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DEPARTMENT OF THE NAVY  
COMMANDER MILITARY SEALIFT COMMAND  
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COMSC INSTRUCTION 4750.2C

Subj: PRESERVATION INSTRUCTIONS FOR MSC SHIPS

Ref: (a) Naval Ships Technical Manual (*NAVSEA S90869-VD-STM-000*),  
Chapter 631  
(b) COMSCINST 4710.7

Encl: (1) Paint and Preservation Instructions for MSC Ships

1. Purpose. To establish policy and procedural guidelines for surface preservation and painting of ships assigned to COMSC and to provide a comprehensive list of approved paints and coatings for use on these ships.
2. Cancellation. COMSCINST 4750.2B.
3. Background
  - a. This revision establishes new policy with respect to draft marks, bans chromate from MSC service, and incorporates new approved coating systems and minor technical clarifications.
  - b. A key element in prolonging the useful life of any ship, both military or commercial, is an effective painting and preservation program to minimize the corrosive effects of operating in a marine environment. MSC has identified paints and specialized coating systems with superior performance, durability, and economic effectiveness for MSC service. Ship mission, operating schedules, areas of operation, and drydocking intervals all influence the type of coating system to be applied. This instruction addresses these situations and provides direction for selecting, applying and maintaining the proper coating systems.
  - c. Reference (a) reflects current technical information on painting and preservation of Navy ships in service. Human health, environmental considerations, and safety precautions also have been thoroughly addressed. It is to be used as general guidance for situations not directly addressed by this instruction.
  - d. Due to MSC policy of utilizing commercial shipyards for performing overhaul and maintenance work, it has become necessary to develop a list of proprietary paints from commercial manufacturers which have proven durable and economical for MSC service. This is

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particularly true for cargo petroleum tanks and underwater hull coatings. Therefore, specific evaluation and approval is required by COMSC for any coating to be used in those areas. Enclosure (1) contains several appendices which list the MSC-approved coating systems.

4. Policy. The following paragraphs broadly define major policies to be followed in planning and preparing paint maintenance on MSC ships:

a. Headquarters does not intend to become involved in the ordinary painting and maintenance details for MSC ships. These are, and will remain, the responsibility of the administrative commanders. This instruction is merely to provide policy guidelines for carrying out these responsibilities. It is not possible to develop a rigid set of rules and regulations to govern the time, cost, or scope of maintenance practices. Professional judgment and experience are the best foundations for making those types of decisions. It is not intended that mass repainting be undertaken as a result of these instructions, but rather, that these guidelines be incorporated in future planning as ships come up for coating maintenance.

b. Due to the impact of anti-fouling systems on fuel consumption, Headquarters has implemented an energy conservation and management program which among other things, determines the most effective type of underwater hull coating system for each MSC ship. Therefore, all coating specifications for underwater hulls shall be coordinated with the Engineering Office (N7).

c. For certain ships in MSC service, particularly the point-to-point tankers (*T-AOT, T-AOG, etc.*), the type and quality of the coating system in cargo petroleum tanks are of major importance. Therefore, all coating specifications for these tanks shall be coordinated with the Engineering Office (N7).

d. The approved coatings lists in the appendices of enclosure (1) are subject to occasional change. Most changes are anticipated to be adding newly-approved coatings; however, it is possible that approval for some systems may be modified or even rescinded. Headquarters (N7) will maintain the current status of approved coatings and should be contacted concerning any approval matters.

e. All matters concerning paint or coatings on contractor-operated MSC ships shall be referred exclusively to Headquarters (N7). Administrative commanders are cautioned to ensure that requests by the contractor operators for special approval or use of coatings are consistent with contracted obligations.

f. Where circumstances require exceptional actions, or where administrative commanders feel there is a reasonable opportunity for a "test patch," deviation from the approved lists may be permitted by the Engineering Officer (N7).

g. When preparing paint work specifications, administrative commanders shall scrupulously maximize competition. Specifications, whenever possible, should call out "...any system

approved per Appendix --- of COMSCINST 47520.2.” If a proprietary product is named, it should always be followed by the phrase “or MSC-approved equivalent.”

5. Limitations. In addition to the specifically approved coatings listed in the appendices of enclosure (1), MSC has imposed the following limitations on the use of certain types of coatings. Administrative commanders shall ensure that such coatings are not used other than indicated below:

- a. Any coal-tar epoxy, or paint containing coal-tar derivatives, is completely banned from MSC service.
- b. Any “red lead” paint is completely banned from MSC service.
- c. Any inorganic or organic zinc coatings are banned from use in MSC petroleum cargo tank service.
- d. By Congressional directive, no coating containing organo-tin ingredients may be applied. Existing coatings, however, may be left in place.
- e. Any zinc chromate paint is completely banned from MSC service.

6. Applicability. This instruction is not a contractual document and is not to be implied or cited as such in any specifications with the exception of referencing the approved coatings listed I the appendices of enclosure (1). This instruction is intended to be used as a guideline for those persons writing specification items related to paint maintenance of MSC ships.

7. Responsibilities. The following responsibilities are assigned:

a. COMSC

(1) The Engineering Officer (N7) is responsible for coordinating painting and preservation policy and for evaluating and approving paint or coating systems for use on MSC ships. As coating technology progresses, the Engineering Officer shall update these policies and guidelines to ensure that the Government is taking advantage of the best economical gains from such progress.

(2) The Engineering Officer also will provide any additional support to the administrative commands as requested in way of technical support or matters of special consideration.

(3) The Engineering Officer will coordinate approval of coating systems for underwater hulls with respect to the energy conservation and management program, and cargo petroleum tanks with respect to sponsor requirements.

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b. Administrative Commanders:

(1) Shall retain the overall responsibility for maintaining MSC ships and the planning thereof. Underwater hull, topsides, cargo, and ballast tank coatings should be periodically inspected and touched-up or renewed. Other shipboard areas shall be recoated as necessary.

(2) Shall prepare and update, on an "as opportune" basis, the surface area and paint schedules as called out in Chapter 9 of enclosure (1). Each revision of these schedules shall be forwarded to Headquarters (*attention N7*) for the purposes of monitoring the performance of any particular paint or coating.

(3) Shall ensure adequate training of port engineer personnel in matters relating to preparing paint work specifications, inspecting and surveying paint work performed by shipyard and, in general, maintaining a high degree of knowledge concerning paints, surface preparation, application techniques, etc.

(4) Shall coordinate with Headquarters any positive or negative experience regarding coating systems. Since administrative commanders will have the best experience concerning true coating performances, any comments or recommendations will be seriously considered.

c. MSC ships:

(1) Masters shall take action to minimize all corrosion by maintaining the integrity of painted surfaces. Damaged, cracked, or blistered coatings shall be properly repaired or touched-up as soon as possible.

(2) Masters shall investigate any areas that seem to be chronically corroding to determine if there is an underlying cause such as pocketed water that cannot drain properly or undetected galvanic coupling between dissimilar metals. Any design or installation deficiencies which promote these situations should be corrected by ship's force or brought to the attention of the administrative commanders.

(3) Any serious failure of a paint system, particularly within six months of being applied, shall be brought to the attention of the administrative commanders for investigation.

Distribution:

SNDL 41B (*MSC Area Commands*) (*less FE, SWA, and EUR*) (50)  
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## PAINT AND PRESERVATION INSTRUCTIONS FOR MSC SHIPS

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- H: Voids, Cofferdams, and Miscellaneous Area Coating Systems
- I: MSC Color Codes

## CHAPTER 1: COATING TECHNOLOGY

### 1.1 Introduction

a. The technology of marine coating systems (*such as paints, soft coatings, etc.*) has advanced significantly in the last decade, and has become increasingly sophisticated. The purpose of this instruction is to provide MSC personnel with direction on COMSC policies concerning maintenance, preservation, and appearance standards for USNS ships.

b. Marine coatings serve two important functions aboard ships: preservation and cosmetic appearance.

c. Preservation is necessary since the sea is an extremely hostile environment to steel ships, and the cost of constantly renewing corroded metal would become prohibitive if left unprotected. However, current preservation systems themselves also are subject to degradation due to weather exposure and also must be maintained or renewed.

d. Cosmetic appearance of the ship serves several functions, the most important being identification (*hull color, distinctive markings, color codes, etc.*). A clean, well maintained ship is also an impressive public symbol of the U.S. Government, especially when visiting overseas ports.

e. For these reasons, the marine coating policies and practices outlined in this COMSC instruction are to be followed by all Area Commanders, port engineers, contractors, and other persons acting on behalf of Military Sealift Command. **ONLY THE APPROVED COATING SYSTEMS OUTLINED IN APPENDICES A-I SHALL BE USED.** As new systems are approved, these appendices will be updated.

### 1.2 Ordinary Corrosion

a. Ordinary corrosion is the process by which unprotected metal such as unpainted steel, aluminum, or copper combines with oxygen ("*oxidation*") and disintegrates.

b. Iron oxide ("*rust*") forms on steel or iron, and is an unstable film: it easily flakes off, exposing fresh metal which corrodes and disintegrates in turn. Eventually, all the steel will be eaten away.

c. Aluminum and copper oxides are much more stable: they form tough adhering films which are not easily removed, sealing the metal from further exposure and inhibiting additional corrosion. Unfortunately, the cost of constructing entire ships out of copper or aluminum is too prohibitive to be practical, in addition to the unsuitability of such material in certain applications. So steel remains as the major material used in ship construction.

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d. The theory behind using a marine paint or other coating is to isolate the metal from contact with water and/or oxygen by forming a physical barrier. In reality, all coatings are highly porous to oxygen (*non-airtight*) and somewhat porous to water; therefore, corrosion is inhibited but not completely prevented. The porosity of a coating is inhibited but not completely prevented. The porosity of a coating is largely dependent upon its material condition: the type of coating, age, how intact it is (*i.e., whether it is cracked or chipped*), how tightly is it bonded to the underlying metal, etc. The rate of corrosion is determined by how much oxygen and water can get into contact with the metal. Warmer temperatures will accelerate the process.

### **1.3 Galvanic Corrosion and Zinc Anodes**

a. Galvanic corrosion occurs when two different metals are in physical contact with each other while immersed in a saline or acidic solution (*this is the "battery principle"*). One metal remains totally unharmed (*the "cathode"*), while the other metal corrodes away (*the "anode"*). Which metal becomes the unharmed cathode is dependent upon the relative reactivity of the two metals involved: steel in contact with copper tends to corrode, whereas steel in contact with zinc is protected (*for this reason, zinc ingots are used as "sacrificial anodes" on steel ship hulls*). Zinc paint coatings are used for the same effect: the coating will sacrifice itself while protecting the steel that it covers.

b. Zinc anodes are usually located on the underwater hull in areas where high turbulence can quickly erode away the protective coating (*such as around the bow or propeller*).

**NOTE: Zinc anodes should never be installed on hulls using an impressed current protection system (*the impressed currents will greatly accelerate the corrosion rate of the zincs*).**

c. Galvanic corrosion is a design/engineering responsibility, and the Port Engineer is not likely to become more involved in this other than maintaining and replacing zinc anodes or steel "waster" pieces in piping systems.

d. Proper performance of a zinc anode system requires that the zincs be fully exposed to seawater. Therefore, zincs must never be painted or covered up (*when the hull is being painted, existing anodes must be masked*).

e. Maintenance of an existing zinc anode system shall be the responsibility of the Area Commander/Port Engineer. Zincs shall be inspected upon each drydocking and replaced if they are more than 50% wasted.

### **1.4 Impressed Current Systems**

a. Impressed current systems also work on the "battery principle:" cathodes (*"reference cells"*) and anodes (*"shields"*) are installed at strategic points on underwater hull. A small electric current is forced through the hull between them, effectively turning the ship into a giant cathode and inhibiting corrosion.

b. Unlike zinc anodes (*which are self-acting*), impressed current systems require electrical power from the ship. The amount of power needed is dependent upon the size of the hull and the location of the reference cells and shields. As with zinc anode systems, the Port Engineer is not likely to become involved with impressed current systems other than maintaining them.

c. The nature of the electric field in the vicinity of the shields is detrimental to most paints (*tending to make them brittle and easily cracked*), and therefore requires careful application. If the impressed current system is slightly out of tune and generating an overvoltage, the paint coating will blister (*unruptured blisters will contain a liquid which feels soapy to the touch*). The steel hull within a radius of five feet from the shield should be initially abrasiveblasted then coated with 20-25 mils of an epoxy paint as general anti-corrosion protection. Reference cells and shield points must never be coated and should be securely masked against abrasiveblasting and painting.

d. Area Commanders/Port Engineers are responsible for maintaining all aspects of an existing system. Converting a new ship over to an impressed current protection system, or modifying an existing system, is a major cost and design project, and shall only be done with explicit approval from COMSC Headquarters (Code N7).

