



**DEPARTMENT OF DEFENSE EXPLOSIVES SAFETY BOARD  
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ALEXANDRIA, VIRGINIA 22331-0600**

**JUN 29 2010**

DDESB-PD

MEMORANDUM FOR HEADQUARTER AIR FORCE SAFETY CENTER  
(ATTENTION: SEW)

SUBJECT: Approval of Four NABCO Incorporated Total Containment Systems: Models 64-SCS, 64-SCS-GT, 42-SCS, and 42-SCS-GT

- References:
- (a) HQ AFSC/EW memorandum, 11 February 2010, Subject: Request Approval to Use the NABCO Inc. Total Containment Vessel, Model 64-GT-SCS at Reduced Quantity-Distance Criteria with attached December 2009 NABCO Test report for the Model 64-GT-SCS
  - (b) HQ AFSC/EW memorandum, undated, Subject: Request Approval of NABCO Inc. Total Containment Vessel, Models 64- SCS/GT and 42-SCS/GT to be added to TP 15, to include a December 2009 NABCO test report for the 42-SCS/GT
  - (c) Test Report, "15-pound C-4 (6.8-kg C-4) Testing for the NABCO 64 Self Closing System (64-SCS) and Gas-Tight System (64-SCS-GT)", May 2010, NABCO, Incorporated, Pittsburg, PA
  - (d) Test Report, "10-pound C-4 (4.5-kg C-4) Testing for the NABCO 42 Self Closing System (42-SCS) and Gas-Tight System (42-SCS-GT)", May 2010, NABCO, Incorporated, Pittsburg, PA
  - (e) NAVEODFAC Report TR-229, "Development and Testing of the MK 634 MOD 0 Explosive Devices Container," March 1980, Naval Explosive Ordnance Disposal Facility, Indian Head, MD 20640
  - (f) DDESB Technical Paper 16, "Methodologies for Calculating Primary Fragment Characteristics," Revision 3, 1 April 2009

Reference (a) requested Department of Defense Explosives Safety Board (DDESB) approval of the NABCO, Incorporated, Total Containment Vessel, Model 64-GT-SCS, with a reduced quantity-distance (QD). Reference (b) requested DDESB approval for the Model 42-GT-SCS, in addition to the Model 64-GT-SCS requested in reference (a). Reference (c) and (d) provided updated test reports for the two vessels, that included the results of May 2010 testing at 125% of the rated capacities of 10 pounds (lbs) and 15 lbs net explosive weight (NEW) of C-4 explosives, respectively, for the 42-GT-SCS and 62-GT-SCS vessels. In addition, reference (e)

was provided to detail the history and extensive blast and fragmentation developmental testing performed with the MK 634 Mod 0 Explosive Devices Container, which is the basis for the NABCO Model 42 and 62 variants. Based on the information provided, DDESB approval is granted for use of the containers for emergency response detonation and transportation, as outlined in the below paragraphs. For the purposes of this approval, the chemical and biological mitigation aspects associated with the gas-tight (GT) variants were not considered, consequently, DDESB review focused on the vessels' capabilities to contain/withstand internal explosion effects from both fragmenting and non-fragmenting explosive devices and the design's slow release of internal blast pressures, thereby contributing to a reduced QD/exclusion area. These vessels are not intended to be used for storage or for routine destruction of ammunition.

