red DC to be displayed on the port and starboard bridge wings. The Deck Seamanship insignia is shown in [Figure 631-10-2](#) and is to be displayed on each side of the bridge bulwark abaft of the Battle Efficiency (E). The deck seamanship award for AOE, AOR, AE, AD, AR, AO and AFS ships will be 30 inches by 30 inches; all other units will be 15 inches by 15 inches.

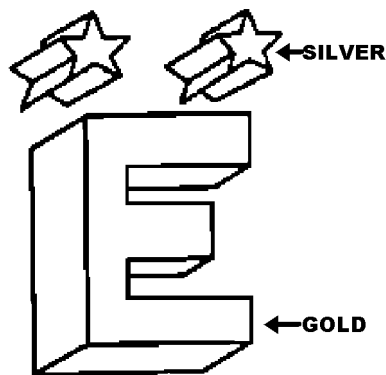


Figure 631-10-1 Example of 10th Consecutive E

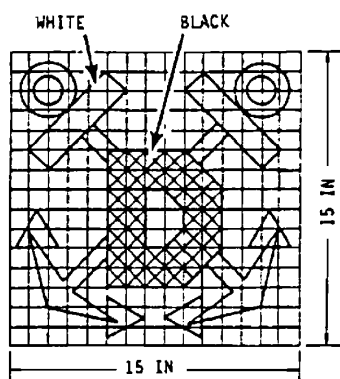


Figure 631-10-2 Deck Seamanship Insignia

631-10.7 SHIP AND SMALL CRAFT INSIGNIAS.

631-10.7.1 SQUADRON INSIGNIA. The display of a squadron insignia on the exterior of surface combatant ships is authorized at the discretion of the Commander, Fleet Forces Command (CFFC). The design initiation can best be done by squadron personnel. Final approval in terms of design, size, placement on the ship exterior, and good taste, rests with CFFC.

631-10.7.2 ASSAULT BOAT INSIGNIA. The assault boat insignia shall be displayed so the arrowhead always points forward (shown in [Figure 631-10-3](#))

631-10.7.3 CONSECUTIVE ASSAULT BOAT INSIGNIA AWARDS. For 10 or more consecutive awards, the Assault Boat Insignia shall conform to [Figure 631-10-4](#), with the gold insignia on a blue shield background. The number of the award is designated by the appropriate blue number in the insignia. Subsequent awards are indicated by the addition of blue stripes.

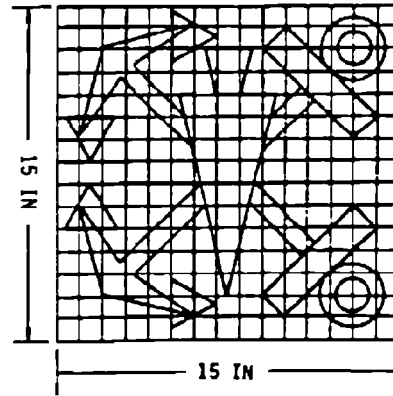


Figure 631-10-3 Assault Boat Insignia

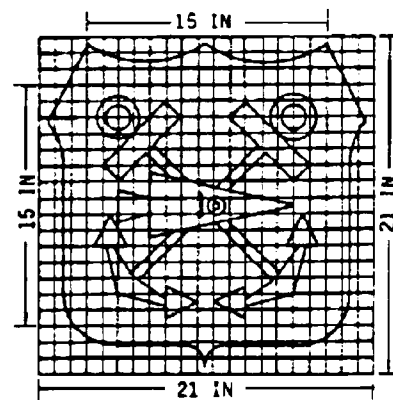


Figure 631-10-4 Example of 10th Consecutive Award Assault Boat Insignia

631-10.7.4 REPLICAS OF CAMPAIGN AND COMMENDATION RIBBONS. Replicas of campaign and commendation ribbons to be painted on ships shall be prescribed by Fleet Commanders, who will also designate the locations and sizes. If desired, the information given in [Table 631-10-3](#) may be used as a guide. The painted replicas of the ribbons should be arranged in the same order as ribbons worn by personnel. There should be a maximum of three ribbons for each horizontal line. The diameter of the operation and engagement stars should be $\frac{3}{8}$ the width of the ribbon. The stars should be painted on the ribbons with the point down.

