Version: 200.20250516

FACILITIES CRITERIA (FC)
FACILITY PLANNING FOR NAVY AND MARINE CORPS SHORE INSTALLATIONS

Series 200: Maintenance and Production Facilities

Record of Changes:

Date	CCN #	CCN Title	Description of change
Nov 2016	21154	Aircraft Armament Systems Shop	Title of this CCN is changed from "Aviation Armament Shop" to "Aircraft Armament Systems Shop". Criteria was also revised.
Dec 2016	21374	Landing Craft Rinse Rack	CCN deleted
Dec 2016	22940	Sawmill	CCN deleted
Dec 2016	22960	Baling Facility	CCN deleted
Dec 2016	21107	Maintenance Hangar - 02 Space (Administrative)	FAC code changed from 1444 to 6100
Jan 2017	21940	Sewage Hose Storage Facility	Reporting requirements corrected to “N”. CCN is inventory only.
Jan 2017	21820	Construction / Weight Handling Equipment Shop	Incorrect diagram reference deleted.
Feb 2017	21920	Pavement And Ground Equipment Shed	Change reporting requirements to “N” as per verbiage in CCN 21910
Feb 2017	21925	Public Works Shops Expendable/Work-In-Process Store	Change reporting requirements to “N” as per verbiage in CCN 21910
May 2018	21181	Engine Test Cell (Non-NAVAIR Depot)	Updated criteria
May 2018	21105	Maintenance Hangar – O/H Space (High Bay)	Updated criteria
May 2018	21106	MAINTENANCE HANGAR – 01 SPACE (Shops And Maintenance Space)	Updated criteria

Date	CCN #	CCN Title	Description of change
May 2018	21107	Maintenance Hangar – 02 Space (Administrative)	Updated criteria
Aug 2019	21101	Aircraft Engine Test Cell Building	Title of this CCN is changed from "Aircraft Acoustical Enclosure" to "Aircraft Engine Test Cell Building".
Sep 2019	21107	Maintenance Hangar – 02 Space (Administrative)	Replaced reference to “UFC 4-211-01N” with “UFC 4-211-01, as updated”
Sept 2019	21105	Maintenance Hangar – O/H Space (High Bay)	Corrected formula for OH required hangar width. Added references to Type IV hangar as a new standard type. Added details to clarify notes for Tables 21105-1a and 21105-1b regarding clearances in the OH space. Added a reference to UFC 4-211-01 for further details. Added clarification for computation of hangar width in Section 21105/06/07-2.1. Also added in this section was a clarification that if an additional designated space is required for PMI, one more space with spread configuration will be provided per Type/Model/Series per installation.
Mar 2020	21105 21105	Maintenance Hangar – O/H Space (High Bay), Table 21105-2 Maintenance Hangar – O/H Space (High Bay), Table 21105-1a	Interim update - Update hangar ratio for P-8A squadrons with a new ratio of ¼ to reflect actual maintenance frequencies. Expanded the width for Type I standard module for the US Marine Corps from 262.5 ft to 270.0 ft to provide the capabilities to conduct periodic maintenance interval work for both F-35B and F-35C Variants. Marine Corps squadrons operate both variants.
July 2020	21211	Missile Module Maintenance and Loading Facility	Added new CCN
July 2020	21331	Shore Depot Level Repair Shop	Added new CCN
July 2020	21332	Shipyard Demilitarization and Recycling Facility	Added new CCN
July 2020	21365	Ship Propulsion Maintenance Facility	Title change from “Nuclear Repair Shop” to remove the word “nuclear”, as per OSD. Also, revised description.

Date	CCN #	CCN Title	Description of change
Feb 2021	21105	Maintenance Hanger – OH Space	Updated hangar ratios in Table 21105-2 for training squadrons under CNATRA to reflect accurate maintenance frequencies. The updated ratios are 0.28 for T-44A and T-44C Variants, and 0.39 for T-6A and T-6B Variants.
June 2021	21105	Maintenance Hangar – OH Space	Add Table 21105-1b, OH Space Standard, F-35C Model. Add Table 21105-1c, OH Space Standard, F-35B Model. Add Figure 1 – OH Space Diagram of F-35C Add Figure 2 – OH Space Diagram of F-35B.
June 2021	21105 21106 21107	Maintenance Hangar – OH Space Shops and Maintenance Administration – 01 Space Operations, Training, and Administration – 02 Space	Information added for Type IV Maintenance Hangar Add Section 21105/06/07-2.4, Type IV Unmanned Aircraft System Requirements. Add Table 21105-2a, OH Space Navy Standard, MQ-4C Triton Model. Add Figure 3 – OH Space Diagram of MQ-4C Triton. Add 21105-7, 01 Space Calculations for MQ-4C Triton. Add 21105-8, 02 Space Calculations for MQ-4C Triton.
October 2021	211 64	Ground Support Equipment Holding Shed (NavAir Depot)	Changed FAC Code to 2185
October 2021	214 40	Vehicle Holding Shed	Changed FAC Code to 2185
October 2021	218 61	Ground Support Equipment Holding Shed	Changed FAC Code to 2185
October 2021	218 65	Equipment Holding Shed (for Code 218-20)	Changed FAC Code to 2185
31 July 2022	218 52	Battery Recharging Shed	Add new category code.
22 Sep 2022	21105 21106 21107	Maintenance Hangar – OH Space Shops and Maintenance Administration – 01 Space Operations, Training, and Administration – 02 Space	On page 200 Series - 31, delete the words “crew and equipment” and replace with the words “shop and maintenance.” On page 200 Series - 31, delete the word “administrative” and add the words “operations; training; and administration.”
30 Sep 2022	21105 21106 21107	Maintenance Hangar – OH Space Shops and Maintenance Administration – 01 Space Operations, Training, and	Change width of wings spread for the C-40A aircraft to 35.8 (meters) and 117-5 (ft.-in.) in Table 21105-3 (Aircraft Widths and Hangar Space Requirements).

Date	CCN #	CCN Title	Description of change
		Administration – 02 Space	
2 Mar 2023	200 Series	UFC 2-000-05N	Change UFC 2-000-05N to FC 2-000-05N document due to the fact that this planning criteria is not unified among the other DoD services.
9 Jun 2023	200 Series 211-05/06/07	FC 2-000-05N Section 21105/06/07-2.1 Category Code 211-05 – OH Space, page 42	Include the correct SI unit of area as m^2 throughout the criteria where applicable. Under heading "FOR P-8A AIRCRAFT," add reference to table 21105-3 with that of table 21105-2.
28 Jun 2023	211-05	Maintenance Hangar – OH Space	Under the heading "Calculating OH Space," update the following: Update nomenclature for aircraft spacing requirements. Revise Table 21105-4 (Required Hangar Width Formulas. Note: Updates are required to be commensurate with the Type I Maintenance Hangar Study.
26 Jul 2023	211-05	Maintenance Hangar – OH Space	For Type III Maintenance Hangar data in Table 21105-1d, change m^2 heading to sq.ft. heading to reflect the correct unit of measure units.
21 Aug 2023	211-05	Maintenance Hangar – OH Space	Add notes at the end of Table 21105-4, Required Hangar Width Formulas, which explain procedures for rounding numbers when calculating the number of aircraft in a hangar. Change "Sample Maintenance Hangar Calculation to align with the Type I Maintenance Hangar formula in Table 21105-4.
25 April 2025	213 10	Dry Dock	Identify Code 900F as the organization responsible for the Dry Dock Certification Program.
16 May 2025	213 10	Pre-Engineered Maintenance Hangar	Delete reference to MIL-HDBK 1028/1C and add reference to UFC 4-211-01 Aircraft Maintenance Hangars.
16 May 2025	211-75	Aviation Life Support Systems Shop	Delete reference to MIL-HDBK 1028/1C and add reference to UFC 4-211-01 Aircraft Maintenance Hangars.
16 May 2025	211-09	Aircraft Boresight Range	Delete reference to MIL-HDBK 1028/1C.
16 May 2025	211-15	Line Maintenance Shelter	Delete reference to MIL-HDBK 1028/1C.

Date	CCN #	CCN Title	Description of change
16 May 2025	211-08	Airframes Shop (Non-NAVAIR Depot)	Delete reference to MIL-HDBK 1028/1C and add reference to UFC 4-211-01 Aircraft Maintenance Hangars.
16 May 2025	211-45	Avionics Shop (Non-NAVAIR Depot)	Delete reference to MIL-HDBK 1028/1C and add reference to UFC 4-211-01 Aircraft Maintenance Hangars.

200 SERIES
MAINTENANCE AND PRODUCTION FACILITIES

Table of Contents

211 MAINTENANCE - AIRCRAFT, SPARES

211-1 GENERAL

Facilities for the maintenance and repair of Navy and Marine Corps aircraft and related spares, including airframes, aircraft engines, aircraft weapons systems, avionics systems, and other related aircraft equipment are planned in accordance with maintenance functions and levels as authorized by the Chief of Naval Operations (CNO). Maintenance classifications are defined in OPNAVINST 4790.2 (series) and are the basis for the Naval Aircraft Maintenance Program (NAMP). These classifications of aircraft maintenance activities of the Naval Establishment are divided into three levels: depot (“D” level) maintenance, intermediate (“I” level) maintenance, and organizational (“O” level) maintenance.

Depot or “D” level maintenance is performed at Naval Aviation industrial establishments to ensure continued flying integrity of airframes and flight systems during subsequent operational service periods. It is performed on material requiring major overhaul or rebuilding of parts, assemblies, subassemblies, and end items. It includes manufacturing parts, making modifications, testing, inspecting, sampling, and reclamations. Depot maintenance supports lower levels of maintenance by providing engineering assistance and performing maintenance that is beyond the capability of the lower level activities. Each requirement for depot maintenance facilities must be planned and justified individually.

“I” level maintenance is the responsibility of, and performed by, designated maintenance activities in support of organizational level activities. The intermediate level maintenance mission is to enhance and sustain the combat readiness and mission capability of supported activities by providing quality and timely support at the nearest location with the lowest practical resource expenditure. Intermediate level maintenance consists of on and off equipment material support and is usually performed at a central facility located either directly on or just off the flight line. Some specific functions of intermediate or “I” level maintenance are shown in Table 21100-1.

Intermediate Maintenance Activities (IMAs) are usually established to support an entire air station or Marine Air Group (MAG). In specific circumstances, IMA shops may be established for support of a specific unit as a department of what would normally be considered an organizational level unit. An example of this would be the establishment of an avionics shop to repair just the special mission equipment installed in reconnaissance aircraft, where only a single squadron at an air station has these aircraft. That shop would be inside the squadron hangar, under the direct control of the squadron Aircraft Maintenance Officer.

Table 21100-1
Intermediate Level Maintenance Functions

Title	Work Center Code	Category Code Number	Function
Aircraft Intermediate Maintenance Activity Management	000	211 16	Supervisory, production control, material and financial management, quality control, training, administration.
Engine Maintenance Shop	400	211 21	Repair of aircraft engines and components, including removal and replacement of compressor sections, combustion sections, turbine sections, engine accessories, propellers and rotor components, auxiliary power units, auxiliary fuel cells, and in-flight refueling stores.
Airframes Shop	500	211 08	Repair and manufacture of aircraft structural and hydraulic components including structural panels, tire and wheel assemblies, brakes, hydraulic pumps, actuators, and line, painting, machining and welding, and non-destructive inspection (NDI).
Avionics Shop	600	211 45	Repair of aircraft avionics and electrical systems including communication, navigation and identification systems, electrical and instrument systems, generators and batteries, fire control systems, radar and electronic counter measures systems, anti-submarine warfare systems, precision measuring equipment and calibration, reconnaissance and photo systems, and module repair and wire harness manufacture.
Armament Shop	700	211 54 211 55	Repair and storage of weapons racks, launchers, guns, tow reels, and, for the Marine Corps, weapons support equipment.
Parachute and Survival Equipment Shop	800	211 75	Repair, maintenance, and periodic inspection of parachutes, life rafts and flotation systems, aviators survival equipment, oxygen regulators and generating systems, ejection seats, and oxygen and nitrogen generating and storage.
Ground Support Equipment Shop	900	218 60 218 61	Repair, maintenance, and storage of aircraft ground support equipment including tow tractors, check stands, aircraft starting units, electrical power carts, hydraulic power carts and servicing units, oxygen and nitrogen servicing carts, and mobile maintenance facilities (vans).

Organizational, or “O” level maintenance, and intermediate, or “I” level maintenance is performed at the individual sites where aircraft are stationed. Both maintenance levels

are segregated into nine divisions, three organizational and six intermediate. These divisions are coded as 100, 200, and 300 for the organizational level maintenance and 400 through 900 for the intermediate level maintenance.

Organizational or “O” level maintenance is normally performed by an operating unit on a day-to-day basis in support of their own operations. The organizational level maintenance mission is to maintain assigned aircraft and aeronautical equipment in a full mission capable status while continually improving the local maintenance process. While organizational level maintenance may be done by intermediate or depot level organizations, it is usually accomplished by maintenance personnel assigned to aircraft squadrons either in aircraft maintenance hangars or on the parking apron immediately outside of the hangar. Some specific functions of the organizational or “O” level maintenance are shown in Table 21100-2.

Table 21100-2
Organizational Level Maintenance Functions

Title	Work Center Code	Category Code Number	Function
Aircraft Division	100	211-06	On aircraft repair and removal and replacement of engines, structural and hydraulic components, aircrew personal and protective equipment, egress and environmental systems, and periodic maintenance.
Avionics/Armament Division	200	211-06	On aircraft repair and removal and replacement of avionics, electrical, instrument, and fire control systems.
Line Division	300	211-06	Plane captains, flight line troubleshooters, support equipment operators, and flight crew.

These are the basic definitions for each level of maintenance. However, when temporarily required by operational or combat necessity, any appropriate operational authorities may authorize or require the performance of any maintenance task that, in their judgment, is within the capability of the personnel, materials, and facilities available.

Any of the three levels of maintenance may be performed by a contracted maintenance organization. The requirements for facilities then are a function of the contract. Additional facilities will not be built to support contract maintenance.

When it is desirable to keep aircraft under local control, space may be required to perform aircraft in-service repair (ISR), integrated maintenance (IMC/IMP),

modifications (MOD) and other program work that may concurrently involve depot, intermediate, and organizational level work on aircraft by squadron, IMA, Naval Air Depot (NAVAIR Depot), and/or contractor personnel. When the existing organizational level spaces cannot accommodate the additional workload generated by ISR, IMC/P, and/or MOD a separate facility will be required.

Those facilities generally categorized as Organizational "O" Level Maintenance facilities are as follows:

211 03	Corrosion Control Hangar
211 04	Pre-Engineered Hangar
211 05	Maintenance Hangar – OH Space
211 06	Maintenance Hangar – 01 Space
211 07	Maintenance Hangar – 02 Space

Those facilities generally categorized as Intermediate "I" Level Maintenance facilities are as follows (also noted as Non-NAVAIR Depot):

211 01	Aircraft Acoustical Enclosure (Non-NAVAIR Depot)
211 08	Airframes Shop (Non-NAVAIR Depot)
211 09	Aircraft Boresight Range (Non-NAVAIR Depot)
211 16	Aircraft Intermediate Maintenance Management (Non-NAVAIR Depot)
211 21	Engine Maintenance Shop (Non-NAVAIR Depot)
211 45	Avionics Shop (Non-NAVAIR Depot)
211 54	Aviation Armament Shop (Non-NAVAIR Depot)
211 55	Aviation Armament Equipment Holding Shed (Non-NAVAIR Depot)
211 75	Parachute/Survival Equipment Shop (Non-NAVAIR Depot)
211 81	Engine Test Cell (Non-NAVAIR Depot)
211 82	Aircraft Weapons Alignment Shelter (Non-NAVAIR Depot)
211 88	Power Check Pad with Sound Suppression (Non-NAVAIR Depot)
211 89	Power Check Pad without Sound Suppression (Non-NAVAIR Depot)

Those facilities generally categorized as Depot "D" Level Maintenance facilities are as follows (also noted as NAVAIR Depot):

211 10	Aircraft Overhaul and Repair Shop (NAVAIR Depot)
211 11	Corrosion Control – Cleaning Shop (NAVAIR Depot)
211 12	Paint and Finishing Hangar (NAVAIR Depot)
211 13	Aircraft Non-Destructive Testing Shop (NAVAIR Depot)
211 14	Aircraft Rework Shop (NAVAIR Depot)
211 20	Aircraft Engine Overhaul Shop (NAVAIR Depot)
211 22	Engine Preparation and Storage Shop (NAVAIR Depot)

211 23	Engine Examination and Evaluation Shop (NAVAIR Depot)
211 24	Dedicated Aircraft Engine Overhaul – General Process (NAVAIR Depot)
211 25	Jet Engine Overhaul Shop (NAVAIR Depot)
211 26	Reciprocating Engine Overhaul Shop (NAVAIR Depot)
211 27	Turbine Engine Overhaul Shop (NAVAIR Depot)
211 30	Aircraft and Engine Accessories Overhaul Shop (NAVAIR Depot)
211 31	Dedicated Aircraft and Engine Accessories Overhaul – General Process (NAVAIR Depot)
211 32	Metal Components Shop (NAVAIR Depot)
211 33	Non-Metals Components Shop (NAVAIR Depot)
211 34	Dynamic Components Shop (NAVAIR Depot)
211 35	Hydraulic Components Shop (NAVAIR Depot)
211 36	Electrical Component Shop (NAVAIR Depot)
211 37	Turbine Accessories Shop (NAVAIR Depot)
211 38	Pneumatic Oxygen Shop (NAVAIR Depot)
211 39	Optical and Photographic Components Shop (NAVAIR Depot)
211 40	Electronics, Communication and Armament System Shop (NAVAIR Depot)
211 41	Dedicated Electronics, Communication and Armament – General Process (NAVAIR Depot)
211 42	Electronic System Components Shop (NAVAIR Depot)
211 43	Inertial Quality Instrument Overhaul Shop (NAVAIR Depot)
211 44	Non-Inertial Quality Instrument Overhaul Shop (NAVAIR Depot)
211 50	Aircraft Armament/Missile Rework Shop (NAVAIR Depot)
211 51	Dedicated Aircraft Armament/Missile Rework – General Process (NAVAIR Depot)
211 52	Aircraft Weapon Overhaul and Test Shop (NAVAIR Depot)
211 53	Air Launched Missile Rework Shop (NAVAIR Depot)
211 60	Support Equipment Rework Shop (NAVAIR Depot)
211 61	Dedicated Support Equipment Rework – General Purpose Shop (NAVAIR Depot)
211 62	Support Equipment Calibration Shop (NAVAIR Depot)
211 63	Ground Support Equipment Rework Shop (NAVAIR Depot)
211 64	Ground Support Equipment Holding Shed (NAVAIR Depot)
211 65	Airborne Weapons Support Equipment Shop (NAVAIR Depot)
211 70	Manufacturing and Repair Shop (NAVAIR Depot)
211 71	Dedicated Manufacturing and Repair – General Purpose Shop (NAVAIR Depot)
211 72	Metal Fabrication/Manufacturing Shop (NAVAIR Depot)
211 73	Metal Treatment Shop (NAVAIR Depot)
211 74	Non-Metal Fabrication/Manufacturing Shop (NAVAIR Depot)
211 76	Miscellaneous Parts/Components Repair Shop (NAVAIR Depot)
211 80	Test and Calibration Shop (NAVAIR Depot)
211 83	Engine Test Cell (NAVAIR Depot)

211 84	Helicopter Blade Test Facility (NAVAIR Depot)
211 85	Radome Test Facility (NAVAIR Depot)
211 86	Radar/Antenna Test Facility (NAVAIR Depot)
211 87	Aircraft Weapons Alignment/Boresight Facility (NAVAIR Depot)
211 90	Other Support Facilities (NAVAIR Depot)
211 91	Uncovered Ramp (NAVAIR Depot)
211 92	Covered Ground Check/Flight Test Facility (NAVAIR Depot)
211 93	Engineering Laboratory (NAVAIR Depot)
211 94	Aircraft Power Check Facilities (NAVAIR Depot)
211 95	Material and Equipment Staging/Storage Facility (NAVAIR Depot)
211 96	Maintenance, Aircraft Spares Storage (Ready Issue/Shop Storage Miscellaneous)
211 97	Plant Services for Aircraft Overhaul (NAVAIR Depot)
211 98	Aircraft Acoustical Enclosure (NAVAIR Depot)
211 99	Hazardous Materials Storehouse (NAVAIR Depot)

211-2 NAVAIR DEPOT FACILITIES

Consistent with DoD Instruction 4151.15, "Depot Maintenance Support Programming Policies," dated November 22, 1976, NAVAIR Depot facilities can be further segregated into Production Shop Categories consistent with the material the shops are established and designed to process and produce as follows:

211-2.1. **Airframe.** These are covered areas associated with processing the airframe under those programs commonly identified as Standard Depot Level Maintenance (SDLM), Programmed Depot Maintenance (PDM), On-Condition Maintenance (OCM), crash damage repair and/or overhaul, modernization, modification, etc. The work functions include cleaning, stripping, disassembly, airframe repair, reassembly, systems check, refinishing, painting, and fueling/defueling using covered facilities. Typical facilities associated with the Airframe Production Shop and their associated Navy Category Codes are:

211 10	Aircraft Overhaul and Repair Shop (Small Aircraft)
211 10	Aircraft Overhaul and Repair Shop (Large Aircraft)
211 11	Corrosion Control Shop
211 12	Paint and Finishing Hangar
211 13	Airframes Nondestructive Inspection Shop
211 14	Airframe Dedicated Machine Shop
211 14	Airframe Dedicated Welding Shop
211 14	Airframe Dedicated Plating Shop
211 14	Airframe Examination and Evaluation, Pre-Shop Analysis and Examination and Inspection Shop
211 14	Maintenance Dock
211 14	Quick Engine Change Shop
211 14	Fuel Systems Maintenance Facility

211-2.2 **Engine.** These are covered areas associated with processing jet, turbojet, and reciprocating type aviation engines in terms of overhaul, low time repair, complete repair, and major inspection. The work functions include uncanning, disassembly, cleaning, material examination, parts reconditioning, subassembly, final assembly and preservation.

Typical facilities associated with the Engine Production Shop and their associated Navy Category Codes are:

211 22	Engine Preparation and Storage Shop
211 23	Engine Nondestructive Testing Shop
211 23	Engine Examination and Evaluation, Pre-Shop Analysis and Examination and Inspection Shop
211 24	Dedicated Engine Cleaning Shop
211 24	Dedicated Engine Paint Shop
211 24	Dedicated Engine Plating Shop
211 24	Dedicated Engine Welding Shop
211 24	Engine Modification and Repair Shop
211 25	Jet Engine Overhaul Shop
211 26	Reciprocating Engine Overhaul Shop
211 27	Turbine Engine Overhaul Shop

211-2.3 **Accessories and Components.** These are covered areas associated with processing airframe and engine accessories. Typical facilities associated with the Accessories and Components Production Shop and their associated Navy Category Codes are:

211 30	Aircraft and Engine Accessories Overhaul Shop
211 31	Dedicated Cleaning Shop
211 31	Dedicated Paint Shop
211 31	Dedicated Machine Shop
211 31	Dedicated Plating Shop
211 31	Dedicated Welding Shop
211 31	Examination and Evaluation, Pre-Shop Analysis, Examination and Inspection Shop
211 31	Hazardous Test Shop
211 31	Reclamation Shop
211 32	Tank and Radiator Repair Shop
211 32	Sheet Metal Shop
211 32	Metal Surface Shop
211 32	Seat Repair Shop
211 32	Metal Bonding Shop
211 32	Container Reclamation Shop
211 33	Life Raft Repair Shop
211 33	Rubber Repair Shop

211 33	Parachute Repair Shop
211 33	Fabric and Upholstery Shop
211 33	Tire Repair Shop
211 33	Plastic and Fiberglass Shop
211 33	Composite Rework Shop
211 34	Propeller and Propeller Control Overhaul Shop
211 34	Rotor Head Overhaul Shop
211 34	Rotor Blade Overhaul Shop
211 34	Transmission/Gearbox Overhaul Shop
211 34	Dynamic Drive System Overhaul Shop
211 35	Hydraulic Components Overhaul Shop
211 35	Bearings Shop
211 35	Aircraft Landing Gear Shop
211 36	Alternator Drive Overhaul Shop
211 36	Electrical Accessories Overhaul and Test Shop
211 36	Battery Shop
211 36	Constant Speed Drive Shop
211 36	Electro-Mechanical Components Shop
211 37	Turbine Accessories Overhaul Shop
211 37	Turbine Accessories Test Shop
211 37	General Purpose Units Shop
211 37	General Purpose Units Test Shop
211 37	Ram/Air Turbine Accessories Overhaul Shop
211 37	Ram/Air Turbine Accessories Test Shop
211 38	Pneumatic Components Overhaul Shop
211 38	Cryogenics Shop
211 38	Oxygen Equipment Shop
211 39	Photographic Equipment Repair Shop
211 39	Optical Component Shop

211-2.4 **Electronic, Communications and Armament Systems.** These are covered areas associated with processing airborne communication and navigation equipment, instruments, airborne data computers, fire control and bombing system equipment, gyroscopes, inertial guidance systems, and other avionics equipment. Typical facilities associated with the Electronic, Communications and Armament Systems Production Shop and their associated Navy Category Codes are:

211 41	Dedicated Cleaning Shop
211 41	Dedicated Paint Shop
211 41	Dedicated Machine Shop
211 41	Dedicated Welding Shop
211 41	Dedicated Plating Shop
211 41	Dedicated Bearings Shop
211 41	Instrument Overhaul Shop

211 42	Armament and Avionics Shop
211 42	Airborne Systems Software Shop
211 42	Navigational Aids Repair Shop
211 42	Avionics Testing Shop
211 43	Inertial Quality Gyroscope Overhaul Shop
211 43	Inertial Guidance System Overhaul and Calibration Shop
211 44	Electronic Instrument Overhaul Shop
211 44	Mechanical Instrument Overhaul Shop
211 44	Non-inertial Gyroscope Overhaul Shop
211 44	Magnetic Instrument Overhaul and Test Shop

211-2.5 **Armament.** These are covered areas associated with processing weapons including guns, missiles, bomb racks, weapon pylons, etc., used by the aircraft in carrying out its assigned mission. Typical facilities associated with the Armament Production Shop and their associated Navy Category Codes are:

211 51	Dedicated Cleaning Shop
211 51	Dedicated Paint Shop
211 51	Dedicated Machine Shop
211 51	Dedicated Welding Shop
211 51	Dedicated Plating Shop
211 52	Aircraft Weapon Overhaul and Test Shop
211 52	Ordnance Equipment Shop
211 52	Weapon Accessories Repair Shop
211 53	Missile Shop

211-2.6 **Support Equipment.** These are covered areas associated with processing aviation general and special support equipment and aerospace ground support equipment. Typical facilities associated with the Support Equipment Production Shop and their associated Navy Category Codes are:

211 61	Dedicated Cleaning Shop
211 61	Dedicated Paint Shop
211 61	Dedicated Machine Shop
211 61	Dedicated Plating Shop
211 61	Dedicated Welding Shop
211 62	Aeronautical Electronic Support Equipment Shop
211 62	Electronic Test Systems Repair Shop
211 62	Precision Measurement Equipment Shop
211 63	GSE Maintenance Shop
211 63	Training Devices Shop
211 63	Hydrostatics Shop
211 64	Ground Support Equipment Holding Shed
211 65	Airborne Weapons Support Equipment Shop

211-2.7 **Manufacture and Repair.** These are covered areas which are not an integral part of other categories previously described, and which contribute to aircraft repair operations by such work functions as parts cleaning and painting, plating and metal processing shop. Typical facilities associated with the Manufacture and Repair Production Shop and their associated Navy Category Codes are:

211 71	Welding Shop
211 71	Foundry Shop
211 71	Peening and Blasting Shop
211 71	Non-destructive Inspection Shop
211 71	Parts Cleaning Shop
211 71	Parts Painting Shop
211 72	Machine Shop
211 72	Grinding Shop
211 72	NC Machine Shop
211 72	Metal Parts Fabrication Shop
211 73	Metal Processing Shop
211 73	Plating Shop
211 73	Heat Treating Shop
211 74	Plastic Fabrication Shop
211 74	Pattern Shop
211 74	Decal Shop
211 74	Woodworking Shop
211 74	Rubber Fabrication Shop
211 76	Tubing Shop
211 76	Cable Shop
211 76	Cordage Shop
211 76	Electrical Cable/Harness Shop

211-2.8 **Test and Calibration.** These are covered areas which are dedicated to test, trim, or calibrate engines, electronics, communications or armament systems. Typical facilities associated with the Test and Calibration Production Shop and their associated Navy Category Codes are:

211 83	Jet Engine Test Cell (10,000 – 16,000 lbs. max. thrust)
211 83	Jet Engine Test Cell (Over 16,000 lbs. max. thrust)
211 83	Jet Engine Test Stand
211 83	Turbo Prop Test Cell
211 83	Reciprocating Engine Test Cell (3,000 HP or less)
211 83	Reciprocating Engine Test Cell (Over 3,000 HP)
211 83	Reciprocating Engine Test Stand
211 83	Turbo Shaft Test Cell
211 83	Turbo Fan Test Cell
211 83	Pneumatic Gas/Air Turbine Test Cell

211 84 Helicopter Blade Test Facility
211 85 Radome Test Facility
211 86 Radar/Antenna Test Facility
211 87 Aircraft Bore Sight Range

211-2.9 **Other.** These are areas used to perform productive work that are not included in the eight Categories listed above. This includes ramp, apron, and aircraft storage sites. Typical facilities associated with the Other Production Shop and their associated Navy Category Codes are:

211 91 Aircraft Rework Apron
211 91 Reclamation Apron
211 91 Armament and Disarmament Pad
211 91 Predock/Postdock Apron
211 91 Aircraft Corrosion Control Facility (Uncovered)
211 91 Ground Check/Flight Test Support (Uncovered)
211 92 Ground Check/Flight Test Support (Covered)
211 93 Material Handlers/Parts Expediters
211 93 Material Control Laboratory
211 93 Standards Laboratory
211 93 Automatic Test Equipment and Numerical Controlled Machine
211 94 Power Check Pad (Without Sound Suppression)
211 94 Power Check Pad (With Sound Suppression)
211 94 Propeller Aircraft Power Check Pad
211 94 Helicopter Aircraft Power Check Pad
211 94 VSTOL Aircraft Power Check Pad
211 95 Packaging and Preservation
211 98 Aircraft Power Check Facility (Covered with Sound Suppression)

211-3 ADDITIONAL MAINTENANCE FACILITIES

Additional air-related maintenance facilities are tabulated under the following category codes:

116 10 Airfield Washrack Pavement
116 15 Aircraft Rinse Facility
116 65 Tactical Van Support Pad
212 30 Missile Assembly and Test Building
214 30 Refueling Vehicle Shop
216 55 Air/Underwater Weapons Shop
218 50 Battery Shop
218 60 Aircraft Ground Support Equipment Shop
218 61 Ground Support Equipment Holding Shed

211-4 AIRCRAFT LOADING

The primary planning factors in determining the size of maintenance facilities are the number of aircraft and spare components that the facility is required to support. Due to the size and complexity of modern test and support equipment, a repair station can be significantly larger than the number of personnel needed to operate it. The following planning factors have taken this into account and are developed accordingly.

When planning aircraft maintenance facilities for a given installation, the number of aircraft and squadrons to be counted is determined by projecting peak scheduled occupancy of all aircraft for which the station will have an aircraft maintenance support mission. Peak scheduled occupancy is defined as the maximum number of aircraft that are scheduled for simultaneous assignment at the installation for the planned construction year.

In May 2003, the Navy developed a new inter-deployment readiness profile, the “Fleet Readiness Concept” (FRC) with the goal of improving the Navy’s speed of response to world events. The FRC developed into the Fleet Response Plan (FRP). FRP was fully implemented in mid-2004 and will modify current ship and squadron operating cycles by adjusting maintenance intervals, along with training and manpower processes, to increase unit availability for surge operations – that is, building the long-term institutional capability to support rapid, massive build-up in deployed Naval forces.

FRP will alter Aircraft Carrier Battle Group/Aircraft Carrier Strike Group deployment cycles such that all aircraft squadrons could be at their respective homebases at the same time. Therefore, the concept of “hot-racking” single-sited air wing airframes is no longer valid. When planning aircraft maintenance hangars, 100% of the squadrons must be allotted space.

In some instances, an installation may be assigned the intermediate maintenance responsibility for aircraft not permanently assigned to the installation. In this case, these aircraft should be added to the base loading for the planning of intermediate maintenance shops.

211-5 AIRCRAFT MAINTENANCE DEPARTMENT OFFICES

The shops comprising the Intermediate Maintenance Facility may be established separately or grouped together in a consolidated complex. Space requirements for each individual shop having a specific category code include the administrative and training space for that shop. In addition, administrative and training spaces are required for the Navy’s Aircraft Intermediate Maintenance Department (AIMD) or the Marine Corps Intermediate Maintenance (IM) offices, preferably in a centrally located administrative building within the maintenance complex. When shops are not consolidated into a complex, consideration shall be given to enlarging the administrative

space in one of the intermediate shops to provide space for the AIMD offices. Space allocations shall be made in accordance with Category Code 211-16, Aircraft Intermediate Maintenance Activity Management.

211-6 MARINE CORPS CRITERIA

Marine Corps aircraft facilities are planned for utilizing the basic criteria for comparable Naval facilities.

211 01 AIRCRAFT ENGINE TEST CELL BUILDING (NON-NAVAIR DEPOT) (m^2 / SF)

FAC: 2114
BFR Required: Y

Design Criteria: UFC 4-212-01, Navy Standard Jet Engine Test Cells

21101-1 **GENERAL.** During the aircraft maintenance and testing process, aircraft engines are run-up while aboard the aircraft (in-frame testing) and when removed from the aircraft (out-of-frame testing). In both cases, high noise levels are generated in surrounding areas unless sound abatement is provided. The aircraft acoustical enclosure, sometimes referred to as a hush house, is a total enclosure for fixed wing aircraft designed to abate noise during in-frame run-up of jet engines. The facility consists of a hangar-like aircraft enclosure, an absorptive augmenter for inducing cooling air and absorbing noise, a 45-degree blast deflector, an observation room with lavatory, and a mechanical equipment room. The observation and mechanical rooms are located adjacent to, not within, the aircraft enclosure.

21101-2 **POLICY.** This Category Code shall be used for acoustical enclosures, which support organizational and intermediate level aircraft maintenance. Enclosures at Naval Air Depots (NAVAIR Depots) supporting depot maintenance shall be Category Code 211 98, Aircraft Acoustical Enclosure (NAVAIR Depot).

For out-of-frame testing see Category Code 211 81, Engine Test Cell (Non-NAVAIR Depot); Category Codes 211 88, Power Check Pad (with Sound Suppression); or 211 89, Power Check Pad (without Sound Suppression).

21101-3 **CRITERIA.** The design of the acoustical enclosure is governed by the size of aircraft and the number and location of the engines.

The acoustical enclosure provides a better working environment than open pads by providing protection from inclement weather and cross winds which adversely affect testing of engines, while at the same time significantly reducing exterior noise levels. NAVFAC P-970, Planning in the Noise Environment, specifies acceptable noise levels for various land uses. Noise levels generated during engine run ups, if not abated,

would restrict land use, require that sound insulation be installed in nearby buildings, or require the run up pad be located at a considerable distance from inhabited buildings. The latter results in increased fuel consumption and lost time while transiting the aircraft to and from the run up area. In addition, noise generated during run ups can result in complaints from civilian communities resulting in local pressure to restrict operations. As indicated by P-970, the total noise environment must be evaluated and the hush house considered as one possible solution to reducing noise levels. Most air installations have had detailed noise studies done as part of the Air Installation Compatibility Use Zone (AICUZ) program. AICUZ studies address solutions to noise problems and may serve as a basis for justifying the requirements for an acoustical enclosure.

If an acoustical enclosure is justified by a detailed analysis of noise problems and potential solutions, then one (1) acoustical enclosure shall be provided for up to 140 aircraft and two (2) for up to 360 aircraft.

Three standard designs are available to support the aircraft mix set forth in Table 21101-1.

Table 21101-1
Aircraft Acoustical Enclosure

Enclosure Type	Chamber Size	Augmenter Length	Aircraft Types
I	25.6 m x 21.9 m (84 ft x 72 ft)	28.9 m (95 ft)	S-3, F-14, F/A-18, A-4, A-6, A-7, T-2
II	24.4 m x 21.9 m (80 ft x 72 ft)	27.4 m (90 ft)	F-14, F/A-18, A-4, A-7, T-2 For A-6 flare Augmenter Bellmouth to 6.24 meters (20.5 feet)
III	20.7 m x 19.5 m (68 ft x 64 ft)	20.4 m (67 ft)	F/A-18, A-4, A-6, A-7, T-2

211 03 CORROSION CONTROL HANGAR (m^2 / SF)
FAC: 2113
BFR Required: Y

Design Criteria: UFC 4-211-02, Aircraft Corrosion Control and Paint Facilities

21103-1 **GENERAL.** The corrosion control hangar provides space for washing, rinsing, paint stripping, corrosion removal, protective coating and painting of aircraft at intermediate and organizational maintenance levels. The hangar along with Aircraft Washback Pavements (Category Code 116 10) and Aircraft Rinse Facilities (Category Code 116 15) support the corrosion control program as described in NAVAIR Technical Manual NAVAIR 01-1A-509. Depot level maintenance facilities for stripping and

complete repainting of aircraft shall be coded as Paint and Finishing Hangar (NAVAIR Depot) (Category Code 211 12).

The corrosion control hangar may be required at Navy and Marine Corps activities to support the OPNAV Corrosion Control Program and to meet the environmental restrictions of the local and state governments. This facility is to be available for repair of damaged paint systems only and not for complete de-paint/repaint of an entire aircraft. That function is restricted to depot level activities. Functions performed in the corrosion control facility include deicing, limited detergent washing and rinsing, paint stripping, corrosion removal, protective coating application and painting, and finish curing and drying. The requirement for a corrosion control hangar should be endorsed by the cognizant Type Commander and NAVAIRSYSCOM prior to approval for planning purposes.

Corrosion Control facilities should consist of at least two (2) bays, one for “dirty” work such as sanding, stripping, and blasting, and one for “clean” work such as priming and painting. One “dirty” bay can support up to 135 aircraft and one “clean” bay can support up to 45 aircraft. There are two (2) corrosion control hangar facility sizes (see Table 21103-1). The small facility will support fixed wing carrier-type and rotary wing aircraft. The large facility will support patrol and transport aircraft.

Consideration must be given to industrial safety and environmental contaminants. The facility will require a laminar flow exhaust system with filtered air intake and outflow. It will require compressed air, both tool air to operate sanders, buffers, and paint guns, and breathing air for personnel. Additional support space in the facility would be required for mixing paint, hazardous material and non-hazardous material storage, gear and tool storage, non-destructive inspection, office, and for locker rooms and toilet facilities.

Table 21103-1
Aircraft Corrosion Control Hangar

Facility Type	Hangar Bay (each bay)	Support Space (each facility)	Aircraft Types
Small	27.4 m x 25.5 m (90 ft x 83.5 ft) 699 m^2 (7,515 SF)	64.7 m x 6.9 m (212.3 ft x 22.7 ft) 446 m^2 (4,819 SF)	Fixed wing, Carrier-type and Rotary Wing (F/A-18, F-14, H-60, H-53, etc.)
Large	36.6 m x 46.2 m (120 ft x 151.5 ft) 1,691 m^2 (18,180 SF)	36.6 m x 11.7 m (120 ft x 38.3 ft) 428 m^2 (4,596 SF)	Patrol and Transport (P-3, C-130, etc.)

Table 21103-2
Aircraft Corrosion Control Hangar
Hangar Requirements

Aircraft Quantity	Hangar Bay "Clean"	Hangar Bay "Dirty"	Support Space
Up to 45	1	1	1
46 – 90	2	1	1
91 – 135	3	1	1
136 – 180	4	2	1
181 – 225	5	2	1
226 – 270	6	2	1

211 04 PRE-ENGINEERED MAINTENANCE HANGAR (m^2 / SF)
FAC: 2111
BFR Required: Y

Design Criteria: UFC 4-211-01, Aircraft Maintenance Hangars

21104-1 **GENERAL.** The pre-engineered maintenance hangar provides an austere facility for organizational level maintenance of Navy and Marine Corps aircraft. It is intended for use primarily at overseas locations, particularly those where tenure may be limited. When provided, the pre-engineered hangars are programmed in lieu of, not in addition to, the larger standard Type I and/or II hangars (Category Codes 211 05/06/07).

The pre-engineered maintenance hangar is intended for the support of a detachment size unit of from three to five aircraft. Each hangar consists of hangar bay (OH) space and limited crew/equipment (01) and administrative (02) space. Movable partitions are provided within the crew/equipment and administrative space to facilitate configuring these areas in accordance with the requirements of the occupant.

There are three (3) types of pre-engineered maintenance hangars (See Table 21104-1). The specific type of hangar depends on the size of aircraft to be maintained. The Type "A" pre-engineered maintenance hangar is designed primarily for fixed wing, carrier-type aircraft and helicopters. It should be noted that a Type "A" hangar may also be utilized for smaller transport aircraft with a wingspan less than 25.5 meters (85 feet). The Type "B" pre-engineered maintenance hangar is designed primarily for shore-based patrol aircraft and transport aircraft with wingspans up to 30.5 meters (100 feet). The Type "C" pre-engineered maintenance hangar is designed primarily for (K)C-130 aircraft but may also be configured to accommodate other large transport aircraft with wingspans up to 40.2 meters (132 feet).

Table 21104-1

Pre-Engineered Maintenance Hangar

Hangar Type	Width and Depth	Gross Area	Aircraft Types
A	32.0 m x 24.4 m (90 ft x 83.5 ft)	818 m^2 (8,800 SF)	Fixed wing, Carrier-type and Rotary Wing. *Note: May also be utilized by smaller transport aircraft with wingspan less than 25.5 meters (85 feet.)*
B	36.6 m x 36.6 m (120 ft x 120 ft)	1,366 m^2 (14,700 SF)	Shore-based Patrol and Transport aircraft with wingspans up to 30.5 meters (100 feet).
C	45.7 m x 42.7 m (150 ft x 140 feet)	1,995 m^2 (21,466 SF)	Primarily (K)C-130 aircraft. *Note: May also be configured to accommodate other large transport aircraft with wingspans up to 40.2 meters (132 feet.)*

Note: (1) Gross Area includes Hangar Door pockets.

211 05 MAINTENANCE HANGAR – O/H SPACE (HIGH BAY) (m^2 / SF)
FAC: 2111
BFR Required: Y

211 06 MAINTENANCE HANGAR – 01 SPACE (SHOPS AND MAINTENANCE ADMINISTARTION) (m^2 / SF)
FAC: 2112
BFR Required: Y

211 07 MAINTENANCE HANGAR – 02 SPACE (OPERATIONS, TRAINING, AND ADMINISTRATION) (m^2 / SF)
FAC: 6100
BFR Required: Y

Design Criteria: UFC 4-211-01, as updated, Aircraft Maintenance Hangars, Type I, Type II, Type III, and Type IV

21105/06/07-1 **GENERAL.** Maintenance hangars are required to provide weather-protected shelter for the servicing and repair of Navy and Marine Corps aircraft at an organizational level and emergency shelter for operable aircraft. Maintenance hangar configured for a Marine Air Logistics Squadron (MALS) may provide for the servicing and repair of aircraft at the intermediate level as well as at the organizational level. See Category 211 Appendix – Marine Corps Aircraft Maintenance Facilities, in which additional special guidance is provided. The supplement is located at the end of the 211 series criteria. There are four basic types of standard modular hangars: Type I, Type II, Type III, and Type IV. These hangars each contain a high bay (OH) space, shop and maintenance (01) space, and operations, training, and administration (02) space. Each of these spaces is assigned a separate category code.

It is extremely difficult to establish specific criteria to meet the requirements of the multi-sized squadrons existing within the various commands of the Navy and Marine Corps. Sizes range from a four aircraft AEW squadron with a complement of about one hundred seventy-five persons to a fifty or more aircraft training squadron with a complement of up to one thousand five hundred persons (including students). Accordingly, the criteria stated herein and further defined in the Unified Facility Criteria (UFC 4-211-01, as updated) “Aircraft Maintenance Hangars” depicts the Type I, Type II, Type III, and Type IV Maintenance Hangar modules developed primarily to maintain squadron facility integrity for standard size fleet squadrons. In this context, “standard size” is defined as a combination of the following factors:

1. A squadron with ten to eighteen carrier aircraft and one hundred fifty to four hundred personnel assigned.
2. A squadron with four to six carrier aircraft and one hundred twenty-five to two hundred personnel assigned.

3. A squadron with six to twelve land based patrol or large transport aircraft and one hundred fifty to four hundred personnel assigned.

In general, the size of the OH space is based on a percentage of the number of Primary Assigned Aircraft (PAA) in a squadron and the technical requirements for ensuring adequate clearances around the aircraft. Planning factors, such as number of personnel in a squadron or number of workspaces required, are used to define the 01 space and the 02 space.

All other squadrons and/or units operating aircraft are considered non-standard. Guidance for applying these criteria to both standard and non-standard size units is contained in subparagraphs 1 and 2 below.

UFC 4-211-01, as updated, contains conceptual floor plans and notional drawings for Type I, Type II, and Type III hangars.

Type I: Primarily designed for carrier aircraft, but adaptable to meet requirements for rotary wing and various types of smaller aircraft. The 01 and 02 spaces in this type of hangar are configured for a typical strike fighter squadron, two carrier airborne early warning squadrons, two carrier electronic attack squadrons, or a helicopter antisubmarine warfare squadron.

Type II: Primarily supports U.S. Marine Corps aviation. Hangar is designed to accommodate CH-53 helicopters, V-22 Ospreys, and C-130 Hercules aircraft. This type of hangar may also accommodate Navy variants of the C-130, V-22, and H-53 aircraft.

Type III: Principally designed for land based patrol (P-8A) and large transport (C-40A) aircraft.

Type IV: Intended for the largest Unmanned Aircraft System (UAS), which is currently the MQ-4C Triton.

Tables 21105-1a and 21105-1b show the standard hangar's dimensional statistics for planning purposes. See also UFC 4-211-01 Table 2-1 for all Minimum Aircraft Maintenance Bay Clearances and Table 7-1 for other standard Hangar Type dimensions and requirements.