#### Terminology to be used:

In order to be consistent within this approval memorandum, the terminology used by NABCO in their test reports will be used herein to designate the total containment systems submitted by the Air Force Safety Center (SEW) for Department of Defense Explosives Safety Board (DDESB) approval. There are actually four separate systems involved: two variants related to the NABCO Model 64 (the Self Closing System (64-SCS) and the Gas Tight System (64-SCS-GT)) and two variants related to the NABCO Model 42 (the Self Closing System (42-SCS) and the Gas Tight System (42-SCS-GT)). All four systems contain explosion effects from an internal explosion up to their rated capacity and utilize the hydraulically-driven self closing system, but only the GT variants (42-SCS-GT and 64-SCS-GT) are equipped with a gas tight system, which mitigates the hazards from an improvised explosive device (IED) that has a biological or chemical hazard associated with it. The two SCS (non-GT) variants provide controlled venting from an internal detonation via a vent port in the roof and around the door; whereas the two SCS-GT variants completely contain all effects from an internal detonation of a chemical or biological IED for processing and internal pressure release at a safe location. In the GT variants, prevention of internal effects leakage (gas, chemical, and biological) is maintained through the use of an electrical pass-through for the charge detonation electrical leads, caps that seal the vents, and by use of O-rings with dovetail grooves in the door that provide a complete seal.

#### Application and background:

a. The NABCO 42-SCS-GT and 64-SCS-GT systems are designed for use by emergency response personnel (such as Explosive Ordnance Disposal (EOD) or a Bomb Squad), to eliminate hazards to personnel and material when improvised explosive devices (IEDs) or unexploded ordnance (UXO) are discovered and need to be transported from the operations site to a suitable disposal site. An example would be finding an IED downtown in a congregated area. Prior to making an assessment of the hazard/risk, emergency response personnel would initially evacuate an appropriately-sized area around the explosive device that was found. As part of their assessment, EOD would 1) determine that the item was safe to be loaded into the total containment vessel and transported to a remote location for removal from the vessel and disposal, or 2) determine that the item should not be moved, and decide to blow it in place using EOD procedures and mitigation techniques, or 3) determine that the item can be moved but not removed safely from the vessel, so would set a counter-charge in the vessel, place the explosive

device inside the vessel and onto the internal basket that centers the charge in the vessel, close/seal the door and detonate the device inside the container, thereby containing effects and virtually eliminating the risk to the surrounding area. In order to transport an explosive device, the device would be placed onto the internal basket, the vessel's door would be closed and sealed, and as the vessel is mounted on a trailer, it would then be towed to the disposal site. A specially designed, stationary frame system prevents the vessel response from being transmitted to the trailer.

b. In the mid to late 1970s, the Naval Explosive Ordnance Disposal Facility (NAVEODFAC), located at Indian Head, MD, in close coordination with their contractor, Batelle Columbus Laboratories, designed, developed and manufactured a full-containment explosive devices container for the reasons described above in paragraph a. Developmental testing was conducted to determine overpressure effects from internal detonations (centered and off-set spherical and rectangular charges), as well as to demonstrate the capability of the container to contain the effects from fragmenting devices (soft-packaged as well as metallic-cased explosive devices). The metallic cased items included 60mm mortars and 2-inch OD by 12-inch long, Schedule 40 pipe bombs that were placed in sacrificial fragment-attenuating tubes (having sand-filled walls and a sand-filled end plug) to prevent excessive damage to the interior of the vessel. The final design of the vessel, named the MK 634 MOD 0 Explosive Devices Container, was manufactured of HY-80 steel, which has the capacity for both elastic and plastic deformation in response to internal detonation forces, and which demonstrated the capability of withstanding repeated internal detonations of fragmenting 10-pound TNT equivalent events. Its development and testing is described in reference (a). Upon completion of this effort, NAVFAC approached a company (now called NABCO) about producing the design on a production basis. Thirty-seven of those units were built. Over the years, the original cumbersome door assembly was replaced with one that was easier to operate, and the MK 634 MOD 0 system was renamed as the NABCO 42-SCS. Further refinements were incorporated over time, and a larger version of the 42-SCS was built and designated as the NABCO 64-SCS, and a GT variant for each model was developed to address additional threats. Those SCS variants, also constructed of HY-80 steel, are the vessels that were tested as described in references (c) and (d). Another significant aspect about the MK 634 MOD 0 is that as part of the NAVFAC testing program, the unit was tested to rupture, which occurred with 40 lbs C-4 explosives, following a 20-pound C-4 explosive detonation test, and a 30-pound C-4 explosive detonation test. This demonstrates the significant safety factor associated with the initial vessel's design, as well as with the follow-on NABCO Model 42 and 64 total containment vessels.