Table 631-10-3 INSIGNIA SIZES AND LOCATIONS BY REPRESENTATIVE SHIP TYPES

Ship Type	Size of Insignia	Location of Insignia
AS	6" by 18"	Windshields at wings of pilot house
CV	8" by 24"	Bulwark area adjacent to the navigating bridge, or starboard side of hangar deck
CVN	8" by 24"	Bulwark area adjacent to the navigating bridge, or starboard side of hangar deck
Surface Combatants: CG, DDG, FFG, LCS	4" by 12"	Outside of bridge shield, port and starboard, 2 feet below edge
LCC, LHA, LHD, LPD, LSD	6" by 18"	Side of wheelhouse above ports

Table 631-10-3 INSIGNIA SIZES AND LOCATIONS BY
REPRESENTATIVE SHIP TYPES - Continued

Ship Type	Size of Insignia	Location of Insignia
ARS, MCM, MHC	4" by 12"	Outside of bridge shield, port and starboard, 2 feet below edge

631-10.8 HOSPITAL SHIPS.

631-10.8.1 RED CROSSES. The red cross shall have a width approximately equal to its height. The width of the arms shall be approximately 1/3 the width or height of the cross. Paint three red crosses (MIL-PRF-24635) on each side of the hull, with the center of each cross at the same distance above the ship's load waterline. Each cross shall be of the maximum possible height, but shall not exceed 9/10 of the ship freeboard at a particular location. The forward cross on each side shall be located in the vicinity of the stem so that, dependent upon the hull lines in that area, it is readily identifiable when viewed from dead ahead of the ship. The center cross on each side shall be located abaft the bridge. The after cross on each side shall be located approximately half-way between the center cross and the ship's stern.

631-10.8.1.1 Larger Sizes. Minor variations in the red cross locations are permissible if the variation permits painting a larger cross because of increased freeboard at a nearby location. If practical, paint red crosses at least 34 by 34 feet on top of the superstructure or awnings fore and aft, or on the helicopter platform in locations visible from the air. The surrounding area shall be blocked in with white paint so the red cross will stand out well on the white background. Paint four red crosses of maximum practical size on the four sides of the stack, located so the cross on the opposite side of the stack may be most clearly seen from astern. Paint one red cross of maximum practical size on the forward vertical face of the forward superstructure, where the cross may be most clearly seen from ahead.

631-10.8.2 SHIP BOATS. Boats shall be painted with a 15-inch by 15-inch red cross (on white background) on each side of the stern. Life rafts shall have 15-inch by 15-inch red crosses (on white backgrounds) on both sides.

631-10.8.3 SHIP NAME. The name of the ship shall be painted in black letters (MIL-PRF-24635) on each side of the bow and across the centerline of rounded sterns, or on each side of pointed sterns.

SECTION 11

QUALITY ASSURANCE FOR CRITICAL COATED AREAS

631-11.1 GENERAL.

The Quality Control (QC) requirements of this section shall form an integral part of a shipyard's, maintenance facility's, or contractors overall QC program. The shipyard/maintenance facility and the contractor (if applicable) Quality Assurance (QA) organization shall be responsible for ensuring all requirements of this section are met. At private shipyards, the local Supervisor shall monitor the contractor's performance to ensure requirements are met in accordance with applicable contracts.

631-11.2 DEFINED CRITICAL COATED AREAS.

Critical coated areas are areas where premature failure of the coating system cannot be detected by routine observation due to inaccessibility, those areas where premature failure impacts mission readiness and availability, those areas where restoration of the failed system cannot be undertaken without laying up the ship at an industrial facility or a forward repair site, and those areas of high corrosion incidence or high industrial representation cost where rigorous QA procedures are required to achieve target coating life goals. The following areas are the defined critical coated areas for the purposes of this NSTM. Additions to this list may be made by the specific job contract specification.

Steel and Aluminum Alloy Surfaces

- a. Tanks and Sumps, including covers
- b. Floodable Voids
- c. Cofferdams
- d. Surface ship Bilges
- e. Well Deck Overheads (Amphibious Ships)
- f. Hanger Decks, Flight Decks, and Vertical Replenishment Decks (Air-Capable Ships)
- g. Helicopter Recovery Device (RAST, ASIST, etc.) Track Troughs
- h. Combustion Air Uptake Spaces and Trunks
- i. Interior surfaces of gas turbine, diesel, and steam combustion air intake plenums, and interior surfaces of Heating, Ventilation, and Air Conditioning (HVAC) intake plenums, each with openings greater than seven (7) square feet.
- j. All recesses on submarines.
- k. Submarine sail and superstructure (fairwater).

Steel Substrates Only

- a. The following Aircraft Launch and Recovery Equipment (ALRE) system areas: Catapult Jet Blast Deflector Pits; Catapult Voids (including wing voids); Catapult Exhaust Blowdown Trunks; barricade stanchions and wells.

All Substrates

- a. MK41 Vertical Launching System (VLS) launcher top and base.

631-11.3 REQUIREMENTS FOR CRITICAL COATED AREAS.

Critical coated areas shall have: surface preparation accomplished by certified blasters; coatings applied by certified painters; test and inspection records maintained in accordance with [Table 631-11-1](#); key checkpoints signed off by certified coating inspectors; and, for commercial shipyards, final inspections performed by a certified coatings inspector authorized to represent NAVSEA.

