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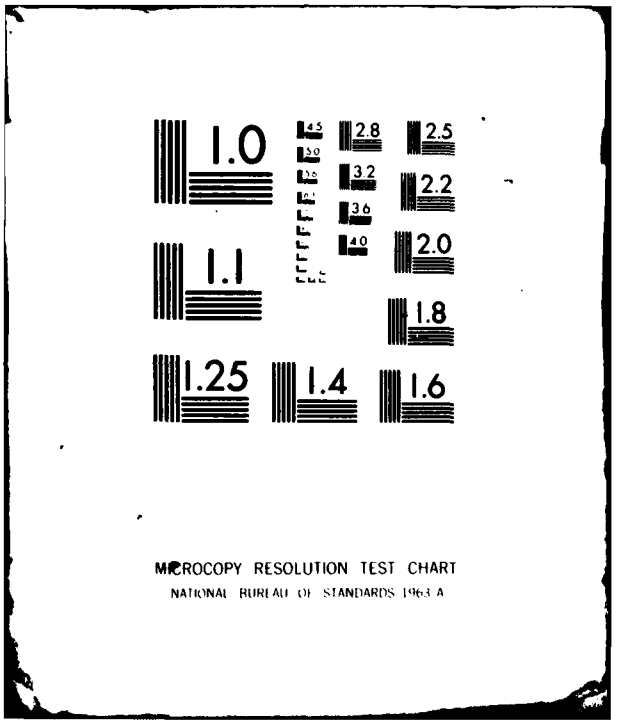
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NWHC REPORT 8053
15 AUGUST 1980

A NAVAL WEAPONS HANDLING CENTER

TECHNICAL REPORT

AD A089305

DEVELOPMENT AND TESTING OF PACKAGING FOR COMMERCIAL SHIPMENT OF SURVIVAL SUPPORT DEVICE

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Survival Support Device	Fiberboard Boxes
Commercial Shipment	Unit Load Test
Pressurized	Cable Cutter

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The Survival Support Device (SSD) is a vessel containing compressed air with a clear plastic hood and a regulating valve. The device is intended to facilitate breathing by personnel while evacuating a smoke or fume filled compartment aboard ship. Based on the relatively high internal pressure of the compressed air, restriction was placed on the commercial shipment of the SSD's by the Department of Transportation.

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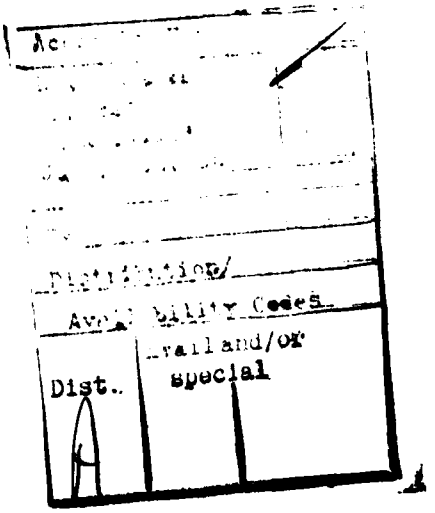
The Naval Weapons Handling Center (NWHC) was tasked to develop a suitable shipping configuration for these devices which would minimize potential hazards to personnel and objects in the event of a failure.

In conjunction with the Naval Explosive Ordnance Disposal Facility (NAVEODFAC), Naval Ordnance Station Indian Head, Maryland, a means of failure simulation was devised. Concurrently, a packaging design was initiated at NWHC based on the predicted failure mode.

On 1 April 1980 tests of fully pressurized SSD's were conducted at NAVEODFAC. Based on successful test results, NAVSEASYSCOM issued a Certification Control Number permitting commercial shipments of the SSD.



