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ORNL Testing of DOT Specification 17H Drums (55-Gallon) for Compliance with DOT Specifications for Type A Packaging

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OPERATIONS DIVISION

ORNL TESTING OF DOT SPECIFICATION 17H DRUMS (55-GALLON) FOR COMPLIANCE WITH DOT SPECIFICATIONS FOR TYPE A PACKAGING

J. S. Baldwin[1]
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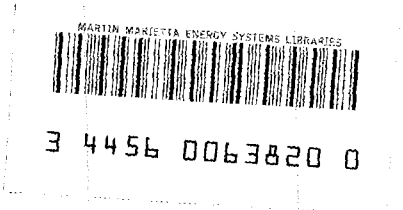

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ABSTRACT

Oak Ridge National Laboratory (ORNL) proposes using Department of Transportation (DOT) specification 17H drums (55-gal) for transporting low-level waste (LLW) to Oak Ridge Gaseous Diffusion Plant (ORGDP) for interim storage. This container type was tested and found to be in compliance with DOT specifications for Type A packaging.

INTRODUCTION

The DOT Code of Federal Regulations (CFR) Title 49, "Transportation," paragraph 173.465, "Type A Packaging Tests," specifies tests that must be performed on containers or packages used for transporting Type A quantities of radioactive waste. To determine compliance with these regulations, black, mild steel, DOT specification 17H drums (55-gal) were tested and found to meet DOT requirements for Type A shipments.

The tests performed were the free drop, compression, and penetration tests. All of the test packages or containers were examined, before testing, to identify and record divergence from specifications, defects in construction, and deterioration or distortion of features. After testing, each package or container was examined to determine if containment was breached or damaged sufficiently to exceed allowable radiation limits. In all tests performed, damage was minor or negligible, and no detectable increase in radiation levels was observed.

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[1] Energy Division.
[2] Engineering Division.

DESCRIPTION OF CONTAINER

All tests were performed on black, mild steel, DOT specification 17H drums (55-gal). The drums exterior diameter is 61 cm (24 in.) and the exterior height is 89 cm (35 in.) (see Fig. 1). The capacity of the drum is 0.21 m^3 (7.5 ft^3), and the sides and bottom of the drum are 18-guage mild steel. The drum has a 14-guage removable head sheet. The gasket is sponge rubber and has a minimum operating range of -40° to 54°C (-40° to 130°F). The maximum loaded weight is 381 kg (840 lb).

FREE DROP TEST

Thus far, two ORNL waste streams have been identified for interim storage at ORGDP. The first stream identified will consist of low-activity solid waste (LASW), and the second waste stream is the clarifier underflow sludge (CUS), resulting from recent modifications in the Process Waste Treatment Plant (PWTP).

For the free drop test, three drums containing "hot" CUS and three drums containing "hot" low-activity solid waste were used. Each of the drums was dropped on a flat, horizontal, sheet steel plate 1.5 m (5 ft) wide, 1.5 m (5 ft) long, and 7.6 m (3 in.) thick from a height of 1.2 m (4 ft).

Of the three drums containing the clarifier underflow sludge, one barrel was dropped on the bottom corner (see Fig. 2), one barrel was dropped on the top bolt ring assembly, and the last of the three barrels was dropped horizontally on the side (see Fig. 3). Damage in all three cases was not severe. Before and after each drop, surface contamination and surface radiation readings were taken (see Fig. 4). After each drop, no detectable increase in either surface contamination or surface radiation was observed, indicating that containment was not breached. Figures 5, 6, and 7 indicate damage to the CUS drums, resulting from the bottom-corner end drop, the top bolt ring assembly drop, and the horizontal side drop, respectively.

The same three drops, bottom-corner end drop (see Fig. 8), top bolt ring assembly drop (see Fig. 9), and horizontal side drop, were performed on the three drums containing LASW. Little damage was observed (see Figs. 10, 11, and 12). Before and after each drop, surface contamination and surface radiation readings were taken. After each drop, no detectable increase in either surface contamination or surface radiation was observed, indicating again that containment was not breached.

The CUS is fairly uniform in gross chemical composition. The percent of solids by weight does vary but usually averages about 20%. The drums selected for the free drop test weighed approximately 227 kg (500 lb) each.

