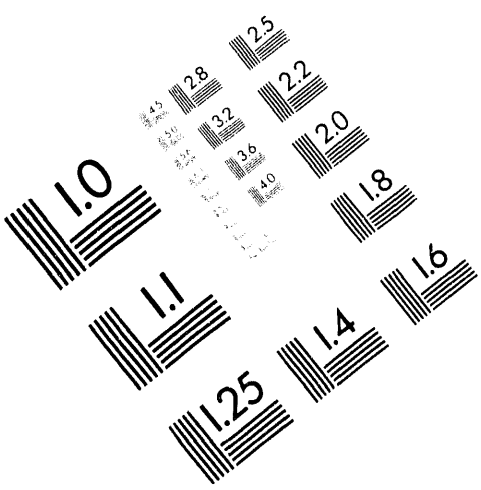
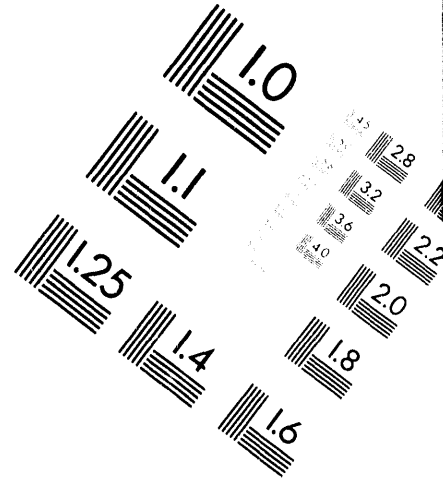
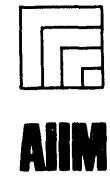

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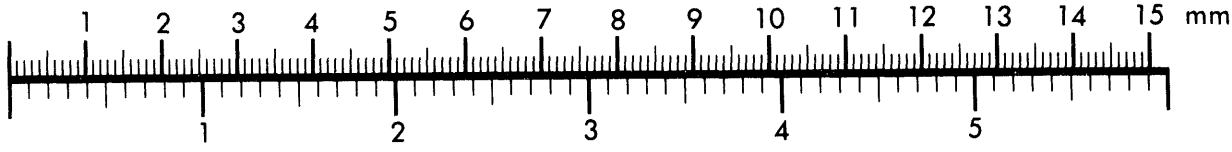

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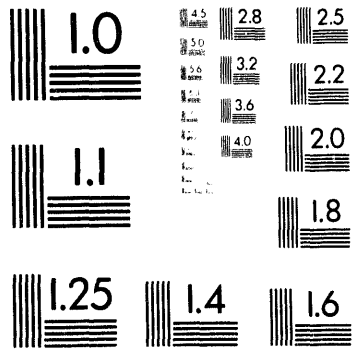

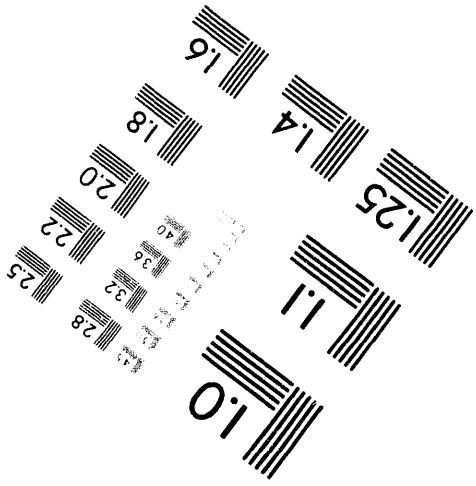
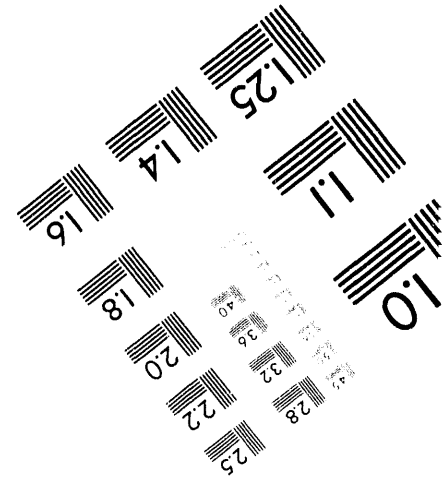

