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TECHNICAL BULLETIN 44-72

1. **Classification: Unclassified.**

2. **Subject: Bomb Transport Trailer.**

3. **Source: Munitions Support Directorate, Picatinny Arsenal, Dover, New Jersey; 13th Ordnance Detachment (EOD), Atlanta, Georgia; 88th Ordnance Detachment (EOD), New Brighton, Minnesota; Suspected Item Disposal Corporation, Opa-Locka, Florida.**

4. **Background**: Bomb transport trailers provide a means of safely transporting an explosive device or suspected explosive device along streets in crowded urban centers from a location where it was found to a remote area where it can be destroyed or dismantled.

This bulletin provides information on the Criminalistics (formerly Colt-Criminalistics) Bomb Transport Trailer manufactured and marketed by Suspected Item Disposal Corporation, Opa-Locka, Florida. It includes construction features of the bomb container and trailer; information on a remote loading chute designed and built by the Munitions Support Directorate, Picatinny Arsenal; blast pressure data; and operational procedures and safety criteria.

The information is based on the manufacturers descriptive literature and on tests conducted by the Munitions Support Directorate, Picatinny Arsenal, and by the 13th and 88th EOD Ordnance Detachments.

This bulletin should not be construed as an endorsement or approval of the items covered. Its objective is merely to report the information derived from testing in order to assist interested public safety officials in determining whether or not this equipment will fill the requirements of their particular situation.

DESCRIPTION

The trailer is available either as a basic model (fig. 1), or as a standard model (fig. 2). The standard model differs from the basic model in that it incorporates compartments for storage of accessory equipment and sheet metal changes to disguise its appearance for use in sensitive public institutional areas.

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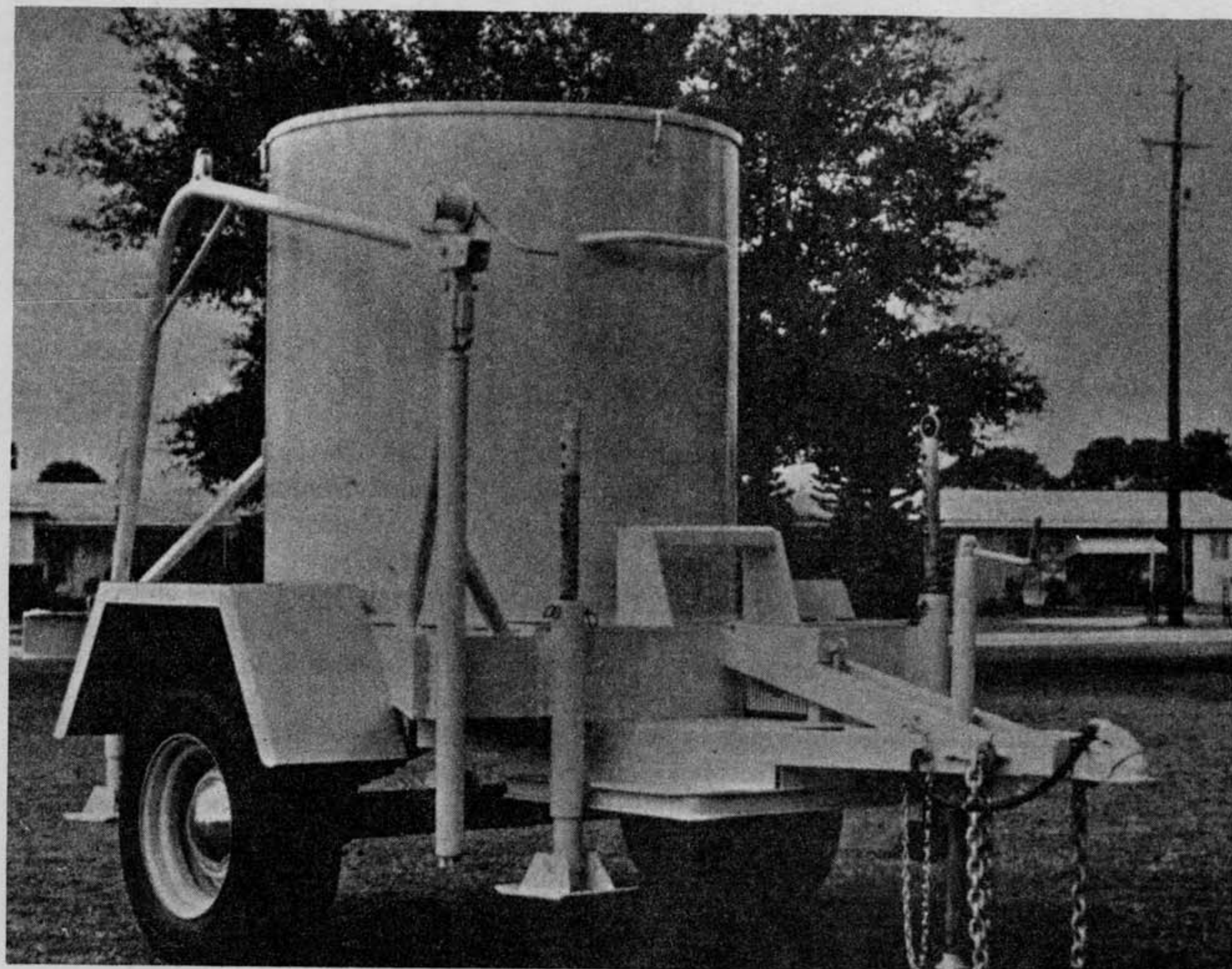

