

## 440 GENERAL SUPPLY BUILDING

This category group consists of the various category codes indicated below which are supply-oriented covered storage and/or storage support facilities, that are assigned to the Supply/Material Department or assigned for storage of operational mount-out stocks.

Category Code	441 10	General Purpose Warehouse
	441 11	General Purpose Warehouse (Marine Corps Installations)
	441 12	Marine Corps Storage/Out-of-Stores/Mount-Out
	441 13	Specific Purpose Warehouse, Marine Corps Logistics Support Base
	441 14	Specific Purpose Warehouse, Marine Corps SASSY Management Unit
	441 20	Controlled Humidity Warehouse
	441 30	Hazardous and Flammables Storehouse
	441 35	General Storage Shed
	441 40	Underground Storage
	441 71	Integrated Logistics Overhaul (ILO) and Outfitting Building
	441 72	SERVMART
	441 73	MTIS Building

Excluded from this category group are the following:

<u>Type Facility</u>	<u>Applicable Code(s)</u>
1. Ammunition and inert ammunition components under the cognizance of the Ordinance Officer	4 2 0
2. Weapon-related storage batteries requiring a storage temperature of less than -10°F	424 10
3. Perishable subsistence, dental, medical, photosensitive and battery supplies requiring storage temperatures of -10°F to 60°F	4 3 0
4. Air, water, and land Cargo Terminal Storage (for throughput operations)	141-12, 153-20 and 141-79
5. Shop stores, ready issue stores, storage for other retail functions and miscellaneous storage <u>not physically located in a Supply/Material Department facility</u> will be categorized under the basic category of the facility and appended with the Navy Code "77" except as otherwise indicated in codes as follows:	
(a) Operation Storage (Ready Issue/Shop Stores/Misc.)	143 77
(b) Aircraft Shops Stores (Expendable Work in process stores)	211 96
(c) Miscellaneous Storage (Ready Issue)	213 77
(d) Pavement and Grounds Equipment Shed	219 20

(e)	Public Works Shop (Expendable/Work in process stores)	219 25
(f)	Public Works Maintenance Storage	219 77
(g)	Maintenance/Production Storage (Ready Issue/Shop Stores/Misc.)	229 77
(h)	RDT&E Storage (Ready Issue/Shop Stores/Misc)	319 15
(i)	Hospital/Medical Storage (Ready Issue/Shop Stores/Misc.)	510 77
(j)	Admin Storage (Ready Issue/Shop Stores/Misc.)	610 77
(f)	Underground Admin Storage (Ready Issue/Shop Stores/Misc.)	620 77
(l)	Troop Housing Storage (Ready Issue/Shop Stores/Misc.)	723 77
(m)	Personnel Support Storage (Ready Issue/Shop Stores/Misc.)	730 77
(n)	Commissary (Including Back-up Storage)	740 23
(o)	Community Storage (Ready Issue/Shop Stores/Misc.)	740 77
(p)	Exchange Central Warehouse (For Code 740 01 and 740 86)	740 85
(q)	Exchange Installation Warehouse	740 86
(r)	Storage for Utility Systems (Ready Issue/Shop Stores/Misc.)	890 77

6. Navy code "77" does not apply to Marine Corps Activities.

# **INTRODUCTION TO SUPPLY CRITERIA**

## **STORAGE AND WAREHOUSE PLANNING GUIDELINES**

The criteria and planning factors necessary for determining storage space requirements for general supply storage facilities in Category Groups 430, 440 and 450 are contained in the following four sections:

### **SECTION 440A: "PLANNING TERMS, SUPPLY FACILITY MANAGEMENT REPORT (SPMR) AND CONVERSION FACTORS"**

This section contains the abbreviations used in the supply criteria, an update of definitions of terms, sample SFMR, the derivation of the Universal Factor for Cube losses in bin, rack and bulk storage areas, discussion of cube relationships, a list of density conversion factors and the MSC commodity conversion factors as used in the supply criteria.

### **SECTION 440B: "GUIDELINES FOR DETERMINING STORAGE SPACE REQUIREMENTS"**

This section contains the procedural guidance for requirements planning for storage activities reporting on the Supply Facility Management Report (SFMR).

### **SECTION 440C: GUIDELINES FOR PLANNING AND SIZING WAREHOUSE CONSTRUCTION AND MODERNIZATION PROJECTS**

This section contains general planning guidance, warehouse characteristics, project planning criteria, warehouse sizing procedures and sample problems, Equivalency Statement, and additional planning guidance.

### **SECTION 440D: STORAGE SPACE ALLOWANCES FOR PRE-POSITIONED WAR RESERVE MATERIAL STOCK (PWRMS)**

This section contains the planning factors used in determining the storage space requirements for PWRMS vehicles.

# STORAGE AND WAREHOUSE PLANNING GUIDELINES

## SECTION 440A

PLANNING TERMS, SUPPLY FACILITY MANAGEMENT REPORT AND CONVERSION FACTORS

The technical planning information provided in this section is as follows:

- PART A. ABBREVIATIONS
- PART B. DEFINITIONS OF TERMS
- PART C. SAMPLE SUPPLY FACILITY MANAGEMENT REPORT (SFMR)
- PART D. DERIVATION OF UNIVERSAL FACTOR FOR CUBE LOSSES IN BIN, RACK AND BULK STORAGE AREAS
- PART E. DISCUSSION OF CUBE RELATIONSHIPS
- PART F. DENSITY CONVERSION FACTORS
- PART G. MSC COMMODITY CATEGORY CONVERSION FACTORS
- PART H. WEIGHTS AND MEASURES

### **PART A. ABBREVIATIONS:**

The following abbreviations are used throughout the 400 series and are supplied as a matter of convenience for quick reference and familiarization:

- SF = Gross Square Feet - (external)
  
- gsf = Gross Square Feet - (internal)
  
- W = Wall Thickness of Outside Perimeter Walls  
(External Structural Loss)
  
- NS = Net Square Feet - Areas Available for Storage of Material
  
- S = Support Facilities
  
- SA = Storage Areas
  
- L = Internal Structural Loss in Storage Areas
  
- A = Aisles in Storage Areas
  
- SH = Average Clear Stacking Height
  
- nsh = Average Net Stacking Height
  
- TCF = Total Cubic Feet
  
- ACF = Attainable Cubic Feet
  
- SFMR = Supply Facility Management Report

## **PART B. DEFINITIONS OF TERMS:**

The definitions of terms given below are used in determining the storage requirements for General Supply Facilities. Note that each definition below is followed by the applicable abbreviation symbol used by the Supply Facility Management Report (SFMR) line number on which data pertaining to the defined term is reported/printed.

### 1. Gross Square Feet (SF) (external)

a. External gross square feet is determined by using the outside dimensions of a storage facility in order to arrive at the gross area. That is, outside length times outside width equals total gross area. Loading platforms and ramps are excluded. This area can also be expressed as the sum of the Storage Areas (SA) plus the Support Facilities (S) plus the outside wall thickness (W). W is zero for open storage. For additional clarification see definition of "Area" in NAVFAC P-78, page 304.

b. SFMR - line 2a - SF.

### 2. Gross Square Feet (gsf) (internal)

a. Internal gross square feet is determined by using the outside dimensions of a storage facility minus the outside wall thickness (W) in order to arrive at the internal gross area. That is, internal length of the facility times internal width of the facility equals the internal gross area expressed as gross square feet (gsf). See "Gross Square Feet (SF)".

b. SFMR - line 7, gsf. This normally represents the total of all storage areas (SA) plus support (S) facilities and is identified as "Gross Space for Supply Operations" on line 7 of the SFMR. If there are any additional gsf ingranted, outgranted, unusable or in standby at an existing activity, such gsf amounts are reported on lines 3 through 6 of the SFMR. If there are no entries on lines 3 through 6, then lines 2 and 7 of the SFMR are equal.

### 3. Wall Thickness of Outside Walls (W)

a. This is the area represented by the thickness of the outside walls. It is zero for open storage areas. It is the difference between the external gross square feet (SF) and the internal gross square feet (gsf) and is considered an external structural loss.

b. SFMR - line 2b, W. This line gives the ratio of the outside dimensions (SF) to the inside dimensions (gsf). The difference between the two equals W. That is, line 2a divided by line 2 equals line 2b.

### 4. Net Square Feet (NS)

This is the sum of actual floor areas on which storage racks and/or bins are erected and on which bulk material is or can be stored.

b. SFMR - line 9 - NS

## 5. Support Facilities (S)

d. These facilities include all space used for preservation, packaging, assembly, packing, crating, container manufacturing, receiving, inspection, identification; shipping and supervisory/clerical offices located in warehouses or other facilities used for supply storage operations. General administrative offices, which are carried under Category Code 610 10 are not included. Also included are employee rest areas, rest rooms, locker rooms, training rooms, time clock areas, mechanical equipment rooms in refrigerated and controlled humidity warehouses; battery charging operations located in warehouses, and similar support functions. Support space also includes elevator shafts, stairwells, ramps and civil engineering (Public Works) functions that are in support of supply operations and are located in warehouses or other facilities used for supply storage operations. Aisles and internal structural loss that are contiguous to or within these support areas are classified as a part of such areas.

Support functions require traditional low rise facilities with clear heights normally ranging between 8 and 12 feet. Higher heights may be practical in shipping and receiving areas if racks are used for temporary holding of incoming material awaiting identification/processing and of outgoing material being staged by customer/destination/carrier.

b. SFMR - line 7d. -S. No data entered. ADP applies. The ADP generated data will reflect the gsf used for functions that support the supply storage operations.

## 6. Storage Areas (SA)

a. This is the total floor area that is dedicated for storage. It includes net storage areas expressed as net square feet (NS) plus contiguous main/cross/storage/personnel aisles plus any internal structural loss (L) within the perimeter of storage areas.

Many modern, state-of-the-art SA facilities are being constructed as single story structures to heights of between 18 and 90 feet within which high-rise bins and racks are erected and serviced by narrow aisle rail or electronic wire guided material handling equipment. Pallet rack and bin shelf modular layout drawings in NAVSUP PUB 529, "Warehouse Modernization and Layout Planning Guide" illustrate SA layouts and furnish data pertaining to square feet per SA module and square foot ratios of SA to NS.

b. SFMR - line 7c - SA

## 7. Internal Structural Loss in Storage Area (L)

a. This is the amount of space not usable as floor area within Storage Areas (SA) because of construction features or physical characteristics. It includes such items as building columns, fire walls, switch panels, sprinkler lines, and door clearances.

b. SFMR - line 7b -(L)

8. Aisles in Storage Areas (A)

a. This is the area dedicated to aisles in Storage Areas (SA). It includes main aisles, cross aisles/storage aisles and personnel aisles contiguous to the Net Square Feet (NS) area within the SA. All other aisles are considered to be a portion of the support facilities (S) space.

b. SFMR - line 7a - A

9. Average Clear Stacking Height (SH)

d. This is the planned or existing average height in feet within Net Square Feet (NS) areas available for stacking material while maintaining vertical safety clearances. This SH is defined as the distance between the floor and lowermost of either sprinkler heads, joists, rafters, beams or roof trusses, lighting fixtures or ductwork from which the following safety clearances as prescribed by DoD 4145.19 R-1, must be deducted:

1. One and one half feet when material heights do not exceed 15 feet.

2. Three feet when when material heights exceed 15 feet.

3. Three feet when hazardous materials are involved or in storage areas not equipped with sprinklers.

4. Exceptions: A clearance of only 14 inches is required for reclaimed drum storage regardless of stacking height, provided that the building is of all metal construction and contains no electric wiring. Also, under operating overhead craneways, allow a vertical safety clearance of 3 feet under the lowermost point of the load(s) representing the maximum vertical load dimension.

Note that the SH, as defined above, is an indicator of only the theoretical capacity of a facility. It does not allow for limitations which may be imposed by existing storage aids, material handling equipment or floor load limitations. Actual storage capacity indicator is designated as nsh (see Definition 10). If major problems are encountered in the planning or evaluation process, consult NAVSUPSYSCOM, Navy Warehouse Utilization Program Manager, or CMC for guidance.

The value for average clear stacking height is determined as follows: For Existing Activities the SH value for the entire activity is determined by calculating the total volume of available storage (multiply NS x SH for each warehouse segment and add results together to determine TCF for the activity) and dividing the result by the total NS for the entire activity.

Example - Assuming an activity has:

One warehouse - 4,000 NS, 10 feet stacking height

One warehouse - 8,000 NS, 20 feet stacking height

Then the SH for the activity will be:

$$\frac{14,000 \times 10 + (8,000 \times 20)}{(4,000 + 8,000)} = 16.6 \text{ feet SH}$$

Existing values for SH by types of space are computed/printed semiannually on line 10d of the Supply Facility Management Report in consonance with NAVSUPINST 4450.22. Activity SFMR's are available at reporting activities and are also distributed by NAVSUP to cognizant activity subclaimants (Supply Officer) and NAVFAC Engineering Field Divisions (Code 201). Such existing value for SH shall be used on the Basic Facility Requirement (BFR). SH values for individual buildings comprising each composite average will be indicated in the Real Property Inventory (RPI). This is to ensure compatibility of units of measure when comparing requirements with available assets. When planning new construction or an acquisition by other means, a different stacking height may be used in accordance with the following formula:

$$NS \times SH = NS' \times SH' = TCF \text{ (total cubic feet) } = \text{a constant}$$

In this formula, NS and SH represent BFR approved values and NS' and SH' (read as NS prime and SH prime) represent any other values that may be used in new construction planning or in planning for acquisition by any other means. See Section 440C for detailed guidance. For assistance in appraising and justifying SH values, consult NAVSUPSYSCOM, Navy Warehouse Utilization Program Manager, or CMC as appropriate. SH is understood to be nsh for Special Supply Operations Facilities and Open Storage Facilities. See note at end.

b. SFMR - line 10d - SH

10. Average Net Stacking Height (nsh)

a. This is the average height to which material can actually be stored. It is a function of the Average Clear Stacking Height (SH) and is modified to reflect limitations such as type of operation, existing storage aids, materials handling equipment, crushability and stackability of material and/or floor load capacity. SH is understood to be nsh for Special Supply Operations Facilities and Open Storage Facilities. See note at end.

b. SFMR - line 11d - nsh

11. Total Cubic Feet (TCF)

This is the volume obtained by multiplying the Net Square Feet (NS) times Average Clear Stacking Height (SH). It represents the theoretical cube storage capacity of the NS floor area since the SH factor does not consider the limitations of materials handling equipment, floor loads, storage aids and the crushability and stackability limitations of material. TCF is understood to be ACF for Special Supply Operations Facilities and Open Storage Facilities. See note at end.

b. SFMR - line 10 - TCF

12. Attainable Cubic Feet (ACF)

This is the volume obtained by multiplying the Net Square Feet (NS) times the Average Net Stacking Height (nsh). It is the actual usable volume of space that can be used for storage since it takes into account the limitations/requirements described for nsh. TCF is understood to be ACF for Special Supply Operations Facilities and Open Storage Facilities. See note at end.

b. SFMR - line 11, ACF

13. Supply Facility Management Report (SFMR). The purpose and use of the SFMR is:

a. Reporting gross, net, occupied and vacant storage space by type of storage facility, to the activity's claimant/subclaimant, the Secretary of the Navy, Secretary of Defense, Office of Management and Budget, the President and Congress.

b. Exchanging compatible storage space data among DoD components to foster optimum use of DoD owned space.

c. Immediate use in conducting Navy and DoD wide and federal government wide storage space management/distribution studies.

d. Evaluating major storage space, military construction or modernization projects.