## 1.5 Paints

a. The most common method of corrosion protection is to coat the metal with a paint. Such a coating nominally serves as a physical barrier, blocking moisture and oxygen from contact with the metal.

b. Most paints are solvent-types: the paint solids are dissolved in a solvent to liquefy them (*making them easier to apply*) and are brushed, rolled, or sprayed onto the surface. The solvent evaporates into the atmosphere, leaving a hard, dry film of solids adhering to the surface. Several coats may be necessary to build up the required thickness. Ordinarily, such paints are approximately 50% solvent, 50% solids; however, new technology is making "high solids" coatings which contain a greater percentage of solids (*therefore requiring fewer coats to achieve a desired thickness*).

c. Other types of coatings are "two-component" paints: a small amount of reagent is stirred into a large amount of paint, provoking a chemical reaction which causes the paint film to harden and adhere ("*curing*"). The curing reaction enhances the paint's cohesion as well, providing for better abrasion resistance. Epoxies and urethanes are the most common two-component paints.

d. Paint solids contain several ingredients, depending upon function (*corrosion-inhibitors for anti-corrosives, biocides for anti-foulants, pigments for color, etc.*). Other ingredients may enhance the coating's resistance to seawater, weather exposure, chemical or fuel attack, mechanical abrasion, etc.

e. The effectiveness of a coating depends upon how successfully it was initially applied: surface preparation (*cleaning away contaminants and roughening it for better mechanical bonding*), application (*properly-mixed ingredients, acceptable temperature and humidity levels,*

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*proper dewpoint, good application techniques*), and subsequent maintenance (*repair or touch-up of damaged areas*) all determine how long and how effective the coating will be.

f. All paint manufacturers document their coatings with a "Product Data Sheet" which provides technical information and guidance for proper use, application, hazards, and other relevant data concerning the coating. Additionally, most responsible paint manufacturers will provide a field representative to assist the Port Engineer or shipyard in ensuring that the paint is properly applied. As part of the overall quality assurance of the coating work, the Port Engineer should not hesitate to make use of these resources.

## CHAPTER 2: COATINGS FOR STEEL

### 2.1 Introduction

This chapter discusses paint technology as applied to steel surfaces. Subsequent chapters will similarly address aluminum, fiberglass, and wooden surfaces.

### 2.2 General Preparation

Prior to actually beginning surface preparation for painting, there are several items which must be accompanied to protect the ship and its equipment from the effects of blasting and painting. The Port Engineer should ensure that the shipyard contractor has taken all these steps:

- a. Mask impressed current reference cells and anodes
- b. Mask zinc anodes
- c. Remove or mask sonar domes
- d. Run overboard discharge hoses from deck scuppers
- e. Plug scuppers, outlets, discharges, etc.
- f. De-grease as necessary
- g. Remove sea-chest covers or strainers
- h. Cover all exposed deck machinery
- i. Seal all ventilation openings to ship interior
- j. Mask all portholes, windows, etc.

### 2.3 Surface Preparation

a. Prior to applying a coating, it is necessary to prepare the steel surface. The degree of preparation is dependent upon the particular coating that will be used (*certain coatings are more tolerant of imperfect surfaces than others*), and the general condition of the surface itself.

b. Generally, surface preparation achieves two purposes:

(1) cleans the surface of contaminants which may chemically or physically interfere with the paint as it dries or cures; and

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(2) provides a good, rough surface (“*anchor profile*”) to which the new paint can adhere.

c. Where an existing coating is largely intact and only needs to be touched-up in local areas, then a full-scale surface preparation will not be needed. If the existing coating has deteriorated substantially, then it may be necessary to completely remove it down to the bare metal and apply a totally new coating. The following methods are typically used for surface preparation:

(1) **Mechanical brushing or sanding:** Small areas may be effectively prepared by using power wirebrushing, disc sanding, or a hand scraper. They offer the advantage of creating less dust and grit than sandblasting, but improper technique using a wirebrush or disc sander can over-polish the surface, leaving it too smooth for proper paint adhesion.

(2) **Abrasivesweeping:** Air-blasting grit onto the surface. Light sweeping takes off loose rust, blistered or flaking paint, marine fouling and any other contaminants, and roughens up the existing paint surface. If properly done, it leaves underlying layers of good paint intact and undamaged. To accomplish abrasivesweeping effectively, considerable operator skill is required to avoid damaging undercoats: sweeping is done by working rapidly at an extremely acute angle to the surface, often at a reduced pressure. **Note: Abrasivesweeping is NOT to be done on ablative/self-polishing type antifoulant coatings, since it will damage or remove them.**

(3) **Abrasiveblasting:** Similar to abrasivesweeping, but done at higher air pressure, and deliberately used to blast all coatings off and expose bare metal. This is the fastest, most-efficient way to prepare large surface areas; however it generates tremendous amounts of dust and grit. The abrasiveblasted profile of the surface should be 2-3 mils as measured on a Keane-Tator Blast Profile Comparator (*profiles which are deeper than this leave uncoated peaks, and waste a lot of paint*). The Steel Structures Painting Council has established standards for different degrees of blasting:

(a) “Commercial Blast” (SP-6): will generally get down to metal but will leave old paint in pits, etc.

(b) “Near-white Blast” (SP-10): good blasting to bare metal, leaves good rough profile.

(c) “White metal Blast” (SP-5): the perfect blast, but expensive to achieve and difficult to hold. This degree of blasting is usually not necessary since all modern paints can get by with just the near-white quality. This blast should never be called out in specifications unless there is an extraordinary requirement, or otherwise required to properly apply the particular overcoating paint or primer.

(4) **Spotblasting:** This is a technique used with touching-up or repairing small damaged areas of existing coating. The affected area is coating. Effective spotblasting requires that the junction between the blasted and intact coatings be “tight” (*no visible blistering, flaking, delamination, etc.*) and that the edge of the intact coating be “feathered” to provide an exceptionally good surface for the new paint to adhere to. Feathering may be accomplished by use of a power disc sander or hand scraper. An inherent danger in spotblasting is severely eroding the steel, especially when working on severely wasted metal. Port Engineers should inspect all spotblasted work to ascertain that excessive steel loss has not occurred.

(5) **Hose washing:** When the ship is drydocked, the specifications should require the underwater hull be hosed down with freshwater within 12 hours of dewatering the drydock, keeping the hull wet with fire hoses in the meantime. This removes much of the slime and marine growth before it dries and hardens (*ultimately saving much time and cost*), and allows for a more-accurate inspection of the existing coating. Washing can be done with firehoses. **Port Engineers shall include hose washing in all drydocking specifications.**

(6) **High-pressure waterwashing:** Freshwater washing of the hull for similar purposes as abrasivesweeping: removal of loose particles, contaminants, marine growth, etc. This technique offers the advantages of not damaging undercoats of paint, and eliminates dust and grit problems. High-pressure waterwashing must be done with special pumps or water cannons, and specifications should require 10-15 gallons/minute at 2000-2500 PSI of pressure from a 3/4-inch nozzle; **firehoses do NOT qualify**. An emulsifying agent or detergent may have to be added to the water as necessary to help cut through heavy oil or grease.

(7) **Hydroblasting** is extremely high pressure freshwater washing of the hull (*typically 5000 to 20,000 PSI*) which can prepare steel similar to a near-white metal blast. It offers the same advantages as waterwashing (i.e., no dust or grit problems), but requires very specialized equipment. However, it is an acceptable alternative to abrasiveblasting as long as the final surface meets the required preparation standards. **Note: this technique should not be used on ablative/self-polishing type anti-foulant coatings, since these coatings will be severely damaged by the high pressures.**

(8) **Citric acid washing:** This is a very sophisticated process developed by the Navy to descale bilges, and does not lend itself to most commercial ship repair yards. Essentially, existing paint in the bilges is removed (*either mechanically or chemically stripped*), then hot citric acid is applied to dissolve scale and rust oxides. Finally, a special solution is expensive, time-consuming, and requires very careful safety and training methods. This technique shall not be used on MSC ships without COMSC approval (Code N7).

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(9) **Inspection:** When the surface has been prepared, both the port engineer and the paint manufacturer's representative should inspect and approve it before allowing application to proceed.

(10) **Dehumidification:** Where tanks to be blasted and coated are so large that the work will span several days, the Port Engineer shall specify use of dehumidification equipment and ducting to ensure preservation of the blasted surfaces until they can be coated.

(11) **Galvanized steel,** such as ventilation ducting or lifeboat hulls, must never be abrasiveswept or blasted since the protective galvanized coating may be damaged. The proper method to prepare a galvanized surface is either with mechanical brushing or using a wash primer (*discussed below*).

## 2.4 Application Methods and Techniques

a. There are several important considerations when applying coatings, and for different types of paint there may be very different requirements. The Port Engineer should request the Product Data Sheet for any paint that he is not personally familiar with.

b. Ambient weather conditions are often critical: winter temperatures in northern shipyards will preclude the use of certain coatings, as may summer humidity in southern shipyards. When it is possible that weather conditions could impact on the paint work, the Port Engineer shall specify that the shipyard uses a feasible method to avoid these problems. Erecting a temporary shelter around the work area, using heat lamps, dehumidifiers, or portable ventilators are all methods that have been successfully used in the past, but it must be kept in mind that every application job is unique and is likely to present its own problems.

c. There are four common methods for applying paints:

(1) **Brush painting** is generally reserved for small touch-up work, or getting into inaccessible places.

(2) **Roller brushing** can be used effectively on larger areas, and offers the same simple portability as brushes.

(3) **Air Spray:** This is the most common method used in shipyards, consisting of a compressed air flow which carries paint through the hose and out the nozzle. Large surface areas can be quickly and efficiently coated, but set-up and clean-up times are greater. Application technique and operator skill also are much more critical here. Problems associated with this method are over-spray (*the nozzle is so far from the surface that the paint dries out in mid-air and fails to adhere very well*), and sagging (*the nozzle is so close to the surface that the paint builds up too thick and then runs down*). Also, if the compressed air is not "dry" the entrained moisture will cause paint failure.

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(4) **Airless Spray:** The paint is directly pumped through the hose (*without any air being mixed in*) and atomizes when striking the surface at very high velocity, which enhances adhesion. This is a fast, efficient method which minimizes overspray, but requires specialized equipment and operator training. Application rates are about 30% higher than for air-spray.

## 2.5 Primers

a. A primer is the first coating put on a raw steel surface. Its purpose is two-fold: to provide immediate corrosion protection, and to serve as a tiecoat between the steel and the succeeding overcoats of the anti-corrosive system.

b. Primers are specially formulated to adhere tightly to the metal surface, and in turn to become a good surface for the next coats of paint which would not normally bond very well directly to the steel. They must be chosen for compatibility with both the base metal (*steel, aluminum, fiberglass, wood, etc.*) and the overcoating paint.

c. Marine primers also must be suited for the intended service such as below waterline (*seawater resistance*) or above waterline (*weather resistance*), cargo tanks (*petroleum resistance*), etc. They also must be compatible with the subsequent overcoat. The Product Data Sheet must be consulted if the port engineer is uncertain of the appropriateness of a primer for its intended service.

d. Primers by themselves usually have poor long-term weather resistance, and must be overcoated within a specific period of time if they are to maintain a good bonding surface for the next coating (*however some of the modern primers are durable enough to serve as a total anti-corrosive system*).

e. A general discussion of the most-commonly encountered primers follows:

(1) **Shop primers** are specifically for short-term protection of subassemblies being put together in the shop. They can be directly welded onto (*provided that the film thickness is not more than 1 mil*). Shop primers are not very durable and must be eventually overcoated. Use of a shop primer is strictly the option of the shipyard; such primers do not count towards the final anti-corrosive system. If the shop primer is relatively intact when it is compatible with the overcoat. Frequently, however, the shop primer becomes damaged or contaminated during the fabrication process, and the Port Engineer should not hesitate to have it cleaned up (*abrasiveswept if necessary*) or even stripped off before being overcoated.

(2) **Wash primers** contain phosphoric acid, which etches the metal and provides better adhesion for the succeeding overcoats. Wash primers are regularly used on a aluminum and galvanized steel. Like shop primers, they are used strictly at the option of the shipyard and do not count towards the final anti-corrosive system.

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(3) **Zinc primers** (*both organic and inorganic*) contain powdered zinc and generally serve as primers for high-performance anti-corrosive systems. Protection is afforded by the galvanic action of the zinc (*servicing as a sacrificial anode*). Organic zincs are no longer being widely used for marine service; Port Engineers should always specify an inorganic zinc primer instead. **Note:** zinc primers should never be used in direct seawater service (*such as ballast tanks or underwater hull*), or in conjunction with any tank coating, or in conjunction with any aviation fuel service (*tanks or pipelines*).

(4) **Epoxy primers:** high performance two-component primers, intended for either additional epoxy overcoats, or as a tie-coat between the steel and a non-epoxy overcoat.