Table 21105-1a
Modular Hangar Dimensional
Statistics for Planning Purposes
Type I Hangar

Category Code 21105 (OH Space)	Dimension - Navy		Dimension - USMC	
	ft	m	ft	m
Width	212	64.62	270	82.30
Depth	95	28.96	95	28.96
Useable Depth(1)	75	22.86	75	22.86
Useable Width(2)	197	60.05	255	77.72
1 Module	212	64.62	270	82.30
1-1/2 Module	318	96.93	405	123.44
2 Module	424	129.24	540	164.59
2-1/2 Module	530	161.54	675	205.74
3 Module	636	193.85	810	246.89
Each Additional 1/2 Module	106	32.31	135	41.15
Category Code 21105 (OH Space)	**Dimension - Navy**		**Dimension - USMC**	
	sq. ft	**sq. m**	**sq. ft**	**sq. m**
Net area per module	20,140	1,871	25,650	2,317
Gross area per module(3)	22,557	2,096	28,728	2,595
Category Code 21106 (01 Space) Shop and Maintenance	**Dimension - Navy**		**Dimension - USMC**	
	sq. ft	**sq. m**	**sq. ft**	**sq. m**
Net area per module	14,245	1,323	20,145	1,872
Gross area per module(4)	19,658	1,826	27,800	2,583
Category Code 21107 (02 Space) - Operations, Training, and Administration	**Dimension - Navy**		**Dimension - USMC**	
	sq. ft	**sq. m**	**sq. ft**	**sq. m**
Net area per module	10,062	935	12,532	1,164
Gross area per module(5)	13,181	1,225	16,417	1,525

Table 21105-1a Notes

(1) Type I useable depth computed upon the requirement for a 10-foot (3.05 meter) clearance from aircraft to nearest fixed obstruction along rear wall of the hangar and a 10-foot (3.05 meter) clearance between aircraft and inside face of front door.

(2) Type I useable width computed upon the requirement for a 7.5 foot (2.23 meter) clearance from aircraft to nearest fixed obstruction along side wall, and 7.5 foot (2.23 meter) clearance between aircraft wing tips.

(3) 12% net-to-gross mark-up factor applied to account for wall thickness, door pockets, and other structural components.

(4) 38% net-to-gross mark-up factor applied to account for wall thickness, elevator(s), mechanical equipment spaces, structural elements, and common spaces.

(5) 31% net-to-gross mark-up factor applied to account for wall thickness, elevator(s), mechanical equipment spaces, structural elements, and common spaces.

Table 21105-1b
OH Space Navy Standard
F-35C Model
Statistics Planning Purposes

CATEGORY	SPACE REQ'T		PLANNING METRICS	
Required Aircraft Parking Positions	**5**		0.33	% of PAA + 1
TOTAL WIDTH	212	LF		
Aircraft with Wings Spread	43	LF	43	F35C Aircraft Width with Wings Spread
Aircraft with Wings Folded (4 X 31')	124	LF	31	F35C Aircraft Width with Wings Folded
Wingtip Clearance (4 X 7.5')	30	LF	7.5	Clearance between Aircraft
Access Clearance (2 X 7.5')	15	LF	7.5	Clearance from Side Wall (Unusable)
TOTAL DEPTH	95	LF		
Aircraft Length	52	LF	52	Aircraft Length
Work Area Length	23	LF	23	Work Area
Personnel & Equipment Clearance	10	LF	10	Hangar Door Clearance (unusable)
Personnel & Equipment Clearance	10	LF	10	Back Wall Clearance (unusable)
NET OH SPACE	20,140	SF		
GROSS AREA	22,557	SF	1.12	OH SPACE Net-to-Gross (NTG)

Key: Variable, depends on PAA and squadron | Standard PAA and squadron | Calculation

FIGURE 1. OH Space Diagram – F35C

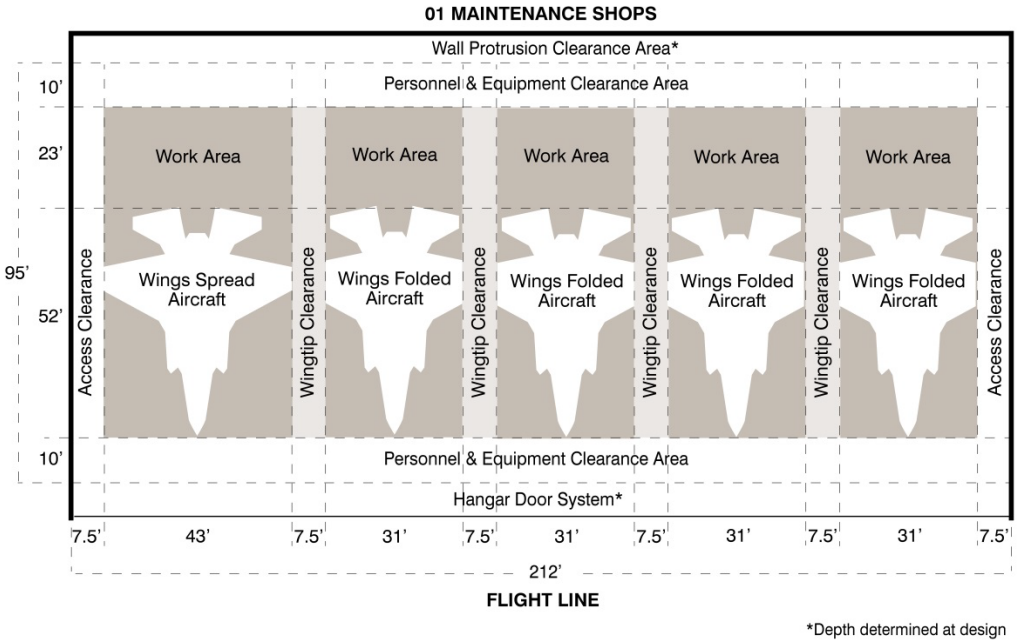


Table 21105-1c
OH Space Marine Corps Standard
F-35B Model
Statistics Planning Purposes

CATEGORY	SPACE REQ'T		PLANNING METRICS	
Required Aircraft Parking Positions	6		0.33	% of PAA + 1
TOTAL WIDTH	262.5	LF		
Aircraft with Wings Spread (6 X35')	210	LF	35	F35B Aircraft Width with Wings Spread
Total Wingtip Clearance (5 X 7.5')	37.5	LF	7.5	Clearance between Aircraft
Access Clearance (2 X 7.5')	15	LF	7.5	Clearance from Side Wall (Unusable)
TOTAL DEPTH	95	LF		
Aircraft Length	52	LF	52	Aircraft Length
Work Area Length	23	LF	23	Work Area
Personnel & Equipment Clearance	10	LF	10	Hangar Door Clearance (unusable)
Personnel & Equipment Clearance	10	LF	10	Back Wall Clearance (unusable)
NET OH SPACE	24,938	SF		
GROSS AREA	27,930	SF	1.12	OH SPACE Net-to-Gross (NTG)

Key: Variable, depends on PAA and squadron | Standard PAA and squadron | Calculation

FIGURE 2. OH Space Diagram – F35B

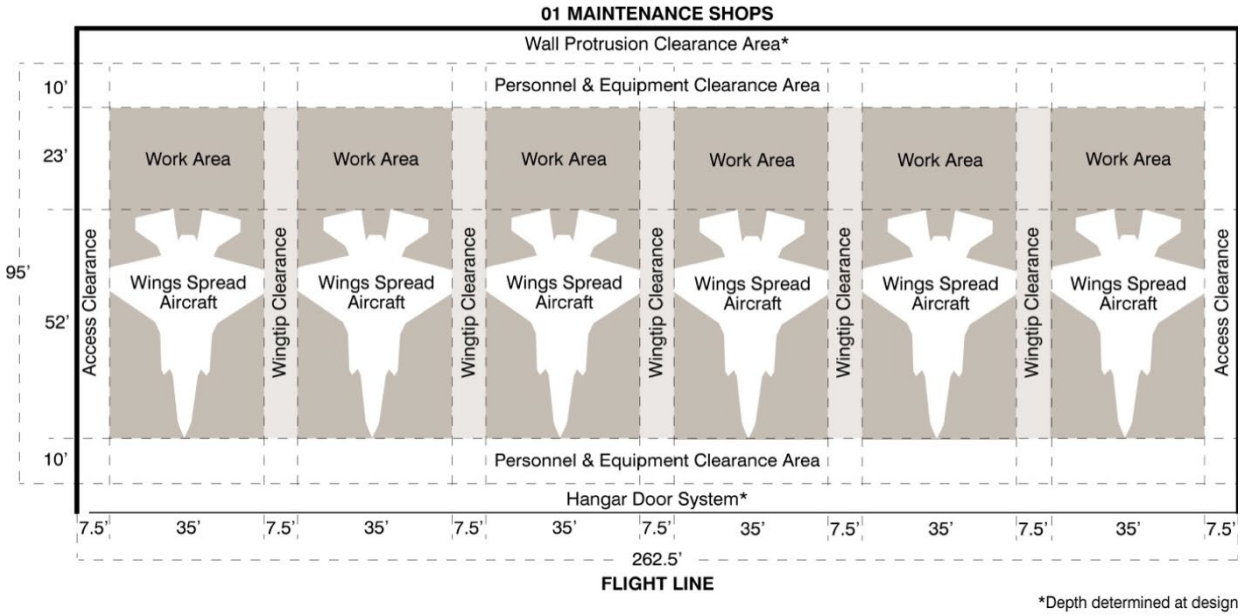


Table 21105-1d
Modular Hangar Dimensional
Statistics for Planning Purposes
Type II and Type III Hangar

Category Code 21105 Hangar Module (OH)	Type II		Type III	
	ft	m	ft	m
Width	325	99.10	165	50.30
Depth	119	36.28	165	50.30
Clear Height	44	12.80	50	14.02
Useable Depth (1)	99	30.18	130	39.63
Useable Width (2)				
1 Module	305	92.99	125	38.11
1-1/2 Module	467	142.38	n/a	n/a
2 Modules	630	192.07	290	88.41
2-1/2 Modules	792	241.46	n/a	n/a
3 Modules	955	291.16	455	138.72
3-1/2 Modules	1,117	340.55	n/a	n/a
4 Modules	1,280	390.24	620	189.02
4-1/2 Modules	1,462	445.73	n/a	n/a
5 Modules	1,605	489.33	785	239.33
5-1/2 Modules	1,747	532.62	n/a	n/a
6 Modules	1,930	588.41	950	289.63
Each Add'n ½ Module	162	49.54	n/a	n/a
Category Code 21105 Hangar Module (OH)	**Type II**		**Type III**	
	sq.ft.	**m^2**	**sq.ft.**	**m^2**
Net Area per Module	38,675	3,593.03	27,225	2,529.29
Gross Area per Module (3)	40,609	3,772.70	28,586	2,655.73
Category Code 21106 Shop and Maintenance Admin. (01)	**Type II**		**Type III**	
	sq.ft.	**m^2**	**sq.ft.**	**m^2**
Gross Area per Module (4)	12,000	1,114.84	12,000	1,114.84
Category Code 21107 Operations, Training, and Administration(02)	**Type II**		**Type III**	
	sq.ft.	**m^2**	**sq.ft.**	**m^2**
Gross Area per Module	12,000	1,114.84	12,000	1,114.84

Table 21105-1b Notes

(1) Type II useable depth computed upon the requirement for a 10-foot (3.05 meter) clearance from aircraft to nearest fixed obstruction along rear wall of the hangar and a 10-foot (3.05 meter) clearance from aircraft to inside face of front door. Type III useable depth computed upon the requirement for a 20-foot (6.10 meter) clearance from aircraft to nearest fixed obstruction along rear wall of the hangar and a 15-foot (4.57 meter) clearance between aircraft and inside face of front door.

(2) Type II useable width computed upon the requirement for a 10-foot (3.05 meter) work clearance from aircraft to nearest fixed obstruction along side wall. Type III useable width computed upon the requirement for a 20-foot (6.10 meter) work clearance from aircraft to nearest fixed obstruction along the side wall.

(3) 5% net-to-gross mark-up factor applied to account for wall thickness and other structural loss. Additional net-to-gross mark-up may be required for hangars utilizing enclosed door pockets.

(4) Excludes an allowance of up to 1,536 sq. ft. (143 m^2.) for mechanical equipment space to house Aqueous Fire Foam Film (AFFF) fire suppression systems.

Due to the different attributes of the functions performed in the three space types, separate net-to-gross (NTG) ratios are provided for each space type in a Type I maintenance hangar:

- Hangar Bay (OH Space) – 1.12
- Shops and Maintenance (01 Space) – 1.38
- Operations, Training, and Administration (02 Space) – 1.31

21105/06/07-2 **Guidelines for Applying Maintenance Hangar Criteria**.
In the application of the criteria for the planning of Maintenance Hangars, the following guidelines are established:

21105/06/07-2.1 **Category Code 211-05 – OH Space.**

(1) One Type I standard hangar module OH space will be planned for each standard size squadron with twelve to eighteen carrier aircraft.

(2) One half a Type I standard hangar module OH space will be planned for each standard size squadron with four to six carrier aircraft.

(3) One Type II standard hangar module OH space will be planned for each standard size squadron with ten to sixteen large helicopter or tilt-rotor aircraft.

(4) One Type III standard hangar module OH space will be planned for each standard size squadron with four to eight land based patrol or large transport aircraft.

(5) The aircraft assigned to all other squadrons or units located on an air station or air facility, including pool or station aircraft, will be combined into a total loading, and the number of hangar modules required for these aircraft will be determined as follows:

Hangar space requirements for both scheduled and unscheduled maintenance vary by aircraft due to maintenance complexity and mission requirements. Carrier and rotary wing aircraft require more maintenance than patrol, special mission, and training aircraft, which require more maintenance than transport aircraft. Carrier and rotary wing aircraft normally require removing skin panels to gain access to Weapons Replaceable Assemblies (WRA). On patrol, special mission, and training aircraft a larger percentage of WRAs are readily accessible from the interior of the aircraft and, therefore, more maintenance is performed on the flight line (parking apron). In general, transport aircraft are less complex and

require less hangar space. Consequently, hangar space requirements should be planned as follows (See Table 21105-2 for details):

(a) OP-Carrier, OP-Rotary, OP-Tilt-Rotor, TRG-Rotary, TRG-Carrier, TRG-Tilt-Rotor, RES-Rotary, RES-Carrier type squadrons: One (1) hangar space for every three (3) aircraft assigned.

(b) OP-Patrol, OP-Special Mission, TRG-Patrol, TRG-New Pilot, TRG-Special Mission, OTH(N)–SAR, OTH(N)-Station, OTH(N)-NTPS, OTH(N)-NSAWC, OTH(MC)-Station, RES-Patrol, RES-Station, RES-Special Mission type squadron: One (1) hangar space for every six (6) aircraft assigned.

(c) RES -Transport type squadron: One (1) hangar space for every nine (9) aircraft assigned.

(d) OP-UAS (BAMS Only) and TRG-UAS (BAMS Only) type squadrons: One (1) hangar space for every two (2) aircraft assigned.

(e) ETD type squadron: Due to the unique and critical nature of the mission, one (1) hangar space per aircraft assigned

(f) RDT&E type squadron: Hangaring requirements vary based on aircraft testing configuration. See Category Code 311-05, 311-06, and 311-07.

OP = Operational
TRG = Training
OTH(N) = Other, Navy
NSAWC = Naval Strike and Air Warfare Center
OTH(MC) = Other, Marine Corps
RES = Reserve
RDT&E = Research, Development, Testing and Evaluation
SAR = Search and Rescue
NTPS = Navy Test Pilot School
ETD = Executive Transport

FOR FIXED WING AIRCRAFT:

Except for Type I hangar (see Table 21105-1a) or special cases, hangar requirements are computed with a distance of 1.52 meters (5 feet) between aircraft and with the aircraft wings folded.

FOR ROTARY WING AIRCRAFT:

Except for Type I hangar (see Table 21105-1a) or special cases, hangar requirements are computed with a distance of 1.52 meters (5 feet) between aircraft and with seventy-five (75) percent of the aircraft with rotors folded. Twenty-five (25) percent of the aircraft are maintained with the rotors in the spread mode.

FOR SPECIAL CASES:

Some aircraft require greater separation distances between parked aircraft to accommodate maintenance equipment as well as proper ingress/egress aisles. These aircraft include the MV-22 and P-8A (MMA).

FOR MV-22 AIRCRAFT:

Hangar requirements are computed with a distance of 3.05 meters (10 feet) between aircraft and with seventy-five (75) percent of the aircraft with wings/rotors spread. Twenty-five (25) percent of the aircraft are maintained with the wing/rotors in the folded mode.

FOR P-8A AIRCRAFT:

Hangar requirements are computed with a distance of 5.18 meters (17 feet) between aircraft.

Tables 21105-2 and 21105-3 provide aircraft widths, hangar space requirements ratios, and type hangar for each aircraft.

Hangar OH space represents the hangar high bay space. While the OH space is intended primarily to provide squadron-level maintenance (organizational or O-level), it is expected that a hangar bay could include an additional space designated for Planned Maintenance Interval (PMI). Naval Aviation Maintenance Program (NAMP) defines PMI as period of time for execution of an Integrated Maintenance Concept/Program (IMC/P) or Phased Depot Maintenance. While PMI can include O-level, intermediate-level (I-level), and depot-level (D-level) actions, the PMI space in a hangar bay is necessary to provide D-level maintenance at an air installation as O-level maintenance is already accounted for elsewhere in the hangar bay and I-level maintenance is generally performed off-aircraft and does not require a hangar spot. Depot-level maintenance is defined as maintenance performed on material requiring major overhaul or rebuilding of parts, assemblies, subassemblies, and end items. This type of maintenance includes manufacturing parts, making modifications, testing,

inspecting, sampling, and reclamation. PMI D-level actions may include major structural repair involving removal and replacement of frames, bulkheads, and frames, along with full H-60 strip and paint.

PMI hangars need to be planned for each Type/Model/Series (TMS) by Commander, Fleet Readiness Center (COMFRC). A designated PMI space within an operational-level hangar bay is only required if PMI D-level maintenance actions under the IMC/P cannot be satisfied by COMFRC with other D-level maintenance space available elsewhere. Input from Commander Naval Air Atlantic/Pacific is necessary for an accurate assessment of the PMI space requirement.

To support this evolution in maintenance functions, the required hangar modules will be calculated using the following methodology:

- First, the product of the PAA and the hangar ratio (hangar ratios are shown in Table 21105-2) will be rounded up to the next integer for any values ending with a fraction of 0.3 or above for the Navy. For the USMC, rounding will follow conventional method (i.e., numbers with a fraction of 0.5 or more will be rounded up to the next integer). The figure will be rounded down for numbers with a fraction less than 0.5.

- Second, the calculated hangar modules will be normalized up to the next 0.5 module to determine the required hangar modules.

This methodology is expected to provide additional hangar spaces for PMI at Navy/USMC installations. For Navy hangars, if an additional designated space is required for PMI, one more space with spread configuration will be provided per Type/Model/Series per installation. This additional requirement must be verified with Commander, Naval Air Force Command (CNAF).

Sensitive Compartmented Information Facility (SCIF)/Special Access Program – Facility (SAP-F): SCIF/SAP-F requirements are design features in DOD ICD 705 incorporated in various functional spaces to allow for the dissemination of sensitive information. Spaces in the 01 and 02 functional areas may require SCIF design features. The mission of the squadron determines whether or not certain spaces in the 01 and 02 functional areas require SCIF design features. SCIF design features typically include shielding of walls, floors, ceilings, and doors; and secure systems such as security, telephone, network, electrical, and room acoustics.

Table 21105-2
Navy and Marine Corps Squadron Types
with
Aircraft and Aircraft Designations

Acronym	Squadron Designation	Aircraft TMS	Squadron Type	Hangar Ratio
Operational Squadrons – Navy				
HS	Helicopter Antisubmarine Squadron	HH-60H SH-60F	OP – Rotary	1/3
HSC	Helicopter Sea Combat Squadron	HH-60H MH-60S SH-60F	OP – Rotary	1/3
HM	Helicopter Mine Countermeasures Squadron	MH-53E	OP - Rotary	1/3
HSL	Helicopter Antisubmarine Squadron (Light)	SH-60B SH-60F	OP - Rotary	1/3
HSM	Helicopter Maritime Strike Squadron	MH-60R	OP - Rotary	1/3
VAQ	Carrier Tactical Electronics Warfare Squadron or Tactical Electronics Warfare Squadron	EA-6B EA-18G	OP - Carrier	1/3
VAW	Carrier Airborne Early Warning Squadron	E-2C E-2D	OP - Carrier	1/3
VFA	Strike Fighter Squadron	F/A-18A F/A-18B F/A-18C F/A-18D F/A-18E F/A-18F JSF	OP - Carrier	1/3
VP	Patrol Squadron	P-3C	OP - Patrol	1/6
		P-8A		Note 1
VPU	Patrol Squadron Special Unit	P-3C	OP - Special Mission	1/6
VQ	Fleet Air Reconnaissance Squadron	P-3C EP-3E	OP - Special Mission	1/6
		EPX E-6B	OP - Special Mission	1/6
VRC	Fleet Logistics Support Squadron	C-2A	OP - Carrier	1/3
VS	Sea Control Squadron	S-3B	OP - Carrier	1/3
BAMS	Broad Area Maritime Surveillance Squadron	UAS	OP – UAS	1/2
TUAV	Tactical Unmanned Aerial Vehicle Squadron	MQ-8B	OP - UAS	TBD

Acronym	Squadron Designation	Aircraft TMS	Squadron Type	Hangar Ratio
Training Squadrons – Navy				
HM (FRS)	Helicopter Mine Countermeasures Squadron (Fleet Replacement Squadron)	MH-53E	TRG – Rotary	1/3
HS (FRS)	Helicopter Antisubmarine Squadron (Fleet Replacement Squadron)	HH-60H SH-60F	TRG – Rotary	1/3
HSC (FRS)	Helicopter Sea Combat Squadron (Fleet Replacement Squadron)	HH-60H MH-60S SH-60F	TRG - Rotary	1/3
HSL (FRS)	Helicopter Antisubmarine Squadron (Light) (Fleet Readiness Squadron)	SH-60B	TRG - Rotary	1/3
HSM (FRS)	Helicopter Maritime Strike Squadron (Fleet Replacement Squadron)	MH-60R	TRG - Rotary	1/3
JSFTS	Joint Strike Fight Training Squadron	F-35C	TRG - Carrier	1/3
VAQ (FRS)	Carrier Tactical Electronics Warfare Squadron or Tactical Electronics Warfare Squadron (Fleet Replacement Squadron)	EA-6B EA-18G	TRG - Carrier	1/3
VAW (FRS)	Carrier Airborne Early Warning Squadron and Fleet Logistics Support Squadron (Fleet Replacement Squadron)	E-2C E-2D C-2A TE-2C	TRG - Carrier	1/3
VFA (FRS)	Strike Fighter Squadron (Fleet Replacement Squadron)	F/A-18A F/A-18B F/A-18C F/A-18D F/A-18E F/A-18F T-34C	TRG - Carrier	1/3
VP (FRS)	Patrol Squadron (Fleet Readiness Squadron)	P-3C P-8A	TRG – Patrol	1/6 Note 1
BAMS (FRS)	Broad Area Maritime Surveillance (Fleet Replacement Squadron)	UAS	TRG – UAS	1/2
EPX (FRS)	Fleet Air Reconnaissance Squadron (Fleet Replacement Squadron)	TBD	TRG - Special Mission	1/6
HT	Helicopter Training Squadron	TH-57B TH-57C TH-57D	TRG – New Pilot	1/6
VT	Training Squadron	T-2C T-34C T-39G T-39N T-44A T-44C T-45A T-45C T-6A T-6B TC-12B	TRG – New Pilot	1/6 1/6 1/6 1/6 0.28 (Note 2) 0.28 (Note 2) 1/6 1/6 0.39 (Note 2) 0.39 (Note2) 1/6

Acronym	Squadron Designation	Aircraft TMS	Squadron Type	Hangar Ratio
Other – Navy				
N/A	Search and Rescue	SH-60F MH-60S	OTH(N) – SAR	1/6
N/A	Station Support Aircraft	C-26D MH-60S SH-60F T-34C UC-12B UC-12F UC-12M	OTH(N) – Station	1/6
NTPS	Navy Test Pilot School	C-12C F/A-18B F/A-18F NP-3D NU-1B NSH-60B OH-58C T-6A T-6B TH6REP U-6A UH-60L X-26A	OTH(N) – NTPS	1/6
NSAWC	Naval Strike and Air Warfare Center	E-2C E-2D F-16A F-16B F-35C F/A-18A F/A-18B F/A-18C F/A-18D F/A-18E F/A-18F MH-60S	OTH(N) – NSAWC	1/6
Operational Squadrons – Marine Corps				
HMH	Marine Heavy Helicopter Squadron	CH-53D CH-53E CH-53K	OP - Rotary	1/3
HMLA	Marine Light Attack Helicopter Squadron	AH-1W AH-1Z UH-1Y	OP - Rotary	1/3
HMM	Marine Medium Helicopter Squadron	C-46E	OP - Rotary	1/3
HMX	Marine Helicopter Squadron	CH-46E VH-3D	OP-Rotary	1/3

Acronym	Squadron Designation	Aircraft TMS	Squadron Type	Hangar Ratio

Acronym	Squadron Designation	Aircraft TMS	Squadron Type	Hangar Ratio
		VH-60N VH-71A VH-71B		
		CH-53E	OP-Rotary	1/3
		MV-22B	OP-Tilt-Rotor	1/3
VMA	Marine Attack Squadron	AV-8B	OP – Carrier	1/3
VMAQ	Marine Tactical Electronics Warfare Squadron	EA-6B	OP – Carrier	1/3
VMFA	Marine Fighter Attack Squadron	F/A-18A F/A-18C JSF	OP – Carrier	1/3
VMFA(AW)	Marine All-Weather Fighter Attack Squadron	F/A-18C F/A-18D JSF	OP – Carrier	1/3
VMGR	Marine Aerial Refueler Transport Squadron	KC-130J KC-130R	OP – Special Mission	1/6
VMM	Marine Medium Tilt-Rotor Squadron	MV-22B	OP – Tilt-Rotor	1/3
Training Squadrons – Marine Corps				
VMAT	Marine Attack Training Squadron	AV-8B TAV-8B	TRG – Carrier	1/3
HMLAT	Marine Light Attack Helicopter Training Squadron	AH-1W AH-1Z HH-1N UH-1N UH-1Y	TRG – Rotary	1/3
HMMT	Marine Medium Helicopter Training Squadron	C-46E	TRG – Rotary	1/3
HMT	Marine Helicopter Training Squadron	CH-53E CH-53K	TRG – Rotary	1/3
VMAQ	Marine Tactical Electronics Warfare Squadron	EA-6B	TRG – Carrier	1/3
JSFTS	Joint Strike Fighter Training Squadron	F-35B(JSF)	TRG – Carrier	1/3
VMFAT	Marine Fighter Attack Training Squadron	F/A-18A F/A-18B F/A-18C F/A-18D T-34C	TRG – Carrier	1/3
HMLAT	Marine Light Attack Helicopter Training Squadron	AH-1W AH-1Z HH-1N UH-1N UH-1Y	TRG - Rotary	1/3
VMGR (FRS)	Marine Aerial Refueler Transport Squadron	KC-130R	TRG – Special Mission	1/6
VMMT	Marine Medium Tiltrotor Training Squadron	MV-22B	TRG – Tilt-Rotor	1/3
Other - Marine Corps				
N/A	Station Support	HH-1N UH-1Y	OTH(MC) - Station	1/6

Acronym	Squadron Designation	Aircraft TMS	Squadron Type	Hangar Ratio
Reserve Force – Navy				
HSC	Helicopter Sea Combat Squadron	HH-60H MH-60S	RES - Rotary	1/3
Acronym	**Squadron Designation**	**Aircraft TMS**	**Squadron Type**	**Hangar Ratio**
HM	Helicopter Mine Countermeasures Squadron	MH-53E	RES - Rotary	1/3
HSL	Helicopter Antisubmarine Squadron (Light)	SH-60B	RES - Rotary	1/3
HSM	Helicopter Maritime Strike Squadron	MH-60R	RES - Rotary	1/3
VAQ	Carrier Tactical Electronics Warfare Squadron or Tactical Electronics Warfare Squadron	EA-6B	RES - Carrier	1/3
VAW	Carrier Airborne Early Warning Squadron	E-2C	RES - Carrier	1/3
VFA	Strike Fighter Squadron	F/A-18A	RES - Carrier	1/3
VFC	Fighter Squadron Composite	F-5F F-5N F/A-18C JSF	RES - Carrier	1/3
VP	Patrol Squadron	P-3C	RES - Patrol	1/6
VR	Fleet Logistics Support Squadron	C-130T C-20D C-20G C-37B C-40A C-9B DC-9	RES - Transport	1/9
ETD	Executive Transport	C-20A C-37A	RES – Transport	1/1
N/A	Miscellaneous Station Support	UC-12B	RES - Station	1/6

Acronym	Squadron Designation	Aircraft TMS	Squadron Type	Hangar Ratio
Reserve Force – Marine Corps				
HMLA	Marine Light Attack Helicopter Squadron	AH-1W AH-1Z UH-1N UH-1Y	RES - Rotary	1/3
HMM	Marine Medium Helicopter Squadron	CH-46E	RES - Rotary	1/3
HMH	Marine Heavy Helicopter Squadron	CH-53E	RES – Rotary	1/3
VMFA	Marine Fighter Attack Squadron	F/A-18A F/A-18C JSF	RES - Carrier	1/3
VMFT	Marine Fighter Training Squadron (Adversary)	F-5F F-5N	RES - Carrier	1/3
VMGR	Marine Aerial Refueler Transport Squadron	KC-130J KC-130T	RES - Special Mission	1/6
VMM	Marine Medium Tiltrotor Squadron	MV-22B	RES - Rotary	1/3
VMR	Marine Transport Squadron	C-20G	RES – Transport	1/9

Acronym	Squadron Designation	Aircraft TMS	Squadron Type	Hangar Ratio
		C-9B HH-46E UC-12B UC-12F UC-35C UC-35D		
N/A	Station Support Aircraft	UC-12B	RES - Station	1/6

Note

1. Based on scheduled maintenance loading of 48% and unscheduled maintenance loading of 52% P-8A VP squadrons experienced over the 4-year period ending 2019, the effective hangar ratio is determined to be to ¼, or 0.25. This ratio applies as an interim update (Source: PMA-290 criteria inquiry dated 21 February 2020).
2. Based on updated maintenance records submitted by Commander, Naval Training Command (CNATRA) with a criteria update request of December 2020.

Table 21105-3
Aircraft Widths and
Hangar Space Requirements

Aircraft TMS	Hangar Type	Width Wings Spread (meters)	Width Wings Spread (ft-in)	Width Wings Folded (meters)	Width Wings Folded (ft-in)	Overall Height (meters)	Overall Height (ft-in)	Length (meters)	Length (ft-in)
AH-1W	I	14.63	48-0	3.28 (2)	10-9 (2)	4.32	14-2	17.68	58-0
AH-1Z	I	14.48	47-6	4.60 (2)	15.1 (2)	4.37	13-6	13.87	45-6
AV-8B	I	9.25	30-4	N/A	N/A	3.55	11-7	14.13	46-4
BAMSUAS	II	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
C-12C	I	16.62	54-6	N/A	N/A	4.57	15-0	13.36	43-10
C-130T	II	40.40	132-7	N/A	N/A	11.69	38-4	29.83	97-10
C-20A	II	23.72	77-10	N/A	N/A	7.47	24-6	25.56	83-10
C-20D	II	23.72	77-10	N/A	N/A	7.47	24-6	25.56	83-10
C-20G	II	23.72	77-10	N/A	N/A	7.47	24-5	26.96	88-5
C-26D	I	17.38	57-0	N/A	N/A	5.09	16-8	18.11	59-5
C-2A	I	24.56	80-7	10.80 (1)	35-5 (1)	5.18	17-0	17.56	57-7
C-37A	II	28.50	93-6	N/A	N/A	7.90	25-10	29.39	96-5
C-37B	II	28.50	93-6	N/A	N/A	7.90	25-10	29.39	96-5
C-40A	III	35.8	117-5	N/A	N/A	12.55	41-2	33.64	110-4
C-9B	II	28.43	93-3	N/A	N/A	8.36	27-5	36.38	119-4
CH-46E	I	15.54	51-0	4.50 (2)	14-9 (2)	5.09	16-8	25.71	84-4
CH-53D	II	22.01	72-2.7	7.29 (2)	23-11 (2)	7.60	24-11	20.55	67-5
CH-53E	II	24.08	79-0	8.66 (2)	28-5 (2)	7.19	23-7	30.18	99-0
CH-53K	II	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
DC-9	II	28.43	93-3	N/A	N/A	8.36	27-5	36.38	119-4
E-2C	I	24.56	80-7	10.80 (1)	35-5 (1)	5.58	18-3.75 (4)	17.53	57-6
E-2D	I	24.56	80-7	10.80 (1)	35-5 (1)	5.58	18-3.75 (4)	17.53	57-6
E-6B	N/A	45.21	148-4	N/A	N/A	12.93	42-5	45.83	150-4
EA-18G	I	13.69	44-11	9.96	32-8	4.89	16-0	18.31	60-1.25
EA-6B	I	16.15	53-0	7.60	24-11	5.08 (5)	16-8 (5)	18.24	59-10
EP-3E	II	30.33	99-6	N/A	N/A	10.24	33-7	35.54	116-7
EPX	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
F-16A	I	9.93	32-7	N/A	N/A	5.06	16-7	15.09	49-6
F-16B	I	9.93	32-7	N/A	N/A	5.06	16-7	15.09	49-6
F-35A	I	10.67	35-0	N/A	N/A	4.33	14-3	15.40	50-6
F-35B	I	10.67	35-0	N/A	N/A	4.31	14-2	15.40	50-6
F-35C	I	13.11	43-0	9.54	31-3	4.42	14-6	15.50	50-10
F-5F	I	8.13	26-8	N/A	N/A	4.00	13-1	15.73	51-7
F-5N	I	8.13	26-8	N/A	N/A	4.07	13-4	14.68	48-2
F/A-18A	I	11.43	37-6	8.38	27-6	4.67	15-4	17.07	56-0
F/A-18B	I	11.43	37-6	8.38	27-6	4.67	15-4	17.07	56-0
F/A-18C	I	12.32	40-5	8.38	27-6	4.67	15-4	17.07	56-0
F/A-18D	I	12.32	40-5	8.38	27-6	4.67	15-4	17.07	56-0
F/A-18E	I	13.68	44-9	9.96	32-8	4.88	16-0	18.39	60-4

Aircraft TMS	Hangar Type	Width Wings Spread (meters)	Width Wings Spread (ft-in)	Width Wings Folded (meters)	Width Wings Folded (ft-in)	Overall Height (meters)	Overall Height (ft-in)	Length (meters)	Length (ft-in)
F/A-18F	I	13.68	44-9	9.96	32-8	4.88	16-0	18.39	60-4
GHMD	II	35.42	116-2	N/A	N/A	4.62	15-2	14.63	48-0
HH-1N	I	14.63	48-0	2.81 (2)	9-2.6 (2)	4.39	14-5	17.48	57-4
HH-46E	I	15.55	51-0	4.50 (2)	14-9 (2)	5.08	16-8	13.92	45-8
HH-60H	I	16.36	53-8	4.37 (2)	14-4 (2)	5.18	17-0	14.25	46-9
KC-130F	II	40.41	132-7	N/A	N/A	11.71	38-5	29.80	97-9
KC-130J	II	40.41	132-7	N/A	N/A	11.71	38-5	29.80	97-9
KC-130R	II	40.41	132-7	N/A	N/A	11.71	38-5	29.80	97-9
KC-130T	II	40.41	132-7	N/A	N/A	11.71	38-5	29.80	97-9
MH-53E	II	24.08	79-0	8.41 (2)	27-7 (2)	8.64	28-4	30.18	99-0
MH-60R	I	16.36	53-8	4.37 (2)	14-4 (2)	5.13	16-10	19.74	64-9
MH-60S	I	16.36	53-8	4.37 (2)	14-4 (2)	5.10	16-8	19.74	64-9
MQ-8B	I	8.38	27-6	1.88 (2)	6-2 (2)	2.87	9-5	9.60	31-6
MV-22B	II	25.82 (3)	84-7 (3)	5.61 (3)	18-5 (3)	6.73 (6)	22-1 (6)	17.50	57-4
NC-130H	II	40.41	132-7	N/A	N/A	11.71	38-5	29.80	97-9
NF/A-18C	I	12.32	40-5	8.38	27-6	4.67	15-4	17.07	56-0
NF/A-18D	I	12.32	40-5	8.38	27-6	4.67	15-4	17.07	56-0
NP-3C	II	30.38	99-8	N/A	N/A	10.26	33-8	35.61	116-9
NP-3D	II	30.38	99-8	N/A	N/A	10.26	33-8	35.61	116-9
NU-1B	I	17.68	58-0	N/A	N/A	3.79	12-5	12.75	41-10
NAV-8B	I	9.25	30-4	N/A	N/A	3.55	11-7	14.13	46-4
NC-12B	I	16.62	54-6	N/A	N/A	4.57	15-0	13.34	43-9
NSH-60B	I	16.36	53-8	4.37 (2)	14-4 (2)	4.57	15-0	19.76	64-9
NSH-60F	I	16.36	53-8	4.37 (2)	14-4 (2)	4.57	15-0	19.76	64-9
NVH-3A	I	18.90	62-0	4.98 (2)	16-4 (2)	5.18	17-0	22.18	72-9
NVH-3D	I	18.90	62-0	4.98 (2)	16-4 (2)	5.18	17-0	21.90	73-0
OH-58C	I	10.77	35-4			2.92	9-7	12.85	42-2
P-3C	II	30.38	99-8	N/A	N/A	10.26	33-8	35.61	116-9
P-8A	III	37.96	124-6	N/A	N/A	12.86	42-2	39.48	129-6
RC-12F	I	16.62	54-6	N/A	N/A	4.57	15-0	13.36	43-10
RC-12M	I	16.62	54-6	N/A	N/A	4.57	15-0	13.36	43-10
S-3B	I	20.93	68-8	8.99	29-6	6.94	22-9	16.26	53-4
SH-60B	I	16.36	53-8	4.37 (2)	14-4 (2)	4.57	15-0	19.76	64-9
SH-60F	I	16.36	53-8	4.37 (2)	14-4 (2)	4.57	15-0	19.76	64-9
T-2C	I	11.64	38-2	N/A	N/A	4.50	14-9	11.79	38-8
T-34C	I	10.19	33-5	N/A	N/A	3.02	9-11	8.74	28-8
T-38C	I	7.70	25-3	N/A	N/A	3.92	12-10.5	14.14	46-4.5
T-39D	I	13.61	44-8	N/A	N/A	4.88	16-0	13.41	44-0
T-39G	I	13.57	44-6	N/A	N/A	4.88	16-0	13.31	43-8
T-39N	I	13.57	44-6	N/A	N/A	4.88	16-0	14.28	46-10
T-44A	I	15.32	50-3	N/A	N/A	4.37	14-4	10.82	35-6
T-44C	I	14.00	45-11	N/A	N/A	4.70	15-5	12.17	39-11
T-45A	I	9.40	30-10	N/A	N/A	4.12	13-6	11.99	39-4

Aircraft TMS	Hangar Type	Width Wings Spread (meters)	Width Wings Spread (ft-in)	Width Wings Folded (meters)	Width Wings Folded (ft-in)	Overall Height (meters)	Overall Height (ft-in)	Length (meters)	Length (ft-in)
T-45C	I	9.40	30-10	N/A	N/A	4.12	13-6	11.99	39-4
T-6A	I	10.18	33-5	N/A	N/A	3.30	10-10	10.16	33-4
T-6B	I	10.18	33-5	N/A	N/A	3.25	10-3	10.16	33-4
TAV-8B	I	9.25	30-4	N/A	N/A	3.53	11-7	11.08	36-4
TC-12B	I	16.61	54-6	N/A	N/A	4.52	14-10	13.36	43-10
TE-2C	I	24.57	80-7	N/A	N/A	5.59	18-4	17.53	57-6
TH-57B	I	10.16	33-4	1.92 (2)	6-3.5 (2)	3.05	10-0	12.09	39-8
TH-57C	I	10.16	33-4	1.92 (2)	6-3.5 (2)	3.05	10-0	12.09	39-8
TH-57D	I	10.16	33-4	1.92 (2)	6-3.5 (2)	3.05	10-0	12.09	39-8
TH-6B	I					2.30	7-6.7	9.25	30-4
TH6REP	TBD								
U-6A	I	14.63	48-0	N/A	N/A	2.74	9-0	9.24	30-4
UC-12B	I	16.61	54-6	N/A	N/A	4.52	14-10	13.36	43-10
UC-12F	I	16.61	54-6	N/A	N/A	4.52	14-10	13.36	43-10
UC-12M	I	16.61	54-6	N/A	N/A	4.52	14-10	13.36	43-10
UC-35C	I	15.90	52-2	N/A	N/A	4.57	15-0	14.91	48-11
UC-35D	I	16.46	54-0	N/A	N/A	4.62	15-2	14.91	48-11
UH-1N	I	14.63	48-0	2.81 (2)	9-2.6 (2)	4.54	14-11		
UH-1Y	I	14.88	48-10			4.50	14-7	17.78	58-4
UH-3H	I	19.00	62-0			5.13	16-10	16.70	54-9
UH-60L	I	16.36	53-8			5.13	16-10	19.76	64-10
VH-3D	I	18.90	62-0	4.98 (2)	16-4 (2)	5.13	16-10	16.70	54-9
VH-60N	I	16.36	53-8			5.13	16-10	19.76	64-10
VH-71A	I	18.59	61-0			6.65	21-10	22.81	74-10
VH-71B	I	18.59	61-0			6.65	21-10	22.81	74-10
X-26A	I	17.42	57-1.5	N/A	N/A	2.82	9-3		

Table 21105-3 Notes:
(1) Propeller disc span, which exceeds folded wing dimension.
(2) Minimum aircraft width with rotors in line with or folded in line with aircraft fuselage.
(3) MV-22 aircraft has multiple stow positions: Flight Ready Position = 25.816 meters (84'7"), Fold Horizontal Position = 16.154 meters (53'0"), Fold Vertical Position = 16.495 meters (54'1"), and Full Stow Position = 5.613 meters (18'5"). Use Flight Ready Position for Wings Spread width and Full Stow Position for Wings Folded width.
(4) Height with rotodome in raised position.
(5) Height with wings folded. Maximum height during wing folding procedure is 6.57 meters (21'6.8"). Aircraft height with wing extended is 4.95 meters (16'3"). Group the total aircraft non-standard loading by type, model, and series and apply the following formulas to each group. Combine the results of each calculation into Type I and Type II module requirements to obtain the required hangar widths to perform both scheduled and unscheduled maintenance in each type of hangar.
(6) Height for spread configuration. If aircraft in folded configuration then height reduced to 5.51 meters (18'1").

Calculating OH Space

Given the standard size of the OH space described previously, when planning OH space, planners shall follow the process below for determining the number of standard hangar modules required, and the gross square feet required.

1. *Gather data input*

Important data is necessary to select and apply correct formula to determine the number of hangar modules required. Data inputs include the following:

- Squadron service type (i.e., Navy or Marine Corps)
- Number of Primary Aircraft Authorized (PAA) for squadron
- Airframe assigned
- Width of aircraft with wings spread (for fixed-wing aircraft)
- Width of aircraft with wings folded (for fixed-wing aircraft)
- Rotor diameter when rotors are spread (for Tilt-Rotor aircraft, Rotor Spread is Flight Ready Position)
- Width of aircraft when rotors are folded or minimum aircraft width with rotors in line or folded in line with aircraft fuselage (for Tilt-Rotor aircraft Rotor Fold is Full Stow Position)

2. *Calculate the required hangar width (RHW) using formulas in Table 21105-4 as follows:*

Using the formulas in Table 21105-04 that includes the following variables:

N = Number of Primary Assigned Aircraft (PAA)

WS = Width of aircraft with wings spread (See Table 21105-3)

WF = Width of aircraft with wings folded (See Table 21105-3)

W = Width of aircraft for aircraft with wings that do not fold

D = Clearance between wingtips and walls or other wingtips, that is 7.5 feet

RS = Rotor diameter when rotors are spread (for Tilt-Rotor aircraft, RS is Flight Ready Position)

RF = Width of aircraft with rotors folded or minimum aircraft width with rotors in line or folded in line with aircraft fuselage (for Tilt-Rotor aircraft RF is Full Stow Position)

Table 21105-4
Required Hangar Width Formulas

Aircraft Type	Required Hangar Width Formula
Carrier Aircraft[1,2,3]	(1 x WS) + (N/3 x WF) + [(N/3 + 1) x D] + WS (for IMP)
Rotary Wing Aircraft[1,2,3]	0.25 x N/3 x RS + 0.75 x N/3 x RF + [(N/3 + 1) x D] + RS (for IMP)
Patrol, Special Mission, and Training Aircraft[2]	N/6 x W + [(N/6 + 1) x D] + W (for IMP)
Transport Aircraft[2]	N/9 x W + [(N/9 + 1) x D] + W (for IMP)
Tilt-Rotor Aircraft[1,2.3]	0.75 x N/3 x RS + 0.25 x N/3 x RF + [(N/3 +1) x D] + RS (for IMP)
Executive Transport Aircraft[2]	N/1 x W + [(N/1 + 1) x D]

[1]If an additional PMI bay is required, add space for WS and D.

[2]When performing calculations for determining the number of aircraft to a hangar, the Navy will incorporate the rounding down of a number when that number is less than 0.3 and rounding up when the number is equal to 0.3 or greater.

[3]For determining the number of aircraft in a hangar for the Marine Corps, use the conventional rounding method, and round up to the nearest whole number when the number is 0.5 or higher.

3. *Determine the number of standard modules required*

Divide the RHW by 212 feet for Navy and 262.5 feet for Marine Corps for partial modules. To determine the number of standard modules required, normalize partial modules as follows:

(a) Less than one module, one module is required.

(b) More than one module but equal one and one half modules, one and a half modules are required

(c) More than one and one half module but less than two modules, two modules are required

(d) Additional modules are determined on the same basis.

4. Calculate the gross square footage (GSF) required

Multiply the net square feet of the standard one-module hangar for either the Navy or Marine Corps by the number of standard modules required then by the1.12 net-to-gross ratio for the GSF required.

Sample Calculation

1. *Gather data inputs*

   Squadron Service: Navy
   Number of PAA: 14 aircraft
   Aircraft Variance: F-35C aircraft
   F-35C wings spread = 43 feet
   F-35C wings folded = 31 feet
   Hangar Ratio: PAA x hangar ratio

2. *Calculate the required hangar width (RHW)*

   N = 14 aircraft

   Hangar Ratio = 14/3
   = 4.66
   = 5 (Round up from 4.66)

RWH = (1 x WS) + (N/3 x WF) + [(N/3 + 1) x D] + WS
= (1 x 43') + (5 x 31') + [(5 + 1) x 7.5'] + 43'
= 43' + 155' + 45' + 43'
= 286'

3. *Determine the number of standard modules required*

   Partial modules = RHW / Standard Module Width
   = 286'/212'
   = 1.34
   = 2 (Round up from 1.34)

   Number of standard modules required = 2.0

4. *Calculate the GSF required*

   GSF = 2 x 212' x 95' x 1.12
   = 45,114 SF

21105/06/07-2.2. **Category Code 211 06 – 01 Space.**

(1) One Type I standard hangar module 01 space will be planned for each standard size squadron with ten to eighteen carrier aircraft.