631-11.3.1 SSPC QP-1 CERTIFICATION. Private shipyards and contractors actually performing preservation of defined critical coated areas shall be certified in accordance with QP-1 as designated by SSPC – The Society For Protective Coatings. This certification must be held by the contractor that actually performs blasting (dry abrasive blasting, slurry blasting, water-jetting, or sponge media blasting) and painting operations. If a specialty sub-contractor is used who only performs power tool cleaning, hand tool cleaning, or other preservation process support tasks, then this contractor does not require QP-1 certification; however, in this case the contractor actually applying the coating shall have QP-1 certification. The local or regional Naval contracting authority may optionally impose additional or higher level requirements, such as requiring all contractors involved in the preservation process to have QP-1 certification. Prime contractors without QP-1 certification may subcontract work to QP-1 certified subcontractors.

631-11.3.2 POTABLE WATER AND FEEDWATER AND HIGH PURITY WATER TANKS. See additional QA requirements for potable water tanks in [paragraph 631-8.5](#) and feedwater and other high purity water tanks in [paragraph 631-8.6](#).

631-11.4 TEST AND INSPECTION RECORDS.

The shipyard shall maintain auditable records of the tests and inspections listed in [Table 631-11-1](#) for critical coated areas. The records shall be designed to provide objective quality evidence that applicable surface preparation and painting procedures were followed and that acceptable conditions and quality attributes were achieved for each parameter defined in [Table 631-11-1](#). A separate set of records shall be maintained for each area painted. Records applicable to painting reported in docking reports shall be incorporated into the painting records required by this section. The records shall be available for three years after the delivery of the ship or completion of an overhaul or refit, unless otherwise specified. At the expiration of the records retention period, NAVSEA or its authorized representatives shall be given a written notification. If no disposition instructions are received within six months from the notification, the records may be destroyed. When preservation work is being performed in accordance with NAVSEA Standard Item 009-32 on defined critical coated areas, the QA Checklist Form Appendices referenced in 009-32 shall be used to provide the required records. QA Checklist Form Appendices are available at: <http://www.nstcenter.com>.

631-11.5 SHIPYARD BLASTERS AND PAINTER CERTIFICATION

The shipyard shall maintain a certification program for blasters and painters. The program shall include minimum training requirements and provide for adequate records verifying the completion and currency of training for each blaster or painter involved in surface preparation or application of coatings. Documentation shall be maintained verifying that only certified blasters and painters are used for preservation work in critical areas. Training shall include all blasting and paint application techniques and procedures appropriate to the surface preparation and coating materials being used. These techniques and procedures include mixing, conditioning and thinning of paints; proper selection, control and maintenance of blasting and application equipment; and blasting and application techniques. For dry abrasive blasting personnel, training shall be SSPC C-7, "Fundamentals of

Dry Abrasive Blast Cleaning”, or an equivalent training program approved by NAVSEA. Plural component pump tenders and coating applicators shall be certified in accordance with the SSPC C-14 “Marine Plural Component Applicator Certification” (M-PCAC) Program or a NAVSEA approved equivalent. For equivalent certifications, a copy of the NAVSEA approval letter shall be maintained by the contractor. SSPC training and certification information can be found on the Internet at <http://www.sspc.org>.

631-11.5.1 SSPC C-7 TRAINING EQUIVALENT. An equivalent SSPC C-7 training program shall include, but not be limited to, the following elements:

- a. Providing an understanding of the importance of surface preparation.
- b. Discussing the benefits, limitations, and safety precautions of dry compressed air abrasive blast cleaning as a surface preparation method.
- c. Providing an understanding of surface profile and how it is produced and measured.
- d. Providing an understanding of SSPC/NACE and other industry standards that define the various levels of surface cleanliness that can be achieved through dry abrasive blasting.
- e. Familiarization with the primary elements of a dry abrasive blast cleaning system, and how each component fits into the overall system, through classroom and hands-on training methods.
- f. Description of the characteristics of different types of abrasives and their effect on blasting productivity, cleaning rates, recyclability, surface profile, dust, and waste generation. Review abrasive blast media specifications such as SSPC-AB 2, SSPC-AB 3, and MIL-A-22262.
- g. Student participation in a hands-on abrasive blasting session.

631-11.6 COATING INSPECTOR CERTIFICATION.