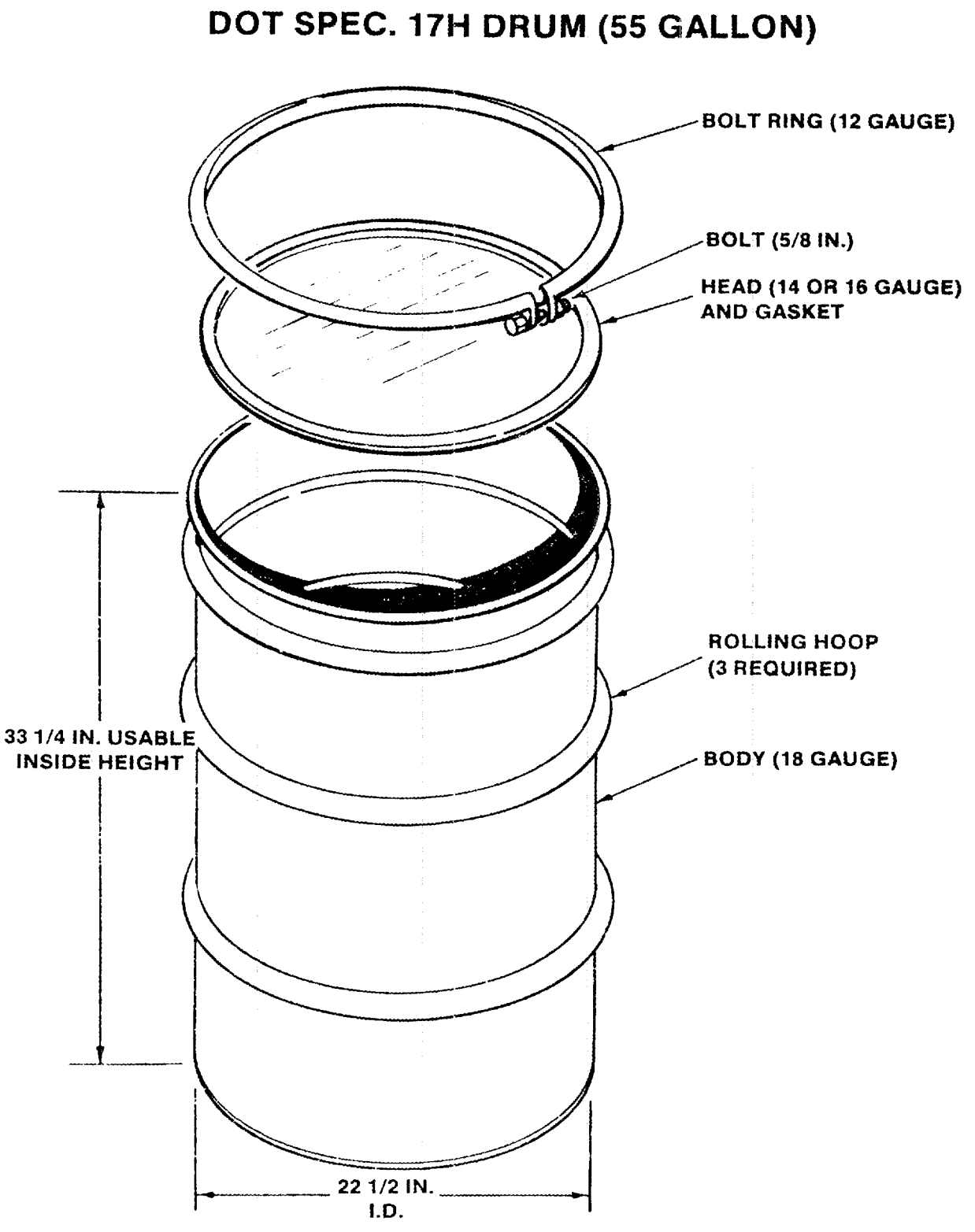

Fig. 1. DOT specification 17H drum (55-gal).

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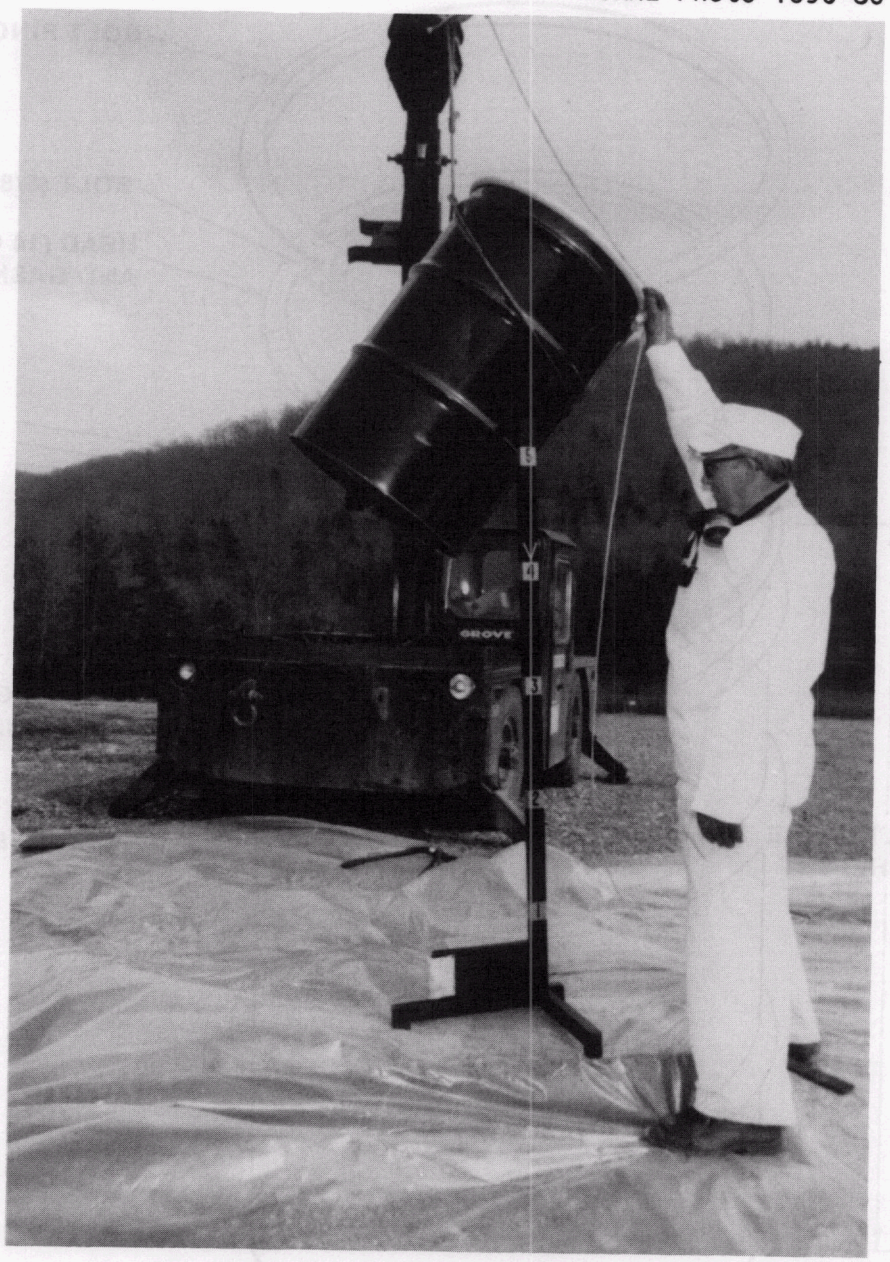

Fig. 2. Drum containing CUS at height of 1.2 m (4 ft) for bottom-corner end drop.