## 2.6 Anti-Corrosive Systems

a. All steel requires anti-corrosive protection. The amount of coverage depends upon intended service and exposure: in some situations a heavy layer of primer will be adequate, and in other instances the primer will have to be built up with additional coats of another paint that provides specialized protection.

b. The purpose of the anti-corrosive coating is to become a physical barrier isolating the steel from water and/or oxygen. No coating, however, is perfectly air or waterproof.

c. The anti-corrosive coating itself can be degraded by exposure to sun or saltwater, therefore it also requires maintenance attention.

d. Not all anti-corrosive systems lend themselves to good cosmetic appearance (*for example, epoxies will quickly chalk when exposed to strong sunlight*) and should be topcoated if appearance is important.

e. Anti-corrosive coatings should be applied only over compatible primers (*as warranted by the manufacturer*).

(1) **Touch-up:** where it is desired to repair local areas, spotblasting is the best method (*unless the dust and grit problems are unacceptable, in which case wirebrushing may be more appropriate*). The steel should be blasted to a near-white condition. The boundary between blasted surface and the surrounding intact paint must be “feathered” using a hand- or wirebrush to roughen the intact paint (*this allows the new coating to bond to the existing one, creating a smooth transition between the touched-up area and the surrounding intact coating*). The exposed steel should then be immediately primed, and eventually overcoated to match the surrounding area.

(2) **Welding:** Apart from shop primers (*and thin-film zinc primers*), Port Engineers shall specify that all paint be scraped or wirebrushed off any welding work (*welding heat will destroy the coating around the hotpoint, and on the reverse side of the plating as well*) and that all damaged areas should be restored as soon as possible.

## 2.7 Anti-Fouling Systems

a. Marine organisms are extremely tenacious and adaptable forms of life, and have developed remarkable adhesives to glue themselves onto almost any type of surface (*only copper is a natural toxin*). Growths of slime, seaweed, barnacles, mussels, etc., increase the frictional drag of the hull and also can choke seawater flow through seachests and piping.

b. The most common way of preventing marine growth is to coat all exposed surfaces with an anti-fouling (AF) paint that contains a mixture of various biotoxins.

c. Anti-fouling systems now fall into two categories:

(1) Conventional

(2) Ablative/Copolymer/Self-smoothing

In either case, the anti-fouling system offers no protection against corrosion and must be applied over a proper anti-corrosive system.

d. **Conventional** AF systems contain biotoxins mixed into a vinyl, chlorinated rubber, or epoxy paint. Such systems generally begin to lose their effectiveness after one year of service and are exhausted after two years. Extra thick build-up is not effective, since the biotoxins buried deep in the underlayers are never in contact with the marine growth.

e. **Ablative/Self-smoothing** AFs contain biotoxins mixed into a copolymer paint. The surface layer of paint is gradually dissolved ("*ablated*") by the seawater, revealing fresh biotoxins that were buried beneath. For this reason, several coats of paint can be built up to provide effective protection for many years. Normal ablative types offer excellent anti-fouling performance (*and associated fuel savings*). The "self-smoothing" types of surface roughness is less than when originally applied (*and thereby offers additional fuel savings by reducing hull roughness*).

f. Most manufacturers of ablative AFs have several types, designed for different ablation rates (*usually for fast, medium, or slow speed service*).

g. The economic choice between a conventional AF system and an ablative one requires a trade-off study which considers application and material costs, annual days-at-sea, cruising speeds, drydocking intervals, and areas of ocean service. For this reason, the decision to convert a hull over to an ablative AF system must be approved by COMSC (Code N7), which is

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monitoring the cost-effectiveness of these coatings; therefore, **Area Commanders/Port Engineers are to advise N7 whenever an ablative system is to be repainted.**

h. **Touch-Up:** Touching-up or renewing a conventional AF coating requires special care if the underlying anti-corrosive system is to be left undamaged. The hull should be only abrasiveswept (*or high-pressure waterwashed*) enough to remove all biofouling, contamination, and to roughen up the surface. The new coating can be painted directly over the remains of the old one. Touching-up or renewing an ablative/self-polishing AF system requires only a thorough waterwashing of the hull. The new coating can be applied directly on the existing one.

i. **Special Comments:** Boottopping, interior of seachests, thruster tunnels, bilge keels, scupper guards, etc., should be coated in the same manner as the rest of the underwater hull. Seachest strainers are best coated by dipping. Shields around impressed current systems should not be painted with anything other than an anti-corrosive (*refer to Section 1.4*).

## 2.8 Specialized Coatings

In addition to the paints discussed above, there are several coatings for specialized service aboard ship.

a. **Non-skid** coatings are painted over decks to provide secure footing in special areas (*such as helo decks, around UNREP stations, etc.*). Chapter 6 (*Sections 6.7 and 6.8*) discusses use of non-skid coatings aboard MSC ships.

b. **Heat-resistant** coatings are used to paint hot surfaces, such as steamlines, boilers, and steam-powered equipment. These coatings are flexible enough to survive thermal expansion and contractions, and do not blister at high temperatures. Use of these coatings is discussed in Chapter 6 (*Sections 6.10 and 6.2*).

c. **Flame-retardant** coatings are types that have been formulated so that the dry film does not burn (*although these paints are still flammable before the solvents have evaporated, nor will they prevent a flammable substrate from burning*). The most common of these paints are chlorinated alkyds, which are extensively used in interior spaces.

d. **Soft coatings** are thick fluids or gels which can be sprayed or “floated” onto a surface, and which never harden. These coatings can be applied to less-than-perfect surfaces, and are well suited for small, inaccessible voids where conventional painting methods are impractical or too expensive (*such as rudder interiors*). **Use of these coatings, other than specified in Chapter 6 (Section 6.17) shall not be done without explicit approval from COMSC (Code N7).**

e. **Terrazzo** is a “cement” flooring material made of inorganic powders and marble chips combined with a synthetic binder. There are two basic types: latex and epoxy. When specifying latex, Port Engineers shall only specify the variety which conforms to MIL-STD-D-3134, with an underlayment conforming to MIL-STD-D-3135. Terrazzo is fire-retardant and moisture-resistant. Has good uses in sanitary wet spaces, foyers, and passageways. Not good for galleys since it absorbs odors.

f. **Tiles** are laid over an underlayment coating (*conforming to MIL-STD-D-3135*) which provides thermal, acoustic, and/or fire insulation. Vinyl and rubber tiles should be generally used throughout interior areas such as staterooms, messrooms, etc. Ceramic tiles are to be used in wet spaces such as toilets, showers, etc. Quarry tiles have excellent resistance to food fats and acids, and are to be used in galleys and pantries.

## **2.9 Inspection and Evaluation Techniques**

This section addresses how the Port Engineer should inspect and approve paint work.

### **a. General preparations**

(1) The Port Engineer shall specify that the shipyard prepare a listing of all work areas to be painted. Each area should be broken down into phases such as “surface preparation,” “1st Coat,” “2nd Coat,” etc. Each of these phases should have sign-off lines for the Port Engineer, the shipyard’s paint foreman, and the paint manufacturer’s representative.

(2) To conduct inspections, the Port Engineer should be equipped with flashlight, pocket mirror, sharp putty knife, dry film gauge, wet film gauge, psychrometer, metal temperature gauge, and surface comparator.

b. **Surface preparation:** Apart from spotblasted touch-up work, all specifications should require the Port Engineer to inspect and approve the prepared surfaces prior to being primed or painted. A **near-white** surface should be a rough, metallic gray color, without any visible discolorations at all. Inspect any pitting to ensure that they have been blasted. All grit and dust should have been vacuumed or swept out, no surfaces should feel gritty (*they should be wiped down with a dry cloth*). Make sure that scaffolding was shifted around so that obstructed points were exposed and blasted. An **abrasiveswept** surface should be free of loose paint or rust flakes, and any remaining paint should be tight. There should be no residual oil, grease, or water on any surfaces to be coated. Port Engineers should refer to visual comparator cards (*such as Swedish SSPC or NACE*) to help assess the quality of the surface preparation.

c. **Applications:** Each coat should be inspected after it has set (*refer to the coating’s Product Data Sheet*). The Port Engineer should make personal notes on points of low or excess film, missed areas (*“holidays”*), pinholes, blisters, sags, runs, puddles, dry-spray (*evidence by a slightly gritty, rough surface*), sand/grit/dust inclusion, lifting of feathered edges, sharp edges, and welds. Defections should be corrected as follows:

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(1) Blisters, sags, runs, and puddles should be scraped smooth and any entrapped solvents wiped away.

(2) Dry-spray (over-spray) should be lightly sanded.

(3) Sand, grit, or other included material must be completely removed.

The Port Engineer should re-inspect the coating after the contractor has cleaned it up, referring back to his notes from the first inspection. When all is in order, both the Port Engineer and the paint manufacturer's representative should sign off approval to proceed. The next coating should be applied as soon as possible to minimize further surface contamination.

d. **Shipyard proposals:** At times, a shipyard may propose using an alternate coating, due to procurement leadtime, weather conditions, application problems, etc. The Port Engineer is not authorized to approve such alternate proposals, since these may impact on future coating work, or entitle the government to a credit (*if the new coating requires less cost or effort on the part of the contractor*). Such proposals are to be referred back the Quality Assurance Divisions (*Codes L-4E or P-4E*) for evaluation.

## CHAPTER 3: COATINGS FOR ALUMINUM

### 3.1 Introduction

- a. This chapter discusses paint technology as applied to external aluminum surfaces (*i.e., those exposed to seawater or weather*).
- b. Major use of aluminum in the MSC fleet is generally limited to certain workboats, lifeboats, and some deckhouse structures.
- c. As discussed in Chapter 1, oxidized aluminum has a tough, adhesive surface film which effectively seals the underlying metal from further exposure. Therefore, ordinary corrosion of aluminum is not a serious problem (*however, the Port Engineer should keep an eye out for galvanic corrosion, where a steel or other metal fitting has come into prolonged contact with the aluminum*).
- d. The main purpose of painting aluminum is to maintain a cosmetic appearance (*i.e., to match surrounding color schemes*).

### 3.2 Surface Preparation

Most of the basic preparation methods previously described in Chapter 2 (*Section 2.2*) can be used on aluminum surfaces, except that when abrasive sweeping or blasting use 80-grit aluminum oxide or garnet abrasive at 65psi air pressure.

### 3.3 Application Methods and Techniques

The same application methods previously described in Chapter 2 (*Section 2.3*) can be used.

### 3.4 Painting

Clean, bare aluminum may be coated as follows:

- a. Epoxies may be applied directly onto the surface.
- b. Alkyd paints must be applied over one coat of an epoxy primer (*1-2 mils DFT*).
- c. Vinyl paints must be applied over one coat of wash primer (*MSC #32*).

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**3.5 Anti-Fouling Systems**

a. Anti-fouling systems are not to be applied to any aluminum craft that are normally dry-stowed (*such as aboard ship*).

b. Launches and workboats which are normally wet-stowed shall be coated with commercial AF paints compatible with the undercoats and aluminum hulls.

## CHAPTER 4: COATINGS FOR FIBERGLASS HULLS

### 4.1 Introduction

a. This chapter discusses paint coatings for fiberglass. In the MSC fleet, major fiberglass use is limited to lifeboats, workboats, liferaft canisters, and weathertight housings for exposed electronic systems (*i.e., radar, radio, COMSAT antennas, etc.*). This chapter is specifically intended for maintenance of fiberglass hulls; if other situations arise concerning fiberglass, the COMSC Engineering Officer (Code N7) can be consulted.

b. The primary reason for painting fiberglass is for cosmetic appearance. Being non-metallic, fiberglass does not corrode, and generally has good weather resistance (*but after several years of exposure, the gel coat may become dull and require painting*).

c. Ordinarily, there are many types of paint systems which can be used to paint fiberglass. However, for the purposes of providing a good, long-lasting coating, silicone alkyd paints are acceptable for MSC service.

### 4.2 Blistering

a. For unknown reasons, molded fiberglass hulls occasionally form blisters in the gel coat (*an affliction sometimes known as "the pox"*). These blisters can form at any time, in a new hull or old, and they must be repaired to preserve the integrity of the hull.

b. Blisters should be removed by disc sanding, and the exposed craters thoroughly cleaned of all loose debris and then filled with an epoxy putty. When the putty has cured, it should be sanded flush with the surrounding surface and painted.

### 4.3 Surface Preparation

Fiberglass is not to be abrasiveswept or blasted. The proper method of preparation is disc sanding, to provide a roughened surface. New fiberglass hulls must be thoroughly de-waxed before being coated.

### 4.4 Application Methods and Techniques

All methods described in Chapter 2 (*Section 2.3*) can be used except for airless spray.

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#### **4.5 Painting**

- a. Fiberglass may be coated with one or two coats of a commercial fiberglass primer suitable for the final topcoat.
- b. If painted, exteriors shall match topside color.

#### **4.6 Anti-Fouling Systems**

- a. No lifeboats, workboats, or launches that are normally dry-stowed (*such as aboard ship*) shall be painted with any anti-fouling coating.
- b. Workboats or launches that are normally wet-stowed shall be given an anti-fouling coating that is specifically formulated for fiberglass surfaces.