Shipyards, Regional Maintenance Centers (RMC), and SUPSHIP Quality Assurance Departments shall maintain a certification program for paint inspectors. The program shall include minimum training requirements and provide for adequate records verifying the completion and currency of training for each paint inspector involved in inspecting surface preparation, or application of coatings. Documentation shall be maintained verifying that only certified paint inspectors are used for inspecting preservation work. Training shall include all techniques and procedures appropriate to inspecting the surface preparation and coating application being used. These techniques and procedures include determining the acceptability of surface preparation prior to commencement of paint application; determining the degree of compliance with blasting and painting procedures appropriate to the surface preparation and coating materials being used; and determining the acceptability of finished products in accordance with established standardized acceptance criteria. At a minimum, coating inspectors shall be certified as having successfully completed the NACE International Coating Inspector Program Session I or the NAVSEA Basic Paint Inspector Course (NBPI), and as having maintained current qualifications or certifications required by these two programs, according to the program upon which the certification is based. The NAVSEA Basic Coating Inspector (NBPI) training course is available from SSPC and other NAVSEA designated organizations. Contact SSPC or NSWCCD-SSES 614 for the availability of this training course.

631-11.7 COATING INSPECTOR RESPONSIBILITIES.

Coating inspectors are responsible for providing reasonable confidence that material receipt and storage, surface preparation, paint application and paint curing are done in accordance with the requirements of this NSTM chapter, NAVSEA-approved ASTM F718 data sheets, paint manufacturer instructions (when specifically invoked in lieu of NAVSEA-approved ASTM F718 data sheets), and other coating process specifications or documents that are invoked in the specification for the work being performed. These responsibilities require the coating

inspector to: inspect material storage and receipt inspection facilities; ensure all inspection equipment requiring calibration certification is certified under organization metrology calibration programs; perform in-process inspections of surface preparation and painting activities and verify successful completion of key checkpoints in the application process; and inspect and accept or reject final paint systems.

631-11.8 INSPECTION OF STORAGE AND RECEIPT INSPECTION FACILITIES.

Inspections of the subject areas shall be done periodically to ensure paints are being stored and receipt inspected in accordance with NAVSEA-approved ASTM F718 data sheets, the manufacturer's Material Safety Data Sheets (MSDS), and the requirements of this NSTM chapter. See [paragraph 631-1.3.8](#) for information on using and obtaining ASTM F718 data sheets. It is an organizational level responsibility to obtain ASTM F718s and Material Safety Data Sheets for specified products. Records of inspection results shall be maintained for NAVSEA audit, in a manner similar to the test and inspection records of [paragraph 631-11.4](#).

631-11.9 IN-PROCESS INSPECTIONS.

Coating inspectors shall be given notice and shall perform an inspection of each critical coated area when the following key checkpoints are reached: surface cleaned and ready for abrasive blasting; surface abrasive blasted and ready for priming; between each successive coat of paint and between stripe coats; final coat of paint applied and area ready for final inspection. The coating inspector shall be independent of the shop or code performing the work. The inspector is required to examine all data maintained by the paint foreman concerning environmental conditions, surface cleanliness, surface profile and paint thickness. Certain data shall always be verified, depending on the checkpoint in question, including surface cleanliness, surface profile, dry film thickness (see Note 10 of [Table 631-11-1](#)) and workmanship. Environmental data, such as temperatures, relative humidity and dew point need only be verified if the inspector is doubtful of the recorded values. Deficiencies in personnel training, certification, record maintenance, equipment maintenance or any matter that is not in accordance with good painting practice shall be recorded. The coating inspector shall verify successful completion of each checkpoint with a signature on an appropriate form, which shall then be maintained in accordance with the instructions of [paragraph 631-11.4](#).

631-11.10 AUDITS OF FACILITY AND IN-PROCESS INSPECTIONS.

In commercial shipyards, a certified paint inspector authorized to represent NAVSEA shall periodically audit the receipt inspection and storage facility and in-process inspections performed by shipyard paint inspectors. Any deficiencies noted shall be reported in a Quality Deficiency Report (QDR).

631-11.11 INSPECTION OF FINAL COATING SYSTEM.

Inspection of final coating systems shall be performed in accordance with section IV.1.e of [Table 631-11-1](#), by certified paint inspectors per [631-11.6](#). For coating systems applied to the requirements of a government contract, acceptance of the final coating system shall be by the prime contractor's authorized representative and the administrative contracting officer's designated NAVSEA representative. The responsibility for proper application including all associated processes for the application of the coating systems resides with the contractor. Coating imperfections found which may cause premature coating failure shall be properly documented, and corrected before the paint system is accepted using appropriate touch-up procedures. Other imperfections in the coating system shall be properly documented and adjudicated via a local Departure From Specification (DFS) or other method appropriate to the work specification or contract. Failure to meet minimum dry film thickness requirements shall result in application of an additional coat or coats of paint in deficient areas before the coating system is accepted.

631-11.12 REVIEW OF RECORDS FOR FINAL COATING EVALUATION.