Figure 1. Criminalistics Bomb Transport Trailer - Basic Model

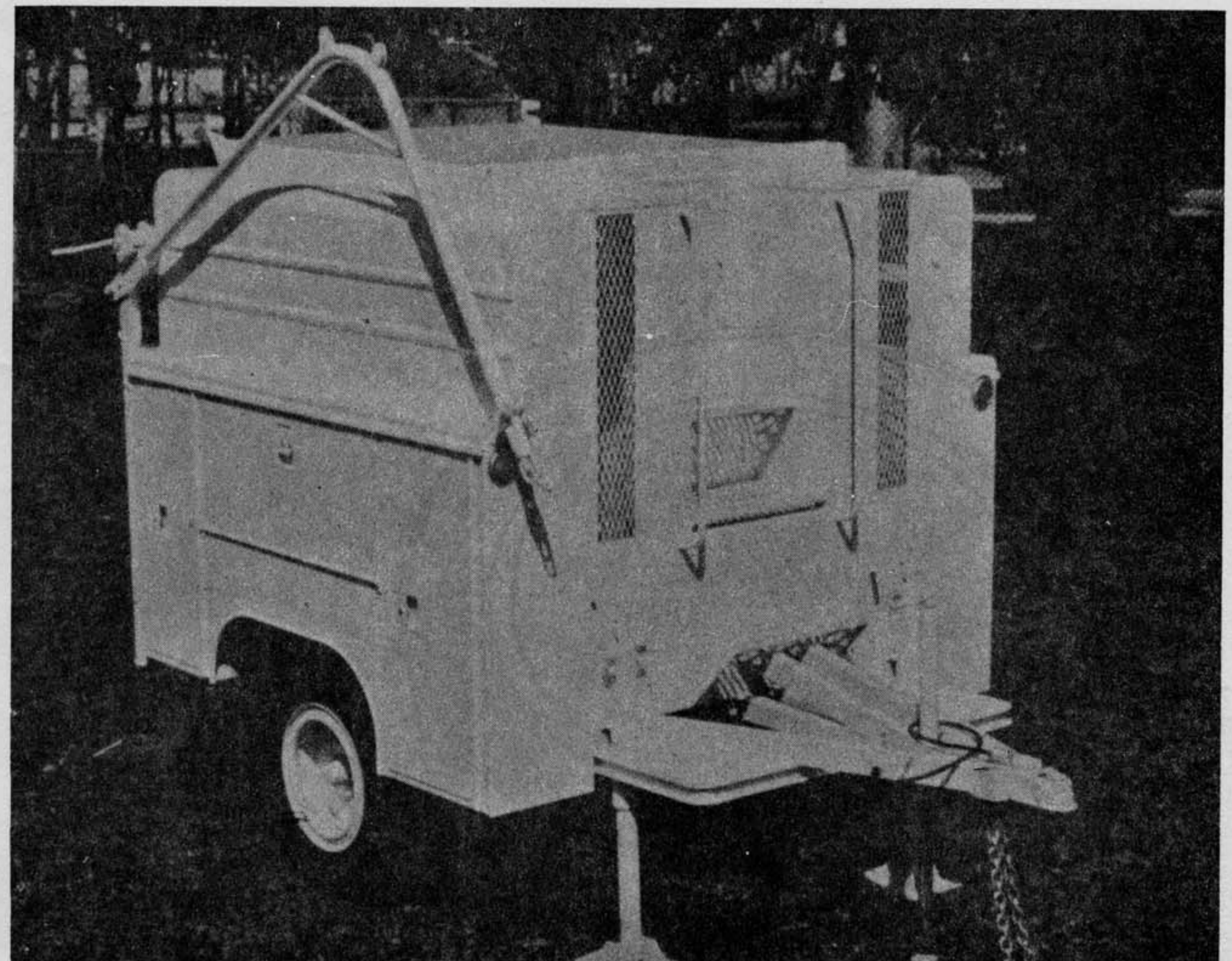

Figure 2. Criminalistics Bomb Transport Trailer - Standard Model

Overall dimensions for both models are 11 feet 4 inches long by 6 feet 4 inches wide by 6 feet 9 inches high. The basic model weighs approximately 6,500 pounds; the standard model approximately 7,500 pounds.