## CHAPTER 5: COATINGS FOR WOOD

### 5.1 Introduction

- a. This chapter discusses preservation methods for weather-exposed woodwork. In the MSC fleet, such woodwork is typically outfittings of lifeboats (*seats, oars, rudders, etc.*).
- b. Refer to Chapter 6 (*Section 6.19*) for required color schemes for lifeboats.

### 5.2 Surface Preparation

- a. Wooden items shall not be abrasiveblasted or abrasiveswept. Proper surface preparation is disc sanding, hand scraping, and use of paint solvents.
- b. All loose paint, blisters, oil, and grease must be removed. Only tightly adhering paint should be left. Wood must be completely dry.

### 5.3 Application Methods and Techniques

Brush painting is best for small areas and touch-up, air spray can be used for larger areas.

### 5.4 Painting

After the wood surface has been prepared, it shall be treated as follows:

- a. One coat of **copper naphenate** wood preservative (*MSC #62*); and
- b. Two coats of an alkyd paint for the finish color (*refer to Appendix I for listing of alkyd paints*).

## CHAPTER 6: APPLICATIONS ABOARD MSC SHIPS

### 6.1 Introduction

a. This chapter addresses coatings for specific areas of MSC service. Certain areas of shipboard use require critical performance from the coating (*such as anti-fouling paints, which affect fuel consumption; and cargo tank coatings, which affect cargo quality*), and the coatings to be used in these areas must have specific COMSC approval. **The lists of approved coatings are contained in Appendices A through I, and shall be strictly adhered to.**

b. Most MSC ships are “gray hulls,” like regular Navy vessels. However, there are some MSC vessels (*such as hospital ships, oceanographic ships, etc.*) which are not gray. The color schemes for these special hulls are addressed in Chapter 7.

c. Where certain MSC ships are maintained by contracted commercial operators, the paint and coating provisions of that contract shall supersede the requirements of this chapter wherever a conflict of instructions occurs.

d. In the discussions below, a “new” coating means that the original coating has been completely removed; a “renewed” coating means completely overcoating an existing one (*after suitable surface preparation*); and “touch-up” refers to renewing just a small, localized area.

### 6.2 Underwater Hull

a. The underwater hull is defined as all areas of hull from keel to 6” below the light load line, including rudder(s), bilge keels, thruster tunnels, but excluding the boottopping.

**NOTE: This is an area of critical service and only those coating systems approved in Appendix A shall be used.**

b. The coating policies of this section are based upon a service period of 30 months (*a normal dry-docking cycle of 24 months, plus a 6-month margin*).

c. Complete reblasting of the hull to near-white steel shall only be done as necessary. The anti-corrosive (AC) systems approved in Appendix A can be expected to last nominally ten years, as long as they are properly maintained and any damaged areas are repaired. Damaged areas of the AC system are to be touched up by spot-blasting, and recoated to match the surrounding area.

d. **Fleeting:** when the underwater hull is specified to be fully blasted to bare metal, the shipyard shall be required to fleet the ship in order to ensure that there is full 100% coverage of the hull with respect to the new anti-corrosive and anti-fouling coatings. When only the anti-fouling coating is to be renewed it is not necessary to fleet the ship. However, Port Engineers shall ensure that subsequent docking positions allow the previously masked portions of the hull to be coated properly.

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e. A new conventional anti-fouling (AF) system shall be applied only when the hull has been completely reblasted.

f. An existing conventional AF system shall be renewed when the entire coat has lost its effectiveness (*the coating shall be waterwashed or abrasiveswept in such a manner as not to damage the underlying AC system, then recoated with a compatible-type AF paint to provide 30-month service*).

g. A new ablative AF system shall be applied only with prior approval from COMSC (Code N7), and only when the hull is due to be completely blasted for a new AC system.

h. Renewal of an existing ablative system shall be done by waterwashing the bottom paint, then building up the entire coating to meet a 30-month service period.

i. Otherwise, local areas of failed or ineffective coatings (*conventional or ablative*) shall be touched-up only enough to provide adequate service until the next normal renewal period.

j. Any zinc anodes which are more than 50% wasted shall be replaced.

### **6.3 Boottopping**

a. The boottopping is that portion of the hull 6" below the light load line to 6" above the deep load line.

**NOTE: This is an area of critical service and only those coating systems approved in Appendix A shall be used.**

b. The boottop coating shall receive the same degree of maintenance as the underwater hull.

c. The boottopping shall always be a black anti-foulant, of the same type of coating as the underwater hull (*i.e., conventional, ablative, etc.*). Use of any other boottop coating than that specified destroys the anti-fouling effects.

### **6.4 Topsides, Hull**

a. The topside hull comprises all the freeboard hull, from 6" above the deep load line to the railings, including bulwarks.

b. Unless otherwise specified in Chapter 7, the freeboard hull color for MSC ships shall be Haze Gray (*MSC #45 or Fed Std Color #26270*).

c. MSC has established a high-performance topside coating system per Appendix B. This system comprises of an inorganic zinc primer, epoxy anti-corrosive, and weather-resistant topcoat. Once applied, the epoxy undercoat should provide protection for 6 to 8 years. The topcoat should be high-pressure waterwashed with freshwater and detergent every year, and can be renewed every second year. Small area touch-up repairs can be done by ship's force, large area touch-up repairs should be done during a regular shipyard availability. **NOTE: Only those coating systems approved in Appendix B shall be used.**

(1) Inorganic zinc primers will only adhere to an abrasive blasted steel surface. The application of inorganic zinc to small, locally-damaged areas is beyond the capability of shipboard equipment. Mechanical grinding is not effective because it polishes the steel rather than leaving the rough surface profile necessary for inorganic zinc adhesion. As a result, the old paint system shall be wire-brushed (or disc-sanded) down to the next intact layer. If the underlying intact layer is inorganic zinc, it shall be overcoated with surface-tolerant epoxy and appropriate topcoat. If the underlying intact layer is the epoxy coat, it shall be topcoated. Care shall be taken to properly roughen and feather edges of the intact paint in order to promote good adhesion of the new coats. (A)

(2) For larger areas requiring industrial assistance, the damaged area shall be spot-blasted down to bare steel and the full, three coat system reapplied. (A)

(3) Ship's force is not to apply inorganic zinc. This material should only be ordered through the paint supply contract for use by industrial contractors. (A)

d. Hull markings are discussed in Section 6.24.

## 6.5 Topsides, superstructure and deckhouses

a. The general topsides include all weather-exposed vertical surfaces, such as superstructure and deckhouses, deck lockers, masts, cargo gear, lifeboats and davits, decks, deck machinery and deck piping (which are each addressed separately in this chapter).

b. Unless otherwise specified in Chapter 7, the topside color for MSC ships shall be Haze Gray (MSC #45 or Fed Std Color #26270).

c. MSC has established a high-performance topside coating system per Appendix B. This system is comprised of an inorganic zinc primer, epoxy anti-corrosive, and weather-resistant topcoat. Once applied, the epoxy undercoat should provide protection for 6 to 8 years. The topcoat should be high-pressure waterwashed with freshwater and detergent every year, and can be renewed every second year. Small area touch-up repairs can be done by ship's force, large area touch-up repairs should be done during a regular shipyard availability. **NOTE: Only those coating systems approved in Appendix B shall be used.**

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- A) (2) For larger areas requiring industrial assistance, the damaged area shall be spot-blasted down to bare steel and the full, three coat system reapplied.
- A) (3) Ship's force is not to apply inorganic zinc. This material should only be ordered through the paint supply contract for use by industrial contractors.

## 6.6 Decks, general

- a. Interior deck coverings in habitability areas are addressed in COMSCINST 9330.6. Interior decks in non-habitability areas are generally painted with a semi-gloss alkyd enamel paint per Appendix C.
- b. Exterior decks include all weather-exposed horizontal surfaces, excepting helo/hangar decks and specific non-skid areas (*which are discussed in Sections 6.7 and 6.8*), and hospital ships (*addressed in Chapter 7*).
- c. All decks and horizontal surfaces visible to surface or air detection shall be Dark Gray (*MSC #35 or Fed Std Color #26081*). Those horizontal surfaces not visible to surface or air detection can be White (*MSC #33 or Fed Std Color #27886*) when this will increase the general light levels; otherwise, these surfaces are to be painted the same as surrounding bulkheads or supporting structures.
- d. Decks should be blasted down to near-white metal only as necessary, and completely recoated. Large deteriorated areas shall be touched up in a shipyard; ship's force shall be responsible for general maintenance and appearance, and shall perform small touch-up work.
- e. When decks are to be blasted down to bare metal, the Port Engineer shall specify an epoxy primer coat at 4 mils and one epoxy topcoat of 5 mils. **Decks subject to excessive wear** may be coated with two coats of Dark Gray epoxy (*Fed Std Color 26081*). A Dark Gray silicone alkyd (*MSC #35*) may be used by ship's force as an alternate topcoat.

## **6.7 Decks, helo and hangar**

a. All helo, VERTREP, and hangar decks certified by the Naval Air Engineering Center (NAEC) shall only be coated with a Class I Grade B rollable epoxy non-skid approved per QPL DOD-C-24667 applied over the manufacturer's designated primer (*or Navy formula 150 if no specific primer is designated*). The dry film thickness of the primer shall be at least 2 mils greater than the measured blasted profile of the steel (*i.e., if blast profile is 3 mils, then primer shall be 5 mils DFT*). Decks shall be marked in accordance with the latest revision of NAEC Bulletin No. 1, "Air Capable Ship Aviation Facilities" using NAEC-approved color topping materials.

b. All non-certified helo decks shall be coated with a commercial non-skid coating in accordance with Section 6.8 below.

## **6.8 Decks, non-skid**

a. The following deck areas shall be coated with a commercial non-skid coating: focs'l and poop deck work zones around windlasses, capstans, and line-handling areas; lifeboat stations; UNREP and FAS stations; and non-certified helo or VERTREP decks. Additionally, a 6-foot wide non-skid "walkway" shall be established on tanker and fleet oiler decks that are exposed to seaways.

b. Non-skid areas shall be prepared by blasting down to near-white metal, applying an epoxy primer (*2 mils greater than blast profile*), and 5-6 mils of a commercial epoxy non-skid coating. "Do-it-yourself" non-skid coatings (*i.e., sandblasting grit stirred into or sprinkled over ordinary deck paint*) are not to be used; ship's crew can requisition non-skid paint from the National Stock System (*refer to MSC #74 in Appendix I*).

c. Where non-skid coatings are subject to excessive wear, such as RO/RO ramps or forklift corridors, a helo deck non-skid coating may be used (*Class I Grade B rollable non-skid approved per QPL DOD-C-24667, applied over the manufacturer's designated primer*).

d. Non-skid areas should not be touched-up or painted over with ordinary deck paint.

## **6.9 Engine Room and Machinery Spaces**

a. This section applies to bulkheads, decks, and overheads or engine rooms, motor rooms, boiler rooms, auxiliary machinery rooms, shaft alleys, and steering gear flats. Machinery and piping within these spaces are addressed separately.

b. Pump rooms aboard oilers and tankers are addressed in Section 6.11.

c. The deck color shall be extended 6" up all bulkheads to form a dado band.

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d. The engine room/machinery spaces shall be painted using the following types and colors:

- (1) Decks, bilges: primed with a surface-tolerant coating (*per Appendix H*), topcoated with Terracotta (MSC #36)
- (2) Bulkheads: Soft White (MSC #26)
- (3) Overheads: same as bulkheads
- (4) Deck gratings: same as decks
- (5) Platform gratings: Black (MSC #48)

#### **6.10 Machinery, Interior and deck**

Machinery falls into three categories: decks machinery (*weather-exposed*), interior machinery (*in engine room or auxiliary spaces*), and hot machinery (*steam-powered, whether exposed or interior*).

Deck machinery: Haze Gray (MSC #45)

Interior machinery: Equipment Gray (MSC #28) trimmed out with Black (MSC #48)

Hot machinery: Heat-resisting aluminum (MSC #54)

#### **6.11 Pump Rooms, for tankers and fleet oilers**

a. Bilges, deck plating, and bulkheads below the gratings shall be given one coat of inorganic zinc primer, an epoxy coat at 4 mils, and topcoated with one coat of Terracotta (MSC #36). These coatings include all equipment foundations and shall be carried 6" above the grating level.

b. Bulkheads shall be Soft White (MSC #26).

c. Valves and piping shall be color-coded for the particular cargo system.

#### **6.12 Masts, Booms, and Kingposts**

All masts, booms, kingposts, etc., shall be painted with Haze Gray (MSC #45 or Fed Std Color 26270) except that the outboard six feet of all boom tips forward of the stack shall be White (MSC #33 or Fed Std Color 27886), and the outboard six feet of all boom tips aft of the stack shall be Black (MSC #48 or Fed Std Color 27038).

#### **6.13 STREAM, UNREP, and FAS equipment**

All machinery shall be Dark Gray (MSC #35 or Fed Std Color 26081), marked white in accordance with the latest revision of NAVSEA Manual NWP-14.