(2) One half Type I standard hangar module 01 space will be planned for each standard size squadron with four to six carrier aircraft.

(a) Provide a minimum of 520.5 m^2 (5,600 SF) per squadron when two squadrons share the same Type I standard hangar module.

(3) One Type II standard hangar module 01 space will be planned for each standard size MV-22 squadron with ten to sixteen aircraft

(4) One Type III standard hangar module 01 space will be planned for each standard size squadron with six to twelve land based patrol aircraft.

(5) As with the aircraft, the personnel of all the other (non-standard) squadrons or units that operate aircraft, except Fleet Readiness Squadrons (FRS) and other training squadrons, will be combined. The authorized 01 space will be computed at the rate of 3 m^2 (32.5 SF) per person for this combined total complement. Movable partitions within the 01 space will facilitate prorating of area for non-standard size squadrons and units.

(6) Squadrons operating with detachments, such as the HSL squadrons, are authorized an additional 19 m^2 (200 SF) of 01 space per detachment based on the average number of detachments on board.

(7) Squadrons with a cargo/passenger transport mission are authorized additional 01 space for the storage of aircraft equipment as follows:

Helicopters and carrier aircraft – 2 m^2 (25 SF) per aircraft.

Multi-engine land based aircraft – 5 m^2 (50 SF) per aircraft.

(8) Since line operations and line maintenance functions must be performed as close as possible to the apron parked aircraft of a squadron, an additional 27.9 m^2 (300 SF) is authorized per squadron. Note, if line operations and line maintenance is currently provided in separate structures, use Category Code 141 30 Aircraft Line Operations Building

and Category Code 211 15 Line Maintenance Shelter for inventory purposes only.

(9) The authorized 01 space for FRS and other training squadrons will be computed at the rate of 3 m^2 (32.5 SF) per permanent billet, less the training department. An additional 12 m^2 (125 SF) per student based on the average on board student load is authorized under Applied Instruction Building (Category Code 171 20) (Flight Training and Briefing Building). The training department billets are deleted from the squadron's complement for requirements calculations as space for these billets is included in the student allowance of 12 m^2 (125 SF). In many squadrons, it may be desirable to locate all, or a portion of the student space allowance in a separate facility or to combine it with the Operational Trainer Facility (Category Code 171 35) (Flight Simulator).

(10) The width of the 01 spaces shall not exceed the width of the computed number of OH modules; however, should the computed 01 space requirement exceed the 01 space available in the computed number of OH modules by twenty percent, authorization for deviations from standard hangar dimensions (see paragraph 1. Design Considerations) may be requested from Commander, Naval Air Systems Command (AIR-8.0Y1).

Maintenance shops compose the majority of the 01 space. Planning factors for 01 space for F-35 aircraft are shown on Tables 21105-4 and 21105-5. Space within the maintenance shops is allocated by the work center planning factor (presented in square feet per work center) and the number of people in each work center. The number of work centers planned per maintenance shop is determined by multiplying the PAA by the hangar ratio (from Table 21105-2). The planning factor for each work center usually accommodates 2-4 maintenance personnel and includes space (based on function) for a computer monitor, worktables/benches, short- term material/tool storage, and internal circulation. For example, the airframes maintenance shop has a recommended planning factor of 350 square feet (SF) per work center. If 10 aircraft are assigned to an F-35C squadron with a 1/3 hangar ratio, three work centers are required to accommodate 6-12 people; therefore, the net area for work centers in the airframe shop is 1,050 SF. In order to account for the variability in shop work schedules and personnel working between the shop and the OH space, use conventional rounding based on the 1/3 hangar ratio for maintenance shop work centers.

Table 21105-5
01 Space Calculations for F-35C and F-35B

CATEGORY	Unit	Unit Metric	Unit Factor	Each F-35C	Each F-35B	Planning Metrics		Space Req't (SF) F-35C	Space Req't (SF) F-35B
SHOPS									
Airframes	Work Centers[1]	0.33	per PAA	3	5	350	SF per Work Center	1,050	1,750
Avionics / Electricians (AT/AE)	Work Centers	0.33	per PAA	3	5	150		450	750
Avionics Vault	Storage Area	0.12	% of Avionics	1.0	1.0	20	% of Avionics room	90	150
Aviation Ordnance (AO)	Work Centers	0.33	per PAA	3	5	200	SF per Work center	600	1,000
Life Support (PR)[2]	Lockers	1.00	per Aircrew	18	24	45	SF per Aircrew	810	1,080
Line Operations	Work Centers	0.33	per PAA	3	5	200	SF per Work Center	600	1,000
Low Observability (LO) Maintenance	Work Centers	0.33	per PAA	3	5	150		450	750
Power Plant	Work Centers	0.33	per PAA	3	5	200		600	1,000
Seat & Canopy Maintenance / AME	Work Centers	1	per PAA	1	1	1000		1,000	1,000
Tool Room	Work Centers	0.33	per PAA	3	5	400		1,200	2,000
PMI Work Area	Each	1	per PAA	1	-	1000	SF per Room	1,000	1,000
Training Room	People	0.15	per Primary Shift	17	25	20	SF per Person	340	500
01 Shops Subtotal								**8,190**	**11,980**
MAINTENANCE ADMINISTRATION[3]									
Ordnance	People	1.00	per Room	1	1	90	SF per Person	90	90
Life Support (PR)	People	1.00	per Room	1	1	90		90	90
Division Office[4]	People	4.00	per Room	4	4	90		360	360
Maintenance Control Area	People	0.05	per Primary Shift	5	8	75		375	600
Maintenance Vault Room	Area	1.00	per Maintenance Control Area	-	-	20	% of Maintenance Control Room	75	120
Maintenance Admin Office	People	1.00	per Primary Shift	-	8	65		-	520
Maintenance Chief	People	1.00	per Room	1	1	90	SF per Person	90	90
Maintenance Officer	People	1.00	per Room	1		90		90	90
Maintenance/Material Control Officer (MCO/MMCO)	People	1	per Room	1	1	90		90	90
Quality Assurance Officer/Assistant	People	1.00	per Room	1	1	90		90	90
Quality Assurance/Quality Control (QA/QC)	People	9.00	per Room	5	8	75		375	600
01 Administration Subtotal								**1,725**	**2,740**
SUPPORT SPACES									
Storage	Room	1.00	per Aircraft	5	6	650	SF Per Aircraft in Hangar Bay	3,250	3,900
Breakroom	People	0.45	per Room	68	99	6	45% of Primary Shift X 6 SF	408	594
Duty/Bunk Room	People	1.00	per Room	1	1	125	SF per Room	125	125
Men's Locker Room[5]	People	0.70	per Room	80	118	4.5	70% of Maint Persons X 4.5 SF	360	531
Women's Locker Room[5]	People	0.30	per Room	34	50	5.5	30% of Maint Persons X 5.5 SF	187	275
01 Support Subtotal								**4,330**	**5,425**
NET 01 SPACE								**14,245**	**20,145**
GROSS 01 SPACE (Net-to-Gross Factor 1.38)								**19,658**	**27,800**

Notes: [1]A single Work Center equates to approximately 2-4 people and planning metric includes space (based on function) for computer desks, work tables/benches, storage, and circulation. [2] Includes flight equipment lockers and applicable work centers. [3] For maintenance administration area calculations, planners can use the 61010 guidance, which provides a maximum allowance of 162.5 GSF per person. [4] Includes Airframes officer, Avionics officer Powerplant officer, and Line officer. [5]Percentages for planning metrics need adjustment for male-female populations.

21105/06/07-2.3. **Category Code 211-07 – 02 Space.**

(1) One Type I standard hangar module 02 space will be planned for each standard size squadron with twelve to eighteen carrier aircraft.

(2) One half Type I standard hangar module 02 space will be planned for each standard size squadron with four to six carrier aircraft.

(3) One Type II standard hangar module 02 space will be planned for each standard size MV-22 squadron with ten to sixteen aircraft

(4) One Type II standard hangar module 02 space will be planned for each standard size squadron with six to twelve land based patrol aircraft.
(5) As with the aircraft, the personnel of all the other (non-standard) squadrons or units that operate aircraft, except FRS and other training squadrons, will be combined. The authorized 02 space will be computed at the rate of 3 m^2 (32.5 SF) per person for this combined total complement. Movable partitions within the 02 space will facilitate prorating of area for non-standard size squadrons and units.

(6) Squadrons operating with detachments such as the HSL squadrons are authorized an additional 19 m^2 (200 SF) of 02 space per detachment based on the average number of detachments on board.

(7) An additional 8 m^2 (80 SF) per squadron of 02 space is authorized for computer equipment room.

(8) The authorized 02 space for FRS and other training squadrons will be computed at the rate of 3 m^2 (32.5 SF) per permanent billet, less than the training department billets.

(9) The width of the 02 spaces shall not exceed the width of the computed number of OH modules; however, should the computed 02 space requirement exceed the 02 space available in the computed number of OH modules by twenty percent, authorization for deviations from standard hangar dimensions (see paragraph 1. Design Considerations) may be requested from Commander, Naval Air Systems Command (AIR-8.0Y1).

1. Design Considerations

In planning the authorized 01 and 02 spaces, the standard hangar modules shown in UFC 4-211-01, as updated, should be used whenever possible; however, due to the large diversity in the size of squadrons and other units, it is realized that deviations from the

standard dimensions of 11.2 meters (36.8 feet) by 71.6 meters (235 feet) for Type I or 15.24 meters (50 feet) by 73.15 meters (240 feet) for Type II may be necessary.

2. Example

a. Background. A station supports 6 fleet operational F/A-18 squadrons. Each squadron has 12 aircraft and an average of 225 officers and enlisted. On average, one third of these squadrons are on extended deployment. In addition, the station supports an F/A-18A FRS operating 32 aircraft with an allowance of 600 officers and enlisted of which thirty-five are assigned to the training department. The squadron convenes 12 classes per year with 13 replacement pilots per class for a 24-week syllabus. Determine the number and type of maintenance hangars required to support these squadrons.

(1) The 6 fleet operational squadrons fit the criteria for standard size carrier type squadrons (12 to 18 carrier aircraft and 150 to 400 personnel); therefore, they each require one Type I hangar module. However, since one third of the squadrons normally are deployed, the station needs only 4 Type I modules to support the 6 squadrons.

(2) The FRS does not fit the criteria for any standard size squadron; therefore, its hangar requirements are determined using the criteria for non-standard squadrons.

Step 1. Determine RHW of O/H space. The F/A-18 is a carrier aircraft and requires one hangar space for every three aircraft. Total requirement is computed using the formula:

$$RHW = (N/3) \times (W) + ((N/3) - 1) \times (D) + 2 \times SC$$

$$RHW = (32/3) \times (8.38) + ((32/3) - 1) \times (1.52) + 2 \times (7.5)$$

$$RHW = (32/3) \times (27.5) + ((32/3) - 1) \times (5) + 2 \times (2.3)$$

RHW = 108.65 meters or two Type I modules (128.90 meters)

RHW = 356.47 feet or two Type I modules (424 feet)

Step 2. Determine required 01 space.

Personnel Allowance	600
Less Training Department Personnel	35
Total:	565

Space required for squadron personnel = (565) x (3) = 1,695 m^2 (18,363 SF)

Space required for line maintenance = 27.9 m^2 (300 SF)

Space for Mechanical/Electrical (AFFF) = 143 m^2 (1,536 SF)

Total 01 Space = 1,865.9 m^2 (20,199 SF)

Step 3. Determine required space 02.

Personnel Allowance	600
Less Training Department Personnel	35
	565

Space required for squadron personnel = (565) x (3) = 1,695 m^2 (18, 363 SF)

Space for Computer Equipment = 8 m^2 (80 SF)

Total 02 Space = 1,703 m^2 (18,443 SF)

Step 4. Determine required student support space.

Average student load =

((24 days) x (5 days/week) x (13 students) x (12 classes)) = 75
(250 classroom days)

Total Training Area =75 Students x 12 m^2 = 900 m^2 (9,375 SF)

Note: Training Area can be located in the aircraft hangar, in a separate facility, or combined with the Operational Trainer Facility (Category Code 171 35) (Flight Simulator).

(10) Every unit requires dedicated administration and support spaces accessible by all personnel in the unit at the unclassified level. These spaces are generally allocated by square feet per person and are very similar to general administrative spaces found in other areas of a military

installation. The administration and support areas are driven by the number of people in the squadron. The administration functions and support areas typically found in 02 space for a JSF squadron are listed in Table 21105-6. Depending on the PAA, more administration and support functions can be assigned to a squadron, in which case documentation must be provided for the additional space.

Table 21105-6
02 Space Calculations for F-35C and F-35B

CATEGORY	Unit	Unit Metric	Unit Factor	Each F-35C	Each F-35B	Planning Metrics		Space Req't (SF) F-35C	Space Req't (SF) F-35B
ADMINISTRATION									
Commanding Officer (CO)	People	1	per Room	1	1	200	SF per Person	200	200
Executive Officer (XO)	People	1	per Room	1	1	200		200	200
Senior Chief	People	1	per Room	1	1	150		150	150
Conference Room	Each	1	per Room	1	1	250	SF per Room	250	250
Reception/Waiting Area	Each	0.05	per Room	1	1	75		75	75
Administration Chief	People	1	per Room	1	1	110	SF per Person	110	110
Admin Personnel	People	6	per Room	4	6	90		360	540
Classified Material Control	People	1	per Room	1	1	110		110	110
Command Career Counselor	People	1	per Room	1	1	110		110	110
Family Readiness	People	1	per Room	1	1	110		110	110
Copy Room	Room	1	per Room	1	1	100	SF per Room	100	100
Flight Surgeon / Medical	People	2	per Room	2	1	100	SF per Physician (FC 2-000-05N, 61074)	200	100
Operations Administration	People	0.15	per Room	2	7	90	SF per Person	180	630
Operations Officer	People	1	per Room	1	1	110		110	110
Assistant Operations Officer	People	1	per Room	1	1	100		100	100
Scheduling	People	1	per Room	2	2	110		220	220
Intelligence Office	People	1	per Room	1	1	100		100	100
Logistics Staff	People	1	per Room	1	4	90		90	360
Logistics Officer	People	1	per Room	1	1	110		110	110
Safety Staff	People	1	per Room	2	3	90		180	270
Safety Officer	People	1	per Room	1	2	110		110	220
Information Systems	People	1	per Room	2	2	90		180	180
02 Administration Sub-total								**3,355**	**4,355**
OPERATIONS AND TRAINING									
Secured Operations Spaces 1	Work-spaces	20	per PAA	1	1	75	SF per workspace (flexible)	1,500	1,500
Secured Operations Spaces 2	Work-spaces	15	per PAA	1	1	100		1,500	1,500
Large Briefing Room(s)	People	1	per Room	2	3	300	SF per Room	600	900
Security Office	People	1	per Room	1	6	110	SF per Person	110	660
Secured Ready Room	People	1	per Pilot	18	24	35	SF per Person	630	840
Small Pilot Planning Rooms	Pilots	0.5	per Pilot	18	24	100	SF per Room	900	1,200
Server Room	Room	1	per PAA	1	1	750	SF per Squadron	750	750
Unisex Restroom	Each	1	per Room	1	1	75	SF per Restroom	75	75
02 Operations and Training Sub-total								**6,065**	**7,425**
SUPPORT SPACES									
First Lieutenant	People	0.10	per Room	1	-	90	SF per Room	90	-
Men's Locker Room[1]	People	0.70	per Room	25	37	4.5	70% of Off & Prof Persons X 4.5 SF	113	167
Breakroom	People	0.45	per Room	16	24	6	45% of Off & Prof Persons X 6 SF	96	144
Storage	Admin/Ops	0.03	per Room	1	1	3.0	% of Administration and Operations	283	353
Women's Locker Room[1]	People	0.30	per Room	11	16	5.5	30% of Off & Prof Persons X 5.5 SF	61	88
02 Support Sub-total								**642**	**752**
NET 02 SPACE								**10,062**	**12,532**
GROSS 02 SPACE (Net-to-Gross Factor 1.31)								**13,181**	**16,417**

Note: [1]Percentages for planning metrics need adjustment for male-female populations.

21105/06/07-2.4. **Type IV Unmanned Aircraft System Requirements.** The requirements of Unmanned Aircraft System (UAS) aircraft are unique and complex encompassing sensitive platform and functional space features. The current UAS aircraft is the MQ-4C Triton. The home basing plan for the Triton is four aircraft to a hangar.

OH Space

The Triton aircraft has a wingspan of 131 feet. The aircraft body, excluding the wings is five feet wide. The length of the aircraft is five feet. The length of the aircraft is 48 feet. All UAS aircraft must be kept in a hangar due to the sensitive components of the aircraft. The position of the aircraft is in two rows of two in the hangar bay. Two aircraft will be side by side and face the hangar door, and the other two aircraft will be in a position at the rear of the two rows of aircraft that face the hangar door.

Clearance Standards

The wingtip clearance between the aircraft is 30 feet. The clearance from the sides of the aircraft to the innermost protrusion from the hangar wall is 15 feet. The distance from the nose of the aircraft to the innermost protrusion of the hangar door is also 15 feet. The distance from the nose of the aircraft of the second row of aircraft to the tail of the first row of aircraft is 15 feet. The distance from the tail of the second aircraft to the innermost protrusion from the rear wall (usually power converters) is 15 feet.

01 and 02 Space

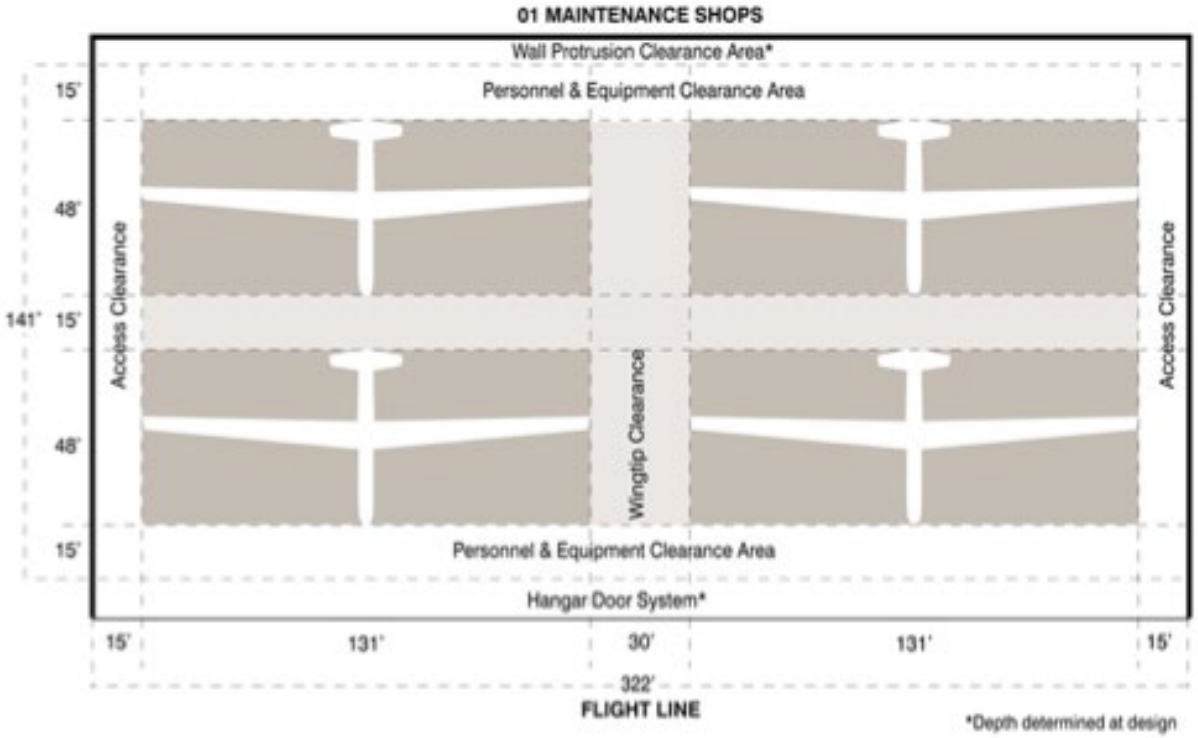
The planning factors for the 01 and 02 space requirements for a Triton hangar are shown in Table 7 and Table 8. The 01 and 02 space figures may differ due to the variation of rotational maintenance detachments for each installation location. The installation must contact CNAL/CNAP N2/N6 to obtain the most detailed information on the maintenance concept and personnel figures for a particular installation.

Table 211-05-2a
OH Space Navy Standard
MQ-4C Triton Model
Statistics Planning Purposes

CATEGORY	SPACE REQ'T		PLANNING METRICS	
Required Aircraft Parking Positions	4			
TOTAL WIDTH	322	LF		
Aircraft Width (131' X 2)	262	LF	131	Two adjacent aircraft
Total Wingtip Clearance	30	LF	30	Clearance between Aircraft
Access Clearance (2 X 15')	30	LF	15	Clearance from Side Wall (Unusable)
TOTAL DEPTH	141	LF		
Aircraft Length (48' X 2)	96	LF	48	Two aircraft nose to tail
Clearance to Hangar Door	15	LF	15	Innermost protrusion of hangar door
Nose to Tail Aircraft Clearance	15	LF	15	Clearance between column of two aircraft
Clearance of Aircraft to Rear Wall	15	LF	15	Back Wall Clearance (unusable)
NET OH SPACE	45,402	SFs		
GROSS AREA	50,850	SF	1.12	OH SPACE Net-to-Gross (NTG)

Key: Variable, depends on PAA and squadron | Standard PAA and squadron | Calculation

FIGURE 3. OH Space Diagram – MQ-4



C Triton

Table 21105-7
01 Space Calculations for MQ-4C Triton

CATEGORY	No. Work Centers	SF per Work Center	Space Req't (SF)
SHOPS			
Maintenance Control - Chief	9	100	900
Maintenance Control – Enlisted	8	60	480
Material Control – Officer	2	100	200
Material Control - Enlisted	9	60	540
Tool Room	3	400	1,200
Power Plants Shop (Aviation Mechanic Techs (AD))	3	175	525
Aviation Structural Mechanics (AM)	3	175	525
Aviation Electronics Techs (AT)	3	200	600
Aviation Electricians (AE)	3	200	600
Mission Control Systems Techs (MCS)	3	200	600
Plane Captains (PC) (Line Shack)	3	100	300
Shops Sub-total			6,470
SUPPORT			
Storage (transit case, secure, consumables)	1	1,300	1,300
Break Room	50	6	300
Male Locker Room	183	5	915
Female Locker Room	36	5	180
Printer Area	1	200	200
Security / Duty Office	1	120	120
Support Sub-total			3,015
Net 02 Space			9,485
Gross 01 Space (Net-to-Gross Ratio 1.38)			13,089

Table 21105-8
02 Space Calculations for MQ-4C Triton

CATEGORY	No. Work Centers	SF per Work Center	Space Req't (SF)
ADMINISTRATION, OPERATIONS, AND TRAINING			
Maintenance Officer	1	120	120
Maintenance Admin & Training - Chief	1	90	90
Maintenance Admin & Training - Enlisted	2	90	180
Quality Assurance & Safety - Officer	1	120	120
Quality Assurance & Safety - Chief	1	90	90
Quality Assurance & Safety - Enlisted	9	90	810
Administration - Chief	1	90	90
Administration - Enlisted	2	90	180
Personnel	3	90	270
1st Lieutenant	4	90	360
Operations	8	90	720
Pilots	4	90	360
Administration, Operations, and Training Sub-Total			3,390
SUPPORT			
Printer Area	1	200	200
SIPR Room	2	100	200
Break Room	40	6	240
Training Space	45	25	1,125
Training Storage	1	200	200
Secure Conference	10	40	400
Forward Operating Base Mission Control System	1	1,400	1,400
Visiting CO and CMC	2	120	240
Support Sub-Total			4,005
Net 01 Space			7,395
Gross 01 Space (Net-to-Gross Ratio 1.31)			9,687

211 08 AIRFRAMES SHOP (NON-NAVAIR DEPOT) (m^2 / SF)
FAC: 2112
BFR Required: Y

Design Criteria: UFC 4-211-01, Aircraft Maintenance Hangars

21108-1 **GENERAL.** An Airframes Division at the intermediate maintenance level is required at Navy and Marine Corps Air installations for the testing, maintenance and repair of airframes components. This section provides a method for determining the space requirements for this division.

The primary function of the airframes shop is to repair aircraft structural and hydraulic. It contains a Structures Branch, a Hydraulics/Pneumatics Branch, a Non-Destructive Inspection (NDI) Branch; and, if authorized by NAVAIRSYSCOM, an Electro-Plating/Anodizing Branch. The shop structure is shown in Table 21108-1. In addition to the specific shop structure shown, support space for material storage, administration, training, male and female locker and restrooms, and a mechanical equipment room.

In addition to the specific shop structure shown in Table 21108-1, other areas required within the Airframes Shop include support and training spaces. Typical support spaces would include personnel support (heads, locker rooms, cleaning gear storage, lounge, etc.), parts storage (parts awaiting maintenance (AWM), material awaiting parts (AWP), test equipment, tools not in use, storage for stock of sheet metal, tubing, hose, composite materials, consumable items, Pre-Expended Bin items, Hazardous Material, Hazardous Waste, and associated items), and specialized mechanical equipment spaces (HVAC, specialized environment control for paint shop to control temperature and humidity, specialized environment control for hydraulics shop for establishment of clean room environment, compressed air to most power tools, paint guns, and breathing apparatus). Typical training spaces may include a classroom.

Table 21108-1
Airframes Shop Structure

Branch Code	Shop Code	Function	Definition
500		**Airframes Division**	**Division supervision**
510		**Structures Division**	**Structures branch supervision**
	51A	Structures Shop	Repair and manufacture of structural components
	51B	Paint Shop	Paint and corrosion control
	51C	Welding Shop	Welding
	51D	Machine Shop	Machining of tools and manufacturing of parts
	51E	Tire/Wheel Shop	Tire replacement and wheel repair
	51F	Composites Shop	Repair of composite structural components
520		**Hydraulics/Pneumatics Branch**	**Hydraulics/Pneumatics branch supervision**
	52A	Hydraulics Shop	Repair and manufacture of hydraulics components
	52B	Brake Shop	Repair of brakes and components
	52C	Strut Shop	Repair of struts
530		**Non-Destructive Inspection (NDI) Branch**	**NDI branch supervision**
	53A	Radiography Shop	X-Ray inspection
	53B	Electrical/Chemical Shop	Electrical/Chemical inspection
540		**Electroplating/Anodizing Branch** ***(if authorized)***	**Electroplating/Anodizing of components**

To determine the square-meter (square-footage) requirements for a given installation, the number of aircraft of all types receiving maintenance support at that installation is totaled. This number is derived by determining the number of aircraft of all types assigned to the installation and subtracting out the number of aircraft normally deployed on ships or detached to another location. The sum is used to enter Column 1 of Table 21108-2, and the required basic area for the Airframes Shop is read in Columns 2 and 3. Table 21108-3 is then entered in order to determine if additional space is required. This area is added to the basic area from Table 21108-2 to provide the required Gross Area for the Airframes Shop. See the following example for a sample computation.

Table 21108-2
Basic Space Allowance for Airframes Shops

Column 1 Total Aircraft	Column 2 Basic Area (Square Meters)	Column 3 Basic Area (Square Feet)
Up to 75	1,283	13,800
76-100	1,422	15,300

Column 1 Total Aircraft	Column 2 Basic Area (Square Meters)	Column 3 Basic Area (Square Feet)
Column 1 Total Aircraft	Column 2 Basic Area (Square Meters)	Column 3 Basic Area (Square Feet)
101-125	1,571	16,900
126-150	1,710	18,400
151-175	1,850	19,900
176-200	1,989	21,400
201-225	2,119	22,800
226-250	2,259	24,300
251+	2,398	25,800

Note: An area of 1,283 m^2 (13,800 SF) is the smallest practical space for an Airframes Division with full capabilities. Some small IMAs may not be tasked to provide all airframes functions. Their space requirements shall be individually justified.

Table 21108-3
Special Space Allowance for Airframes Shops

Column 1 Special Requirement	Column 2 Additional Space (Square Meters)	Column 3 Additional Space (Square Feet)
F-14 Support (HCT-12 Equipment)	114	1,225
S-3 Support (Beryllium Brakes Maintenance)	51	550
E-2 Support (Vapor Cycle Maintenance)	57	610
Composite Shop (Note 1)	151	1,630
Electro-Plating/Anodizing Shop (Note 2)	63	680

Note 1: Required in support of AV-8, F/A-18, and SH-60 aircraft.
Note 2: Required only when authorized by COMNAVAIRSYSCOM IAW OPNAVINST 4790.2.

1. Example Computation

Number of Aircraft	Type
44	S-3
96	A-7
80	F/A-18
220	

In accordance with Table 211-08B, a total of 220 aircraft requires a basic area of 2,119 m^2 (22,800 SF). From Table 211-08C it is determined the S-3 support requires an additional 51 m^2 (550 SF) and the Composite Shop required for F/A-18 support adds an additional 151 m^2 (1,630 SF). This gives a gross area as follows:

Basic Area	-	2,119 m^2	22,800 SF
S-3 Support	-	51 m^2	550 SF
Composite Shop	-	151 m^2	1,630 SF
Gross Area	-	2,321 m^2	24,980 SF

211 09 AIRCRAFT BORESIGHT RANGE (NON- NAVAIR DEPOT) (EA)
FAC: 1791
BFR Required: Y

21109-1 **GENERAL.** One aircraft boresight range is required at Navy and Marine Corps air installations that service aircraft equipped with fixed guns or gun pods. One boresight range has the capacity to boresight and fire-in 40 such aircraft each month on a single shift basis. A requirement for more than one boresight range at any station must be individually justified. There are two (2) types of ranges:

1.) Type “A” Semi-Enclosed. The Type “A” range shall be located in proximity to taxiways, but special care must be taken to ensure that no visual obstruction occurs between the control tower and runways and taxiways. Due to noise generation and safety considerations, this facility shall be separated from inhabited structures and the station boundary by a minimum distance of 366 meters (1,200 feet).

2.) Type “B” Open. In addition to the location criteria listed above for a Type “A” range, the Type “B” range requires a danger zone area, 1,555 meters (1,700 yards) wide and 6,401 meters (7,000 yards) long.

Both the Type “A” and Type “B” boresight ranges shall have a length of 50.8 meters (2,000 inches) from the firing point of the aircraft to the target at the firing-in-butt.

Generally, a Type “A” range is used unless there is existing land or restricted water area available for the 6,401 meters (7,000 yard), 60-degree sector danger zone required by a Type “B” range. Prevailing winds shall be considered for orientation and noise abatement; however, where practicable, the boresight range should be oriented north and south to avoid firing toward the sun during early or late hours.

A taxiway, Category Code 112 10 is required for access to this facility. An aircraft parking apron with tie-downs, Category Code 113 20 is required to park and secure the aircraft during gun alignment.

In addition, a standard 12- by 20-foot line shelter is planned with this facility for crew shelter and storage of jacks and tiedown gear. See Category Code 211 15, Line Maintenance Shelter, for criteria.

211 10 AIRCRAFT OVERHAUL AND REPAIR SHOP (NAVAIR DEPOT) (m^2 / SF)

FAC: 2116
BFR Required: Y

21110-1 **GENERAL.** An Aircraft Overhaul and Repair Shop is required for the Airframe Production Shop of the Naval Air Depot (NAVAIR Depot). There are generally two types of aircraft overhaul and repair shops. One supports aircraft overhaul and repair of trainer aircraft, fighter aircraft, and helicopters and one supports aircraft overhaul and repair of cargo, transport, and patrol aircraft.

There are no specific criteria developed for this Category Code. An engineering study must be performed to determine requirement.

211 11 CORROSION CONTROL – CLEANING SHOP (NAVAIR DEPOT) (m^2 / SF)

FAC: 2116
BFR Required: Y

21111-1 **GENERAL.** A Corrosion Control – Cleaning Shop is required to provide space for aircraft corrosion control and decontamination facilities designed for cleaning, paint stripping, etc., of the complete aircraft for the Airframe Production Shop of the Naval Air Depot (NAVAIR Depot).

There are no specific criteria developed for this Category Code. An engineering study must be performed to determine the requirement.

211 12 PAINT AND FINISHING HANGAR (NAVAIR DEPOT) (m^2 / SF)

FAC: 2116
BFR Required: Y

21112-1 **GENERAL.** A Paint and Finishing Hangar is required for the Airframe Production Shop of the Naval Air Depot (NAVAIR Depot). This facility provides space to repaint an entire aircraft.

There are no specific criteria developed for this Category Code. An engineering study must be performed to determine the requirement.

211 13 AIRCRAFT NON-DESTRUCTIVE TESTING SHOP (NAVAIR DEPOT) (m^2 / SF)
FAC: 2116
BFR Required: Y

21113-1 **GENERAL.** An Aircraft Non-Destructive Testing Shop is required to provide space for the non-destructive inspection of airframes for the Airframe Production Shop of the Naval Air Depot (NAVAIR Depot).

There are no specific criteria developed for this Category Code. An engineering study must be performed to determine requirement.

211 14 AIRCRAFT REWORK SHOP (NAVAIR DEPOT) (m^2 / SF)
FAC: 2116
BFR Required: Y

21114-1 **GENERAL.** An Aircraft Rework Shop is required for the Airframe Production Shop of the Naval Air Depot (NAVAIR Depot). Included within this Category Code are:

a. Airframe Dedicated Machine Shop
b. Airframe Dedicated Welding Shop
c. Airframe Dedicated Plating Shop
d. Airframe Examination and Evaluation, Pre-Shop Analysis and Examination and Inspection Shop
e. Maintenance Dock
f. Quick Engine Change Shop – Facility used for quick engine change and engine build-up including de-seal and re-seal operations.
g. Fuel Systems Maintenance Facility

There are no specific criteria developed for this Category Code. An engineering study must be performed to determine the requirement.

211 15 LINE MAINTENANCE SHELTER (m^2 / SF)
FAC: 2112
BFR Required: Y

21115-1 **GENERAL.** Line maintenance shelters are required in support of aircraft located on aircraft parking aprons and at aircraft boresight ranges (Category Code 211 09). For aircraft located on the aircraft parking apron, they provide shelter for squadron line personnel awaiting aircraft that are ready for launch, returning from flight, or being serviced. For aircraft located at the aircraft boresight range, they provide crew shelter and storage for aircraft jacks and tiedown gear. For newer hangars, this requirement is included in the Aircraft Maintenance Hangar – 01 Space, Category Code 211 06 and as

such included in the hangar. However, if space constraints exist in older hangars, or the aircraft parking apron is not in the immediate vicinity of the squadron hangar a line maintenance shelter will be provided. One (1) line maintenance shelter may be planned for each aircraft maintenance hangar module and one (1) for each aircraft boresight range.

The aircraft line maintenance shelter is 6.1 meters (20 feet) by 3.7 meters (12 feet) and is usually a portable facility that is planned as collateral equipment for the basic facility. Collateral equipment is not categorized as Class II real property and thus cannot be included in the real property inventory (RPI). However, this Category Code is being retained for real property inventory purposes since many of the existing facilities are not portable and accordingly must be reported in the Navy Facility Asset Data Base (NFADB).

For inventory purposes, the following guidance is provided:

a.) Line maintenance shelters directly associated with squadron line personnel awaiting aircraft that are readying for launch, returning from flight, or being serviced use Category Code 211 06, Aircraft Maintenance Hangar – 01 Space.

b.) Line maintenance shelters used at aircraft boresight ranges to provide crew shelter and storage for aircraft jacks and tiedown gear use this Category Code.

211 16 AIRCRAFT INTERMEDIATE MAINTENANCE ACTIVITY MANAGEMENT (NON-NAVAIR DEPOT) (m^2 / SF)

FAC: 2116
BFR Required: Y

21116-1 **GENERAL.** Management space provides for the control, monitoring, and administration of the Intermediate Maintenance Activity (IMA). The Aircraft Maintenance Officer and staff are responsible for the administration and supervision of the maintenance effort for the IMA. These responsibilities include production control, material control, financial accounting, training, personnel, administration, quality control, technical publications library, data analysis, and tool control for common and special tools and test equipment. The Naval Aeronautical Engineering Services Unit staff and personnel perform In-Service Engineering Agent (ISEA) functions for aircraft and are often co-located in the same spaces. These functions and the specific requirements of each branch are defined by OPNAVINST 4790.2E (series) and are highlighted in Table 21116-1.

Table 21116-1
IMA Management

Branch Code	Shop Code	Function	Definition
010		Aircraft Maintenance Officer (AMO)	IMA Supervisory
01A		Assistant Aircraft Maintenance Officer (AAMO)	IMA Supervisory and Training
01S		AMO Secretary/Reception	Administration
011		Maintenance/Material Control Officer (MMCO)	Production/Material Control Supervisory
020		Production Control	Control of maintenance effort
030		Maintenance Administration	Administration, training, and personnel management of IMA
040		Quality Assurance	Quality Control
	04A	Technical Publication Library	Receipt, issue and storage of master copies of all publications used in the IMA
	04B	Ground Safety	IMA safety office
	04C	Data Analysis	Data gathering, analysis, and reporting. Also includes space for NALCOMIS master computers.
	04D	Quality Management/Verification	Quality Assurance Representatives office and files
050		Material Control	Receipt, issue, ordering, and technical support for all parts required by IMA
	05A	Material Screening	Receipt of all incoming parts to IMA, screening for reparability, issue to shop for repair, receipt from shop, and issue to Supply Dept.
	05B	Material Procurement/Accounting	Ordering and technical support for parts requested by shops. Financial accounting of all IMA accounts
	05C	Individual Material Requirements Readiness List (IMRL) Manager	Management of IMRL which includes all special tools, test equipment, support equipment, and associated items
	05D	Tool Control Center	Management of common hand tools
070		NAESU	Contractor and government technical instructors

Personnel requirements to meet these functions are not noticeably affected by aircraft loading. One size space will be provided for all IMAs. Provide 917 gross m^2 (9,875 GSF) for IMA management functions.

211 17 REGIONAL AIRCRAFT SERVICE FACILITY (m^2 / SF)
FAC: 2116
BFR Required: Y

21117-1 **DEFINITION.** During day-to-day aircraft operations, space often may be required to perform aircraft in-service repair (ISR), integrated maintenance (IMC/IMP), modifications (MOD) and other program work that may concurrently involve depot, intermediate, and organizational level work on aircraft by squadron, IMA, Naval Air Depot (NAVAIR Depot), and/or contractor personnel. When the existing organizational level spaces cannot accommodate the additional workload generated by ISR, IMC/P, and/or MOD and it is desirable to keep aircraft under local control, a separate facility will be required.

The Regional Aircraft Service Facility provides space to perform aircraft in-service repair (ISR), integrated maintenance (IMC/IMP), modifications (MOD) and other program work that may concurrently involve depot, intermediate, and organizational level work on aircraft by squadron, IMA, Naval Air Depot (NAVAIR Depot), and/or contractor personnel. Facility is comprised of High-Bay Maintenance Bays, Shop Area, and Administrative Support Space. Shop and Administrative Support areas will be limited to minimal required supporting current and projected programs.

Criteria for this Category Code are currently under development.

211 20 AIRCRAFT ENGINE OVERHAUL SHOP (NAVAIR DEPOT) (m^2 / SF)
FAC: 2116
BFR Required: Y

21120-1 **GENERAL.** An Engine Overhaul Shop is required to provide space associated with processing jet, turbojet, and reciprocating type aviation engines in terms of overhaul, low time repair, complete repair, and major inspection. The work functions performed within this space include un-canning, disassembly, cleaning, material examination, parts reconditioning, subassembly, final assembly and preservation.

There are no specific criteria developed for this Category Code. An engineering study must be performed to determine the requirement.

211 21 ENGINE MAINTENANCE SHOP (NON-NAVAIR DEPOT) (m^2 / SF)
FAC: 2112
BFR Required: Y

21121-1 **GENERAL.** An Engine Maintenance Shop provides space for all work centers within the Power Plants Division of an Intermediate Level Maintenance Activity (IMA). The CNO and the CMC assign aircraft maintenance tasks and responsibilities to activities of Naval operating/Training Forces and Fleet/non-Fleet Marine Forces. The NAVAIRSYSCOM, through the NAVAIRNOTE 4700, assigns maintenance tasks and responsibilities for Gas Turbine Engines. Individual IMAs will only be allocated the space required to perform maintenance on the engines, equipment or components authorized for repair at that activity by higher authority, (i.e., NAVAIR/Type Commanders). The authorized work centers may be obtained by the use of Individual Component Repair List (ICRL) for the given IMA.

The Power Plants or Aircraft Engine Maintenance Shop is required to maintain the aircraft engine and associated components. The primary function is to repair aircraft engines, engine components, propellers, rotors, auxiliary power units (APUs), and auxiliary fuel and refueling stores. It contains a Jet Engine Branch, Reciprocating Engine Branch, Propeller Branch, Rotor Dynamics Branch, Test Cell Branch, Auxiliary Fuel Stores Branch, and Navy Oil Analysis Program Laboratory. The shop structure is shown in Table 21121-1.

Table 21121-1
Aircraft Engine Maintenance Shop Structure

Branch Code	Shop Code	Function	Definition
400		**Power Plants Division**	**Division supervision**
410		**Jet Engine Division**	**Jet Engine Branch supervision**
	51A	Structures Shop	Repair and manufacture of structural components
	51B	Paint Shop	Paint and corrosion control
	51C	Welding Shop	Welding
	51D	Machine Shop	Machining of tools and manufacturing of parts
	51E	Tire/Wheel Shop	Tire replacement and wheel repair
	51F	Composites Shop	Repair of composite structural components
420		**Reciprocating Engine Branch**	**Repair of reciprocating engines**
	52A	Hydraulics Shop	Repair and manufacture of hydraulics components
	52B	Brake Shop	Repair of brakes and components
	52C	Strut Shop	Repair of struts
430		**Propeller Branch**	**Repair of aircraft propellers**
	53A	Radiography Shop	X-Ray inspection
	53B	Electrical/Chemical Shop	Electrical/Chemical inspection

Branch Code	Shop Code	Function	Definition
440		Rotor Dynamics Branch	Repair of helicopter rotor and associated components
450		Test Cell Branch	Supervisory, scheduling, and maintenance for Test Cell operation
460		Auxiliary Fuel Stores Branch	
470		Navy Oil Analysis Program Laboratory	
480		Welding Shop	

Table 21121-1 lists the space requirements for the main engine work area (high bay) for first and second degree engine maintenance for supported number of a given type of aircraft. The following data items were taken into consideration to arrive at the listed space requirements:

1. Size of engine
2. Number of engines per aircraft
3. Number, type and size of required maintenance stands
4. Work benches
5. Work center administrative and storage area
6. Fire lane/aisle space
7. Mean flight hours between failures (MFHBF) of engines requiring removal to an IMA.
8. Average turnaround time (TAT) of engine in IMA
9. Flight hours between inspections (FHBI)
10. Elapsed inspection time (EIT)
11. Quick engine change assembly (QECA) elapsed build up time (EBT)
12. Aircraft monthly utilization

Table 21121-2 lists the percentage factor of the sum total from Table 21121-1 to determine the additional space required for division administration, utilities and other support functions such as supply support, welding and cleaning shops. These spaces are normally provided in shop wing and/or mezzanine areas.

Table 21121-3 lists the space requirements of additional work centers required for applicable components within the Power Plants Division, if authorized by higher authority to be supported at a given IMA. These spaces may be housed in the high bay area or in a separate building/location.

Note: Though more than one type of the aircraft supported may have the same basic component, only one work center will be required.

Example: F-18 and AV-8 both have an Auxiliary Power Plant (APU); however, only one APU work center will be required.

Table 21121-4 list the space requirements in the main engine work area (high bay) for situations where an AIMD is assigned repair responsibilities for a predetermined number of given type engines not related to those generated by the aircraft directly supported.

To establish space requirements for the Power Plant Division, add the space required for the given numbers of each type aircraft supported from Table 21121-1 and space computed from Table 21121-4. Add to this the additional percentage of space authorized from Table 21121-2 and the additional authorized space from Table 21121-3.

Note: At most installations there are aircraft assigned in support roles, i.e. helicopters or utility type aircraft. These are not computed in the space requirements as they are normally supported by other designated IMAs or depot level activities.

Example Computation – Power Plants Division Shop Space Allowance using an aircraft mix of 44 A-6, 84 F-18, 62 P-3, 23 H-46 and 40 TF-30 engines.

From Table 21121-1

	No. A/C	Type A/C	Area (m^2)		Area (SF)	
	44	A-6	648		6,975	
	84	F-18	1,057		11,375	
	62	P-3	630		6,775	
	23	H-46	109		1,175	
Subtotal			2,444	m^2	26,300	SF

From Table 21121-4

No. Eng.	Factor (m^2)	Factor (SF)	Area (m^2)	Area (SF)
40	7	76	280	3,040

Total 21121-1 and 21121-4

2,724	m^2
29,340	SF

From Table 21121-2

2,724 m^2. x 44% = 1,199 m^2
29,340 SF x 44% = 12,910 SF

Total space requirements from Tables 21121-1 and 21121-4 allow up to 2,724 m^2 (29,340 SF) for the high bay area. Table 21135-2 allows up to 1,199 m^2 (12,910 SF) which is 44% of the high bay area for shop wing/mezzanine space.

Table 21121-1 and 21121-4		2,724 29,340	m^2 SF
Table 21135-2	(44% of 2,724 m^2) (44% of 29,340 SF)	1,199 12,910	m^2 SF
Subtotal =	3,923 42,210		m^2 SF

3,923 m^2 (42,210 SF) constitutes the primary Power Plants Division. If authorized by higher authority, additional applicable work center space requirements from Table 21121-3 shall be added.

From Table 21121-3

	A-6	F-18	P-3	H-46				
Propeller			X		272	m^2	2,925	SF
APU		X	X	X	167	m^2	1,800	SF
Rotor Dynamics				X	314	m^2	3,375	SF
Aux. Fuel Stores	X	X			314	m^2	3,375	SF
					1,067	m^2	11,475	SF

Note: Only one work center of each type is required.