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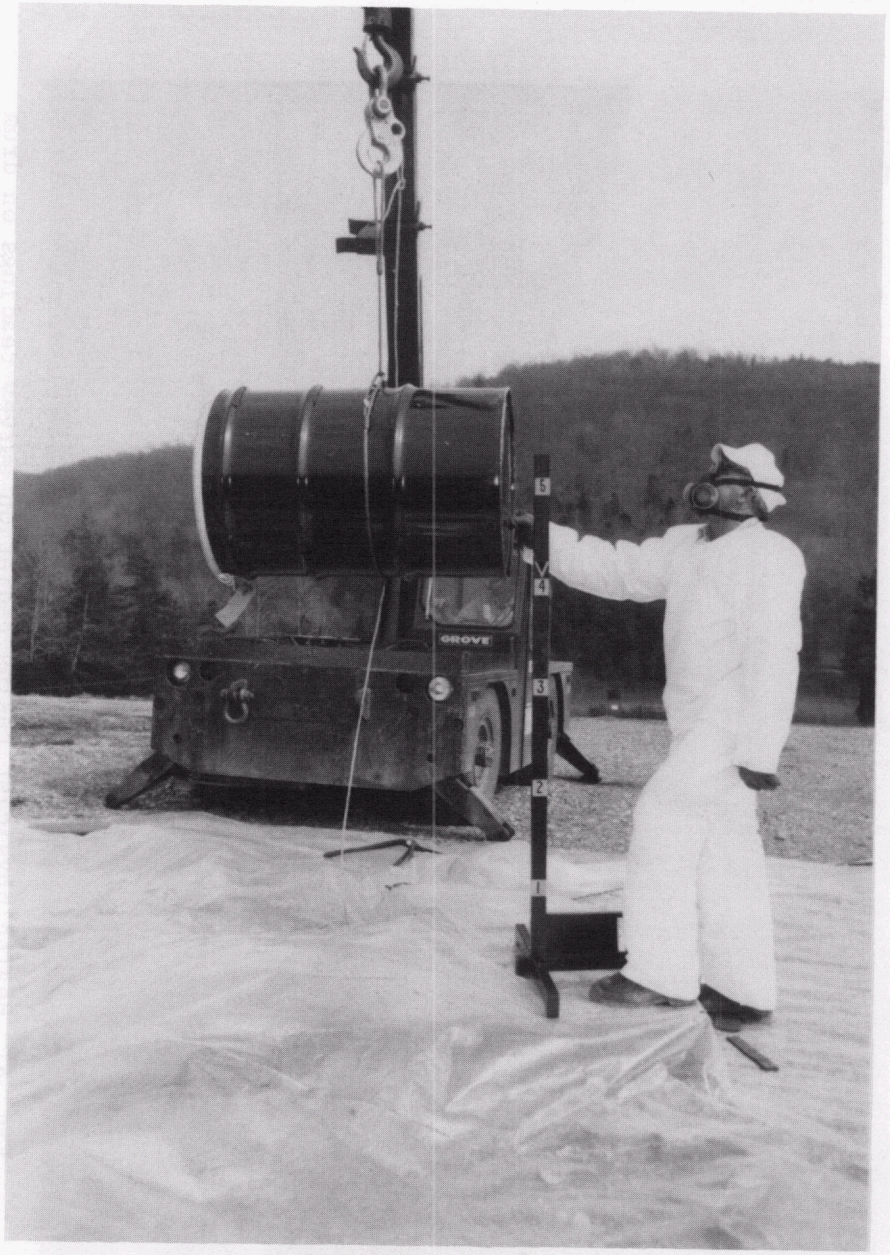

Fig. 3. Drum containing CUS at height of 1.2 m (4 ft) for horizontal side drop.

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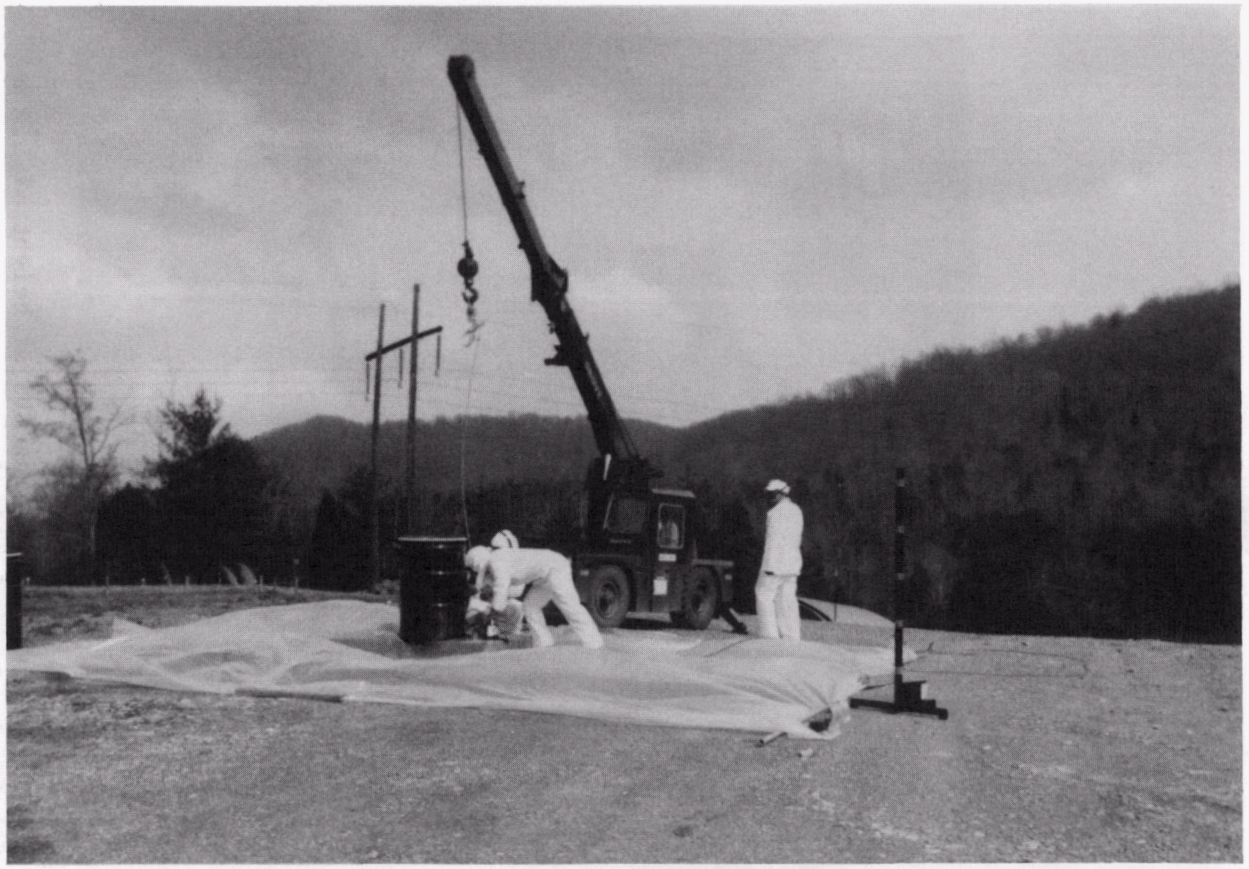

Fig. 4. Health physicist taking radiation survey readings on drum containing CUS before the free drop test.

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Fig. 5. Damage to drum containing CUS, resulting from the bottom-corner end drop.

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Fig. 6. Damage to drum containing CUS, resulting from the top bolt ring assembly drop.

