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1404430-44  
1404464-78

DDESB-KT (NAVFACENGCOM/25 Sep 85) 3rd End  
SUBJECT: Box Magazines Type C & D

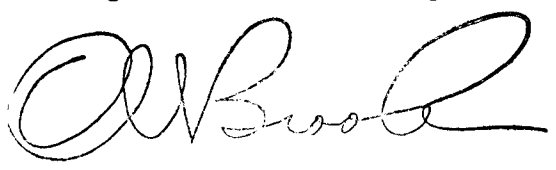
Department of Defense Explosives Safety Board, 2461 Eisenhower Avenue,  
Alexandria, VA 22331-0600 05 NOV 1985

TO: Chief of Naval Operations (OP-04), Department of the Navy,  
Washington, DC 20350

amh  
11/4/85

SS  
11/04/85

As requested, we have reviewed the drawings for subject magazines to determine their suitability to be approved as equal to Standard Magazines identified in paragraph B.1, Chapter 5 of DoD 6055.9-STD. Based on the information furnished, the Type C Box Magazine as described in NAVFAC drawing numbers 1404430 through 1404444, dated 20 Sep 1985, and the Type D Box Magazine as described in NAVFAC drawing numbers 1404464 through 1404478, dated 20 Sep 1985, are approved. These drawing numbers will be added to the list of approved Standard Magazine designs in the next change to DoD 6055.9STD.



Encls  
wd

O. M. Brooks  
Captain, USN  
Chairman

CF:  
COMNAVFACENGCOM (FAC-04T5)  
COMNAVSEASYSOM (SEA-06H)

File 3

0042p/amh/Price

S: 539/255



DEPARTMENT OF THE NAVY

NAVAL FACILITIES ENGINEERING COMMAND

200 STOVALL STREET  
ALEXANDRIA, VA 22332-2300

04T5B/HDN  
11163

25 SEP 1985

From: Commander, Naval Facilities Engineering Command  
To: Department of Defense Explosive Safety Board, Alexandria, VA  
Via: (1) Commander, Naval Sea Systems Command (Code 06H)  
(2) Chief of Naval Operations (Code OP-411)

Subj: BOX MAGAZINES TYPE C&D

Encl: (1) Design Criteria for Box Magazine Types C&D  
(2) NAVFAC Drawings (Nos. 1404430 thru 1404444 and 1404464 thru 1404478)

1. The design criteria and drawings for the subject box magazines are forwarded by enclosures (1) and (2) for your review. After completion of the review, it is requested that the drawings be signed approved in the space provided on the title block.
2. The subject magazines, which are needed as soon as possible for near term construction, were developed to provide construction standards to accommodate special storage requirements for the Tomahawk missile. The main objective in the design of these magazine standards is to provide a 25' wide door into each bay of a three and five bay configuration and to incorporate the latest design criteria. Enclosure (1) lists the design criteria used for both magazines. The criteria is in conformance with the new Tri-Service manual, NAVFAC P-397, titled "Structures to Resist the Effects of Accidental Explosions". This manual is being developed by Amman & Whitney who also developed the subject magazines. NAVFAC and the Naval Civil Engineering Laboratory (NCEL) have reviewed and approved the subject design.
3. In addition to approving the subject drawings, it is requested that these drawings be listed as approved Standards in DOD 6055.9-STD (DOD Ammunition and Explosives Safety Standards).
4. If there are any questions on any of the above, please contact Howard Nickerson, 04T5B, (commercial) 325-0464. After you have signed the drawings please notify Mr. Nickerson who will pick them up.

CHARLES D. MARKERT  
Acting Assistant Commander for  
Engineering and Design

Copy to:  
NCEL (B. Armstrong, L51; J. Tancreto; L51, B. Keenan L51)  
CNO, OP-03

100285 0002



DEPARTMENT OF THE NAVY

NAVAL SEA SYSTEMS COMMAND  
WASHINGTON, DC 20362-5101

IN REPLY REFER TO

8020  
Ser 06H1/857

10 OCT 1985

FIRST ENDORSEMENT on NAVFACENCOM ltr 04T5B/HDN 11163 of  
25 Sep 1985

From: Commander, Naval Sea Systems Command  
To: Chairman, Department of Defense Explosives Safety Board  
Via: Chief of Naval Operations (OP-411)

Subj: BOX MAGAZINES TYPE C & D

1. Forwarded, recommending approval of the design criteria and drawings for the magazines.

Copy to:  
NAVFACENCOM (04T5B/HDN)  
NCEL (L51)  
CNO (OP-03)

A handwritten signature in black ink, appearing to read "M. R. Van Slyke".

M. R. VAN SLYKE  
By direction



DEPARTMENT OF THE NAVY  
OFFICE OF THE CHIEF OF NAVAL OPERATIONS  
WASHINGTON, DC 20350-2000

IN REPLY REFER TO  
8020  
Ser 411F/5U395807  
15 Oct 85

SECOND ENDORSEMENT on NAVFACENGCOM ltr 04T5B/HDN 11163 of 25 Sep  
1985

From: Chief of Naval Operations  
To: Chairman, Department of Defense Explosives Safety Board

Subj: BOX MAGAZINES TYPE C & D

Ref: (a) DOD 6055.9-STD

1. Forwarded in accordance with reference (a), recommending approval of subject magazines as standard magazines.

A handwritten signature in cursive script that reads "Robert L. Wernsman".