Table 21121-1
Space Allowance for Engine Maintenance Shop

A-4 J-52			A-6 J-52			A-7 TF-41			F-4 J79		
No. A/C	**Area (m^2)**	**Area (SF)**	**No. A/C**	**Area (m^2)**	**Area (SF)**	**No. A/C**	**Area (m^2)**	**Area (SF)**	**No. A/C**	**Area (m^2)**	**Area (SF)**
1-9	86	925	1-8	137	1,475	1-10	184	1,975	1-8	184	1,975
10-19	137	1,475	9-16	239	2,575	11-21	332	3,575	9-17	332	3,575
20-28	188	2,025	17-24	342	3,675	22-32	481	5,175	17-24	481	5,175
29-38	239	2,575	25-32	444	4,775	33-42	630	6,775	25-32	630	6,775
39-47	290	3,125	33-40	546	5,875	43-53	778	8,375	33-40	778	8,375
48-57	342	3,675	41-48	648	6,975	54-63	927	9,975	41-49	927	9,975
58-66	393	4,225	49-56	751	8,075	64-74	1,076	11,575	50-57	1,076	11,575
67-76	444	4,775	57-64	853	9,175	75-85	1,225	13,175	58-65	1,225	13,175
No. A/C	**Area (m^2)**	**Area (SF)**	**No. A/C**	**Area (m^2)**	**Area (SF)**	**No. A/C**	**Area (m^2)**	**Area (SF)**	**No. A/C**	**Area (m^2)**	**Area (SF)**

A-4 J-52			A-6 J-52			A-7 TF-41			F-4 J79		
77-85	495	5,325	65-72	955	10,275	86-95	1,373	14,775	66-73	1,373	14,775
86-95	546	5,875	73-80	1,057	11,375	96-106	1,522	16,375	74-81	1,522	16,375
96-104	597	6,425	81-88	1,160	12,475	107-116	1,671	17,975	82-89	1,671	17,975
105-114	648	6,975	89-96	1,262	13,575	117-127	1,820	19,575	90-98	1,820	19,575
115-123	699	7,525	97-104	1,364	14,675	128-135	1,968	21,175	99-106	1,968	21,175
124-133	751	8,075	105-112	1,466	15,775	136-148	2,117	22,775	107-114	2,117	22,775
134-142	802	8,625	113-120	1,568	16,875	149-150	2,191	23,575	115-122	2,266	24,375
143-150	853	9,175	121-128	1,671	17,975				123-130	2,414	25,975
			129-136	1,773	19,075				131-138	2,563	27,575
			137-145	1,875	20,175				139-150	2,712	29,175
			146-150	1,926	20,725						

Table 21121-1 (Continued)
Space Allowance for Engine Maintenance Shop

F-14 TF-30			F-18 F404			H-1 T400			H-2 T58		
No.A/C	Area (m^2)	Area (SF)	No.A/C	Area (m^2)	Area (SF)	No.A/C	Area (m^2)	Area (SF)	No.A/C	Area (m^2)	Area (SF)
1-8	184	1,975	1-8	137	1,475	1-16	72	775	1-6	109	1,175
9-17	332	3,575	9-17	239	2,575	17-33	109	1,175	7-12	184	1,975
18-26	481	5,175	18-25	342	3,675	34-49	146	1,575	13-19	258	2,775
27-35	630	6,775	26-34	444	4,775	50-66	184	1,975	20-25	332	3,575
36-44	778	8,375	35-43	546	5,875	67-83	221	2,375	26-32	407	4,375
45-53	927	9,975	44-51	648	6,975	84-99	258	2,775	33-38	481	5,175
54-62	1,076	11,575	52-60	751	8,075	100-116	295	3,175	39-45	555	5,975
63-71	1,225	13,175	61-69	853	9,175	117-133	332	3,575	46-51	630	6,775
72-79	1,373	14,775	70-77	955	10,275	134-150	369	3,975	52-57	704	7,575
80-88	1,522	16,375	78-86	1,057	11,375				58-64	778	8,375
89-97	1,671	17,975	87-94	1,160	12,475				65-70	853	9,175
98-106	1,820	19,575	95-103	1,262	13,575				71-77	927	9,975
107-115	1,968	21,175	104-112	1,364	14,675				78-83	1,002	10,775
116-124	2,117	22,775	113-121	1,466	15,775				84-90	1,076	11,575
125-133	2,266	24,375	122-129	1,569	16,875				91-96	1,150	12,375
134-142	2,414	25,975	130-138	1,671	17,975				97-102	1,225	13,175
143-150	2,563	27,575	139-147	1,773	19,075				103-115	1,373	14,775
			148-150	1,829	19,675				116-128	1,522	16,375
									129-141	1,671	17,975
									142-150	1,782	19,175

Table 21121-1 (Continued)
Space Allowance for Engine Maintenance Shop

H-3 T58			H-46 T58			H-53 T64			H-60 T700		
No.A/C	**Area (m^2)**	**Area (SF)**	**No.A/C**	**Area (m^2)**	**Area (SF)**	**No.A/C**	**Area (m^2)**	**Area (SF)**	**No.A/C**	**Area (m^2)**	**Area (SF)**
1-8	109	1,175	1-21	72	775	1-6	86	925	1-9	72	775
H-3 T58			**H-46 T58**			**H-53 T64**			**H-60 T700**		
No.A/C	**Area (m^2)**	**Area (SF)**	**No.A/C**	**Area (m^2)**	**Area (SF)**	**No.A/C**	**Area (m^2)**	**Area (SF)**	**No.A/C**	**Area (m^2)**	**Area (SF)**
9-16	184	1,975	22-42	109	1,175	7-12	137	1,475	10-18	109	1,175
17-24	258	2,775	43-64	146	1,575	13-18	188	2,025	19-28	146	1,575
25-32	332	3,575	65-85	184	1,975	19-24	239	2,575	29-37	184	1,975
33-41	407	4,375	86-107	221	2,375	25-30	290	3,125	38-47	221	2,375
42-49	481	5,175	108-128	258	2,775	31-36	342	3,675	48-56	258	2,775
50-57	555	5,975	129-150	295	3,175	37-42	393	4,225	57-65	295	3,175
58-65	630	6,775				43-48	444	4,775	66-75	332	3,575
66-74	704	7,575				49-54	495	5,325	76-84	369	3,975
75-82	778	8,375				55-60	546	5,875	85-94	407	4,375
83-90	853	9,175				61-66	597	6,425	95-103	444	4,775
91-98	927	9,975				67-72	648	6,975	104-113	481	5,175
99-106	1,002	10,775				73-78	699	7,5	114-122	518	5,575
107-115	1,076	11,575				79-85	751	8,075	123-131	555	5,975
116-123	1,150	12,375				86-91	802	8,625	132-141	593	6,375
124-131	1,225	13,175				92-103	904	9,725	142-150	630	6,775
132-139	1,299	13,975				104-115	1,006	10,825			
140-148	1,373	14,775				116-127	1,108	11,925			
149-150	1,411	15,175				128-139	1,211	13,025			
						140-150	1,313	14,125			

Table 21121-1 (Continued)
Space Allowance for Engine Maintenance Shop

C-2 T56			C-130 T56			P-3 T56			S-3 TF34		
No.A/C	**Area (m^2)**	**Area (SF)**	**No.A/C**	**Area (m^2)**	**Area (SF)**	**No.A/C**	**Area (m^2)**	**Area (SF)**	**No.A/C**	**Area (m^2)**	**Area (SF)**
1-19	109	1,175	1-10	184	1,975	1-8	109	1,175	1-6	86	925
20-39	184	1,975	11-20	332	3,575	9-16	184	1,975	7-13	137	1,475
40-58	258	2,775	21-30	481	5,175	17-24	211	2,275	14-19	188	2,025
59-78	332	3,575	31-41	630	6,775	25-32	332	3,575	20-26	239	2,575
79-97	407	4,375	42-51	778	8,375	33-40	407	4,375	27-32	290	3,125
98-117	481	5,175	52-61	927	9,975	41-48	481	5,175	33-39	342	3,675
118-136	555	5,975	62-71	1,076	11,575	49-57	555	5,975	40-45	393	4,225
137-150	630	6,775	72-82	1,225	13,175	58-65	630	6,775	46-52	444	4,775
			83-92	1,373	14,775	66-73	704	7,575	53-59	495	5,325
			93-102	1,522	16,375	74-81	778	8,375	60-65	546	5,875
E-2 T56			103-112	1,671	17,975	82-89	853	9,175	66-72	597	6,425
			113-123	1,820	19,575	90-97	927	9,975	73-78	648	6,975
No.A/C	**Area (m^2)**	**Area (SF)**	124-133	1,968	21,175	98-106	1,002	10,775	79-85	699	7,525
			134-143	2,117	22,775	107-114	1,076	11,575	86-91	751	8,075
1-39	109	1,175	144-150	2,266	24,375	115-122	1,150	12,375	92-98	802	8,625
40-78	184	1,975				123-130	1,225	13,175	99-105	853	9,175
79-116	258	2,775				131-138	1,299	13,975	106-111	904	9,725
117-150	332	3,575				139-146	1,373	14,775	112-124	1,006	10,825
						147-150	1,448	15,575	125-137	1,108	11,925
									138-142	1,211	13,025
									143-150	1,313	14,125

Table 21121-1 (Continued)
Space Allowance for Engine Maintenance Shop

AV-8 F402			OV-10 T76			TA-4 J52			TH-1 T53		
No.A/C	**Area (sq.m)**	**Area (SF)**	**No.A/C**	**Area (sq.m)**	**Area (SF)**	**No.A/C**	**Area (sq.m)**	**Area (SF)**	**No.A/C**	**Area (sq.m)**	**Area (SF)**
1-11	258	2,775	1-8	72	775	1-7	86	925	1-26	72	775
12-22	481	5,175	9-16	109	1,175	8-15	137	1,475	27-53	109	1,175
23-33	704	7,575	17-24	146	1,575	16-23	188	2,025	54-80	146	1,575
34-45	927	9,975	25-32	184	1,975	24-30	239	2,575	81-107	184	1,975
46-56	1150	12,375	33-40	221	2,375	31-38	290	3,125	108-134	221	2,375
57-67	1373	14,775	41-49	258	2,775	39-46	342	3,675	135-150	258	2,775
68-78	1596	17,175	50-57	295	3,175	47-54	393	4,225			
79-90	1820	19,575	58-65	332	3,575	55-61	444	4,775			
91-101	2043	21,975	66-73	369	3,975	62-69	495	5,325			
102-112	2266	24,375	74-81	407	4,375	70-77	546	5,875			
113-123	2489	26,775	82-90	444	4,775	78-84	597	6,425			
124-135	2712	29,175	91-98	481	5,175	85-92	648	6,975			
136-146	2935	31,575	99-106	518	5,575	93-100	699	7,525			
147-150	3158	33,975	107-114	555	5,975	101-108	751	8,075			
			115-122	593	6,375	109-115	802	8,625			
			123-130	630	6,775	116-123	853	9,175			
			131-139	667	7,175	124-131	904	9,725			
			140-147	704	7,575	132-138	955	10,275			
			148-150	741	7,975	139-146	1006	10,825			
						147-150	1057	11,375			

Table 21121-1 (Continued)
Space Allowance for Engine Maintenance Shop

TH-57 T63			T2C J85			T-34C PT-6			T-39D J60		
No.A/C	Area (sq.m)	Area (SF)	No.A/C	Area (sq.m)	Area (SF)	No.A/C	Area (sq.m)	Area (SF)	No.A/C	Area (sq.m)	Area (SF)
1-15	53	575	1-7	109	1,175	1-6	72	775	1-6	137	1,475
16-30	72	775	8-14	184	1,975	7-13	109	1,175	7-13	239	2,575
31-45	91	975	15-22	258	2,775	14-20	146	1,575	14-20	342	3,675
46-60	109	1,175	23-29	332	3,575	21-27	184	1,975	21-27	444	4,775
61-75	128	1,375	30-37	407	4,375	28-33	221	2,375	28-34	546	5,875
76-90	146	1,575	38-44	481	5,175	34-40	258	2,775	35-41	648	6,975
91-105	165	1,775	45-52	555	5,975	41-47	295	3,175	42-48	751	8,075
106-120	184	1,975	53-59	630	6,775	48-54	332	3,575	49-55	853	9,175
121-135	202	2,175	60-67	704	7,575	55-60	369	3,975	56-62	955	10,275
136-150	221	2,375	68-74	778	8,375	61-67	407	4,375	63-68	1,057	11,375
			75-82	853	9,175	68-74	444	4,775	69-75	1,160	12,475
			83-89	927	9,975	75-81	481	5,175	76-82	1,262	13,575
			90-97	1,002	10,775	82-88	518	5,575	83-89	1,364	14,675
			98-104	1,076	11,575	89-94	555	5,975	90-96	1,466	15,775
			105-111	1,150	12,375	95-101	593	6,375	97-103	1,569	16,875
			112-119	1,225	13,175	102-108	630	6,775	104-110	1,671	17,975
			120-126	1,299	13,975	109-115	667	7,175	111-117	1,773	19,075
			127-134	1,373	14,775	116-121	704	7,575	118-124	1,875	20,175
			135-141	1,448	15,575	122-135	778	8,375	125-137	2,080	22,375
			142-150	1,522	16,375	136-150	853	9,175	138-150	2,284	24,575

Table 21121-1 (Continued)
Space Allowance for Engine Maintenance Shop

T-44A PT-6		
No.A/C	Area (sq.m)	Area (SF)
1-8	109	1,175
9-16	184	1,975
17-24	258	2,775
25-33	332	3,575
34-41	407	4,375
42-49	481	5,175
50-57	555	5,975
58-66	630	6,775
67-74	704	7,575
75-83	778	8,375
84-91	853	9,175
92-99	927	9,975
100-108	1,002	10,775
109-116	1,076	11,575
117-124	1,150	12,375
125-132	1,225	13,175
133-141	1,299	13,975
142-150	1,373	14,775

Table 21121-2
Additional Space Requirements

m^2	SF	Percentage	m^2	SF	Percentage
Up to 1,394	Up to 15,000	50%	3,021 – 3,253	32,501 – 35,000	42%
1,395 – 1,626	15,001 – 17,500	49%	3,254 – 3,485	35,001 – 37,500	41%
1,627 – 1,859	17,501 – 20,000	48%	3,486 – 3,718	37,501 – 40,000	40%
1,860 – 2,091	20,001 – 22,500	47%	3,719 – 3,950	40,001 – 42,500	39%
2,092 – 2,323	22,501 – 25,000	46%	3,951 – 4,182	42,501 – 45,000	38%
2,324 – 2,556	25,001 – 27,500	45%	4,183 – 4,415	45,001 – 47,500	37%
2,557 – 2,788	27,501 – 30,000	44%	4,416 – 4,647	47,501 – 50,000	36%
2,789 – 3,020	30,001 – 32,500	43%	4,648 and Up	50,001 and Up	35%

Table 21121-3
Support Work Centers

Group	Work Area	Aircraft	Adjustment (m^2)	Adjustment (SF)
A.	Auxiliary Fuel Stores	A-4, A-6, A-7,F-4, F-14, F-18	314	3,375
B.	Auxiliary Power Units	C-2, C-130, E-2, F-18, H-46, H-53, H-60, P-3, S-3, AV-8	167	1,800
C.	Propellers	C-2, C-130, E-2, P-3, T-34, OV-10	272	2,925
D.	Rotor Dynamics	H-1, H-2, H-3, H-46, H-53, H-60	314	3,375

Table 21121-4
Space Allowance for Additional Engines Processed

Type Engine	Factor (m^2)	Factor (SF)
J-52	7	77
J-79	12	126
F-404	5	54
T-58	4	46
T-700	4	44
TF-34	5	52
T-76	4	43
PT-6	4	40
T-53	3	30

Type Engine	Factor (m^2)	Factor (SF)
TF-41	10	112
TF-30	7	76
T-400	4	48
T-64	9	92
T-56	6	65
F-402	12	130
J-85	5	51
J-60	5	54
T-63	2	21

To calculate the required work space, multiply the factor by the number of engines projected to be processed in a 12 month period, add this to the existing work area from Table 211-21A and apply Table 211-21B.

If a new Work Center is established, the minimum area should be 2,000 Sq.ft.

Pavement is provided for outside storage of engines in sealed containers calculated at 25 percent of the gross building area.

211 22 ENGINE PREPARATION AND STORAGE SHOP (NAVAIR DEPOT) (m^2 / SF)

FAC: 2116
BFR Required: Y

21122-1 **GENERAL.** An Engine Preparation and Storage Shop is required provide space used in preparing engines for test, storage or shipment for the Engine Production Shop of the Naval Air Depot (NAVAIR Depot).

There are no specific criteria developed for this Category Code. An engineering study must be performed to determine requirement.

211 23 ENGINE EXAMINATION AND EVALUATION SHOP (NAVAIR DEPOT) (m^2 / SF)

FAC: 2116
BFR Required: Y

21123-1 **GENERAL.** An Engine Examination and Evaluation Shop is required for the Engine Production Shop of the Naval Air Depot (NAVAIR Depot). Included within this Category Code are:

a. Engine Non-Destructive Testing Shop
b. Engine Examination and Evaluation, Pre-Shop Analysis, Examination and Inspection Shop

There are no specific criteria developed for this Category Code. An engineering study must be performed to determine requirement.

211 24 DEDICATED AIRCRAFT ENGINE OVERHAUL – GENERAL PROCESS (NAVAIR DEPOT) (m^2 / SF)

FAC: 2116
BFR Required: Y

21124-1 **GENERAL.** A Dedicated Aircraft Engine Overhaul – General Process Shop is required for the Engine Production Shop of the Naval Air Depot (NAVAIR Depot). Included within this Category Code are:

a. Engine Dedicated Cleaning Shop
b. Engine Dedicated Paint Shop
c. Engine Dedicated Machine Shop
d. Engine Dedicated Plating Shop
e. Engine Dedicated Welding Shop
f. Engine Modification and Repair Shop

There are no specific criteria developed for this Category Code. An engineering study must be performed to determine requirement.

211 25 JET ENGINE OVERHAUL SHOP (NAVAIR DEPOT) (m^2 / SF)
FAC: 2116
BFR Required: Y

21125-1 **REQUIREMENT.** A Jet Engine Overhaul Shop is required for the Engine Production Shop of the Naval Air Depot (NAVAIR Depot).

211 26 RECIPROCATING ENGINE OVERHAUL SHOP (NAVAIR DEPOT) (m^2 / SF)
FAC: 2116
BFR Required: Y

21126-1 **REQUIREMENT.** A Reciprocating Engine Overhaul Shop is required for the Engine Production Shop of the Naval Air Depot (NAVAIR Depot).

211 27 TURBINE ENGINE OVERHAUL SHOP (NAVAIR DEPOT) (m^2 / SF)
FAC: 2116
BFR Required: Y

21127-1 **REQUIREMENT.** A Turbine Engine Overhaul Shop is required for the Engine Production Shop of the Naval Air Depot (NAVAIR Depot).

211 30 AIRCRAFT AND ENGINE ACCESSORIES OVERHAUL SHOP (NAVAIR DEPOT) (m^2 / SF)
FAC: 2116
BFR Required: Y

21130-1 **REQUIREMENT.** An Aircraft and Engine Accessories Overhaul Shop is required to provide space for the overhaul and testing of miscellaneous accessories such as control assemblies, engine fuel system components, and accessories gear drive for the Accessories and Components Production Shop of the Naval Air Depot (NAVAIR Depot).

There are no specific criteria developed for this Category Code. An engineering study must be performed to determine the requirement.

211 31 DEDICATED AIRCRAFT AND ENGINE ACCESSORIES OVERHAUL – GENERAL PROCESS (NAVAIR DEPOT) (m^2 / SF)

FAC: 2116
BFR Required: Y

21131-1 **GENERAL.** A Dedicated Aircraft and Engine Accessories Overhaul – General Process Shop is required for the Accessories and Components Production Shop of the Naval Air Depot (NAVAIR Depot). Included within this Category Code are:

a. Accessories and Components Dedicated Cleaning Shop
b. Accessories and Components Dedicated Paint Shop
c. Accessories and Components Dedicated Machine Shop
d. Accessories and Components Dedicated Plating Shop
e. Accessories and Components Dedicated Welding Shop
f. Examination and Evaluation, Pre-Shop Analysis, examination and Inspection Shop
g. Hazardous Test Shop – This facility is used to test a portion of the accessory items overhauled. Because of the volatile fluid with which they are tested or the hazardous conditions of testing, the test area must be rigidly controlled. Items such as fuel pumps, fuel controls, etc. are worked in this area.
h. Reclamation Shop – Facility for removal of useable parts from defective end item components.

There are no specific criteria developed for this Category Code. An engineering study must be performed to determine the requirement.

211 32 METAL COMPONENTS SHOP (NAVAIR DEPOT) (m^2 / SF)

FAC: 2116
BFR Required: Y

21132-1 **GENERAL.** A Metal Components Shop is required for the Accessories and Components Production Shop of the Naval Air Depot (NAVAIR Depot). Included within this Category Code are:

a. Tank and Radiator Repair Shop – Facility to repair all types of radiators, inter-coolers and metal tanks.
b. Sheet Metal Shop – Facility for repair of surface sheet metal parts.
c. Metal Surface Shop – Facility for repair of wings, doors, stabilizers, tail booms, control surfaces, etc.
d. Seat Repair Shop.
e. Metal Bonding Shop.
f. Container Reclamation Shop – Facility for repair of engine, transmission, rotor blade and other type metal containers.

There are no specific criteria developed for this Category Code. An engineering study must be performed to determine the requirement.

211 33 NON-METAL COMPONENTS SHOP (NAVAIR DEPOT) (m^2 / SF)
FAC: 2116
BFR Required: Y

21133-1 **GENERAL.** A Non-Metal Components Shop is required for the Accessories and Components Production Shop of the Naval Air Depot (NAVAIR Depot). Included within this Category Code are:

a. Life Raft Repair Shop – Facility to repair inflatable life vests, dinghies, etc..
b. Rubber Repair Shop – Facility for the repair of rubber equipment such as aircraft fuel cells and molded rubber products.
c. Parachute Repair Shop – Facility for repair of parachutes, aerial pickup gear, etc.
d. Fabric and Upholstery Shop.
e. Tire Repair Shop.
f. Plastic and Fiberglass Shop – Facility for the repair of fiberglass and reinforced plastic items such as radomes, wingtips, ducts, covers, canopies, hatches and windows.
g. Composite Rework Shop.

There are no specific criteria developed for this Category Code. An engineering study must be performed to determine requirement.

211 34 DYNAMIC COMPONENTS SHOP (NAVAIR DEPOT) (m^2 / SF)
FAC: 2116
BFR Required: Y

21134-1 **GENERAL.** A Dynamic Components Shop is required for the Accessories and Components Production Shop of the Naval Air Depot (NADEP). Included within this Category Code are:

a. Propeller and Propeller Control Overhaul Shop
b. Rotor Head Overhaul Shop
c. Rotor Blade Overhaul Shop
d. Transmission/Gearbox Overhaul Shop
e. Dynamic Drive System Overhaul Shop – Facility used for the repair of drive shafts, pitch links, swash plates, etc..

There are no specific criteria developed for this Category Code. An engineering study must be performed to determine requirement.

211 35 HYDRAULIC COMPONENTS SHOP (NAVAIR DEPOT) (m^2 / SF)
FAC: 2116
BFR Required: Y

21135-1 **GENERAL.** A Hydraulic Components Shop is required for the Accessories and Components Production Shop of the Naval Air Depot (NAVAIR Depot). Included within this Category Code are:

A. Hydraulic Components Overhaul Shop
B. Bearings Shop - Specialized shop in which bearings are cleaned, disassembled, inspected, reassembled and tested.
C. Aircraft Landing Gear Shop - Facility used for the repair and overhaul of aircraft landing gear components such as wheels, brakes, and struts.

There are no specific criteria developed for this Category Code. An engineering study must be performed to determine the requirement.

211 36 ELECTRICAL COMPONENTS SHOP (NAVAIR DEPOT) (m^2 / SF)
FAC: 2116
BFR Required: Y

21136-1 **GENERAL.** An Electrical Components Shop is required for the Accessories and Components Production Shop of the Naval Air Depot (NAVAIR Depot). Included within this Category Code are:

a. Alternator Drive Overhaul Shop
b. Electrical Accessories Overhaul and Test Shop – Facility used in the overhaul and test of electrical components including electrical systems, starters, control equipment and converters, etc..
c. Battery Shop – Facility for the repair and test of aircraft batteries.
d. Constant Speed Drive Shop
e. Electro-Mechanical Components Shop – Facility used to repair Electro-Mechanical actuators, cargo and rescue hoists, etc.

There are no specific criteria developed for this Category Code. An engineering study must be performed to determine the requirement.

211 37 TURBINE ACCESSORIES SHOP (NAVAIR DEPOT) (m^2 / SF)
FAC: 2116
BFR Required: Y

21137-1 **GENERAL.** A Turbine Accessories Shop is required for the Accessories and Components Production Shop of the Naval Air Depot (NAVAIR Depot). Included within this Category Code are:

a. Turbine Accessories Overhaul Shop – Facility for overhaul of air compressor type equipment, such as air turbine starters, air conditioning packs, and air driven motors.
b. Turbine Accessories Test Shop
c. General Purpose Units Shop – Facility for the overhaul and repair of gas/air turbine engines and auxiliary power units, installed on the aircraft other than its' primary propulsion unit.
d. General Purpose Units Tests Shop
e. Ram/Air Turbine Accessories Overhaul Shop – Facility used for the overhaul of air driven accessories such as ram air turbines and scoops.
f. Ram/Air Turbine Accessories Test Shop

There are no specific criteria developed for this Category Code. An engineering study must be performed to determine the requirement.

211 38 PNEUMATIC OXYGEN SHOP (NAVAIR DEPOT) (m^2 / SF)
FAC: 2116
BFR Required: Y

21138-1 **GENERAL.** A Pneumatic Oxygen Shop is required for the Accessories and Components Production Shop of the Naval Air Depot (NAVAIR Depot). Included within this Category Code are:

a. Pneumatic Components Overhaul Shop
b. Cryogenics Shop
c. Oxygen Equipment Shop – Facility used for repair of oxygen regulators, converters, etc.

There are no specific criteria developed for this Category Code. An engineering study must be performed to determine the requirement.

211 39 OPTICAL AND PHOTOGRAPHIC COMPONENTS SHOP (NAVAIR DEPOT) (m^2 / SF)

FAC: 2116
BFR Required: Y

21138-1 GENERAL. An Optical and Photographic Components Shop is required for the Accessories and Components Production Shop of the Naval Air Depot (NAVAIR Depot). Included within this Category Code are:

a. Photographic Equipment Repair Shop – Facility for the repair of aircraft cameras and other photographic items.
b. Optical Component Repair Shop

There are no specific criteria developed for this Category Code. An engineering study must be performed to determine the requirement.

211 40 ELECTRONICS, COMMUNICATION, AND ARMAMENT SYSTEM SHOP (NAVAIR DEPOT) (m^2 / SF)

FAC: 2116
BFR Required: Y

21140-1 **GENERAL.** An Electronics, Communication, and Armament System Shop is required to provide space associated with processing airborne communication and navigation equipment, instruments, airborne data computers, fire control and bombing system equipment, gyroscopes, inertial guidance systems, and other avionics equipment.

There are no specific criteria developed for this Category Code. An engineering study must be performed to determine the requirement.

211 41 DEDICATED ELECTRONICS, COMMUNICATION, AND ARMAMENT – GENERAL PROCESS SHOP (NAVAIR DEPOT) (m^2 / SF)

FAC: 2116
BFR Required: Y

21141-1 **GENERAL.** A Dedicated Electronics, Communication, and Armament – General Process Shop is required for the Electronic, Communication, and Armament Systems Production Shop of the Naval Air Depot (NAVAIR Depot). Included within this Category Code are:

a. Electronics, Communication, and Armament Systems Dedicated Cleaning Shop
b. Electronics, Communication, and Armament Systems Dedicated Paint Shop
c. Electronics, Communication, and Armament Systems Dedicated Machine Shop
d. Electronics, Communication, and Armament Systems Dedicated Welding Shop
e. Electronics, Communication, and Armament Systems Dedicated Plating Shop
f. Electronics, Communication, and Armament Systems Dedicated Plating Shop
g. Electronics, Communication, and Armament Systems Dedicated Bearings Shop
h. Instrument Overhaul Shop

There are no specific criteria developed for this Category Code. An engineering study must be performed to determine requirement.

211 42 ELECTRONIC SYSTEM COMPONENTS SHOP (NAVAIR DEPOT) (m^2 / SF)

FAC: 2116
BFR Required: Y

21142-1 **GENERAL.** An Electronic System Components Shop is required for the Electronic, Communication, and Armament Systems Production Shop of the Naval Air Depot (NAVAIR Depot). Included within this Category Code are:

a. Armament and Avionics Shop – Facility for the repair of navigational missile and bombing radar, electronic countermeasure equipment, flight facilities and communication equipment, electronic instruments, and fire control systems.
b. Airborne Systems Software Shop – Facility for the preparation, repair or modification of software packages for aircraft automated systems.
c. Navigational Aids Repair Shop – Facility for the repair of airborne navigational instruments such as celestial tracking system, sextants, driftmeters, etc..
d. Avionics Testing Shop

There are no specific criteria developed for this Category Code. An engineering study must be performed to determine requirement.

211 43 INERTIAL QUALITY INSTRUMENT OVERHAUL SHOP (NAVAIR DEPOT) (m^2 / SF)

FAC: 2116
BFR Required: Y

21143-1 **GENERAL.** An Inertial Quality Instrument Overhaul Shop is required for the Electronic, Communication, and Armament Systems Production Shop of the Naval Air Depot (NAVAIR Depot). Included within this Category Code are:

a. Inertial Quality Gyroscope Overhaul Shop – Environmental controlled space for the overhaul of inertial quality gyroscopes. Inertial quality gyroscopes are those having a radome drift rate of 0.25 degrees per hour or less. All other gyroscopes are considered non-inertial quality for facility categorization purposes.
b. Inertial Guidance System Overhaul and Calibration Shop

There are no specific criteria developed for this Category Code. An engineering study must be performed to determine the requirement.

211 44 NON-INERTIAL QUALITY INSTRUMENT OVERHAUL SHOP (NAVAIR DEPOT) (m^2 / SF)

FAC: 2116
BFR Required: Y

21144-1 **GENERAL.** A Non-Inertial Quality Instrument Overhaul Shop is required for the Electronic, Communication, and Armament Systems Production Shop of the Naval Air Depot (NAVAIR Depot). Included within this Category Code are:

a. Electronic Instrument Overhaul Shop – Facility used to support communications electronic instruments such as systems and display panels, oscilloscopes, etc..
b. Mechanical Instrument Overhaul Shop – Facility for the overhaul of items such as bank indicators and air speed indicators.
c. Non-inertial Gyroscope Overhaul Shop – Facility used to overhaul non-inertial gyroscope devices such as N-1 compass gyroscopes, bomb navigational system gyroscopes, etc.
d. Magnetic Instrument Overhaul and Test Shop

There are no specific criteria developed for this Category Code. An engineering study must be performed to determine the requirement.

211 45 AVIONICS SHOP (NON-NAVAIR DEPOT) (m^2 / SF)
FAC: 2112
BFR Required: Y

21145-1 **GENERAL.** An Avionics Division at the intermediate maintenance level is required at Navy and Marine Corps Air installations for the testing, maintenance and repair of avionics systems. This section provides a method for determining the space requirements for this division. For additional guidance applicable to Marine Corps installations, see the 211 Supplement – Marine Corps Aircraft Maintenance Facilities. The Avionics Division is made up of standard size work centers, variable size work centers and support spaces.

a. Standard size work centers are those that do not vary with type/model of aircraft and size is determined by function and/or support equipment, i.e.: 60A Corrosion Control, 61D Crypto Repair, 62D Battery.

b. Variable size work centers are those that vary in size due to the quantity of support equipment required based on the number of aircraft supported, i.e.: 610 Comm./Nav., 62A Electrical, 64A Radar, 65A SACE, and 65P VAST.

c. Support spaces consist of those areas not directly involved in actual repair of aircraft components, i.e.: administrative, material control, production control, mechanical equipment room, passageways, locker rooms/heads, and the Precision Measuring Equipment (PME) work centers.

Refer to UFC 4-211-01 information on Avionics Shops.

The determination of gross square-footage requirements for a given air installation is accomplished through the use of Table 21145-1, Individual Aircraft Basic Allowance, and Table 21145-2, Multiple Aircraft Percentage Factors. This latter Table provides adjustments based on reduced requirements of support equipment due to commonality of aircraft components and to prevent duplicate allocations of standard size work centers and support spaces which are included in each individual aircraft basic space allowance.

Initially Table 21145-1 is entered using the number of assigned aircraft of each type/model. This provides the basic allowance for each type, and except as modified by Table 21145-3, is the total gross area for the support of a single type/model aircraft.

For installations supporting two or more type/model aircraft, the individual aircraft basic allowances from Table 21145-1 for each type/model are listed in descending order. Table 21145-2 is then entered with the first aircraft (largest basic space allowance) as the prime and the second aircraft as the secondary. The corresponding percentage factor is the percentage of the second aircraft's basic space allowance that will be added to the total space allowance of the first aircraft in computing the total space requirements. The percentage factor for the third (and succeeding) aircraft are

determined by entering Table 21145-2 with each aircraft in the secondary column and selecting the smallest percentage factor when considered with all the other type/model aircraft with larger basic space allowances as the prime. These factors are applied to each aircraft's basic space allowance and the results added to compute the total space allowance for the installation.

Tables 21145-1 and 21145-2 are designed for Avionics Divisions of medium to large size Intermediate Maintenance Activities that normally require separate space for the full range of work centers. In smaller activities several functions are usually combined, reducing overall space requirements. Table 21145-3 provides an adjustment factor that is to be applied when the gross space allowance determined from Tables 21145-1 and 21145-2 is less than 40,000 square feet.

Table 21145-1
Individual Aircraft Basic Space Allowance
(Values in 100 m^2/100 SF)

	A-4		TA-4		A-6		EA-6		KA-6		
Up to	m^2	SF	m^2	SF	m^2	SF	m^2	SF	m^2	SF	Up to
4	12.08	130	9.48	102	22.87	246	23.05	248	19.33	208	**4**
8	12.08	130	9.48	102	23.05	248	23.14	249	19.33	208	**8**
12	12.08	130	9.48	102	23.42	252	23.24	250	19.33	208	**12**
16	12.08	130	9.76	105	23.80	256	23.42	252	19.33	208	**16**
20	12.08	130	9.76	105	24.26	261	23.61	254	19.33	208	**20**
24	12.08	130	9.95	107	24.45	263	24.07	259	19.43	209	**24**
28	12.08	130	10.04	108	24.63	265	24.54	264	19.43	209	**28**
32	12.08	130	10.22	110	24.82	267	24.91	268	19.43	209	**32**
36	12.08	130	10.32	111	25.28	272	25.19	271	19.43	209	**36**
40	12.08	130	10.50	113	25.84	278	25.47	274	19.52	210	**40**
44	12.08	130	10.60	114	26.31	283	25.75	277	19.52	210	**44**
48	12.08	130	10.78	116	26.86	289	26.03	280	19.52	210	**48**
52	12.27	132	10.88	117	27.33	294	26.31	283	19.52	210	**52**
60	12.27	132	11.06	119	28.35	305	26.86	289	19.52	210	**60**
68	12.36	133	11.43	123	28.63	308	27.51	296	19.71	212	**68**
76	12.46	134	11.71	126	29.00	312	28.16	303	20.08	216	**76**
84	12.64	136	12.08	130	29.28	315	28.81	310	20.08	216	**84**
92	12.73	137	12.46	134	29.65	319	29.56	318	20.26	218	**92**
100	12.83	138	12.83	138	30.02	323	30.30	326	20.45	220	**100**
116	12.92	139	13.29	143	30.30	326					**116**
132	13.01	140	13.76	148	30.67	330					**132**
148	13.11	141	14.31	154	31.05	334					**148**
164						340					**164**
180						347					**180**
196						354					**196**

Table 21145-1 (Continued)
Individual Aircraft Basic Space Allowance
(Values in 100 m^2/100 SF)

	A-7		C-2		C-130		E-2		F-4		
Up to	**m^2**	**SF**	**m^2**	**SF**	**m^2**	**SF**	**m^2**	**SF**	**m^2**	**SF**	**Up to**
4	27.70	298	16.17	174	11.71	126	20.08	216	13.85	149	**4**
8	27.70	298	16.17	174	11.71	126	20.64	222	14.13	152	**8**
12	27.70	298	16.17	174	11.71	126	20.64	222	14.41	155	**12**
16	27.98	301	16.17	174	11.71	126	21.75	234	14.69	158	**16**
20	27.98	301	16.17	174	11.71	126	22.40	241	14.97	161	**20**
24	28.26	304	16.27	175	11.71	126	22.40	241	15.06	162	**24**
28	28.44	306	16.27	175	11.90	128	22.40	241	15.15	163	**28**
32	28.63	308	16.27	175	12.08	130	22.40	241	15.24	164	**32**
36	28.63	308	16.36	176	12.27	132	22.59	243	15.24	164	**36**
40	28.81	310	16.36	176	12.36	133	22.77	245	15.34	165	**40**
44	29.09	313	16.45	177	12.46	134	22.87	246	15.34	165	**44**
48	29.19	314	16.55	178	12.64	136	23.05	248	15.43	166	**48**
52	29.37	316	16.55	178	12.83	138	23.42	252	15.52	167	**52**
60	29.84	321	16.73	180	13.01	140	23.70	255	15.62	168	**60**
68	30.30	326	16.73	180	13.20	142	23.80	256	15.71	169	**68**
76	30.77	331	16.82	181	13.38	144	23.98	258	15.80	170	**76**
84	31.23	336	16.92	182	13.66	147	24.07	259	15.89	171	**84**
92	31.70	341	16.92	182	13.94	150	24.26	261	15.99	172	**92**
100	32.16	346	17.01	183	14.22	153	24.35	262	16.08	173	**100**
116	33.46	360									**116**
132	34.86	375									**132**
148	36.16	389									**148**
164	37.55	404									**164**
180	38.95	419									**180**
196	40.34	434									**196**

Table 21145-1 (Continued)
Individual Aircraft Basic Space Allowance
(Values in 100 m^2/100 SF)

	F-14		F/A-18		AH-1T		AH-1W		UH-1		
Up to	m^2	SF	m^2	SF	m^2	SF	m^2	SF	m^2	SF	Up to
4	25.56	275	27.70	298	13.01	140	12.46	134	11.53	124	4
8	26.96	290	27.70	298	13.01	140	12.46	134	11.53	124	8
12	26.96	290	27.70	298	13.01	140	12.46	134	11.53	124	12
16	28.63	308	27.70	298	13.01	140	12.46	134	11.53	124	16
20	30.02	323	27.70	298	13.01	140	12.46	134	11.53	124	20
24	31.14	335	27.89	300	13.01	140	12.46	134	11.53	124	24
28	32.25	347	28.07	302	13.01	140	12.46	134	11.53	124	28
32	33.37	359	28.26	304	13.01	140	12.46	134	11.53	124	32
36	33.65	362	28.44	306	13.01	140	12.46	134	11.53	124	36
40	33.93	365	28.72	309	13.01	140	12.46	134	11.53	124	40
44	34.21	368	28.91	311	13.01	140	12.46	134	11.53	124	44
48	34.48	371	29.09	313	13.01	140	12.46	134	11.53	124	48
52	34.76	374	29.37	316	13.01	140	12.46	134	11.53	124	52
60	35.14	378	29.56	318	13.01	140	12.46	134	11.53	124	60
68	35.60	383	29.93	322	13.01	140	12.55	135	11.53	124	68
76	35.97	387	30.30	326	13.01	140	12.55	135	11.62	125	76
84	36.44	392	30.67	330	13.01	140	12.55	135	11.62	125	84
92	36.90	397	31.05	334	13.01	140	12.64	136	11.62	125	92
100	37.27	401	31.42	338	13.01	140	12.64	136	11.62	125	100
116	38.57	415	31.42	338	13.01	140					116
132	39.04	420	32.07	345	13.01	140					132
148	39.50	425	32.72	352	13.01	140					148
164	39.97	430	33.37	359	13.01	140					164
180	40.43	435	34.02	366	13.01	140					180
196	40.81	439	34.67	373	13.01	140					196

Table 21145-1 (Continued)
Individual Aircraft Basic Space Allowance
(Values in 100 m^2/100 SF)

	SH-2		SH-3		CH-46		CH-53		RH-53		
Up to	m^2	SF	m^2	SF	m^2	SF	m^2	SF	m^2	SF	Up to
4	11.53	124	13.11	141	12.73	137	10.13	109	21.01	226	4
8	11.53	124	13.11	141	12.73	137	10.13	109	21.19	228	8
12	11.53	124	13.11	141	12.73	137	10.13	109	21.29	229	12
16	11.53	124	13.11	141	12.73	137	10.13	109	21.47	231	16
20	11.53	124	13.11	141	12.73	137	10.13	109	21.56	232	20
24	11.53	124	13.11	141	12.73	137	10.13	109	21.75	234	24
28	11.62	125	13.11	141	12.73	137	10.13	109	21.94	236	28
32	11.62	125	13.11	141	12.73	137	10.13	109	22.12	238	32
36	11.71	126	13.11	141	12.83	138	10.22	110	22.31	240	36
40	11.71	126	13.20	142	12.83	138	10.22	110	22.59	243	40
44	11.71	126	13.20	142	12.83	138	10.32	111	22.96	247	44
48	11.80	127	13.20	142	12.83	138	10.41	112	23.33	251	48
52	11.80	127	13.20	142	12.83	138	10.41	112	23.52	253	52

	SH-2		SH-3		CH-46		CH-53		RH-53		
Up to	m^2	SF	m^2	SF	m^2	SF	m^2	SF	m^2	SF	Up to
60	11.80	127	13.20	142	12.83	138	10.50	113	23.89	257	**60**
68	11.90	128	13.29	143	12.92	139	10.69	115	24.26	261	**68**
76	11.99	129	13.29	143	12.92	139	10.88	117	24.63	265	**76**
84	11.99	129	13.29	143	12.92	139	11.06	119	25.00	269	**84**
92	12.08	130	13.38	144	13.01	140	11.25	121	25.47	274	**92**
100	12.18	131	13.38	144	13.01	140	11.43	123	25.84	278	**100**
116											**116**
132											**132**
148											**148**
164											**164**
180											**180**
196											**196**

Table 21145-1 (Continued)
Individual Aircraft Basic Space Allowance
(Values in 100 m^2/100 SF)

	SH-60		P-3		S-3		AV-8		OV-10		
Up to	m^2	SF	m^2	SF	m^2	SF	m^2	SF	m^2	SF	Up to
4	16.55	178	23.42	252	27.89	300	16.55	178	12.83	138	**4**
8	16.55	178	23.42	252	30.77	331	16.55	178	13.01	140	**8**
12	16.55	178	23.42	252	32.25	347	16.55	178	13.29	143	**12**
16	16.55	178	23.52	253	33.65	362	16.55	178	13.48	145	**16**
20	16.55	178	23.61	254	33.65	362	16.55	178	13.85	149	**20**
24	16.55	178	23.80	256	33.93	365	16.55	178	14.41	155	**24**
28	16.55	178	23.98	258	34.21	368	16.55	178	14.69	158	**28**
32	16.55	178	24.07	259	34.39	370	16.55	178	14.97	161	**32**
36	16.55	178	24.35	262	34.67	373	16.64	179	15.06	162	**36**
40	16.55	178	24.72	266	34.95	376	16.73	180	15.15	163	**40**
44	16.55	178	25.00	269	35.14	378	16.73	180	15.24	164	**44**
48	16.55	178	25.38	273	35.41	381	16.82	181	15.43	166	**48**
52	16.55	178	26.03	280	35.69	384	16.92	182	15.62	168	**52**
60	16.55	178	26.68	287	35.97	387	17.10	184	15.89	171	**60**
68	16.64	179	27.33	294	36.44	392	17.29	186	16.08	173	**68**
76	16.73	180	28.26	304	36.81	396	17.47	188	16.36	176	**76**
84	16.92	182	28.91	311	37.27	401	17.66	190	16.64	179	**84**
92	17.10	184	29.56	318	37.74	406	17.85	192	16.92	182	**92**
100	17.29	186	30.12	324	38.11	410	17.94	193	17.20	185	**100**
116	17.38	187			39.04	420	18.40	198			**116**
132	17.57	189			40.06	431	18.87	203			**132**
148	17.66	190			40.99	441	19.33	208			**148**
164							19.80	213			**164**
180							20.26	218			**180**
196							20.73	223			**196**

Table 21145-2
Multiple Aircraft Percentage Factors

SECONDARY AIRCRAFT	PRIMARY AIRCRAFT											
		A-4	TA-4	A-6	EA-6	KA-6	A-7	C-2	C-130	E-2	F-4	
	A-4	--	26	12	21	8	13	27	28	17	14	A-4
S	TA-4	11	--	12	25	11	9	11	14	11	10	TA-4
E	A-6	N/A	N/A	--	28	N/A	44	N/A	N/A	39	N/A	A-6
C	EA-6	N/A	N/A	34	--	N/A	51	N/A	N/A	44	N/A	EA-6
O	KA-6	N/A	N/A	5	10	--	26	N/A	N/A	32	N/A	KA-6
N	A-7	N/A	N/A	40	46	N/A	--	N/A	N/A	N/A	N/A	A-7
D	C-2	N/A	N/A	28	34	28	28	--	N/A	5	N/A	C-2
A	C-130	26	23	27	36	25	25	16	--	18	28	C-130
R	E-2	N/A	N/A	39	40	30	36	N/A	N/A	--	N/A	E-2
Y	F-4	N/A	37	32	41	32	31	44	38	35	--	F-4
	F-14	N/A	N/A	44	47	N/A	36	N/A	N/A	N/A	N/A	F-14
A	F/A-18	N/A	N/A	45	51	N/A	33	N/A	N/A	N/A	N/A	F/A-18
I	AH-1T	21	32	22	32	21	21	32	31	21	23	AH-1T
R	AH-1W	19	30	20	28	19	19	31	31	17	20	AH-1W
C	UH-1	12	24	12	23	11	11	24	23	11	14	UH-1
R	SH-2	23	22	24	33	23	23	24	23	21	24	SH-2
A	SH-3	24	32	23	28	23	23	32	33	22	25	SH-3
F	CH-46	27	38	28	30	27	27	38	36	25	30	CH-46
T	CH-53	15	29	15	27	14	16	29	28	14	18	CH-53
	RH-53	N/A	N/A	52	57	N/A	51	N/A	N/A	49	N/A	RH-53
	SH-60	N/A	N/A	28	27	27	27	36	N/A	28	N/A	SH-60
	P-3	N/A	N/A	49	60	N/A	48	N/A	N/A	47	N/A	P-3
	S-3	N/A	N/A	47	51	N/A	36	N/A	N/A	N/A	N/A	S-3
	AV-8	N/A	N/A	33	42	41	35	50	N/A	38	N/A	AV-8
	OV-10	21	31	19	33	23	12	35	29	22	26	OV-10

Table 21145-2 (Continued)
Multiple Aircraft Percentage Factors

SECONDARY AIRCRAFT	PRIMARY AIRCRAFT										
		F-14	F/A-18	AH-1T	AH-1W	UH-1	SH-2	SH-3	CH-46	CH-53	RH-53
	A-4	8	15	15	16	N/A	27	18	23	N/A	14
	TA-4	13	21	12	12	12	10	11	24	28	10
	A-6	21	46	N/A	N/A	N/A	N/A	N/A	N/A	N/A	53
	EA-6	25	52	N/A	N/A	N/A	N/A	N/A	N/A	N/A	55
	KA-6	27	32	N/A	N/A	N/A	N/A	N/A	N/A	N/A	46
	A-7	33	36	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	C-2	27	34	N/A	N/A	N/A	N/A	N/A	N/A	N/A	45
	C-130	27	33	24	27	N/A	25	25	31	N/A	25
	E-2	20	40	N/A	N/A	N/A	N/A	N/A	N/A	N/A	46
	F-4	31	39	N/A	N/A	N/A	N/A	N/A	N/A	N/A	33
	F-14	--	39	N/A	N/A	N/A	N/A	N/A	N/A	N/A	58
	F/A-18	45	--	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	AH-1T	21	29	--	N/A	N/A	N/A	21	38	N/A	19
	AH-1W	18	24	5	--	N/A	N/A	19	23	N/A	16
	UH-1	12	21	6	24	--	23	12	17	N/A	9
	SH-2	25	33	23	25	23	--	10	N/A	N/A	21
	SH-3	23	31	N/A	N/A	N/A	N/A	--	31	N/A	19
	CH-46	27	20	25	N/A	N/A	N/A	27	--	N/A	21
	CH-53	15	24	10	12	11	28	13	19	--	7
	RH-53	51	56	N/A	N/A	N/A	N/A	N/A	N/A	N/A	--
	SH-60	27	32	N/A	N/A	N/A	N/A	N/A	N/A	N/A	45
	P-3	19	45	N/A	N/A	N/A	N/A	N/A	N/A	N/A	62
	S-3	24	39	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	AV-8	33	26	N/A	N/A	N/A	N/A	N/A	N/A	N/A	45
	OV-10	24	26	16	N/A	N/A	N/A	20	22	N/A	19

Table 21145-2 (Continued)
Multiple Aircraft Percentage Factors

SECONDARY AIRCRAFT	PRIMARY AIRCRAFT: SH-60	P-3	S-3	AV-8	OV-10	SECONDARY AIRCRAFT
A-4	25	36	16	16	16	A-4
TA-4	24	23	14	21	11	TA-4
A-6	N/A	49	44	N/A	N/A	A-6
EA-6	N/A	55	51	N/A	N/A	EA-6
KA-6	N/A	44	31	51	N/A	KA-6
A-7	N/A	48	28	N/A	N/A	A-7
C-2	37	27	22	51	47	C-2
C-130	35	25	19	33	24	C-130
E-2	N/A	45	34	50	N/A	E-2
F-4	42	49	32	40	34	F-4
F-14	N/A	56	16	N/A	N/A	F-14
F/A-18	N/A	50	45	N/A	N/A	F/A-18
AH-1T	30	38	20	29	18	AH-1T
AH-1W	26	37	18	23	16	AH-1W
UH-1	21	31	11	21	6	UH-1
SH-2	34	22	15	32	23	SH-2
SH-3	32	32	15	30	22	SH-3
CH-46	36	31	27	19	22	CH-46
CH-53	26	39	16	24	11	CH-53
RH-53	N/A	63	52	N/A	N/A	RH-53
SH-60	--	42	27	50	44	SH-60
P-3	N/A	--	43	N/A	N/A	P-3
S-3	N/A	46	--	N/A	N/A	S-3
AV-8	N/A	44	37	--	43	AV-8
OV-10	32	30	12	30	--	OV-10

Table 21145-3
Adjustment Factor for Small Avionics Divisions

Gross Space (m^2)	Gross Space (m^2 / SF)	Factor
929 – 1,208	10,000 – 12,999	.50
1,209 – 1,487	13,000 – 15,999	.55
1,488 – 1,765	16,000 – 18,999	.60
1,766 – 2,044	19,000 – 21,999	.65
2,045 – 2,323	22,000 – 24,999	.70
2,324 – 2,602	25,000 – 27,999	.75
2,603 – 2,881	28,000 – 30,999	.80
2,882 – 3,160	31,000 – 33,999	.85
3,161 – 3,439	34,000 – 36,999	.90
3,440 – 3,717	37,000 – 39,999	.95
3,718 and up	40,000 and up	1.00

Example 1 - One type/model aircraft assigned.