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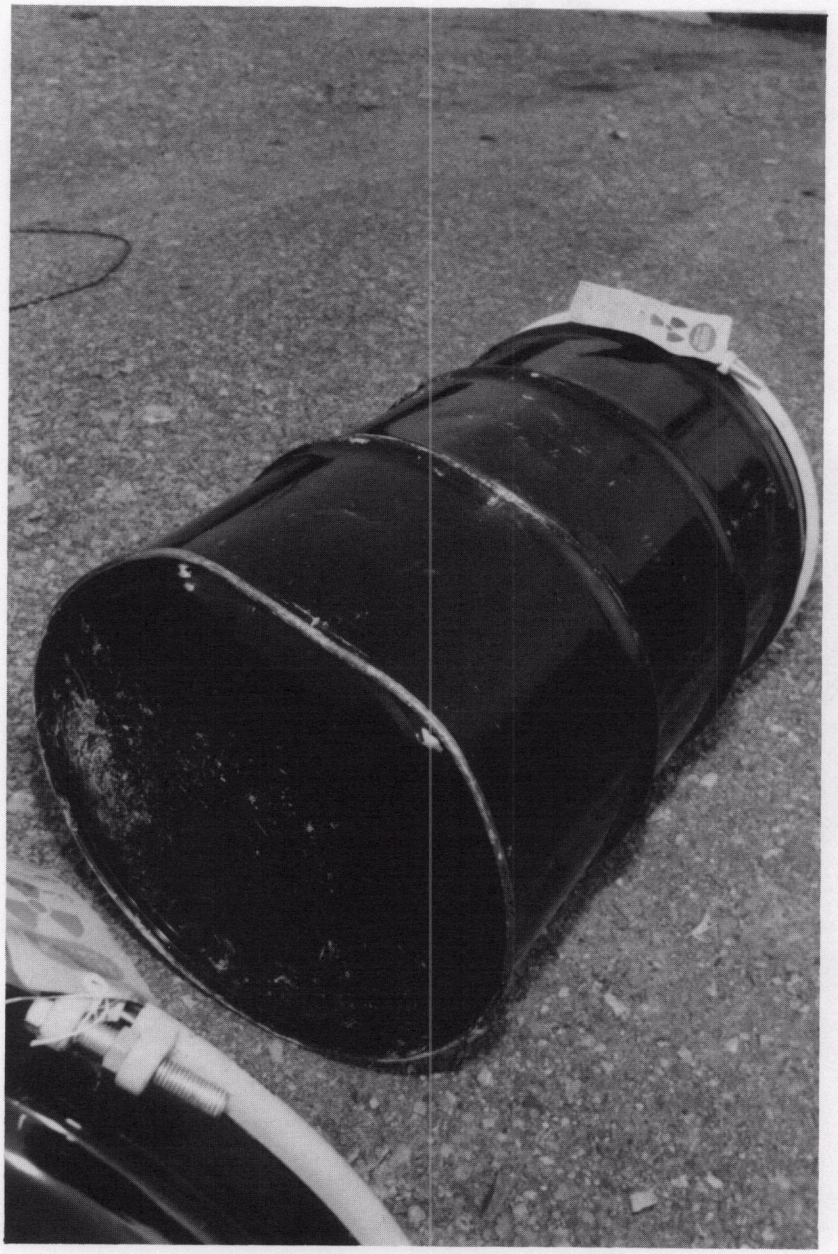

Fig. 7. Damage to drum containing CUS, resulting from the horizontal side drop.

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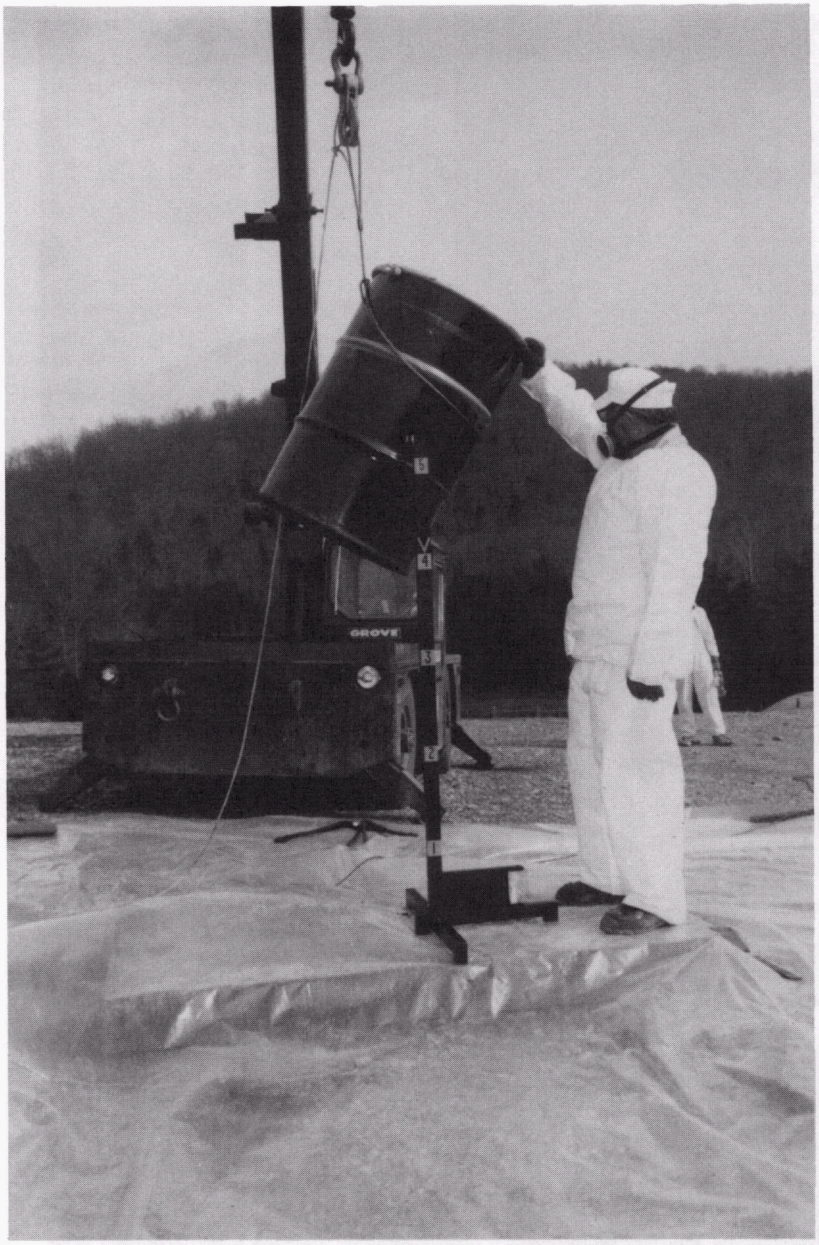

Fig. 8. Drum containing LASW at height of 1.2 m (4 ft) for top bolt ring assembly drop.