The trailer incorporates two closed bottom, steel containers (one within the other) to contain the lateral forces of an explosion and direct the fragmentation and blast pressure upward. See figure 3.

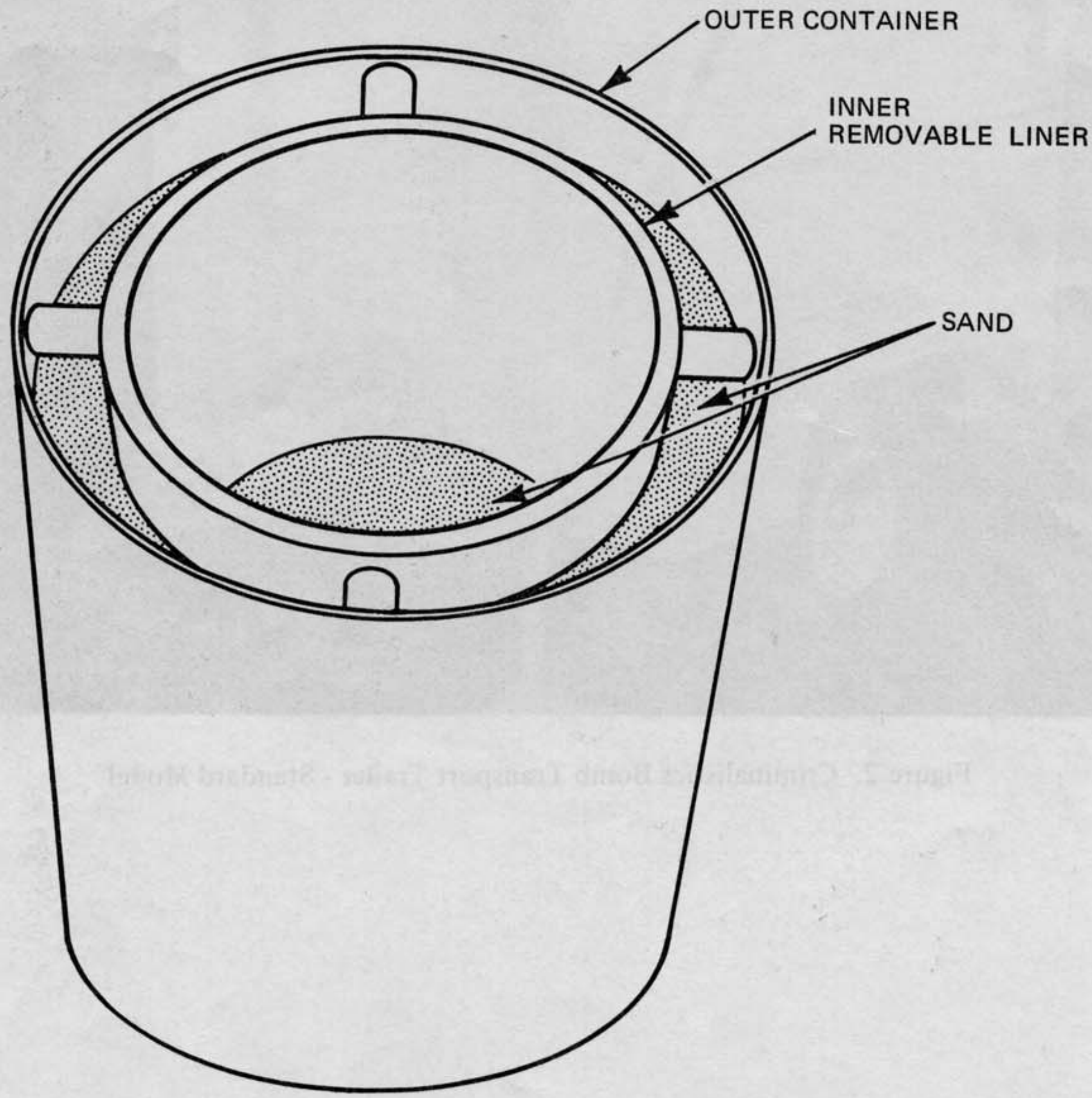

Figure 3. Inner and Outer Containers

The outer container is a 1/2-inch thick welded steel cylinder, 4 feet in diameter and 4 feet high, welded to the 1/2-inch plate steel floor of the trailer chassis.