There are 100 assigned aircraft of the type/model indicated in Column (1) below. Column (2) contains the basic space requirement from Table 21145-1.

Step 1.

Obtain basic space requirement for the type/model aircraft by entering Table 21145-1 with the quantity of aircraft to be supported.

Column (1)	Column (2)
100 F-14	3,727 m^2 (40,100 SF)

Since there is only one type/model assigned and the space requirement is over 3,718 m^2 (40,000 SF), no further computations are required.

Gross space allowance for Avionics Division – 3,727 m^2 (40,100 SF)

Example 2 - One type/model aircraft assigned.

There are 8 assigned aircraft of the type/model indicated in Column (1) below. Column (2) contains the basic space requirement from Table 21145-1. Column (3) contains the adjustment factor for a small avionics division from Table 21145-3. Column (4) contains the adjusted space requirement.

Step 1.

Obtain basic requirement for the type/model aircraft by entering Table 21145-1 with the quantity of aircraft supported.

Column (1)	Column (2)
8 E-2	22,200 SF

Step 2.

Since the space requirement in Column (2) is less than 40,000 SF obtain the adjustment factor for small avionics divisions from Table 21145-3.

Column (1)	Column (2)		Column (3)		Column (4)
8 E-2	2,064 m^2	x	.70	=	1,445 m^2
	22,200 SF	x	.70	=	15,540 SF

Gross space allowance for Avionics Division – 1,445 m^2 (15,540 SF)

Example 3 - Two Type/Model aircraft assigned

There are 144 assigned aircraft of the type/model and number indicated in Column (1) below. Column (2) contains the basic space requirements from Table 21145-1. Column (3) contains the percentage factor for the secondary aircraft (smallest basic space allowance). Column (4) contains the total space requirement.

Step 1.

Obtain basic space requirements for both type/model aircraft by entering Table 21145-1 with quantity of aircraft to be supported.

Column (1)	Column (2)
100 F-14	3,727 m^2 (40,100 SF)
44 F-4	1,534 m^2 (16,500 SF)

Step 2.

Obtain percentage factor for secondary aircraft by crossing from that aircraft in secondary column to the column under the prime aircraft (F-4 to F-14 = 35%) of Table 21145-2.

Column (1)	Column (2)	Column (3)
100 F-14	3,727 m^2 (40,100 SF)	
44 F-4	1,534 m^2 (16,500 SF)	31%

Step 3.

Enter 100% of prime aircraft basic space requirement (Column (2)) in Column (4). Calculate percentage (Column (3)) of secondary aircraft space requirement (Column (2)) and enter in Column (4). Add requirements of Column (4) for total avionics division requirement.

Column (1)	Column (2)		Column (3)		Column (4)
100 F-14	3,727 m^2	x	1.00	=	3,727 m2
	40,100 SF	x	1.00	=	40,100 SF
	1,534 m^2	x	0.31	=	476 m^2
44 F-44	16,500 SF	x	0.31	=	5,115 SF
					4,203 m^2
					45,215 SF

Gross space allowance for Avionics Division – 4,203 m^2 (45,215 SF)

Example 4 - Three or more Type/Model aircraft assigned

There are 196 assigned aircraft of the type/model and number indicated in Column (1) below. Column (2) contains the basic space requirements from Table 21145-1 in descending order of size. Column (3) contains the lowest percentage factor from Table 21145-2 for each secondary type aircraft when considered against those with larger basic space requirements as prime. Column (4) contains the total space requirement.

Step 1.

Obtain basic space requirements for both type/model aircraft by entering Table 21145-1 with quantity of aircraft to be supported.

Column (1)	Column (2)
100 F-14	3,727 m^2 (40,100 SF)
28 E-2	2,240 m^2 (24,100 SF)
44 F-4	1,534 m^2 (16,500 SF)
24 TA-4	995 m^2 (10,700 SF)

Step 2.

Select lowest percentage factor for secondary type aircraft for Column (3) by crossing from that aircraft in secondary column and considering each aircraft assigned with a larger basic space requirement as a prime aircraft.

a.The E-2 has only the F-14 with a larger basic space requirement therefore 20% will be used in Column (3).

b.The F-4 has both the E-2 (35%) and the F-14 (31%) with larger basic requirements. The F-14 has the lowest percentage factor (31%) so this will be entered in Column (3).

c.The TA-4 has all the other types with larger basic space requirements. The E-2 (11%) has a lower percentage factor than the F-14 (13%), but a higher percentage factor than the F-4 (10%); therefore, 10% shall be entered in Column (3).

Step 3.

Enter 100% of prime aircraft basic space requirement in Column (4). Calculate percentage (Column (3)) of secondary aircraft space requirement (Column (2)) and enter in Column (4). Add requirements of Column (4) for total avionics division requirement.

Column (1)	Column (2)		Column (3)		Column (4)
100 F-14	3,727 m^2	x	1.00	=	3,727 m^2
	40,100 SF	x	1.00	=	40,100 SF
28 E-2	2,240 m^2	x	0.20	=	448 m^2
	24,100 SF	x	0.20	=	4,820 SF
44 F-44	1,534 m^2	x	0.31	=	476 m^2
	16,500 SF	x	0.31	=	5,115 SF
24 TA-4	995 m^2 x	0.10		=	100 m^2
	10,700 SF	x	0.10		1,070 SF
					4,751 m^2
					51,105 SF

Gross space allowance for Avionics Division – 4,751 m^2 (51,105 SF)

211 50 AIRCRAFT ARMAMENT/MISSILE REWORK SHOP (NAVAIR DEPOT) (m^2 / SF)

FAC: 2116
BFR Required: Y

21150-1 **GENERAL.** An Aircraft Armament/Missile Rework Shop is required to provide space associated with processing weapons including guns, missiles, bomb racks, weapon pylons, etc., used by aircraft in carrying out its assigned mission.

There are no specific criteria developed for this Category Code. An engineering study must be performed to determine the requirement.

211 51 DEDICATED AIRCRAFT ARMAMENT/MISSILE REWORK SHOP – GENERAL PURPOSE (NAVAIR DEPOT) (m^2 / SF)

FAC: 2116
BFR Required: Y

21151-1 **GENERAL.** A Dedicated Aircraft Armament/Missile Rework – General Purpose Shop is required for the Armament Production Shop of the Naval Air Depot (NAVAIR Depot). Included within this Category Code are:

a. Armament Dedicated Cleaning Shop
b. Armament Dedicated Paint Shop
c. Armament Dedicated Machine Shop
d. Armament Dedicated Welding Shop
e. Armament Dedicated Plating Shop
f. Aircraft Weapon Overhaul and Test Shop
g. Ordnance Equipment Shop
h. Weapon Accessories Repair Shop – Facility for the repair of bomb racks, weapon pylons, etc.

There are no specific criteria developed for this Category Code. An engineering study must be performed to determine the requirement.

211 52 AIRCRAFT WEAPON OVERHAUL AND TEST SHOP (NAVAIR DEPOT) (m^2 / SF)

FAC: 2116
BFR Required: Y

21152-1 **GENERAL.** An Aircraft Weapon Overhaul and Test Shop is required for the Armament Production Shop of the Naval Air Depot (NAVAIR Depot). Included within this Category Code are:

a. Aircraft Weapon Overhaul and Test Shop
b. Ordnance Equipment Shop
c. Weapon Accessories Repair Shop – Facility for the repair of bomb racks, weapon pylons, etc.

There are no specific criteria developed for this Category Code. An engineering study must be performed to determine the requirement.

211 53 AIR LAUNCHED MISSILE REWORK SHOP (NAVAIR DEPOT) (m^2 / SF)
FAC: 2116
BFR Required: Y

21153-1 **GENERAL.** An Air Launched Missile rework Shop is required to provide space for the repair of air launched missiles for the Armament Production Shop of the Naval Air Depot (NAVAIR Depot).

There are no specific criteria developed for this Category Code. An engineering study must be performed to determine the requirement.

211 54 AIRCRAFT ARMAMENT SYSTEM SHOP (NON-NAVAIR DEPOT) (m^2 / SF)

Refer to the following publications for AAS storage facility preservation criteria:
CNAFINST 8380.2 and NAVAIR 15-01-500

FAC: 2112
BFR Required: Y

21154-1 **GENERAL.** Prior to commencing any I-Level facilities projects, coordination and planning must be conducted with the Command for which the facility is intended. Consideration must be made for other required duties of the occupying section. The Aircraft Armament Systems (AAS) shop and shops related to AAS sub-systems may be called different names. Within a Navy Command these shops fall under the Ordnance Division in the Maintenance Department. At a Marine Aviation Logistics Squadron (MALS), the AAS shop is under the Ordnance Department and not under the cognizance of the Maintenance Department. MALS Ordnance has the additional responsibilities of operating a Munitions shop, an Ammunition Stock Recording Section (ASRS), a Tool Room, a Production Control (PC) section, and an administrative section.

An Aircraft Armament Systems (AAS) shop is required at Navy and Marine Corps Intermediate Level (I-Level) maintenance activities to support combat aircraft. AAS encompasses five distinct subsystems; Aircraft Armament Equipment (AAE), Aircraft Gun Systems (AGS), Aircraft Crew Served Weapons (ACSW), ACSW mounts, and Laser Aiming Devices (LAD). Although missiles and rockets are handled at the missile maintenance shop or rocket assembly and loading areas, maintenance of AAS launchers is conducted in the AAS shop.

Aircraft that require support from this shop can be classified in three general groups, the attack/fighter group which require extensive support, the Anti-submarine Warfare (ASW), and Transport groups which require much less support. Table 21154-1 below lists the aircraft in each group. The Navy/Marine Corps aircraft that do not appear in either group generally do not require support from an AAS shop.

Table 21154-1
Aircraft Classification

Attack/Fighter	ASW	Transport
F-35	SH-60	KC-130HH
F/A-18	P-3	CH-53
AV-8	S-3	MV-22
AH-1/UH-1	P-8	
E/A-6		

The determination of gross square footage requirements for a given air installation is accomplished through the use of Table 21154-2 Space Allowance for Basic Aircraft Armament System Division, Table 21154-3 Space Allowance for AAS Pool, and Table 21154-4 Space Allowance for the Armament Weapons Support Equipment (AWSE) Work Center (for those activities having this responsibility). (Type Commander 8380 series instructions determine which activities have Aircraft Armament System Equipment Pool responsibilities).

Initially Table 21154-2 is entered in Column (1) using the total number of assigned attack and fighter aircraft. The gross area is read in Column (2). For those activities without any attack or fighter aircraft but having other type aircraft that require Armament Division support, such as P-3, S-3, etc., enter Column (1) with total number of these aircraft. The required gross area is read in Column (3).

Table 21154-2
Space Allowance for
Basic Aircraft Armament System Division

Column (1) No. Aircraft	Column (2) Attack/Fighter (m^2)	Column (2) Attack/Fighter (SF)	Column (3)* ASW (m^2)	Column (3)* ASW (SF)
Up to 50	325	3,500	251	2,700
51-75	409	4,400	288	3,100
76-100	465	5,000	325	3,500
101-125	502	5,400		
126-175	567	6,100		
176-225	623	6,700		
226 +	651	7,000		

*Do not use when activity also supports attack and/or fighter aircraft, use allowance from Column (2) only.

The above space allowances include space for degreasing, storage of guns, administration, production control, training, supply and tool room, male and female personnel facilities and a mechanical equipment room. If an I-level facility utilizes and stores Aircraft Crew Served Weapons (ACSW), the area which these systems are stowed must meet the Unified Facilities Criteria for Armories, Refer to UFC 4-215-1 (i.e. physical security and humidity controlled).

Example Computation 1 – Aircraft Armament Systems Shop

Assigned aircraft:	80	F-35
	56	F/A-18A
	42	S-3A
Total	178	

Since base loading includes attack and fighter aircraft, only those numbers are used to enter Table 21154-2. Therefore, Column (1) is entered with 136 aircraft. A required area of 567 m^2 (6,100 SF) is read from Column (2).

Example Computation 2 – Aircraft Armament Systems Shop

Assigned aircraft:	42	P-3C
	22	CH-53
Total	64	

This base loading does not include either attack or fighter aircraft, consequently the total number of aircraft is used to enter Table 21154-2. Entering Column (1) with 64 aircraft, a required area of 288 m^2 (3,100 SF) is read from Column (3).

Activities that have the assigned responsibilities of maintaining an Aircraft Armament System Equipment Pool, the basic shop requirement from Table 21154-2 will be increased by the requirement from Table 21154-3.

Table 21154-3
Space Allowance for
Aircraft Armament System Equipment Pool

Column (1) Aircraft	Column (2) Area Per Aircraft (m^2)	Column (2) Area Per Aircraft (SF)
E/A-6	3	32
F-35	6.1	66
F/A-18	5.9	64
AH-1/UH-1	5	54
MV-22	1.11	12
CH-53	7.1	76
SH-60	0.5	5
P-3	1.1	12
S-3	0.9	10
P-8	0.5	5
AV-8B	3.5	38
KC-130HH	1.11	12

The above allowance provides space for Pool storage and the issuing and receiving functions only. Administrative and other support functions are provided in the basic allowance from Table 21154-2.

Example Computation 3 – Aircraft Armament System Equipment Pool

Assigned aircraft are identical to Example Computation 1 above, however pool support is also provided for 30 SH-60B at another station.

Type A/C (Column (1))	Area Per A/C (m^2) (Column (2))	Area Per A/C (SF) (Column (2))	Number A/C	m^2	SF
F-35	6.1	66	80	488	5,253
F/A-18A	5.9	64	56	330	3,552
S-3A	0.9	10	42	38	409
SH-60B	0.5	5	30	15	161
Total space requirement				871	9,375

This requirement is added to the basic requirement from Table 21154-2, 567 m^2 (6,100 SF), to give a total requirement of 1,438 m^2 (15,475 SF) for the Aircraft Armament System Shop.

Marine Corps activities have the additional responsibility of conducting maintenance on AWSE. Space for this added function is provided by Table 21154-4. It is based on the activities' allowance for weapons trailers.

Table 21154-4
Space Allowance for
Armament Weapons Support Equipment Work Center

Column (1) Type Trailer	Column (2) Area Per Trailer (m^2)	Column (2) Area Per Trailer (SF)
AM32K-10	2.3	25
MHU-151/M	1.4	15

The above allowance provides space for the AWSE work center only. Administration and other support functions are provided in the basic allowance from Table 21154-2.

Example Computation 4 – Aircraft Armament Systems Shop

A Marine Corps activity has a base loading as shown below, with the armament equipment pool responsibility for the same number and type aircraft.

Base loading: 20 AV-8 Aircraft

24 AH-1Z Aircraft
16 CH-53E Aircraft
15 F-35 Aircraft
25 AM32K-10 Trailers
28 MHU-151/M Trailers

a.) Basic shop requirement

Attack Aircraft:	20	AV-8
	24	AH-1
	15	F-35
Total	59	

Enter Table 21154-2, Column (1) with 59 aircraft. A required area of 409 m^2 (4,400 SF) is read from Column (2).

b.) Aircraft Armament System Equipment Pool

Type A/C (Column (1))	Area Per A/C (m^2) (Column (2))	Area Per A/C (SF) (Column (2))	Number A/C	m^2	SF
AV-8	3.5	38	20	70	753
AH-1Z	5	54	24	120	1,292
CH-53E	7.1	76	16	114	1,227
F-35	6.1	66	15	92	990
Total space requirement				396	4,262

c.) Armament Weapons Support Equipment Work Center

Type Trailer	Area per Trailer (m^2)	Area per Trailer (SF)	No. Trailer	m^2	SF
AM32K-10	2.3	25	25	58	624
MHU-151/M	1.4	15	28	39	420
Total space requirement				97	1,044

Total gross square feet for Aircraft Armament System Shop

	m^2.	SF
a.) Basic Shop Requirement	409	4,400
b.) Equipment Pool Requirement	396	4,262
c.) Support Equipment W/C Requirement	97	1,044
Total	902	9,706

211 55 AVIATION ARMAMENT SUPPORT EQUIPMENT HOLDING SHED (NON-NAVAIR DEPOT) (m^2 / SF)

Refer to the following publications for AAS storage facility preservation criteria:
CNAFINST 8380.2 and NAVAIR 15-01-500

FAC: 4412
BFR Required: N

21155-1 **GENERAL.** For Marine Corps activities, an aviation armament support equipment holding shed is planned in conjunction with the Category Code 211 54, Aircraft Armament System Shop. The shed provides cover for weapons trailers, bomb cradles, and other armament support equipment and is an integral part of Marine Aviation Logistics Squadrons' Ordnance Department.

The holding shed requirement is based on a unit space for each weapons trailer in accordance with Table 21155-1. The gross square feet requirement is sized by multiplying the unit space for each type trailer by the activity's allowance.

Table
21155-1
Space Allowance for Armament Weapons Support Equipment Holding Shed

Type Trailer	Area per Trailer (m2)	Area per Trailer (SF)
A/M32K-10	12.4	133
MHU-151/M	6.7	72
U-21	12.4	133

Example Computation 1 – Holding Shed

A Marine Aviation Logistics Squadron (MALS) has an allowance of thirty AM32K-10 trailers and twenty-five of the smaller MHU-151/M trailers, and one U-21 maintenance trailer.

Type Trailer	Area per Trailer (m^2)	Area per Trailer (SF)	No. Trailer	m^2	SF
A/M32K-10	12.4	133	30	372	3,990
MHU-151/M	6.7	72	25	168	1,800
U-21	12.4	133	1	12.4	133
			Total	552.4	5,923

211 60 SUPPORT EQUIPMENT REWORK SHOP (NAVAIR DEPOT) (m^2 / SF)
FAC: 2116
BFR Required: Y

21160-1 **GENERAL.** A Support Equipment Rework Shop is required to provide space associated with processing aviation general and special support equipment and aerospace ground support equipment.

There are no specific criteria developed for this Category Code. An engineering study must be performed to determine the requirement.

211 61 DEDICATED SUPPORT EQUIPMENT REWORK GENERAL PURPOSE SHOP (NAVAIR DEPOT) (m^2 / SF)
FAC: 2116
BFR Required: Y

21161-1 **GENERAL.** A Dedicated Support Equipment Rework General Purpose Shop is required for the Support Equipment Production Shop of the Naval Air Depot (NAVAIR Depot). Included within this Category Code are:

a. Support Equipment Dedicated Cleaning Shop
b. Support Equipment Dedicated Paint Shop
c. Support Equipment Dedicated Machine Shop
d. Support Equipment Dedicated Plating Shop
e. Support Equipment Dedicated Welding Shop

There are no specific criteria developed for this Category Code. An engineering study must be performed to determine the requirement.

211 62 SUPPORT EQUIPMENT CALIBRATION SHOP (NAVAIR DEPOT) (m2. / SF)
FAC: 2116
BFR Required: Y

21162-1 **GENERAL.** A Support Equipment Calibration Shop is required for the Support Equipment Production Shop of the Naval Air Depot (NAVAIR Depot). Included within this Category Code are:

a. Aeronautical Electronic Support Equipment Shop – Includes mobile maintenance facility construction, outfitting and repair.
b. Electronic Test Systems Repair Shop – Facility for the repair of VAST, ATE, etc.

c. Precision Measurement Equipment Shop – Facility used to repair, calibrate and certify precision measurement and test equipment.

There are no specific criteria developed for this Category Code. An engineering study must be performed to determine the requirement.

211 63 GROUND SUPPORT EQUIPMENT REWORK SHOP (NAVAIR DEPOT) (m^2 / SF)

FAC: 2116
BFR Required: Y

21163-1 **GENERAL.** A Ground Support Equipment Rework Shop is required for the Support Equipment Production Shop of the Naval Air Depot (NAVAIR Depot). Included within this Category Code are:

a. GSE Maintenance Shop – Facility used for the servicing and maintaining of ground support equipment such as work stands, firefighting equipment, portable air conditioners, air compressors, generators, etc..
b. Training Devices Shop – Facility used to repair and modify training aids such as mock-ups, cut away models, etc.
c. Hydrostatics Shop – Facility used to periodically inspect and overhaul of hydrostatic equipment.

There are no specific criteria developed for this Category Code. An engineering study must be performed to determine the requirement.

211 64 GROUND SUPPORT EQUIPMENT HOLDING SHED (NAVAIR DEPOT) (m^2 / SF)

FAC: 2185
BFR Required: Y

21164-1 **GENERAL.** A Ground Support Equipment Holding Shed is required for the Support Equipment Production Shop of the Naval Air Depot (NAVAIR Depot).

There are no specific criteria developed for this Category Code. An engineering study must be performed to determine the requirement.

211 65 AIRBORNE WEAPONS SUPPORT EQUIPMENT SHOP (NAVAIR DEPOT) (EA)

FAC: 2112
BFR Required: Y

21165-1 **GENERAL.** An Airborne Weapons Support Equipment Shop is required for the Support Equipment Production Shop of the Naval Air Depot (NAVAIR Depot).

There are no specific criteria developed for this Category Code. An engineering study must be performed to determine the requirement.

211 70 MANUFACTURING AND REPAIR SHOP (NAVAIR DEPOT) (m^2 / SF)

FAC: 2116
BFR Required: Y

21170-1 **GENERAL.** A Manufacturing and Repair Shop is required to provide space for aircraft repair operations by such work functions as parts cleaning and painting, plating and metal processing shop.

There are no specific criteria developed for this Category Code. An engineering study must be performed to determine the requirement.

211 71 DEDICATED MANUFACTURING AND REPAIR – GENERAL PURPOSE SHOP (NAVAIR DEPOT) (m^2 / SF)

FAC: 2116
BFR Required: Y

21171-1 **GENERAL.** A Dedicated Manufacturing and Repair - General Purpose Shop is required for the Manufacture and Repair Production Shop of the Naval Air Depot (NAVAIR Depot). Included within this Category Code are:

a. Welding Shop
b. Foundry Shop
c. Peening and Blasting Shop
d. Non-destructive Inspection – Magnetic particle, Dye Penetrant, etc..
e. Parts Cleaning Shop
f. Parts Painting Shop

There are no specific criteria developed for this Category Code. An engineering study must be performed to determine the requirement.

211 72 METAL FABRICATION/MANUFACTURING SHOP (NAVAIR DEPOT) (m^2 / SF)
FAC: 2116
BFR Required: Y

21172-1 **GENERAL.** A Metal Fabrication/Manufacturing Shop is required for the Manufacture and Repair Production Shop of the Naval Air Depot (NAVAIR Depot). Included within this Category Code are:

a. Machine Shop
b. Grinding Shop – Facility is used primarily for close tolerance grinding of metal parts that have been built up by metalizing or electroplating processes.
c. NC Machine Shop – Facility primarily using numerically controlled machines; separate from common machine shop.
d. Metal Parts Fabrication Shop

There are no specific criteria developed for this Category Code. An engineering study must be performed to determine the requirement.

211 73 METAL TREATMENT SHOP (NAVAIR DEPOT) (m^2 / SF)
FAC: 2116
BFR Required: Y

21173-1 **GENERAL.** A Metal Treatment Shop is required for the Manufacture and Repair Production Shop of the Naval Air Depot (NAVAIR Depot). Included within this Category Code are:

a. Metal Processing Shop – Facility for metal treating processes such as nickel braze, ceramic coating, plasma, etc.
b. Plating Shop
c. Heat Treating Shop – Facility for heat treating metals such as tempering, annealing, quenching, stress relieving, etc.

There are no specific criteria developed for this Category Code. An engineering study must be performed to determine the requirement.

211 74 NON-METAL FABRICATION/MANUFACTURING SHOP (NAVAIR DEPOT) (EA)

FAC: 2116
BFR Required: Y

21174-1 **GENERAL.** A Non-Metal Fabrication/Manufacturing Shop is required for the Manufacture and Repair Production Shop of the Naval Air Depot (NAVAIR Depot). Included within this Category Code are:

a. Plastic Fabrication Shop – Facility for the manufacture of plastic items such as tubing, caps, covers, panels, foam container liners, templates, fixtures and tooling.
b. Pattern Shop
c. Decal (Graphic Arts) Shop
d. Woodworking Shop
e. Rubber Fabrication Shop – Facility for fabrication of rubber equipment such as aircraft fuel cells and molded rubber products.

There are no specific criteria developed for this Category Code. An engineering study must be performed to determine the requirement.

211 75 AVIATION LIFE SUPPORT SYSTEMS SHOP (NON-NAVAIR DEPOT) (m^2 / SF)

FAC: 2184
BFR Required: Y

Design Criteria: UFC 4-211-01, Aircraft Maintenance Hangars

21175-1 **GENERAL.** An Aviation Life Support Systems Shop is required at Navy and Marine Corps air installations for inspecting, repairing, and repacking of parachutes, flotation devices, oxygen and other life support equipment. See basic Category 211 Supplement, Maintenance, Aircraft spares for Marine Corps Aircraft Maintenance Facilities, for which special guidance is provided.

21175-2 **APPLYING CRITERIA**. To determine the gross square footage requirements for a given air installation, the number of each type assigned aircraft, Column (1), is multiplied by the corresponding sizing factor in Column (2) of Table 21175-1. The sum of the products for each type of aircraft becomes the “basic sizing factor” which determines the number of packing tables required. This is used to enter Table 21175-2 to obtain the basic area allowance. Add to this the square footage of the largest sized Aviators Safety Equipment (Flotation) Shop from Column (3) and the largest sized Oxygen Regulator and Equipment Shop from Column (4) of Table 21175-1 to obtain the “gross square foot” requirement.

The basic area allowance from Table 21175-2 includes the following support spaces:

Male and Female lavatories and lockers
Training/Conference room
Administrative office
Sewing/Fabrication room
Production Control
Storage area
Washer and Dryer room
Mechanical room

In the one (1) packing table shop no separate areas are planned for the training/conference, sewing/fabrication rooms nor the administrative office. Space is planned within the production control area for the administrative functions, while the other functions are planned for within the packing table area.

Planning factors do not include space for a parachute hanging tower, a Liquid Oxygen (LOX) Farm nor for an Ejection Seat Shop. If an intermediate maintenance activity plans to operate/maintain a LOX Farm and/or an Ejection Seat Shop or has a special requirement for a hanging tower, such as support of a SEAL team, space allocation must be justified separately.

Table 21175-1
Sizing Factors for
Aviation Life Support Systems Shop

Column (1) Type A/C	Column (2) Parachute Shop Factor	Column (3) Flotation Shop	Column (4) Oxygen Shop
A-4	0.0016	M	L
TA-4	0.0032	M	L
A-6	0.0032	M	L
EA-6	0.0064	M	L
A-7	0.0016	M	L
TA-7	0.0032	M	L
C-2	0.0032	L	L
C-130	0.0064	L	S
E-2	0.0080	M	L
F-4	0.0032	M	L
F-14	0.0032	M	L
F/A-18	0.0016	M	L
TF/A-18	0.0032	M	L
H-1	0.0001	S	S
H-2	0.0001	S	S

Column (1) Type A/C	Column (2) Parachute Shop Factor	Column (3) Flotation Shop	Column (4) Oxygen Shop
H-3	0.0001	L	S
H-46	0.0001	L	S
H-53	0.0001	L	S
H-60	0.0001	L	S
P-3	0.0368	L	S
S-3	0.0064	M	L
T-2	0.0032	M	S
AV-8	0.0016	M	L
TAV-8	0.0032	M	L
OV-10	0.0032	M	S
Values of Column (3) S = 300 Sq.Ft. M = 500 Sq.Ft. L = 900 Sq.Ft.		**Value of Column (4) S = 300 Sq.Ft. L = 500 Sq.Ft.**	

Table 21175-2
Basic Allowance for
Aviation Life Support Systems Shop

Factor Total	Basic Allowance
0 to 1	3,000 Sq.Ft.
More than 1 to 2	5,000 Sq.Ft.
More than 2	6,000 Sq.Ft.

Example Computation 1

A/C	No.	Column (2)	Factor Product	Column (3)	Column (4)
F-14	120	0.0032	0.3840	M	L
TA-4	18	0.0032	0.0576	M	L
A-4	6	0.0016	0.0096	M	L
E-2	30	0.0080	0.2400	M	L
			0.6912	M	L

From Table 211-75B 0.6912 = 3,000 sq.ft..
From Table 211-75A Column (3) “M” = 500 sq.ft.
From Table 211-75A Column (4) “L” = 500 sq.ft..
4,000 sq.ft.

Example Computation 2

A/C	No.	Column (2)	Factor Product	Column (3)	Column (4)
P-3	60	0.0368	2.2080	L	S
H-2	10	0.0001	0.0010	S	S
H-3	40	0.0001	0.0040	L	S
			2.2130	L	S

From Table 211-75B	2.2130 =	6,000	sq.ft.
From Table 211-75A	Column (3) "L" =	900	sq.ft.
From Table 211-75A	Column (4) "S" =	300	sq.ft.
		7,200	sq.ft.

Example Computation 3

A/C	No.	Column (2)	Factor Product	Column (3)	Column (4)
A-7	115	0.0016	0.1840	M	L
S-3	40	0.0064	0.2560	M	L
F/A-18	24	0.0016	0.0384	M	L
TF/A-18	6	0.0032	0.0192	M	L
H-3	4	0.0001	0.0004	L	S
			0.4980	L	L

From Table 21175-2	0.4980 =	3,000	sq.ft.
From Table 21175-1	Column (3) "L" =	900	sq.ft.
From Table 21175-1	Column (4) "L" =	500	sq.ft.
		4,400	sq.ft.

211 76 MISCELLANEOUS PARTS/COMPONENTS REPAIR SHOP (NAVAIR DEPOT) (m^2 / SF)

FAC: 2116
BFR Required: Y

21176-1 **GENERAL.** A Miscellaneous Parts/Components Repair Shop is required for the Manufacture and Repair Production Shop of the Naval Air Depot (NAVAIR Depot). Included within this Category Code are:

a. Tubing Shop
b. Cable Shop
c. Cordage (Flight Controls) Shop
d. Electrical Cable/Harness Shop

There are no specific criteria developed for this Category Code. An engineering study must be performed to determine requirement.

211 80 TEST AND CALIBRATION SHOP (NAVAIR DEPOT) (m^2 / SF)
FAC: 2116
BFR Required: Y

21180-1 **GENERAL.** A Test and Calibration Shop is required to provide space dedicated to test, trim, or calibrate engines, electronics, communications or armament systems. This is the main Category Code used for the Test and Calibration Production Shop of the Naval Air Depot (NADEP).

There are no specific criteria developed for this Category Code. An engineering study must be performed to determine the requirement.

211 81 ENGINE TEST CELL (NON-NAVAIR DEPOT) (m^2 / SF)
FAC: 2118
BFR Required: Y

Design Criteria: UFC 4-212-01, Navy Standard Jet Engine Test Cells

21181-1 **GENERAL.** An engine test cell provides an acoustic attenuated and fully instrumented enclosure in which uninstalled turbojet and turbofan engines are tested at installations where intermediate level maintenance engine repair work is performed. The enclosure provides a better working environment than open pads by providing protection from inclement weather and cross winds which adversely affect testing of engines, while at the same time significantly reducing exterior noise levels. NAVFAC P-970, Planning in the Noise Environment, specifies acceptable noise levels for various land uses. See Category Code 211 01, Aircraft Acoustical Enclosure (Non-NAVAIR Depot), for P-970 requirements.
Current Navy aircraft inventory includes two types of jet engines: turbo fan/turbo jet engines and turbo shaft jet engines, which power aircraft with rotors or propellers. The test cells for these two types of engines would differ in size due to the differences in power requirements, volume of exhaust, and noise levels.

This facility shall support out of frame testing for the Intermediate-level Engine Maintenance Shop (Non-NAVAIR Depot), Category Code 211 21.
The facility includes spaces for engine mounts, fueling system, and observation and control. Engine test stands and Power Check Pads, without Sound Suppression (Non-NAVAIR Depot), Category Code 211 89 or with Sound Suppression (Non-NAVAIR Depot), Category Code 211 88, are normally authorized for all stations or activities requiring jet engine test facilities.

If possible, the Test Cell should be sited close to the Engine Maintenance Shop. It will require a paved access road for towing engines from the shop. Consideration should be given to enclosing existing open Power Check Pads.

The number of test cells required is based on the total monthly engine runs required and availability of a test cell for testing. The total monthly engine runs would be determined by the program management activity involved for each engine. The required monthly production could be estimated from total flight hours, number squadrons, and number of engine runs for each engine. The availability of a cell available for testing runs on a monthly basis can be determined with input from Fleet Readiness Center and NAVAIR Aircraft Engine Test System (AETS) Fleet Support Team (FST) based on operational data. It is estimated that 60% to 80% of the time a test cell is in operation is available for engine testing due to maintenance requirements, scheduled or unscheduled. For a newer test cell, percentage availability is closer to 80% whereas an older test cell is expected to be available closer to 60% of the time.

Besides availability, several other factors impact production rate including the time required for each engine run, number of shifts available for a test cell, and number of days a test cell is in operation on a monthly basis.

The following example illustrates the methodology for defining the requirement for test cells at Naval Air Oceana Test Cell involving two engines for F/A 18A-F aircraft.

Table 21181-1
Out-Of-Frame Engine Test Facility Requirements
Global Engine Repair
Naval Air Station Oceana

Item Description	Unit	Value	Note/Computation
Total Monthly Engine Runs Required			
Required production per month (projected up to the next 5-yrs)	F404 Engine	17	Data obtained from PMA
	F414 Engine	18	Data obtained from PMA
Total monthly production requirement	Engine Tests/Mo	35	Summary of monthly productions for all engines
Number of engine runs per engine test	Engine Runs/ Engine Test	2	Requirement set by PMA
Total monthly engine runs required	Engine Runs/Mo	70	Total monthly production requirement X Number of engine runs per engine test
Monthly Engine Runs Per Cell			

Item Description	Unit	Value	Note/Computation
Time required for one engine run	Hrs.	8	Data obtained from test cell operation
Shifts per available day		2	Average based on annual operation
Operating hours per shift	Hrs.	8	Data obtained from test cell operation
Operating hours per day	Hrs.	16	Shifts per available day X Operating hours per shift
Number of days test cell is available per month	Days/Cell/Mo	20	Average based on annual operation
Operating hours per cell per month	Hrs./Cell/Mo	160	Operating hours per day X Number of days test cell is available per month
Availability of test cell for engine testing	Percentage	60%	Average based on annual operation, determined with input from FRC/AETS FST
Available hours for engine testing per cell per month	Hrs./Cell/Mo	96	Operations hours per cell per month X Availability of test cell for engine testing
Monthly engine runs per test cell	Engine Runs/ Cell/Mo	24	Available hours for engine testing per month / Time required for one engine run
Number of Test Cells Required			
Number of test cells required	Cells	2.92	Total monthly engine runs required / Monthly engine runs per test cell
Number of test cells required, rounded up	Cells	**3**	

211 82 AIRCRAFT WEAPONS ALIGNMENT SHELTER (NON-NAVAIR DEPOT) (m^2 / SF)

FAC: 2116
BFR Required: Y

21182-1 **GENERAL.** A minimum of one aircraft weapons alignment shelter is required at Navy and Marine Corps air installations having fighter or attack aircraft which require alignment of on-aircraft weapons systems. In addition to weapons systems alignment, which is the process of mechanically and electrically aligning aircraft weapons electronic systems to a common aircraft axis, this facility provides space for on-aircraft electronic maintenance of the weapons systems. For the mechanical alignment of guns attached to aircraft, see Aircraft Boresight Range (Non-NAVAIR Depot), Category Code 211 09. If vehicle and aircraft access pavement is required, see Category Code 851 10, Roads, and 113 40, Aircraft Access Apron.

To determine the square footage requirements for a given air installation, the number of assigned aircraft of the types that require weapons calibration is first determined. This number is used to enter column 1 of Table 21182-1. Columns 2 and 3 of Table 21182-1 show the number of bays and gross area of structure required respectively.

Table 21182-1
Space Allowances for Aircraft Weapons Alignment Shelter

Column 1	Column 2	Column 3
No. A/C	**No. Bays**	**Gross Area m^2 (SF)**
Up to 20	1	488 (5,246)
21 to 41	2	969 (10,423)
42-63	3	1,441 (15,503)
64-87	4	1,913 (20,583)
88-114	5	2,385 (25,663)
115-145	6	2,858 (30,743)
146-181	7	3,330 (35,822)
182-223	8	3,802 (40,902)
224-272	9	4,274 (45,983)
over 272	10	4,746 (51,063)

211 83 ENGINE TEST CELL (NAVAIR DEPOT) (m^2 / SF)
FAC: 2118
BFR Required: Y

21183-1 **GENERAL.** An Engine Test Cell is required for the Test and Calibration Production Shop of the Naval Air Depot (NAVAIR Depot). Included within this Category Code are:

a. Jet Engine Test Cell (10,000 – 16,000 lbs. maximum thrust)
b. Jet Engine Test Cell (Over 16,000 lbs. maximum thrust)
c. Jet Engine Test Stand – Facility for testing jet aircraft engines which has no acoustical noise abatement and is not part of an enclosed facility.
d. Turbo Prop Test Cell
e. Reciprocating Engine Test Cell (3,000 HP or less)
f. Reciprocating Engine Test Cell (Over 3,000 HP)
g. Reciprocating Engine Test Stand - Facility for testing reciprocating aircraft engines which has no acoustical noise abatement and is not part of an enclosed facility.
h. Turbo Shaft Test Cell
i. Turbo Fan Test Cell
j. Pneumatic Gas/Air Turbine Test Cell

There are no specific criteria developed for this Category Code. An engineering study must be performed to determine the requirement.

211 84 HELICOPTER BLADE TEST FACILITY (NAVAIR DEPOT) (m^2 / SF)
FAC: 2116
BFR Required: Y

21184-1 **GENERAL.** A Helicopter Blade Test Facility is required for the Test and Calibration Production Shop of the Naval Air Depot (NAVAIR Depot).

There are no specific criteria developed for this Category Code. An engineering study must be performed to determine the requirement.

211 85 RADOME TEST FACILITY (NAVAIR DEPOT) (m^2 / SF)
FAC: 2116
BFR Required: Y

21185-1 **GENERAL.** A Radome Test Facility is required for the Test and Calibration Production Shop of the Naval Air Depot (NAVAIR Depot).

There are no specific criteria developed for this Category Code. An engineering study must be performed to determine the requirement.

211 86 RADAR/ANTENNA TEST FACILITY (NAVAIR DEPOT) (m^2 / SF)
FAC: 2116
BFR Required: Y

21186-1 **GENERAL.** A Radar/Antenna Test Facility is required for the Test and Calibration Production Shop of the Naval Air Depot (NAVAIR Depot).
There are no specific criteria developed for this Category Code. An engineering study must be performed to determine the requirement.

211 87 AIRCRAFT WEAPONS ALIGNMENT/BORESIGHT FACILITY (NAVAIR DEPOT) (m^2 / SF)
FAC: 2116
BFR Required: Y

21187-1 **GENERAL.** An Aircraft Weapons Alignment/Boresight Facility is required for the Test and Calibration Production Shop of the Naval Air Depot (NAVAIR Depot).

There are no specific criteria developed for this Category Code. An engineering study must be performed to determine the requirement.

211 88 POWER CHECK PAD WITH SOUND SUPPRESSION (NON-NAVAIR DEPOT) (m^2 / SF)
FAC: 2118
BFR Required: Y

21188-1 **GENERAL.** Power check pads provided with fixed or portable sound suppressors which meet desired noise criteria are categorized here. Planning is the same as in Category Code 211-89. NAVFAC P-970 provides an analytical method for evaluating location of the power check pad with respect to inhabited areas. It shows how to calculate the expected noise levels and estimate the probable response to the noise. This noise survey is essential for substantiating the requirement for a power check pad with sound suppression.

211 89 POWER CHECK PAD WITHOUT SOUND SUPPRESSION (NON-NAVAIR DEPOT) (m^2 / SF)

FAC: 2118
BFR Required: Y

21189-1 **GENERAL.** Navy and Marine Corps air installations where aircraft are permanently assigned, and aircraft maintenance is performed require power check facilities. The power check pad is used to test and adjust engines mounted in the aircraft, in-frame testing. Employing portable engine test stands, the power check pad is used for uninstalled engine testing. A power check pad includes Portland cement concrete airfield pavement with securing fittings, and, where required, protection walls and blast deflectors. NAVFAC P-970, Planning in the Noise Environment, specifies acceptable noise levels for various land uses. See Category Code 211 01, Aircraft Acoustical Enclosure (Non-NAVAIR Depot), for P-970 requirements.

Power check pads without sound suppression shall only be planned when a noise survey, as laid out in P-970, has shown that the location will not result in the need for sound suppression.

One power check pad for in-frame testing shall be planned to support up to 140 aircraft and two will support up to 360 aircraft. Out-of-frame testing facilities should be planned in conjunction with Category Code 211 81, Engine Test Cell (Non-NAVAIR Depot). The power check pad should be at least 610 meters (2,000 feet) from any other activity, and preferably at greater distances from administrative, training, housing, and other inhabited buildings in order to reduce the sound suppression requirement. When used for uninstalled engine testing, the power check pad includes provision for portable fueling and instrumentation equipment and must be located for ready accessibility from the Engine Maintenance Shops, Category Code 211 21. At existing airfields, maximum use shall be made of surplus airfield pavement that can be modified to satisfy the power check pad requirement.

211 90 OTHER SUPPORT FACILITIES (NAVAIR DEPOT) (m^2 / SF)

FAC: 2116
BFR Required: Y

21190-1 **GENERAL.** Other Support Facilities are those areas used to perform productive NAVAIR Depot work that have not been previously identified. This includes ramp, apron, and aircraft storage sites.

There are no specific criteria developed for this Category Code. An engineering study must be performed to determine the requirement.

211 91 UNCOVERED RAMP (NAVAIR DEPOT) (m^2 / SF)
FAC: 2118
BFR Required: Y

21191-1 **GENERAL.** Uncovered Ramp is required to perform NAVAIR Depot-specific maintenance and production functions. Included within this Category Code are:

a. Aircraft Rework Apron – Uncovered areas specifically assigned for NAVAIR Depot maintenance.
b. Reclamation Apron – Uncovered areas assigned to depot maintenance used for performing aircraft reclamation work.
c. Armament and Disarmament Pad
d. Pre-dock /Post-dock Apron
e. Aircraft Corrosion Control Facility (Uncovered)
f. Ground Check/Flight Test Support (Uncovered)

There are no specific criteria developed for this Category Code. An engineering study must be performed to determine the requirement.

211 92 COVERED GROUND CHECK/FLIGHT TEST FACILITY (NAVAIR DEPOT) (m^2 / SF)
FAC: 2116
BFR Required: Y

21192-1 **GENERAL.** A Covered Ground Check/Flight Test Facility is required for the Naval Air Depot (NAVAIR Depot).

There are no specific criteria developed for this Category Code. An engineering study must be performed to determine the requirement.

211 93 ENGINEERED LAB (NAVAIR DEPOT) (m / SF)
FAC: 2116
BFR Required: Y

21193-1 **GENERAL.** An Engineering Lab is required to provide space to support NAVAIR Depot-specific maintenance and production functions. Included within this Category Code are:

a. Material Handlers/Parts Expediters
b. Material Control Laboratory
c. Standards Laboratory
d. Programmer's – Automatic Test Equipment and Numerical Controlled Machine

There are no specific criteria developed for this Category Code. An engineering study must be performed to determine the requirement.