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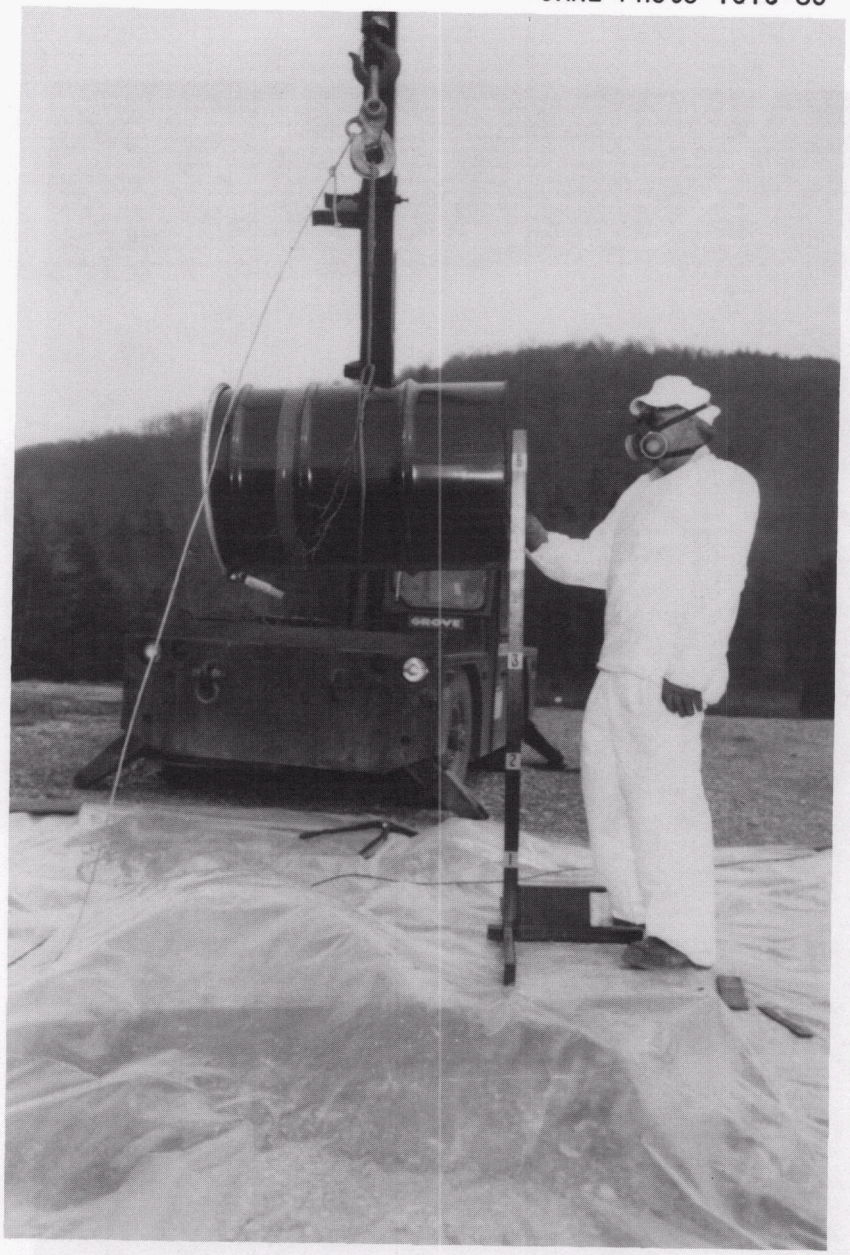

Fig. 9. Drum containing LASW at height of 1.2 m (4 ft) for top bolt ring assembly drop.

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Fig. 10. Damage to drum containing LASW, resulting from the bottom-corner end drop.

ORNL-Photo 1606-86

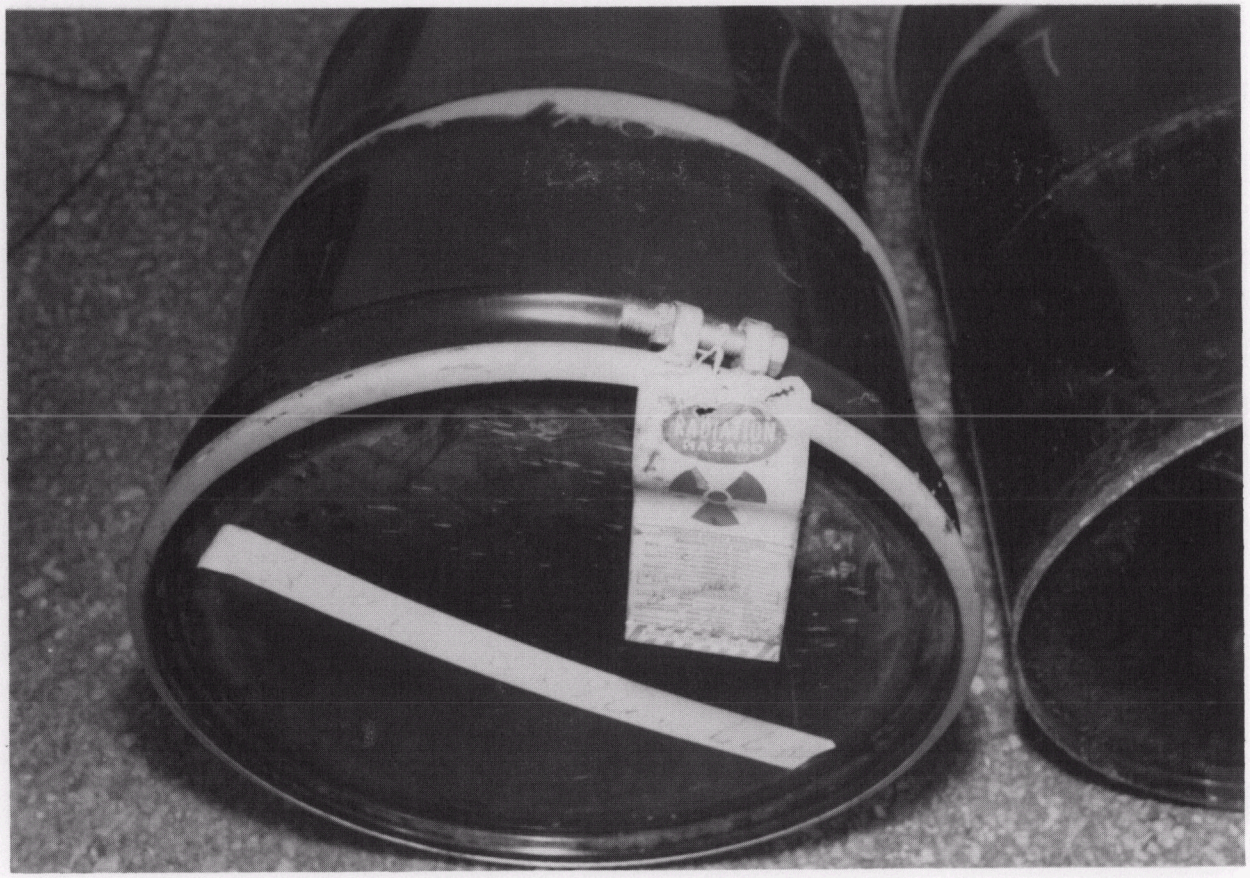

Fig. 11. Damage to drum containing LASW, resulting from the top bolt ring assembly drop.