8. Identifying future peacetime and contingency storage requirements.

f. Evaluating the extent to which storage space policies are being implemented.

g. Determining TCF analyses for facility management.

h. Computation for support of BFR documentation.

14. Installation Military Strength is basically defined as the entire complement of officers and enlisted personnel permanently assigned to an installation. If other military units are operating as tenants of the installation, their count may be included only if the host installation has the mission to provide supply storage support and if tenants' supply support requirements are included on the host BFR. The basic military strength may be modified if civilians, students, transient, or other personnel are authorized to receive supply storage support. (See note under Table 440-3 for Naval Air Reservists).

\*NOTE: SERVMART, MTIS, ILO and Outfitting Facilities are "Special Supply Operations Facilities" (CCN 441-70 Series) that normally require material to be in reach of users/operators at floor level. Therefore, facility capacity in terms of SH and TCF is not a performance indicator and nsh and ACF are applicable for requirements planning. In Open Storage Facilities (CCN 451-10), there is no building structure involved with SH and TCF parameters. Therefore, with Special Supply Operations Facilities and Open Storage Facilities, SH is equated to nsh and TCF is equated to ACF for requirements planning purposes.

### **PART C. SAMPLE SUPPLY FACILITY MANAGEMENT REPORT (SFMR)**

The following pages 440A 8 through 440A-12, provide a reduced photocopy of the SFMR.

### SUPPLY FACILITY MANAGEMENT REPORT

(1) FY (2) QTR (3) UIC (4) SUFFIX (5) TENANT SITE CODE (6) NAME OF INSTALLATION (7) CITY STATE COUNTRY CODE (8) COMPLEX CODE (9) COMPONENT CODE (10) NAVAL DIST (11) MAJOR CLAIMANT (12) SUB CLAIMANT (13) ACTY TYPE (14) EFD (15) GEO LOCATION CODE

Item (Unit of Measure is in Thousands except for Data on Lines preceded by an asterisk (*)): See General Note A	Total Covered  (Cols C thru L)	Covered Supply Facilities (Groups 420, 430 & 440)										Open Supply Facilities (425 & 451)	
		Covered General Supply Facilities (430 & 440)								Covered Ammunition Supply Facilities (Group 420)		Improved	Unimproved
		Gen Purpose (C & D)		Control Humidity 441:20	Flam Hazardous 441:30	Refrigerated (G & H)		Shed 441:35	Special Supply OPs 441:70s	Magazine 421 and 423	Inert 421		
		Heated 441:10	Unheated 441:10			Chill 431:10	Freeze 431:10						
A	B	C	D	E	F	G	H	I	J	K	L	M	N

**SECTION A - Gross Storage Space - Square Feet** (gcf - inside Dimensions, SF - Outside Dimensions)

1. Total gcf on Line 2 of Prior 30 June Report														
2. Total host-owned gcf This Report (2a minus ext. wall thickness)														
a. SF from Real Property Inventory (RPI)														
b. Ratio of SF to gcf (2a:2)														
3. Unusable gcf														
4. Recoupable gcf in Standby														
5. Total Outgranted gcf (5a+5b) 1/														
a. To Non-DOD Users														
b. To DOD Users														
c. Portion of 5b to Other Navy Users														
6. Ingranted DOD and Other gcf Used (not Reported on Line 2 or RPI) 1/														
a. Portion of 6 Ingranted from Other DOD Activities 1/														
b. Portion of 6a Ingranted from Other Navy Activities														
7. Total gcf Used for Supply Ops (2+6 minus 3, 4, and 5; also 7c+7d)														
a. gcf of Aisles in Storage Areas (SA)														
b. gcf of Structural Loss in SA														
c. Total gcf in SA (7a+7b+9)														
d. Total gcf in Support (S) Facilities (7 minus 7c)														
*e. Ratio of SA to NS (7c:9)														
*f. Ratio of S to NS (7d:9)														
*g. Ratio of S to TCF (7d:10)														
h. Portion of 7 Used for Non-Stock Accommodation Storage (Detail in Format A)														
8. Structural Loss, Aisles & Support (S) Facilities (7 minus 8; also 7a+7b+7d)														

1/ NOTE: Detail in Remarks





Item (Unit of Measure is in Thousands except for Data on Lines preceded by an asterisk (*)): See General Note A  A	General Purpose  441-10 C & D	Controlled Humidity  441-20 E	Flammable Hazardous  441-30 F	Refrigerated  431-10 G & H	Shed  441-35 I	Special Supply OPs  141-70s J 3/	Open Improved  451-10 M	Column J "Break-out"		
								Outfitting and ILO  441-71 J - O	SERVMART  441-72 J - S	MTIS  441-73 J - M

**SECTION D - Computations in Support of Basic Facility Requirements (BFR) Documentation - See NAVFAC P-80**

18. Projected FYDP M/Ts of Mat'l to be Stored and TCF Allowed a. Projected Requirements Decimal Multiplier (e.g., 1.0=no change, and will be assumed by ADP if data not entered, 1.25=25% increase, .90=10% decrease) 4/																				
b. Empirical Value of M/Ts of Material to be Stored (18a X 13f)																				
c. Projected Value of M/Ts of Material to be Stored 4/																				
d. Empirical Value of TCF Allowed in Bin, Rack & Bulk Areas (7B.4 TCF per M/T X 18c or 18b if 18c is blank)																				
e. Proposed/Approved BFR Value of TCF Allowed (Based on above or Personnel/Aircraft Tables) 4/																				
19. Allowable SH and nsh Values a. Values for Existing Facilities (nsh from 11d for J and M, SH from 10d for other Columns)																				
b. Values for Req'd non-existing facilities not on 19a (Enter Values of 4 to 10 for nsh and 10 for SH, see NAVFAC P 80)																				
20. Projected NS Allowed a. Empirical Value (18e/ 19a/b or 18d/ 19a/b if 18e is blank)																				
b. Proposed/Approved BFR Value 4/																				
21. Projected SF per NS Multiplier a. Empirical Value Based on Reporting Activity Data (9d X 2b)																				
b. Empirical Value Based on Activity Group Average (NAVSUP Input)																				
c. Proposed/Approved BFR Value (Normally 21a unless otherwise specified) 4/																				
22. Projected SF Allowed a. Empirical Value (20b X 21c or 20a X 21c if 20b is blank)																				
b. Proposed/Approved BFR Value 4/																				
*23. Date(s) of Approved BFR (Leave Blank if above BFR data are proposed) 5/																				

3/ NOTE: Column J reflects totals for all 441-70 series codes. Develop "break-outs" by Category Code in columns to right that reconcile with totals in Column J.  
 4/ NOTE: Maintain approved BFR Values within 10% of empirical values. Include Column N with Column M BFR data by "transposing" M/T requirements via Line 18a or 18c; similar transpositions apply to other columns to reflect actual requirements vice current availability by type of space.  
 5/ NOTE: Insert month/year of BFR approval in each column; (e.g., "0484" = April 1984) Leave blank in any column reflecting proposed/not approved BFR data.

Continued

Item (Unit of Measure is in Thousands except for Data on Lines preceded by an asterisk (*): See General Note A  A	General Purpose  441-10 C & D	Controlled Humidity  441-20 E	Flammable Hazardous  441-30 F	Refrigerated  431-10 G & H	Shed  441-35 I	Special Supply OPs  141-70a J & J	Open Improved  451-10 M	Column J "Break out"		
								Outfitting and ILO  441-71 J - O	SERVMART  441-72 J - S	MTIS  441-73 J - M

**SECTION E - TCF Analysis (For Facilities Management/Acquisition Justification)**

24. Current apparent TCF Excess (+) or Deficit (-) (11 minus 18a (or 18d if 18a is blank) in Col. J and M; 10 minus 19a (or 19d if 19a is blank) in all other columns)											
a. Additional ACF Reasonably Obtainable (for Line 11) With Rererohousing/New Equipment (Within Line 10) &/											
25. TCF Requiring Replacement or Major Modification (25a+25b)											
a. TCF Functionally Substandard											
b. TCF Structurally Substandard											
26. Additional TCF Obtainable (26a+b+c+d+e)											
a. Recoupable from Standby (Line 4)											
b. Recoupable from Outgrants (Lines 5a & 5b)											
c. Recoupable by Reducing SA Aisle Widths and/or Support (S) Facilities (Lines 7a & 7d)											
d. Obtainable from Reassigned Facilities											
e. Programmed for Construction/Major Modification (Explain in Remarks)											
27. Projected FYDP TCF Excess (+) or Deficit (-) (24 minus 25 + 26)											
28. Additional Non-Programmed/Anticipated TCF Requirements (Explain in Remarks)											

g/ NOTE: If TCF values on Line 24 appear to overstate excesses or understate deficits on the basis of actual NS utilized, it is probable that the cube loss "differential" between TCF on Line 10 and ACF on Line 11 exceeds standard allowances; analysis of Lines 12g and 13h applies. This can be corrected by increasing nh values reflected on Line 11d by rererohousing and/or acquisition of new equipment to increase material stacking heights and ACF values on Line 11.

**REMARKS**

Provide detail for Lines 5, 6, 16, 17, 25a and 28, as applicable, (See Note 2/), explain differences between Lines 1 and 2 of 5,000 or more sq. ft. in Column B and 20,000 or more sq ft in Column M; cite NAVSUP/OASD approvals of diversions of covered space exceeding 10,000/40,000 sq ft, respectively, during one FY; also, provide remarks on Ammunition Supply Facilities required by NAVSUPINST 4480.22A.

**GENERAL NOTES:**

- A. Insert all "Raw" input data into unshaded blocks as appropriate. Then, enter computed values in shaded blocks using formulas printed on each shaded line to verify accuracy and intent of input data. All input data will be in thousands (000s), except those lines preceded by an asterisk (\*) will be in units. See transmittal sheet formats for location of decimal points.
- B. Use verified input data in unshaded blocks for preparation of transmittal sheets for keypunching.
- C. Shaded blocks on this Worksheet will contain computer generated data on ADP printouts. Therefore, Transmittal Sheets must not include any Worksheet data in shaded blocks.
- D. Cross-hatched blocks are to be left blank.

**CERTIFICATION**

I certify this report, annotated as necessary, is correct for time period ending \_\_\_\_\_

Signature: \_\_\_\_\_

Title/Code: \_\_\_\_\_

FOC: Name: \_\_\_\_\_

Code: \_\_\_\_\_

Phone: Autovon \_\_\_\_\_

Commercial \_\_\_\_\_

## **PART D. DERIVATION OF "UNIVERSAL FACTOR" FOR CUBE LOSSES IN BIN, RACK AND BULK STORAGE AREAS**

The information furnished below provides the methodology used in the derivation of basic cube formulas for bulk, bin and pallet rack storage areas. This is followed by a table of data that is used in developing the formula on Line 13d of the SFMR that results in ADP computation/ printout of Measurement Tons (M/Ts) of material in store on Line 13f of the SFMR. This information indicates how different types of space losses and actual available storage space are determined and accounted for.

The primary result is the derivation of a "Universal Factor" for determining TCF requirements that is equally applicable to bin, rack and bulk storage areas. It is thus possible to determine TCF facility requirements to accommodate amounts of material to be stored without regard to storage and handling equipment considerations.

This Universal Factor is stated as:

"1.96 TCF are allowed per cubic foot of material to be stored", or multiplying both numbers in this ratio by 40 cubic feet (per M/T) gives:

"78.4 TCF are allowed per M/T of material to be stored".

### DERIVATION OF BASIC CUBE PLANNING FORMULA FOR BULK STORAGE AREAS

#### GIVEN:

NS = Net Square Feet for Storage of bulk materials (excludes aisles and structural loss)

SH = Average Clear Stacking Height of facility in feet - measured to a point 18 or 36 inches below sprinklers, OH cranes and other obstructions

TCF = Total Cubic Feet = NS X SH

nsh = Net Average Stacking Height - Measured to potential height of material stacks - is height attainable with existing MHE and floor load limitations

ACF = Attainable Cubic Feet = NS X nsh

#### ALLOWANCES:

1. A 19% cube loss allowance around material stacks in "utilized" NS areas. (.81 is the average ratio of occupied NS to "utilized" NS)
2. A 15% NS vacancy allowance for "Operational Flexibility" (.85 is the allowable ratio of "utilized" NS to total NS)

3. A 25% SH vacancy allowance above bulk stacks of material for surges, expansion, material crushability/stackability, and floor load/MHE limitations\* (.75 is the ratio of planned material stack heights to total SH)

COMPUTATIONS:

1. Planned ratio of occupied NS to total NS =  $.81 \times .85 = .688$  NS
2. Planned ratio of occupied SH to total SH = .75 SH
3. Since  $TCP = NS \times SH$ , the planned ratio of occupied TCP to total  
 $TCF = NS \times .75 SH = .688 NS \times .75 SH = .516$  TCP (use .51 TCP)

Therefore for planning purposes: TCF Allowed = cu. ft. of material to be stored : .51, or,

$$\begin{aligned} TCP \text{ ALLOWED} &= 1.96 \times CU. FT. OF MATERIAL TO BE STORED \\ &= 78.4 \times M/Ts OF MATERIAL TO BE STORED^{**} \end{aligned}$$

Notes:

- \*MY "cube loss" or difference between TCF and ACF in bin and rack storage areas must be charged against this 25% SH vacancy allowance,
- \*\*One M/T = 40 Cu. Ft.