#### **6.14 Cargo Holds**

- a. Bulkheads, interior of cargo hatch coamings, cargo trunks, etc., in way of cargo spaces shall be painted White (*MSC #16*).
- b. Overheads shall be painted same as bulkheads.
- c. Decks shall be painted Dark Gray (*MSC #35*).
- d. Wooden cargo battens also shall be Dark Gray (*MSC #35*).
- e. Vertical ladders, and bulkheads in way of ladders, shall be gloss Black (*MSC #48a*) with hazard markings per Section 6.23.
- f. All U-bolts, D-rings, padeyes, and other fittings intended for use during cargo handling shall be painted gloss Red (*MSC #4*), and stenciled alongside in gloss Red with "ATTACH BLOCK HERE".

#### **6.15 Tanks**

- a. The importance of ensuring proper coating lifetime in tanks, especially cargo tanks, requires proper attention to surface preparation and paint application. The Port Engineer should specify the use of dehumidification equipment, careful clean-up of blasting grit and dust, full stripe coating of all edges and corners, and thorough inspection at each phase of the coating work.
- b. **Saltwater ballast tanks** shall only be coated with any of the coating systems listed in Appendix G.
- c. **Freshwater ballast, feedwater tanks** shall only be coated with any of the systems listed in Appendix F.
- d. **Potable water, cargo water tanks** shall be coated only with those coatings listed in Appendix E or otherwise approved by Naval Sea Systems Command (*NAVSEA*).
- e. **Cargo petroleum tanks**, including those for DFM or JP-5, shall be coated only with those systems approved in Appendix D.
- f. **Ship's service tanks**, such as FO, DO, or LO shall be left uncoated. Tanks for JP-5 shall be coated with any system approved in Appendix D.

#### **6.16 VOIDS, COFFERDAMS, CHAIN LOCKERS**

- a. These spaces shall be coated with any system listed in Appendix H.
- b. Anchor chains are addressed per Section 6.27.

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### 6.17 Rudders, Kort Nozzles

- a. The exterior areas of rudders and Kort nozzles are considered part of the high-turbulence regions of the underwater hull and shall be treated as per Appendix A.
- b. The interior surfaces may be preserved by float-coating with any system listed in Appendix H.

### 6.18 Stacks

- a. All MSC ships, regardless of type or hull color, shall have their stacks painted with the distinctive color bands described below. The painting of other insignia or markings is strictly prohibited.
- b. Stacks shall receive the same maintenance attention as the deckhouse and superstructure.
- c. The widths of the color bands are proportional to the overall height of the stack (“H” as illustrated in Figure 6-1).
  - (1) Top band: Black (MSC #48), for a width of two-fifteenths of “H”
  - (2) 2nd band: Haze Gray (MSC #45), for one-fifteenth of “H”
  - (3) 3rd band: Blue (MSC #46), for one-fifteenth of “H”
  - (4) 4th band: Yellow (MSC #47), for of one-fifteenth of “H”
  - (5) Lower portion: The remainder of the stack (*below the yellow band*) shall be painted the same color as the surrounding deckhouse, except as otherwise directed in Chapter 7.
- d. MSC seal: The use of the MSC seal on stacks has been discontinued (*due to excessive maintenance efforts*).

### 6.19 Lifeboats, Liferings, Liferafts, Davits

- a. **Lifeboats** shall be prepared in a manner suitable for their construction (*i.e., galvanized steel, aluminum, or fiberglass*). Lifeboat hull color shall match surrounding superstructure color. The interior of open lifeboats shall be given two topcoats of International Orange (MSC #55), except where the lifeboats are stowed forward of the bridge and the bright color would interfere with navigation (*in such situations, the interior may be given two topcoats of Haze Gray (MSC #45)*). The canopies of encapsulated lifeboats shall be International Orange (MSC #55). On each side of the bow shall be stenciled the ship’s name and lifeboat number (*in black letter not less than 3” high*), the cubical contents and number of allowed persons that can be carried (*in black letters not less than 1-1/2” high*). Additionally, on at least two thwarts shall be stenciled the number of allowable persons that can be carried (*in black letters not less than 3” high*).

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- b. Lifeboat **oars** shall be International Orange (*MSC #55*) with grips and blade tips painted White (*MSC #33*). Stenciled on each oar shall be the ship's name.
- c. The lifeboat **release levers** shall be gloss Red (*MSC #4*), with red luminous tape around the handle ends. The raised lettering on the levers shall be white. The background hull and footings in way of, and for 6" around, the levers also shall be painted white to ensure good contrast for night visibility.
- d. **Liferings** and **liferrafts** shall be maintained in accordance with manufacturer's recommendations. Ship's name should be stenciled on each item.
- e. Davits shall be painted to match superstructure color. "Witness marks" shall be painted on both tracks and arms to indicate the point at which power hoisting of the davits should be stopped. Such witness marks shall normally be White (*MSC #33*), at least 1-1/2" wide, located where they are readily visible to the winch operator, and should be in alignment before the limit switch is required to function.

## 6.20 Piping Systems

- a. Interior piping (*except fire systems discussed in Section 6.21*) shall be painted to match surrounding areas, and stenciled with white lettering to identify service and flow. Valve bodies and wheels shall be painted gloss Black (*MSC #48a*), except those uninsulated valves subjected to high temperatures: these shall be painted with heat-resistant aluminum paint (*MSC #54*).
- b. When painting valves, label plates are to be properly masked.
- c. **Steam piping on weather decks** exposed to green seas shall be coated with 4 mils of inorganic zinc primer (*per Appendix H*) and topcoated.
- d. **Exterior riser plugs** for shoreside connections shall be color-coded as follows:

Fresh water:	Blue ( <i>MSC #46</i> )
Fireman:	Red ( <i>MSC #4</i> )
JP-5:	Purple ( <i>MSC #70</i> )
Steam:	Haze Gray ( <i>MSC #45</i> )
Fuel:	Haze Gray ( <i>MSC #45</i> )

Each of these risers shall have white letter stenciling to identify their service.

## 6.21 Fire and Washdown Systems

- a. **Firemains** shall be painted to match surrounding compartment or deck colors, stenciled in red to read "FIREMAN" with an arrow indicating direction of flow. All valve bodies and handles, fire cabinets and associated fittings shall be painted or trimmed with gloss Red (*MSC #4*).

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b. **Carbon Dioxide (C02) piping** shall be gloss Red (*MSC #4*), with white stenciling "C02" and an arrow indicating direction of flow. This includes nozzles, valves, and control handles.

c. **Halón piping** shall be painted to match surrounding compartment or deck colors, stenciled in red to read "HALON" with an arrow indicating direction of flow. All nozzles, valves, and control handles shall be painted or trimmed with gloss Red (*MSC #4*).

d. **Washdown system brackets** for chemical, biological, and radiological (*CBR*) defense shall be painted International Orange (*MSC #55*). Ship's fore shall ensure that fog nozzles remain fully functional and unclogged at all times.

## 6.22 Wiring Systems

Wireways, electric cabling, stuffing tubes, and similar electrical fittings shall be painted to match surrounding compartment surfaces. Where cabling runs in bilges, it shall be painted White (*MSC #16*).

## 6.23 Hazard Markings

a. All points posing inherent hazards to personnel shall be clearly and distinctively painted with alternating black and yellow stripes. This includes low beams, high hatch coamings, protruding corners, and other stumbling or tripping hazards.

b. Such hazard markings shall be diagonal, alternating stripes of gloss Black (*MSC #48a*) and Yellow (*MSC #47*). The width of the stripes should be proportional to the hazardous area, ranging from 1-1/2" to 4" in width.

c. **Interior stairways** shall have the top and bottom risers painted with a 4" band of yellow or white.

d. **Vertical ladders** shall have the top one foot and bottom six feet of the handrails painted yellow. Top and bottom rungs also shall be yellow.

e. Professional judgment and experience must be used to guide the use of these hazard markings.

## 6.24 Hull Markings

a. Apart from the general hull colors, the following markings are to be applied to all MSC ships.

b. All letters and numbers shall be outlined with welding beads, and shall be Black (**MSC #48**) unless otherwise indicated. Refer to Figure 6-2 for additional illustration.

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c. On **ships longer than 200 feet**, other than Naval Fleet Auxiliary Ships, the ship's name shall appear on both the bow and stern in lettering 15" high and 1-7/8" nominal thickness. Above the name shall be the caption "U S NAVAL SHIP" in lettering 10" high and 1-1/4" thick. At the bow, this caption shall be spaced 6" above the ship's name; at the stern, this caption shall be spaced 24" above the name.

d. **Naval Fleet Auxiliary Ships** longer than 200 feet shall have stern markings identical to the above, but no name or caption on the bow. Instead, bows shall have Navy hull numbers (*white with black shadowing*) in accordance with NAVSHIP drawing S2804-921819, "Distinguishing Figures for Misc Vessels."

e. **Ships less than 200 feet** in length shall have name and/or number appearing on both and stern, in lettering 12" high and 2" thick. Above this shall be the caption "U S NAVAL SHIP" in lettering 9" high and 1-1/4" thick. At both bow and stern, this caption shall be spaced 12" above the name.

f. **Draft marks:** All ships shall have draft marks both port and starboard at the bow, midships, and stern. All numbers shall be Arabic numerals, precisely 6" high, and spaced 6" vertically. The bottom of the number shall coincide with the draft it represents. These marks should extend 3 feet above the boottopping at the bow and stern, and 6 feet above the boottopping amidships. Numbers above the boottopping shall be black; numbers within and below the boottopping shall be an anti-foulant of the same type (*but contrasting color*) as the underwater hull coating. All marks shall extend in a vertical line perpendicular to the baseline (*bow marks shall not follow rake of the stem*).

g. **Projection marks:** Where a sonar dome or some other obstacle projects more than 6" below the keel, a separate set of Arabic numeral draft marks shall be applied to the hull both port and starboard, representing the draft from the bottom of the projection. These marks shall continue 5 feet above the boottopping, and 6" above the uppermost mark should be lettered "PROJ." Where two projections are less than 10% of the ship's length-between-perpendiculars (*LBP*) apart, only the deeper projection need be marked.

h. **Load line and Plimsoll markings:** These markings are determined by the American Bureau of Shipping and shall not be changed unless a new Load Line certificate is issued. Markings shall be white.

i. **Name boards:** All MSC ships shall be equipped with teak or varnished nameboards, engraved with the name of the ship only. Lettering shall be 12" high and 1-7/8" nominal thickness (*except where the name would require boards of excessive length*). Lettering and border shall be trimmed with gold.

j. **Awards:** The Chief of Naval Operations has approved participation of MSC ships in the CNO Surface Ship Safety Awards program. Each winner is authorized to display a green "S" (*for safety*) marking on the bridge bulwarks (*port & stbd*). Letters shall be Green (*MSC #64*), measure 15" x 12", of standard Navy block shape and shading.

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## **6.25 Damage Control Lockers**

Distinctive markings of damage control (*DC*) lockers and equipment stowed therein is considered necessary to provide ready identification, and to avoid misplacement or misuse of equipment. Therefore, in order that the identifying paint markings for all DC lockers and equipment in MSC ships will be standardized, the following markings shall be used:

- a. The inner and outer sides of the door shall be International Orange (*MSC #55*), with 3" black stencil lettering reading "DAMAGE CONTROL LOCKER." If there are two or more lockers onboard, each locker will be given one, two, etc. vertical black stripes, 1" wide, identifying the locker. Ships with only one DC locker shall omit this black stripe.
- b. The handles or other suitable parts of tools and other equipment stowed in any DC locker also shall be painted International Orange, and where practicable shall be marked with one, two, etc. black bands to identify the DC locker where it is stowed.

## **6.26 Decontamination Stations**

- a. Weather doors to decontamination stations shall be Haze Gray (*MSC #45*). Door dogs shall be gloss Black (*MSC #48a*). On the weather side of the door shall be 3" black letter stenciling "DECONTAMINATION STATION ENTRANCE" and "EXIT TO INTERIOR."

## **6.27 Anchors & Anchor Chains**

- a. Anchors shall be painted to match freeboard hull color.
- b. MSC uses U.S. Navy markings for anchor chains (as opposed to merchant marine markings).
- c. Detachable links are painted red, white, or blue:

Red at 15 fathoms;  
White at 30 fathoms;  
Blue at 45 fathoms;  
Red at 60 fathoms;  
White at 75 fathoms, and so on.

