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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) Basic guidance is presented for the design of shipyard maintenance facilities covered by Category Group 213. The contents include general design criteria and instruction for obtaining specific criteria for the shop structure to be designed.		

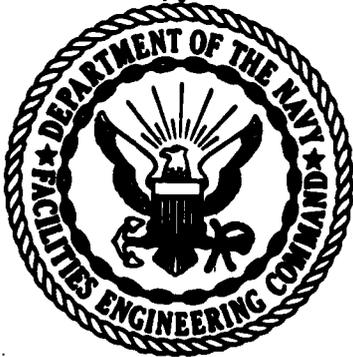
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SHIPYARD MAINTENANCE FACILITIES

DESIGN MANUAL 28.2

APPROVED FOR PUBLIC RELEASE

DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND

200 STOVALL STREET
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FOREWORD

This design manual is one of a series developed from an evaluation of facilities in the shore establishment, from surveys of the availability of new materials and construction methods, and from selection of the best design practices of the Naval Facilities Engineering Command, other Government agencies, and the private sector. This manual uses to the maximum extent feasible, national professional society, association, and institute standards in accordance with NAVFACENGCOM policy. Deviations from these criteria should not be made without prior approval of NAVFACENGCOM Headquarters (Code 04).

Design cannot remain static any more than can the naval functions it serves or the technologies it uses. Accordingly, recommendations for improvement are encouraged from within the Navy and from the private sector and should be furnished to NAVFACENGCOM Headquarters (Code 04). As the design manuals are revised, they are being restructured. A chapter or a combination of chapters will be issued as a separate design manual for ready reference to specific criteria.

This publication is certified as an official publication of the Naval Facilities Engineering Command and has been reviewed and approved in accordance with SECNAVINST 5600.16.



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MAINTENANCE FACILITIES DESIGN MANUALS

<u>DM No.</u>	<u>Superseded Chapters in Basic DM-28</u>	<u>Title</u>
28.1	1	Aircraft Maintenance Facilities
28.2	2 & 5	Shipyards Maintenance Facilities
28.3	3	Maintenance Facilities for Ammunition, Explosives, and Toxics
28.4	4	General Maintenance Facilities
28.5	6	Environmental Control - Design of Clean Rooms
28.6	-	Aircraft Fixed Point Utility Systems

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SHIPYARD MAINTENANCE FACILITIES

Section 1. INTRODUCTION

1. **SCOPE.** This manual contains criteria for the design of shipyard maintenance shop structures at all naval shore activities. The criteria are intended to serve as a guide for economical and appropriate design of facilities for orderly, efficient industrial operations required for repair, overhaul, and modernization of naval ships and service craft.
2. **CANCELLATION.** This manual on shipyard maintenance facilities, NAVFAC DM-28.2, cancels and supersedes Chapters 2 and 5, NAVFAC DM-28, Maintenance Facilities of December 1974, Change 1 of January 1975, Change 2 of October 1975, and Change 3 of June 1976.
3. **RELATED CRITERIA.**
 - a. Other NAVFAC Design Manuals. For criteria related to shipyard maintenance facilities, but appearing elsewhere in the Design Manual series, see page Reference-1.
 - b. Planning Criteria. Planning criteria for shipyard maintenance facilities covered by this manual are contained in Facility Planning Factor Criteria for Navy and Marine Corps Shore Installations, NAVFAC P-80, Volume I, where each facility is listed in the numerical sequence by the Navy category code number assigned to that facility.
4. **POLICY.** Before the design of a Naval-Shipyard maintenance facility is begun, the Naval Sea Systems Command (NAVSEA) will decide if an Advanced Industrial Engineering Study (AIES), to be performed by a qualified engineering firm is necessary and, if so, will authorize such a study. The basic input for the performance of the study is provided by a computer program developed by NAVSEA. That program, known as the Industrial Planning Systems (IPS) yields the gross facility, equipment, and manpower requirements needed to accomplish a given workload. The purpose of the AIES is to analyze the computer outputs and, applying sound industrial engineering practice, develop the final equipment selections and the optimum shop layout for efficient operations. This engineering study will be made available to the Naval Facilities Engineering Command (NAVFAC) as strict design criteria. Contact NAVSEA Headquarters and NAVFAC Headquarters for specific design criteria.

Section 2. GENERAL DESIGN CRITERIA

1. **ENERGY CONSERVATION.** Energy conservation shall be a major consideration in the design of building envelopes, mechanical systems, and electrical systems for shipyard maintenance facilities. (See Heating, Ventilating, Air Conditioning and Dehumidifying Systems, NAVFAC DM-3.3 and Energy Budgets for New Facilities, NAVFAC INST 4101.1). Each building envelope shall be insulated to provide the minimum heat transmission ("U") factors practical to meet Energy Budgets.

2. **BUILDING PROTECTION.** The building structure of all shipyard maintenance facilities, including corners, doors, structural members, etc., shall be protected from damage by vehicles and moving loads by the installation of concrete filled pipe guards, bumpers, railings, corner guards, and similar protective features.