DERIVATION OF BASIC CUBE PLANNING FORMULA  
FOR  
BIN AND PALLET RACK STORAGE AREAS

GIVEN:

- NS = Net Square Feet on which bins and racks are erected (excludes aisles and structural loss)
- SH = Average Clear Stacking Height of facility in feet - measured to a point 18 or 36 inches below sprinklers, OH cranes and other obstructions
- TCF = Total Cubic Feet =  $NS \times SH$
- nsh = Net Average Stacking Height - is height to tops of bins or material in racks
- ACF = Attainable Cubic Feet =  $NS \times nsh$

ALLOWANCES:

1.  $TCF = ACF$  (no cube loss above bins or racks)\*
2. Structural loss within bins and racks = 25% of TCF
3. Cube available for stock occupancy = 75% of TCF
4. Maximum stock level = 100% of cube available

5. Low average stock level = 35% of cube available

COMPUTATIONS:

$$\text{Expected Avg. cube occupancy} = \frac{100\% + 35\%}{2} \times .75 \text{ TCF} = .51 \text{ TCF}$$

Therefore, for planning purposes: TCF Allowed = Cu. Ft. of Material to be Stored - .51, or,

$$\begin{aligned} \text{TCF ALLOWED} &= 1.96 \times \text{CU. FT. OF MATERIAL TO BE STORED} \\ &= 78.4 \times \text{M/Ts OF MATERIAL TO BE STORED}^{**} \end{aligned}$$

Notes:

\*Any "cube loss" or difference between TCF and ACF in bin and rack storage areas must be charged against the 25% SH vacancy allowance in bulk storage areas.

\*\*One M/T = 40 Cu. Ft.

TABLE 13d

TABLE OF MULTIPLIERS FOR LINE 13d OF  
NAVY SUPPLY FACILITY MANAGEMENT REPORT

PERCENTAGES OF ACF UTILIZED		
Bin Plus Rack Areas (Lines 13a + 13b)	Bulk Areas (Line 13c)	Decimal Multiplier (Line 13d)
0%	100%	.81*
10	90	.78
20	80	.75
30	70	.72
40	60	.69
50	50	.66
60	40	.63
70	30	.60
80	20	.57
90	10	.54
100	0	.51**

\*In bulk storage areas, .81 is the average ratio of occupied NS to utilized NS (Page 440A-13, Allowances). The same value is assumed applicable as the ratio of occupied ACF to utilized ACF on the basis that any potentially vacant/honeycombed cube loss is accounted for by the decimal multiplier on Line 13e.

\*\*In bin and rack storage areas, .51 is the average ratio of occupied ACF to utilized ACF (Page 440A-15, Computations).

#### FORMULA FOR DECIMAL MULTIPLIER

Data in the above table can be stated mathematically as follows:

Decimal Multiplier = .30 x ACF Utilized in Bulk Areas - Total ACF Utilized in Bin, Rack and Bulk Areas + .51; or,

Decimal Multiplier = .30 x (Line 13c - Line 13) + .51

### **PART E. DISCUSSION OF CUBE RELATIONSHIPS**

1. Material Cube and the Measurement Ton. The cube of material may be expressed in terms of several units of measure. However, cubic feet and Measurement Tons are the most commonly used in the Navy. A Measurement Ton (M/T) is a volumetric unit of measure defined as 40 cubic feet. A M/T of material can be configured in any shape. It can be visualized, for example, as 40 cubes of material measuring one cubic foot each. The cube of material in bin, rack and bulk storage areas is normally quantified in terms of cubic feet of material or M/Ts of material. The M/T is the preferred unit of measure in the Navy since it is the standard unit of measure used for shipboard cargo.

The following information may prove useful in estimating M/Ts of material in storage when no other data are available. A M/T of material is the appropriate average cube of pallet load of Navy shipment cargo on a standard Navy/DoD 40" x 48" pallet with a load height averaging 36", including pallet. The cube of an average Navy pallet load in storage is typically 0.8 M/Ts or 40" x 48" with a load height averaging 30", including pallet. The maximum pallet load height specified by Military Standard 147 is 54", including pallet. A pallet load measuring 40" x 48" x 54" high, including pallet equals 60 cubic feet or 1.5 M/Ts of material. The maximum cargo load size specified by Military Standard 147 on a 40" x 48" pallet (with material overhanging on pallet) is 43" x 52" x 54" high, including pallet. A load measuring 43" x 52" x 30.9" high, including pallet, equals 40 cubic feet or one M/T.

2. Total Cubic Feet and The Universal Factor. Part D of section 440A furnishes the derivation of the "Universal Factor" which provides for the determination of Total Cubic Feet required based on the cubic feet or M/Ts of the material to be stored. The Universal Factor allows 1.96 cubic feet of space for every cubic foot of material that is to be stored, i.e., a ratio factor of 1.96 to 1 applies. This can also be stated as a ratio factor of 78.4 to 40 if both the "1.96" and the "1" are multiplied by 40. The "Universal Factor" can thus be stated in either one of two ways, i.e., "1.96 TCF are allowed per M/T of material to be stored" or "78.4 TCF are allowed per M/T of material to be stored." The term "Universal Factor" is used because it

applies equally to bin, rack and bulk storage areas. That is, it applies to all TCF in SA Facilities. This is an extremely convenient factor for determining storage space requirements since it means that TCF can be determined, on the basis of M/Ts or cubic feet of material to be stored, without regard to whether bin, rack or bulk facilities are or will be used to satisfy the requirement. Thus, the function of determining the BFR for TCF can be completely separated from the function of facility layout, equipment selection, comparative cost analysis and integrated systems development. This latter function is covered in Section 440C, "Guidelines for Planning and Sizing Warehouse Construction and Modernization Projects".

3. Pallet Load Cube and Rack Cube Requirements. Standard Navy/DoD pallet racks are illustrated in detail in Section 6 of NAVSUP Pub 529, "Warehouse Modernization and Layout Planning Guide." They are also P-80 illustrated in modular elevation and layout drawings for pallet handling/storage systems in Section 21 of the Pub 529. It will be noted that one "standard" Navy/DoD double-opening pallet rack shelf is 40" deep by 108" wide. A "stack" of multiple level shelves is supported at each end by a 40" deep x 3" wide rack upright. The floor area or Net Square Feet (NS) occupied by one "stack" of such double-opening shelves in a "line" of multiple level shelves is 30.84 NS (40" x 111" divided by 144 square inches per square foot). Thus, the NS occupied by one "stack" of single pallet loads in racks is 15.42 NS. DoD Regulation 4145.19-R-1 stipulates that the average vertical shelf spacing of Navy/DOD pallet racks is about 4 feet. Adding an allowance of about 1 1/2 percent for sprinklers in racks gives an average SH value per shelf level of 4' x 1.015 or 4.06 SH. Thus, the average TCF utilized per pallet opening or "slot" equals 4.06 SH x 15.42 NS equals about 62.6 TCF per pallet slot. Paragraph 1 above states that the average pallet load in storage equals 0.8 M/Ts. Thus, the TCF required for the average pallet load in storage equals 78.4 TCF (Universal Factor) x 0.8 or about 62.6 TCF required.

Summarizing the foregoing paragraph gives the following: 62.6 TCF are AVAILABLE per average Navy/DoD pallet rack slot with 4' vertical shelf spacing or, 62.6 TCF are required per average Navy storage pallet load with 0.8 M/Ts.

On a direct proportion basis, these data can be expanded as follows for estimating M/Ts of material in pallet rack storage when no other data are available:

Pallet Rack Vertical Shelf Spacing	Average M/Ts per Pallet Load of Material In Store
3 feet	0.6 M/Ts
4 feet	0.8 M/Ts
5 feet	1.0 M/Ts
6 feet	1.2 M/Ts

NOTE: For activities reporting on the SFMR, M/Ts of material in store in bin, rack and bulk storage areas are developed empirically by ADP and printed on Line 13f by type of space/Facility Category Code.

**PART F. DENSITY CONVERSION FACTORS:\***

The following information provides the conversion factors pertaining to the different types of materials to be stored as well as to their related Navy cognizant symbols. These factors were summarized from NAVMAT P-4000-2. This NAVMAT publication provides additional information on density factors, DOD classes of supply and consumption rates.

Material Types	Navy Cog.	M/T Per S/T	S/T Per M/T
	symbols		
Tactical Vehicles (Automotive)	9A,9E	4.73	.210
Clothing	9D,9U	3.00	.333
Construction (Minor)	9C	2.75	.364
(Major)	2C	2.14	.476
Electronics (Retail)	9N,9Y	3.25	.308
(Repair Parts)	2G,4G,1N-		
	2N,4N,8N	3.02	.333
General	9G,90,9Q	2.50	.400
Industrial	0S,92	2.00	.500
Medical	9L	3.25	.308
Substance (Dry)	9MF	2.10	.476
(Chill)	9MP	1.40	.714
(Freeze)	9MP	1.70	.588
Shipboard (Assemblies)	2F,40,60		
	22,2P,4P,6P		
	8P,8T,2X,8X	2.32	.430
(Repair Parts)	1H,2H	1.92	.520
Aeronautical (General)	1R,2R,2V	4.24	.240
(Major)	4V,8R	2.86	.370
(Repairables)	8F,8J,8K,8V,8W	2.00	.500
(Repair Parts)	4A,bE,9F,9H		
	9I,9J		
	9K,4R,5R,9V	2.32	.430
Ammunition	2E,8E	1.07	.935
	2T,4T,8T	1.46	.685
	All Cog		
	(General,		
	(Mix, AE LOAD)	1.35	.740
(Air General)	2E	1.07	.935
(Air Missiles)	8E	1.07	.935
(Surface General)	2T	1.07	.935
(Torpedoes)	4T	1.07	.935
(Surface Missiles)	8T	2.32	.430
Weapons (Assemblies)	25	1.07	.935
(Repair Parts)	1A,2A	3.02	.330
Spec. Weapons (Ordnance)	6A,8A	3.02	.330
(Navigation)	6H	1.92	.520
Petroleum (Packaged)	1W	1.50	.667
(Bulk)	1W	1.04	.967
Ground Support MHE	1B,2B,20	2.32	.430
IPE	4L,8L,2S,2M	4.73	.210
MSTS	0X	4.73	.210
Forms and Pubs	0I,1I,0K		
	0P,6V	1.33	.750

\*Summarized from NAVMAT P-4000-2; additional information on density factors, DOD classes of supply and consumption rates is available in this publication

**PART G. MSC COMMODITY CATEGORY CONVERSION FACTORS:**

The following conversion factors indicate the number of measurement tons (40 cubic feet) found in a short ton (2,000 lbs) by type of material to be stored.

<u>MSC COMMODITY CATEGORY</u>	<u>M/T Per S/T</u>
Ammunition .....	1.01
Household Goods .....	6.06
Privately-owned Vehicles (POVs) .....	7.54
General Material .....	2.32
Refrigerated Material .....	1.86
Special Material .....	4.73
Weighted Average (without aircraft) .....	2.48
Aircraft .....	53.69
Weighted Average (with aircraft) .....	2.63

WEIGHTS AND MEASURES

A list of weights and measures is provided as a matter of convenience and to ensure uniformity among all activities when calculating storage requirements.

1 M/T (Measurement Ton) .....	40 Cu Ft
1 S/T (Short Ton) .....	2,000 Lbs
1 L/T (Long Ton) .....	2,240 Lbs
1 Cu Ft .....	7.4805 U.S. Gallons
1 U.S. Gallon .....	0.133681 Cu Ft
1 U.S. Barrel .....	42 U.S. Gallons

## SECTION 440B

### GUIDELINES FOR DETERMINING STORAGE SPACE REQUIREMENTS

The technical planning information provided in this section is as follows:

PART A: Introduction

PART B: Analytical Method: Five Steps for Determining Storage Space Requirements

PART C: Procedure for Determining Cube Requirements for Material to be Stored

PART D: Procedure for Determining Requirements for Storage Facilities Using the SFMR

#### PART A: INTRODUCTION

1. Applicability. Guidelines for determining storage space requirements contained in this section apply specifically to General Supply Storage Facilities in Category Groups 430 (Cold Storage), 440 (Other Covered Storage) and 450 (Open Storage). Descriptions of individual facilities within these groups are furnished by category code number.

There are two methods for computing storage space requirements.

- a. The SFMR Method
- b. The Analytical Method

Both of these methods provide the documentation required to support the Basic Facilities Requirements (BFR) in the Shore Facilities Planning System. Part B of this section provides the procedure for determining the cube requirements for both of these methods.

SFMR Method: Procedural guidance for requirements planning is furnished in this section for storage activities reporting on the Supply Facility Management Report, (SFMR) in accordance with NAVSUPINST 4450.2219, "Supply Facility Management Reporting, Requirements Planning and Acquisition Justification System." The SFMR includes a reporting format for "Computation in Support of Basic Facility Requirements (BFR) Documentation." This format is used as the primary basis for requirements planning guidance in this section. The SFMR must be submitted to NAVSUP on a cyclic/situation basis by all Navy/Marine Corps storage activities having 20,000 or more gross square feet of covered Ammunition and/or General Supply Storage Facilities (Category Groups 420, 430, and 440).

Analytical Method: This method is used for BFR purposes only and is not a substitute for completing the SFMR. This method takes an analytical approach which requires five steps in order to derive the storage requirements. This method may also be applied to storage facilities at activities not required to report on the SFMR and to facilities not reportable on the SFMR if the cube of material to be stored is known or can be determined. This includes Supply Storage Facilities in Category Groups 430, 440 and 450 (for activities under

the 20,000 gross square foot threshold) as well as to non-supply storage facilities in other category groups.

**PART B. Analytical Method: Five Steps for Determining Storage Space**

**Requirements.** There are five steps required for determining storage space requirements by this method. Detailed procedures for determining the cube requirements is furnished in PART D below.

Step 1: Determine the TCF required for the cube/Measurement Tons of material to be stored. This is done by multiplying the Measurement Tons of material to be stored by 78.4 TCP (factor required per Measurement Ton of material to be stored) or 1.96 TCF required per cubic foot of material to be stored. The TCF required per man per month and per aircraft are also available directly from Tables 440B-1 and 440B-2 respectively. For cold storage requirements, see Table 431-10A and 431-10B.

Step 2: Determine a SH value. For an existing facility use the current SH value. For a planned facility use:

- a. 4 to 10 feet for open storage.
- b. 4 feet for MTIS, ILO and Outfitting facilities (up to 12 feet if racks are planned).
- c. 4 feet for display gondolas and 7 feet for bin shelving in SERVMARTS.
- d. Use 10 feet normally for all other covered storage facilities.
- e. For a high rise facility, see Section 440C, Part C for conversion.

NOTE: These SH values are for BFR planning purposes only. For SH values applicable to follow-on modernization/construction planning, guidance in Section 440C applies.

Step 3: Determine the projected NS requirement by dividing the projected TCF required by the SH value determined in Steps 1 and 2 above,

Step 4: Select an appropriate "SF per NS Multiplier." For planned facilities, use the applicable Activity Group average value in Table 440B-3. For existing facilities, use the actual SF value divided by the NS value at the activity (Line 21a on SFMR). Compare this actual value with the average value for the activity's "Group" (Table 431-10B of Section 431 and Table 440B-3 of Section 440B). If the actual activity value is questionable, the applicable Activity Group average value or some intermediate value may be used, if documented/justified. If the activity is reporting on the SFMR, compare this actual value with the 1, average value for the activity's group, Line 21b of the SFMR. See Section 440C, PART C, for conversion.