1 of 1

WHC-SA-2361-FP

Operational Guidance for Using DOT-6M/2R Packaging

Prepared for the U.S. Department of Energy
Office of Environmental Restoration and
Waste Management

Westinghouse Hanford Company Richland, Washington

Hanford Operations and Engineering Contractor for the
U.S. Department of Energy under Contract DE-AC06-87RL10930

Conf-9405109--3

WHC-SA-2361-FP

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Date Published
March 1994

To be Presented at
U.S. DOE Defense Programs
Packaging Workshop
Knoxville, Tennessee
May 16-20, 1994

To be Published in
Conference Proceedings

Prepared for the U.S. Department of Energy
Office of Environmental Restoration and
Waste Management

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Richland, Washington 99352

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Approved for Public Release

WHC-SA-2361-FP

OPERATIONAL GUIDANCE FOR USING DOT-6M/2R PACKAGING

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ABSTRACT

The purpose of this paper is to describe a new U.S. Department of Energy (DOE), Transportation Management Division task to create a U.S. Department of Transportation (DOT) Specification 6M/2R packaging configuration user's guide. The need for a user's guide was identified because the DOT-6M/2R packaging configuration is widely used by DOE site contractors, and DOE receives many questions about the approved packaging configurations. Currently, two DOE organizations have the authority to approve new DOT-6M/2R configurations. For Defense Programs, the Transportation and Packaging Safety Division (EH-332) administers the program. For Environmental Restoration and Waste Management, the Transportation Management Division (EM-261) administers the program.

To assist site contractors to determine who has the appropriate approval authority for new configurations, the DOE will use a technical review coordinator. The technical review coordinator will be responsible for developing a user's guide for shipping Type B quantities of radioactive and fissile material, including plutonium, in DOT-6M/2R specification packages. To date, the technical review coordinator is the Westinghouse Hanford Company (WHC).

The user's guide will identify the DOE-approved DOT-6M/2R configurations and operating procedures, and explain how to have new configurations approved by the DOE. The packaging described in the user's guide is subject to the applicable DOT requirements and identified DOE restrictions. These packaging configurations will be considered acceptable for transport of Type B quantities of radioactive and fissile material, including plutonium. Once the DOE approves the packaging, the technical review coordinator will be responsible for distributing revisions to the user's guide.

See Figures 1 and 2 for examples of typical DOT-6M/2R packaging configurations.

I. INTRODUCTION

During the 1960s, the Rocky Flats Plant (RFP) developed a packaging configuration for shipping plutonium. This packaging was adopted by the DOT as the DOT-6M. As authorized by DOT regulations, the DOT-6M packaging is used today for shipping Type B quantities of radioactive materials (Title 49, Code of Federal Regulations, Part 173 [49 CFR 173], Subpart I, "Radioactive Materials"). In 1980, the Nuclear Regulatory Commission (NRC) expressed concerns about shipping plutonium in the DOT-6M packaging. Changing specifications required additional containment for plutonium (per 10 CFR 71.42). The NRC felt the DOT-6M packaging was sufficient for an overpack, but not for an inner vessel. The NRC also wanted assurance that the 2R vessel would meet the newly quantified leak rates in the

International Atomic Energy Agency (IAEA) regulations.

In response to the NRC's concerns, the DOE and its contractors expended considerable effort to determine what role the DOT-6M packaging should have for shipping DOE-owned plutonium. Three alternatives were evaluated:

- Improve DOE DOT-6M procedures to resolve specific concerns raised by the NRC
- Procure and use packaging that is presently certified for shipment of plutonium
- Design and certify new packagings to ship plutonium.