The inner, removable liner is constructed of 1-inch thick welded steel, and is 3 feet in diameter by 3 feet 8 inches high, with a contoured bottom of 1 inch thick welded steel. The inner liner is supported by nine rubber cylinders with steel rod cores. Eight cylinders are attached to the sides of the liner and one is attached to the center of the outer container floor.

Before placing the trailer into service, the space between the outer container and the inner liner must be filled with dry, fine grain sand. Additionally, the bottom of the inner liner must be filled with sand.

Additional construction features of the trailer include a single axle, dual, leaf-type springs, two-12 ply radial tires, spring loaded jacks at each corner of the trailer, a manually retractable jack located on the trailer tongue, an optional loading boom and a removable metal cover for the containers.

A Picatinny Arsenal designed loading chute consists of two 8 foot long by 16 inch wide V-shaped aluminum sections with positioning brackets, pulleys for pull and guide ropes, and brackets for bolting the sections together.

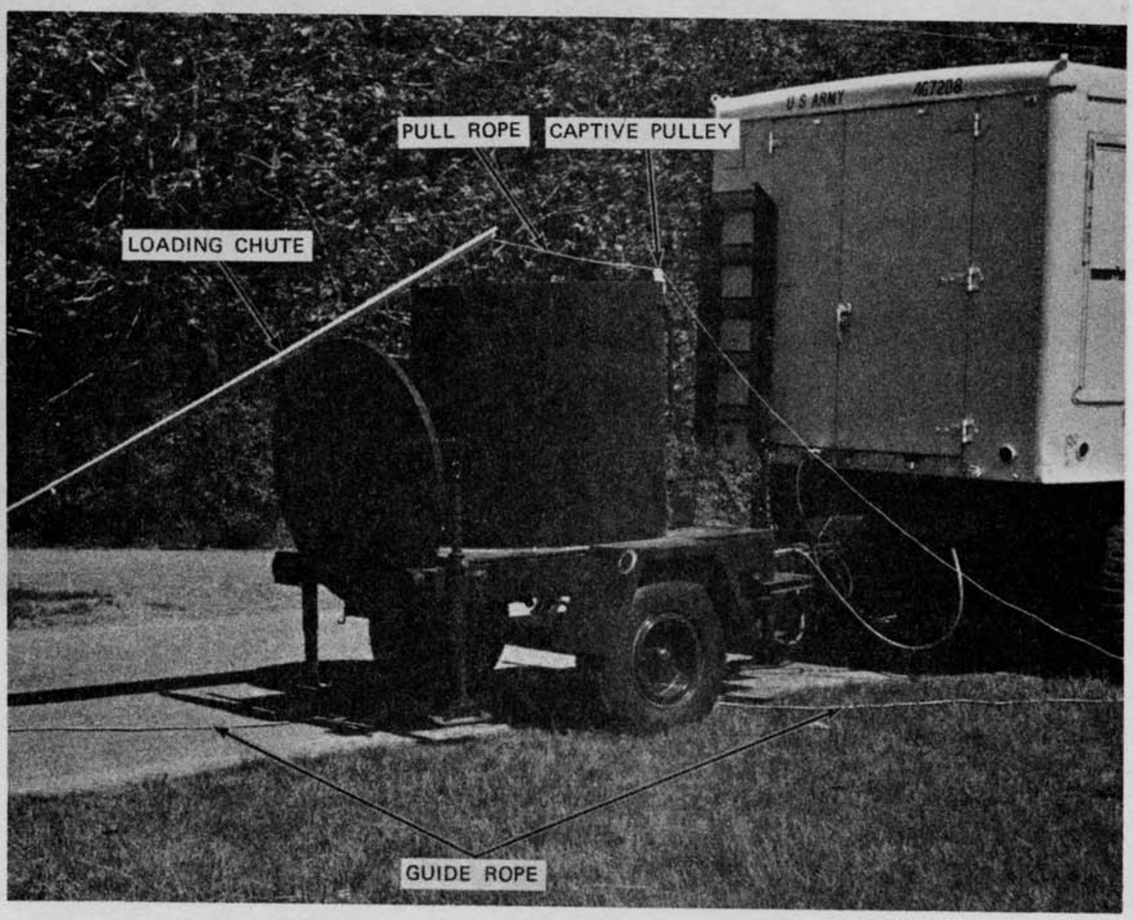

Figure 4. Use of Loading Chute in Recovery of Device at Ground Level

Figure 5. Explosive Device at Base of Chute

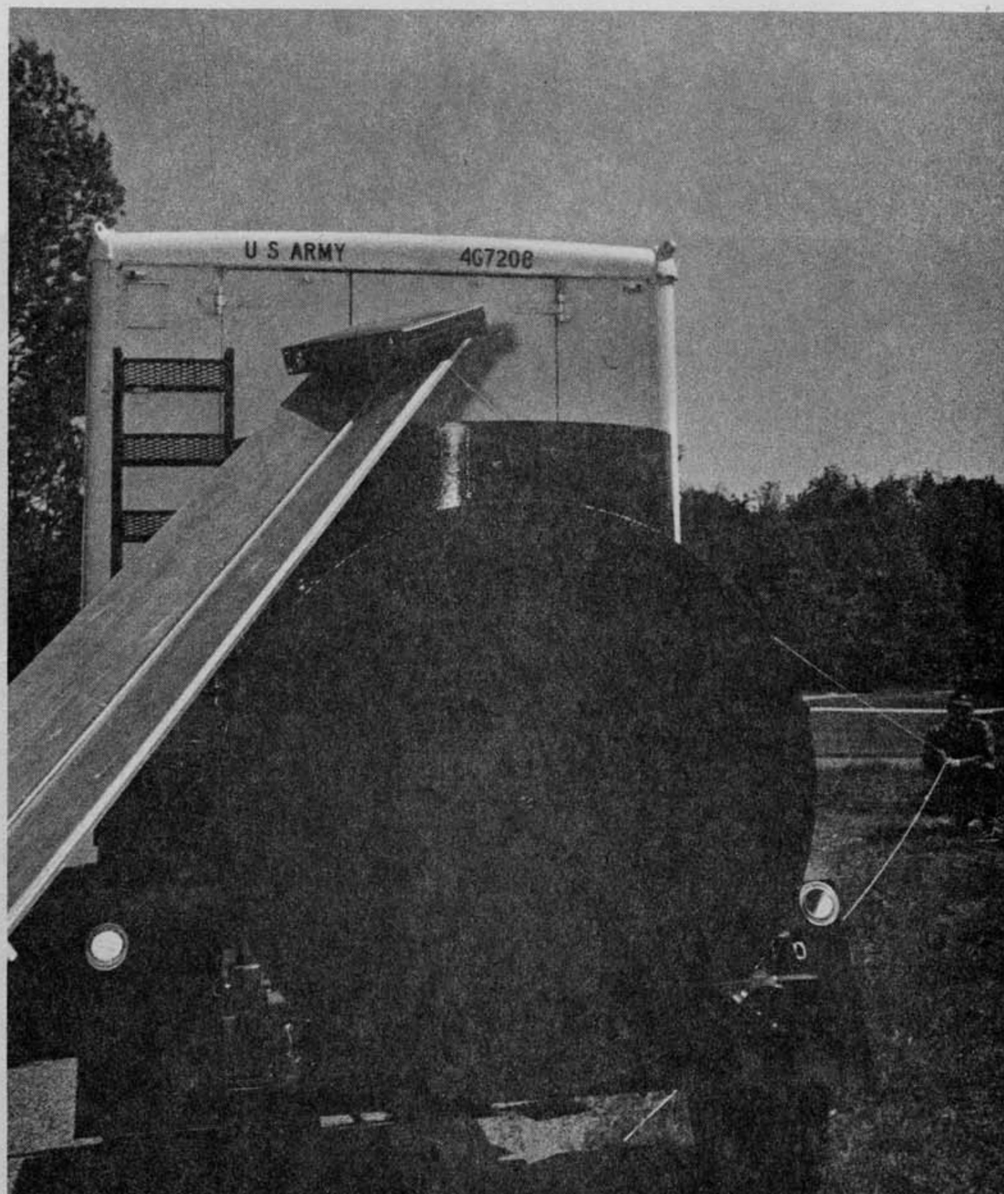

Figure 6. Explosive Device at Top of Chute

Figure 7. Explosive Device Being Lowered Into Container

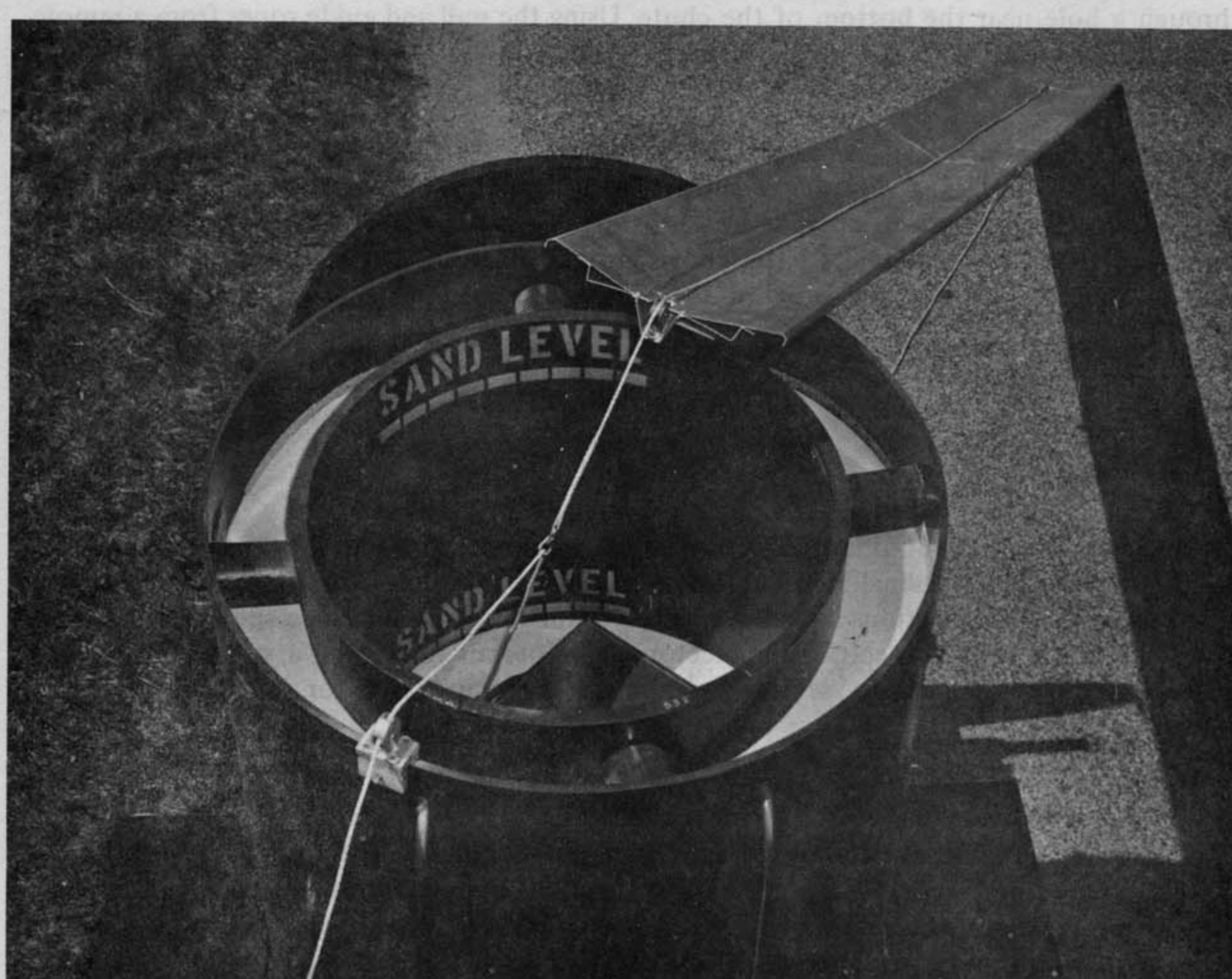

Figure 8. Explosive Device in Container

USE OF LOADING CHUTE

The loading chute is designed for use with the basic model of the trailer. The purpose of the loading chute is to permit remote recovery of an explosive device and it may be used in one of two ways.

First, the chute may be used to recover a device at ground level. See figures 4 through 8. In this configuration the chute is extended down from the container in a direction facing the device. The pull rope is laid out from a remote position. With the trailer between the device and the operator, the pull rope is pulled up over the trailer, across the containers, down the chute, and attached to the device. The guide rope is attached to the pull rope through a hole near the bottom of the chute. Using the pull and guide ropes from a remote location, the device is pulled to the top of the chute from where it may be gently lowered into the inner container.

In its second application, the chute may be used to recover a device from an above ground location such as an opening in a building (fig. 9). In this configuration the chute is extended from the container to the above ground location. The pull and guide ropes are attached and the device is recovered in the manner described in the previous paragraph.