- d. Links on either side of the detachable link are painted white:

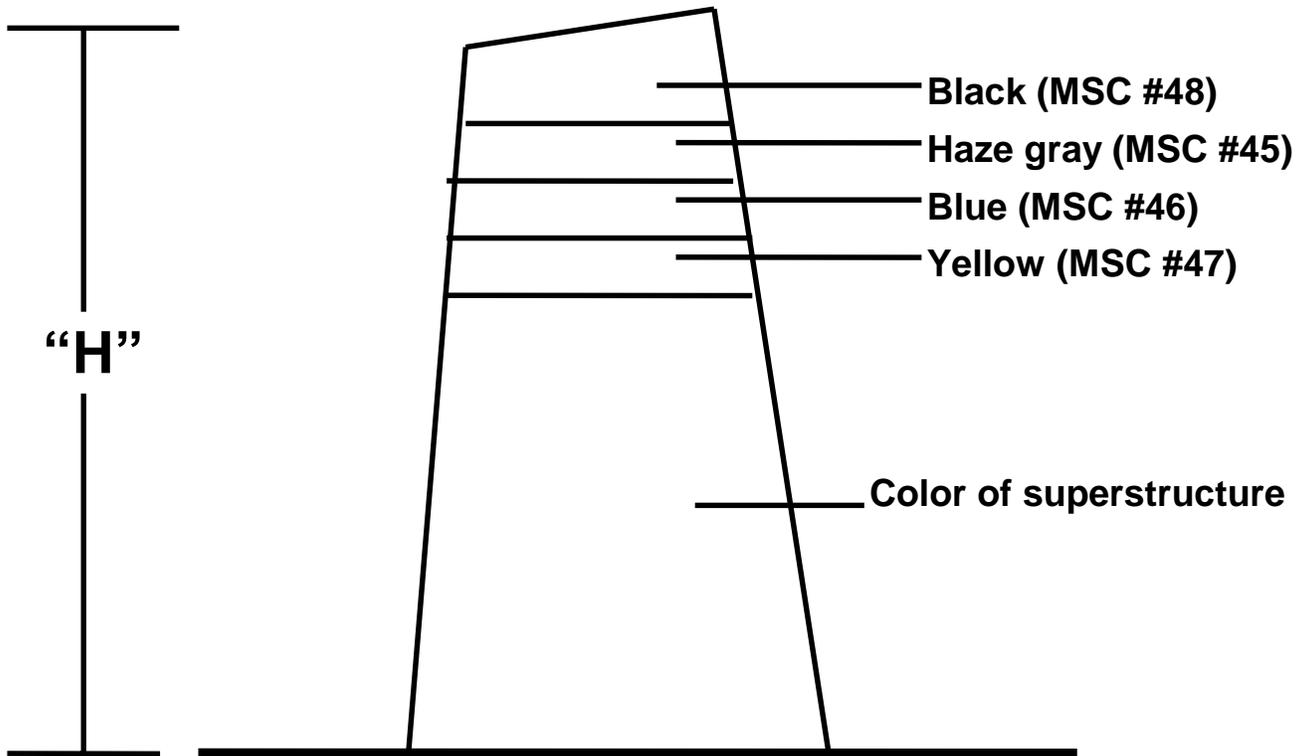
One white link each side at 15 fathoms;  
Two white links each side at 30 fathoms;  
Three white links each side at 45 fathoms, and so on.

- e. All links on the next-to-last shot are painted yellow.
- f. All links on the last shot are painted red.
- g. In addition to painted links, wire wraps around stud links on either side of the detachable links may be used:

One turn of wire on first stud from each side of detachable link at 15 fathoms;

Two turns of wire on second stud from each side of detachable link at 30 fathoms;

Three turns of wire on third stud from each side of detachable link at 45 fathoms, and so on.



**NOTES:**

1. Bands shall be parallel to baseline, outlined by weld beads.
2. Black band shall be  $2/15$  of "H" in height.
3. Other color bands shall each be  $1/15$  of "H" in height.
4. Refer to Chapter 6.18 for general discussion; refer to Chapter 7 for special MSC vessel discussion.

**FIGURE 6-1  
STACK MARKINGS**



**NOTES:**

1. This sketch is representative of MSC longer than 200 feet (refer to Chapter 6.24 for shorter vessels)
2. All lettering shall be Black (MSC #48), outlined by weld beads.
3. Vertical separation "V" at bow shall be 6 inches, at stern 24 inches.
4. Typical stbd bow markings shown above (port side similar) Stern markings similar except cruiser sterns shall be marked on both port & stbd sides, fantail sterns shall be marked on centerline.
5. Naval Fleet Auxiliary ships shall have stern markings as above (*stern centerline only*), but only Navy numbers on each side of bow.

**FIGURE 6-2  
BOW & STERN MARKINGS**

## CHAPTER 7: SPECIAL MSC SHIPS

### 7.1 Introduction

a. Some ships within the MSC fleet are exempted from the normal exterior paint colors: hospital ships (T-AH class), special mission ships, transport tankers (T-AOT class), and certain other ships when requested by the sponsor. This chapter addresses the specific changes for these vessels; all other markings and colors shall be in accordance with Chapter 6.

b. Where certain MSC ships are maintained by contracted commercial operators, the paint and coating provisions of that contract shall supercede the requirements of this chapter wherever a conflict of instructions occurs.

### 7.2 Hospital Ships

a. USNS hospital ships shall conform to all appropriate Geneva Convention requirements. The color schemes discussed below conform to the Convention.

b. Hospital ship red crosses shall have widths approximately equal to their heights, with the width of the arms approximately 1/3 the height of the cross. All crosses shall be outlined with welding bead and painted gloss Red (MSC #4 or Fed Std Color 11105).

c. All exterior vertical and horizontal surfaces above the waterline shall be White (MSC #33 or Fed Std Color 27886) except as discussed below. This includes deckhouses, decks, stacks, booms, davits, masts, lifeboat exteriors, etc.

d. The stack shall be White (MSC #33 of Fed Std Color 27886) with the normal black, gray, blue and yellow MSC color bands (per Section 6.18). Additionally, there shall be four red crosses, as large as practicable, on the stack. These crosses shall be positioned so that at least one is visible when viewed from any side of the ship.

e. Helo decks shall be painted and marked in accordance with NAEC requirements.

f. All hospital ships over 450' long shall have their name appear on both bow and stern, in black lettering 20" high and 1-7/8" nominal thickness. Above the name shall be the caption "U S NAVAL HOSPITAL SHIP" in lettering 16" high and 1-1/4" nominal thickness. This caption shall be spaced 6" above the name at the bow and 24" above the name at the stern. All lettering shall be outlined with welding bead.

g. There shall be three red crosses on each side of the hull, with the centers of the crosses all at the same height above the load line. The height of the crosses shall be approximately 9/10 of the freeboard. The forward cross shall be located in the vicinity of the stem to enhance its visibility when the ship is seen from dead ahead. The center cross shall be located abaft the

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bridge. The after cross shall be located approximately half-way between the center cross and stern.

h. There shall be one red cross, as large as practicable, on the forward vertical surface of the superstructure, located for maximum visibility when the ship is viewed from dead ahead.

i. There shall be red crosses, preferably 34 x 34 feet, on top of the superstructure deck fore and aft, located for maximum visibility from the air.

j. Lifeboat exteriors shall be white with the normal black markings (refer to Chapter 6, Section 6.19). Additionally there shall be red crosses, 15 x 15 inches, on each side of bow and stern. Interiors shall be in accordance with the normal requirements for lifeboats.

### **7.3 Special Mission Ships**

a. To be painted White (Fed Std Color 27886) using the approved coating systems of Appendix B:

- Hull, boottopping to bulwark rail
- Inboard side of bulwark
- All exterior vertical surfaces
- Masts and booms
- Antenna and platforms
- Stack (below MSC color bands)
- Davits and lifeboat exteriors
- Vent cowls, interior and exterior
- Crosstrees and mast extensions

b. To be painted gloss Black (MSC #48a or Fed Std Color 17038):

- Anchors and chains
- Bits, chocks, and rollers
- Door dogs
- Mast tops and boom tips (6") on booms aft of stack

c. To be painted Dark Gray (MSC #35 or Fed Std Color 26081):

- All decks, and exposed horizontal surfaces
- All deck machinery

### **7.4 Tankers (T-AOT class)**

a. **Underwater hull** shall be a MSC-approved ablative anti-fouling system, per Appendix A.

- b. **Boottopping** shall be a MSC-approved ablative anti-foulant, black (refer to Appendix A).
- c. **Hull (deep load line to railing)** to be painted gloss Black (Fed Std Color 17038)
- d. **Stacks (below color bands)** to be painted Haze Gray (Fed Std Color 26270).
- e. **Cargo-handling valves** shall be color-coded per cargo system (using red, blue, green, tan, and orange alkyd paints, per Appendix I).
- f. To be painted Soft White (Fed Std Color 27780):
  - Superstructure
  - Deckhouses, msthouses
  - Other exterior vertical surfaces, etc.
  - Aprons (above railing level)
  - Railings
  - Masts, booms, kingposts
  - Expansion trunks
  - Valve stands
  - Lifeboats, davits
- g. To be painted Dark Gray (MSC #35 or Fed Std Color 26081):
  - Decks
  - Catwalks
  - Manifolds (except valve wheels to be color coded)
- h. To be painted White (MSC #33 or Fed Std Color 27886):
  - Deck tripping hazards
  - Draft marks
- i. To be painted gloss Black (MSC #48a or Fed Std Color 17038):
  - Winches, windless
  - Anchors, chains
  - Bits, chocks, rollers
  - Door dogs

## CHAPTER 8: INTERIOR SPACES AND COLOR SCHEMES

### 8.1 Introduction

- a. This chapter addresses paint and color schemes for those spaces not called out in Chapter 6.
- b. Where certain MSC ships are maintained by contracted commercial operators, the paint and coating provisions of that contract shall supercede the requirements of this chapter wherever a conflict of instructions occurs.
- c. In general, the interior areas aboard ship fall into two categories: work spaces (such as offices, workshops, duty stations, etc.), and living spaces (such as quarters, lounges, recreational areas, etc.).
- d. COMSCINST 9330.6 provides directions on outfitting interior spaces with respect to deck tiles, carpets, bulkhead and joiner colors, and furnishings. This chapter is intended to supplement that instruction.

### 8.2 Work Spaces

All work areas shall be painted in accordance with the color schemes of Appendix C.

### 8.3 Living Spaces

These areas shall be painted in accordance with the color schemes of Appendix C. However, in those spaces generally used for relaxation and recreation by the crew, the pastel colors (MSC #3, #7, #8, #9, #15, #21, and #28) may be coordinated with the overall decor of the space.

## CHAPTER 9: DOCUMENTATION

### 9.1 Introduction

This chapter addresses proper documentation and recordkeeping necessary to monitor and plan for effective paint maintenance of MSC ships. It is imperative that the Area Commanders maintain these records; Port Engineers shall specify that they are revised by the contractor whenever any paint or coating work is done.

### 9.2 Surface Area Schedule

a. For each ship there should be developed a "Surface Area Schedule," which should list the painted surface areas of all major shipboard areas:

Underwater hull (including all appendages)  
Boottopping  
Topside hull  
Each coated tank (potable water, ballast, cargo, etc.)

b. This Schedule should be in booklet format (8-1/2" by 11"), with an assigned drawing number. The Area Commanders may develop their own standard format and have contractors actually complete the schedule as each ship comes up for overhaul.

c. The purpose of this Schedule is to provide accurate information for making material and labor cost estimates.

### 9.3 Paint Schedule

a. For each ship there should be developed a "Paint Schedule," which records all paint applied to the major surface areas (listed above in Section 9.2) by shipyards. This Schedule should be organized in such a manner that it can be easily revised, and will present a paint history of each ship.

b. For all areas, the Schedule should record surface preparation, primers, and each overcoat. Colors, types, DFT millages, application method, company also should be recorded.

c. This Schedule should be in booklet format (8-1/2" by 11") with an assigned drawing number, an regularly revised whenever any major paintwork is done. Area Commanders may develop their own standard format and have contractors actually complete or revise the schedule as each ship comes up for overhaul.

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d. It should be noted that the typical "Paint Report" submitted by shipyards or other contractors does not necessarily provide all the information listed above. Area Commanders are directed to ensure that accurate records and revisions to the Paint Schedule are made whenever any of the critical areas are painted.

e. The purpose of this Schedule is to provide performance records for various paint brands, and for planning future paint work.

## CHAPTER 10: COST ESTIMATING

### 10.1 Introduction

a. This chapter presents methods for accurately preparing material and labor cost estimates for major paintwork. The estimating factors for labor also include supporting crew (pot tenders, hose handlers, sand vacuuming, etc.).

b. When performing estimates, remember that each square foot will usually be painted with several coats (primer, plus each overcoat).

c. The paint coverage per square foot can vary from paint to paint; the factors below are only typical estimates:

Primer, regular:	360 sq ft/gal
Primer, epoxy:	185 sq ft/gal
Inorganic zinc:	370 sq ft/gal
Alkyds; enamels:	300 sq ft/gal
Epoxy, regular:	65 sq ft/gal
Epoxy, high build:	320 sq ft/gal
Anti-foulant, convt'l:	300 sq ft/gal
Anti-foulant, ablative:	150 sq ft/gal

d. When the coating's Product Data Sheet is available, the theoretical coverage can be calculated as follows:

$$\text{Sq ft per gallon} = 12 \times (\% \text{Solids}) / (\text{mils DFT per coat})$$

*(where %Solids = percentage paint solids by volume)*

Example: a high-build epoxy contains 56% solids by volume. Therefore, a 4-mil DFT coat will cover approximately 168 sq ft/gallon.