The first alternative was chosen. Technical reviews and safety assessments have been performed on the DOT-6M specification packaging, DOT-2R welds associated with the DOT-6M packaging, the types and quantities of radioactive material shipped in the DOT-6M packaging, and packaging to replace the DOT-6M. In 1988, a DOE task force performed a technical review of the DOT-6M packaging. The review and subsequent documentation found that the DOT-6M packaging merits continued use.

In 1989, DOE Headquarters issued directives to all Defense Programs Operations Offices that future shipments of Type B radioactive material in the DOT-6M packaging implement the applicable requirements as specified in the DOE task force's technical document.[1] Additional requirements for Type B quantity shipments were also imposed at that time. In general, the additional requirements include: An evaluation of the payload configuration against hypothetical accident conditions; load testing of the existing inner-vessel (DOT-2R) welds; and DOE-HQ approval of the configuration.[2] These improved safety enhancements would allow interim use of the DOT-6M until a replacement container is available.

Deviations from the procedural requirements identified in the DOE task force's document require demonstration and documentation of an equivalent degree of safety. Approval of the desired procedural deviations is required from the appropriate DOE Operations Office and Headquarters. Note that materials meeting the definitions of low specific activity (LSA), limited quantity (LQ), and Type A quantity are exempted from the additional requirements imposed by the DOE. These additional restrictions are for Type B quantities of radioactive or fissile materials, including plutonium.

Only existing DOT-2R vessels that have had their bottom plate welds static force and leak tested in accordance with the "Final Report from the Container Weld Advisory Committee,"[3] may be used. The requirement for this testing is a result of weld defects found in 1988 in DT-14A packages fabricated by a particular manufacturer; the welds did not meet design requirements. Because the manufacturer was a major supplier of DOT-2R inner containers for DOT-6M packages, the integrity of DOT-2R inner containers was a concern. The Container Weld Advisory Committee (CWAC) recommended static force testing to ensure that the weld is strong enough to withstand the postulated hypothetical accident condition loadings. The leak testing is to ensure that no leak paths exist in the weld. The safety enhancements developed will allow interim use of the DOT-6M until a replacement container is available.

In 1990, a memo to the operations offices from the Transportation Management Division approved nine DOT-6M configurations and procedures. "If these procedures and configurations are followed, we believe that all DOT requirements are met. Thus they may be used by any site for making shipments in DOT-6M packaging indefinitely."[2]

II. REQUIREMENTS

Several activities must be performed to ensure that a DOT-6M/2R packaging is properly

prepared for safe transport and in full compliance with the applicable regulations and additional DOE requirements.

Shipments must be made in the approved configurations identified in Section V of this document or in a configuration approved in accordance with the process identified herein. Updates to the user's guide will identify any additional configurations approved.

A. Design and Fabrication Requirements

1. U.S. Department of Transportation and Nuclear Regulatory Commission

Refer to the appropriate regulations outlined in 49 CFR 173, Subpart A, Subpart B, and specifically Subpart I, "Radioactive Materials"; 49 CFR 178.354; and 49 CFR 178.360 that are applicable for shipments using a DOT-6M/2R packaging configuration.

2. U.S. Department of Energy

The DOE imposed additional requirements that apply to shipments of Type B plutonium oxide and Type B radioactive materials using the DOT-6M/2R configurations, specifically in the areas of configuration approval and weld tests. The DOE requires that quality control be implemented as needed for the shipper to ensure compliance with the regulations.

(a) Troy Wade Memo[1]

- Implement new operational and quality assurance procedures.
- Implement applicable requirements specified in SAND88-3005, "A Review of the Safety Features of 6M Packagings for DOE Programs," September 1988.[4]
- For Type B plutonium oxide shipments only, the following additional requirements are imposed:
  - Ship only by Safe-Secure Trailer (SST)
  - Implement operating procedures
  - Testable double containment
  - Configurations are limited to the following gross weights:

    38 L, 73 kg (10 gal, 160 lb)
    113 L, 136 kg (30 gal, 300 lb).
- Any desired deviations from these requirements must be approved by the DOE.
- Develop and implement a weld inspection policy.