3. **FIRE PROTECTION.** Fire protection for all shipyard maintenance facilities including considerations for building construction, life safety, hazardous conditions, extinguishing systems, and fire detection and alarm, shall be provided in accordance with Fire Protection Engineering, NAVFAC DM-8 as applicable to the specific building.

4. **SAFETY.** Designs of facilities shall meet all requirements of the Occupational Safety and Health Act Standards Manual. Adequate space shall be provided around machines and equipment for safe operation.

5. **ARCHITECTURAL REQUIREMENTS.** Standard construction, materials, and finishes shall be in accordance with Architecture, NAVFAC DM-1. The following requirements shall be given particular consideration:

a. **Storage.** Adequate in-process storage shall be provided throughout shops where fabrication work is performed and adequate storage for materials, tools, and equipment shall be provided in accordance with the Industrial Planning Systems (IPS) program.

b. **Acoustics.** See acoustical criteria in NAVFAC DM-1, Section 4 and noise and vibration control criteria in Mechanical Engineering, NAVFAC DM-3, Chapter 15.

(1) Administration areas, shop foremen offices, lunchrooms, etc., shall be located and designed to provide acoustical isolation from noisy shop areas.

(2) Acoustical control measures shall be utilized to minimize noise buildup and reverberation throughout large shop areas.

c. **Enclosed Areas.** Grinding and sawing operations, when practical, shall be located in enclosed areas provided with dust exhaust systems and sound absorbing materials. Vision panels shall be provided in doors to enclosed areas for monitoring the safety of operators.

d. Toilets. Toilet, shower, eyewash, and change facilities shall be provided as applicable for both male and female personnel.

e. Loading Dock Ramp Protection. Each facility requiring a loading dock ramp shall be provided side edge protection in accordance with Section 1910.23c, OSHA Standards.

6. STRUCTURAL REQUIREMENTS. Structural design shall be in accordance with Structural Engineering, NAVFAC DM-2 Series, with particular attention to floor loading in industrial areas; Seismic Design for Buildings, NAVFAC P-355; and Structures to Resist the Effects of Accidental Explosions, NAVFAC P-397.

7. MECHANICAL REQUIREMENTS. Mechanical design shall be in accordance with NAVFAC DM-3 Series with particular attention to the following:

a. Compressed Air.

(1) Compressed air at 100 psi generally should be provided for most facilities. When compressed air is required, provide adequate outlets at work benches and other work areas.

(2) Where compressed air is required for breathing purposes, provide outlets at work benches and other work areas in accordance with OSHA Standards, Subpart I - Personal Protective Equipment.

(3) Consider the requirements of the facility to determine if a separate air compressor should be provided rather than utilizing a central air supply. A separate air compressor would assure that an adequate quantity of compressed air is available, especially for facilities such as an abrasive blast facility. Separate air compressors may also provide lower operating and distribution costs.

(4) Compressed air supplies must be clean and dry. The design of compressed air systems shall utilize adequate filters and dryers.

b. Ventilation.

(1) Exhaust systems for fume removal shall be provided for all areas where toxic materials are handled and welding operations occur in accordance with OSHA standards and the recommended practice contained in Industrial Ventilation, A Manual of Recommended Practice.

(2) Dust collection systems shall be provided for grinding and sawing operations in accordance with OSHA and Industrial Ventilation requirements. Dust collection systems for woodworking facilities shall be carefully designed to prevent problems of clogged hoppers. Consider running exhaust ductwork under floor slabs, in large open areas such as woodworking shops, to minimize overhead interferences.

(3) Air handling and exhaust systems for facilities involved with asbestos and electroplating shall be provided in accordance with OSHA and Industrial Ventilation requirements.

c. Environmental Control. Air conditioning with humidity control shall be provided for communication equipment shops, instrument repair areas, calibration laboratories, etc. Air conditioning for other areas shall be provided as required by NAVFAC DM-3.3 and the Department of Defense Construction Criteria Manual, DOD 4270.1-M. In addition to the normal heating requirements for industrial facilities, steam may be required for certain industrial processes. The total heating requirement shall be defined in the initial planning stages.

d. Emergency Showers. Adequate emergency showers and eyewashes shall be provided for all areas where toxic and hazardous chemicals are handled.

e. Clean Rooms. Clean room criteria is included in Environmental Control - Design of Clean Rooms, NAVFAC DM-28.5.

f. Distribution of Utilities. Utility distribution shall normally be a fixed system. Based on facility function, the flexibility provided a two-way underfloor grid system may be required by the user in spite of prohibitive costs. In such an event, if the system is approved for use by NAVFAC Headquarters, the grid will provide flexibility for work station movement and the mechanical utilities shall be loop fed throughout and provided with sufficient isolation valves to allow changeovers with minimal interruption to other work-in-progress.

8. ELECTRICAL REQUIREMENTS. Electrical design shall be in accordance with Electrical Engineering, NAVFAC DM-4 Series with particular attention to the following:

a. Power.

(1) Single-phase, 120-volt, 20-ampere, 60-Hertz convenience outlets shall be provided in all spaces with spacing as required by National Electrical Code, NFPA 70.