TEST AND EVALUATION

General

Several factory modified versions of the basic model of the trailer were purchased for testing by Picatinny Arsenal, and for field evaluation by selected Army Explosive Ordnance Disposal units. Modifications included an air-hydraulic braking system, a special trailer hitch coupling, and a special electrical connector, all to permit towing by a standard 2-1/2 ton military vehicle. In addition, several inner liners were purchased for testing as individual items.

The tests were conducted using various weights of a commercial and a military explosive. The commercial explosives used were HDP1 Primers, with a detonation velocity of 24,000 feet per second. This type of explosive is among the most dense and has the highest detonating velocity of commercial explosives and, therefore, would provide test results for "worst case" situations. The military explosive used was TNT, with a detonating velocity of 22,500 feet per second.

Test Results for Inner Liners

For this series of tests the inner liners were instrumented with strain gages at various exterior locations. The intent was to determine the limit of the liners' ability to contain explosive forces. In all tests the explosives were placed on general purpose sand in the center of the bottom of the liner. A new liner was used for each type of explosive.

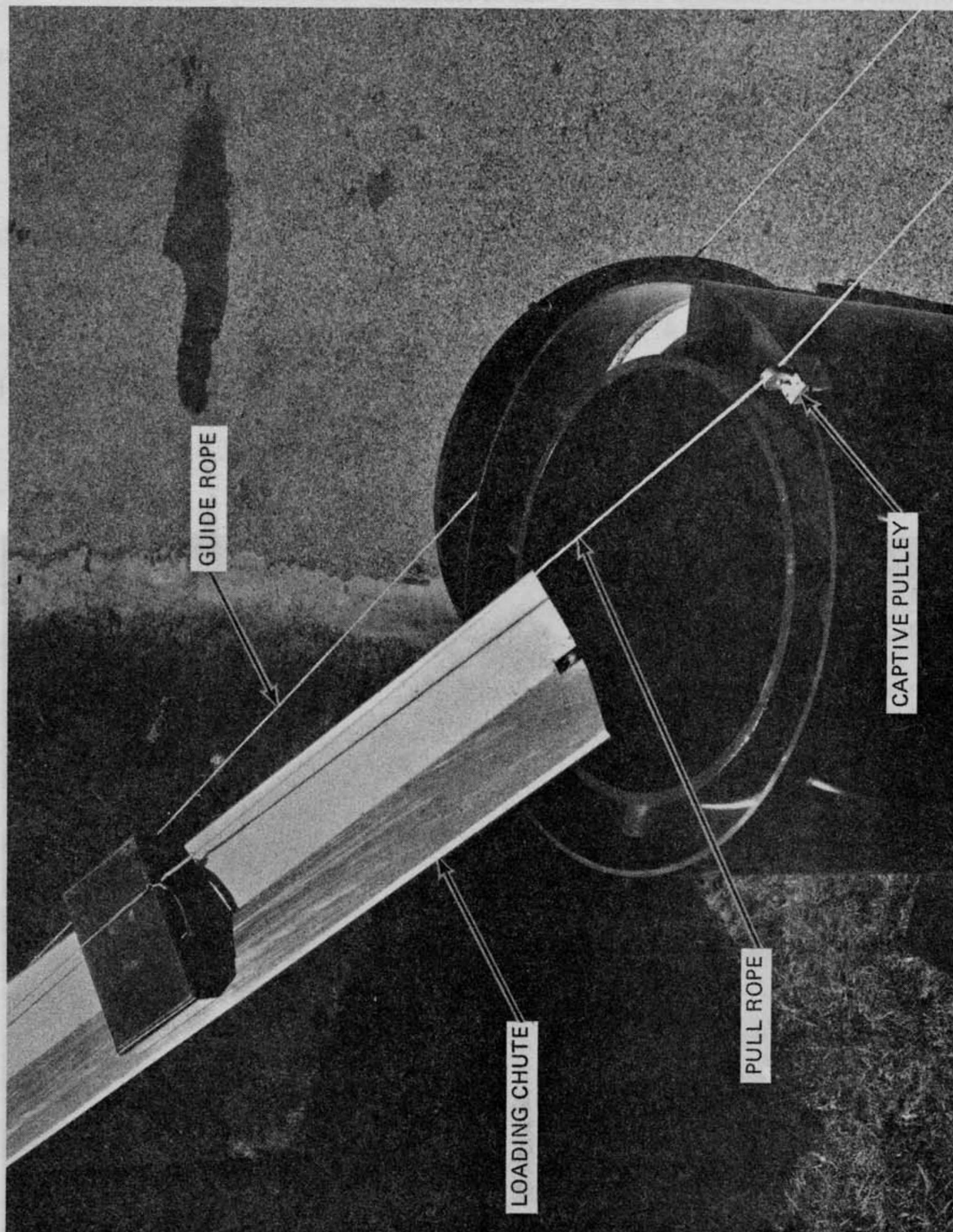

Figure 9. Use of Loading Chute in Recovery of Device From an Above Ground Location

HDP1 Explosive

Test 1 - Five pounds of explosive. Upon detonation, the gages recorded a slight deformation of the liner. No bulges, cracks or fractures were visually evident.