A certified paint inspector authorized to represent NAVSEA shall review the paint records of each critical area to ensure the coating installer has maintained adequate control of the surface preparation and painting process. Records shall include all the test and inspection data required by [Table 631-11-1](#). Failure to produce such records, or records which indicate that surface preparation and painting was not done in accordance with governing specifications/instructions, may be grounds for rejection.

631-11.13 ACCEPTANCE/REJECTION OF FINAL COATING SYSTEMS.

Certified coating inspectors authorized to represent NAVSEA are responsible for accepting or rejecting completed coating systems in critical coated areas. Acceptance or rejection of coatings shall be based on a review of the painting records for the area and in inspection of the area, in accordance with [paragraphs 631-11.11](#) and [631-11.12](#).

Table 631-11-1 QUALITY CONTROL PARAMETERS FOR PRESERVATION OF CRITICAL COATED AREAS

Parameter	Shipyard Procedure Coverage ¹	Test or Inspection Record Coverage ²
I. Materials (Refer to 631-5.14 and 631-7.1.4)		
1. Sources of receipt inspection	1.a. Requirement to assure material certification for abrasive blast media is in accordance with MIL-A-22262 or SSPC-AB 3, as required by the job specification.	1.a. Copy of abrasive blast media material certification.
	1.b Requirement for material certifications of coatings used in accordance with the applicable coating material specification.	1.b Copy of original coating manufacturer's certificate of compliance
	1.c. Procedures for conformance tests to be conducted, as required, to provide reasonable confidence that the paint meets specification requirements.	1.c. Document the following for receipt inspection of paints for critical coated areas as follows: A. Date paint was received by coating installer B. Purchase order number C. Receiving location D. Paint manufacturer E. Product name and number F. Batch number of paint G. Shelf life of paint (expiration date) H. Quantity received (gals) I. Results of conformance tests ⁹ J. Remarks K. Signature of Supervisor or Q.A. Inspector
2. Storage	2.a. Requirement to check shelf life of paints for critical coated areas prior to issue from warehouse.	2.a. Certification of adequate shelf life at time of issue from warehouse.
	2.b. Requirement to discard paints whose shelf life has expired, or will expire prior to use, or re-verify quality (by testing) of paints that exceeded their shelf life.	2.b. Record results of re-qualification testing.
	2.c Requirement to monitor paint storage temperatures for 24 hours prior to use.	2.c Record the minimum and maximum paint storage temperatures.
II. Surface Preparation³ (Refer to 631-5.2.2 and 631-5.14)		

**Table 631-11-1 QUALITY CONTROL PARAMETERS FOR
PRESERVATION OF CRITICAL COATED AREAS - Continued**

Parameter	Shipyard Procedure Coverage ¹	Test or Inspection Record Coverage ²
1. Abrasive Blasting	1.a. Requirements for dew point, relative humidity, ambient temperature and surface temperature in accordance with NSTM Chapter 631 .	1.a. Record the dew point, relative humidity, ambient temperature and surface temperatures prior to and every 4 hours during abrasive blasting.
	1.b. Requirements for cleaning surfaces free of oil, grease, and other contaminants that could become imbedded in the surface by blasting.	1.b. Results of pre-blast inspection. ⁸
	1.c. Degree of blast cleaning relative to surface being prepared and paint to be applied after blasting. ⁵	1.c. None
	1.d. Blasting methods and abrasive size, to ensure acceptable surface preparation and profile. ⁴	1.d. None
	1.e. Requirements for post-blasting cleanup prior to commencement of painting.	1.e. None
	1.f. Requirement for post-blasting and pre-painting inspection.	1.f. Results of inspection, including condition of prepared surface and profile, surface conductivity, residual dust, adequacy of cleanup and readiness to commence painting. ⁶
	1.g. Requirement for inspection of welds and edges prior to blasting.	1.g. Results of inspection of all welds and edges
2. Other Cleaning Methods	2.a. Procedures for miscellaneous cleaning methods (e.g., solvent, fresh water, steam, alkaline, power tool, waterjetting, etc.).	2.a. In accordance with appropriate process instructions.
	2.b. Surface conditions to be achieved and residual dust removed.	2.b. Results of pre-paint inspection for surface preparation and cleanliness. ⁶
III. Painting (Refer to 631-7.1.4)		
1. Environmental	1. Requirements for dew point, relative humidity, ambient temperature and surface temperature in accordance with standards of NSTM Chapter 631 , or NAVSEA-approved ASTM F718 data sheet.	1. Record the dew point relative humidity, ambient temperature and surface temperature prior to and every 4 hours during paint application. ⁸
2. Materials	2.a. Paints used are in accordance with the applicable job specification and ship's schedule as modified by NSTM Chapter 631 , or NAVSEA Standard Item 009-32, or instructions for nuclear spaces, or ship non-deviation drawings.	2.a. None
	2.b. Procedures for controlling the use of paint during inclement weather and where industrial operations occur (e.g., blasting, grinding, sweeping) to ensure protection from airborne contaminants.	2.b. None