NWHC REPORT 8053

NAVAL WEAPONS STATION EARLE
NAVAL WEAPONS HANDLING CENTER

DEVELOPMENT AND TESTING

OF PACKAGING FOR

COMMERCIAL SHIPMENT

OF SURVIVAL SUPPORT DEVICE

ABSTRACT

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INTRODUCTION AND BACKGROUND

The Survival Support Device (SSD) is a short term breathing apparatus intended to facilitate escape from smoke or fume filled compartments. The SSD contains compressed air and is constructed of stainless steel tubing connected to a regulating valve and a clear plastic hood. The SSD is supplied with a carrying case and is issued in individual fiberboard boxes.

An earlier and physically identical model has been in service for approximately 6 years and had been shipped by commercial means. However, in order to provide longer breathing time (i.e., more air) the internal pressure was increased from 5000 psi in the old model to 6500 psi in the newer model. The Department of Transportation (DOT) placed a restriction on the commercial transport of the newer SSD model based on their opinion that the higher internal pressure had significantly reduced the design margin of safety.

NWHC was tasked by NAVSEASYSCOM to design, construct, test and evaluate packaging for commercial shipping and to produce documentation suitable for obtaining DOT exemption. Based on a review of fleet experience with the previous model and an analysis of potential failure modes, it was concluded that the worst case would be inadvertant rapid decompression due to failure of the tubing. This could be caused by fatigue cracks, corrosion or punctures. Consideration was also given to possible fragmentation of a failed SSD followed by puncturing of adjacent SSDs in a unit load.

EQUIPMENT AND MATERIALS

1. Lear Siegler SSD w/Case (As req'd)
2. Cable Cutter (P/N 100996-3) w/Charge, Actuator and Wiring
3. Tri State Engineering Cargo Tainer Clearview 40" x 48" x 30"
4. Fiberboard Boxes (PPP-B-636) (As req'd)
5. Fiberboard Material (PPP-B-640) (As req'd)
6. Dimensional Lumber Bracing (As req'd)
7. Plywood 46" x 38" x 3/8"

PACKAGING AND PACKING DEVELOPMENT

NWHC addressed the anticipated sudden depressurization of a single SSD by designing an overpack which provided venting (i.e., an avenue of escape for the released air). (Figure 1) The venting was accomplished by construction of relatively simple separators and an arrangement of the units such that each unit was adjacent to an open vent channel. Final containment in the event of possible fragmentation of one or more units would be provided by the wire mesh pallet crate or the 3/8" plywood cover.

In accordance with guidelines from NAVSEASYSCOM, NWHC specified the grouping of eight SSDs in individual fiberboard boxes as a unit of issue. This also provides ease of handling. The unit load was comprised of 12 of the eight packs for a total of 96 units.

FAILURE SIMULATION

A means of tubing failure on demand was required in order to validate any packaging configurations proposed. NWHC received technical assistance in this regard from the Naval Explosive Ordnance Disposal Facility (NAVEODFAC) at Naval Ordnance Station (NOS) Indian Head. NAVEODFAC recommended trials of two methods. The first method utilized a small linear shaped explosive charge attached to the tubing. The second method involved use of a device normally used to sever steel cable. This device, the "cable cutter," uses a small firing squib detonated inside of a closed cylindrical chamber. Upon detonation, an internal piston is propelled outward. At the other end of the piston is a wedge shaped cutter. Anything placed between the cutter and the anvil baseplate will be severed.

An evaluation of the methods above was conducted on two unpressurized SSDs at NAVEODFAC on 28 January 1980. (Figures 2, 3 and 4) Following the detonation of a small linear shaped charge positioned on the SSD tubing, not only was the tubing severed, but the blast also caused secondary punctures in the tubing and destruction of the carrying case. (Figures 5 and 6) It was concluded that the explosive method was too powerful for the intended purpose.

The test of the "cable cutter" produced excellent results. Figure 7 shows that the SSD was still in the same location as before the "cable cutter" actuation. In fact, there was no outward indication that the squib had fired. It was necessary to dismount the cable cutter and examine the tubing. Figure 8 shows the partially severed tubing. If the SSD had been a pressurized unit, a rapid depressurization would have followed.