NOTE: As with SH values above, these SF per NS values are for BFR planning purposes only. For SF per NS values applicable to follow-on modernization/construction planning, guidance in Section 440C applies.

Step 5: Determine the SF required by multiplying the NS by the SF per NS multiplier determined in Steps 3 and 4.

## **PART C: PROCEDURES FOR DETERMINING CUBE REQUIREMENTS FOR MATERIAL TO BE STORED**

This part applies to both the Analytical and SFMR methods for determining storage requirements for an activity's Five Year Defense Program (FYDP). These procedures provide guidance for determining planned TCF requirements based on the cube of material to be stored and furnish guidance in determining cube requirements for amounts of material to be stored for input to Part D.

### 1. Procedures for Existing Activities.

a. Use Current M/Ts of Material in Store as Baseline Data. Use historical M/Ts of material in store by Facility Category Code as baseline data. Line 13f of the SFMR applies for reporting activities. Other activities may estimate M/Ts of material in store on pallets in bulk and rack storage using estimating guidance in Part E of Section 440A. The cube of material in bins/shelving/drawers can similarly be estimated. Alternatively, activities not reporting on the SFMR can use the SFMR format and related procedures in NAVSUPINST 4450.22A to develop estimated M/Ts of material in store in the same manner that is used for reporting activities. Another alternative is to develop line item listings of material in store with cube data in a manner similar to procedures described in subparagraph b (2) below.

b. Determine Projected Requirements for M/Ts of material to be stored during FYDP by calculating any additions to or reductions from current baseline M/Ts in store by type of space/Facility Category Code. If no changes are anticipated, proceed to guidance in subparagraph 2c below. If changes are anticipated procedures and suggested sources for data are as follows:

(1.) Obtain Change Data from Tables. Determine net additions or reductions in personnel and/or air-craft to be supported. Next, obtain TCF requirements per man per month and/or per aircraft from Table 431-10A in Section 431 and from Tables 440B-1 and 440B-2 in Section 440B, as applicable. Note that Tables 440B-1 and 440B-2 furnish TCF requirements specifically for Category Codes 441-35 and 441-50 but that only one total TCF is furnished for Category Codes 441-10, 441-20, 441-30 and 441-40. This total TCF requirement must be distributed among the four Facility Category Codes as appropriate. See guidance regarding use of each of these four types of space given under category code descriptions in Section 441. Divide TCF required for each Category Code by the Universal Factor of 78.4 to convert to M/Ts. This procedure applies to installation-type activities that primarily support personnel or personnel and aircraft. It does not apply to supply center, depots or industrial activities.

SAMPLE DATA (Applicable to SFMR and non-SFMR reporting activities) EXAMPLE for Category Code 441-10:

1. Baseline of 8,920 M/Ts (Line 13f of SFMR).
2. Net additions in aircraft and personnel provide a net additional allowance of 69,932.8 TCF using Tables 431-10A, 440B-1 and 440B-2.
3. No other changes in cube of material to be stored.

CALCULATIONS:

1. 69,932.8 divided by 78.4 TCF per M/T = additional 892 M/T requirement.,
2. This represents a 10 percent increase over baseline 8,920 M/Ts. It can be expressed as a "Projected Requirements Decimal Multiplier" of 1.1. (Enter 1.10 on Line 18a of SFMR).
3. Projected M/Ts of material to be stored =  $1.10 \times 8,920 = 9,812$  M/Ts (Line 18b of SFMR).

(2) Obtain Chance Data Using Material Listings with Line Item Cube Data. Determine additions or reductions in quantities of material to be stored. Develop listings of line item changes with individual cubic foot values and determine net cubic foot additions or reductions. Line item cube data in load lists and data banks is currently rather limited but with the introduction of the Naval Integrated Storage Tracking and Retrieval System (NISTARS) at Naval Supply Centers during 1984, such data may be available at/from Naval Supply Centers for most system stock items during the 1985/1986 timeframe. Actual measurements may have to be taken or estimated for items for which cube data may not otherwise be available. Divide net cubic foot additions or reductions by 40 cubic feet per M/T to obtain net additions or reductions in M/Ts of material to be stored. This procedure is applicable to all storage activities.

SAMPLE DATA (Applicable to SFMR and non-SFMR reporting activities) EXAMPLE for Category Code 441-10:

1. Baseline of 8,920 M/T's currently in store (Line 13f of SFMR).
2. Net additions in cube of stock items and other material that represent a net addition of 35,680 cubic feet of material to be stored.
3. No other net changes in cube of material to be stored.

CALCULATIONS:

1. 35,680 cubic feet of material divided by 40 cubic feet per M/T = additional 892 M/T requirement.
2. This represents a 10 percent increase over baseline of 8,920 M/Ts which can be expressed as a "Projected Requirements Decimal Multiplier" of 1.1 (enter 1.10 on Line 18a of SFMR).
3. Projected M/Ts of material to be stored =  $1.10 \times 8,920 = 9,812$  M/Ts (Line 18b of SFMR).

(3) Estimate Percentage of Change by Task/Mission Change. If all or portions of projected additions or reductions cannot be determined as in subparagraph b(1) and b(2) above, it may be necessary to estimate changes as percentages of baseline data. That is, changes in projects, tasks and mission may have to be expressed as percent changes in baseline M/Ts. This will require creative use of line item, cube and workload data currently available at the storage activity. Conversion tables in Section 440A and in NAVMAT

P-7000-2, "Logistic Reference Data" may be useful in this regard. Include reasonable projections for Accommodation Storage of non-supply system materials in support of local as well as regional and Navy-wide requirements, as applicable. If this procedure is used, rationale and supporting data must be documented. Additional guidance in estimating requirements may be requested from NAVSUP, Warehousing, Equipment and Systems Branch on AV 227-2358 or 1100.

SAMPLE DATA (Applicable to SFMR and non-SFMR reporting activities) EXAMPLE for Category Code 441-10:

1. Baseline of 8,920 M/Ts currently in store (Line 13f of SFMR)
2. Net estimated additions in a listing of documented requirements resulting in estimated increase of 10% in M/Ts to be stored.
3. No other net changes in cube of material to be stored.

CALCULATIONS:

1. A 10 percent increase in M/Ts can be expressed as a "Projected Requirements Decimal Multiplier" of 1.1 (enter 1.10 on Line 18a of SFMR).
2. Projected M/Ts of material to be stored =  $1.10 \times 8,920 = 9,812$  M/Ts (Line 18b of SFMR).

(4) Combine Change Data Elements That Are Not Duplicative. It is possible that any 2 or all 3 of the methods for computing net changes in M/T requirements described in subparagraphs b(1), b(2) and b(3) above could be applicable at the same time, provided there is no duplication in material represented by the individual net change data elements. If, for example, 2 of the 3 sample computations above were not duplicative, the net Projected Requirements Decimal Multiplier would be:

10% increase + 10% increase = 20% increase = 1.20 "Decimal Multiplier."

c. Validate Projected Cube Requirements by Type of Space.

(1) Evaluate Type of Space Available Versus Type Required. In many cases, the type of space actually required for storage of material on hand may not be available and other space may have to be substituted. For example, if there is no controlled humidity space available for storage of items for which such space is justifiable, such material may have to be stored in general purpose space until controlled humidity space becomes available. Similarly, there may be material in open storage that requires general purpose warehouse space or shed storage space. In such cases, historical (baseline) data showing cube of material in store by type of space should be adjusted so that forecasted requirements are specified in terms of types of space actually required. For activities reporting on the SFMR, such adjustments can be made using instructions for Lines 18a and 18c.

(2) Storage of Gas Bottle Cylinders and Drummed POL. When planning facility requirements for flammables/hazardous materials, be certain that bottle gas cylinders and drummed petroleum, oils and lubricants (POL) are not planned for storage in flammables/hazardous warehouses. These items should be planned for storage in shed space. If POL drums have been hot dip galvanized for protection, they may be planned for storage in open storage facilities. DoD Regulation 4145.19-R-1, "Storage and Materials Handling" should be used for guidance in providing the appropriate types of storage facilities for materials to be stored.

c. BFR Allowances. Develop BFR for existing activities in accordance with PART D below. SFMR line entries start with Line 18a for existing activities.

## 2. Procedures for New Activities.

a. Determine Projected TCF Allowances. Determine TCF requirements during the new activity's FYDP by type of space/Facility Category Code. Procedures and suggested data sources are as follows:

(1) Obtain TCF Allowances from Tables. Obtain TCF Allowances per man per month and/or per aircraft from Table 431-10A in Section 431 and from Tables 440B-1 and 440B-2 in Section 440B, as applicable. Note that Tables 440B-1 and 440B-2 furnish TCF Allowances specifically for Category Codes 441-35 and 451-10, but that only one total TCF Allowance is given for category codes 441-10, 441-20, 441-30 and 441-40. This total TCF Allowance must be distributed among the four category codes, as required. See guidance regarding use of each of these four types of space given under category code descriptions in Section 441. This procedure will normally apply to installation-type activities that primarily support personnel or personnel and aircraft. It will not apply to supply centers, depots or industrial activities.

(2) Develop TCF Allowances Using Material Listings with Line Item Cube Data. Develop listings of line items to be carried with individual cubic foot values. Line item cube data in load lists and data banks is currently rather limited but, with introduction of the Naval Integrated Storage Tracking and Retrieval System (NISTARS) at some Naval Supply Centers during 1984, such data may be available from these supply centers for most supply system stock items during the 1985/1986 timeframe. Actual measurements may have to be taken or estimated for items for which cube data may not otherwise be available. Tables in Section 440A and NAVMAT P-7000-2, "Logistic Reference Data," may prove useful in developing data in some cases. In other cases, cube data on material to be stored may best be obtained from an existing activity with a mission and task functions similar to those assigned to the new activity. After determining the cube of material to be stored by type of space, multiply such cubic foot values by the Universal Factor, "1.96 TCF Allowed per cubic foot of material to be stored," to obtain projected TCF Allowances. These procedures are applicable to all types of storage activities.

b. BFR. Develop BFR for new activities in accordance with procedures in Part D below. SFMR line entries start with Line 18e for new activities.

**PART D: PROCEDURES FOR DETERMINING REQUIREMENTS FOR STORAGE FACILITIES USING THE SFMR.**

1. Introduction. Part B above furnishes Summary Highlights of five steps required for determining BFR for storage facilities. Detailed procedures for these five steps are given in Item 4 below in the format used by activities reporting existing storage facilities on the SFMR. These procedures are also applicable to non-reporting activities.

2. Types of Space Reported on the SFMR. NAVSUPINST 4450.22A furnishes complete procedural guidance for the reporting and submission of data on the SFMR with the exception of Section D for which procedural guidance is furnished below for "Computations in Support of BFR Documentation." A copy of the SFMR ("Worksheet" version) is furnished in Section 440A for convenience. The types of space for which data are entered in Section D of the SFMR are divided into two columnar categories. These are identified in the procedures as "Main Columns" and "Break-out Columns" which consist of the types of space/Facility Category Codes listed below.

Main Columns. There are 7 Main Columns in Section D that reflect a continuation of availability, utilization and occupancy data in Sections A, B and C of the SFMR. The General Purpose Warehouse Column (Column C + D) in Section D reflects the total of heated and unheated general purpose data in columns C and D of Sections A, B and C. Similarly, the Refrigerated Warehouse Column (Column G + H) in Section D reflects the total of chill and freeze data in Columns G and H of Sections A, B and C. The 7 "Main Columns" are as follows:

<u>SFMR Column(s)</u>	<u>Category Code</u>	<u>Facility Description</u>
C+D	441-10	General Purpose Warehouse (includes MARCORPS CCN's 441-11, 441-13 and 441-14)
E	441-20	Controlled Humidity Warehouse
P	441-30	Flammables/Hazardous Materials Warehouse
G+H	431-10	Refrigerated Warehouse
I	441-35	Shed Storage Facility
J	441-70's	Special Supply Operations Facilities (See "Break-out Columns" below)
M	451-10	Open Storage Facilities (Improved)

Break-out Columns. There are 3 columns in Section D used for "Break-out" of data in the "Main Column" containing data totals for "Special Supply Operations" (Column J) in the 441-70 series. Data in Column J of Sections A, B, and C of the SFMR reflect the totals for the 3 categories of "Special Supply Operations" identified in the "Break-out" columns of Section D as follows:

<u>SFMR Column</u>	<u>Category Code</u>	<u>Facility Description</u>
J-O	441-71	Integrated Logistics Overhaul (ILO) and Outfitting Building
J-S	441-72	SERVMART Facility
J-M	441-73	Material Turned Into Store (MTIS) Facility

Descriptions of these Supply Storage Facilities are furnished in Category code sequence in Sections 431, 441 and 451.

3. General Comments on use of the SFMR for Support of BFR Documentation.

a. Worksheet and Printout Versions. The SFMR format printed in NAVSUPINST 4450.22A and reprinted for convenience in Section 440A of this publication is the "Worksheet" version that is used for the initial SFMR submission by activities reporting to NAVSUP for the first time. It may also be used by non-reporting activities as a tool for developing computations in support of BFR documentation.

It will be noted that the "Worksheet" version of the SFMR contains clear blocks, shaded blocks and cross-hatched blocks. Clear blocks are for "raw" input data; shaded blocks are for data entries that are mathematically derived by formulas on shaded lines that use data on other lines; crosshatched blocks are not to be used. The ADP printout version of the SMFR uses pointed brackets to identify lines or portions of lines that contain clear blocks on the "Worksheet" version and on which "raw" input data are entered.

Activities reporting on the SFMR use the ADP printout version (after initial submissions on the "Worksheet" version) to annotate new or change data on the most recent NAVSUP ADP printouts. Annotated entries include entry of all "raw" new or change input data on bracketed lines. Annotations also include follow-on entry of new/change computed values on unbracketed lines (shaded on Worksheet); computations are based on formulas printed in the line description for each unbracketed/shaded line and are performed to verify the accuracy and intent of annotated "raw" input data. Verified data on bracketed/unshaded lines (or portions of such lines) are entered on transmittal sheets for keypunching. Data on unbracketed/shaded lines are not entered on transmittal sheets for keypunching since data for these lines will be computer-generated on follow-on ADP printouts.