(b) Final Report From the Container Weld Advisory Committee[3]

Recommendations for inspections, test, and acceptance criteria for existing DOT-6M/2R inner container welds:

- Each DOT-6M/2R with welded end plates should be tested so that the end plate will be subjected to an outward directed uniaxial static force of 11,077 kg (24,400 lb). Subjecting the DOT-2R weldment to the static force test will ensure that the weld is strong enough to withstand the postulated hypothetical accident condition loadings. Acceptance criteria for the force test shall be based on no detectable yielding of the weld.
- If the container successfully passes the static force test, a leak test shall be conducted to check for unacceptable leak paths in the weld. The leak test shall be conducted in accordance with

American National Standards Institute (ANSI) N14.5 for leak tests on packages for shipment of radioactive materials.[5]

- If individual DOT-2R inner containers are not permanently marked or do not have a traceable Quality Assurance (QA) file, the container shall be permanently marked and a QA file established.

- Paragraph 3(b) of 49 CFR 178.104 excludes the use of cast iron for DOT-2R fabrication. Replace any malleable iron end caps with acceptable material end caps after proof testing.

Recommendations for inspection, test, and acceptance criteria for future DOT-6M/2R inner container welds:

- For double containment (plutonium), use materials specified in American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section III,[6] NB-2000 and apply fracture toughness criteria defined in Nuclear Regulatory Commission (NRC) NUREG/CR-3019.

- For single containment, use materials specified in ASME Section III, ND-2000 with emphasis on specifying "normalized, fine-grained practice."

- Provide an option for using austenitic stainless steel.

Requirements for Welding Program:

- Remove weld joint from high-stress regions where possible.

- Provide workmanship criteria according to ASME Section III, NB-4000 for double containment (plutonium) or to ASME Section III, ND-4000 for single containment.

- Provide inspection criteria according to ASME Section III, NB-5000 for double containment (plutonium) or to ASME Section III, ND-5000 for single containment.

- Locate full penetration welds where they can be easily evaluated by nondestructive examination (NDE) techniques.

Requirements for QA Program:

- Adhere to QA criteria defined in 10 CFR 71.

- Adhere to ASME Section III, NCA for material traceability and document control.

- No "N" stamp is required.

B. Packaging Operations

Packaging operations involve assembling the packaging, loading the contents, closing the package, and preparing for shipment. The operating instructions for a packaging are the primary vehicle for the shipper to maintain control on the assembly, loading, and closure processes for a packaging system and its preparation for shipment and other items. Accordingly, shippers are requested to ensure that the operating instructions for the packaging system to be used implement the operational requirements discussed in the following paragraphs.

The recommendations outlined in Reference 4 of this document should also be followed.

The operating instructions should consist of the following primary elements:

- Packaging description
- Authorized contents
- Preloading inspections
- Loading procedure
- Preparation for shipment
- Preshipment inspections
- Shipment requirements
- Unloading procedure
- Reuse/reconditioning

The shipper should determine, in accordance with the following requirements, the preloading inspections to be performed and the acceptance criteria considered necessary to ensure that the packaging complies and that adequate quality control is implemented:

49 CFR 173.474, Quality control for construction of packaging

49 CFR 173.475, Quality control requirements prior to each shipment of radioactive materials.

The loading procedure should address all operations necessary to correctly assemble the packaging components, load the contents, close the packaging, and prepare the package for transport.

The section addressing preparation for shipment should address labeling and placarding requirements (49 CFR 173.444 and 173.446) and any other applicable requirements. If the package must be secured to the conveyance in a particular fashion, this should also be specified in a subsection called, "Tiedown."

The section addressing preshipment inspections should address verifications for compliance with the following requirements:

49 CFR 173.441, Radiation level limitations

49 CFR 173.442, Thermal limitations

49 CFR 173.443, Contamination control.

The section addressing shipment requirements should address requirements and procedures applicable when the package is en route to its destination. For example, the requirements of 49 CFR 173.447, "Storage incident to transportation," should be addressed in this section.