211 94 AIRCRAFT POWER CHECK FACILITIES (NAVAIR DEPOT) (m^2 / SF)
FAC: 2118
BFR Required: Y

21194-1 **GENERAL.** Aircraft Power Check Facilities are required to perform NAVAIR Depot-specific maintenance and production functions. Included within this Category Code are:

a. Power Check Pad (No Sound Suppression)
b. Power Check Pad (With Sound Suppression)
c. Propeller Aircraft Power Check Pad
d. Helicopter Aircraft Power Check Pad
e. VSTOL Aircraft Power Check Pad

There are no specific criteria developed for this Category Code. An engineering study must be performed to determine the requirement.

211 95 MATERIAL AND EQUIPMENT STAGING/STORAGE FACILITY (NAVAIR DEPOT) (m^2 / SF)
FAC: 2116
BFR Required: Y

21195-1 **GENERAL.** A Material and Equipment Staging/Storage Facility for Naval Air Depot (NAVAIR Depot) is required to provide space for Packaging and Preservation of material.

There are no specific criteria developed for this Category Code. An engineering study must be performed to determine the requirement.

211 96 MAINTENANCE – AIRCRAFT/SPARES STORAGE (m^2 / SF)
FAC: 2116
BFR Required: Y

21196-1 **GENERAL.** Storage facilities for miscellaneous aircraft equipment/parts/goods, etc., will be provided only where it can be individually justified. In addition to the method of determining the gross square-footage requirement, the justification should include an explanation as to why the storage requirement cannot be met through storage space provided within hangars/shops or 440 series covered general supply facilities. No specific criteria are available for this type of facility;

however, general information on normal stacking heights, SF per measurement ton, and other warehousing parameters are provided in Category Code 440 series.

211 97 PLANT SERVICES AND AIRCRAFT OVERHAUL (NAVAIR DEPOT) (m^2 / SF)

FAC: 2116
BFR Required: Y

21197-1 **GENERAL.** A Plant Services and Aircraft Overhaul Facility is required to provide space which is used in providing general support for all aircraft production operations. General support includes functions such as management, supervision, engineering, clerical functions, plant maintenance, central or general storage, quality assurance, and materials testing. This Category Code includes offices, cafeterias, supervisors' workspace, shop parts storage areas, dispatching facilities, inspection facilities, stairwells, auxiliary equipment rooms, walls, etc.

There are no specific criteria developed for this Category Code. An engineering study must be performed to determine requirement.

211 98 AIRCRAFT ACOUSTICAL ENCLOSURE (NAVAIR DEPOT) (m^2 / SF)

FAC: 2116
BFR Required: Y

21198-1 **GENERAL.** An Aircraft Acoustical Enclosure is required to provide a covered facility for the in-frame aircraft engine run-up maintenance and testing performed by NAVAIR Depot. The aircraft acoustical enclosure, sometimes referred to as a hush house, is a total enclosure for fixed wing aircraft designed to abate noise during in-frame run-up of jet engines. The facility consists of a hangar-like aircraft enclosure, an absorptive augmenter for inducing cooling air and absorbing noise, a 45-degree blast deflector, an observation room with lavatory, and a mechanical equipment room. The observation and mechanical rooms are located adjacent to, not within, the aircraft enclosure.

There are no specific criteria developed for this Category Code. An engineering study must be performed to determine requirement.

211 99 HAZARDOUS MATERIAL STOREHOUSE (NAVAIR DEPOT) (m^2 / SF)
FAC: 4413
BFR Required: Y

21199-1 **GENERAL.** A Hazardous Material Storehouse for Naval Air Depot (NAVAIR Depot) is required to provide space for the storage of hazardous substances and materials.

There are no specific criteria developed for this Category Code. An engineering study must be performed to determine requirement.

211 SUPPLEMENT – MARINE CORPS AIRCRAFT MAINTENANCE FACILITIES

211-1 GENERAL

Facilities for the maintenance and repair of Navy and Marine Corps aircraft and related spares, including airframes, aircraft engines, aircraft weapons systems, avionics systems, and other related aircraft equipment are planned in accordance with maintenance functions and levels as authorized by the Chief of Naval Operations (CNO). Maintenance classifications are defined in OPNAVINST 4790.2 (series) and are the basis for the Naval Aircraft Maintenance Program (NAMP). Within the Marine Corps, the Deputy Commandant for Aviation (DC/A) is responsible for planning and coordinating staff activities for all matters relative to organization, equipment, manpower, training, and support of Marine Corps aviation units and installations, including all Aviation Logistics (AVLOG) matters. Because Marine Corps aviation is an integral part of naval aviation, DC/A is responsible to the CNO to ensure that Marine Corps aviation is in consonance with the overall Naval Aviation Program.

OPNAVINST 4790.2 (series) supports CNO/Commandant of the Marine Corps (CMC) readiness and safety objectives, and provides for optimum use of manpower, facilities, materiel, and funds. The NAMP is founded upon three-level maintenance concept: depot (“D” level) maintenance, intermediate “I” level maintenance and organizational (“O” level) maintenance. It is the authority governing management of D-level, I-level, and O-level aviation and aeronautical equipment maintenance. It provides the management tools required for efficient and economical use of personnel and material resources in performing maintenance. It also provides the basis for establishing standard organizations, procedures, and responsibilities for accomplishing all maintenance on naval aircraft, associated materiel, and equipment. The division of maintenance into the three levels allows management to:

i. Classify maintenance functions by levels.

ii. Assign responsibility for maintenance functions to a specific level.

iii. Assign maintenance tasks consistent with the complexity, depth, scope, and range of work to be performed.

iv. Accomplish any particular maintenance task or support service at a level that ensures optimum economic use of resources.

v. Collect, analyze, and use data to assist all levels of NAMP management.

211-2 DEPOT LEVEL MAINTENANCE

D-level maintenance is performed at naval aviation industrial establishments to ensure continued flying integrity of airframes and flight systems during subsequent operational service periods. D-level maintenance is also performed on material requiring major overhaul or rebuilding of parts, assemblies, subassemblies, and end items. It includes manufacturing parts, modifying, testing, inspecting, sampling, and reclamation. D-level maintenance supports O-level and I-level maintenance by providing engineering assistance and performing maintenance beyond their capabilities. D-level maintenance functions are grouped as follows:

i. Standard D-level maintenance of aircraft.

ii. Rework and repair of engines, components, and support equipment.

iii. Calibration by Navy calibration laboratories.

iv. Incorporation of technical directives (TDs).

v. Modification of aircraft, engines, and support equipment.

vi. Manufacture or modification of parts or kits.

vii. Technical and engineering assistance by field teams.

viii. Aircraft armament or aircraft and equipment under reliability-centered maintenance (RCM).

ix. Rework of expeditionary airfield (EAF) components.

211-3. D-LEVEL MAINTENANCE CATEGORY CODES AND REQUIREMENT

Facilities that are generally categorized as D-level maintenance facilities (also noted as NAVAIR depot) are shown in Table 211-5 “”D” Level Maintenance Facilities” and described in Section 211-1.10 “Facilities Categorized as “D” Level Maintenance” of the introduction to this category code series, “Series 211 Maintenance – Aircraft, Spares”. Each requirement for depot maintenance facilities must be planned and justified individually.

211-4 ORGANIZATIONAL LEVEL MAINTENANCE

O-level maintenance is performed by operating units (squadrons) on a day-to-day basis in support of their operations. The O-level maintenance mission is to maintain assigned aircraft and aeronautical equipment in a full mission-capable status while continuing to improve the local maintenance process. While O-level maintenance may be done by I-level or D-level activities, O-level maintenance is usually accomplished by maintenance personnel assigned to aircraft squadrons. Generally, O-level maintenance can be grouped under the following categories:

i. Inspections.

ii. Servicing.

iii. Handling.

iv. On-equipment corrective and preventative maintenance, including repair, removal, and replacement of defective components.

v. Class V (A) ordnance loading/unloading and arming/dearming.

vi. Incorporation of TDs

vii. Recordkeeping and reports preparation.

viii. Age exploration or aircraft and equipment under RCM.

211-4.1 **O-level Maintenance Category Codes.** Facilities that are generally categorized as O-level maintenance facilities are shown in Table 21100-2 “”O” Level Maintenance Facilities” and described in Section 211-1 “Facilities Categorized as “O” Level Maintenance” of the introduction to this category code series, “Series 211 Maintenance – Aircraft, Spares”. Marine Corps requirements for organizational level aircraft maintenance facilities are computed in the same manner as Navy requirements. See Category Codes 211 03, 211 04, 211 05, 211 06, and 211 07 for individual computation methodologies.

211-5 INTERMEDIATE LEVEL MAINTENANCE

Marine Corps air installations may be assigned limited intermediate maintenance level responsibilities for its own aircraft; however, most I-level aircraft maintenance is performed by a Marine Air Logistics Squadron (MALS). The I-level maintenance mission is to enhance and sustain the combat readiness and mission capability of supported activities by providing quality and timely material support at the nearest location with the lowest practical resource expenditure. I-level maintenance consists of on-and off-equipment materiel support and may be grouped as follows:

i. Performance of maintenance on aeronautical components and related support equipment and EAF components.

ii. Calibration of designated equipment.

iii. Processing aircraft components from stricken aircraft.

iv. Providing technical assistance to supported units.

v. Incorporation of TDs.

vi. Manufacture of selected aeronautical components, liquids, and gases (cryogenics).

vi. Performance of on-aircraft maintenance when required.

vii. Age exploration of aircraft and equipment under RCM.

viii. Weapons preparation.

211-6 MARINE AIR LOGISTICS SQUADRON

MALS was developed by the Marine Corps to enhance the aviation unit's transition from a garrison configuration to the composite Aviation Combat Element (ACE) of a Marine Air Ground Task Force (MAGTF).

The composition and size of a MAGTF may vary, but the organizational structure will always be composed of four elements. These elements consist of the Command Element (CE), the Ground Combat Element (GCE), the Aviation Combat Element (ACE), and the Combat Service Support Element (CSSE). The composition and size of the MAGTF is structured to achieve the missions required to meet the existing world threats. The MAGTF may be employed in three sizes: a Marine Expeditionary Unit (MEU), a Marine Expeditionary Brigade (MEB), and a Marine Expeditionary Force

(MEF). The composition of the ACE is task-organized to conduct tactical air operations to support each of these MAGTF elements.

211-6.1 **MALS Organization.** The MALS is a command entity emulating the organizational structure of other Marine squadrons. A typical MALS is composed of the following Departments:

1) MALS Maintenance Department
2) Aviation Supply Department (ASD)
3) MALS Operations Department
4) Aviation Information Systems Department

211-6.1.1 **MALS Maintenance Department.** The Aviation Logistics functions of the MALS maintenance department include aircraft, avionics, support equipment maintenance, flight equipment, cryogenics, aviation ordnance, and maintenance data collection and analysis. All available talents and resources are used to ensure components are repaired to the highest standard of quality to further enhance the warfighting capabilities of the customer (the tactical squadrons). Specific responsibilities are as follows:

- Coordinate control of aircraft maintenance performed by, and in support of, squadrons and units under the cognizance of the MAG Commanding Officer, and materiel condition and combat readiness of assigned weapons systems and equipment.

- Conduct liaison among squadrons, stations, MAWs, and other activities in connection with maintenance or materiel matters.

- Ensure squadrons within the MAG provide augmentation personnel on a temporary additional duty basis as required for training in the maintenance of organic systems and subsystems by the I-level.

- Coordinate pre-deployment planning for the provisioning of personnel, facilities, support equipment, and services for supported squadrons.

- Screen supported deploying squadron materiel to ensure only materiel considered essential to support the specific deployment is embarked, and consolidation of multiple squadron requirements is made whenever possible.

- Screen appropriate Marine Aviation Logistics Support Program (MALSP) individual material readiness list (IMRL) allowances to ensure they are tailored to support the quantity and type aircraft assigned to the MAG squadrons.

- Ensure the MAG aircraft assignment board (or equivalent) is maintained and reflects current status.

- Maintain liaison with supported squadron maintenance material control centers and the ASD and ensure adequate validation and reconciliation of outstanding requirements takes place.

- Monitor MAG squadrons to ensure an effective maintenance program is being conducted.

- Monitor MAG squadrons to ensure an active and effective quality assurance monitoring program exists.

- Monitor MAG squadrons to ensure correct maintenance, administration, and material handling procedures are used, directing particular attention to the detection and removal of all administrative impediments to aircraft readiness.

- Assist squadrons in obtaining technical engineering assistance.

- Coordinate with other staff organizations to ensure maintenance facility requirements for both MALS and O-level are updated and submitted as required.

- Coordinate the assignment of aircraft parking spaces within the MAG.

- Ensure an aggressive and effective management program is in place to control cannibalization of aeronautical equipment. To the maximum extent possible, ensure selective cannibalization actions are planned to prevent aircraft from being in a non-flyable status for more than 30 consecutive days.

- Ensure inter-MALS liaison is maintained for repair of components in the secondary repair site program.

- Coordinate D-level drive-in or field modifications of assigned aircraft.

- Ensure an effective program is in place to perform a quarterly review of the MALS individual component repair list.

- Conduct regular meetings, chaired by the maintenance officer and co-chaired by the Aviation Supply Officer, with supported units to ensure optimum communication and coordination.

- Analyze the mission accomplishment and capabilities of the department using reports provided by the maintenance data system (MDS) on a continuing basis.

Within the MALS Maintenance Department there are two divisions:

a) Avionics Division
b) Aviation Ordnance Division

a) Avionics Division. The avionics division provides maximum support, coordination, and leadership to the MALS' mission in the areas of aircraft maintenance, avionics equipment maintenance, integrated logistics resource management, and professional personnel development.

All maintenance and support of the MALS and supporting activities, avionics equipment – to include weapons repairable assemblies, shop repairable assemblies, support equipment, test measuring and diagnostic equipment, and "Navy funded" computers and peripherals – will be performed by personnel assigned within the avionics division. These functions encompass programs, equipment, and support for activities both internal and occasionally external to the MAG. The avionics division, responsible to the maintenance officer, has the overall responsibility for the production effort within the MALS, on matters dealing with the scheduling, prioritization, and production of avionics equipment.

An avionics division exists within each MALS and consists of the following functional branches: avionics branch, precision measurement equipment branch, and various production branches necessary to support flying squadrons of the MAG. Each branch is responsible for the maintenance of its avionics equipment, the welfare of its personnel, an accurate accountability of work center IMRL assets, and individual branch security. The avionics branch is responsible for overall division administrative duties and I-level maintenance on avionics equipment. Depending on the type of aircraft supported, the avionics branch may contain up to five work centers: communications/navigation, electrical/instrument repair, automatic test equipment, electronic warfare, and radar.

b) Aviation Ordnance Division. The function of the aviation ordnance division is to provide the MALS with logistical and management support of class V(A) ordnance, aircraft armament equipment (AAE), and armament weapons support equipment (AWSE). This is done by interpreting and implementing the ordnance policies and procedures for the MAG. The MALS ordnance staff:

- Ensures the management and distribution of authorized noncombat expenditure allocation (NCEA).

- Assists the MAG in developing testing and training requirements for aviation ordnance.

- Ensures proper logistical support and storage requirements for prepositioned ware reserve materiel requirements assets are identified, including buildup and delivery of class V(A), ammunition stock points, advanced bases, and forward arming and refueling points.

- Manages the MAG's ordnance safety program and ensures explosive safety policies and procedures are issued as required.

- Ensures compliance with the policies and procedures set forth in OPNAVINST 8000.16A, "Naval Ordnance Maintenance Management Program (NOMMP)", when preparing quality deficiency reports, explosive mishap reports, technical publication deficiency reports, and engineering investigation requests.

- Ensures class V(A) materiel is managed per the current revision of NAVSUP P-724, "Conventional Ordnance Stockpile Management Policies and Procedures Manual", and other related directives.

- Establishes and monitors the handling, qualification, and certification program for nonnuclear aviation ordnance and nonnuclear explosive devices for the MALS.

- Establishes and maintains a satellite production control work center.

- Analyzes production and readiness division using reports provided by the MDS.

- Ensures satellite production efforts support the maintenance department's goals, objectives, and standards.

- Publishes a monthly maintenance and training plan for airborne weapons, training assets, AWSE, AAE, and formal in-Service training of aviation ordnance personnel.

- Ensures all maintenance performed on the AAE pool and AWSE is per the standards and guidelines established by the MALS maintenance department.

- Provides information on manpower, equipment, class V(A) materiel, and facilities to appropriate authorities.

- Establishes a verification program for technical manuals and directives maintained by the division.

- Establishes an AAE pool per MAW and aircraft controlling custodian/type commander (TYCOM) directives.

- Ensures the Retail Ordnance Logistics Management System (ROLMS) and the standardized conventional ammunition automated inventory record are used to manage class V (A).

- Monitors and coordinates nonexpendable aviation ordnance support provided by the MALSP.
- Ensures the division maintains the capability to operate from advanced bases and forward arming and refueling points.

- Coordinates pre-deployment planning for ordnance personnel, facilities, support equipment, ordnance materiel, and services to support squadrons (NAVSEA OP-5 Vol III, “Ammunition and Explosives Ashore, Advance Bases”).

- Screens squadron materiel requests and the availability of class V (A) assets to ensure only material considered essential is embarked.

- Ensures appropriate levels of support are identified in the time-phased force and deployment data (TPFDD) database.

211-6.1.2 **Aviation Supply Department (ASD)**. The ASD executes all functions dealing with the inventory, storage, and management of Navy-provided materiel. The ASD staff functions include, but are not limited to, the direct responsibilities listed in the following paragraphs. An ASD exists within each MALS with physical location of the divisions within the ASD varying depending upon local situations. However, preferred locations are adjacent to the maintenance department production divisions. The hours of operation will be consistent with the operating hours of supported organizations.

Within the ASD there are seven divisions:

a) Supply Response Division
b) Consumables Management Division
c) Repairables Management Division
d) Supply Accounting Division

e) Squadron Support Division
f) Supply Management Division
g) Supply Personnel and Administration Division

a) Supply Response Division. The supply response division is responsible for the initial screening and technical research of all requisitions assigned by Naval Aviation Logistics Command Management Information System (NALCOMIS). The supply response division will refer consumable requisitions that cannot be filled from supply officer stores to the appropriate supply point of entry. The supply response division is also responsible for the reconciliation and monitoring of all outstanding direct turn-over (DTO) requisitions except for custodial, pre-expended bins, and service market items.

b) Consumables Management Division. The consumables management division is responsible for the procurement, receipt, storage, issue, delivery, and inventory of all consumable material.

The consumables management division consists of the following five branches:

i. Receiving Branch
ii. Consumable Delivery Branch
iii. Consumables Storage Branch
iv. Consumable Control Branch
v. Pre-Expended Branch

i. Receiving Branch. The receiving branch receipts and redistributes all material shipped to the MAG/MALS from external sources.

ii. Consumable Delivery Branch. The consumable delivery branch delivers all consumable issues, consumable DTO receipts, and processes related transactions.

iii. Consumables Storage Branch. The consumables storage branch stores, issues, and inventories all consumable material in the supply officer's stores and is divided into the consumable storage section and the consumable issue section.

iv. Consumable Control Branch. The consumable control branch manages inventory of consumable material.

v. Pre-Expended Branch. The pre-expended branch establishes, manages, and replenishes pre-expended bin sites authorized by the AVNSUPO or maintenance officer.

c) Repairables Management Division. The repairables management division is responsible for:

- Repairables allowance management, procurement, receipt, storage, issue, delivery, and inventory of all repairable materiel.

- Induction and recovery of repairables into/from the Intermediate Maintenance Activity “abd” for shipment and tracking beyond-the-capability-of-maintenance components to the appropriate activity.

- Management and control of all classified and fleet controlled material (repairable and consumable).

The repairables management division consists of the following five branches:

i. Repairables Control Branch
ii. Repairables Delivery Branch
iii. Repairables Storage Branch
iv. Awaiting Parts Branch
v. Supply Shipping Branch

i. Repairables Control Branch. The repairables control branch:

- establishes and maintains repairable allowances and is responsible for their procurement, inventory, and accountability.

- processes repairable requisitions and receipts with exceptions, and all repairables returned from the Intermediate Maintenance Activity.

- screens and tracks carcasses that are beyond-the-capability-of-maintenance.

- performs all duties on classified material (receipt, storage, issue, packaging, and shipment). Procedures for handling classified material are in Secretary of the Navy Instruction (SECNAVINST) 5510.36, “DON Information Security Program Regulation”, and OPNAVINST 5218.7B, “Navy Official Mail Management Instructions”.

ii. Repairables Delivery Branch. The repairables delivery branch delivers all repairable materiel (issues and DTO) to the customer. It also picks up all non-ready for issue repairable components from the customer ensuring accuracy of all documents, i.e., logbook, scheduled removal card, and maintenance action form (MAF).

iii. Repairables Storage Branch. The repairables storage branch is responsible for the receipt, issue, storage, and inventory of all repairable materiel in the supply officer's store. The storage of repairables is broken down into two separate sections – weapons repairable assembly and shop repairable assembly.

iv. Awaiting Parts Branch. The awaiting parts branch stores and manages repairable components awaiting repair parts.

v. Supply Shipping Branch. The supply shipping branch packages and ships all aeronautical-related components and equipment.

d) Supply Accounting Division. The supply accounting division is responsible for all tasks related to maintaining and reporting the financial accounts granted to the ASD.

The supply accounting division consists of the following two branches:

i. End Use Branch
ii. Stock Fund Branch

i. End Use Branch. The end use branch maintains and reports all end use accounts allocated to the ASD and is divided by operating target (OPTAR) funding.

ii. Stock Fund Branch. The stock fund branch reports transactions, which affect the Navy Working Capital Fund (NWCF) special accounting class (SAC) 207 inventory. It also verifies the financial processing of all transactions processed by the MALS.

e) Squadron Support Division. The squadron support division is responsible for receiving, processing, and monitoring all requirements for aeronautical-related custodial materiel and maintaining custody records for all organizational allowances.

The squadron support division consists of the following two branches:

i. Customer Assistance Branch
ii. Custody Records Branch

i. Customer Assistance Branch. The customer assistance branch receives, processes, and monitors all requirements for aeronautical-related custodial material.

ii. Custody Records Branch. The custody records branch maintains the custody record cards for all organizational allowance material, such as IMRL, TBA, COSAL, controlled equipage listed in the NAVAIR 00-35QH-2 (Section H), and maintenance assist modules/test bench installations. This branch also formulates the quarterly and annual budgets and the mid-year budget review for all custodial material.

f) Supply Management Division. The supply management division is composed of the most knowledgeable and experienced aviation supply personnel responsible for monitoring the overall supply department operation, technical training, and MALSP allowances and pickups (as they pertain to deployed and contingency operations).

The supply management division consists of the following two branches:

i. Audit Branch
ii. MALSP Support Branch

i. Audit Branch. The audit branch monitors all supply functions within the ASD to ensure compliance with authorized procedures and achievement of established goals.

ii. MALSP Support Branch. The MALSP support branch validates and loads MALSP allowances and monitors pickups.

g) Supply Personnel and Administration Division. The supply personnel and administration division is responsible for the administrative control of all personnel assigned. The supply personnel and administration division perform clerical functions and maintains the master files of all messages, orders, correspondence, and directives for the ASD.

The supply personnel and administration division consist of the following two branches:

i. Supply Personnel Branch
ii. Supply Administrative Branch

i. Supply Personnel Branch. The supply personnel branch performs functions related to administrative control of all personnel within the ASD.

ii. Supply Administrative Branch. The supply administrative branch provides clerical assistance for the ASD as directed by the AVNSUPO or the aviation supply chief.

211-6.1.3 **MALS Operations Department.** The MALS is a command entity similar to other Marine squadrons. The MALS operations officer is the chief advisor to the MALS Commanding Officer for all matters pertaining to planning and execution of tactical operations involving aviation logistical support (ALS). The MALS operations department is responsible for identifying, planning, coordinating, and supervising all operational AVLOG planning requirements.

The MALS operations department coordinates with both the parent MAG and each supported squadron regarding ALS for deployed squadrons and detachments. It also serves as the MALS point of contact for all deployment support involving the unit deployment program, L-Class/aircraft carrier (CV)/aircraft carrier (nuclear) (CVN) and aviation logistics support ships (T-AVB)/maritime pre-positioning force (MPF) employment plans and milestone reporting. It is also responsible for AVLOG force deployment planning and execution (FDP&E) as it relates to deliberate and crisis action planning (CAP).

211-6.1.3.1 **Deliberate Planning**. Deliberate planning is conducted during peacetime to develop and refine war plans. Planning in this fashion allows for orderly and methodical command and staff participation in the preparation of a plan. Deliberate planning is conducted when there is ample time for detailed, methodical, and comprehensive planning and coordination. The deliberate planning process culminates with the creation and refinement of time-phased force and deployment data (TPFDD) and its placement into the Joint Operation Planning and Execution System (JOPES). The following steps will be followed during the deliberate planning process. The MALS operations department:

- Coordinates the range and depth of AVLOG support required to support the concept of operations as defined by the MAW AVLOG plans section.

- Reviews all plans that require employment of AVLOG and class V(A) support and coordinates operational AVLOG as required to support each plan.

- Coordinates the review of operational and contingency plans (OPLANs/CONPLANs) with internal MALS department.

- Determines, in coordination with consolidated administration, assignment of MALS core and augments personnel to:

- Maritime prepositioning ship (MPS) survey, liaison, and reconnaissance party, arrival and assembly operations element, and offload preparation party.

- T-AVB.

- CV/CVN/general purpose amphibious assault ship (LHA)/multi-purpose amphibious assault ship (LHD).

- Ashore ACE bed-down airfield.

The MALS operations department also reviews each applicable deliberate plan and determines:

- If the commander's intent and end state for each deliberate plan/CONPLAN have been met.

- The employment, configuration, and coordination of arrival date of the T-AVB.

- The TPFDD for of AVLOG assets into the theater of operations.

- Each MALS unit line number is identified on the TPFDD.

- Site survey for the MALS bed-down sites.

- Geo-prepositioning support equipment offload distribution and assignment plan.

211-6.1.3.2 **Crisis Action Planning**. CAP performed by AVLOG planners at all levels must recognize that CAP is not governed by rigid steps as it is a flexible means of coordinating staff action. However, certain conditions may be viewed as probable with respect to the preparation of deployment data in response to any crisis action situation. If the crisis is in response to a contingency for which deliberate planning has been conducted, the existing planning data can be used as a tool to develop tailored support. If the crisis is in response to a contingency for which no deliberate

planning has been previously conducted, ALS must be tailored without the benefit of existing data. During CAP, the MALS operations department is responsible for:

- Recommending to the MALS CO operational priorities for the movement of MALS support.

- Acting as the MALS point of contact for the wing staff when the CAP is established.

- Coordinating the development and implementation of troop movements from home station to the sea/airport of embarkation.

- Coordinating with other MALS departments/sections to identify and tailor ALS.

- Determining priorities for MALS replacements in coordination with the S-1.

- Coordinating MALS operations security and signal security.

211-6.1.4 **Aviation Information Systems Department**. The Aviation Information Systems Department (AISD) provides data processing support to the supply and maintenance departments. The AISD is responsible for the administration, operation, and maintenance of all computer systems and networks throughout the supply, maintenance, and ordnance departments.

Within the AISD there are five divisions:

a) Administration Division
b) Customer Support Division
c) Network Administration Division
d) Systems Processing Division
e) Maintenance Support Division

a) Administration Division. The administration division is responsible for the administrative control of all personnel assigned. Personnel within the division perform clerical functions and maintain the master files for messages, orders, correspondence, and directives for the AISD.

b) Customer Support Division. The customer support division is the primary manager for customer support within the AISD. Unit/department representatives will forward discrepancies that cannot be resolved locally

to the customer support division, who will then initiate the discrepancy into the maintenance cycle. The customer support division will further operate as the department issue and receive desk, production control/help desk call center, AISD asset manager, and supply/maintenance liaison, providing monitored support to the MAG relative to aviation information systems. In addition, the customer support division will substantiate and prioritize AISD requirements submitted via the supply department.

c) Network Administration Division. The network administration division is responsible for the management of all automated information systems (AIS) network resources within the MAG. These responsibilities include managing and upgrading network operating systems, data assurance, user account management, network architecture documentation and upgrade planning, network security, workstation software standardization.

d) Systems Processing Division. The systems processing division provides data processing support to the supply and maintenance departments. The systems processing division is responsible for administrative and operational control of the Intermediate Maintenance Activity Naval Tactical Command Support System (NTCSS) systems. The systems processing division is also responsible for coordination of application workload and output to the supply applications administrator and the maintenance applications manager.

e) Maintenance Support Division. The maintenance support division consists of AISD technicians that provide direct maintenance and installation support for all AIS and MALS core network assets.

Marine Corps Intermediate Maintenance Requirements Example Calculation:

Because of the expeditionary nature of the Marine Corps air support mission, many of the aircraft intermediate level maintenance shops are located in deployable mobile facilities (MFs). For this reason, Marine Corps aircraft intermediate level maintenance facilities in the continental United States are a combination of permanent facilities and mobile vans while Navy aircraft intermediate maintenance facilities are all permanent facilities.

The MFs (generally 2.4 m x 2.4 m x 6.1 m (8 ft x 8 ft x 20 ft) vans) used by the MALS conform to International Organization of Standardization container dimensions and are configured to perform a multitude of missions. MFs require a concrete pad and utility support when at home base. This allows the MFs to be used, maintained, and always ready to deploy for their primary mission. See Category Code 116 65, Mobile Facility Support Pad for concrete pad and utility support requirements.

When at home base, MFs are used primarily for training. It is also crucial to keep the MFs in good working order in case of rapid deployment need. If MFs are utilized at the home base, they should not reduce the various intermediate maintenance shop requirements.

Marine Corps aircraft intermediate level maintenance facilities are planned utilizing the basic criteria for comparable Navy facilities except that it is necessary to:

a. Provide one Type I hangar module for each Marine Air Logistics Squadron (MALS) assigned to an installation. This hangar supports the intermediate level maintenance program and is in addition to hangars required for organizational maintenance.

b. Size intermediate level maintenance shops in the same manner as Navy requirements.
c. Plan airframes shop requirements as part of the MALS hangar 01 space, and this space should be categorized as 211 06 rather than 211 08.

The following is an example of how to determine the amount of permanent intermediate level maintenance shop space required for a MALS (in addition to one Type I hangar), with the gross requirements for each shop being computed utilizing the appropriate criteria.

Example: Taking a MALS which supports a group composed of 4 VMA squadrons composed of 20 AV-8B aircraft each, 2 VMAQ squadrons composed of 8 EA-6B aircraft each, and 2 VMGR squadrons composed of 7 KC-130 aircraft each. Additionally, the MALS has 10 AM32K-4 and 10 MHU-151/M armament trailers. The MALS has mobile facilities, and the air station has 60 fixed point utility stations. Intermediate level maintenance shop space requirements are computed for each basic shop. In this example, airframes, avionics, aviation armament, aviation life support systems, and ground support equipment shops are computed. Hangar space requirements for organizational maintenance are computed utilizing the same criteria as for Navy hangars. See Aircraft Maintenance Hangar, Category Codes 211 05, 211 06, and 211 07. In addition, one Type I maintenance hangar is required for the MALS.

Step 1: Select the appropriate intermediate level shop Category Codes:

i. Airframes Shop: Category Code 211 08
ii. Aircraft Intermediate Maintenance Activity Management: Category Code 211 16
iii. Engine Maintenance Shop: Category Code 211 21
iv. Avionics Shop: Category Code 211 45
v. Aviation Armament Shop: Category Code 211 54
vi. Aviation Life Support Systems Shop: Category Code 211 75
vii. Ground Support Equipment Shop: Category Code 218 60
viii. Ground Support Equipment Shed: Category Code 218 61

Step 2: Airframes Shop (211 08)

a.) Using computation methodology for Category Code 211 08:

Type of Aircraft	Number of Aircraft
AV-8B	80
EA-6B	16
KC-130	14
Total	110

In accordance with Table 21108-2, a total of 110 aircraft requires a basic area of 1,571 m^2 (16,900 SF). Using Table 21108-3, it is determined the Composite Shop required for AV-8B support adds an additional 151 m^2 (1,630 SF). This gives a gross area as follows:

Airframes Shop Summary:

Component	m^2	SF
Basic Area	1,571	16,900
Composite Shop	151	1,630
Gross Airframes Shop Area	1,722	18,530

The Airframes Shop shall be located in the Type I hangar configured for the MALS.

Step 3: Aircraft Intermediate Maintenance Activity Management (211 16)

a.) Using computation methodology for Category Code 211 16:

The management spaces provide for the control, monitoring, and administration of the Intermediate Maintenance Activity (IMA). The Aircraft Maintenance Officer and staff are responsible for the administration and supervision of the maintenance effort for the IMA. These responsibilities include production control, material control, financial accounting, training, personnel, administration, quality control, technical publications library, data analysis, and tool control for common and special tools and test equipment. The Naval Aeronautical Engineering Services Unit (NAESU) staff and personnel performing In-Service Engineering Agent (ISEA) functions for aircraft are often collocated in these same spaces.

Provide 917 m^2 (9,875 SF) for IMA management functions.

Step 4: Engine Maintenance Shop (211 21):

a.) Using computation methodology for Category Code 211 21:

Type of Aircraft	Number of Aircraft
AV-8B	80
EA-6B	16
KC-130	14

Using Table 21121-2:

Aircraft		Area	
No.	Type	m^2	SF
80	AV-8B	1,820	19,575
16	EA-6B	239	2,575
14	KC-130	332	3,575
	Subtotal	2,391	25,725

Using Table 21121-3:

Additional Space Requirement based on total space allowance computed using Table 21121-2.

Computed Space Allowance (from table 21121-2)	Square Meters (from Table 21121-3)	Square Feet (from Table 21121-3)	Percent Factor (from Table 21121-3)
2,391 m^2 25,725 SF	2,324 – 2,556	25,001 – 27,500	45%

2,391 m^2 x 45% = 1,076 m^2 or 25,725 SF x 45% = 11,576 SF

High Bay Area (Subtotal from Table 21121-2): 2,931 m^2 (25,725 SF)
Shop Wing/Mezzanine (Subtotal from Table 21121-3): 1,076 m^2 (11,576 SF)

Total Engine Maintenance Shop = (2,931 + 1,076) m^2 = 4,007 m^2
(25,725 + 11,576) SF = 37,301 SF

If authorized by higher authority, additional applicable work center space requirements from Table 21121-4 shall be added.

Using table 21121-4:

Work Center	AV-8B	EA-6B	KC-130	M2	SF
Propeller			X	272	3,375

Auxiliary Power Unit	X		X	167	1,800
Rotor Dynamics				0	0
Auxiliary Fuel Stores		X		314	3,375
			Total	753	8,550

Note: Only one work center of each type is required.

Step 5: Avionics Shop (211 45)

a.) Using computation methodology for Category Code 211 45:

Obtain the basic space requirements for all type/model aircraft by entering Table 21145-1 with quantity of aircraft to be supported. Select the lowest percentage factor for secondary type aircraft for Column (3) by crossing from that aircraft in secondary column and considering each aircraft assigned with a larger basic space requirement as a prime aircraft.

i. The AV-8B has only the EA-6B with a larger basic space requirement therefore 42% will be used in Column (3).

ii. The KC-130 has both the AV-8B (33%) and the EA-6B (36%) with larger basic requirements. The AV-8B has the lowest percentage factor (33%) so this will be entered in Column (3).

iii. The EA-6B aircraft has the largest basic space requirement, therefore it is the prime aircraft with a percentage factor of 100% entered in Column (3).

Column (1)	Column (2) (Table 21145-1)		Column (3) (Table 21145-2)	Column (4) [Col(2) x Col(3)]	
	m^2	SF		m^2	SF
80 AV-8B	1,766	19,000	0.42	742	7,980
16 EA-6B	2,342	25,200	1.00	2,342	25,200
14 KC-130	1,171	12,600	0.33	386	4,158
			Gross Avionics Shop Area	3,470	37,338

Step 6: Aviation Armament Shop (211 54)

a.) Using computation methodology for Category Code 211 54:

Type of Aircraft	Number of Aircraft	Trailer Type	Number of Trailers
AV-8B	80	AM32K-4A	10
EA-6B	16	MHU-151/M	10
KC-130	14	Total	20
Total	110		

i. Basic Shop Requirement

Determine the Aircraft Classification by entering Table 21154-1.

AV-8B: Attack/Fighter
EA-6B: Attack/Fighter
KC-130: Not Applicable

Obtain the basic space allowance by entering Table 21154-2. For a total of 96 Attack/Fighter Aircraft the basic space allowance is 465 m^2 (5,000 SF).

ii. Aviation Armament Equipment Pool Requirement

Column (1) Type A/C	Column (2) Area per A/C		Number of A/C	Pool Support Space	
	m^2	SF		m^2	SF
AV-8B	3.5	38	80	280	3,040
EA-6B	7.3	78	16	117	1,248
KC-130	N/A	N/A	14	0	0
Total Equipment Pool Support Space				397	4,288

iii. Armament Weapons Support Equipment Work Center (Marine Corps requirement ONLY)

Column (1) Type Trailer	Column (2) Area per Trailer		Number of Trailers	Area for Trailers	
	m^2	SF		m^2	SF
AM32K-A4	2.3	25	10	23	250
MHU-151/M	1.4	15	10	14	150
Total Equipment Pool Support Space				37	400

Aviation Armament Shop Summary:

Area	m^2	SF
Basic Shop	465	5,000

Aviation Armament Equipment Pool	397	4,288
Armament Weapons Support Equipment Work Center	37	400
Gross Aviation Armament Shop Area	899	9,688

Step 7: Aviation Life Support Systems Shop (211 75)

a.) Using computation methodology for Category Code 211 75:

Type of Aircraft	Number of Aircraft
AV-8B	80
EA-6B	16
KC-130	14
Total	110

Obtain the Parachute Shop Factor (Column (2)), Flotation Shop size (Column (3)), and Oxygen Shop size (Column (4)) for all type/model aircraft by entering Table 21175-1.

i. The Parachute Shop Factor is 0.0016, the Flotation Shop size is M (46.5 m^2 (500 SF)), and the Oxygen Shop size is L (46.5 m^2 (500 SF)) for the AV-8B aircraft.

ii. The Parachute Shop Factor is 0.0064, the Flotation Shop size is M (46.5 m^2 (500 SF)), and the Oxygen Shop size is L (46.5 m^2 (500 SF)) for the EA-6B aircraft.

iii. The Parachute Shop Factor is 0.0064, the Flotation Shop size is L (83.7 m^2 (900 SF)), and the Oxygen Shop size is S (27.9 m^2 (300 SF)) for the AV-8B aircraft.

A/C Type	Number of A/C	Table 21175-1 Column (2)	Factor Product	Table 21175-1 Column (3)	Table 21175-1 Column (4)
AV-8B	80	0.0016	0.1280	M	L
EA-6B	16	0.0064	0.1024	M	L
KC-130	14	0.0064	0.0896	L	S
		Total:	0.3200	L	L

From Table 21175-2, Basic Allowance for 0.3200 = 279 m^2 (3,000 SF)

From Table 21175-1, Column (3), Flotation Shop, “L”= 83.7 m^2 (900 SF)

From Table 21175-1, Column (4), Oxygen Shop, “L”= 46.5 m^2 (500 SF)

Total Aviation Life Support Systems Shop = 409.2 m^2 (4,400 SF)

Step 8: Ground Support Equipment Shop (218 60)

a.) Using computation methodology for Category Code 218 60:

Type of Aircraft	Number of Aircraft
AV-8B	80
EA-6B	16
KC-130	14
Total	110

b.) From Table 21860-1:

Component	Number of Aircraft	
	80 (up to 120)	
	m^2	SF
Support Equipment Division/admin/ production control/tool room/ IMRL/ material control/SE pool	104	1,114
SE Training/License	28	300
Support	90	967
Net to gross (19%)	149	1,600
SE Gas Engine and Turbine Shop	28	300
SE Structural/Hydraulics Shop	74	800
SE Corrosion Control Shop	74	800
SE Electrical Repair Shop	28	300
SE Component Repair Shop	65	700
SE Periodic Maintenance Shop	63	680
Air Conditioning Repair Shop	-	-
SE Repair Lanes/Service Bays	229	2,460
Total Shop Area	931	10,021

c.) Shop Area size adjustment for existing Fixed Point Utility Stations (FPUS).

Number of apron parking spaces with FPUS = 60

60 apron spaces with FPUS multiplied by 1.0 m^2 (11.2 SF) = 60 m^2 (672 SF)

Reduce area by 60 m^2 (672 SF)

Total Ground Support Equipment Shop Area = (931 – 60) m^2 = 871 m^2
(10,021 – 672) SF = 9,349 SF

Step 9: Ground Support Equipment Shed (218 61)

a.) Using computation methodology for Category Code 218 61:

Type of Aircraft	Number of Aircraft
AV-8B	80
EA-6B	16
KC-130	14
Total	110

b.) From Table 21861-1:

	Shed Area	
No. of Aircraft	m^2	SF
101-125	1,771	19,050

Total Ground Support Equipment Shed = 1,771 m^2
(19,050 SF)

In summary, the Intermediate Maintenance Shop space requirements for the MALS used for this example are:

1.	Airframes Shop	=	1,722	m^2	18,530	SF
2.	IMA Management	=	917	m^2.	9,875	SF
3.	Engine Maintenance Shop	=	4,007	m^2.	37,301	SF
4.	Avionics Shop	=	3,470	m^2.	37,338	SF
5.	Aviation Armament Shop	=	899	m^2	9,688	SF
6.	Aviation Life Support Systems Shop	=	409	m^2.	4,400	SF
7.	Ground Support Equipment Shop	=	871	m^2	9,349	SF
8.	Ground Support Equipment Shed	=	1,771	m^2	19,050	SF

In addition to the shop spaces listed above, one Type I hangar is required for support of the MALS. The hangar requirement is in addition to the hangar modules for organizational level maintenance as computed in Category Codes 211-05, 211-06, and 211-07.

212 MAINTENANCE - GUIDED MISSILES

212-1 This basic category provides facilities and shops for maintenance and repair of guided missile systems, ground handling, and launching equipment. Under certain circumstances, the maintenance and storage for these missiles are integrated and the missiles are maintained where they are stored.

212 10 GUIDED MISSILE INTEGRATION FACILITY (SF)
FAC: 2121
BFR Required: Y

21210-1 **DESCRIPTION.** The purpose of this facility is to assemble new-production components of air launched guided missiles and perform any required maintenance on fleet returned All-Up-Round (AUR) missiles or components. Missiles are returned from the fleet at service inspection time when the maintenance due date is assigned to the missiles so require. This type of facility is primarily found at Naval Weapons Stations. However, it is also found at Naval Air Stations and other ordnance related activities.

21210-2 **REQUIREMENT.** A typical facility is capable of servicing four different types of missiles and is composed of six basic areas which are expressed in net square feet (NSF) as shown in Table 21210-1 below.

Table 21210-1 Basic Areas of Guided Missile Integration Facility

Description of Basic Area	NSF
De-canning and Storage Area	3,050
Open Work Area and Support Maintenance	3,050
Assembly Area (Test Cell)	4,169
Missile Storage	1,229
Office/Library	1,160
Mechanical Equipment Room & Toilet	1,146
Total	**13,804**

21210-2.1 **Net to Gross Conversion.** The net to gross conversion factor for this facility is 1.24. Therefore, multiply the NSF times 1.24 to obtain the gross square feet (GSF) for the facility (i.e., 13,804 NSF x 1.24 = 17,117 GSF).

21210-2.2 **Facilities Servicing More Than Four Missile Types.** In the event that more than four types of missiles are required to be serviced, the size of the facility may be increased by 3,451 NSF or 4,280 GSF per additional type of missile.

21210-3 **Air Launched Missile Industrial Processing Guide (ALM-IPG).** Additional information pertaining to the type of test performed and the amount of time required for each test involving the Sidewinder, Sparrow, Walleye, Shrike and Phoenix missile may be obtained from the ALM-IPG which is promulgated by Technical Manual Identification Number (TMIN) TW 800-AA-MMI-000/ALM - IPG.

21210-3.1 **Volumes in ALM-IPG.** The Guide consists of a general information volume and five additional volumes of data, each of which is dedicated to a particular missile. The Guide presently consists of the volumes shown in Table 21210-2.

Table 21210-2. Volumes Contained in ALM-IPG

Volume	Title	Technical Manual ID Number
1	General Information	TW 800-AA-MMI-010/ALM-IPG
2	SIDEWINDER AIM-9G/H/L	TW 800-AA-MMI-020-/ALM-IPG
3	SPARROW AIM-7E/F and RIM-7E/H	TW 800-AA-MMI-030/ALM-IPG
4	WALLEYE Guided Weapon	TW 800-AA-MMI-040/ALM-IPG
5	SHRIKE AGM-45A/B	TW 800-AA-MMI-050/ALM-IPG
6	PHOENIX AIM-54A	TW 800-AA-MMI-060/ALM-IPG

21210-3.2 **Ordering the ALM-IPG.** Copies of the Guide may be ordered from Code 2242 of the Pacific Missile Test Center, Point Mugu, CA, either as a complete set under TMIN-TW 800-AA- 000/ALM-IPG or as individual volumes using the individual volume Technical Manual Identification Number.

212 11 MISSILE MODULE MAINTENANCE AND LOADING FACILITY (SF)
FAC: 2121
BFR Required: Y

21211-1 **DESCRIPTION.** This facility will provide the Maintenance and Explosive Operation Location, EOL, for the Navy's new Missile Module Weapons Systems. The facility will be sited for Ordnance handling and provide maintenance/ordnance loading high bay, a tool room, parts room, pressurized wash system, MM elevated cleaning pit(s), Male/Female locker/shower rooms, overhead crane, and administrative support space.

21211-2 No planning factors are currently available for this facility. An engineering analysis is needed to determine facility space requirements.

212 20 MISSILE EQUIPMENT MAINTENANCE SHOP (SF)
FAC: 2123
BFR Required: Y

21220-1 No planning factors are currently available for this facility. Activities with a limited amount of missile-handling equipment should consider performing their maintenance in an Automotive Vehicle Maintenance Shop (Category Code 214 20).

212 30 MISSILE ASSEMBLY AND TEST BUILDING (SF)
FAC: 2121
BFR Required: Y

21230-1 **DESCRIPTION.** This facility is required to support intermediate level maintenance of surface launched guided missiles. Component sections of the missile are tested, assembled into a missile of the required configuration, and tested as an all-up-round. Missiles may be received/shipped as bare missiles or packaged in containers.

21230-2 **REQUIREMENT.** Bridge cranes are needed to handle the missiles in the receiving/shipping area and onto the test beds in the test cells. Test cells should be constructed for an explosion hazard of 300 lbs. net explosives weight. See Table 21230-1 for guidance on sizing the facility.