TEST AND EVALUATION

Two tests were conducted on pressurized SSDs at NOS Indian Head on 1 April 1980. The purpose of the testing was to determine the effects of an inadvertant rapid depressurization of a fully charged SSD in (1) its own carrying case and individual fiberboard box and (2) when packaged as in (1) but placed in the interior of a unit load shipping configuration as shown in Figure 1. The failure simulation for both tests utilized the remotely triggered "cable cutter" previously described.

1. Single Unit Test

The single unit was prepared for testing by installing a cable cutter, and leading out the wires while repackaging the SSD in its carrying case and fiberboard box. (Figure 9)

SURVIVAL SUPPORT DEVICES
SHIPPING CONFIGURATION

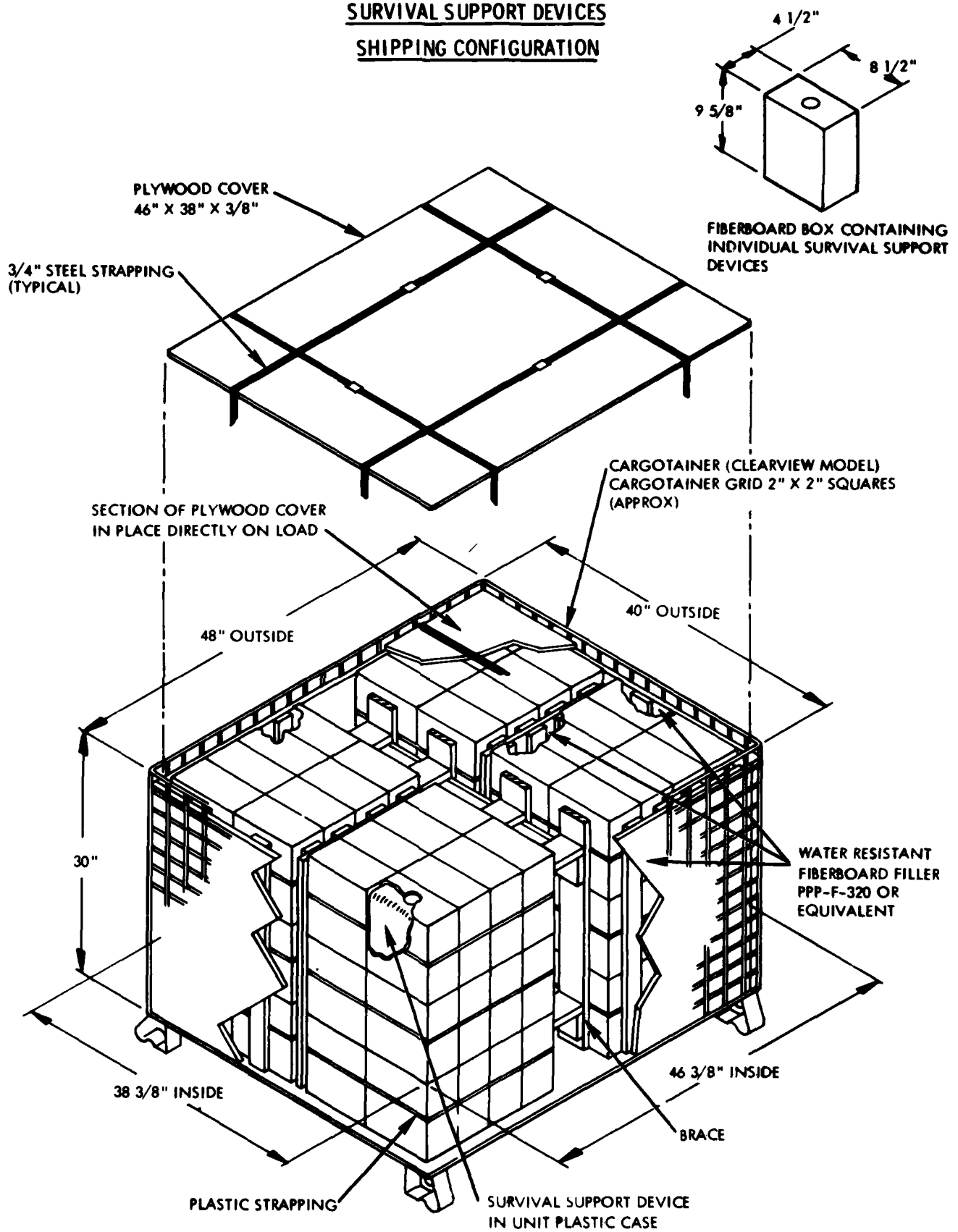

Figure 1 - Survival Support Devices
Shipping Configuration

Figure 2 - Small Linear Shaped Charge
Mounted On SSD Tubing
Before Trial

Figure 3 - "Cable Cutter" Mounted On
SSD Tubing - Before Trial

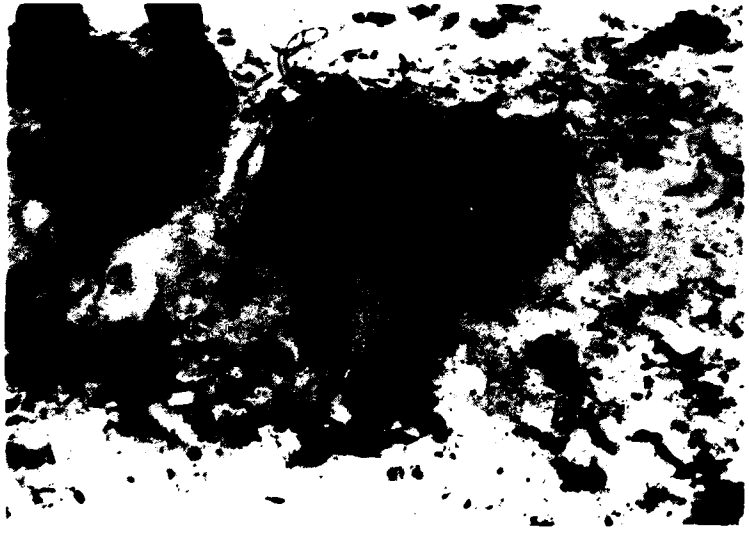

Figure 4 - Unpressurized SSD With Linear
Charge On Test Range
Before Trial

Figure 5 - Unpressurized SSD With Linear
Charge On Test Range
After Trial

Figure 6 - Unpressurized SSD With Linear Charge On Test Range - After Trial (Close-Up)

Figure 7 - Unpressurized SSD With "Cable Cutter" After Trial

Figure 8 - Partially Severed Tubing On Unpressurized SSD - After Trial (Cable Cutter Removed)

