

STORAGE MODULES ISS FOR EXPANDING THE CAPACITY OF STORAGE ROOMS

Product Datasheet

Storage modules are designed and tested to prevent transfer of explosion (deflagration or detonation, action of shock wave, fragments or sharp flame) between modules. Modules are rectangular-shaped boxes with connecting points for mounting them together creating walls with user-defined heights and lengths.

Storage modules minimize safety distances because despite total number of the modules and total weight of the explosive materials stored inside, the maximum hazard event from them is limited to a single module only. Thus, despite storing e.g. tons of explosives in these modules in one magazine, safety distances shall be calculated from the maximum unit content (e.g. 2.5 kg TNT eq.).

This minimization of safety distances improves logistics, which is especially visible in manufacturing operations. Available rooms in manufacturing buildings can be modified to intermediate stores with maximum capacity corresponding to size of the room but with very low safety distances (defined by unit content of one module, i.e. max. 2.5 kg TNT eq.). Such solution shortens transport distances in industry.

Storage modules provide for possibility to store normally incompatible materials (such as high explosives with initiators and pyrotechnics and primary explosives) together in a single storage room, which is otherwise forbidden by most of national explosives laws. Even if one module with a sensitive or unstable material explodes, contents of the other modules are left unreacted.

Modular construction of the storage modules allows to create walls of the modules of different heights and lengths (see Fig. 2). Being only screwed together, the modules can easily be mounted, dismantled, moved to different location or reconfigured in case of need.



APPLICATION

The storage modules were especially designed for safe storage of mass detonating (hazard class 1.1) explosive materials such as high explosives, initiators, highly-caloric deflagrating pyrotechnic mixtures causing transfer of explosion by shock wave, sharp flame, thermal impulse or fragment impact.

Storage capacity of the modules for different classes of explosive materials

The ISS storage modules were subjected to detonation tests by the manufacturer and found resistant against transfer of explosion from one module to another in these weights and configurations of stored explosive materials:

- A single tube of the module can contain maximum of 2.5 kg of high explosives with detonation heat TNT eq. or lower.
- The maximum allowed quantity per one tube is reduced to half, i.e. to 1.25 kg net weight, for high explosives with detonation heat higher than TNT eq., unless the module resistance is proven by the detonation experiments with the modules carried out by the user (see the following paragraph).
- When shock sensitive high explosives or primary explosives having shock wave sensitivity higher than commercial dynamite are to be stored within the modules, the user has to carry out the detonation experiments for module resistance before first use of the modules. The detonation experiments shall be carried out in test configurations representing the worst-case scenario for storage of the explosive materials for the user.
- Alternatively it is allowed to store a maximum of 2.6 kg of pyrotechnic mixtures Type A in a single tube of the module. Pyrotechnic mixtures Type A are defined for this purpose as pyrotechnic mixtures capable of explosive reaction generating shock wave with TNT eq. higher than 50%. This category typically covers powdered mixtures containing chlorates or perchlorates together with metal powders (tested on $KClO_4/Zr$ mixture). Pyrotechnic mixtures Type A must be placed in separate boxes not containing more than 70 grams of pyrotechnic mixtures per box and the boxes must be placed inside a pallet providing for even distances between the boxes. The pallets with the boxes are then put on the trays of the modules.
- Alternatively it is allowed to store a maximum of 3 kg of pyrotechnic mixtures Type B. Pyrotechnic mixtures Type B are defined for this purpose as pyrotechnic mixtures not capable of explosive reaction generating shock wave with TNT eq. higher than 50 % TNT eq. (tested on B/ KNO_3 mixture).

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INSTRUMENT DESCRIPTION

A single storage module is a rectangular box containing two steel tubes placed above each other and welded at their ends inside a steel box. Each tube is closed at its back by a welded steel lid and a hinged front lid.

The front lid closes the tube water-tight using a lever lock. The locking mechanism is designed to be bimanual so that operators cannot attempt to open the boxes while holding explosive materials in their hands. A brass pin on a brass chain fixes the handle of the lever lock in a closed position and clearly shows the closed position for quick control. The front lid opens on self-lubricating brass hinges down on non-sparking retainers (covered by rubber) showing the interior of the tube, which contains two steel trays with retainers centering the stored materials inside the tube. Water-tight joint of the lid with the tube is achieved by pressing a rubber sealing in the internal groove of the lid.

Design of all moveable parts is solved for preventing intensive impacts or friction of two sparking metals. Non-sparking self-lubricating brass hinges, brass parts or electrostatic-conductive rubber are used in all friction points. The modules contain shaped protective barriers ensuring that accidental explosion in one tube does not damage lids of the surrounding tubes by shock wave or flying parts of the lid.

Each module has grounding connectors for grounding of the whole setup to a common potential. Fully conductive joints are made between lids, steel box, tubes and internal trays of the module. All rubber sealing in lids that keep the internal space of the tubes watertight are electrostatic conductive. All steel parts are galvanized for increasing protection against corrosion.

Free space between the tubes in the steel box of the module shall be filled with dry sorted sand in the first installation of the modules. The sand helps to attenuate shock wave loading and increases structural stability of the complete setup of the modules.

Modules can be horizontally and vertically connected together to sets (walls) containing 2 modules (4 tubes) on each other and unlimited number (defined by available space in a room) of modules on sides. Each module contains assembly holes for anchoring and mutual connecting. The walls of modules are placed on a steel frame of required length, which is anchored to the ground. Back side of the modules is anchored to the walls of the structure



Fig. 2: Example of a wall set up with 8 modules (40 kg TNT eq. storage capacity)

to increase stiffness at static and dynamic loading. The steel frames on which the modules are placed ensure at least 150 mm minimum height of the lowest tray in the modules from the floor.

Storage capacity	2.5 kg TNT eq. in one tube = 5 kg TNT eq. per module
Tube internal dimensions	Diameter x length = 324 x 500 mm
Module outside dimensions	Height x width x length closed (open) = 803 x 400 x 588 (959) mm
Empty weight of the module	135 kg
Weight of sand to fill one module	100 kg
Total weight of the filled module	235 kg

The design of ISS storage modules was developed based on specific customer's requirements. Modifications of this standard design or development of another custom-made design of the modules with different storage capacity and/or tube internal dimensions or other design features are possible.