One copy of a fully annotated ADP printout or fully completed "Worksheet" version of the SFMR, with transmittal sheets containing all raw input data for keypunching, is submitted by the reporting activity to NAVSUP for ADP processing as an updated or initial report printout. Two copies of the ADP printout are furnished by NAVSUP to the reporting activity, one copy is furnished to the cognizant NAVFAC Engineering Field Division and one copy is furnished to the cognizant subclaimant command. One of the two copies furnished to the reporting activity by NAVSUP is subsequently annotated with new/change data by the activity and returned to NAVSUP as the new report submission.

b. General Comments on Data Entries in Section D of the SFMR. With the exception of 6 lines, all data entries on Lines 18a through 22b of Section D will be expressed in terms of thousands of units, carried to 2 decimal positions: e.g., 54,324 will be entered as 54.32; 54,325 will be entered as 54.33. The exceptions are Lines 18a, 19a, 21a, 21b and 21c. Data on these lines will be expressed in units carried to 2 decimal positions; e.g., a "Projected Requirements Decimal Multiplier" of 1.25 on Line 18a, 10.00 feet of stacking height on Line 19a or 19b, and SF per NS Multiplier of 2.32 on Line 21a, 21b or 21c. For reference and convenience purposes, these 6 lines as well as Line 23 (for entry of BFR approval date) are preceded by an asterisk (\*) on the ADP and Worksheet versions of the SFMR as well as in the instructions for entering data on these lines in Item 4 below.

4. Procedures for Data Entries on Format of Section D of the SFMR. Procedures given below are to be used in determining BFR Allowance values for the 4 standard units of measures applicable to storage and warehousing facilities. These are TCF, SH (or nsh), NS and SF (or SY). See Section 440A, Part B for details. Instructions are for all columns with specific guidance pertaining to the "Column J Break-out" columns when necessary for clarity.

Step 1: Determine Projected TCF Requirements for the Activity's FYDP.

\*Line 18a. "Projected Requirements Decimal Multiplier". This line is applicable to any column/type of space having an entry for current M/Ts of Material in Store on Line 13f of the SFMR. If there is an entry of M/Ts in Store on Line 13f in Column J, such M/Ts will have to be distributed to the "Break-out Columns" (on backup documentation) in order for Line 18a to be applicable to the "Break-out Columns". Using procedures in Item 1 of Part C above, determine if there is to be a change in "baseline" data on Line 13f during the activity's FYDP. Enter 1.00 on Line 18a in any column in which there is to be no change in M/Ts of Material to be Stored: enter 1.25 if there is to be an increase of 25 percent; enter .90 if there is to be a decrease of 10% etc. If M/Ts of material are projected for storage in a type of facility that does not currently exist, the projected amount should be entered directly on Line 18c in the applicable column(s). Prepare back-up documentation to justify any entries on Line 18a other than 1.00 and all entries on Line 18c for facilities that do not currently exist. Retain/submit justification documentation as required by Item 5 below.

Line 18b. "Empirical Value of M/Ts of Material to be Stored (18a X 13f)". Enter in any column the value obtained by multiplying Line 13f by Line 18a in each column, as applicable. The result(s) is/are the apparent M/Ts of material that are to be stored. ADP applies on printouts for (bracketed) "Main Columns" only. Raw input data (equal to Column J data) distributed to "Break-out Columns" must be entered on Transmittal Sheet 2 for keypunching and ADP processing.

Line 18c. "Projected Value of M/Ts of Material to be Stored".

For Existing Facilities. If, in any column, there is currently an M/T value that is within 10% of the empirical value on Line 18b, it is not necessary to change the value on Line 18c unless desired. Enter the empirical value (Line 18b) as the projected value if there is no current projected value on Line 18c that is within 10% of the empirical value.

For Non-Existing Facilities. If, for any type of non-existing facility, a requirement to store a quantity of M/Ts of material has been determined in Item 1 of Part C above, enter the required quantity on Line 18c in the applicable column.

Transposition of data. If, for example, there is an entry on Line 18b indicating a projection of 10,000 M/Ts of material to be stored in general purpose warehouse space, and if 600 of these M/Ts are justified as requiring controlled humidity warehouse space that does not currently exist, such data should be "transposed" on Line 18c as follows:

Line	G. P. Warehouse	C. H. Warehouse
Number	<u>(441-10)</u>	<u>(441-20)</u>
18b	10,000	
18c	9,400	600

Similar procedures may apply to transpositions of projected M/Ts of material to be stored from unimproved open storage to improved open storage, or from open storage to shed storage, etc. Transpositions can be to types of facilities that currently exist or do not exist. Provide backup data with BFR submissions : see Item 5 below.

Line 18d. "Empirical Value of TCF Allowed in Bin, Rack and Bulk Storage Areas (78.4 TCF per M/T X 18c or 18b if 18c is blank)". Compute and enter values using the given formula in any column, as applicable. ADP applies on printouts.

Line 18e. "Proposed/Approved BFR Value of TCF Allowed".

For Existing Activities. If, in any column, there is currently an approved BFR value within 10% of the empirical value on Line 18d, it is not necessary to change the value on Line 18e unless desired. Conversely, enter the empirical value (Line 18e) as the proposed BFR value if there is no current approved BFR value within 10% of the empirical value.

For New Activities. If TCF Requirements for new activities have been determined by type of space using procedures in Item 2 of Part C above, enter the required quantity of TCF on Line 18e in the applicable column(s). Lines 18a through 18d will not apply to new activities. Furnish backup data with BFR submissions; see Item 5 below.

STEP 2: Determine Allowable SH and nsh Values.

\*Line 19a. "Values for Existing Facilities (nsh from line 11d for Columns J and M; SH from Line 10d for other columns)". For existing facilities only, enter values as indicated in Line Description. If there is an entry in Column J, enter the applicable value(s) in the "Break-out Columns", as appropriate. If more than one type of Special Supply Operations facility currently exists, compute the nsh value for each type of facility by dividing the total Attainable Cubic Feet (ACF) by the total Net Square Feet (NS) applicable to each type of facility. For guidance, see Part B above and Definitions of Terms in Section 440A. Also, see NAVSUPINST 4450.22A and use Storage Unit

Reports (NAVSUP Form 605) in accordance with NAVSUP Manual, paragraph 27028. ADR applies on printouts for "Main Columns" only. Raw input data in "Break-out Columns" must be entered on Transmittal Sheet 2 for keypunching and ADP processing. See Item 5 below regarding backup worksheet data for "Break-out Columns".

\*Line 19b. "Values for Required Non-Existing Facilities Not on Line 18a". For non-existing facilities only, enter proposed SH and nsh values, Do not enter values on this line in any column if there is a value for existing facilities on Line 19a in the same column. For open storage facilities, enter a value of between 4 and 10 feet nsh. If possible, select a value comparable to the average nsh value for an open storage facility at a similar type storage activity. For SERVMARTS, suggest use of 4 feet nsh for display gondola port ions, 7 feet nsh for bin shelving portions and up to 12 feet nsh for rack portions. For Outfitting, ILO and MTIS facilities, suggest use of up to 12 feet nsh for rack portions and 4 feet nsh for other portions. Preliminary planning and layout sketches should be developed for SERVMARTS, MTIS ILO and Outfitting facilities before selecting nsh values. For all other non-existing covered storage facilities normally use 10 feet SH for BFR purposes. For BFR documentation purposes, "nsh" allowances for open storage facilities and for Special Supply Operations facilities will be identified as "SH" allowances.

NOTE: SH Allowances developed in accordance with the above procedures are for BFR purposes only. For SH values applicable to modernization or new construction planning, guidance in Section 440C applies.

STEP 3: Determine Projected NS Allowed.

Line 20a. "Empirical Value (18e divided by 19a or 19b; or, 18d divided by 19a or 19b if 18e is blank)". In each column, compute the applicable NS Allowed using the given formula, as appropriate. ADP entries apply on printouts.

Line 20b. "Proposed/Approved BFR Value". In any column, if there is currently an approved BFR value that is within 10 percent of the empirical value on Line 20a, it will not be necessary to change the value on Line 20b unless desired. Conversely, enter the empirical value (Line 21a) as the proposed BFR value if there is no current approved BFR value within 10 Percent of the empirical value in any column(s),

STEP 4: Select An Appropriate SF per NS Multiplier.

\*Line 21a. Compute and enter value using the given formulae as applicable, in each "Main" column. Compute values for Lines 9d and 2c and then apply the given formula (9d x 2b) for "Break-out columns". This will require supplemental worksheet data for "Break-out columns". See Item 5 below. ADP entries apply on printouts of Main Columns only. Raw input data in "Break-out Columns" are entered on Transmittal Sheet 2 for keypunching and ADP processing.

\*LINE 21b. "Empirical Value Based on the Activity's Croup Average." Data on this line will be entered by NAVSUP on ADP Printout versions of SFMR and will represent average values by type of space for the activity's group\*

For example, if the activity is a shipyard, the latest average values for all shipyards will be entered by NAVSUP by type of space. Average values as of June 1983 are furnished for refrigerated facilities in Table 431-10B of Section 431, and for other types of facilities (except "Break-out" facilities) in Table 440B-3. Historical data for "Break-out" facilities is not currently available but will be added to Line 21b on ADP printouts when available.

\*Line 21c. "Proposed/Approved BFR Value". For existing facilities, normally use the activity's actual SF value divided by the actual NS value for each type of space at the activity; i.e., normally use data on Line 21a. If actual value is questionable, the applicable activity group average value or some intermediate value may be used, if determined applicable and justified (see item 5 below) in support of BFR documentation. For non-existing facilities, use the applicable activity group average value on Line 21b.

NOTE: As with SH values above, these SF per NS Multiplier values are for BFR purposes only. For SF per NS multiplier values applicable to modernization or construction planning, guidance in Section 440C applies.

STEP 5: Determine Projected SF Allowed.

Line 22a. "Empirical Value (20b X 21c or 20a X 21c if 20b is blank)". Compute and enter value using the given formulas, as applicable in each column. ADP applies on printouts.

Line 22b. "Proposed/Approved BFR Value". In each column, if there is currently an approved BFR value that is within 10 percent of the empirical value on Line 22a, it is not necessary to change the value on 22b unless desired. Conversely, enter the empirical value (Line 22a) as the proposed BFR value if there is no current approved BFR value within 10 percent of the empirical value. Alternatively, the approved BFR value may be correct for existing facilities on the basis of experience, even though it deviates from the empirical value by more than 10 percent. In this event, the applicable SF per NS Multiplier on Line 21c may be incorrect and in need of analysis and change.

\*Line 23. "Date(s) of Approved BFR". If, in any column, the TCF, NS and SF values entered on Lines 18e, 20b and 22b, respectively, are all within 10 percent of NAVSUP and NAVFAC approved BFR documentation, enter the month and year of such approval. For example, if the applicable date is April 1984, enter "0484". Conversely, leave the line blank or delete a prior approval date (with "0"/zero entry) in any column which does not have BFR approved values or values within 10 percent of empirical values on all 3 of the applicable lines. Alternatively, date entries and deletions may be made by NAVSUP.

NOTE: See Sample Problem Number 1 in Section 440C of this publication for sample computations using the format of Section D of the SFMR.

5. Submission of BFR Documentation for Storage Space Requirements

a. Navy Activities Reporting on the SFMR. Activities reporting on the SFMR will prepare BFR data in Section D of the SFMR in accordance with procedures given in Item 4 above. Additionally, when back-up justification

documentation is required by procedures in Item 4 above for Lines 18a, 18c, 18e, 19a, 21a and/or 21c, detailed back-up justification must be developed and retained by the activity for "call up" submission to NAVSUP or other commands, if required. Such detailed justification will be included with submissions of MILCON project documentation to support data used in the "Equivalency Statement" and in reconciliation of BFR/deficiency data with MILCON data. See procedural requirements in Parts C and D of Section 440C.

Summary justification comments of the detailed back--up justification documentation retained at reporting activities will be developed for Lines 18a, 18c, 18e and/or 21c, as applicable (not required for Lines 19a and 21a). These summary comments will be developed for entry in the "Remarks" Section of the SFMR and will be keyed to the applicable line number and column alpha character code. See guidance for preparation of ADP Transmittal Sheet 3 in NAVSUPINST 4450.22a. The following guidance applies to preparation of summary justification comments for the "Remarks" Section of the SFMR:

<u>Line No.</u>	<u>Guidance</u>
18a	Furnish summary justification for any value on Line 18a other than 1.00. Explain why there is an anticipated increase or decrease in the current M/Ts in Store reported on Line 13f. List summary data for each major element of anticipated change.
18c&18e	Furnish summary justification for any value on Line 18c or Line 18e that is in a data column for a type of facility that does not currently exist at the activity, and/or in which there is value for M/Ts of Material in Store on Line 13f. Explain with summary data each aspect of "transposition" and/or basis for new M/T or TCF requirements.
21c	Furnish summary justification for any value on Line 21c that differs from the empirical value on Line 21a in the same column. Procedural guidance for Lines 21c and 22b are both applicable.

When it is not feasible to adequately summarize justification documentation in the "Remarks" Section of the SFMR, submitted supplemental documentation to NAVSUP and prepare a short comment for the "Remarks" Section that references the dated supplemental documentation.

All summary justification "Remarks" will be retained on SFMR printouts until deleted. See instructions for Transmittal Sheet 3 in NAVSUPINST 4450.22a.

Section D data and related "Remarks" developed in accordance with the foregoing will be submitted to NAVSUP (along with new/change data for Sections A, B, C and E and related "Remarks") with Transmittal Sheets 2 and 3, respectively. Such submissions will provide for NAVSUP key-punching/ADP processing of new/change data and "Remarks" in consonance with the provisions of NAVSUPINST 4450.22a.

Upon review and technical approval of empirical or proposed BFR values for TCF, SH, NS and SF, NAVSUP will forward such values along with a copy of the SFMR printout to NAVFAC for review, administrative approval and entry of approved TCF, SH and SF values into the Shore Facility Planning System.

b. Navy Activities not Reporting on the SFMR. For activities not reporting on the SFMR, the same data preparation procedures given above can be followed for manual entry of data in the format of Section D of the SFMR. Such data with related back-up justification documentation should be forwarded to NAVFAC Engineering Field Divisions in accordance with NAVFACINST 11010.44.

c. Marine Corps Activities. All Marine Corps activities are required to report BFR information on the SFMR. BFR's submitted to Headquarters Marine Corps for approval should, therefore, be consistent with the SFMR and should be based on the data contained in sections A, B, and C. Preparation and submission of the BFR and any other backup documentation should be in accordance with Marine Corps Order P11000.12.

d. Additional Guidance. If additional guidance is desired, contact the Warehousing, Equipment and Systems Branch at NAVSUP on AVN 227-2358 or 227-1100. MARCORPS activities should contact MARCORPS Headquarters, Supply Management Section on AVN 224-1474 or the Facilities Branch on AVN 224-1369.