ROBERT L. WERNSMAN  
By direction

Copy to:  
COMNAVFACENGCOM (FAC-04T5)  
COMNAVSEASYSKOM (SEA-06H)

DESIGN CRITERIA FOR BOX MAGAZINES TYPES C&D

The subject magazine designs provide structures of sufficient strength to prevent propagation of an accidental explosion based on the standard intermagazine separation distances and blast loads listed on the next page under design loads. The listed intermagazine orientations develop the critical loading for the roof and headwall. Naval Civil Engineering Laboratory used ESKIMO VI test results to determine these loads. The loads include the effects of 1.2 factor of safety on the 350,000 lbs. H.E. rated capacity of the subject magazines (i.e. Design Charge Wt=1.2x350,000=420,000). The design methods and parameters used were similar to those used for NAVFAC's Type A Concrete Box Magazine Standard except as updated by ESKIMO VI test data. The Structural behavior assumptions are as follows:

(a) Head Wall (Doors & Pilasters):

Single-leaf sliding doors are designed for positive blast loading (not for rebound and negative pressure). The doors span vertically. The blast load reactions of the door are resisted by the bottom trench beam and the top header beam. The reaction of the door produces a direct load and a torsional load on the header beam and a direct load on the trench beam. The direct load from the header beam is resisted by the roof slab which in turn transfers the load to the side walls. The direct load from the trench beam is resisted by the floor slab. The pilasters resist the torsional load from the header beam.

(b) Roof:

Designed as a flat slab which can undergo large deflections because of tension membrane stresses that are developed. Roof also transfers direct load from door header beam to side walls.

(c) Side & Back Walls:

Designed for lateral earth pressure.

## DESIGN LOADS

### Soil Data

- |  |   |           |
|--|---|-----------|
| 1. Assumed Soil Bearing Capacity                   | - | 4,000 psf |
| 2. Assumed Dynamic Response Factor                 | - | 2.5       |
| 3. Assumed Lateral Soil Pressure Coefficient       |   |           |
| a. Magazine Walls                                  | - | 0.5       |
| b. Wing Walls                                      | - | 0.3       |
| 4. Assumed Coefficient of Friction (conc. on soil) | - | 0.5       |

### Static Loads

- |  |   |          |
|--|---|----------|
| 1. Roof Dead Load (1-1/2 ft. Earth Fill + 6 in. Gravel Fill) | - | 200 psf  |
| 2. Floor Live Load   | - | 2000 psf |
| 3. Platform and Ramp Live Load                               | - | 1000 psf |
| 4. Roof Live Load  | - | 100 psf  |

### Seismic Load

Earthquake motions up to Zone 4

### Blast Loads

Based on Intermagazine Separation Distances for a Quantity (W) of HE equal to 350,000 pounds as follows:

- Roof - Donor Magazine Located at  $2W^{1/3}$  to the Rear of the Acceptor Magazine
- Headwall - Donor Magazine Located at  $2W^{1/3}$  to the Front of the Acceptor Magazine
- Pressure - Time Variation (Triangular Load)\*
  - Roof -  $P_{SO} = 108 \text{ psi}$ ;  $t_0 = 25 \text{ ms}$ ;  $I_S = 1350 \text{ psi-ms}$
  - Head Wall  $P_r = 360 \text{ psi}$ ;  $P_{SO} = 80 \text{ psi}$ ;  $t_r = 10 \text{ ms}$ ,  $t_0 = 17.6 \text{ ms}$ ,  
 $I_r = 1800 \text{ psi - ms}$ ;  $I_S = 705 \text{ psi-ms}$

\* Determined by Naval Civil Engineering Laboratory.

Enclosure (1)<sub>2</sub>

### Static Stresses

- |   |               |
|---|---------------|
| 1. Concrete Compression Strength ( $f'_c$ )     | - 4,000 psi   |
| 2. Reinforcement ( $f_s$ ) (ASTM A615 Grade 60) | - 66,000 psi* |
| 3. Structural Steel ( $f_s$ ) (ASTM A36)        | - 39,600 psi* |

\* Increased 10 percent above minimum as specified by ASTM

### Dynamic Load Factors

- |                     |        |
|---------------------|--------|
| 1. Concrete         | - 1.19 |
| 2. Reinforcement    | - 1.17 |
| 3. Structural Steel | - 1.3  |

### Dynamic Stresses

- |  |              |
|--|--------------|
| 1. Concrete Compression Strength ( $f'_{dc}$ ) | - 4,760 psi  |
| 2. Reinforcement ( $f_{ds}$ )                  | - 77,220 psi |
| 3. Structural Steel ( $f_{ds}$ )               | - 51,480 psi |

### Deflection Criteria (Maximum Support Rotation)

- |                |            |
|----------------|------------|
| 1. Roof Slab   | 8 degrees  |
| 2. Head Wall   | 6 degrees  |
| 3. Header Beam | 2 degrees  |
| 4. Pilaster    | 3 degrees  |
| 5. Blast Doors | 12 degrees |