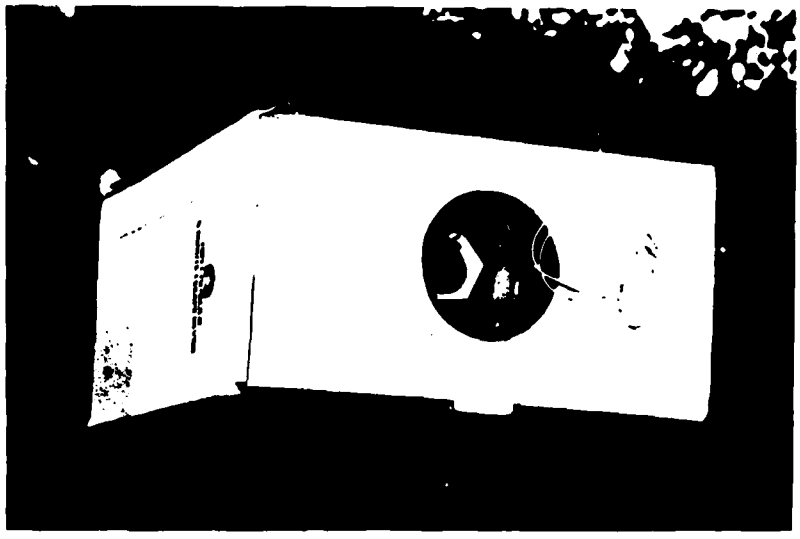

Figure 9 - Pressurized SSD on Test Range Prior To Trial

Direct observation during the test was not possible. Following the test, no change in the orientation or location of the unit was noted. Except for the intentionally severed tubing (confirmed by removal of the cutter), no damage was evident to the SSD, the carrying case or the fiberboard box. Subsequent examination of the high speed motion pictures confirmed no movement of the test unit during the test; but as evidence of the release of air from the SSD, when the tubing was severed, it was noted that the top flap of the fiberboard box lifted or bulged slightly (but did not open) and then returned to its original position.

2. Unit Load Test

The preparation of the unit load (96 SSDs in a wire mesh pallet crate) required almost complete disassembly of the unit load as prepared by and transported from NSRDC Annapolis, MD. It was found that plastic strapping, as specified by NWHC, was loose on all of the eight-packs. This was due to either improper installation, or stretching during the transport from NSRDC Annapolis and the handling at NAVOEDFAC Indian Head. This situation had been anticipated and filament reinforced tape was available for rebanding the eight packs, if necessary. Two out of the 12 eight packs required rebanding. The rest were satisfactory when handled with care and only carried a few feet. The eight-pack containing the test unit was a rebanded group. (Figure 10) The tape was judged to be more suitable than the plastic strapping.

The cable cutter was installed on the test unit and unit load was reassembled. The eight pack with the test unit was placed in the center tier and the test unit was positioned on the interior adjacent to a fiberboard separator. (Figures 11 and 12) This was considered to be a minimum venting location.

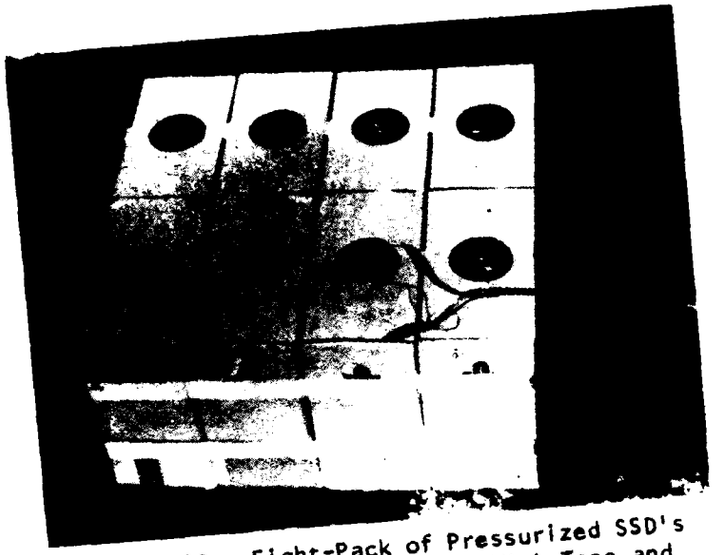

Figure 10 - Eight-Pack of Pressurized SSD's After Rebanding With Tape and Installation of Cable Cutter