The unloading procedure should detail all steps necessary to safely unload the package from the conveyance and for unloading the contents from the packaging. Special attention must be given to type of room filtration, protective clothing, health physics monitoring, and radioactive material packaging when unpacking dispersible, fissile, or other radioactive materials. Appropriate safety measures are to be taken to reduce the level of risk to as low as reasonably achievable (ALARA).

If the packaging may be reused, the operating instructions should include procedures for reconditioning the packaging to a state that will meet the design requirements established in the drawing and specification.

C. Quality Assurance

The stated objective of the DOE QA program for DOT-6M packagings is to monitor the various aspects of design, fabrication, procurement, and maintenance procedures to meet the transportation objectives that support DOE defense programs and waste management program activities. The QA program implemented by the shipper's organization must implement actions to provide adequate confidence that the shipments will comply with DOT regulations.

The shipper's QA program should contain the following elements:

- Design Control
- Procurement Document Control

- Instructions, Procedures, and Drawings
- Document Control
- Control of Purchased Materials, Equipment, and Service
- Identification and Control of Materials, Parts, and Components
- Control of Special Processes
- Inspection Control
- Required Test Control
- Control of Measuring and Test Equipment
- Handling, Storage, and Shipping
- Inspection, Test, and Operating Status
- Control of Nonconforming Materials, Parts, or Components
- Quality Assurance Corrective Actions
- Quality Assurance Records
- Quality Assurance Audits.

III. HOW TO OBTAIN DOE APPROVAL FOR NEW DOT-6M/2R CONFIGURATIONS

Each new DOT-6M/2R configuration must be approved by the DOE prior to first use. The requestor, the DOE, and the technical review coordinator each have definite roles in obtaining and granting approval of new configurations, that will be placed in the user's guide.

A. Responsibility of Requestors

To receive approval of a new packaging configuration, packaging operation procedures and QA documentation are to be submitted to the appropriate DOE operations office. A copy of all documentation is to be provided to the DOE-HQ office as outlined in Section III B and III C of this document. The DOE requires that quality control be implemented as needed for the shipper to ensure compliance with the regulations.

The requestor must ensure that the new configuration satisfies the requirements outlined in 10 CFR 71, 49 CFR 173, Subpart I, "Radioactive Materials," 49 CFR 178.354, and 49 CFR 178.360 that are applicable for shipments using a DOT Specification 6M/2R packaging configuration.

The DOE has imposed additional requirements applicable to shipments of Type B quantities of plutonium oxide and Type B radioactive materials using the DOT-6M/2R configurations, specifically in the areas of configuration approval and weld tests as stated in Section II.

Any organization wishing to have a packaging qualified in one of these programs should contact the responsible person listed for the appropriate program.

B. The U.S. Department of Energy - Defense Programs

For Defense Programs, the DOT-6M/2R Program is currently administered by the DOE, Transportation and Packaging Safety Division (EH-332), in Germantown, Maryland. The responsible person is as follows:

M. E. Wangler, Director
Transportation and Packaging
Safety Division
U.S. Department of Energy, EH-332
19901 Germantown Road
Germantown, MD 20874
(301) 903-5078

C. The U.S. Department of Energy - Environmental Restoration and Waste Management Programs

For the Environmental Restoration and Waste Management Programs, the DOT-6M/2R Program is currently administered by the DOE, Transportation Management Division (EM-261), in Germantown, Maryland. The responsible person is as follows:

L. G. Blalock, Director
Transportation Management Division
U.S. Department of Energy, EM-261
19901 Germantown Road
Germantown, MD 20874
(301) 903-7273

D. Responsibility of Technical Review Coordinator

The Westinghouse Hanford Company, Transportation and Packaging Department, is currently conducting the evaluation activities. The persons responsible for these activities are as follows:

J. H. Hummer, Manager
Westinghouse Hanford Company
P.O. Box 1970, MSIN: G2-02
Richland, WA 99352
(509) 376-9361

D. L. Kelly
Westinghouse Hanford Company
P.O. Box 1970, MSIN: G2-02
Richland, WA 99352
(509) 372-2276

New requests for approval, submitted to the DOE from the field, will be provided to the technical review coordinator. Depending on how complex the DOT-6M package configuration is, the coordinator may need to organize a team of technical experts. The review team will review the technical documentation and submit comments to the review coordinator. If a review team is used, the coordinator will review the comments for accuracy and applicability and assemble the comments for transmittal to the DOE. If the coordinator performs the review, he/she will transmit the comments directly to the DOE. The DOE will then transmit the comments to the requestor. Once approval of the configuration is granted by the DOE, the technical review coordinator is responsible for distributing information regarding the newly approved configuration to the known copy holders of the user's guidance document. The technical review coordinator is also responsible for distributing any revisions to existing information within the user's guidance document.

IV. APPROVAL PROCESS

The approval process for new packaging will be outlined in the user's guide once the process has been approved by the DOE.

V. APPROVED CONFIGURATIONS

Currently, six operations offices have approved DOT-6M/2R configurations. Nine configurations have been approved by the DOE for use by its contractors.[2] These configurations and their approval dates are as follows:

- Los Alamos National Lab:
  Special form PuO_2 (03/89)
  Samples, Mixed Fission Product (07/89)
  U, Pu, Np, Am, Cm Capsules (10/89)

- Rocketdyne:
  Pu Capsule (07/90)
  Pu Metal (08/90)

- Argonne National Labs-West:
  Radioactive & Fissile Material (07/89)

- Martin Marietta Energy Systems, Inc.:
  U-235 Material (12/89)

- Westinghouse Hanford Company:
  Pu Metal (02/90)

- Rocky Flats Plant:
  Pu Metal and Powder (08/90).

VI. SUMMARY

The DOE will use a technical review coordinator to minimize confusion in obtaining approvals to DOT-6M/2R configurations for use by the DOE.

The technical review coordinator will be developing a user's guide that identifies the nine currently approved configurations.

The technical review coordinator will request assistance from the field to obtain the existing approved configurations for the user's guide. A working committee meeting is scheduled for early August 1994 to review logistics of the user's guide. Individuals who may have any DOT-6M/2R approved configuration files or who are interested in participating on the working committee may contact:

D. L. Kelly
Westinghouse Hanford Company
P.O. Box 1970, MSIN: G2-02
Richland, WA 99352
(509) 372-2276

VII. REFERENCES

1. T. E. WADE, "Resolution of Issues Regarding the Department of Transportation (DOT) Specification 6M Package and 2R Inner Vessel," U.S. Department of Energy-Headquarters, Washington, D.C., (letter dated January 24, 1989).

2. ROY F. GARRISON, "Configurations and Procedures Approved for Use of DOT 6M," U.S. Department of Energy-Headquarters, Washington, D.C., (letter dated September 17, 1990).

3. Department of Energy Container Weld Advisory Committee, Final Report from the Container Weld Advisory Committee, TRAC-0164, U.S. Department of Energy, Washington, D.C., (1989).

4. Sandia National Laboratories, A Review of the Safety Features of 6M Packagings for DOE Programs, SAND88-3005, TTC-0879, Sandia National Laboratories, Albuquerque, New Mexico, (1988).

5. ANSI, American National Standard for Radioactive Materials--Leakage Tests on Packages for Shipment, ANSI Standard N14.5-1987, American National Standards Institute, New York, New York (1987).

6. ASME, Boiler and Pressure Vessel Code, Section III, "Rules for Construction of Nuclear Power Plant Components," American Society of Mechanical Engineers, New York, New York, (1986).