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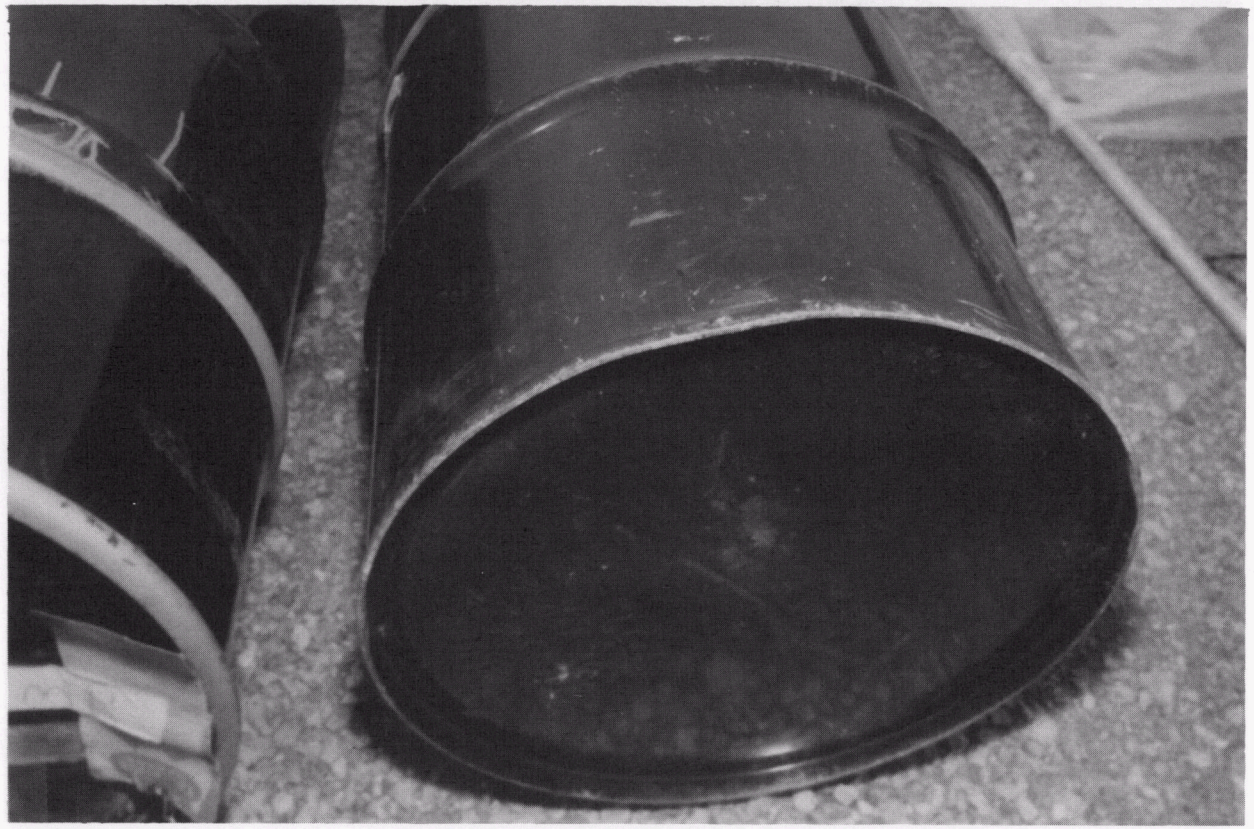

Fig. 12. Damage to drum containing LASW, resulting from the horizontal side drop.

The drums tested containing LASW were selected at random. The drums contained various amounts of compactible and "noncompactible" waste. Compactible waste consists of items such as plastic bags and bottles, paper, rubber, shoe covers, etc. "Noncompactible" waste consists of items such as wood, metallic objects, heavy containers, etc. The drums varied in weight from approximately 20 to 102 kg (45 to 225 lb).

COMPRESSION TEST

The compression test was performed by placing the drum on a flat horizontal concrete pad. A total of 1385 kg (3055 lb) was placed uniformly on top of the drum for a period of 24 h (see Fig. 13). No deformation or other damage to the top, bottom, or sides of the drum occurred. Drums filled with LASW will have a maximum weight of 135 kg (300 lb), and drums filled with the CUS will have a maximum weight of 272 kg (600 lb). DOT requires that the compressive load be equivalent to five times the weight of the actual package. This requirement has been satisfied.

PENETRATION TEST

The penetration test was performed by placing a drum on a flat, horizontal concrete pad and dropping a steel bar, 3.2 cm (1.25 in.) in diameter with a hemispherical end (see Fig. 14) weighing 6 kg (13.2 lb) (see Fig. 15), from a height of at least 1 m (3.3 ft) (see Fig. 16). The steel bar was dropped perpendicularly to the center of the head of the drum (see Fig. 17) because this was considered to be the weakest point of the drum. The head of the drum is 14-guage, whereas the body of the drum is 18-guage (see Fig. 1). These tests resulted in negligible damage to the head of the drum (see Fig. 18).

CONCLUSIONS

Applicable tests specified by DOT in 49 CFR 173.465 for Type A containers have been performed at ORNL. Tests performed included the free drop, compression, and penetration tests. The free drop test was performed using the actual proposed waste streams identified for interim storage at ORGDP. Drums containing sludge showed no severe damage, and containment was not breached. Drums containing low-activity bulk-solid waste showed very little damage, and containment was not breached. The compression test indicated no detectable damage or other effects, and results from the penetration test indicated that negligible damage occurred. These drums have been found to be in compliance with DOT regulations and will be used by ORNL to transport radioactive waste to ORGDP for interim storage.

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Fig. 13. DOT specification 17H drum subjected to a uniform compressive load of 1886 kg (3055 lb).