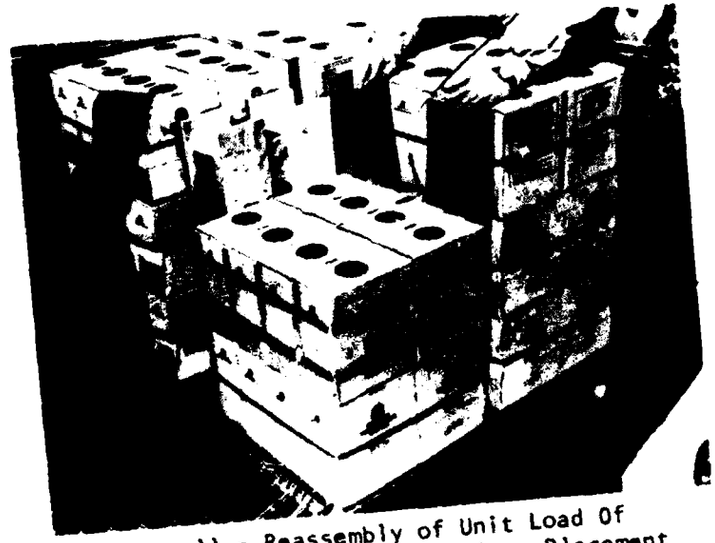

Figure 11 - Reassembly of Unit Load Of Pressurized SSD's - Placement Of Eight-Pack With Test Unit is Shown

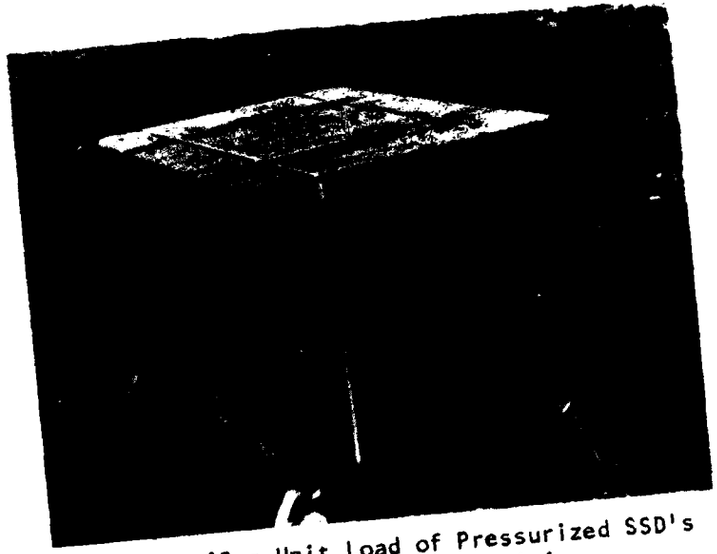

Figure 12 - Unit Load of Pressurized SSD's Prior To Trial

Figure 13 - Test SSD After Actuating Cable Cutter and Partial Disassembly Of Unit Load (Note Top Flap of Fiberboard Box Open and View Window of Carrying Case Ajar)