(2) For equipment that has sensitive or critical power requirements, provide power supplies separate from equipment such as welders that cause power fluctuations.

b. Lighting.

(1) Consider utilizing high efficiency light sources such as high pressure sodium vapor fixtures in high ceiling areas for energy conservation.

(2) Carefully match the type of lighting and location of fixtures with the type of work to be performed in the shop. (See criteria for interior lighting and emergency exit lighting in NAVFAC DM-4.4.)

c. Electromagnetic Interference. For facilities or shop areas that require electromagnetic interference suppression, see Electromagnetic Radiation Hazards, NAVSEA OP 3565, Volumes I and II.

d. Battery Charging. For facilities that require charging of batteries, see criteria in General Maintenance Facilities, NAVFAC DM-28.4.

e. Distribution of Utilities. Consider an underfloor distribution system as described in Section 2, paragraph 7.f. Sufficient switches shall be provided to conveniently isolate power circuits for changeovers.

9. WEIGHT-HANDLING EQUIPMENT. When bridge cranes, monorail hoists, jib cranes, etc., are required, they shall be in accordance with Chapter 1 of Weight-Handling Equipment and Service Craft, NAVFAC DM-38.

SECTION 3. NUCLEAR POWERED SHIPS

1. DESIGN REQUIREMENTS. In accordance with responsibilities assigned to COMNAVSEA under OPNAVINST C 3000.5C, functional design requirements for Nuclear Support Maintenance Facilities for nuclear powered ships must be submitted to NAVSEA 08 for technical concurrence. See OPNAVINST 11010.20D, Paragraph 3405.

Appendix A
METRIC EQUIVALENTS

METRIC EQUIVALENT CHART

The following metric equivalents are approximate and were developed in accordance with ASTM E 621.

English (psi)

100

Metric (kPa)

700

REFERENCES

DOD Publications

DOD 4270.1-M Department of Defense Construction
Criteria Manual

DOD publications may be obtained from the Department of Defense, The Pentagon, Washington, D.C. 20301.

Industrial Ventilation, A Manual of Recommended Practice, American Conference of Governmental Industrial Hygienists, Committee on Industrial Ventilation, P.O. Box 16153, Lansing, Michigan, 48901.

National Fire Protection Association

NFPA 70 National Electrical Code

NFPA standards are available from the National Fire Protection Association, Boston, MA 02110.

NAVFACENGCOCOM Design Criteria

DM-1	Architecture
DM-2 Series	Structural Engineering
DM-3 Series	Mechanical Engineering
DM-4 Series	Electrical Engineering
DM-5 Series	Civil Engineering
DM-7	Soil Mechanics, Foundations, and Earth Structures
DM-8	Fire Protection Engineering
DM-9	Cold Regions Engineering
DM-25 Series	Waterfront Operational Facilities
DM-28.4	General Maintenance Facilities
DM-28.5	Environmental Control - Design of Clean Rooms
DM-29	Drydocking Facilities
DM-38	Weight-Handling Equipment and Service Craft

Reference-1

INST 4101.1	Energy Budgets for New Facilities
P-80, Volume I	Facility Planning Factor Criteria for Navy and Marine Corps Shore Installations
P-355	Seismic Design for Buildings
P-397	Structures to Resist the Effects of Accidental Explosions

Government agencies may obtain NAVFAC Design Manuals, Instructions, and P-Publications from the U.S. Naval Publications and Forms Center, 5801 Tabor Ave., Philadelphia, PA 19120. TWX: 710-670-1685, AUTOVON: 442-3321. The stock number is necessary for ordering these documents and should be requested from the NAVFACENGCOM Engineering Field Division in your area.

NON-Government organizations may obtain NAVFAC Design Manuals, Instructions, and P-Publications from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

NAVSEA Publications

NAVSEA OP 3565	Electromagnetic Radiation Hazards
Volume I	(Hazards to Personnel, Fuel, and Other Flammable Material)
Volume II	
Part One	(Hazards to Unclassified Ordnance Systems)
Part Two	(Hazards to Classified Ordnance Systems)

Government agencies may obtain NAVSEA Publications from the U.S. Naval Publications and Forms Center, 5801 Tabor Ave., Philadelphia, PA 19120. TWX: 710-670-1685, AUTOVON: 442-3321. The stock number is necessary for ordering these documents and should be requested from the NAVFACENGCOM Engineering Field Division in your area.

Occupational Safety and Health Act Standards Manual, Department of Labor, Occupational Safety and Health Administration (OSHA), Washington, D.C. 20210.

OPNAV Instructions

INST C 3000.5C	Operation of Naval Nuclear Powered Ships
INST 11010.20D	Facilities Projects Manual

Government agencies may obtain OPNAV Instructions from the U.S. Naval Publications and Forms Center, 5801 Tabor Ave., Philadelphia, PA 19120. TWX: 710-670-1685, AUTOVON: 442-3321. The stock number is necessary for ordering these documents and should be requested from the NAVFACENGCOM Engineering Field Division in your area.

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