Table 21230-1. Space Allowances for Surface Launched Guided Missiles

Weapons System	Gross SF
Standard	
Assembly	9,300
Control Cell	1,045
4 Test Cells	2,040
Packaging	2,500
Warheading, SW	450
Component rework, stores	6,600
Other	5,755
TOTAL	**27,690**
Harpoon	
Assembly and holding area	13,425
Control Cell	925

Weapons System	Gross SF
2 Test Cells	920
Office and stores	860
TOTAL	**16,130**

212 40 MISSILE COMPONENT SLING TEST TOWER (EA)
FAC: 2124
BFR Required: N

21240-1 **DESCRIPTION.** This facility is used to test the tensile strength of all forms of weapons handling equipment such as slings, beams, bars, etc. It is used in testing developmental equipment and the periodic testing of handling equipment.

21240-2 **REQUIREMENT.** The tower is a requirement of any station that is involved with handling heavy loads of ammunition, such as weapon stations and those activities that load and offload ammunition ships.

212 50 SUBMARINE LAUNCHED BALLISTIC MISSILE PROCESSING FACILITIES (SF)
FAC: 2126
BFR Required: Y

21250-1 **DESCRIPTION**. These facilities are required to receive components; checkout, assemble, refurbish, and repair Submarine Launched Ballistic Missiles (SLBMs) such as the TRIDENT II, D5 missile. Criteria for these facilities are dependent on the type of missile and have been developed and are available from the Navy's Strategic Systems Programs (SSP). All SLBM processing facilities are within high security areas and have special construction features such as high capacity environmental control systems, super flat floors, special trenching and conveying systems, and ordinance grounding and lightning protection systems.

21250-2 **REQUIREMENT**. No planning factors are currently available for this facility. For administrative spaces within these facilities, see Facility Class 600.

21250-2.1 Motor Transfer Facility (MTF). This facility provides the capability of receiving and transshipping SLBM missile motors and components and Active Inert Missiles (AIMs).

21250-2.2 Inert Component Control Building (ICCB). The ICCB provides for the support of missile systems level package processing, storage for guidance

systems, missile assembly checkout, instrumentation sub-system/package checkout, AIM recertification, and electronic repair.

21250-2.3 Radiographic Inspection Building (RIB). The RIB provides the capability for film and computed tomography of SLBM rocket motors. It also provides a film radiographic capability for small ordnance components and low energy real-time radiography capability for gas generators.

21250-2.4 Missile Inspection Building (MIB). The MIB provides buildup and checkout of first, second, and third stage motors, Thrust Vector control (TVC) systems installation/ removal and leak test, motor pressurization (leak search), conduit installation, and igniter installation; additionally, a cell will be provided to support motor nozzle removal/installation.

21250-2.5 Missile Assembly Building (MAB). The MAB provides the assembly, disassembly, and checkout of tactical SLBMs.

21250-2.6 Limited Area Processing and Storage Complex (LAPSC). The LAPSC receives processes and stores Strategic weapons Systems (SWS) components.

21250-2.7 Vertical Missile Packaging Building (VMPB). The VMPB provides for the packaging/un-packaging of SLBMs and the mating and de-mating of their SWS systems.

212 77 GUIDED MISSILES/SPARES STORAGE (READY ISSUE/ SHOP STORES/MISC.) (SF)

FAC: 2121
BFR Required: Y

21277-1 **DESCRIPTION.** These facilities are storage facilities for miscellaneous equipment or goods related to guided missiles that will be provided only where it can be individually justified.

21277-2 **REQUIREMENT.** There are no criteria for this type of facility. General information on normal stacking heights, SF per measurement ton requirements, and other parameters are provided in the Category Code 440 series.

213 MAINTENANCE - SHIPS AND FLOATING EQUIPMENT

213-1 **FACILITY MAINTENANCE.** This basic category provides facilities for maintenance of vessels of all types. These facilities include graving dry docks, fixed cranes, marine railways, ship repair shops, and amphibian vehicle maintenance shops. For waterfront operational facilities, see Category Group 150. For administrative facilities, see Facility Class 600.

213 10 DRY DOCK (SF)
FAC: 2131
BFR Required: Y

21310-1 **DESCRIPTION.** A dry dock is a long narrow basin sited in the foreshore of a harbor. Its entrance is closed by a movable caisson or by gates. The basin is so constructed that a vessel may be placed in it and the water removed, allowing the vessel to settle on supports located on the dock floor. In this way the underwater portion of the vessel is exposed for routine maintenance and repair or for those coming into a dry dock in a damaged condition. Dry docks vary in size in accordance with the dimensional characteristics of the vessels to be serviced. Hence, each dock is designed and constructed to satisfy the special requirements of a particular vessel or class of vessels.

21310-2 **SITING A DRY DOCK.** The siting of a dry dock at an existing naval shipyard entails the analysis of many vital factors. Some recommendations for siting are the following:

1. Locate the dry dock near the shipyard shop area for access to piping, electrical, woodworking, metalworking, machining and similar shops.

2. Locate near sources of power and fresh water.

3. Orient the dry dock to require the minimum length of track for gantry cranes.

4. Provide adequate ship approaches to the docks. The approach or turning basin should have a width in front of the dock of at least two times the dock length properly oriented for turning. The depth should be no less than that at the entrance sill of the dry dock.

5. Clearance must be provided from structures flanking the approach path of the ship. A distance of not less than 150 feet should be planned between such structures and the side of the ship to provide space for tugs to operate while maneuvering the ship.

21310-3 **Dry Dock Certification.** Coordinate with the local shipyard Facilities Program Manager, Code 900F, to obtain information on the Dry Dock Certification Program.

213 20 MARINE RAILWAY (EA)
FAC: 2132
BFR Required: Y

21320-1 **DESCRIPTION.** The function of a marine railway is to bring a vessel out of the water for the purpose of making all parts available for overhaul, and to return the vessel to the water when the work is finished. The facility consists of rail trackage from a point on shore to an anchored position at a submerged depth; a railway beaching cradle or dolly for mating a vessel or small boat; and hauling machinery (hoist house) to pull the cradle-mounted vessel up the inclined track to a position on shore.

21320-2 **CAPACITY.** The capacity of a marine railway is usually given as the weight (displacement) in long tons of the largest ship that can be lifted. The maximum size and capacity of Navy marine railways has been restricted to about 3,000 tons that is the size required for the largest destroyer.

21320-3 **SITING.** The sites chosen for marine railways should satisfy the following requirements:

21320-3.1 **Distance to the Channel.** The distance from the high water line or the bulkhead line to the navigation channels must be adequate for construction of the offshore end of the railway and must provide a safe fairway for vessels approaching and leaving the cradle.

21320-3.2 **Inshore Area.** The space available on land, including the frontage along the shore, must be sufficient for the inshore end of the railway, the hoist house, necessary clearances, spur tracks, roadways, cranes and working areas. Some of the larger marine railways will extend approximately 500 feet inshore.

21320-3.3 **Hydrographic Conditions.** The natural slope of the bottom along the offshore end of the railway, to prevent silting, should be lower than the grade of the tracks.

21320-3.4 **Foundations.** The soil conditions for the length of the railway must be of sufficiently high quality to make possible a design of foundations that will assure rigid control of settlement.

21320-3.5 **Favorable Climatic and Tidal Conditions.** The proposed location should be protected as much as possible from strong winds and waves.

21320-4 **DESIGN CRITERIA.** For design criteria, see NAVFAC DM-29.

213 30 SHORE INTERMEDIATE MAINTENANCE ACTIVITY (SIMA) (SF)
FAC: 2133
BFR Required: Y

21330-1 **DESCRIPTION.** This facility (SIMA) provides space for the fleet intermediate level maintenance operations. A SIMA has two basic components: maintenance shops and administration. These components may be established separately or as a consolidated complex.

21330-1.1 **Maintenance Shops.** Following is a partial list of functions in the maintenance component:

1. Machine Shop (Inside and Outside)
2. Hydraulic Shop; Valve and Regulator Shop; Pump and Pipe Shops
3. Boiler Shop; Automatic Combustion Control Shop
4. Optical Shop; Gyro Compass Shop; Test Equipment Shop
5. Internal Combustion Engine Shop; Gas Turbine Shop
6. Air Conditioning and Refrigeration Shop
7. Electrical, Electronics and Crypto Equipment Shops; Battery Shop
8. Sheet metal, Ship fitter and Welding Shops; Foundry
9. Carpenter, Pattern and Boat Repair Shops; Lagging and Insulation Shop
10. Riggers, Canvas and Paint Shops
11. Sandblasting Shop
12. Chemical, Metallurgical and Non-Destructive Testing Laboratories
13. Instrument Repair and Calibration Laboratory
14. Noise and Vibration-Analysis Laboratory

21330-1.2 **ADMINISTRATIVE SPACES.** The administrative component provides space for:

1. Offices; Central, Technical and Study Libraries; Records Storage
2. Classrooms, Projection Room, Audio-Visual Aid Preparation
3. Computer Operations and Analyst Record Storage

213 31 SHORE DEPOT LEVEL REPAIR SHOP (SF)
FAC: 2133
BFR Required: Y

21211-1 **DESCRIPTION.** An enclosed building used to perform depot level maintenance on components and accessories of ships and amphibious vehicles that cannot be repaired on board the vessels. This shop may include areas for electronics repair, welding, painting, small item fabrication, and a variety of other repair shop functions.

21211-2 No planning factors are currently available for this facility. An engineering analysis is needed to determine facility space requirements.

213 32 SHIPYARD DEMILITARIZATION AND RECYCLING FACILITY (SF)
FAC: 2134
BFR Required: Y

21211-1 **DESCRIPTION.** A Shipyard Demilitarization and Recycling Facility that is used to provide administrative, shop, logistics, and personnel support space in direct support of demilitarization and recycling of surface ships and submarines.

21211-2 No planning factors are currently available for this facility. An engineering analysis is needed to determine facility space requirements.

213 40 FIXED CRANE STRUCTURES (EA)
FAC: 2137
BFR Required: Y

21340-1 **DESCRIPTION.** The principal types of fixed cranes are pillar, pillar-jib, and jib. The hammerhead and tower cranes are also classed as stationary when mounted on fixed towers.

21340-2 **CRITERIA.** See NAVFAC DM-38, for criteria and procedures to be followed in the selection of weight handling equipment for specific installations.

213 41 THROUGH 213 67 - SHIP REPAIR SHOPS

21341 through 21367-1 **CATEGORY CODES.** Ship repair shops and related facilities included in Category Code series 213 are shown in Table 21341 through 21367-1.

Tables 21341 through 21367-1. Ship Repair Shops and Related Facilities

Category Code	Description
213 41	Central Tool Shop
213 42	Shipfitting Shop
213 43	Sheet Metal Shop
213 44	Forge and Heat Treat Shop
213 45	Welding Shop
213 48	Quality Assurance Office
213 49	Inside Machining Shop
213 50	Optical Shop
213 51	Weapons Shop
213 52	Marine Machining Shop
213 53	Boilermaking Shop
213 54	Electrical Shop
213 55	Pipefitting Shop
213 56	Woodworking Shop
213 57	Electronics Shop
213 58	Boat Shop
213 59	Abrasive Blast Facility
213 60	Paint and Blasting Shop
213 61	Rigging Shop
213 62	Sail Loft
213 63	Foundry
213 64	Patternmaking Shop
213 65	Nuclear Repair Shop
213 66	Temporary Services Shop
213 67	Pumphouse, Dry Docks

21341 through 21367-2 **DELETED CATEGORY CODES.** The following category codes have been deleted and the functions formerly performed therein have been reassigned to other category codes as indicated:

21341 through 21367-2.1 Category Code 213 46 (Galvanizing Shop) and Category Code 213 47 (Plating Shop) are now included in Category Code 213 49 (Inside Machining Shop).

21341 through 21367-2.2 Category Codes 213 50 (Optical Shop), 213 58 (Boat Shop), 213 59 (Abrasive Blast Facility) and 213-62 (Sail Loft) are not for use at the shipyards since these functions are included in other category codes for shipyards. These category codes are intended for use by other ship maintenance activities which support the repair of ships, such as ship repair facilities located at naval stations, intermediate maintenance activities, and other activities performing intermediate level maintenance rather than depot level maintenance.

21341 through 21367-3 **REQUIREMENTS.** There are currently no criteria available for these category codes. The quantitative requirements for shop facilities in Basic Category 213 should be determined on an individual basis, based on the experience and knowledge of the activity involved and the Naval Sea Systems Command. One method which can be used to develop the requirement for a specific shop is discussed below.

21341 through 21367-3.1 **EQUIPMENT TABLE.** Determine the types and number of pieces of equipment and laydown/workstation areas that the shop requires to perform their work. Develop a table that shows the following information: (a) name of equipment or laydown/workstation area; (b) actual floor area occupied by the equipment or area; and (c) any clearances required to allow access to the equipment/area, provide safety zones, or meet operational requirements. A sample table is shown in Table 21341 through 21367-2.

Tables 21341 through 21367-2. Sample Equipment/Work Area Table

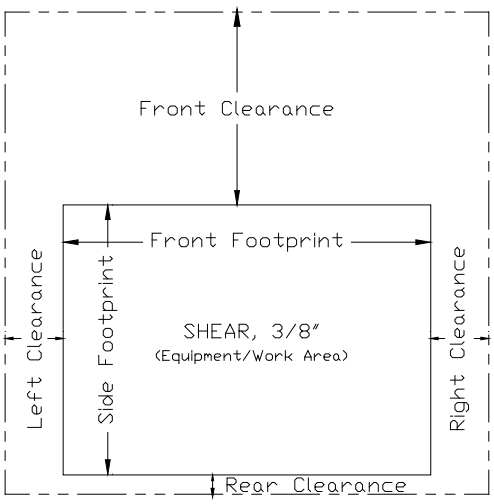
Equipment/ Work Area	Qty	Footprint (LF)		Clearance (LF)				Overall Dimension (LF)		Total Area (SF)
		Front	Side	Right	Left	Front	Rear	Front	Side	
Table, Small	4	5	4	0	0	4	4	5	12	240
Table, Large	1	13	5	4	4	4	4	21	13	273
Grinder	1	3	3	3	3	3(1)	0	9	6	54
Drill Press	1	7	3	3	3	5(1)	5	13	13	169
Shear, 3/8"	1	19	14	3	3	10	1	25	25	625
TIG Welder	2	3	2	0	0	4(2)	1(2)	3	7	42

Equipment/ Work Area	Qty	Footprint (LF)		Clearance (LF)				Overall Dimension (LF)		Total Area (SF)
		Front	Side	Right	Left	Front	Rear	Front	Side	
Storage Rack	9	9	4	0	0	10	3	9	17	1,377

Equipment/Work Area clearances can be shared with other equipment clearances and circulation unless otherwise noted:
(1) Clearances can be shared with clearances for other equipment/work areas, but not circulation.
(2) Clearances can not be shared with other clearances or circulation.

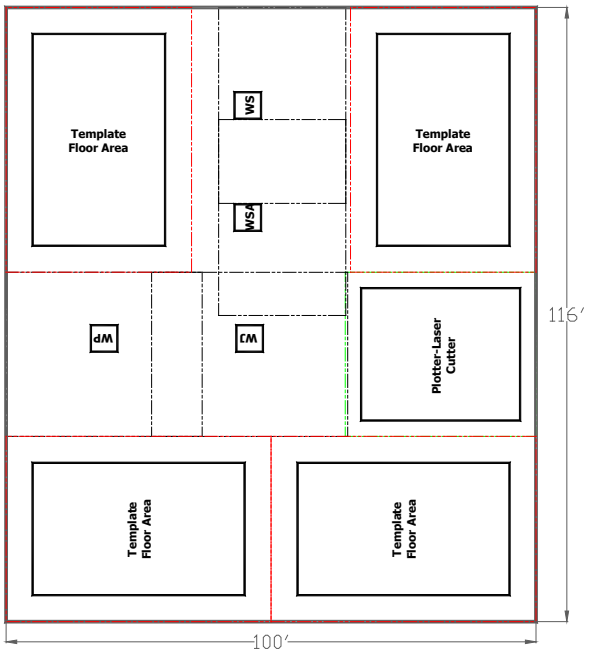
21341 through 21367-3.2 **DRAWINGS.** Once the table is completed, a conceptual drawing of an “ideal” shop containing the required equipment and areas can be completed to develop a net floor area requirement. As the drawing is developed, it is important to account for the following: (a) material and personnel flow in the shop and (b) how clearances can or cannot be shared. A sample drawing of a single piece of equipment/area is shown in Figure 21341 through 21367-1.

Figures 21341 through 21367-1. Drawing of Equipment/Area and Clearances



See Figure 21341 through 21367-2 for a sample drawing of a conceptual shop layout, where the solid lines show the actual equipment/area dimensions, and the dashed lines show the clearance requirements.

Figures 21341 through 21367-2. Sample Shop Layout Drawing



21341 through 21367-3.3 **NET TO GROSS CONVERSION.** The drawing yields a net requirement in square feet for the shop. To convert this into a gross requirement, multiply the net requirement by 1.25.

213 41 CENTRAL TOOL SHOP (SF)
FAC: 2133
BFR Required: Y

21341-1 **CENTRAL TOOL SHOP (SHOP 06).** The central tool shop is responsible for the design, development, manufacture and maintenance of prototype and conventional tooling such as cutting machines, dies, molds, cleanliness plugs, cutters, jigs, fixtures, and special tools. The shop conducts the maintenance program for electrical and mechanical maintenance of numerically controlled and conventional machine tools and plant equipment. This includes installation, preventive maintenance, repair, analytical checkout, rehabilitation, and lubrication. This shop operates all tool rooms throughout the shipyard. Additionally, the shop operates high-pressure air equipment servicing ship systems as well as refilling high-pressure cylinders.

213 42 SHIPFITTING SHOP (SF)
FAC: 2133
BFR Required: Y

21342-1 **SHIPFITTING SHOP (SHOP 11).** The shipfitting shop is responsible for the back-shop modification, fabrication, repair, and assembly of various metal structural parts of the ship's hull, superstructure and interior ship structure by using shipfitting equipment, plate and shape structures, and other metals; and then through computer design, templating, laying-out, cutting, shaping, flanging, straightening, bending, and hot forming of all types and sizes of metal plates and shapes; and then positioning, aligning, fitting-up, and securing parts and subassemblies into ship component assemblies.

213 43 SHEET METAL SHOP (SF)
FAC: 2133
BFR Required: Y

21343-1 **SHEET METAL SHOP (SHOP 17).** The sheet metal shop is responsible for developing, fabricating, and installing ventilation and air conditioning ductwork; fabricating and installing store-room workshop and stowage facilities, non-structural bulkheads and partitions; the manufacture and installation of label plates; and outfitting of galley, berthing, habitability and office space for naval vessels.

213 44 FORGE AND HEAT TREATING SHOP (SF)
FAC: 2133
BFR Required: Y

21344-1 **FORGE AND HEAT TREATING SHOP (SHOP 11).** The forge and heat treating shop is responsible for hot-forging, heat treating, inspecting, cleaning, and repairing various metal structural parts of a ship's hull, superstructure, interior ship structure, mechanical systems, machinery systems, anchor chain, and ship's propellers by using forging equipment, material billets, and other metals; and then through hammering, pressing, hot-rolling, heat-treating (annealing, tempering, hardening, quenching), sawing, threading, grinding, inspecting, and surface finishing (tumbling, cleaning, coating) of all types and sizes of metal shapes into a ready ship component.

213 45 WELDING SHOP (SF)
FAC: 2133
BFR Required: Y

21345-1 **WELDING SHOP (SHOP 26).** The welding shop is responsible for all of the welding, flame cutting, carbon arc gauging, and related processes required by the various shops of the Operations and Production Resources Departments of the shipyard and the Public Works Center located at the shipyard. In addition to the major involvements of cutting and welding the various structural, sheet metal, and piping materials, operations include repair of castings, combating of valves, hard-surfacing of materials subjected to abrasive wear, shooting and welding studs and fasteners, metal spraying, casting, bonding, and welding of lead shielding, and stress relieving of shipboard elements.

213 48 QUALITY ASSURANCE OFFICE
FAC: 2133
BFR Required: Y

21348-1 **QUALITY ASSURANCE OFFICE (CODE 130).** The quality assurance office is responsible for inspection and tests to determine compliance with specifications, plans, orders, directives, and sound shop and marine practices; non-destructive testing services; and technical direction, consulting and advisory services on those processes, materials, and systems for fabrication and repair to shops. It is also responsible for providing chemical and metallic laboratory services; test instrument calibration; and technical support for test, analyses, evaluation, and procedures for use of metallic and non-metallic materials.

213 49 INSIDE MACHINING SHOP (SF)
FAC: 2133
BFR Required: Y

21349-1 **INSIDE MACHINING SHOP (SHOP 31).** The inside machining shop is responsible for performing horizontal boring, vertical boring, planing and heavy lathe work in manufacturing, altering, and repairing ship machinery and shipyard manufactured items; performing engine lathe turning, horizontal and vertical turret lathe turning, boring, facing, and other turning work; performing milling, grinding, hobbing, broaching, shaping, slotting, lapping, honing, balancing work, layout work and drilling on castings and fabrications; and performing disassembly, inspection, reverse engineering, repair, reassembly, and testing of main propulsion units, pumps, valves, turbines, air compressors, propellers, and miscellaneous auxiliary machinery. This shop also assembles new manufactured equipment. Additionally, this shop is responsible for all metal finishing processes including electroplating, dalic plating, galvanizing, and metal polishing.

213 50 OPTICAL SHOP (SF)
FAC: 2133
BFR Required: Y

No criteria are currently available for this code. This category code is not for use by shipyards. See the general discussion in paragraph 21341 through 21367-2.2.

213 51 WEAPONS SHOP (SF)
FAC: 2133
BFR Required: Y

21351-1 **WEAPONS SHOP.** The weapons shop is responsible for the repair, overhaul, alignment, installation, checking out, testing and calibration of all weapons systems, integrated systems, such as missile systems and associated components, including gun mounts, turrets, saluting batteries, launching pads, mechanical components of fire control, radar antennas and sonar equipment. This shop is also responsible for the repair, overhaul, calibration, and adjustments and testing of gunsights, range-finders, torpedo directors, telescopic gunsights, periscopes, binoculars, stereo-trainers, and other miscellaneous repair of instruments, etc.

213 52 MARINE MACHINING SHOP (SF)
FAC: 2133
BFR Required: Y

21352-1 **MARINE MACHINING SHOP (SHOP 38).** The marine machining shop is responsible for the installation and testing of all main propulsion machinery, auxiliaries, rudders, shafting, sea valves, deck machinery, laundry and galley equipment, arresting gear, and catapults on ships undergoing repair and conversion. This shop repairs, installs, and performs necessary tests on main and auxiliary diesel engines and their associated equipment as well as hydraulic speed gears on ships. The marine machining shop also refuels, repairs, and tests nuclear reactor plants as well as their associated systems and components. This shop works on any mechanical component that is removed from or installed on a ship or submarine.

213 53 BOILERMAKING SHOP (41) (D) (SF)
FAC: 2133
BFR Required: Y

21353-1 **BOILERMAKING SHOP (SHOP 41).** The boilermaking shop is responsible for the repair, conversion, and building of steam generating equipment used to furnish steam to main and auxiliary machinery. This includes the fabrication, assembly, installation, testing, cleaning, and repair of the steam generators, uptakes, stacks, and blower ducts as well as the fabrication, repair and testing of pressure vessels, incinerators, and spark arrestors.

213 54 ELECTRICAL SHOP (SF)
FAC: 2133
BFR Required: Y

21354-1 **ELECTRICAL SHOP (SHOP 51).** The electrical shop is responsible for accomplishing the installation, repair, maintenance, alteration, troubleshooting, and test of all power, lighting, and interior communication systems and equipment aboard Naval ships and submarines; for manufacture of switchboards, electrical control equipment, and components; for the installation, repair and alteration of nuclear electrical components and systems; and for repair and calibration of all electrical instrumentation.

213 55 PIPEFITTING SHOP (SF)
FAC: 2133
BFR Required: Y

21355-1 **PIPEFITTING (SHOP 56).** The pipefitting shop is responsible for accomplishing the layout, fabrication, installation, dismantling, repair, cleaning, testing, and inspection of piping systems and gaskets on both nuclear and non-nuclear systems in the shop as well as onboard ships and submarines; fabrication, repair, and installation of radar waveguides; installation, repair, and testing of refrigeration systems, air conditioning systems, and oxygen-nitrogen systems; and cleaning, testing and inspection of pressure vessels.

21355-2 **PIPE AND COMPONENT INSULATING (SHOP 57).** This group insulates steam, hot water and chilled water piping systems, ductwork and bulkheads aboard ship and performs some insulation and maintenance and repair on shipyard equipment such as furnaces.

213 56 WOODWORKING SHOP (SF)
FAC: 2133
BFR Required: Y

21356-1 **WOODWORKING SHOP (SHOP 64).** The woodworking shop is responsible for accomplishing operations performed by boat builders, woodcraftsmen, and shipwrights to construct and repair wooden and plastic boats, wooden portable buildings and shelters, hollow booms, wooden tank, practice torpedoes, and flight deck panels; repairing and manufacturing furniture and cabinets; laminating all sizes of wooden members; manufacture and repair accommodation ladders; perform dry kiln operations; and install and repair all types of acoustic and thermal insulations. Working from plans and specifications, they arrange docking blocks to provide for the dry docking of all classes of naval vessels and direct the positioning of the vessel for proper landing on the blocks. Additionally, the woodworking shop repairs and installs wooden decks, erects pipe stagings and lifelines; fabricates and installs boat stowages, builds shipping cradles, shores and blocks cargo aboard ships, manufactures and repairs wooden gangways and platforms, and fabricates and constructs refrigerated spaces aboard ships. This shop also manufactures plastic items such as pipe, radomes, fairwaters, tanks, antenna cones, and submarine fairing plates. They make resin foam pours in voids and perform grouting operations. The woodworking shop also installs and repairs plastic laminates and hull dampening materials on naval vessels and installs polyethylene shielding around nuclear reactors. They provide reference lines used in construction, repair, and alteration of all types of ships as well as taking measurements of ships' characteristics. This shop applies plastisol coatings; installs linoleum, rubber, asphalt, and ceramic tile. The sail loft section fabricates, repairs and installs containments for nuclear and non-nuclear use, tents, weather covers, shrink wrap enclosures, upholstery, gun and other assorted covers.

213 57 ELECTRONICS SHOP (SF)
FAC: 2133
BFR Required: Y

21357-1 **ELECTRONICS SHOP (SHOPS 52, 66 AND 67).** The electronics shop is responsible for accomplishing installation, repair, overhaul, modification check-out, adjustment, test, and calibration of radar, sonar, communications, cryptographic data processing, antennas, navigation, and electronic countermeasure equipment and systems on and for surface ships, submarines, and shore stations. The electronics shop is also responsible for repair, calibration, and certification of electronic and nuclear instruments for the shipyard, ships, and shore activities, and installation, repair, and testing of gyro compasses.

213 58 BOAT SHOP (SF)
FAC: 2133
BFR Required: Y

No criteria are currently available for this Category Code. This Category Code is not for use by shipyards. See the general discussion in paragraph 21341 through 21367-2.2.

213 59 ABRASIVE BLAST FACILITY (SF)
FAC: 2133
BFR Required: Y

No criteria are currently available for this code. This Category Code is not for use by shipyards. See the general discussion in paragraph 21341 through 21367-2.2.

213 60 PAINT AND BLASTING SHOP (SF)
FAC: 2133
BFR Required: Y

21360-1 **PAINT AND BLASTING SHOP (SHOP 71).** The paint and blasting shop is responsible for surface preparation, including abrasive blasting, for the application or installation of protective, decorative, and functional paints, coatings, films, and for installation of deck, floor, and wall coverings. This includes design, layout, lettering, sign and poster making; silk screen processing; artificial and natural wood finishing; all types of painting and preservation on board ship; operation of pickling and chemical cleaning plant for preservation of material; abrasive blasting services; and the laying or installation of terrazzo, magnesite, and concrete.

213 61 RIGGING SHOP (SF)
FAC: 2133
BFR Required: Y

21361-1 **RIGGING SHOP (SHOP 72/CODE 700).** The rigging shop is responsible for operations performed by riggers, sailmakers, tank and component cleaners, laborers, upholsterers, fabric workers, and diving operations required for repair, overhaul, conversion, and construction of Naval vessels and equipment.

213 62 SAIL LOFT (SF)
FAC: 2133
BFR Required: Y

No criteria are currently available for this code. This category code is not for use by shipyards. See the general discussion in paragraph 21341 through 21367-2.2.

213 63 FOUNDRY (SF)
FAC: 2133
BFR Required: Y

21363-1 **FOUNDRY.** The foundry is responsible for manufacturing cores for iron, steel, and non-ferrous casting in the Core Unit; preparing and mixing sand, processing and making molds, steel castings, pouring steel from furnaces, melting, and manufacturing steel, and shaking out steel castings from molds after pouring in the steel foundry unit; pouring and melting non-ferrous metals and alloys, processing and making molds for brass castings, and shaking out non-ferrous castings in the non-ferrous unit; processing and making molds for iron castings, pouring iron, melting iron-alloys and shaking out iron castings from molds in the iron unit; clearing castings, shipping finished castings.

213 64 PATTERNMAKING SHOP (SF)
FAC: 2133
BFR Required: Y

21364-1 **PATTERNMAKING SHOP.** The patternmaking shop is responsible for the manufacture, repair, and alteration of wood patterns required to produce castings; manufacture of metal parts for wood and plastic patterns and metal patterns; manufacture of mock-ups for patterns; manufacture of sheet plastic by forming, fabricating, cementing, and dyeing; manufacture of plastic patterns; and receiving, storing and issuing pattern mock-ups and models.

213 65 SHIP PROPULSION MAINTENANCE FACILITY (SF)
FAC: 2136
BFR Required: Y

21365-1 **DESCRIPTION.** The Ship Propulsion Maintenance Facility is responsible for the repair of reactor plant components of ship propulsion systems.

213 66 TEMPORARY SERVICES SHOP (SF)
FAC: 2133
BFR Required: Y

21366-1 **TEMPORARY SERVICES SHOP (SHOP 99).** The temporary services shop is responsible for electrical, piping, and ventilation systems as related to temporary services. Temporary services include compressed air, water, steam, oxygen, electrical power and lighting, ventilation, telephones, inerting, air analysis, shipside sewage connections, communications systems, distilled water for ships' boilers, CO2 fire extinguishers, static dehumidification, electric, steam, and induction heat; besides responsibility for radioactive waste collection systems, delivery and distribution of pure water systems, distribution of temporary electric power, breathing air systems for reactor plants, chilled water and air conditioning systems, filtering for reactor plants, ventilation systems, communications systems involved in nuclear refueling operations, and deoxygenating pure water nitrogen systems. This shop also manufactures and repairs rubber products.

213 67 PUMPHOUSE, DRY DOCKS (SF)
FAC: 2134
BFR Required: Y

21367-1 **DESCRIPTION.** The dry dock pumphouse is used to house dry dock dewatering pumps and associated equipment.

213 68 DIVE SHOP (SF)
FAC: 2134
BFR Required: Y

21368-1 **CRITERIA.** No criteria are currently available for this code.

213 70 SHIP SERVICES SUPPORT BUILDING (SF)
FAC: 2134
BFR Required: Y

21370-1 **DESCRIPTION.** A ship services support building is used to provide office and shop space in direct support of maintenance and repair work for surface ships and submarines. The office area supports those individuals involved in executing work onboard ships, and includes people such as project superintendents, work supervisors, design engineers and test personnel. Additionally, quality assurance inspectors responsible for ship work inspection operate from these facilities. Another function in this type of facility is an area for kitting of material and work packaging. The purpose of the shop area is to perform rapid minor work required to support the maintenance and repair operations, i.e., rather than sending a small item requiring a minor modification back to the shop, the modification would be made at the dry dock or pier site.

21370-2 **REQUIREMENTS.** With the exception of shop space, all requirements are based upon the corresponding category codes providing those particular types of functions. For example, the administrative space for the office area is based on the criteria provided for in Category Code 610 10, Administrative Office. Required storage should be categorized under Category Code 213 77, Maintenance-Ship/Spares Storage (Ready Issue/Shop Stores/Miscellaneous). The quantitative requirements for shop facilities should be determined on an individual basis, based on the experience and knowledge of the activity involved and the Naval Sea Systems Command. See paragraph 21341 through 21367-3 for additional guidance on developing shop space requirements.

213 73 LANDING CRAFT WASH RACK (EA)
FAC: 2135
BFR Required: Y

21373-1 **DESCRIPTION.** The primary function of this facility is to wash down Landing Craft Air Cushions (LCAC) vehicles after every mission in order to remove sand and salt spray. However, this type of washdown pit may be used for other types of amphibious landing craft requiring similar purging. Wash water treatment is incorporated into the design of the facility.

21373-2 **REQUIREMENT.**

21373-2.1 **JEFF Type Craft.** A wash rack for JEFF type craft is 75 ft wide by 150 ft long. This criteria can be modified to suit other amphibious landing crafts as well.

21373-2.2 **All Other Amphibious Landing Craft.** For all other types of amphibious landing craft requiring similar cleaning, select the largest craft that

the facility will service and add 27 feet to its width and 30 feet to its overall length (with all ramps, doors, etc., extended) to determine the size of the washdown pit.

213 75 AMPHIBIAN VEHICLE MAINTENANCE SHOP (SF)
FAC: 2134
BFR Required: Y

21375-1 **DESCRIPTION.** The amphibian vehicle maintenance shop provides special work areas for performing all organizational maintenance functions on the amphibian vehicles of the Marine Corps Amphibious Tractor Battalion and in the case of the Navy, all organizational and intermediate level maintenance on Landing Craft Air Cushion (LCAC) vehicles. In the case of the latter, the depot level maintenance is performed at a Naval Air Rework Facility or contractor plant.

21375-2 **REQUIREMENT FOR MARINE CORPS.** The maintenance shop for the amphibian vehicles of the Marine Corps Amphibious Tractor Battalion includes administrative and training areas as well as storage space for OEM equipment, tools and mount out. The total shop area will vary depending upon the number of companies assigned to the Amphibious Tractor Battalion. A typical Marine Corp facility that would accommodate one battalion, i.e., four companies, would have a space requirement of 42,600 gross square feet of which 700 gross square feet would be dedicated to the mechanical equipment room. The size of the facility would be adjusted accordingly as the number of companies in the battalion increase or decrease.

21375-3 **REQUIREMENT FOR LCAC (NAVY).** Criteria for a typical LCAC maintenance facility with 54 assigned craft is as follows:

21375-3.1 **Maintenance Bay.** Provide maintenance bay space for 15% of assigned craft. Note: LCAC craft is 48 ft. x 90 ft. with 15 ft. ramps on each end. Accordingly, bay space is increased to 75 ft. x 150 ft. or 11,250 net square ft. to allow sufficient work area around each craft. Net to gross conversion is 1 to1.15, or:

11,250 NSF x 1.15 = 12,937.5 GSF
12,937.5 GSF/craft x 8 craft = 103,500 GSF

21375-3.2 **Maintenance Shops.** Maintenance shops capable of providing organizational and intermediate level support are as follows:

Propeller shop	3,642 SF
Engine shop	1,101 SF
Hydraulic shop	522 SF
Skirt repair shop	2,216 SF

Welding shop	720 SF
Sheet metal shop	1,260 SF
Gluing shop	726 SF
Electrical shop	1,050 SF
Electronics shop	1,041 SF
Battery shop	396 SF
Tool room	1,185 SF
Locker room	5,375 SF
Maintenance control	900 SF
	20,134 SF

Net to Gross Conversion: 1:1.25 or 20,134 x 1.25 = 25,168 GSF

21375-3.3 **Control Tower/Operations Room.** A Control Tower/Operations Room is an additional requirement for a LCAC Operational Base and can be an integral part of the maintenance facility by providing an additional 190 GSF. This facility should have an unobstructed view of the parking apron, taxiway, ramp and waterfront in order to allow coordination of operations to preclude accidents. Communications equipment and traffic controllers are housed in this facility.

21375-3.4 **Squadron Operations/Training Space.** Squadron Operations/Training Space requirements are met by providing space for classrooms briefing room and a structural maintenance laboratory. The following areas are provided to meet the requirements for a LCAC Operational Base having 54 assigned craft.

21375-3.4.1 **Training/Maintenance Space.** Compute the requirement for training/maintenance space within the Squadron Operations/Training Space as follows:

- Classroom Requirements: Using criteria for category code 171 10 for one 20 person operational class and one 20 person maintenance class, 2 x 20 PN x 22 SF/PN = 880 NSF

- Briefing Room: A large classroom is required for general briefing and combined classes. Maximum loading is 40 persons. Accordingly, 40 PN x 21 SF/PN = 840 NSF

- Structural Maintenance Laboratory: Three mock-up equipment modules for skirt, prop, turbine, gear box and electronic bench yield 219 NSF x 3 = 657 NSF

- Therefore, the total net requirement (classroom + briefing room + structural maintenance laboratory) equals 880 NSF + 840 NSF + 657 NSF, which equals 2,377. To convert the net requirement to

a gross requirement, use a conversion factor of 1.33; i.e., 2,377 NSF x 1.33 = 3,160 GSF.

21375-3.4.2 **Administrative Space.** The administrative space for 27 officers and 69 enlisted personnel = 96 personnel x 150 GSF/PN = 14,400 GSF.

21375-3.4.3 **Composite Space Requirement.** The composite space requirement equals the combined sum of the training/maintenance and administrative spaces or: 3,140 GSF (training/maintenance) + 14,400 GSF (administrative) = 17, 560 GSF (total).

21375-3.5 **Total Requirement for a LCAC Maintenance Facility.** Accordingly, the total requirement for a LCAC maintenance facility supporting 54 craft is:

Maintenance Bay Space	103,500 GSF
Maintenance Shops	25,168 GSF
Control Tower/Operations Room	190 GSF
Squadron Operations/Training Space	17,560 GSF
Total	146,418 GSF

213 77 MAINTENANCE - SHIPS/SPARES STORAGE (READY ISSUE/SHOP STORES/MISC.) (SF)
FAC: 4421
BFR Required: Y

21377-1 **DESCRIPTION.** Storage facilities for miscellaneous equipment or goods related to ship maintenance facility support will be provided only where it can be individually justified.

21377-2 **REQUIREMENT.** There are no criteria for this type of facility. General information on normal stacking heights, square feet per measurement ton requirements, and other parameters are provided in the Category Code 440 series.

214 MAINTENANCE - TANK, AUTOMOTIVE

214 Facilities for maintenance and repair of combat and noncombat motorized vehicles. For weapons, see Category Code series 215; for tracked amphibious vehicles see Category Code series 213; for construction equipment see Category Code series 218.

214 10 COMBAT VEHICLE MAINTENANCE SHOP (SF)
FAC: 2141
BFR Required: Y

21410-1 This facility provides specialized work areas, equipment, and storage for overhaul of combat vehicles such as self-propelled gun carriages and tanks. For Marine Corps Organizational Maintenance Shop, see Category Code 214 51; for Field Maintenance Shop, see Category Code 214 53.

214 20 AUTOMOTIVE VEHICLE MAINTENANCE SHOP (SF)
FAC: 2141
BFR Required: Y

21420-1 **PURPOSE AND FUNCTION**. Automotive vehicle maintenance facilities are required to provide covered work areas for inspection, maintenance, and repair of all transportation equipment assigned to an installation, and as applicable, its supported activities. For reasons of overall efficiency and economy, the maintenance and operations function for automotive, construction, materials handling, and railroad equipment are combined. In areas where combined facilities are not feasible, special facilities for construction equipment maintenance and railroad equipment maintenance will be provided. See Category Codes 218 20 and 218 40 for planning data for separate shop facilities.

21420-2 **REQUIREMENTS**. The number and types of the equipment maintained by the activity will govern the size of the facility required, that is, the size is directly proportional to the number of general repair bays required to perform the assigned maintenance task. General repair space requirements are computed from the productive space factors contained in Tables 21420-1, 21420-2 and 21420-3. A 2-bay facility will be considered as the minimum requirement. After the repair bay requirements have been computed, the area required for administrative and indirect as well as direct support functions can be determined from Table 21420-4.

21420-3 **SPACE REQUIREMENTS**. Space requirements for an automotive vehicle maintenance shop are computed as follows:

21420-3.1 **Step 1.** Prepare an inventory listing by equipment costs codes for all of the equipment supported (see Column 1 of Tables 21420-1, 21420-2, and 21420-3). If a combined automotive/construction equipment/weight-handling maintenance shop is planned, consider all equipment codes; if a separate construction/weight-handling equipment shop is planned under Category Code 218 20, omit equipment cost codes 2300 to 2840, 3100 to 3720, 4210 to 4952, and 8120 to 8800 (to be used for determining Category Code 218 20 requirements).

21420-3.2 **Step 2.** Multiply the total equipment inventory as listed in Step 1 for each equipment code group by its corresponding space factor, (shown in Column 3 of the tables) to determine the repair bay requirements for that specific code group.

21420-3.3 **Step 3**. Total the individual code computations to determine the number of repair bays required for all of the equipment supported. For example:

Equipment Code	Number of Pieces	Productive Space Factor	Repair Bay Requirements
0061-0099	1	0.063	0.063
0102-0299	11	0.015	0.165
0300-0700	60	0.023	1.380
0800	25	0.016	0.400
1000	26	0.020	0.520
2000	2	0.016	0.032
3000	1	0.025	0.025
4000	26	0.020	0.520
5000	47	0.016	0.752
7000	6	0.030	0.180
8000	3	0.092	0.276
Total repair bay requirements			4.313 (or 4 bays)

21420-4 Column (1) is done in even numbers. If the calculation of the number of repair bays is less than the odd number 5 as shown in the example, round down to the next even number 4. If the calculation is more than the odd number of bays (i.e., 5.313), round up to the next even number of bays (i.e., 6).

21420-5 To determine the total square-footage of area required for general repair bays multiply the number of bays determined in Step 3 by 480 (the square footage of a single 16 by 30 foot general repair bay). The number of square feet of administrative and indirect support area requirements is directly proportional to the number of repair bays, as shown in Column 3 of Table 21420-4.

21420-5.1 The administrative and indirect support area includes the following facilities:

1. Administrative office for maintenance and operations personnel.
2. Drivers and operators training, licensing, and ready room.
3. Locker, lunch, and conference room.
4. Toilet facilities.
5. Parts supply, issue, and storage room.
6. Tool room.

21420-6 In addition to repair bay and administrative area requirements, consideration must also be given to such direct support facilities as tire shop, body shop, battery shop, engine and accessories overhaul shop, paint shop, dynamometer test bay, steam cleaning and wash bay, and lube storage. Engine overhaul and paint and body shops should be provided.

21420-7 The direct support facility requirements shown in column 4 of Table 21420-4 provide for complete shop facilities. The total gross space allowance in column 5 is the maximum allowed for the indicated number of repair bays.

General Work Bay Space Factors
Table 21420-1. Automotive Equipment Codes 0061 through 0905

Equipment Cost Code (Column 1)	Abbreviated Description (Column 2)	Productive Space Factor (Column 3)
0061 to 0099	Buses	0.063
0102 to 0299	Sedans, station wagons, and ambulances	0.015
0300 to 0745	Trucks	0.023
0800 to 0897	Trailers	0.016
0900 to 0905	Motorcycles, scooters, etc.	0.004

Table 21420-2. Materials Handling Equipment Codes 1100 through 1900

Equipment Cost Code (Column 1)	Abbreviated Description (Column 2)	Productive Space Factor (Column 3)
1100 to 1900	Tractors (warehouse) Trucks (fork-lift, crane platform and side loaders)	0.020

Table 21420-3. Construction and Allied Equipment Codes 2300 Through 8800

Equipment Cost Code (Column 1)	Abbreviated Description (Column 2)	Productive Space Factor (Column 3)
2300 to 2840	Crushing, mixing, batching and paving equipment (mixers, pavers, distributors, spreaders, heaters)	0.016
3100 to 3720	Drilling, blasting, and driving equipment (compressors and drills)	0.025
4210 to 4952	Excavating and grading equipment (crawler cranes, graders, loaders, rollers, scrapers, tractors, etc.)	0.020
5110 to 5930	Miscellaneous construction and maintenance equipment (generators, pumps, cleaners, sweepers, mowers, snowplows, garbage trucks, mobile shops)	0.016
7100 to 7501	Firefighting equipment (trucks, pumps, etc.	0.030
8120 to 8800	Weight handling equipment (truck mounted, cruiser, and boat cranes)	0.092

21420-8 **SITE LOCATION**. In choosing a site for new transportation equipment maintenance facility a number of conditions should be given careful consideration. The facility should be located adjacent to or within the major industrial area which it serves. Caution should be exercised to ensure that the site selected has adequate land area to accommodate all support facilities, equipment holding and parking area, and sufficient room for employee parking. Criteria for employee parking can be found in Category Code 852 10. Site location may be influenced to some degree when railroad equipment is involved because of the track location and approach.

21420-9 **MAINTENANCE FACILITY**. When available sites for the automotive vehicle maintenance facility prove to be either inadequate or inappropriate for the inclusion of construction and/or railroad equipment maintenance, separate shop structures for the service and maintenance of these types of equipment will be provided. See Code 218 40 for planning criteria for a special railroad equipment maintenance shop.

Table 21420-4. Space Requirements for Automotive Vehicle Maintenance Facility

Repair Bays		Administrative and Indirect Support Area (Sq. ft.) (Column 3)	Direct Support Area (Sq. ft.) (Column 4)	Total Gross Space Allowance (Sq. ft.) (Column 5)
(No.) (Column 1)	(Sq. ft.) (Column 2)			
2	960	600	1,440	3,000
4	1,920	1,500	2,720	6,140
6	2,880	1,950	3,480	8,310
8	3,840	2,400	4,230	10,470
10	4,800	3,100	4,270	12,170
12	5,760	3,800	5,210	14,770
14	6,720	4,200	6,000	16,920
16	7,680	4,700	6,070	18,450
18	8,640	5,100	6,080	19,820
20	9,600	5,500	6,170	21,270
22	10,560	5,900	6,210	22,670
24	11,520	6,300	6,250	24,070
26	12,480	6,850	6,290	25,620
28	13,440	7,400	6,330	27,170
30	14,400	7,750	6,370	28,520
32	15,360	8,100	6,480	29,940
34	16,320	8,400	6,520	31,240
36	17,280	8,700	6,560	32,540
37	18,240	9,000	6,580	33,820
40	19,200	9,300	6,600	35,100
42	20,160	9,600	6,640	36,400
44	21,120	9,900	6,680	37,700
46	22,080	10,200	6,720	39,000
48	23,040	10,500	6,780	40,320

214 30 REFUELING VEHICLE SHOP (SF)
FAC: 2141
BFR Required: Y

21430-1 **AIRCRAFT REFUELER TRUCKS.** Aircraft refueler trucks and other portable fuel dispensing equipment are not serviced or repaired in the automotive vehicle maintenance shop because of the explosive hazard involved. Accordingly, a separate explosion proof and fire-resistant maintenance/repair facility is provided. The facility is located a minimum of 100 feet from other structures. See Table 21430-1 for the refueling vehicle shop space allowances.