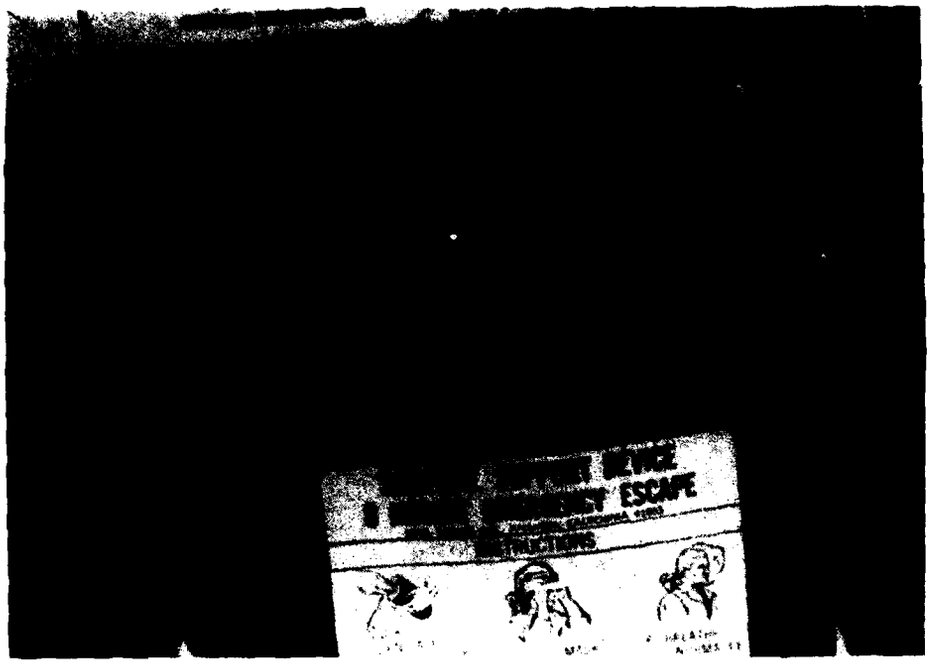

Figure 14 - Separation of Carrying Case Upper and Lower Portions Upon Removal From Fiberboard Box

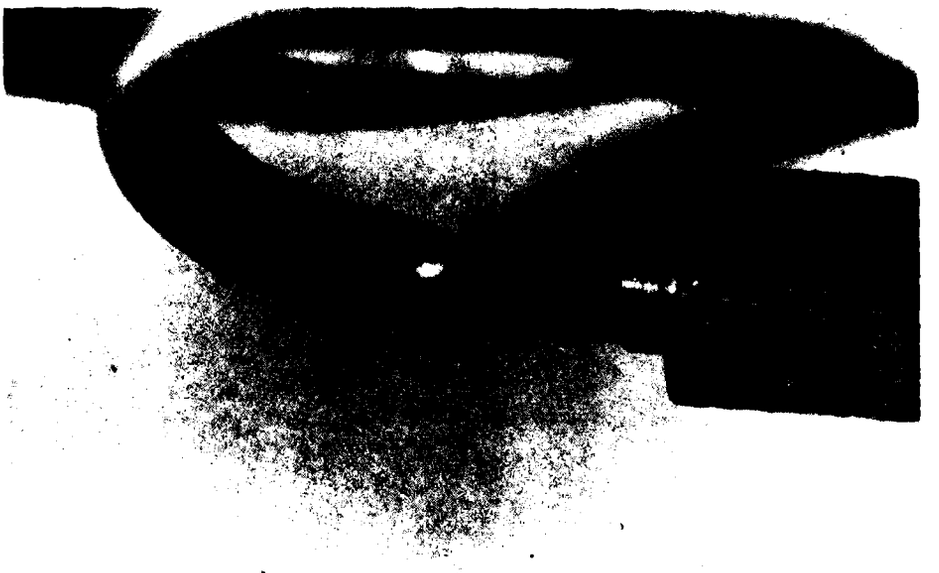

Figure 15 - Close-Up of Partially Severed Tubing (Typical of Both the Single SSD and the Unit Load SSD)

Subsequent to the firing attempt, the unit load was disassembled in order to confirm a successful firing. This was evident as soon as the top tier eight-pack above the test unit was removed. The test unit box flap was open and the upper portion of the carrying case was separated from the lower portion. The view window had separated from the upper case portion but was still on top of the case inside of the box. (Figures 13 and 14) No damage occurred to any of the adjacent boxed SSDs. The cable cutter was removed and verification was made that the tubing had been severed. (Figure 15)

Based upon the results of the evaluation of the packing and packaging, NAVSEASYSCOM issued Certification Control Number (CCN) NA-80-502. That CCN permits shipment by all commercial modes except passenger aircraft.

NWHC completed and issued the documentation package (NAVSEA-DL 5166665) based on the proposed shipping configuration (Figure 1) except for the substitution of filament tape in place of plastic strapping.

CONCLUSIONS

As a result of the tests of the charged SSDs described herein, it is concluded that:

1. Rapid depressurization will not propel an SSD packed in its carrying case and fiberboard box.

2. Rapid depressurization will not result in fragmentation or pose a hazard to adjacent personnel or objects.

3. Incorporating venting capability to the shipping configuration is a suitable technique for ensuring that, in the event of an inadvertent rapid depressurization, the unit load will remain intact.