TABLE 4408-1

Storage Space Allowances in Gross Square Feet (SF) and Total Cubic Feet (TCF)  
for Navy and Marine Corps Aircraft with a Stacking Height OF 10 Feet

Type Aircraft Supported (For aircraft not listed use allowances for a similar type aircraft)	Type Space and Cat. Codes					
	Warehouse		Shed		Open Storage	
	441-10		441-35		451-10	
	20/30/40					
	SF	TCF*	SF	TCF*	SF	TCF*
VF F-4, F-8	382	1,736	8	64	110	312
VF F-14	407	1,850	8	64	115	326
VA A-4, A-7, AV-8	407	1,850	8	64	115	326
VA A-3, A-5, A-6	407	1,850	8	64	120	340
VP P-2, P-3	713	3,241	51	408	225	638
VR C-1, C-47, C-117, C-119, C-131	356	1,618	15	120	125	355
VA C-54, C-118, C-121, C-130	534	2,427	30	240	200	507
VS S-2, S-3	407	1,850	8	64	115	326
VU C-45, U-1, U-11	254	1,155	5	40	50	142
VU U-16	356	1,618	15	120	125	355
VT T-28, T-34	178	809	5	40	50	142
VT T-1, T-2, T-29, T-33, T-39	382	1,736	8	64	110	312
VO O-1, OV-10, U-6, U-11	178	809	5	40	50	142
H H-1, H-13	178	809	5	40	50	142
H H-2, H-3, H-19, H-34, H-46	254	1,155	8	64	75	213
H H-53	356	1,618	15	120	125	355
VW E-1, E-2	916	4,164	51	408	275	780

\* TCF allowances in this table are constant for all combinations of NS X SH. The SF allowances in this table are based on an SH of 10 feet for warehouse and shed facilities and a SH of 4 feet for open storage facilities. NS values for each pair of TCF and SF in the table can thus be determined by dividing TCF values for covered storage facilities by 10 feet SH and for open storage facilities by 4 feet SH. The applicable SF/NS Multipliers used in developing the table are 2.20 for warehouses, 1.25 for sheds and 1.41 for open storage facilities.

Normally, only the TCF allowances in the table will be used in developing requirements for existing facilities; both the TCF and SF allowances may be used (with related SH and NS allowances) for developing requirements when the type facility for which all such allowances are used does not currently exist at the activity for which requirements are being developed; requirements planning guidance in Section 440B applies.

TABLE 440B-2

Storage Space Allowances in Gross Square Feet (SF) and Total Cubic Feet (TCF)  
Per Man Per Month with a Stacking Height of 10 Feet

Installation Military Strength**	Type Space and Cat. Codes					
	Warehouse		Shed		Open Storage	
	441-10 20/30/40 SF	TCF*	441-35 SF	TCF*	451-10 SF	TCF*
First 4,000	15.27	64.98	2.03	15.98	5	16.26
Next 2,000	10.18	43.32	1.52	11.97	3	9.76
Next 2,000	5.09	21.66	0.51	4.02	2	6.50
All above 8,000	3.05	12.98	0.00	0.00	0	0.00

\* The TCF allowances in this table are constant for all combinations of NS X SH. The SF allowances in this table are based on an SH of 10 feet for warehouse and shed storage facilities and an SH of 4 feet for open storage facilities. NS values for each pair of TCF and SF values in the table can thus be determined by dividing TCF for covered storage facilities by 10 feet SH and for open storage facilities by 4 feet SH. The applicable SF/NS Multipliers used in developing the table are 2.35 for warehouses, 1.27 for sheds and 1.23 for open storage facilities.

Normally, only the TCF allowances in the table will be used in developing requirements for existing facilities; both the TCF and SF allowances may be used (with related SH and NS allowances) for developing requirements when the type facility for which all such allowances are used does not currently exist at the activity for which requirements are being developed; requirements planning guidance in Section 440B applies.

\*\* In the case of Naval Air Reserve Stations, authorized military strength will include active duty personnel on a 100 percent basis, plus inactive reserve (weekend) personnel on a 25 percent basis, except in the provision for clothing storage and issue wherein the inactive reserve personnel will also be included on a 100 percent basis.

TABLE 440B-3

Gross Square Feet (SF) Multipliers Applicable to Net Square Feet (NS) Allowances  
for Traditional Low-Rise Storage Facilities in Category Groups 440 and 450\*

Type of Activity Group	441-10's	441-20	441-30	441-35	441-70's	451-10
Air Installation Facilities (Navy)	2.51	1.68	1.67	1.25	1.90	1.44
Air Installation Facilities (Marine Corps)	2.02	1.47	1.81	1.04	2.54	1.29
Marine Corps Ground Activities	1.81	1.84	1.49	1.38	1.43	1.19
Communications Stations	2.13	1.03	1.03	1.03	1.03	2.78
Security Group Activities	1.43	1.03	-	1.03	-	-
RDT&E Activities (Under CNM)	1.83	3.50	1.34	1.55	1.94	1.23
RDT&E Activities (Miscellaneous)	1.55	-	2.06	-	-	1.46
Naval Stations	2.34	1.33	1.35	1.25	1.80	1.23
Naval Weapon Stations	1.63	3.42	1.46	1.06	2.86	1.24
Supply Activities	2.49	1.67	2.60	1.78	2.94	1.88
Training Activities	2.38	2.88	1.88	1.37	1.85	1.26
Shipyards and Ship Repair Facilities	2.08	2.06	1.55	1.14	1.67	1.34
Medical Activities (Hospitals, Dispensaries)	2.52	1.42	1.03	1.03	1.03	1.10
Construction Battalion Centers	1.50	1.44	1.49	1.43	1.89	1.94
Miscellaneous Navy Activities (Activities above not included in)	1.65	1.57	1.37	-	1.46	1.52
Total Navy Average	2.14	1.46	1.71	1.33	2.35	1.61

\* SF per NS Multipliers for warehouse facilities are average historical values that are based on traditional low-rise warehouses with wide aisles for counterbalanced forklift truck operations. For existing activities, these values are furnished to assist the planner in evaluating actual SF/NS Multipliers; such actual values for activities reporting on the SFMR are determined and printed by ADP on Line 21a of the SFMR; Line 21b of the SFMR exhibits average SF/NS Multipliers for the "Type of Activity Group" of which the reporting/planning activity is a part. The SF/NS Multipliers in this table and those appearing on Lines 21a and 21b of the SFMR are to be used in developing BFR documentation for traditional low-rise facilities. If new construction of high-rise, state-of-the-art facilities is planned, guidance in Section 440C applies.

## SECTION 440C

### **GUIDELINES FOR PLANNING AND SIZING WAREHOUSE CONSTRUCTION AND MODERNIZATION PROJECTS**

The technical planning information provided in this section is as follows:

PART A: General Planning Guidance

PART B: Warehouse Bay Sizes, Elevations and Configurations

PART C: Project Planning Criteria

PART D: Warehouse Sizing Procedures and Sample Problems

PART E: Additional Planning Guidance

**PART A: GENERAL PLANNING GUIDANCE.** In view of recent state-of-the art advances in integrated warehousing facilities and equipment systems and congressional removal of dollar restrictions per square foot of new construction, Clear Stacking Height (SH) design constraints are discontinued. Guidance in selecting appropriate values of SH for use in preparing documentation for submission of warehouse construction projects is available in NAVSUP Publication 529, "Warehouse Modernization and Layout Planning Guide" (1984 Revision). Empirical data in this publication and recent construction experience indicate that on a life-cycle total system cost basis, traditional low rise warehouses with low SH values and large building "footprints" are significantly more costly to construct and operate than modern high rise warehouses with high SH values and reduced footprints having the same Total Cubic Feet (TCF) capacity in net storage areas. Experience indicates that savings realized in facility construction costs (i.e., brick, mortar, etc.) by building modern high rise rather than traditional low rise warehouses are typically more than adequate to cover the cost of high rise storage aids and companion narrow aisle high reach material handling vehicles. If the material handling vehicles are used for unit load handling or order picking of materials in storage rack/bin areas and are guided by floor or overhead truss mounted rails or by electronic guidewire buried in the floor, the storage aids and companion handling vehicles can sometimes be procured with construction funds as built in equipment. For additional information or assistance, contact the NAVSUP, Navy Warehouse Utilization Program Manager, on AV 227-2358 or 227-1100.

The NAVSUP Pub 529 includes warehouse modular layout drawings and system selection/design criteria for use in developing functional warehouse configurations, bay sizes and elevations. The system selection and design criteria are based on current state-of-the-art storage and handling total system concepts. The Pub 529 criteria provide preliminary comparative costs for alternative combinations of facilities, equipment and manpower. The criteria are based on projected daily issues and replacement transactions and on quantities of material to be stored evaluated by material groupings. These criteria are also applicable to modernization within existing high bay structures such as heavy duty warehouses with craneways no longer in use and aircraft hangars no longer required for aircraft operations. Subsequent to

development of functional design based on use of NAVSUP Pub 529, follow-on Architect-Engineer designs should be developed using complementary guidance in NAVFAC DM 32.2, "Covered Storage" and NAVFAC P-272, "Definitive Designs for Naval Shore Facilities" (Drawings 1404208 through 1404214). See additional planning guidance in Part E below.

**PART B: WAREHOUSE BAY SIZES, ELEVATIONS AND CONFIGURATIONS.** Modular drawings in Sections 21 and 22 of NAVSUP Pub 529 include bay sizes and elevations for different storage/handling systems. Exact bay sizes in each case should be determined on the basis of total system analysis and selection in accordance with Section 17 of the NAVSUP Pub 529. If warehouses must be built urgently and functional storage/handling system layouts are to be planned at a later date, the universal bay size (33' by 64') furnished in Table 1 of the NAVFAC DM 32.2 and used in NAVFAC Definitive Drawings 1404208 through 1404214 should normally be used. Layout of bays should be planned to configure a building that is approximately square since the perimeter walls to floor space ratio is most efficient in terms of construction and operating costs in that arrangement. See details in NAVFAC DM 32.2 and Section 17 NAVSUP Pub 529.

Recent availability of electronically guided forklift/pallet handling/ order picking trucks that are capable of reaching storage heights of 45 feet and of storage/retrieval (S/R) machines capable of reaching heights of over 80 feet provides an opportunity to significantly increase the density of storage per square foot of floor and land area. This is particularly advantageous in congested tidewater areas where land is scarce and any reduction in facility "footprint" requirements can be significantly beneficial. Thus, the basic envelope of a modern warehouse should be a square building with a high ceiling.

The development of expandable construction techniques that utilize concrete, metal and other panel type walls permits the design of warehouse buildings that are capable of expanding with a minimum of building modifications. If a self supporting steel frame and roof structure is used with curtain type walls, size can be flexible. When coupled with the concept of cyclic "loop flow" to minimize back hauling and overall travel of material, this feature gives added credibility to the design of square buildings with a corner oriented site configuration. Section 17 of NAVSUP Pub 529 illustrates a site pattern with the rail and truck dock access at right angles and with the high capital investment facilities (restrooms, other employees facilities, mechanical equipment systems, etc.) in the corner of the junction of the rail and truck docks. By locating mezzanines over low bay functional areas such as bulk storage areas, docks, personnel facilities, supervisory offices, material identification and screening, etc., the roof above such areas can be designed to be at the same level as the roof over high bay storage areas. Mezzanines may be used for support functions such as personnel support facilities, assembly, preservation, packaging and packing. Bin, mini-S/R and carousel storage can also be considered for mezzanine levels. See Sample Problem Number 3 in Part D below. Dock designs should be developed in accordance with guidance in NAVFAC DM 32.2 and Section 23 of NAVSUP Pub 529.

**PART C: PROJECT PLANNING CRITERIA.** Criteria for planning and programming new construction or modernization/expansion within existing facilities are as follows:

1. Determine BFR allowances by facility category code using procedures in Section 440B of NAVFAC P-80.

2. For each facility category code, determine portions of BFR allowances that are deficient in terms of the following units of measure as defined in Section 440A of NAVFAC P-80.

- a. Total Cubic Feet (TCF)
- b. Stacking Height (SH or nsh)
- c. Net Square Feet (NS)
- d. Gross Square Feet (SF)

3. Plan facility sizing for the proposed construction or modernization project on the basis of the following two criteria:

d. Maintain the planned TCF value approximately equal to the allowable BFR deficiency value.

b. Maintain the allowable BFR deficiency value of the SF minus NS "delta" (difference) as a maximum value in layout planning.

4. Upon completion of project planning and facility layout, summarize applicable BFR and project data in the following "Equivalency Statement":

"This facility of \_\_\_\_\_ Total cubic Feet (TCF) with \_\_\_\_\_ Net Square Feet (NS) and \_\_\_\_\_ Gross Square Feet (SF) at an Average Clear Stacking Height (SH) of \_\_\_\_\_ feet is EQUIVALENT TO a BFR deficiency allowance of \_\_\_\_\_ TCF with \_\_\_\_\_ NS and \_\_\_\_\_ SF for an SH of \_\_\_\_\_ feet." AN EQUIVALENCY STATEMENT IS TO BE INCLUDED ON ALL PROJECT DOCUMENTATION TO SHOW RECONCILIATION OF THE PROPOSED PROJECT SCOPE WITH THE ALLOWABLE BFR DEFICIENCY VALUES.

**PART D: WAREHOUSE SIZING PROCEDURES AND SAMPLE PROBLEMS.** The following sample problems are developed on succeeding pages to facilitate explanation of sizing procedures that are based on project planning criteria in Part C above:

Sample Problem Number 1 is a MILCON sizing problem based on satisfying the total BFR allowance for controlled humidity space. The problem involves replacing an entire existing warehouse comprised of both Storage Area (SA) facilities and Support (S) facilities. See Definitions and Lines 7 through 7g of the Supply Facility Management Report (SFMR) exhibited in Section 440A of NAVFAC P-80.

Sample Problem Number 2 is a MILCON sizing problem based on satisfying a portion of the total BFR allowance for general purpose warehouse space. The problem involves replacement of some existing substandard SA and S facilities plus an addition of SA and S facilities to satisfy new mission requirements.

Sample Problem Number 3 furnishes sample guidance in combining several types of warehouse space and functions into a single structure. The problem involves utilizing multiple floor level construction as well as high rise single floor level construction resulting in a single level roof and a relatively square footprint.

SAMPLE PROBLEM NUMBER 1

This is a MILCON sizing problem based on satisfying the total BFR allowance for a controlled humidity warehouse. The problem involves replacing an entire existing warehouse containing both SA and S facilities.

1. Sample BFR Computations

ASSUME :

a. Replacement of the one existing functionally and structurally substandard controlled humidity warehouse, Category Code 441-20, at a Naval activity currently reporting on the SFMR. The warehouse comprises both SA and S facilities.

b. BFR values computed/entered on Lines 18a through 22b of the activity's SFMR as given below are approved as BFR allowances.