Table 21430-1. Space Allowances - Refueling Vehicle Shop

No. of Refuelers Supported	No. of Repair Stalls	Gross Area (Sq ft)
Up to 8	1	1,080
9 to 16*	2	1,800

* One additional 720-square-foot (16 x 45 ft) stall may be planned for each increment of eight refuelers above sixteen.

One 16 x 45 foot pad for purging fuel tanks should be provided for each facility.

214 40 VEHICLE HOLDING SHED (AWAITING PARTS AND REPAIR) (SF)
FAC: 2185
BFR Required: Y

21440-1 **DEADLINED EQUIPMENT**. This facility is a part of the automotive vehicle maintenance shop with the main purpose of providing a covered area for holding deadline equipment awaiting repairs. Whenever possible, it should be located near the main repair shops. Space requirements are computed as follows:

21440-1.1 **Self-propelled Equipment**. Provide one bay or stall for every 30 pieces of self-propelled equipment supported up to 1,000 units and one additional bay for every 50 units supported over 1,000. Bays will be 12 feet by 35 feet or 420 square feet in area.

214 51 AUTOMOTIVE ORGANIZATIONAL SHOP (SF)
FAC: 2141
BFR Required: Y

21451-1 This facility provides work areas for Fleet Marine Force (FMF) units to perform maintenance on items of organizational equipment. The shop space includes administrative and dispatching areas as well as storage for OEM equipment, tools, and parts.

21451-2 This category code includes requirements previously given in Category Code 214 52, Combat Organizational Shop (now deleted).

21451-3 Conduct an engineering study to determine requirements.

214 53 FIELD MAINTENANCE SHOP (COMBAT / AUTOMOTIVE / TRACK) (SF)
FAC: 2141
BFR Required: Y

21453-1 This facility provides specialized work areas for performing 3rd and 4th echelon maintenance functions on items of tactical equipment involving primarily rolling stock items of motor transport and engineer equipment. These are limited to use by the Service Battalion of the Marine Division and appropriate elements of the Force Service Regiment. The shop space includes administrative and training areas as well as storage space for tools, parts, and maintenance float equipment.

21453-2 For other field maintenance functions see Category Codes 215 60, 217 30, and 218 80.

21453-3 Conduct an engineering study to determine requirements.

214 55 VEHICLE WASH PLATFORM (SF)
FAC: 2145
BFR Required: N

21455-1 **REQUIREMENTS.** Vehicle wash platforms equipped with hose connections should be provided on the basis of one vehicle washing space for each 50 vehicles assigned to the motor pool. Where the motor pool supports multiple commands (Expeditionary Support Units) vehicle wash platforms should be sized based on the number of self-powered Civil Engineering Support Equipment (CESE) assigned to the ESU and the largest single command's CESE in the supportive Command. Where CESE and Service Craft and Boat Accounting Report (SABAR; vehicles/boats) are both present in the command, it is to be assumed that the CESE count alone will

support the wash platform requirements. Where a single motor pool supports a single command of 150 plus pieces of self-powered CESE, the wash platform will be sized on the average number of self-powered pieces of CESE withdrawn in support either training or deployment. Vehicle wash platforms are also used to clean the SABAR assigned to the command but the SABAR does not count against total component count. A sediment basin for grit and soil will be provided and will drain into an oil water separator. Gross calculated area includes the sediment basin. . Vehicle wash platform/sediment basin(s) should be covered to reduce the amount of rain water to be treated by the oil water separator (see below for property record card use). Although a BFR is not required for the CCN, a BFR is provided for planning purposes. Final platform/ sediment basin details will be developed at design/construction phases.

21455-2 **PROPERTY RECORD CARD (PRC) USE.** See below guidance on appropriate property record card use. Use CCN 14313 “Operational Vehicle and Equipment Canopy” to capture any canopies associated with wash racks:

- Capture all vehicle wash racks at single location on a single property record card. Record the quantity of wash racks using the primary UM (EA) and the total square footage amount (cumulative for all racks) under the area UM (SF).
- Capture any overhead canopies under CCN 14313 (see above) on separate property record cards from the wash platform. If the canopy is contiguous, one PRC will suffice and both its quantity (1; EA) and area (SF) should be captured. If the actual canopy dimensions or design drawings are unavailable to determine the area, an estimate can be made by measuring the structural system layout and adding an estimate of the canopy overhang on each side. Where multiple canopies are observed, each will have its own facility number and PRC.
- In the “Notes” section of all associated PRCs, delineate the site location for references purposes.

214 56 GREASE RACK (EA)
FAC: 2145
BFR Required: N

21456-1 One grease rack (two vehicles) will be provided for each 125 vehicles.

215 MAINTENANCE - WEAPONS, SPARES

215-1 This group includes facilities for maintenance of small arms, automatic weapons, mortars, artillery guns, launchers, flamethrowers, torpedo tubes, harbor protective nets, and non-electronic equipment. See UFC 4-229-01N for design criteria. For missile maintenance facilities, see Category Group 212.

215 10 SMALL ARMS SHOP (SF)
FAC: 2152
BFR Required: Y

21510-1 A small arms shop is used to support small arms maintenance and repair for various Marine Corps activities or units. This shop is required to perform the pre-fire inspection (LTI) of all small arms weapons issued and recovered and to repair those weapons which are damaged or malfunctioned. The weapons are broken down, visually inspected, inspected by use of various gages, magnifying glasses, etc., repaired, lubricated, etc., and reassembled.

21510-2 The criteria indicated for category code 143-45, Armory, should provide adequate space allocation for any type of small arms shop provided: (a) the armory services only the activity at which it is located and (b) the small arms weapons are limited to those personnel physically stationed at that activity.

21510-3 This shop is a small arms maintenance and repair facility, and the weapons serviced here are not limited to those handled by the personnel assigned to the activity at which it is located. Accordingly, the size of the shop is based upon the number of weapons repaired per month and not like the armory, whose size is determined by the number of personnel stationed at the activity.

21510-3.1 A small arms shop shall meet the following requirements:

a. Positive weapon security in a humidity controlled, secure environment.
b. A rapid, individual weapon issue/recovery system.
c. A quick, twice daily inventory capability of all weapons.
d. Weapon repair bench (each).
e. A weapon maintenance area for individual weapon maintenance by the person to whom the weapon is assigned.
f. Space for a technical library.
g. Space for the storage of sensitive or highly pilferable emergency supplies for assigned reaction forces.
h. Parts storage.
i. Weapons cleaning and coating area.
j. Secured flammable storage area.

21510-4 The size of the shop is governed by the average number of weapons serviced during an average month. See Table 21510-1 for gross square foot allowance to determine the area requirement.

Table 21510-1. Small Arms Shop

Number of Weapons Serviced per Month	Gross Square Feet per Weapon
Up to 1,000	1.25
1,000 to 2,000	1.10
2,000 to 5,000	1.00
5,000 to 10,000	0.074
For each weapon over 10,000	Add 0.20

Example: The number of gross square feet required for a small arms shop servicing 10,350 weapons per month is: 10,350 x 0.20 + 2,070 gross square feet.

215 20 LIGHT GUN (20 MM TO 5 IN) SHOP (SF)
FAC: 2152
BFR Required: Y

215 30 HEAVY GUN (6 IN TO 16 IN) SHOP (SF)
FAC: 2152
BFR Required: Y

215 40 HARBOR PROTECTIVE NET SHOP (SF)
FAC: 2134
BFR Required: N

215 50 LAUNCHER AND PROJECTOR MAINTENANCE SHOP (SF)
FAC: 2152
BFR Required: Y

21520/30/40/50-1 At present there are no criteria for Category Codes 215 20 through 215 50. However, an engineering space analysis based on maintenance throughput, ordnance equipment size, maintenance staffing, and support space should determine the space requirements.

215 60 FIELD MAINTENANCE SHOP (ORDNANCE) (SF)
FAC: 2151
BFR Required: Y

21560-1 This field maintenance shop provides specialized work areas for performing 3rd and 4th echelon maintenance on all items of ordnance equipment authorized repaired by the Force Service Support Group (FSSG). The shop space

includes administrative and training areas as well as storage space for tools, parts, and maintenance float equipment. Perform an engineering space analysis based on maintenance throughput, ordnance equipment size, maintenance staffing and support space should determine the space requirements.

21560-2 For other field maintenance functions, see Category Codes 214 53, 217 30, and 218 80.

216 MAINTENANCE AMMUNITION, EXPLOSIVES & TOXICS

216-1 **DEFINITION.** This group includes facilities for maintenance of ammunition, rockets, bombs, mines, grenades, torpedoes, depth charges, demolition materials, pyrotechnics, missile fuels, and related chemicals. OPNAV Instruction 8000.16 series provides maintenance policies, procedures, and responsibilities for the conduct of the Naval Ordnance Maintenance Management Program. Siting criteria and guidance on standard operating procedures for these facilities can be found in NAVSEA OP-5 Vol. 1. Consult the design criteria, UFC 4-216-02, when developing space requirements.

216 05 CHANGE/RELIEF HOUSE (SF)

FAC: 2162
BFR Required: N

21605-1 **DEFINITION.** This is a building, typically associated with explosives operating building(s), containing facilities for employees to change to and from work clothes. This facility may provide sanitary services, drinking fountains, lockers, and lunchrooms and may house the explosive plant office. See NAVSEA OP-5 for siting considerations.

21605-2 **CRITERIA.** There is no planning criterion for this function. Given the above listed functions and the number of personnel expected to use the facility, an engineering space analysis should produce an adequate requirement.

216 10 AMMUNITION REWORK AND OVERHAUL SHOP (SF)

FAC: 2162
BFR Required: Y

21610-1 **DEFINITION.** Overhauling ammunition includes determining the serviceability of the primary components of an item, and performing exterior maintenance as required to render the item fully serviceable.

21610-2 **CRITERIA.** There is no planning criterion for this function. An engineering space analysis based on the type of ammunition, maintenance throughput, ordnance equipment size, maintenance staffing, storage and support space should determine the space requirements.

216 20 ROCKET REWORK AND OVERHAUL SHOP (SF)
FAC: 2162
BFR Required: Y

21620-1 **DEFINITION.** Overhauling rockets includes determining the serviceability of the primary components of an item, and performing exterior maintenance as required to render the item fully serviceable.

21620-2 **CRITERIA.** There is no planning criterion for this function. An engineering space analysis based on maintenance throughput, ordnance equipment size, maintenance staffing, storage and support space should determine the space requirements.

216 30 MINES AND DEPTH CHARGE REWORK AND OVERHAUL SHOP (SF)
FAC: 2162
BFR Required: Y

21630-1 **DEFINITION.** Overhauling mines and depth charges includes determining the serviceability of the primary components of an item, and performing exterior maintenance as required to render the item fully serviceable.

21630-2 **CRITERIA.** There is no planning criterion for this function. An engineering space analysis based on maintenance throughput, ordnance equipment size, maintenance staffing, storage and support space should determine the space requirements.

216 40 TORPEDO SHOP (SF)
FAC: 2162
BFR Required: Y

21640-1 **DEFINITION.** Torpedo shop functions include but are not limited to: preventive and corrective maintenance as wells as hardware and operational software upgrades on torpedo Warshot and Exercise configurations. The Exercise configuration is recovered after firing and is processed for reuse. Torpedo processing includes complete disassembly, repair and reassembly into the desired configuration. The torpedo shops require special industrial processes to handle the OTTO fuel II used in torpedo propulsion systems. Typically, suites of electronic and mechanical test equipment are required to support different torpedo functions and components.

Maintenance processes are documented in Technical Manuals series SW13-EO-PRO-10 thru 060, which are maintained by Naval Undersea Warfare Center Newport.

21640-2 **CRITERIA.** There is no planning criterion for this function. An engineering space analysis based on maintenance throughput, equipment size, maintenance staffing, storage and support space should determine the space requirements.

216 50 SPECIAL WEAPONS SHOP (SF)
FAC: 2153
BFR Required: Y

21650-1 **DEFINITION.** Special weapons shop functions include, but are not limited to, determining the serviceability of the primary components of an item, and performing exterior maintenance as required to render the item fully serviceable.

21650-2 **CRITERIA.** There is no planning criterion for this function. An engineering space analysis based on maintenance throughput, ordnance equipment size, maintenance staffing, storage and support space should determine the space requirements.

216 55 AIR/UNDERWATER WEAPONS SHOP (AIRBORNE TORPEDOES/ AIRDROP WEAPONS) (SF)
FAC: 2161
BFR Required: Y

21655-1 **AIR/UNDERWATER WEAPONS (AUW) SHOP.** An Air/Underwater Weapons (AUW) Shop is required at Navy and Marine Corps air stations as designated by the Chief of Naval Operations. The AUW shop contains space and equipment for the storage, test, check, assembly, and limited maintenance of airborne torpedoes and other airdrop weapons.

21655-2 **CRITERIA.** When an AUW Shop is authorized, the standard shop has the following requirements:

Shop Building	7,192 gross square feet
Vehicle Shelter	1,612 gross square feet

Floor plan templates are shown in UFC 4-126-02.

216 60 QUALITY EVALUATION LABORATORY (SF)
FAC: 2162
BFR Required: Y

21660-1 **QUALITY EVALUATION LABORATORY.** A Quality Evaluation Laboratory (QEL) supports the QE program by performing analysis and tests to determine and maintain quality assurance of ammunition, explosives and toxins.

21660-2 **CRITERIA.** There is no planning criterion for this function. An engineering space analysis based on throughput, equipment size, lab space requirements, staffing and support space should determine the space requirements.

216 77 AMMUNITION/EXPLOSIVES MAINTENANCE STORAGE (SF)
FAC: 2162
BFR Required: Y

21677-1 **AMMUNITION/EXPLOSIVES MAINTENANCE STORAGE.** Storage facilities for miscellaneous equipment related to ammunition/explosives maintenance facilities will be provided only where it can be individually justified.

21677-2 **CRITERIA.** There are no criteria for this type of facility. General information on normal stacking heights, net to gross multipliers, and other parameters are provided in Category Code 440 series.

217 MAINTENANCE - ELECTRONICS AND COMMUNICATION EQUIPMENT

217-1 This basic category includes facilities and shops for maintenance and repair of radio and radar equipment, antennas, radiation aids, sonar equipment, transmission and reception equipment, and guided bombs.

217 10 ELECTRONICS/COMMUNICATIONS MAINTENANCE SHOP (SF)
FAC: 2171
BFR Required: Y

21710-1 Electronics maintenance shops at Naval and Marine Corps activities provide facilities for maintenance and repair of non-airborne equipment (see Category Code 211 45, Avionics Shop (Non-NAVAIR Depot) for airborne equipment repair facilities).

21710-2 It contains office and support spaces for the Equipment Maintenance Officer (EMO) and the EMO Staff, equipment maintenance and training areas, and a small storage area for parts and supplies directly under the control of the EMO. A small electronics and communications maintenance shop integral to the function it supports should be contained within the analysis of that function and not classified as Category Code 217 10.

21710-3 No specific criteria are provided. An engineering evaluation can be conducted to determine the office space and support area requirements using guidance contained within the Category Code series 131 Introductory section. For maintenance and training area, the quantity and type of items required may be selected from Table 131 and appropriate allowances applied. For storage area, an engineering evaluation can be used to determine the volume of material required to be stored. The standard stacking height for this type of material is 1.83 meters (6 feet). A factor of 1.07nsm/cm is applied to the volume of material to determine the required net square meters (m^2). A conversion factor of 1.65 for net square meters to gross square meters is appropriate.

217 20 COLLIMATION TOWER (EA)
FAC: 2173
BFR Required: N

21720-1 Collimation facilities are required at shipyards for electronic and optical alignment of fire control and radar equipment aboard ships. This facility consists of a steel tower approximately 125 to 150 feet in height and a small instrument building at the lower base.

217 30 FIELD MAINTENANCE SHOP (COMMUNICATIONS/ ELECTRONICS) (SF)
FAC: 2171
BFR Required: Y

21730-1 This field maintenance shop provides specialized work areas for performing 3rd and 4th echelon maintenance on all items of communications/electronics equipment authorized repaired by the Service Battalion of the Marine Division and the Force Service Regiment. The shop space includes administrative and training areas as well as storage space for tools, parts, and maintenance float equipment. For other field maintenance functions, see Category Codes 214 53, 215 60 and 218 80. Conduct an engineering study to determine requirements.

217 40 ANTENNA TEST RANGE (EA)
FAC: 2173
BFR Required: N

21740-1 This facility is for testing electronic equipment and communication antennas after completion of maintenance, repair and overhaul work. This range has to be individually planned. Standard planning factors are not available.

217 50 SENSOR ACCURACY CHECK SITE (SACS) (EA)
FAC: 2173
BFR Required: Y

21750-1 The primary purpose of this facility is to measure the performance of shipboard sensors in an in-port environment on completion of overhaul or during normal port upkeep of Navy ships. This facility can be planned for only when authorized by the Commander, Naval Sea Systems Command.

21750-2 The SACS is a unique test and evaluation facility which provides an independent, real-time measure of gyrocompass, sonar, echo sounder and sonar communications set performance and accuracy. The SACS design permits sensor evaluations under test conditions especially favorable to the ship: (1) the ship is tested in port with all normal dockside facilities available; (2) measurements are external to the ship so that “at sea” performance is determined; (3) data are analyzed in real-time providing immediate identification of sensor deficiencies and verification of corrective actions; and (4) all major sonar parameters are measured in a single comprehensive test.

21750-3 **MAJOR FACILITY COMPONENTS.**

21750-3.1 **Control Center**: The building in which test points on the ship’s sensors are monitored, and control is maintained over all SACS equipment. The building contains signal generating, receiving and processing devices and automatic data acquisition and analysis equipment.

21750-3.2 **Pile Mounted Transducers.** Transducers mounted to the 31 pilings of the SACS array. The transducers are spaced at 10-degree intervals and are used for sonar range and bearing error measurements.

21750-3.3 **Moveable Carriage with Transducer.** A calibrated directional transducer that can be moved vertically and in azimuth; it is used for receiver and transmitter performance measurements.

21750-3.4 **Ship's Transducer Location System (STLS).** A system of three transducers used to continuously monitor the position of the ship's sonar transducer to an uncertainty of less than one inch.

21750-3.5 **Automatic Ship's Head Measuring System (ASHMS).** A system of specially configured TV cameras that is used to provide ship's heading to an accuracy of better than 0.01 degree.

21750-3.6 **Mooring System**. A system of five hydraulic winches from which wire ropes are extended to the ship in order to maintain the ship's sonar transducer near the center of the SACS array.

21750-3.7 **Slip Services.** The ship receives 800 amps, 440 volts, steam, fresh water, telephone connections and generous parking space while in port.

21750-3.8 **Echo Sounder Test Array**: An array of four transducers placed on the bottom of the bay directly below the ship's fathometer.

21750-3.9 **Depth.** A minimum depth of 50 feet Mean Lower Low Water is required at the site of the subject facility due to the variety of vessels that can be expected to be serviced.

217 77 ELECTRONICS - SPARES AND STORAGE (READY ISSUE/SHOP STORES / MISCELLANEOUS) (SF)

FAC: 2171
BFR Required: Y

21777-1 **Electronics and Communications Storage.** Support multiple commands or multiple Departments/Divisions within a command. It is under the control of the Communications Department. Storage of material under the control of the Logistics and Supply Department should be classified within CCN 143-77. Storage areas in support of small electronics and communications maintenance shops integral to the function they support are considered part of those functions.

21777-2 **No specific criteria provided**. An engineering evaluation can be used to determine the volume, in cubic meters (cm), of material required to be stored. The standard stacking height for this type of material is 1.83 meters (6 feet). A factor of 1.07nsm/cm is applied to the volume of material to determine the required net square meters (m^2). A conversion factor of 1.65 for net square meters to gross square meters is appropriate.

218 MAINTENANCE - MISCELLANEOUS PROCURED ITEMS AND EQUIPMENT

218 10 CONTAINER REPAIR AND TEST BUILDING (SF)

FAC: 2182
BFR Required: Y

21810-1 A container repair and test facility services only empty containers. The size of the facility is relevant to processing approximately 1 percent of the containers and chassis involved in the handling and shipping operations. The facility provides for structural testing, minor repairs, and cosmetic services for damaged or structurally marginal containers.

21810-2 Assuming a 750-container throughput capability per 24-hour day, the number of bays in the repair facility can be estimated as follows:

1% x 750 = 7.5 containers per day
Assume 4 hours work per container - 4 x 7.5 = 30 hours
Assume 8 hours working day - 30 / 8 = 3.75, say 4 bays

21810-3 A typical 4-bay facility with supporting tool room, administrative space, and personnel support area is shown in Figure 218-10. The bays are serviced by a bridge crane with a lifting capacity of 5 tons. Storage space of 2,130 square yards for 16 empty containers should be provided adjacent to the facility. The 4 bays testing and repair area is 1,920 square feet. The administrative space is 800 square feet for a total gross area of 2,720 square feet.

218 20 CONSTRUCTION/WEIGHT HANDLING EQUIPMENT SHOP (SF)

FAC: 2182
BFR Required: Y

21820-1 Special shop structures for the maintenance and repair of construction/weight-handling equipment are planned only for areas where combined automotive, weight-handling, railroad and/or construction equipment maintenance facilities are not feasible. Construction/weight-handling equipment shop requirements are based on the space factors contained in Category Code 214 20, Automotive Vehicle Maintenance Shop.

21820-2 Included in this category are special construction and utility shops for Marine Corps units. These shops are normally part of the Headquarters Battalion, Force Service Regiment, and the Fleet Marine Force (FMF) Engineer Battalions. Conduct an engineering study to determine requirements.

218 25 MARINE AIR-BASE SQUADRON (MABS) FACILITY (SF)
FAC: 2181
BFR Required: Y

21825-1 This Category Code is used for inventory purposes only.

218 30 DRUM RECONDITIONING PLANT (SF)
FAC: 2182
BFR Required: Y

21830-1 The drum reconditioning plant is planned for those fuel facilities where fuel drums are returned for refilling or storage before reissue. Normal drums that require reconditioning at frequent intervals are the 55-gallon steel type. The drum reconditioning facility requires a minimum of two buildings: one for the boiler plant and the other housing the reconditioning facilities. The boiler house will be approximately 800 square feet, and the reconditioning building housing the internal washing, removal of surface depressions, internal chaining, external wire brushing, chime rolling, testing, welding, internal preservation, and painting will be approximately 3,600 square feet. This plant has a capacity of approximately 3,000 55-gallon drums per month.

218 35 CABLE REPAIR HOUSE (SF)
FAC: 2182
BFR Required: Y

21835-1 No criteria are currently available for this Category Code.

218 40 RAILROAD EQUIPMENT SHOP (SF)
FAC: 2183
BFR Required: Y

21840-1 The railroad equipment maintenance facility is a special shop structure to house material and equipment for the service and maintenance of railroad locomotives and locomotive cranes. The facility is required where installations operate and maintain railroad equipment for the handling of supplies. In areas where it is practicable, the railroad equipment maintenance shop will be combined with the Automotive Vehicle Maintenance Shop and/or the Construction/Weight-Handling Equipment Shop, and the number of repair bays (with pits) may be determined as follows:

Locomotives Supported	Repair Bays	Area SF
1-5	1	960
6-12	2	1,980
13 and over	3	2,880

21840-2 The numbers of additional bays are similarly determined from the above table.

218 45 INSTRUMENT CALIBRATION SHOP (SF)
FAC: 2182
BFR Required: Y

21845-1 **REPAIR.** This shop performs calibration, repair, and certification of all measurement instruments assigned to an activity. Space requirements are governed primarily by the number of pieces of equipment requiring calibration. The facility should be dust-free, temperature and humidity controlled and protected from electromagnetic interference. It is essential that the site selected for the location of this facility be free of ambient vibration to avoid interference with calibration operations. Normally the following spaces are included:

21845-1.1 **Calibration Laboratory**

21845-1.2 **Cleaning Room** is used for cleaning and drying equipment to be calibrated.

21845-1.3 **Utilities Room** is required so that utilities components can be isolated from the laboratory working area.

21845-1.4 **Storage Areas** for incoming and outgoing items, spare parts and equipment.

21845-1.5 **Administration Area.** The administration area provides office space, technical library, and file storage. Space allowances are planned in accordance with Category Code 610-10.

21845-2 **FOR SPECIFIC GUIDANCE.** See Joint Systems Commands publication Calibration Facility Requirements (NAVAIR 17-35 FR-02 NAVSEA OD 45842 and NAVELEX 0967-LP-465-8010) and Naval Shore Electronics Criteria (NAVELEX 0101, 114) calibration program.

218 50 BATTERY SHOP (SF)
FAC: 2181
BFR Required: Y

21850-1 A battery shop is required to service and charge batteries. As an example, typical batteries serviced at an air installation are lead-acid batteries used for ground support equipment (GSE) and nickel-cadmium and silver-zinc batteries for aircraft at the intermediate maintenance level. A shop is normally required at each Navy and Marine Corps air installation having approximately 75 or more aircraft. The gross area of the battery shop is 1,110 square feet. This shop size can accommodate a maximum workload of eight nickel-cadmium and 40 lead acid batteries per work shift. The shop size should be modified for other workloads, with the major change being in the amount of space needed for charging benches.

218 51 BATTERY RECHARGING SHOP (SF)
FAC: 2181
BFR Required: Y

21851-1 This category code is for use at activities which have a requirement to recharge battery powered equipment such as forklift trucks used at supply centers. The requirement is a function of the number and size of the equipment being serviced and must be determined on an individual basis or in the case of forklift trucks, the following criteria may be used: 100 square feet per forklift which includes 40 square feet for the average vehicle itself and 60 square feet for aisle and workspace, based on a 1.5:1.0 ratio. In all instances, compliance must be maintained to OSHA regulations regarding the venting of hydrogen gas, floor drains, flush facilities, explosion proof wiring and lighting, etc.

218 52 BATTERY RECHARGING SHED (SF)
FAC: 2185
BFR Required: Y

21852-1 This category code captures battery charging structures/sheds at activities that have a requirement to recharge battery powered equipment such as forklifts and similar equipment. It supports either charging batteries outside of equipment or for temporarily supporting the requirement to charge housing equipment batteries.

218 60 GROUND SUPPORT EQUIPMENT SHOP (SF)
FAC: 2181
BFR Required: Y

21860-1 The intermediate level maintenance of aircraft ground support equipment (GSE) is performed in this shop. Ground support equipment, often referred to as yellow gear, includes such items as tow tractors, trucks, forklifts, trailers, compressors, power generators, maintenance stands, jacks and other ground equipment which support aircraft operations.

The GSE shop requirement is based upon the average number of on-board aircraft and is sized in accordance with Table 21860-1 with the following modifications:

1. The areas shown in the table were developed for base loadings comprised mainly of VF, VA, VP, and VEW aircraft. Activities supporting primarily helicopter or basic propeller training operations normally would not require a shop size greater than 12,500 SF regardless if the station loading exceeds 100 aircraft.

2. Stations which have a Fixed Point Utility System (FPUS) installed in the aircraft parking apron shall reduce the shop requirement by 640 square feet for each full increment of 75 aircraft spaces equipped with FPUS. See the example at the end of this section.

3. Stations having less than 40 aircraft shall individually justify a requirement for a GSE shop. Consideration will be given to maintaining the GSE gear in the Automotive Vehicle Maintenance Shop (Category Code 214 20) prior to requesting a separate GSE shop.

Table 21860-1
Ground Support Equipment Shop

Number of Aircraft	Shop Area (SF)
40-50	6,250
51-75	9,400
76-100	12,500
101-125	13,950
126-150	15,400
151-175	16,850
176-200	18,300
201-250	21,200
251-300	24,100

The above shop allowance includes workspace for: battery shop, engine shop, paint shop, tire and wheel repair, jack repair and vehicle framework. Supporting space for ready issue of parts, tool storage, classrooms, locker room, offices, and a mechanical

equipment room are also included. A covered storage area for GSE gear is planned in conjunction with the GSE shop (see Category Code 218 61, Ground Support Equipment Holding Shed). A sample computation for a GSE shop is given below:

Example – GSE Shop

Given: Average on board aircraft – 179
Fixed Point Utility System (FPUS) provided for 90 apron parking spaces

From Table 21860-1, shop area to support 179 aircraft equals 18,300 SF.

Reduction for FPUS:
90 apron spaces with FPUS divided by 75 = 1.2, use 1.0
Reduce area by 1.0 x 640 SF
Requirement equals 17,660 SF (18,300 – 640).

218 61 GROUND SUPPORT EQUIPMENT HOLDING SHED (SF)
FAC: 2185
BFR Required: Y

21861-1 DEFINITION. The ground support equipment (GSE) holding shed is planned in conjunction with the Category Code 218 60, Ground Support Equipment (GSE) Shop. The shed provides protective cover for GSE gear awaiting and undergoing intermediate level maintenance and is an integral part of the GSE Shop compound.

The GSE shed requirement is based upon the average number of on-board aircraft and is sized in accordance with Table 21861-1 with the following modifications:

1. The areas shown in the table were developed for base loadings comprised mainly of VF, VA, VP, and VEW aircraft. Activities supporting primarily helicopter or basic propeller training operations normally would not require a shop size greater than 19,500 SF regardless if the station loading exceeds 100 aircraft.

2. Stations which have a Fixed Point Utility System (FPUS) installed in the aircraft parking apron shall reduce the shop requirement by 640 square feet for each full increment of 75 aircraft spaces equipped with FPUS. See Category Code 218 60 for an application for a similar reduction to the GSE shop.

Table 21861-1
GSE Holding Shed

Number of Aircraft	Shed Area (SF)
40-50	9,750
51-75	14,625
76-100	19,500
101-125	19,967
126-150	20,435
151-175	20,902
176-200	21,370
201-250	22,300
251-300	23,230

218 62 SHIPBOARD AIRCRAFT SUPPORT EQUIPMENT FACILITY (SF)
FAC: 2182
BFR Required: Y

21862-1 No criteria are currently available for this Category Code.

218 65 EQUIPMENT HOLDING SHED (For Category Code 218 20) (SF)
FAC: 2185
BFR Required: Y

21865-1 This facility is required in conjunction with Construction/Weight-Handling Equipment Shop, Category Code 218 20 for the purpose of protection of equipment awaiting repairs. The number and size of holding bays has to be determined on an individual basis and is dependent upon the type of equipment to be supported.

218 68 PRODUCTION EQUIPMENT MAINTENANCE SHOP (SF)
FAC: 2182
BFR Required: Y

21868-1 No criteria are currently available for this Category Code.

218 70 OFFICE EQUIPMENT/APPLIANCE REPAIR SHOP (SF)
FAC: 2182
BFR Required: Y

21870-1 Appropriate facilities may be provided to perform maintenance and repair of office equipment and small appliances. The space requirement for this facility is governed by the number of machines supported by the activity. See Table 21870-1.

Table 21870-1. Space Allowance - Office Equipment/Appliance Repair Shop

Number of Machines Supported	Gross SF Area
500	400
1,000	600
1,500	800
2,000	1,000
2,500	1,200
3,000	1,400
5,000	1,600

218 71 DENTAL EQUIPMENT MAINTENANCE BUILDING (SF)
FAC: 2182
BFR Required: Y

21871-1 No criteria are currently available for this Category Code.

218 77 REPAIR SHOP STORAGE (SF)
FAC: 2182
BFR Required: Y

21877-1 No criteria are currently available for this Category Code.

218 80 FIELD MAINTENANCE SHOP (GENERAL SUPPLY) (SF)
FAC: 2182
BFR Required: Y

21880-1 This field maintenance shop provides specialized work areas for Fleet Marine Force (FMF) units performing 3rd and 4th echelon maintenance on all items of general supply equipment. This function is performed primarily by the General Supply

Maintenance Company, Maintenance Battalion, of the Force Service Regiment. The shop space includes administrative and storage space for tools, parts, and maintenance float equipment.

21880-2 For other field maintenance functions see Category Codes 214 53, 215 60, and 217 30.

21880-3 Conduct an engineering study to determine requirements.

218 90 AVIATION SUPPORT EQUIPMENT SHOP (NALC) (SF)
FAC: 2182
BFR Required: Y

21890-1 No criteria are currently available for this Category Code.

218 91 MOBILE VAN SHOP (NALC) (SF)
FAC: 2181
BFR Required: Y

21891-1 No criteria are currently available for this Category Code.

218 92 AVIATION SUPPORT / FEEDER SHOP (NALC) (SF)
FAC: 2182
BFR Required: Y

21892-1 No criteria are currently available for this Category Code.

219 MAINTENANCE - INSTALLATION, REPAIR AND OPERATION

219-1 This basic category includes maintenance shops for repair and overhaul of installation facilities (public works and public utilities), including installed shop and other equipment, and utility distribution systems, used in support of maintenance operations at military and/or industrial installations. The maintenance and repair of vehicles and weight-handling and construction equipment, utility plant, and maintenance shops are not included in this category. For the former, see Category Code series' 214 and 218, and the latter, see Category Code series 811.

219 10 PUBLIC WORKS SHOP (SF)
FAC: 2191
BFR Required: Y

NOTE: For shop planning in Public Work Centers, individual guidance will be provided by NAVFAC.

21910-1 This facility supports the Maintenance Division of the Public Works Department. This Division is responsible for management of the Preventive, Maintenance Inspection (PMI) program and is tasked to perform maintenance on:

21910-1.1 All buildings, grounds and ground structures.

21910-1.2 Utilities plants and distribution systems when requested by the Utilities Division.

21910-1.3 Heating, air-conditioning and refrigeration systems.

21910-1.4 Internal communications and alarm systems.

21910-1.5 Roads and trackage.

21910-2 This work includes repairs, alterations and new construction incident to maintenance; except work that may be accomplished by private contract. In addition, the Maintenance Division is responsible for the following services:

21910-2.1 Respond to emergency and/or service work requests.

21910-2.2 Provide caretaking services.

21910-2.3 Provide upkeep to all grounds of the activity.

21910-2.4 Provide for solid waste collection.

21910-2.5 Provide pest control service.

21910-3 Certain Public Works Department functions are not performed at the Public Works Shop as defined for Category Code 219 10, such as:

21910-3.1 Administration when not in direct support of a maintenance shop. This includes offices for the Public Works Officer (PWO), Assistant PWO, Maintenance Control Division, Maintenance Division supervisor and staff, Engineering Division, Administrative Division and Housing Division.

21910-3.2 Work performed by the Utilities Division such as operating utilities plants and distribution systems.

21910-3.3 Maintenance and repair of automotive equipment.

21910-4 Facilities for these functions are categorized under the following Category Groups as appropriate: 610- Administration, 218- Maintenance—Facilities for Miscellaneous Procured Items and Equipment, 214- Maintenance—Tank, Automotive, and the applicable code groups in the 800 series – Utilities and Ground Improvements.

21910-5 The maximum allowable gross area for public works shops, including space for heating and mechanical equipment, is based on the number of military and civilian maintenance personnel permanently assigned to the maintenance organization. This does not include those personnel involved in functions not directly performed by the shop as outlined above. Table 21910-1 lists the gross area for the various sizes of maintenance shops including Category Code 219 20, Pavement and Grounds Equipment Shed and 219 25, Public Works Shops Expendable/Work-in-Process Store.

Table 21910-1. Space Allowance - Public Works Shops*

Shop Type	Total Maintenance Personnel	Gross Area (SF)*
A	10-30	8,700
B	31-50	12,100
C	51-100	16,700
D	101-150	21,100
E	151-300	28,300
F	301-500	34,800
	Over 500	100 SF/Pers.

* The areas indicated in Table 21910-1 represent the entire composite area for the Public Works Maintenance Shop. Included within these figures are the areas allocated for category codes 219 20, Pavement and Grounds Equipment Shed, Table 21920-1, and 219 25, Public Works Shops Expendable/Work-In-Process Store, Table 21925-1. The requirement for the last two codes must not be added to this code but rather are considered an integral part of it. The figures indicated in the tables for these two codes are provided as a guide as to how category code 219 10 may be subdivided. In the event the requirement for category codes 219 20 and 219 25 are less than indicated, it is not necessary to reduce the figures indicated in Table 21910-1 but rather, this difference in area may be used for other functions performed by this shop.

21910-6 The gross areas listed in Table 21910-1 provide for the following functions: (1) the woodworking shop, including furniture repair, packing, and crating, excluding the packing and crating in Category Code series' 441 and 442); (2) the electrical shop, refrigeration and air conditioning shop; (3) plumbing and heating shop; (4) metal work shop, including machine shop, sheet metal, iron work, welding, and blacksmith facilities; (5) paint shop; (6) routine maintenance and service shops, including custodial, preventive maintenance, refuse collection, insect and rodent control, road maintenance facilities, moving and rigging, and emergency service shops; (7)

central tool issue, shop stores and shop toilets, and locker rooms, and (8) administrative spaces in direct support to shop operations, corridors, and necessary service space directly related to the shop. If other than the foregoing functions are required, space may be appropriately increased if justifications are documented.

219 20 PAVEMENT AND GROUNDS EQUIPMENT SHED (SF)

FAC: 4422
BFR Required: N

21920-1 The pavement and ground equipment shop will provide holding space and minor maintenance space for tractors, lawnmowers, snowplows, and other miscellaneous equipment used for roads and ground maintenance. This shop can be independent of the Public Works Maintenance Shop (Category Code 219 10) but is related for space allowances to the corresponding PW shop type. The gross square foot allowances on Table 21920-1 are provided for planning guidance only and are not additive to the Public Works shop allowances. See footnote to Table 21910-1.

Table 21920-1. Space Allowance - Pavement and Grounds Equipment Shop

Shop Type	Gross Area (SF)
A	525
B	700
C	850
D	1,100
E	1,800
F	2,200

219 25 PUBLIC WORKS SHOPS EXPENDABLE/WORK-IN-PROCESS STORE (SF)

FAC: 2191
BFR Required: N

21925-1 The public works shops expendable/work-in-process store holds the ready-issue items for public works daily maintenance, job order materials for the maintenance of station facilities and materials that are considered critical items for emergencies/service. It is independent of the General Supply Storage (Category Code 441 10). The shop can also be independent of the Public Works Shop (Category Code 219 10) but is related for space allowances to the corresponding PW shop type. See Table 21925-1. The gross square foot allowances on Table 21925-1 are provided for planning guidance only and are not additive to the Public Works shop allowances. See footnote to Table 21910-1.

Table 21925-1. Space Allowances - Public Works Shop Store

Shop Type	Gross Area (SF)
A	650
B	1,000
C	1,100
D	1,400
E	2,200
F	2,500

219 30 PAINTING AND RELATED OPERATIONS BUILDING (SF)
FAC: 2191
BFR Required: Y

21930-1 The function of the painting and related operations building is to provide space for painting and other operations which may not be functionally compatible or hazardous to the building or types of operation conducted in the public works shop, Category Code 219 10. This facility is considered as an integral part of Category Code 219 10 but may, in some instances, be a separate building if safety or functional requirements so dictate. However, in all cases, the area allocated for this facility must be considered as part of the area for the corresponding shop types listed in Table 21910-1 and must not be considered as an additional requirement.

219 31 PAINTING AND RELATED OPERATIONS STRUCTURE (EA)
FAC: 2192
BFR Required: N

21931-1 The painting and related operations structure is a facility used for painting and those operations which are not suitable to be carried on in Category Code 219 30, Painting and Related Operations Building. This code may include structures like a sandblast scaffold, paint spray booth, preservation dip tank, pickling tank, sandhopper, sandblasting facilities, open paint canopy, sand handling bin, etc. There are no specific planning criteria for these structures; each requirement must be individually justified.

219 40 SEWAGE HOSE STORAGE FACILITY (EA)
FAC: 2192
BFR Required: N

21940-1 This Category Code is for inventory purposes only.

219 77 PUBLIC WORKS MAINTENANCE STORAGE (READY ISSUE/SHOP STORES/MISC.) (SF)
FAC: 2191
BFR Required: Y

21977-1 This facility is a general warehouse for the storage of items and materials required for the maintenance of station buildings and grounds. It is independent of the ready-issue storage facilities required in direct support of the public works shops (use Category Code 219 25).
21977-2 Shed storage space is required to provide covered storage for certain items of equipment and supplies needed for base operation and maintenance, which do not require regular warehouse storage, yet must be protected from the weather. Table 21977-1 may be used to determine covered storage requirements for various sizes of public works facilities.

Table 21977-1. Public Works Storage Areas

Shop Type	Gross SF Area	
	Covered	Shed
A	3,400	2,300
B	3,400	2,300
C	3,400	2,300
D	6,000	4,000
E	12,500	8,300
F	19,200	12,800

NOTE: For Public Works Storage supporting PW shops larger than type F, add the following areas for each maintenance craftsman over 500: covered 40 SF; Shed - 25 SF

220 PRODUCTION

220-1 The production facility is part of the production system that processes raw materials, components and labor into finished goods.[1] Production facilities are typically “one-of-a-kind” therefore space requirements should be developed “from the ground up”; first for the individual workstations; then departmental requirements by summing the workstations within the department. Applying industrial engineering practices and methods would provide sufficient and accurate space requirements. Accurate future product demand forecasts are necessary so the facility can be sized for future growth. The facility should be sized for forecasted production growth 5 to 10 years beyond initial operating capability. [2]

This methodology applies for the following category codes:

221 10 AIRCRAFT ENGINE-ASSEMBLY PLANT (SF)
FAC: 2211
BFR Required: Y

221 20 AIRFRAME ASSEMBLY PLANT (SF)
FAC: 2211
BFR Required: Y

221 30 AIRCRAFT ACCESSORIES –ASSEMBLY PLANT (SF)
FAC: 2211
BFR Required: Y

222 10 MISSILE ASSEMBLY-PLANT (SF)
FAC: 2221
BFR Required: Y

222 20 MISSILE HANDLING LAUNCH EQUIPMENT (SF)
FAC: 2221
BFR Required: Y

223 10 FABRICATION & ASSEMBLY BUILDING (SF)
FAC: 2231
BFR Required: Y

223 30 SHIP-BUILDING DRYDOCKS (SF)
FAC: 2233
BFR Required: Y

224 10 COMBAT-VEHICLE ASSEMBLY PLANT (SF)
FAC: 2241
BFR Required: Y

224 20 AUTOMOTIVE-VEHICLE ASSEMBLY PLANT (SF)
FAC: 2241
BFR Required: Y

225 10 SMALL-ARMS PLANT (SF)
FAC: 2251
BFR Required: Y

225 20 LIGHT-GUN PLANT (SF)
FAC: 2251
BFR Required: Y

225 30 HEAVY-GUN PLANT (SF)
FAC: 2251
BFR Required: Y

225 40 HARBOR-PROTECTIVE-NET PLANT (SF)
FAC: 2251
BFR Required: Y

225 50 LAUNCHER & PROJECTOR PLANT (SF)
FAC: 2251
BFR Required: Y

225 60 ARMOR-PLATE PLANT (SF)
FAC: 2251
BFR Required: Y

226 10 BAG-CHARGE-FILLING PLANT (SF)
FAC: 2261
BFR Required: Y

226 15 CASE-FILLING PLANT (SF)
FAC: 2261
BFR Required: Y

226 20 CASE-OVERHAUL TANK-REPAIR FACILITY (SF)
FAC: 2261
BFR Required: Y

226 25 40MM-LOADING PLANT (SF)
FAC: 2261
BFR Required: Y

226 30 20MM-LOADING PLANT (SF)
FAC: 2261
BFR Required: Y

226 35 MAJOR-CALIBER PROJECTILE-LOADING PLANT (SF)
FAC: 2261
BFR Required: Y

226 40 MEDIUM-CALIBER PROJECTILE-LOADING PLANT (SF)
FAC: 2261
BFR Required: Y

226 45 LARGE-CALIBER ROCKET-MOTOR LOADING PLANT (SF)
FAC: 2261
BFR Required: Y

226 50 MEDIUM-CALIBER ROCKET-MOTOR-LOADING PLANT (SF)
FAC: 2261
BFR Required: Y

226 55 CAST-HIGH-EXPLOSIVES FILLING PLANT (SF)
FAC: 2261
BFR Required: Y

226 56 CAST-HIGH-EXPLOSIVES FILLING FACILITY (SF)
FAC: 2262
BFR Required: N

226 60 SPECIAL-WEAPONS PLANT (SF)
FAC: 2261
BFR Required: Y

226 65 PROPELLANT & RELATED-CHEMICAL PLANT (SF)
FAC: 2261
BFR Required: Y

226 66 PROPELLANT & RELATED-CHEMICAL FACILITY (SF)
FAC: 2262
BFR Required: N

226 70 READY-AMMUNITION BELTING PLANT (SF)
FAC: 2261
BFR Required: Y

226 75 UNDERWATER DEMOLITION EQUIPMENT PLANT (SF)
FAC: 2261
BFR Required: Y

226 80 AMMUNITION-LOADING PLANT (SF)
FAC: 2261
BFR Required: Y

226 81 DEMILITARIZATION BUILDING (SF)
FAC: 2264
BFR Required: Y

226 82 DEMILITARIZATION FACILITY (EA)
FAC: 2265
BFR Required: N

226 85 FUSE-ASSEMBLY PLANT (SF)
FAC: 2261
BFR Required: Y

226 86 MINE-ASSEMBLY PLANT (SF)
FAC: 2261
BFR Required: Y

226 88 PYROTECHNIC PRODUCTION FACILITY (SF)
FAC: 2261
BFR Required: Y

227 10 RADIO & RADAR EQUIPMENT PLANT (SF)
FAC: 2271
BFR Required: Y

227 20 SONAR EQUIPMENT PLANT (SF)
FAC: 2271
BFR Required: Y

227 30 GUIDANCE EQUIPMENT PLANT (SF)
FAC: 2271
BFR Required: Y

227 35 PRINTED-CIRCUIT SHOP (SF)
FAC: 2271
BFR Required: Y

228 10 PARACHUTE & SURVIVAL-EQUIPMENT PLANT (SF)
FAC: 2281
BFR Required: Y

228 20 CONSTRUCTION EQUIPMENT PLANT (SF)
FAC: 2281
BFR Required: Y

228 30 RAILROAD EQUIPMENT PLANT (SF)
FAC: 2281
BFR Required: Y

228 35 OPTHALMIC-SUPPORT BUILDING (SF)
FAC: 5302
BFR Required: Y

229 10 ASPHALT PLANT (EA)
FAC: 2291
BFR Required: Y

229 20 CONCRETE-BATCHING PLANT (EA)
FAC: 2291
BFR Required: Y

229 30 ROCK-CRUSHER PLANT (EA)
FAC: 2291
BFR Required: Y

229 35 POWDER-TANK/FLAKE-TANK STORAGE (BL)
FAC: 8999
BFR Required: N

229 50 PRINTING PLANT (SF)
FAC: 6103
BFR Required: Y

229 77 MAINTENANCE-PRODUCTION STORAGE-READY ISSUE ETC. (SF)
FAC: 2281
BFR Required: Y

229 80 CONTAINER ASSEMBLY BUILDING (SF)
FAC: 2281
BFR Required: Y