c. Batelle Columbus Laboratories accomplished extensive fragmentation testing, as detailed in reference (e), to determine the MK 634 MOD 0's capabilities to withstand fragment impact. Testing showed that the vessel could easily withstand fragments/debris generated by breakup of the centering basket assembly on which charges were placed. In addition, testing was conducted to demonstrate the capability of the container to contain the effects from fragmenting devices (soft-packaged as well as metallic-cased explosive devices). The metallic cased items tested included 60mm mortars and 2-inch OD by 12-inch long, Schedule 40 pipe bombs. Those fragmenting items were placed in sacrificial fragment-attenuating tubes (having sand-filled walls and an end plug) to prevent excessive damage to the

interior of the vessel. Testing showed successful containment of fragmentation with minimal internal damage.

With regards to the Model 42 and 64 variants, NABCO accomplished extensive full-scale testing with the four variants, to include 125% of rated capacity testing with each of the SCS variants, and this testing is also detailed in references (c) and (d). Based on successful testing, the allowable rated capacity for the NABCO 42-SCS and 42-SCS-GT is 10 pounds net explosive weight (NEW) of C-4 explosives (or TNT equivalent material of 12.8 pounds), and the allowable rated capacity for the NABCO 64-SCS and 64-SCS-GT is 15 lbs NEW of C-4 explosives (or TNT equivalent material of 19.20 lbs). Based on the results of testing, the associated exclusion distance is 5 feet (ft) for all variants of the NABCO 42 and 64, when the doors are secured. Because of the use of these containers for explosive devices emergency response, the 5 ft is considered a minimum exclusion distance for non-related personnel when the doors are sealed and an explosive device is contained within. When the doors are open or an explosive device is located outside of it, appropriate distances will be determined by on-site emergency response personnel in the application of their work/criteria. Public traffic route, intraline, and intermagazine distances are not applicable to the use of these vessels, for their intended purposes.

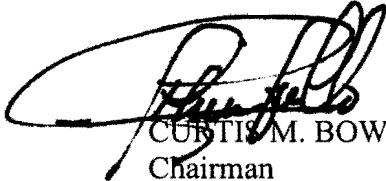
With regards to fragmenting munitions transportation/destruction within the vessels, users must use the fragment-attenuating tubes that are provided by NABCO for fragmenting items greater than 40mm outside diameter (OD). If the fragmenting items will not fit in the fragment attenuation shield, then the item cannot be considered for detonation/transportation in the vessels, without first completing a careful assessment about the penetration hazard posed by that item. Reference (f) can be used for making such an assessment. For items under 40mm OD, these items may be placed directly onto the basket assembly. The rationale for this exclusion is that DDESB has previously approved NABCO storage containers for storage of fragmenting munitions of that diameter, without restriction because those fragments are easily defeated by the steel construction of the storage vessels. The same situation applies to the NABCO Model 42 and 64 vessel construction.

Following an internal detonation, a post-detonation inspection shall be conducted in accordance with Appendix B of references (c) and (d). A vessel that has exceeded any maximum, allowable measurement (as provided by NABCO) between fiducial mark sets, or that exhibits any cracking, or that has any internal fragment penetrations that exceed the specified maximum depth shall be immediately taken out of service. Close coordination will be maintained with NABCO prior to any repairs being performed and before any unit is returned to service.

Because of the nature of the operations involved (emergency response), the requirement for a DDESB approved site plan is not applicable. The operations associated with the use of the NABCO Models 42 and 64 total containment systems shall be conducted in accordance with applicable EOD criteria/guidance.

These approved systems will be added to DDESB Technical Paper 15, Approved Protective Construction.

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