GIVEN:

<u>SFMR Line No.</u>	<u>Quantity</u>	<u>Description</u>
13f	8116.9	Apparent M/Ts of material currently in store
18a	1.10	Projected increase of 10% in quantity of M/Ts to be stored, stated as decimal multiplier.
18b	8928.6	Projected M/Ts of material to be stored (13f X 18a)
18d	700,000	Projected TCF allowed (18b X 78.4 TCF per M/T)
10d & 19a	10 feet	Average SH value of existing facilities
20a	70,000	Projected NS allowed (18d divided by 19a)
21a & 21c	2.142	Existing/Projected SF/NS Multiplier for SH value of 10 feet (9d X 2b)
22b	150,000	Projected SF allowed (20a X 21c)

SUMMARY OF ALLOWABLE BFR DEFICIENCIES:

700,000 TCF  
10 Feet SH  
70,000 NS  
150,000 SF  
80,000 SF minus NS "Delta"

COMMENTS:

a. The allowable TCF can be satisfied by any combination of NS X SH that equals 700,000 TCF. For example: 10' SH X 70,000 NS or 35' SH X 20,000 NS or 70' SH X 10,000 NS = 700,000 TCF.

b. The 80,000 SF "Delta" is the maximum area allowed for Support (S) facilities and for aisles and structural loss in Storage Area (SA) facilities. See Definitions and Lines 7a through 7d of the SFMR in Section 440A of NAVFAC P-80.

2. MILCON Sizing Computations.

PROCEDURES:

Use NAVSUP Pub 529 system selection criteria and standard modular layout/elevation drawings.

b. Hold allowable TCF constant in determining NS allowable values for any SH values selected using NAVSUP Pub 529 guidance.

c. Develop functional layout. Total SF of layout should not exceed NS of layout plus Allowable SF minus NS "Delta." If good layout practice is applied, the "Allowable Delta" will typically be considerably in excess of layout requirements.

d. Develop an "Equivalency Statement."

ASSUME:

a. MILCON Scope is defined by allowable BFR deficiencies summarized in Item 1 above.

b. A 35 foot SH turret truck/rack system is selected as the least cost total system alternative, based on NAVSUP Pub 529 system selection criteria that include comparative costs for facilities, equipment and handling labor.

c. Planning and layout efforts evolve the following:

(1) NS = 20,000 (700,000 TCF divided by 35' SH)

(2) SF = 62,000 based on layout. This is less than the 100,000 SF allowed (20,000 NS plus 80,000 SF "Delta")

COMMENT:

The SPINS Multiplier for the above equals 62,000 SF/20,000 NS or 3.1. This compares favorably with SF/NS Multipliers for comparable 32 foot SH turret truck/rack systems planned or constructed recently. For example, a 3.3 ratio applies to a 32,000 SF facility with a turret/rack system and a 4.0 ratio applies to a 13,000 SF facility with a turret truck/rack system. Note that the SF/NS ratio decreases as the building size increases. The SF/NS ratio will also vary from one type storage/ handling system to another. The Total SF of a warehouse facility is equal to the total of its S and SA (if any) segments. Note on modular layout drawings for storage/handling systems in Sections 21 and 22 of NAVSUP Pub 529 that the SA/NS ratio will vary from one system to another. The SA/NS ratio is basically a function of storage aisle and cross aisle widths; the narrower the aisles, the lower the SA/NS ratio and, therefore, the lower the SF/NS ratio.

EQUIVALENCY STATEMENT:

The following Equivalency Statement reflects the above and is to be entered on submissions of applicable construction project or modernization/expansion project documentation: "This facility of 700,000 TCF with 20,000 NS and 62,000 SF at an SH of 35 feet IS EQUIVALENT TO a BFR allowance/deficiency of 700,000 TCF with 70,000 NS and 150,000 SF at an SH of 10 feet."

NOTE: For additional planning information and latest data on SF/NS Multipliers for recent high rise construction projects, contact NAVSUP, Navy Warehouse Utilization Program Manager, Autovon 227-2358 or 227-1100.

SAMPLE PROBLEM NUMBER 2

This is a MILCON sizing problem based on satisfying a portion of the total BFR allowance for general purpose warehouse space. The problem involves replacement of some existing substandard SA and S facilities plus an addition of SA and S facilities to satisfy new mission requirements.

1. Sample Computations of Allowable BFR Deficiencies.

ASSUME:

d. Replacement of two general purpose warehouses, Category Code 441-10, that are structurally substandard. These are Warehouse 100, used exclusively as an S facility to perform shipping, receiving and miscellaneous support functions, and Warehouse 102 used as an SA and S facility to perform storage functions as well as miscellaneous support functions. These warehouses are at a Naval activity currently reporting on the SFMR. Backup detailed information on TCF, SH, NS and/or SF values for these storage units are contained in Storage Unit Reports (NAVSUP Forms 605) in accordance with NAVSUP Manual, Paragraph 27028. Comparable data should be maintained in Facility Planning Documents in accordance with NAVFACINST 11010.44 Series.

b. Current Category Code 441-10 assets (including Warehouses 100 and 102) are equal to current approved BFR allowances.

c. The storage activity is an air station that has been designated by higher authority to support a new type aircraft that is planned to be operational at the air station in about two years or within the current Five Year Defense Plan (FYDP). TCF allowances for the additional aircraft and personnel translate to an increase of 10 percent in the quantities of M/T's of material to be stored based on the Universal Factor of 78.4 TCF allowed per M/T of material to be stored. See sample Data/Calculations in Part C, Item l.b.(1) of Section 440B, aircraft/ personnel tables with TCF and SF allowances in Section 440B and derivation of the Universal Factor in Section 440A of NAVFAC P-80.

d. Approved BFR allowances are determined as in Sample Problem Number 1 above.

e. The applicable Table of Derived Allowable BFR Deficiencies is as follows:

<u>Description</u>	<u>TCF</u>	<u>SH</u>	<u>NS</u>	<u>SF</u>	<u>SF Minus NS Delta</u>
Approved FYDP BFR Allowances (Includes + 10%)	7,700,000	10	770,000	1,650,000	880,000
Current Asset	<u>7,000,000</u>	10	<u>700,000</u>	<u>1,500,000</u>	<u>800,000</u>
Current deficiency (w/o replacements)	700,000	10	70,000	150,000	80,000
Replace Building 100 (S Facility)	0	N/A	0	120,000	120,000
Replace Building 102 (SA and S Facility)	<u>1,300,000</u>	13	<u>100,000</u>	<u>240,000</u>	<u>140,000</u>
Allowable BFR Deficiencies (with replacement of Bldgs 100 and 102)	2,000,000	11.76	170,000	510,000	340,000

COMMENTS:

a. The Allowable TCF Deficiency can be satisfied with any single combination or multiple combinations of NS X SH that equal a total of 2,000,000 TCF.

b. The 340,000 SF "Delta" is the SF maximum allowed for Support (S) facilities and for aisles and structural loss in Storage Area (SA) facilities.

c. Note that Building 100 has no Storage Area (SA) facilities and, therefore, it has no TCF, SH or NS values.

## 2 . MILCON Sizing Computations.

### PROCEDURES:

Use procedures outlined in Sample Problem Number 1 above.

### ASSUME:

a. MILCON scope is defined by Allowable BFR Deficiencies as listed in the table in Item 1 above.

b. A 50 foot SH storage/retrieval (S/R) system is selected as the least cost total system alternative for the pallet rack storage requirements listed in the table below and that a 25 foot SH order picking truck system is selected as the least cost total system alternative for the bin storage requirements listed in the table below. These selections were made on the basis of system selection criteria in NAVSUP Pub 529 that include comparative costs for facilities, equipment and handling labor.

c. The data listed in the following Table of MILCON Facility Requirements are derived from use of system selection criteria in the NAVSUP Pub 529 and reflect MILCON sizing derived from follow-on functional analysis and layout drawings.

Type	Facility	Functional Area	TCF	SH	NS	SF	"Delta"
S		Shipping/Receiving Miscellaneous supplies	0	N/A	0	120,000	120,000
SA		S/R Pallet Storage	1,000,000	50	20,000	40,000	20,000
SA		Order Picking Truck -Bin Storage	<u>1,000,000</u>	25	<u>40,000</u>	<u>120,000</u>	<u>80,000</u>
SA & S		Total MILCON Facility Require- ments	2,000,000	33.3	60,000	280,000	220,000

### COMMENTS:

a. Note that the Planned Total MILCON Requirement of 2,000,000 TCF is equivalent to the Allowable BFR Deficiency value of 2,000,000 TCF in the Table of Derived Allowable BFR Deficiencies in Item 1 above. Similarly, note that the Planned Total MILCON Facility Requirement of 220,000 SF for the "Delta" is less than the Allowable BFR Deficiency value of 340,000 SF. Thus, the proposed MILCON sizing meets the criteria of Part C above.

b. Note that for the S/R Pallet Storage System requirement, the gross to net or SA/NS ratio is 40,000 SF/20,000 NS or 2.00. This is comparable to the SA/NS ratio entered on the modular layout drawing for this system in the NAVSUP Pub 529. Similarly, the SA/NS ratio of 120,000 SF/40,000 or 3.00 for the Order Picking Truck/Bin System is comparable to the SA/NS ratio entered on the modular layout drawing for this system in the NAVSUP Pub 529.

EQUIVALENCY STATEMENT:

The following Equivalency Statement applies to the foregoing and is to be entered on submissions of applicable project documentation:

"This facility of 2,000,000 TCF with 60,000 NS and 280,000 SF at an average SH value of 33.3 feet IS EQUIVALENT TO a BFR allowance/deficiency of 2,000,000 TCF with 170,000 NS and 510,000 SF at an average SH of 11.76 feet,"

SAMPLE PROBLEM NUMBER 3

This sample problem furnishes guidance in combining several types of warehouse functional areas into a single structure. The problem involves utilizing multiple floor level construction as well as high bay single floor level construction resulting in a flat roof with a relatively square footprint at ground level.

Assume that a decision is made to combine Total MILCON Facility Requirements of Example Problem Number 2 above into a single MILCON project.

Data developed during layout planning for the three functional segments listed in Sample Problem Number 2 are summarized below for integrated layout planning purposes:

<u>Project Segment</u>	<u>Space Requirements</u>	<u>Location of Project Segment</u>
Pallet Rack S tot-age Area	40,000 SF at 50' SH	Ground level adjacent Shipping/Receiving/ Misc. Support area
Shipping/Receiving/ Misc. Support Facility Area	120,000 SF*	Ground level adjacent to Pallet Rack Storage Area
Bin Storage	120,000 SF at 25' SH*	Above 120,000 SF Shipping /Receiving/ Misc. Support Area

\*The height of the Shipping/Receiving/Misc. Support area should be planned SO that such height plus the 25 foot SH of the bin storage area plus the flooring/sprinklers/other fixtures between such two floors equate to the 50 foot SH of the adjacent Pallet Rack Storage area.

The foregoing reveals that a single facility occupying a ground area of 160,000 SF (40,000 SF + 120,000 SF) and having a flat roof over such entire area at a height that is adequate to accommodate the 50 foot SH requirement in the Pallet Rack Storage area will accommodate all three project segments. One example of a configuration for such building is 400 feet long by 400 feet wide and approximately 56 feet high (outside dimensions). This scenario satisfies guidance in Part B above, in NAVFAC DM 32.2 and in Section 17 of NAVSUP Pub 529 regarding the desirability of constructing high rise buildings that are relatively square and have a single roof level for economic purposes whenever possible.

**PART E: ADDITIONAL PLANNING GUIDANCE.** will not always be possible or feasible to construct square buildings with a single roof level. Guidelines pertaining to factors bearing on this issue and other issues that relate to sample problems in Part D and to related discussion in the last paragraph of Part B are listed below:

1. Whenever functionally and economically feasible, consider constructing high rise SA facilities as a contiguous addition to existing low rise facilities. Use existing low rise buildings as S facilities for accommodation of support functions and as SA facilities for storage of bulk materials that cannot be stored in high rise pallet, cantilever or other type racks.

2. When a high rise warehousing facility is being planned to resolve Allowable BFR Deficiencies that include a TCF requirement for bulk storage, consider the following options:

a. Locate the bulk material SA facility on the first floor level under mezzanine levels whenever possible, using an SH value of 12 to 16 feet.

b. If it is not realistic to locate the bulk material SA facility and/or all support functions under mezzanines as proposed in Item 2.a and Sample Problem Number 3 above, respectively, or in existing/contiguous low rise structures as proposed in Item 1 above, consider the following two alternatives:

(1) Plan the construction of the new facility with two roof levels. Provide a high roof level above high rise SA facilities and a low roof level above support functions and bulk storage SA requirements.

(2) Plan the construction of the new facility with a single high roof level if future expansion of high rise SA requirements is anticipated. Locate bulk storage SA requirements and "relocate" support functions in the area of the planned structure identified for future expansion of high rise SA requirements. This scenario should be adopted only if it can be operationally and economically justified. If adopted on this basis, assume for practical purposes that the SH value chargeable to bulk storage areas is 12 to 16 feet when computing the TCP capacity of such areas for the "Equivalency Statement" required on applicable MILCON documentation; use the actual SH value (3 feet below roof truss, sprinklers and other overhead obstructions) when computing the value of "TCF in Bulk Storage Areas" required for entry on Line 10c of the SFMR.

3. For a correlation between Allowable BFR Deficiency values for pallet rack areas and the number of pallets to be stored, see Section 14.3.4 of the NAVSUP Pub 529. Note that an average of about 0.8 M/T's of material are to be Planned for storage in each pallet load location when standard Navy/DOD 108 inch wide double opening shelving is spaced on 48 inch vertical centers. Modular elevation drawings in Section 21 of the NAVSUP Pub 529 apply. Similarly, note that an average of about 1.1 M/T's of material are to be planned for storage in each pallet load location when such shelving is spaced on 66 inch vertical centers. The modular elevation drawing in Appendix C of NAVSUP Pub 529 applies. Similar correlations are applicable to other storage

and handling systems illustrated in Sections 21 and 22 of NAVSUP Pub 529. The Universal Factor of "78.4 TCF Allowed per M/T of Material to be Stored" is applicable in such correlations.

NOTE: For additional information or assistance, contact the NAVSUP, Navy Warehouse Utilization Program Manager on AV 227-2358 or 227-1100.

## SECTION 440D

### STORAGE SPACE ALLOWANCES (NS) FOR VEHICLES IN PRE-POSITIONED WAR RESERVE MATERIAL STOCK (PWRMS)

Activities having a mission to store and issue vehicles in pre-positioned war reserve material stock are authorized covered storage for their vehicles if they are subject to prolonged severe weather conditions.

There are two methods for determining storage space requirements for vehicles in PWRMS. The method selected should be based upon the information available and the data required.

#### METHOD 1.

In those instances when the dimensions of vehicles are not available, or are subject to drastic change, Table 440D-1 may be used as broad planning guidance for use in determining the gross square footage requirement for this facility, which is based upon the number and types of vehicles to be stored.

TABLE 440-DI  
Storage Space Allowances (SF) Per PWRMS Vehicle

Type of Equipment in PWRMS	Total SF Allowance Per Vehicle
General Purpose Vehicles	220
Construction Equipment	330
Special Purpose Vehicles	330

#### METHOD 2.

The total net and gross square foot storage requirement can be determined when the number and type of each vehicle is known. The criteria and supporting tables are provided in the "CATEGORY CODE 440-SUPPLEMENT STORAGE SPACE ALLOWANCES(NS) FOR VEHICLES IN PREPOSITIONED WAR RESERVE MATERIAL STOCK (PWRMS)" and is located at the back of this section, starting on page 440S-1.