**Table 631-11-1 QUALITY CONTROL PARAMETERS FOR
PRESERVATION OF CRITICAL COATED AREAS - Continued**

Parameter	Shipyard Procedure Coverage ¹	Test or Inspection Record Coverage ²
3. Mixing	3.a. Mixing ratios, techniques, and thinners applicable to paint (NSTM Chapter 631 , or NAVSEA-approved ASTM F718 data sheet).	3.a. Random verification of compliance.
	3.b. Requirements for conditioning temperatures and induction times in accordance with applicable job specification, NSTM Chapter 631 , or NAVSEA-approved ASTM F718 data sheet.	3.b. None
4. Application	4.a. Requirement to record time of surface preparation and priming in accordance with NSTM Chapter 631 .	4.a. Record start and end times for surface preparation methods, and start time 631-8.5.5 of primer application.
	4.b. Procedure for ventilation requirements for the type of tank being painted.	4.b. For potable water and feedwater tanks, verification of compliance to requirements of ventilation between coats.
	4.c. Inspection and measurement criteria such as wet film thickness.	4.c. None
IV. Cure/Post Cure (Refer to 631-7.1.4)		
1. Drying	1.a. Requirement for inspection of each coat of paint for workmanship and dry film thickness applied in accordance with NSTM Chapter 631 .	1.a. Inspection Results. ^{7,10}
	1.b. Requirements to record time between subsequent coats of paint in accordance with NSTM Chapter 631 .	1.b. Time between subsequent coats of paint.
	1.c. Requirement to pre-coat (stripe) all flanges, edges and weld seams with an approved color of the coating system that contrasts with both the previous and subsequent full coats, applied between each coat of specified system in accordance with NSTM Chapter 631 .	1.c. Verification striping was done.
	1.d. Required time for drying and curing prior to service; requirements for environmental conditions.	1.d. Drying and curing times. For potable water and feedwater tanks, verification of compliance to requirements of 631-8.5 and 631-8.6 ventilation after final coat. ⁸
	1.e. Requirements for inspection of finished painted surfaces for workmanship (e.g., drips, runs, sags) and total film thickness applied.	1.e. Inspection results. ⁷
2. Touch-Up	2. Requirements for touch-up.	2. Inspection of proper surface preparation and paint used and final thickness.
NOTES: General: Refer to the following paragraphs for the requirements for methods, sampling rates and acceptance criteria for the tests and inspections described in this table: Paragraph 631-5.2.2 Pre-Surface Preparation		

**Table 631-11-1 QUALITY CONTROL PARAMETERS FOR
PRESERVATION OF CRITICAL COATED AREAS - Continued**

Parameter	Shipyard Procedure Coverage ¹	Test or Inspection Record Coverage ²
Paragraph 631-5.14 Surface Preparation Paragraph 631-7.1.4 Coating Application and Curing General : In addition to the test records described in this table, a legible copy, in hard copy or electronic media form, of the ASTM F718 data sheet for each coating used shall be submitted as a part of the documentation package. 1. Procedures for surface preparation and painting shall include hold points (check points) for applicable inspections and tests. Inspection procedures shall incorporate normal and necessary safety requirements. 2. All test and inspection records shall be signed and dated by inspectors qualified to conduct such tests and inspections. All test and inspections noting unsatisfactory conditions shall be followed up to verify that adequate corrective actions are satisfactorily completed. 3. Abrasive blast cleaning or waterjetting shall be required for full repainting of designated critical coated areas. For repair of existing coatings, procedures for surface preparation will be tailored to account for the specific materials to be coated (e.g., galvanized or un-galvanized steels, plastics, previously painted, etc.) and for the paint to be applied (e.g., primers, anti-corrosive, anti-fouling systems, etc.). 4. Detailed requirements may be included by reference to other Shipyard Standard Procedures. 5. Degree of surface cleanliness, required surface profile, and other special conditions to be achieved shall be specified for each blasting operation. 6. The record shall show the extent of the inspection and detailed results. Degree of surface cleanliness, surface profile, removal of residual dust, surface conductivity, and adequacy of cleanup operations shall be recorded. 7. The record shall show the extent of the inspection and detailed results. 8. Records shall be signed by a qualified Trade Monitor, Foreman, or Paint Inspector. All key checkpoints shall be signed by a certified coatings inspector, as defined in paragraph 631-11.6. 9. Receipt inspection of paints used in defined critical coated areas shall consist of either performing the conformance inspection tests required in the individual paint specification, or verifying the successful completion of these tests by the vendor by reviewing the certificate of compliance or vendor material test certification data. 10. For underwater hull coatings, to avoid delaying application of the first coat of the antifouling paint, the dry film thickness of the second coat of anticorrosive paint shall be determined by calculation from the measured wet film thickness (WFT). See paragraph 631-8.4.1.7.		