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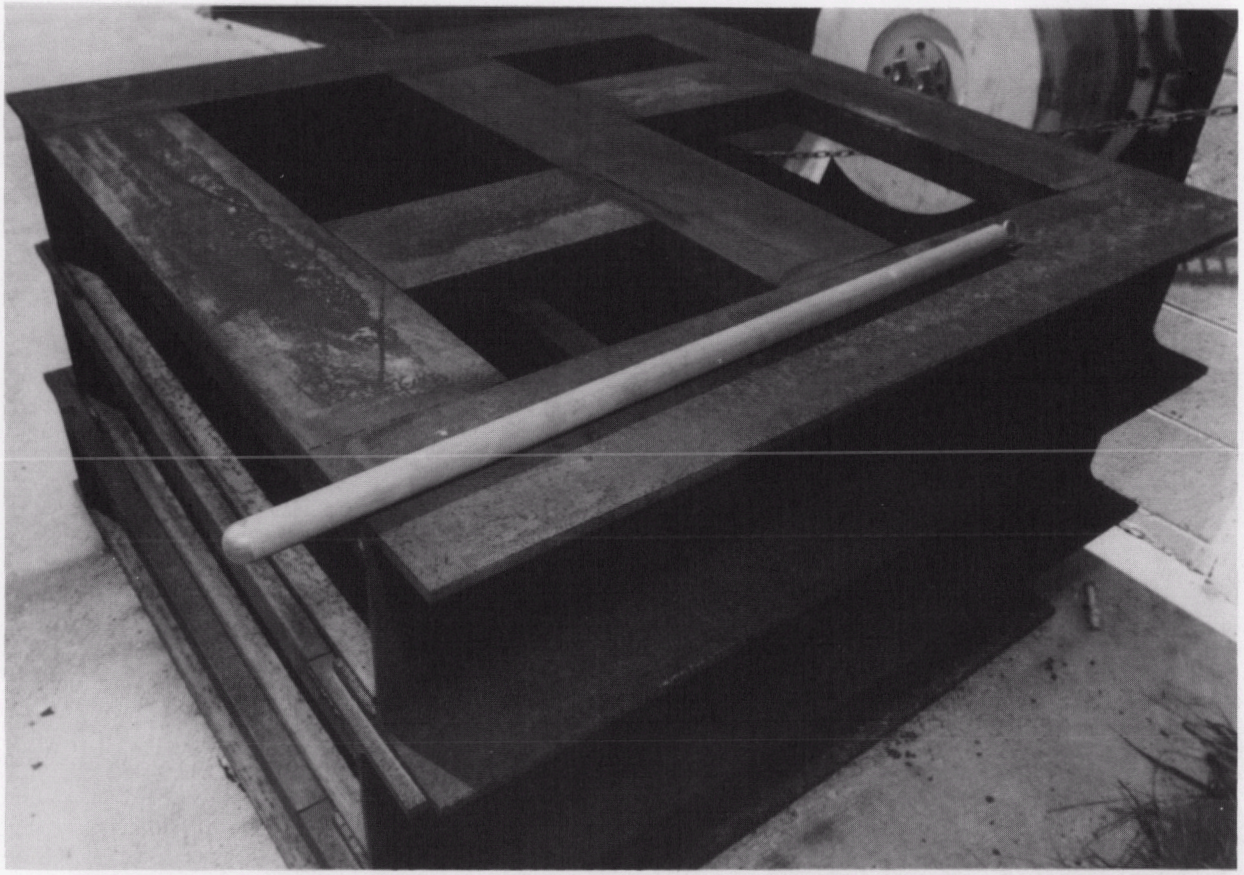

Fig. 14. Steel bar with hemispherical end used for penetration tests.

ORNL-Photo 1788-86

Fig. 15. Steel bar weighed 6 kg (13.2 lb).

ORNL-Photo 1786-86

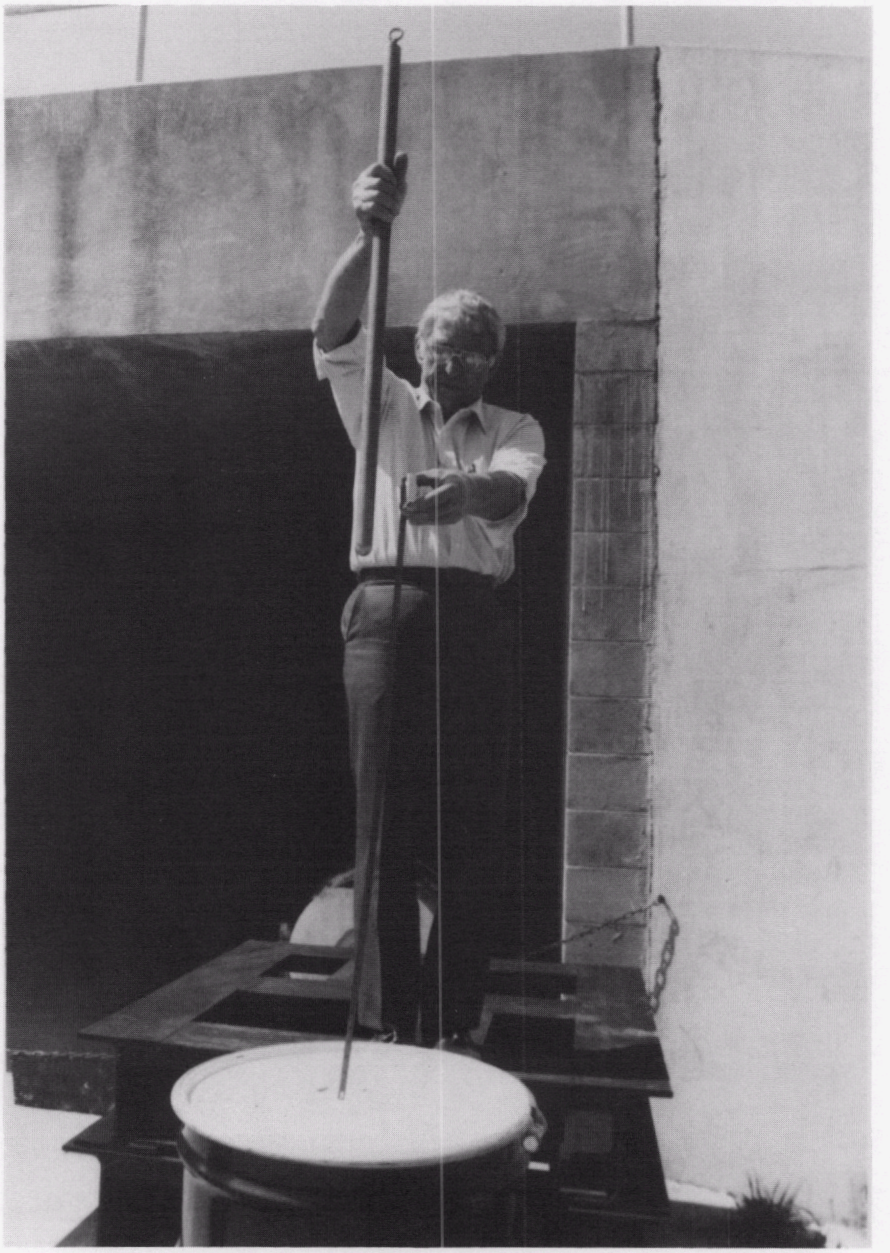

Fig. 16. Steel bar dropped from a minimum height of 1 m (3.3 ft).