DOT Specification 6M Package
(per 49 CFR 178.354)

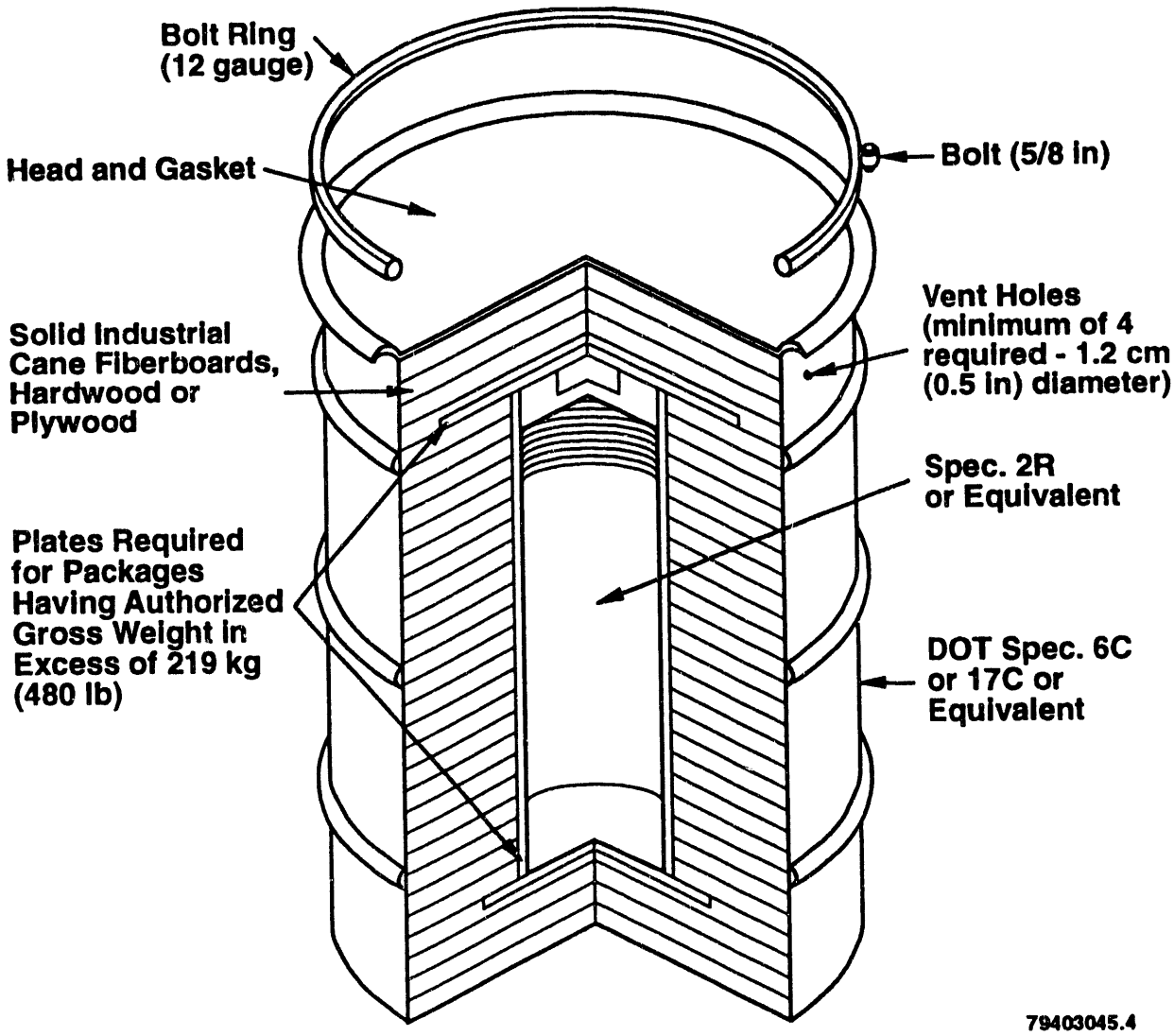

Figure 1

DOT Specification 2R Vessel
(per 49 CFR 178.360)