### 10.2 Spotblasting and Touch-up

- a. Estimate tons of grit, at 15 lbs per sq. foot
  - " gallons of primer
  - " gallons of overcoat(s)
  - " labor, at 1.8 man-hrs per ton of grit
  - " labor, at 1.0 man-hrs per gallon of paint
  
- b. Calculate cost of paint (primer and overcoats)
  - " cost of grit
  - " cost of labor

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**10.3 Abrasiveblasting Hull, Topsides, and Decks**

- a. Estimate tons of grit, at 10 lbs per sq. foot  
" labor, at 1.2 man-hrs per ton of grit
- b. Calculate cost of grit  
" cost of labor

**10.4 Abrasiveblasting Cargo Holds, Tanks**

- a. Estimate tons of grit, at 20 lbs per sq. foot  
" labor, at 4.3 man-hrs per ton
- b. Calculate cost of grit  
" cost of labor

**10.5 Spray-painting Hull (underwater and freeboard)**

- a. Estimate gallons of primer  
" gallons of overcoat(s)  
" gallons of anti-fouling  
" labor, at 0.8 man-hrs per gallon
- b. Calculate cost of paint  
" cost of labor

**10.6 Spray-painting Topsides (decks, deckhouses)**

- a. Estimate gallons of primer  
" gallons of overcoat(s)  
" labor, at 1.0 man-hrs per gallon
- b. Calculate cost of paint  
" cost of labor

**10.7 Spray-painting Holds, Tanks**

- a. Estimate gallons of primer  
" gallons of overcoat(s)  
" labor, at 1.5 man-hrs per gallon
- b. Calculate cost of paint  
" cost of labor

**10.8 Adjustments**

- a. Add 33% of paint gallons to cover for spray loss.
- b. Add 15% of material cost to cover additional miscellaneous materials (thinners, paintbrushes, consumables, etc.).
- c. Add 10% of labor to cover additional labor (general set-up, clean-up, etc.).
- d. Add 25% of labor time for minor staging, 50% of labor time for major staging.

## APPENDIX A

### UNDERWATER HULL COATING SYSTEMS

#### **A.1 General Notes**

- a. Only the coating systems listed below are approved for use on MSC vessels. Converting a hull from a conventional to an ablative anti-fouling system requires prior TRANSALT approval from COMSC (Code N7).
- b. Refer to Chapter 6 for additional discussion on underwater hulls.
- c. Coatings are given in mils DFT. Each overcoat shall be a different color from its undercoat (to ensure good contrast during application).
- d. As the result of a Congressional directive, Department of Defense (including MSC) is prohibited from applying any coating which contains organotin ingredients. For this reason, many of the anti-fouling coatings previously approved for MSC use are disqualified under this directive; they may be reinstated at a future date if the prohibition is lifted.

#### **A.2 Boottopping**

The boottopping shall be given the same anti-corrosive system as the rest of the underwater hull, but shall be topcoated with black anti-fouling paint (of same type and total millage as the AF coats).

#### **A.3 High-turbulence Areas**

Areas on the underwater hull subject to high turbulence (such as seachests, rudders, Kort nozzles, etc.) may be coated with an abrasion-resistant epoxy system listed below:

**Ameron:** AMERLOCK 400 Glassflake (12 mils DFT)

**Hempel Marine:** HEMPADUR 3555 (30 mils DFT)

**Devco:** DEVGUARD 238 (10 mils DFT)

**Internat'l Paint:** INTERSHIELD EPA491/489 (25 mils DFT)

#### **A.4 Conventional Underwater Hull Systems (Tin-free)**

**Ameron:** AMERCOAT 83 epoxy (1 coat at 4 mils)  
AMERCOAT 84 epoxy (1 coat at 4 mils)  
AMERCOAT 275E/277E vinyl copper AF (2 coats at 2 mils ea)

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or AMERCOAT 385 epoxy (2 coats at 4 mils ea)  
AMERCOAT 275E/277E vinyl copper AF (2 coats at 2 mils ea)

**Devoe Marine:** DEVRAN 201 primer (1 coat at 3 mils)  
DEVRAN 230 hi-build epoxy AC (1 coat at 6 mils)  
DEVRAN 223 convent'l AF (2 coats at 4 mils ea)

(Note: For temperatures below 40 degrees F, the FCA231 reactor may be substituted for FPA327 and the KHA 414 reactor may be substituted for KHA062)

#### **A.5 Ablative Underwater Hull Systems (30-month)**

**Ameron:** AMERCOAT 83 epoxy (1 coat at 4 mils)  
AMERCOAT 84 epoxy (1 coat at 4 mils)  
AMERCOAT 70ESP ablative copper AF (2 coats at 3 mils ea)

or AMERCOAT 385 epoxy (2 coats at 4 mils ea)  
AMERCOAT 70ESP ablative copper AF (2 coats at 3 mils ea)

**Devoe Marine:** DEVRAN 201 primer (1 coat at 3 mils)  
DEVRAN 230 hi-build epoxy AC (1 coat at 6 mils)  
DEVOE ABC-3 tin-free ablative AF (2 coats at 4 mils ea)

(Note: For temperatures below 40 degrees F, DEVRAN 234QC may be substituted for DEVRAN 230)

or BARRUST 235 hi-build epoxy AC (2 coats at 5 mils ea)  
DEVOE ABC-3 tin-free ablative AF (2 coats at 4 mils ea)

**Hempel Marine:** HEMPADUR 4563 hi-build epoxy (2 coats at 5 mils ea)  
HEMPEL 7660 tin-free AF (2 coats at 4 mils ea)

**Internat'l Paint:** INTERGARD FP series/FPA327 epoxy (2 coats at 4 mils)  
INTERCLENNE BRA 540 tin-free AF (2 coats at 4 mils ea)

or INTERTUF KH series/KHA062 epoxy (2 coats at 4 mils)  
INTERCLENNE BRA 540 tin-free AF (2 coats at 4 mils ea)

(Note: For temperatures below 40 degrees F, the FCA231 reactor may be substituted for FPA327 and the KHA 414 reactor may be substituted for KHA062)

## APPENDIX B

### HULL AND TOPSIDES COATING SYSTEMS (Weather-exposed surfaces above Deep Load Line)

#### **B.1 General Notes**

(R)

a. Only the coating systems listed below are approved for use on the hulls and topsides of MSC vessels. The urethane system is to be used from the date of this change forward. The rest of the coatings listed are vinyls and may be used for touchup work. When a vessel requires a complete recoat or is restricted by state regulations from using vinyl paints during yard periods, the urethane system shall be used. Additional urethanes shall be added to the list upon their approval. The colors are addressed in Chapters 6 and 7.

b. The coating systems below are high-performance systems. Once applied, the epoxy AC should have a service life of 6 to 8 years. During that time, the topcoat should be washed (with a high pressure freshwater nozzle and water-based detergent) every 12 months during each annual overhaul period. Urethane paints are two component paints that require light sanding prior to touchup, and are more sensitive than vinyls to environmental conditions during application. Follow the application instructions provided with the product.

c. Damaged areas can be prepared according to product application instructions and touched up using any compatible primers, epoxies and topcoats listed.

(1) Inorganic zinc primers will only adhere to an abrasive blasted steel surface. The application of inorganic zinc to small, locally-damaged areas is beyond the capability of shipboard equipment. Mechanical grinding is not effective because it polishes the steel rather than leaving the rough surface profile necessary for inorganic zinc adhesion. As a result, the old paint system shall be wire-brushed (or disc-sanded) down to the next intact layer. If the underlying intact layer is inorganic zinc, it shall be overcoated with surface-tolerant epoxy and appropriate topcoat. If the underlying intact layer is the epoxy coat, it shall be topcoated. Care shall be taken to properly roughen and feather edges of the intact paint in order to promote good adhesion of the new coats.

(2) For larger areas requiring industrial assistance, the damaged area shall be spot-blasted down to bare steel and the full, three coat system reapplied.

(3) Ship's force is not to apply inorganic zinc. This material should only be ordered through the paint supply contract for use by industrial contractors.

d. Coatings are given in mils DFT. Each overcoat shall be a different color from its undercoat (to ensure good contrast during application).

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e. The basic system consists of an inorganic zinc primer, epoxy AC, and final topcoat (1 coat each).

### **B.2 Approved Systems**

	<u>Inorganic Zinc (2-3 mils DFT)</u>	<u>Epoxy AC (5 mils DFT)</u>	<u>Topcoat (2-3 mils DFT)</u>
<b>Ameron:</b>	Dimetcote D9FT	Amercoat 350FD	Amercoat 234
<b>Ameron:</b>	Dimetcote D9FT	Amercoat 385	Amershield (urethane)
<b>Carboline:</b>	Carbozinc 11	Carboline 190HB	Carboline 1294
<b>Chugoku Marine:</b>	8-2 Primer	Epicon HB-CL	Ravax Topside
<b>Devoe Marine:</b>	Catha-coat 302	Devran 230	Devran 229
<b>Hempel Marine:</b>	Galvosil 1562	Hempadur 4523	Hempatex 5636
<b>Internat'l Paint:</b>	Interzinc QHA027	FP or KH series	VF or FZ series
<b>Jotun Valspar:</b>	13-F-12	65 series	22 or 29 series

\*Or Galvosil 1578

**APPENDIX C**

**INTERIOR COLOR CODES**

This appendix addresses color schemes for interior shipboard spaces not specifically covered in Chapters 7 and 8. Refer to Appendix I for the MSC color codes.

<u>Space</u>	<u>Bulkheads</u>	<u>Overheads</u>	<u>Decks</u>
Ammunition spaces	White, 26	White, 26	White,33
Barber shop	White, 26	White, 26	Dark Gray, 35
Baths, hospital	White, 17	White, 17	Dark Gray, 35
Charthouse	Green, 7	Green, 7	Dark Gray, 35
Clipping rooms	White, 26	White, 26	Dark Gray, 35
Control rooms, helo	White, 26	White, 26	Dark Gray, 35
Galleys	White, 16	White, 16	Dark Gray, 35
Gun mount enclosures	White, 26	White, 26	Dark Gray, 35
Gyro rooms	Green, 7	White, 26	Dark Gray, 35
Hangers, helo	White, 26	White, 26	Dark Gray, 35
Laundry	White, 17	White, 17	Dark Gray, 35
Machinery spaces	White, 26	White, 26	Terracotta, 36
Medical/dental areas*	Green, 7	Green, 7	Dark Gray, 35
Offices, general	Green, 7	White, 26	Dark Gray, 35
Offices, helo	White, 26	White 26	Dark Gray, 35
Pantries	White, 16	White, 16	Dark Gray, 35
Passageways	White, 26	White, 26	Dark Gray, 35
Pilothouse	Green, 7	Green, 7	Dark Gray, 35
Quarters/Mess rooms:			
Officer, CPO	Green, 7	White, 26	Dark green, 37
Crew	White, 26	White, 26	Dark green, 35
Radio room	Green, 7	White, 26	Dark green, 37
Recreation rooms	Green, 7	White, 26	Dark Gray, 35
Sculleries	White, 17	White, 17	Dark Gray, 35
Shops	White, 26	White 26	Terracotta, 36
Staterooms, cabins	Green, 7	White, 26	Dark green, 37
Store/issue rooms	White, 26	White, 26	Dark Gray, 35
TACAN room, helo	White, 26	White, 26	Dark Gray, 35
Troop berth/messing	White, 26	White, 26	Dark Gray, 35
Washrooms, T/S areas	White, 17	White, 17	Dark Gray, 35
Workshops, helo	White, 26	White, 26	Dark Gray, 35

\*except offices

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### **Special Compartments:**

Battery Shop:

bulkheads to be acid-resisting White, 63  
overheads to be acid-resisting White, 63  
decks to be acid-resisting White, 63, tinted Dark Gray, 35

Darkrooms:

bulkheads to be acid-resisting White, 63, tinted Equipment Gray, 28  
overheads to be acid-resisting White, 63, tinted Equipment Gray, 28  
decks to be acid-resisting White, 63, tinted Equipment Gray, 35

Reefer Gratings, wooden: Spar varnish, 59

Gratings, aluminum: uncoated

Light locks, light traps: flat Black, 50

Reefers: Orange shellac, 60, or Diamond Kote, 66

### **NOTES:**

1. Variations in colors and materials for decks, bulkheads, overheads, and furnishings are addressed in COMSCINST 9330.6, and the colors for habitability spaces may be selected to match the general decor, using MSC colors #3, #7, #8, #9, #15, #21, and #28.
2. Decks covered with magnesite, tile, quarry tile, or other similar materials shall be maintained in accordance with NAVSHIPS Technical Manual, Chapter 634. If the detergent P-D-22 (NSN 7930-00-249-8036) is found to be unsatisfactory, authorization is granted to use commercial detergent Diasyn No. 7, or its equivalent.
3. Wherever deck paint is used, a 6" dado (mopping band) should be carried up the adjacent bulkheads.