SECTION 12

PRESERVATION PROCESS INSTRUCTIONS

631-12.1 GENERAL.

NAVSEA has developed Preservation Process Instructions (PPIs) to supercede NAVSEA Task Group Instructions (TGIs). PPIs provide detailed instructions and procedures for specific surface ship preservation evolutions to include safety precautions, surface preparation, selection of appropriate coating systems and third party quality assurance check points. PPI use is not required, but the documents are excellent resources for use in specifying, managing, and conducting QA/QC on their respective coating jobs. The PPIs listed herein will require tailoring and additions if used for submarine painting operations.

631-12.2 APPROVED PRESERVATION PROCESS INSTRUCTIONS.

The PPIs listed in [Table 631-12-1](#) are approved for use as appropriate for specific surface ship preservation operations. Modifications to these PPIs can be expected in the future as part of a continual review process. Follow-up changes will be issued as necessary when PPIs are modified and/or new PPIs are approved for fleet use. Additional PPIs exist for deck coverings; refer to NSTM Chapter 634.

631-12.3 PRESERVATION PROCESS INSTRUCTION AVAILABILITY.

Copies of the latest revisions of PPIs are available from the National Surface Treatment Center (NST Center) web site, <http://www.nstcenter.com/>.

631-12.4 TECHNICAL CONFLICTS.

Conflicting technical requirements between other sections of this technical manual, Preservation Process Instructions, standard work items and local instructions must be resolved by NAVSEA before any work is allowed to proceed.

631-12.5 QUALITY ASSURANCE FORMS.

Quality inspection forms are to be completed for each preservation job. When preservation work is being performed in accordance with NAVSEA Standard Item 009-32 on defined critical coated areas, the QA Checklist Form Appendices referenced in 009-32 shall be used to provide the required records. QA Checklist Form Appendices are available at: <http://www.nstcenter.com/NavyResources.aspx>.

Table 631-12-1 APPROVED PRESERVATION PROCESS INSTRUCTIONS

PPI Number	PPI TITLE
63101-000	PRESERVATION PROCESS INSTRUCTION (PPI) CORE
63101-000QA	QUALITY ASSURANCE FORMS FROM CORE PPI
63101-001H	PRESERVATION PROCESS INSTRUCTION (PPI) for BALLAST TANKS, FLOODABLE & NON-FLOODABLE VOIDS, COLLECTION, HOLDING, AND TRANSFER TANKS, AND FUEL & COMPENSATING FUEL TANKS to be used in conjunction with CORE PPI 63101-000 with a Cleanliness Level of SSPC-SP 10 Surface Preparation
63101-001A	PRESERVATION PROCESS INSTRUCTION (PPI) for POTABLE WATER TANKS, to be used in conjunction with CORE PPI 63101-000 with a Surface Preparation Method of Abrasive Blasting