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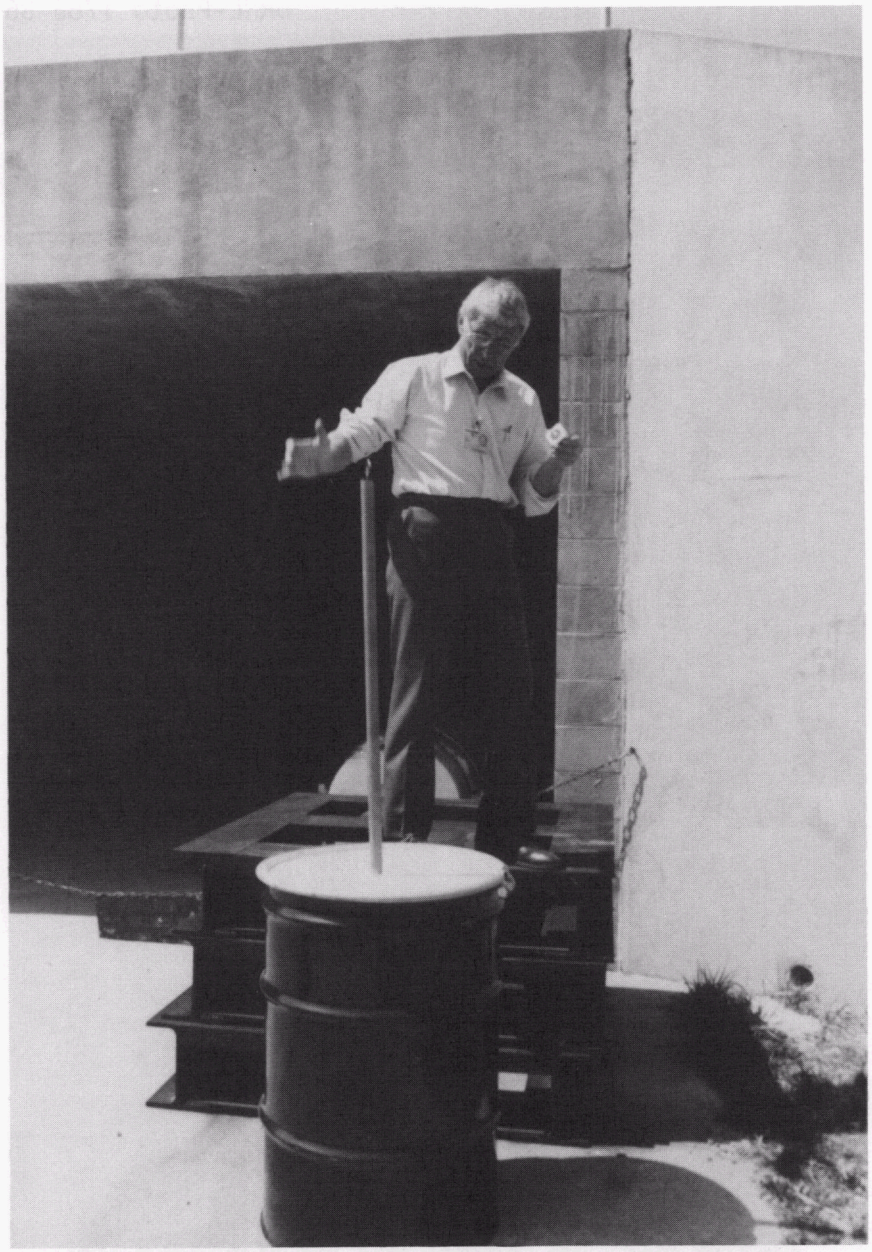

Fig. 17. Steel bar dropped perpendicularly to center of head of drum.

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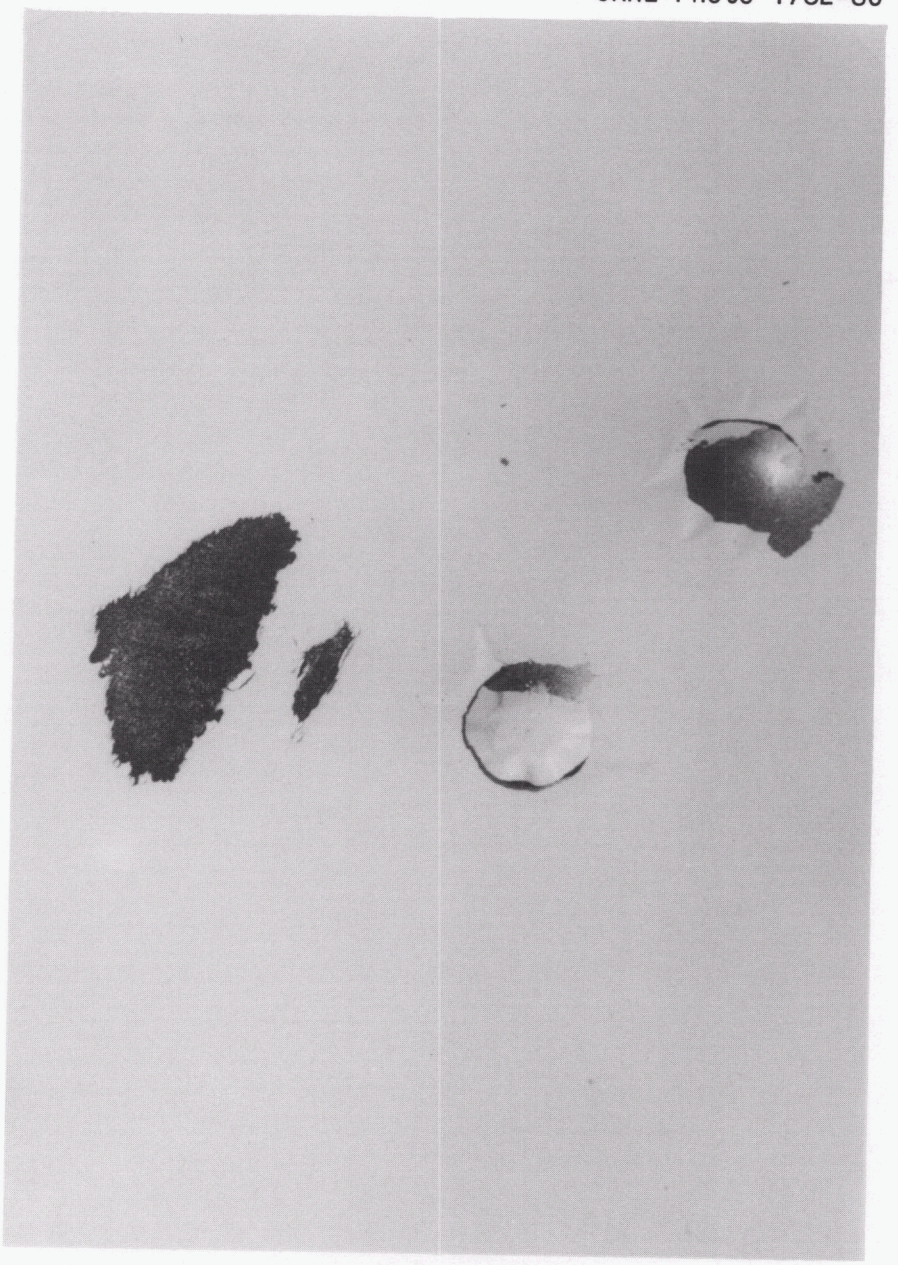

Fig. 18. Indentations on head of drum, resulting from the penetration test.

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