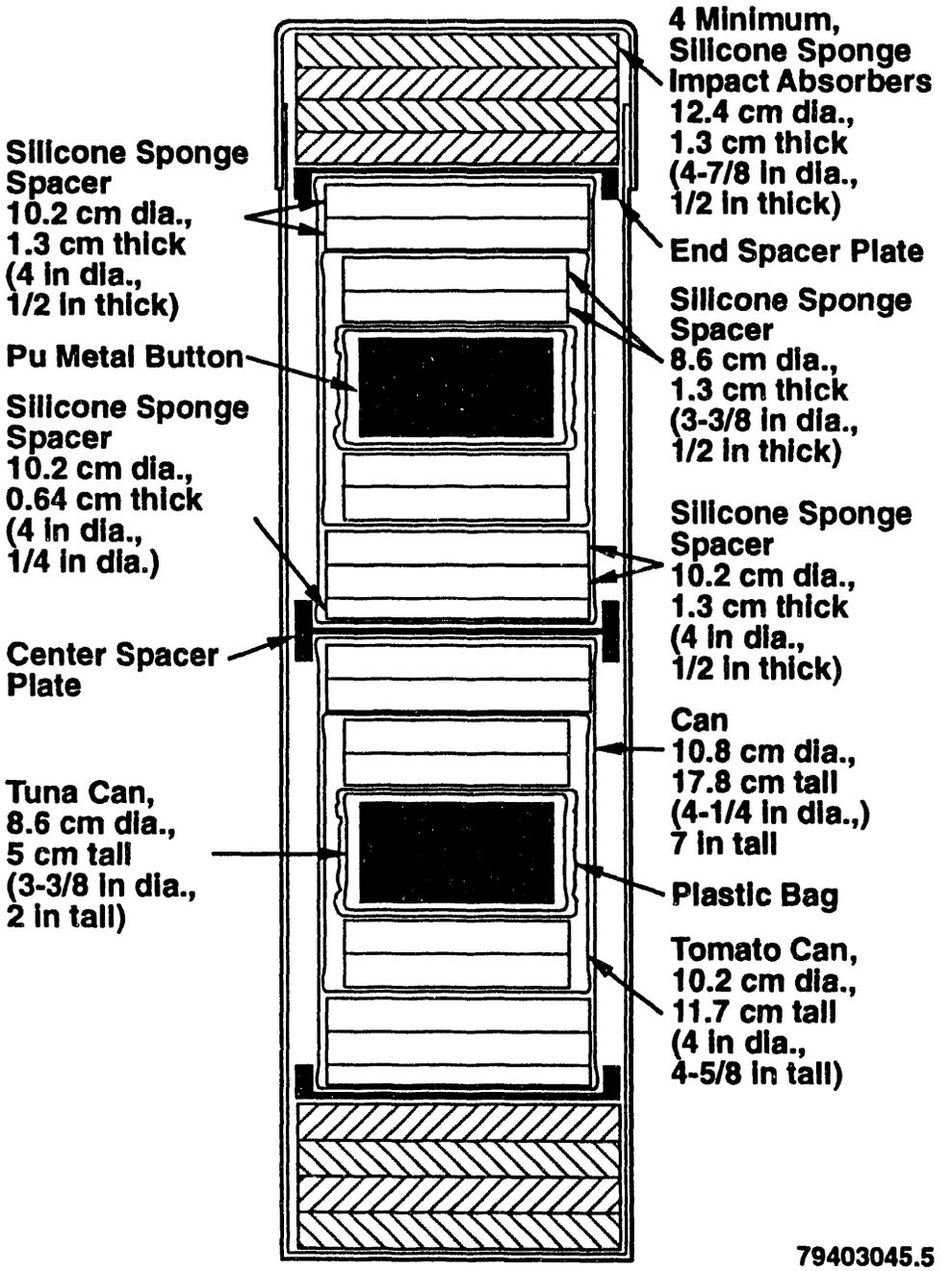

Figure 2

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