Table 631-12-1 APPROVED PRESERVATION PROCESS INSTRUCTIONS

- Continued

PPI Number	PPI TITLE
63101-003H	PRESERVATION PROCESS INSTRUCTION (PPI) for BILGES to be used in conjunction with CORE PPI 63101-000 with a Cleanliness Level of SSPC-SP 12 WJ-2L or SSPC-SP 10 Surface Preparation
63101-004H	PRESERVATION PROCESS INSTRUCTION (PPI) for WELL DECK OVERHEAD to be used in conjunction with CORE PPI 63101-000 with a Surface Preparation Method of Abrasive Blasting
63101-005H	PRESERVATION PROCESS INSTRUCTION (PPI) for EXTERIOR TOPSIDE to be used in conjunction with CORE PPI 63101-000 with a Cleanliness Level of SSPC-SP-10 or SSPC-SP-12 WJ-2L Surface Preparation
63101-006H	PRESERVATION PROCESS INSTRUCTION (PPI) for REPAIR / REPLACEMENT OF SANITARY SPACE COATING SYSTEMS (OVERHEAD / BULKHEADS) to be used in conjunction with CORE PPI 63101-000 with a Cleanliness Level of SSPC-SP 11 (Minimum) Surface Preparation
63101-007L	PRESERVATION PROCESS INSTRUCTION (PPI) for REPAIR TO MIL-DTL-24441 & MIL-PRF-23236, Types IV, V, & VI COATING SYSTEMS IN BILGES to be used in conjunction with CORE PPI 63101-000 with a Cleanliness Level of SSPC-SP 11 (Minimum) Surface Preparation
63101-008H	PRESERVATION PROCESS INSTRUCTION (PPI) for AFFF STATIONS - DECK AND FOUNDATIONS to be used in conjunction with CORE PPI 63101-000 with a Cleanliness Level of SSPC-SP 10 or SSPC-SP 11 (Minimum) Surface Preparation
63101-009H	PRESERVATION PROCESS INSTRUCTION (PPI) for REPAIR TO OVERBOARD DISCHARGE PIPE LINING WITH CURED IN PLACE PIPE (CIPP) LINER SYSTEM to be used in conjunction with CORE PPI 63101-000 with a Cleanliness Level of SSPC-SP 3 Surface Preparation
63101-010H	PRESERVATION PROCESS INSTRUCTION (PPI) DDG-51 CLASS (GUIDED MISSILE DESTROYER) MIXING ROOM STEEL SUBSTRATE to be used in conjunction with CORE PPI 63101-000 with a Cleanliness Level of SSPC-SP 10 Surface Preparation
63101-011H	PRESERVATION PROCESS INSTRUCTION (PPI) CG-47 CLASS (GUIDED MISSILE CRUISER) MIXING ROOMS ALUMINUM SUBSTRATE to be used in conjunction with CORE PPI 63101-000 with a Cleanliness Level of SSPC-SP 10 Surface Preparation
63101-012H	PRESERVATION PROCESS INSTRUCTION (PPI) for VENT PLENUMS, DUCTS AND TRUNKS to be used in conjunction with CORE PPI 63101-000 with a Cleanliness Level of SSPC-SP 10 Surface Preparation
63101-014	PRESERVATION PROCESS INSTRUCTION (PPI) for REPAIR TO BALLAST TANKS to be used in conjunction with CORE PPI 63101-000 with a Surface Preparation Method of UHP Water Jetting
63101-015H-A	PRESERVATION PROCESS INSTRUCTION (PPI) for UNDERWATER HULL to be used in conjunction with CORE PPI 63101-000 with a Surface Preparation Method of Abrasive Blasting
63101-015H-B	PRESERVATION PROCESS INSTRUCTION (PPI) for UNDERWATER HULL to be used in conjunction with CORE PPI 63101-000 with a Surface Preparation Method of UHP Water Jetting
63101-016H	PRESERVATION PROCESS INSTRUCTION (PPI) for POTABLE WATER TANKS WITH VOLUME EQUAL TO OR GREATER THAN 1000 GALLONS to be used in conjunction with CORE PPI 63101-000 with a Cleanliness Level of SSPC-SP-10 Surface Preparation
63101-017H-A	PRESERVATION PROCESS INSTRUCTION (PPI) for RECOVERY, ASSIST, SECURING, AND TRAVERSING (RAST) TRACK to be used in conjunction with CORE PPI 63101-000 with a Cleanliness Level of SSPC-SP 12 WJ-2L or SSPC-SP 10 (RAST Track Trough) and Cleanliness Level of SSPC-SP 10 (RAST Track Cover/Side Plates) Surface Preparation

Table 631-12-1 APPROVED PRESERVATION PROCESS INSTRUCTIONS

- Continued

PPI Number	PPI TITLE
63101-017H-B	PRESERVATION PROCESS INSTRUCTION (PPI) for RECOVERY, ASSIST, SECURING, AND TRAVERSING (RAST) TRACK SYSTEM to be used in conjunction with CORE PPI 63101-000 with a Cleanliness Level of SSPC-SP 12 WJ-2L or SSPC-SP 10 (RAST Track Trough) and Cleanliness Level of SSPC-SP 12 WJ-2L or SSPC-SP 10 immediately after completion of blasting operations and light flash rust immediately prior to application of first coat of paint (RAST Track Cover/ Side Plates) Surface Preparation
63101-018H	PRESERVATION PROCESS INSTRUCTION (PPI) for HIGH TRAFFIC AREA INTERIOR DECKS to be used in conjunction with CORE PPI 63101-000 with a Cleanliness Level of SSPC-SP 10 Surface Preparation
63101-019H	PRESERVATION PROCESS INSTRUCTION (PPI) for MCM Class Bearing and Shaft to be used in conjunction with CORE PPI 63101- 000 with a Cleanliness Level of SSPC-SP 10 Surface Preparation
63101-020H	PRESERVATION PROCESS INSTRUCTION (PPI) for MCM and MHC Class Propeller and Metallic Underwater Hull Appendages to be used in conjunction with CORE PPI 63101-000 with a Cleanliness Level of SSPC-SP 10 Surface Preparation
63301-001H	IMPRESSED CURRENT CATHODIC PROTECTION (ICCP) ANODE & DIELECTRIC SHIELD INSPECTION / REPAIR / REPLACE INSTRUCTION Cleanliness Level of SSPC-SP-5 Surface Preparation

APPENDIX A**TECHNICAL MANUAL DEFICIENCY/EVALUATION REPORT (TMDER)****NOTE**

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