## APPENDIX D

### CARGO PETROLEUM TANK COATING SYSTEMS

#### D.1 General Notes

- a. The coatings used for cargo petroleum tanks are critical for preserving the quality of the cargo; therefore, only those systems listed below shall be used for this service.
- b. Prior to beginning general spray painting, all edges, corners, and other difficult-to-reach places shall first be given stripe coats by brush or roller.
- c. Coats are given as mils DFT. Each overcoat shall be a different color from its undercoat (to ensure good contrast during application).

#### D.2 Approved Systems

**Ameron:** AMERCOAT 81 epoxy (1 coat at 4 mils)  
AMERCOAT 82 epoxy (1 coat at 4 mils)

or AMERCOAT 395 epoxy (2 coats at 4 mils ea)

or AMERCOAT 395FD epoxy (2 coats at 4 mils ea)

or AMERCOAT 400WG epoxy (2 coats at 4 mils ea)

or AMERCOAT 346 epoxy (2 coats at 4 mils ea)

or AMERCOAT 351 epoxy (2 coats at 4 mils ea)

**Chugoku:** EPICON T-500 PRIMER R (1 coat at 5 mils)  
EPICON T-500 FINISH B (1 coat at 5 mils)

or EPICON T-500 PRIMER R (1 coat at 4 mils)  
EPICON T-500 UNDERCOAT (1 coat at 4 mils)  
EPICON T-500 FINISH A (1 coat at 3 mils)

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**Devoe Marine:** DEVRAN 202A primer (1 coat at 2 mils)  
DEVRAN 215 topcoat (1 coat at 6 mils)

or DEVRAN 244HS epoxy (2 coats at 4 mils ea)

or DEVCHEM 252 epoxy (3 coats at 3-4 mils ea)

or BAR RUST 245 epoxy (1 coat at 4 mils)  
DEVRAN 244HS epoxy (1 coat at 4 mils)

or BAR RUST 236 epoxy (2 coats at 5 mils ea)

**Hempel Marine:** HEMPADUR 1540 epoxy (2 coats at 4 mils ea)

or HEMPADUR 3544 epoxy (2 coats at 4 mils ea)

**Internat'l Paint:** INTERGARD TB series/TBA327 epoxy (2 coats at 4 mils ea)

**Jotun Valspar:** SOVAPON 264 epoxy (2 coats at 4 mils ea)

**Seaguard:** HULLGUARD #1 epoxy primer (1 coat at 4 mils)  
HULLGUARD #3 epoxy (1 coat at 4 mils)

## APPENDIX E

### POTABLE WATER, CARGO WATER TANK COATING SYSTEMS

#### E.1 General Notes

a. In addition to the system listed below, any other system approved for potable water service by Naval Sea Systems Command (NAVSEA) may be used, including QPL-approved manufacturers of MIL-P-14441 Formulas 150, 152, and 156.

b. These coatings can significantly affect taste and odor qualities of ship's potable water. Accordingly, it is imperative that the manufacturer's directions for applying and curing the coatings be stringently followed. This particularly includes nozzles tip sizes, wet film thickness, temperatures and other curing parameters.

c. Prior to beginning general spray painting, all edges, corners, and other places difficult to properly spray shall be given stripe coats by brush or roller.

d. All coats shall be cured no less than 48 hours (at 70 degrees F minimum) between coats, and the final coat shall be cured no less than 7 days (at 70 degrees F minimum) prior to flushing and chlorination. Forced ventilation shall be maintained during curing periods, and heaters shall be set up when necessary to maintain the minimum temperatures.

#### E.2 Approved Systems

**Devoe Marine:** DEVRAN 207 epoxy (3 coats at 2 mils ea)

**Internat'l Paint:** INTERGARD EXA471/473 epoxy (1 coat at 4 mils)  
INTERGARD EXA472/473 epoxy (1 coat at 4 mils)

**Jotun Valspar:** SOVAPON 264 epoxy (2 coats at 4 mils ea)

**Seaguard Corp:** HULLGUARD NO. 1 epoxy (1 coat at 3 mils)  
HULLGUARD NO. 9 epoxy (2 coats at 3 mils ea)

## APPENDIX F

### FEEDWATER, FRESHWATER BALLAST TANK COATING SYSTEMS

#### **F.1 General Notes**

- a. All coatings approved for potable water tank service (Appendix E) are also approved for feedwater and freshwater ballast tank service.
- b. Prior to beginning general spray painting, all edges, corners, and other places difficult to properly spray shall be given stripe coats by brush or roller.
- c. Coats are given as mils DFT. Each overcoat shall be a different color from its undercoat (to ensure good contrast during application).

#### **F.2 Approved Systems (in addition to Appendix E)**

**Ameron:** AMERCOAT 395 series epoxy (2 coats at 4 mils ea)

or AMERCOAT 81 epoxy (1 coat at 4 mils)  
AMERCOAT 82 epoxy (1 coat at 4 mils)

**Carboline:** CARBOLINE 1970 epoxy primer (1 coat at 4 mils)  
CARBOLINE 1971 epoxy (1 coat at 4 mils)

**Devoe Marine:** DEVRAN 244HS series epoxy (2 coats at 4 mils ea)

or BARRUST 235 epoxy (2 coats at 4 mils ea)

or BARRUST 236 epoxy (2 coats at 4 mils ea)

**Hempel Marine:** HEMPADUR 1540 series epoxy (2 coats at 4 mils ea)

or HEMPADUR 3544 epoxy (2 coats at 4 mils ea)

**Internat'l Paint:** INTERGARD TB series/TBA327 epoxy (2 coats at 4 mils)

or INTERTUF KH series/KHA062 epoxy (2 coats at 4 mils)

**Jotun Valspar:** FARBOIL 51E series epoxy (2 coats at 4 mils ea)

## APPENDIX G

### SALTWATER BALLAST, SANITATION TANK COATING SYSTEMS

#### G.1 General Notes

- a. All coatings approved for cargo petroleum tank service (Appendix D) are also approved for saltwater ballast/sanitation tank service.
- b. Prior to beginning general spray painting, all edges, corners, and other places difficult to properly spray shall be given stripe coats by brush or roller.
- c. Coats are given in mils DFT. Each overcoat shall be a different color from its undercoat (to ensure good contrast during application).

#### G.2 Approved Systems (in addition to Appendix D)

- Ameron:** AMERCOAT 350FD epoxy (2 coats at 4 mils ea)  
or AMERCOAT 385 epoxy (2 coats at 4 mils ea)
- Carboline:** CARBOLINE 1970 epoxy primer (1 coat at 4 mils)  
CARBOLINE 1971 epoxy (1 coat at 4 mils)
- Devoe Marine:** BAR RUST 235 epoxy (2 coats at 5 mils ea)
- Internat'l Paint:** INTERGARD EXA471/EXA473 epoxy (1 coat at 5 mils)  
INTEGARD EXA472/EXA473 epoxy (1 coat at 5 mils)  
or INTERTUF KH series/KHA062 epoxy (2 coats at 4 mils)
- Jotun Valspar:** FARBOIL 99PR epoxy primer (1 coat at 4 mils)  
FARBOIL 99E epoxy (1 coat at 4 mils)

## APPENDIX H

### VOIDS, COFFERDAMS, and MISCELLANEOUS AREA COATING SYSTEMS

#### H.1 Ordinary Usage

Where these spaces can be properly prepared, they may be coated with any of the inorganic zinc paints listed in Appendix B.

#### H.2 Compromised Surfaces

Where it is not possible to prepare the steel surface properly for an inorganic zinc coating, then any of the systems listed below can be applied onto a "compromised surface" if it has been mechanically cleaned, degreased, and all loose rust and scale has been removed:

**Ameron:** AMERLOCK 400 (2 coats at 6 mils ea)

**Carboline:** CARBOMASTIC 15 (2 coats at 6 mils ea)

**Chugoku:** SUPER BONDEX (2 coats at 6 mils ea)

**Devoe Marine:** BAR-RUST 235 (2 coats at 8 mils ea)

**Hempel:** HEMPADUR 4515 (2 coats at 8 mils ea)

**Internat'l Paint:** INTERTUF KH series/KHA062 epoxy (2 coats at 4 mils)

**Jotun Valspar:** 75 series epoxy mastic (2 coats at 6 mils ea)

#### H.3 Inaccessible Voids

Small, inaccessible voids may be coated with any corrosion preventive compound conforming to MIL-C-16173 or MIL-C-11796.

**APPENDIX I**

**MSC COLOR CODES**

a. These are the COMSC-approved colors and paint types called out in this instruction. These are the only paints to be used aboard MSC ships, unless otherwise directed in Appendices A through H.

b. In general, the color codes listed below conform as much as possible to the U.S. Navy General Specifications (“Gen Specs”).

c. Any commercial brand of paint which meets the military or government specification may be used, or the paint may be ordered through the national stock supply system (the National Stock Numbers listed below are taken from the “**Afloat Shopping Guide**” (NAVSUP Publication 4400), prepared by Navy Fleet Material Support Office).

<b>MSC No.</b>	<b>Color</b>	<b>Federal Standard Color</b>	<b>Type</b>	<b>Military or Gov’t Spec</b>	<b>National Stock No. (8010-00-</b>
3	Beach Sand	22563	Tint (see Note 1)	DOD-C-22325	577-4929
4	Red	11105	Alkyd, gloss	TT-E-489	616-7489
7	Pastel Green, 125	24585	Chlor, alkyd	DOD-E-24607	577-4735
8	Rosewood	22519	Tint (see Note 1)	DOD-C-22325	577-4928
9	Clipper Blue	24516	Tint (see Note 1)	DOD-C-22325	577-4933
15	Sunglow	23697	Tint (see Note 1)	DOD-C-22325	577-4932
16	White	17875	Alkyd, gloss	TT-E-489	286-9088
17	White	27886	Epoxy, semi-gloss	MIL-P-24441	421-2435
21	Pastel Blue	25526	Tint (see Note 1)	DOD-C-22325	899-0686
26	Soft White, 124	27780	Chlor, alkyd	DOD-E-24607	577-4739
28	Equip Gray, 126	26307	Chlor, alkyd	DOD-E-24607	577-4737
32	Pretreatment, 117	33481	Wash primer	MIL-P-15328	(Note 2)
33	White	27886	Silicone alkyd	TT-E-490	145-0165
35	Dark Gray, 20	26008	Alkyd, semi-gloss	MIL-E-699	286-9083
36	Terracotta, 23	20109	Alkyd, semi-gloss	MIL-E-18210	292-1813
37	Dark Green, 19	34092	Alkyd, flat	MIL-E-18214	286-3986
42	Black, glossy	17038	Per Appendix B	commercial brand	
44	Soft White	27780	Per Appendix B	commercial brand	
45	Haze Gray	26270	Silicone alkyd	TT-E-490	917-2256
46	Blue	15123	Alkyd, gloss	TT-E-489	853-1859
47	Yellow	13538	Alkyd, gloss	TT-E-489	616-7488
48	Black, 24	27038	Alkyd, semi-gloss	MIL-E-698	285-4896
48a	Black	17038	Alkyd, gloss	TT-E-489	527-2050
50	Flat Black, 104	37038	Alkyd, flat	MIL-P-15146	286-8294
51	Primer, 84	33481	Zinc chromate	TT-P-645	165-8557
54	Heat-resistant		Aluminum	TT-P-28	815-2692

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MSC No.	Color	Federal Standard Color	Type	Military or Gov't Spec	National Stock No. (8010-00-)
55	Int'l Orange	12197	Alkyd, gloss	TT-E-489	527-3200
57	Zinc dust, 102		Navy Formula 102	MIL-E-15145	290-6645
59	Spar varnish, 80		Phenolic resin	TT-V-119	251-6980
60	Shellac		Orange	TT-S-300	161-7278
62	Wood preservative		Copper Napthenate	MIL-W-18142	(Note 3)
63	Acid-resist White			MIL-P-24441	(Notes 4, 5)
64	Green	14062	Alkyd, gloss	TT-E-489	298-2296
66	Diamond Kote 554		Tnemec Co.		(see Note 4)
70	Purple	17142	Alkyd, gloss	TT-E-489	530-5559
72	Dark Gray, 155		Epoxy, semi-gloss	MIL-P-24441	410-8467
74	Non-skid deck				(see Note 6)
76	Orange	12246	Alkyd, gloss	TT-E-489	527-3201
78	Tan	10324	Alkyd, gloss	TT-E-489	040-3759

NOTES:

1. These tints come packaged in 1/2-pint cans. The desired color is achieved by mixing one can per gallon of Soft White (MSC #26).
2. National stock number for this item: 8030-00-165-8577
3. National stock number for this item, 1-gal can: 8030-00-282-0970  
5-gal can: 8030-00-281-2717
4. Any commercial brand suitable for marine use
5. Can be tinted as necessary
6. Commercial brands using mineral grit only, equivalent in color to Dark Gray (MSC #35); or "non-slip flight deck compound" (NSN 5610-01-078-9283), Dark Gray, applied by roller or towel, supplied in 5-gal pails.