Covered vehicle holding space for a maintenance function will be assigned under the appropriate "shop" code. For example, covered storage for pavements and grounds equipment is assigned to Category Code 219-20; ground support equipment is assigned to Category Code 218-61; and vehicle parking areas (open) is carried under 852-10.

**CATEGORY CODE 440 - SUPPLEMENT STORAGE SPACE ALLOWANCES (NS)  
FOR VEHICLES IN  
PRE-POSITIONED WAR RESERVE MATERIAL STOCK (PWRMS)**

**VEHICLE SPACE FACTORS**

Table 440-D2 provides a means of determining the amount of space (gross square feet) needed to store various types of vehicles. A vehicle space factor of 1 equals 101 square feet of floor space. To determine the space factor of a vehicle not listed multiply the vehicle length by the vehicle width and divide by 101.

**VEHICLE SPACE REQUIREMENTS**

The total amount of space required to store the assigned vehicles may be computed as follows:

- (a) Determine the number of vehicles, by type, for which storage space is required.
- (b) Assign to each vehicle the appropriate space factor obtained from Table 440D-2 and compute the total of the space factors so obtained.
- (c) To determine the total net square feet required, multiply the total space factor obtained by 101.
- (d) To determine the total gross feet required, use Table 440D-3.

**TCF REQUIREMENTS**

To determine TCF for each vehicle group or class of vehicles, multiply the NS allowance for the vehicle group by the height of the tallest vehicle in the group. The height of the tallest vehicle in the group is the SH for the group.

See the definitions for TCF, NS and SH in Section 440A.

Therefore, for planning purposes:

$$\text{TCF} = \text{NS} \times \text{SH}$$

TABLE 440D-2  
VEHICLE SPACE FACTORS

COMMERCIAL DESIGN GENERAL PURPOSE VEHICLES		COMMERCIAL DESIGN SPECIAL PURPOSE VEHICLES	
	Vehicle Space Factors		Vehicles Space Factors
Ambulances	1.5	Carrier, Amphibious, Cargo, or Snomobile	2.5
Bus, 12 passenger, 4 X 2	1.6	Crane, Models L-3010, MC-1, A-16	6.0
Bus, BOC, 37 passengers or less	1.6	Crane, Model H-11	4.5
Bus, BOC, 38 passengers & over	2.5	Dolly Trailer	0.1
Bus, Integral & Convertible	3.5	Semitrailer, Van Refrigerator	2.5
Bus, Multi-Train (4 unit)	12.0	Semitrailer, All Others	0.6
Carriers, all	2.5	Trailers, All	0.4
Dolly Trailer Converter	0.1	Truck, Airfield Line Servicing	2.0
Motorcycles	0.6	Truck, Armored Payroll	3.0
Scooters	0.6	Truck, Coal	2.5
*Sedans	1.0	Truck, Dump, 23,999 GVW & less	2.5
Semitrailer, Van	0.6	Truck, Dump, 24,000 GVW & over	3.0
Semitrailer, All others	0.4	Truck, Dump, Off-the-Road	4.0
*Station Wagons	1.0	Truck, High Lift	3.0
Trailers, All	0.4	Truck, High Reach	4.0
Truck, Panel	1.5	Truck, Insulator Washing	2.0
Truck, Multistop	1.0	Truck, Maintenance	1.0
Truck, Jeep	1.5	Truck, Material Handling	3.5
Truck, Pickup	1.0	Truck, Refrigerator Van	3.5
Truck, 15,999 GVW & less	1.0	Truck, Refuse	3.5
Truck, 16,000 - 18,999 GVW	2.0	Truck, Tank Fuel, 1200 gal. & less	2.5
Truck, 19,000 - 23,999 GVW	2.5	Truck, Tank Fuel, over 1200 gal.	3.0
Truck, 24,000 GVW & over	3.0	Truck, Tank Lavatory, Waste, or Water Servicing	2.5
Truck Tractor, 23,999 GVW & less	2.0	Truck, Tank Water/Waste	3.5
Truck Tractor, 24,000 - 39,499 GVW	2.5	Truck, Telephone Main & Cntrn	2.5
Truck Tractor, 39,500 & Over	3.0	Truck, Wrecker, 21,000 GVW & less	2.5
		Truck, Wrecker, over 21,000 GVW	3.5
*When equipped with air conditioning add .1 equivalent.		CONSTRUCTION AND BASE MAINTENANCE EQUIPMENT	
NOTE: For commercial design trucks (all series) add 0.2 for four-wheel drive.		Batching Plant	1.5
		Compactor, Engine Driven	4.0
		Concrete Block Crane, Crawler & Truck Mounted, 20 ton &, less	5.5
		Crane, Crawler & Truck Mounted, over 20 ton	6.0
		Crane, Towed	4.0

TABLE 440D-2  
(Continued)

Vehicle Space Factors		Vehicle Space Factors	
Crushing & Screening Plant	4.0	Sweeper, Rotary Towed	1.0
Digger Strainer	3.0	Sweeper, Snow Air Blast	2.5
Distributor, Bituminous, Truck mounted	3.0	Sweeper, Vacuum, Runway	4.0
Distributor, Bituminous, Trailer mounted	1.5	Sweeper, Warehouse	1.0
Distributor, Water Truck	3.5	Tractor, Tracked, Size 1 thru 4	4.0
Ditching Machine	3.5	Tractor, Tracked, Size 5 &, over	6.0
Drill, Rock	2.0	Tractor, Wheeled, Ind & Agric	2.5
Dryer, Aggregate	3.0	Tractor, Wheeled w/Bulldozer	6.0
Dryer, Mixer Bituminous/Concrete	3.0	Trailer, Dump	1.0
Earth Auger	1.0	Trencher	3.0
Excavator	3.0	Truck, Dump, Off-the-Road	4.0
Grader, Road Motorized	3.5	Well Drilling Machine	2.0
Grader, Road Towed	1.5		
Grouting Machine	3.0	MATERIALS HANDLING EQUIPMENT	
Heater, Bituminous	3.0	Conveyor, Aggregate	1.0
Joint Cleaning-Refacing Unit	1.0	Conveyor, Belt	2.0
Joint Sealing Unit	1.0	Conveyor, Drag	1.5
Kettle, Heating Bituminous	0.5	Crane, Warehouse Electric	1.0
Loader, Aggregate	2.5	Crane, Warehouse Gas	2.0
Loader, Belt	2.5	Tractor, Warehouse Electric	1.0
Loader, Full Tracked	4.0	Tractor, Warehouse Gas	1.0
Loader, Scoop	4.0	Trailer, Cargo Loading/Unloading	0.5
Marker, Traffic Line, Runway	6.0	Trailer, Palletized Cargo	0.8
Marker, Traffic Line, other than Runway	2.0	Truck, Platform	1.5
Mixer, Bituminous	2.5	Truck, Forklift Electric/Gas	1.5
Mixer, Concrete, Truck Mounted	4.0	Truck, Pallet Electric	1.5
Mixer, Concrete, Trailer Mounted	1.0	Truck, Sideloader	1.5
Mixer, Rotary Tiller	2.0	Truck, Straddle Carry	3.0
Paving Machine	3.0	Truck, Stake Airfield, Elevating or Fixed Platform	3.0
Plow, Cable	2.5	4K Forklift, 463L	1.5
Reeling Machine	1.5	6K Forklift, 4631, A/S32H-7	3.0
Roller, Road Towed	0.5	6K Forklift, Rough Terrain, A/S32H-13	3.0
Router, Road	1.0	10K Forklift, 463L, A/S32H-10	3.0
Sawmill, Trailer Mounted	1.5	10K Forklift, Heady Duty, P100-48-AF	3.0
Scraper, Road Motorized	3.5	10K Forklift, Adverse Terrain, A/S32H-15	4.0
Scraper, Road Towed	1.5	25K Loader, A/S32H-5	12.0
Scrubbing Machine	1.0	40K Loader, A/S32H-6	14.0
Semitrailer, Tank Water Distributor	3.0	55K Loader, A/S32H-16	14.0
Snow Removal Unit, Bank Rotary	5.0	10K Rough Terrain Loader, a/S32H-12	12.0
Snowplows, All others	3.5	Sled, Flatbed	0.4
Spreader, Aggregate	1.0	Sled, Staked	0.3
Sweeper, Magnetic	1.5		
Sweeper, Rotary Self-Propelled	1.8		

TABLE 440D-2  
(Continued)

MILITARY DESIGN, GENERAL PURPOSE

Vehicle Space Factors

Ambulances	1.6
Dolly Trailer Converter	0.1
Semitrailer, Van	0.6
Semitrailer, All others	0.4
Trailers, All	0.4
Truck, 5,999 GVW & less	1.5
Truck, 6,000 - 16,999 GVW	2.0
Truck, 17,000 GVW & over	2.5
Truck Tractor, 20,999 GVW & less	2.0
Truck Tractor, 21,000 - 44,500 GVW	2.5
Truck Tractor, 44,501 GVW & over	3.0

MILITARY DESIGN, SPECIAL PURPOSE

Armored Car or Truck	2.5
Carrier, Amphibious, Cargo, or Personnel	3.0
Semitrailer, Acid	3.0
Semitrailer, Cargo Cylindrical Type	2.0
Semitrailer, Compressed Gas	3.0
Semitrailer, Fuel, 2500 gals. & less	2.0
Semitrailer, Fuel over 2500 gals	3.5
Semitrailer, Recharging LOX/N Cylindrical	3.5
Semitrailer, Runway Foaming	2.5
Semitrailer, Tank LOX/N, NTET, UDMH or N2O4	3.5
Semitrailer, Tank Water	0.4
Semitrailer, Tank Water/Alcohol	3.5
Semitrailer, Van Refrigerator	2.5
Semitrailer, All others	0.6
Trailer, Fire Crash	0.2
Trailer, All others	0.4
Tractor, Aircraft Towing, MB-2	5.0
Tractor, Aircraft Towing, MB-4	2.4
Tractor, Aircraft Towing U-30	8.0
Tractor, Aircraft Towing, Intermediate U-18	4.0
Truck, Airfield Line Servicing	2.0
Truck, Coal	2.5
Truck, Dump, 32,000 GVW & less	3.0
Truck, Dump, 33,000 GVW & over	3.5
Truck, Ffgt Crash (O-11 or P-2)	15.0

Vehicle Space Factors

Truck, Ffgt Crash (O-6 or P-4)	10.0
Truck, Ffgt Crash (P-6, R-2, R-2A, P-10)	3.0
Truck, Fire Pumper	3.5
Truck, Flatbed	1.0
Truck, High Lift	3.0
Truck, High Reach	4.0
Truck, Insulator Washing	2.0
Truck, Refrigerator Van	3.5
Truck, Refuse	3.5
Truck, Tank Demineralized Water	5.0
Truck, Tank Fuel 2500 gals. & less	3.0
Truck, Tank Fuel, over 2500 gals.	6.5
Truck, Tank Liquid Nitrogen	3.0
Truck, Tank Potable Water, 250 gals.	2.0
Truck, Tank Water	3.0
Truck, Tank Water/Waste	4.0
Truck, Telephone Maint & Cntrn, 12,500 GVW & less	1.0
Truck, Telephone Maint & Cntrn, 12,501 GVW & over	2.5
Truck, Van, 12,500 GVW & less	1.0
Truck, Van, 12,501 - 23,999 GVW	2.5
Truck, Van, 24,000 GVW & over	3.0
Truck, Wrecker	3.5

NON-REGISTERED VEHICLES AND OTHER EQUIPMENT

Aerator, Turf	0.3
Auger Attachment	0.5
Cleaner, Steam	0.5
Compressor, Air, to 600 CFM	2.0
Compressor, Air, Gasoline Engine Driven	0.5
Compressor, Air, Power Driven	0.2
De-icer H-33	5.0
De-icer, Spray Truck Mounted	5.0
Digger, Post Hole	0.5
Ditcher Attachment	0.5
Edger, Push Type and Tractor Mounted	0.5
Hoe, Back Attachment	0.5
Hose, Car, Fuel Service 0.5 Line Marker, Street & Pavement	0.4
Missile Checkout Test Station	0.8
Mixer, Application Unit	1.0

TABLE 4400-2

(Continued)

Vehicle Space Factors		Vehicle Space Factors	
Mower, Gasoline Engine Drive, to 25"	0.3	Driven	
Mower, Gasoline Engine Driven, to 76"	0.8	Sod Cutter, Gasoline Engine Driven	0.5
Mower, Towed, to 15'	0.6	Sprayer, Towed	0.5
Mower, Towed, Gang Type	0.5	Stump Remover, Towed	0.5
Platform, Acft Service, A/S32H-13 (except Mtd Equip)	3.0	Tamper, Gasoline Engine Driven	0.5
Pneumatic Test Set Van	0.8	Trailer, Airdome Utility 5000 Lb.	0.4
Power Unit, Under 3KW	0.2	Trailer, Compressed Gas	1.0
Power Unit, 3KW to 4.0KW Inclusive	0.5	Trailer, Hose Cart	0.5
Power Unit, 5KW to 14 KW Inclusive	1.0	Trailer, Missile Support	0.4
Power Unit, 15 KW to 59 KW Inclusive	2.0	Trailer, Missile Transporter	2.0
Power Unit, 60KW to 99KW Inclusive	2.5	Trailer, Stake	0.4
Power Unit, 100KW to 150KW inclusive	3.0	Trailer, Utility	0.2
Pump, Diaphragm, Gasoline Engine Driven	0.4	Trailer, Van	0.4
Pump, Engine	0.5	Trailer, Warehouse	0.4
Pump, Water, Gasoline Engine Driven	0.4	Truck, Aircraft, Prop Handling, A/32M-6	5.0
Saw, Chain, Gasoline Engine Driven	0.5	Truck Decontaminator	2.5
Screed, Gasoline Engine Driven	0.3	Trub-Fogger	0.5
Sickle Bar Attachment	0.5	Unit, Fuel Purification	0.4
Snowblower, Sidewalk, Gasoline Engine	0.8	Unit, Purging, Trailer Mounted	0.2
		Welder, Gasoline Engine Driven	0.4
		Lubrication Unit, Skid, Mtd, GED	0.5

TABLE 440D-3

VEHICLE STORAGE SPACE REQUIREMENTS

Vehicle Space Factor	Area, Gross Square Feet
25 - 50	3,600
51 - 100	7,200
101 - 150	10,800
151 - 250	18,000
251 - 350	26,280
351 - 450	32,400
451 - 650	46,800
651 - 850	59,500
851 - 1,000	74,700