Test 2 - Five pounds of explosive. Upon detonation, although the gages again recorded a slight deformation of the liner, no bulging or fracture was visually evident.

Test 3 - Ten pounds of explosive. Upon detonation, a bulge was evident around the circumference of the liner just above the level of the sand. See figure 10.

Test 4 - Twenty pounds of explosive. Upon detonation, increased bulging was evident. The liner did not fracture.

Test 5 - Same as Test 4.

Test 6 - Twenty pounds of explosive. Upon detonation, the liner fractured into several large sections. See figure 11.

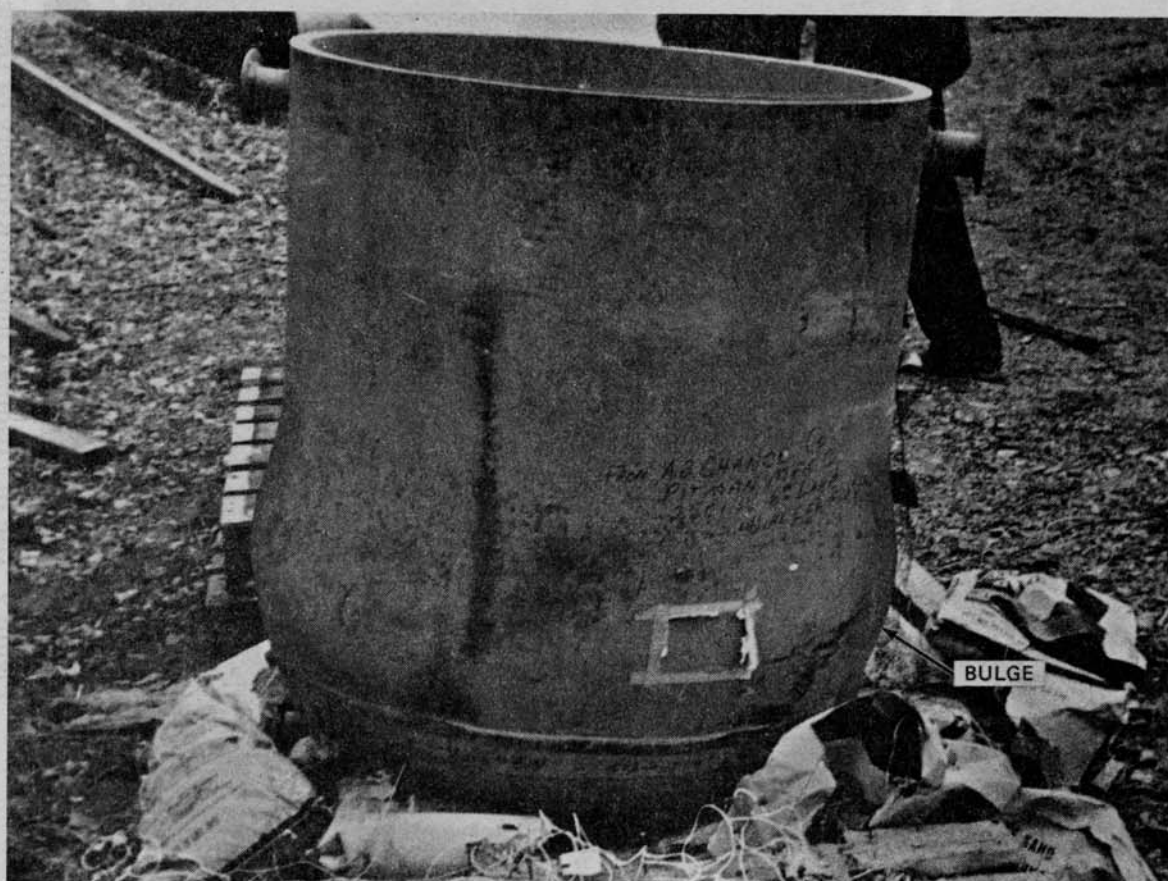

Figure 10. Bulge on Inner Liner After Test Using 10 Pounds of HDP1 Explosive

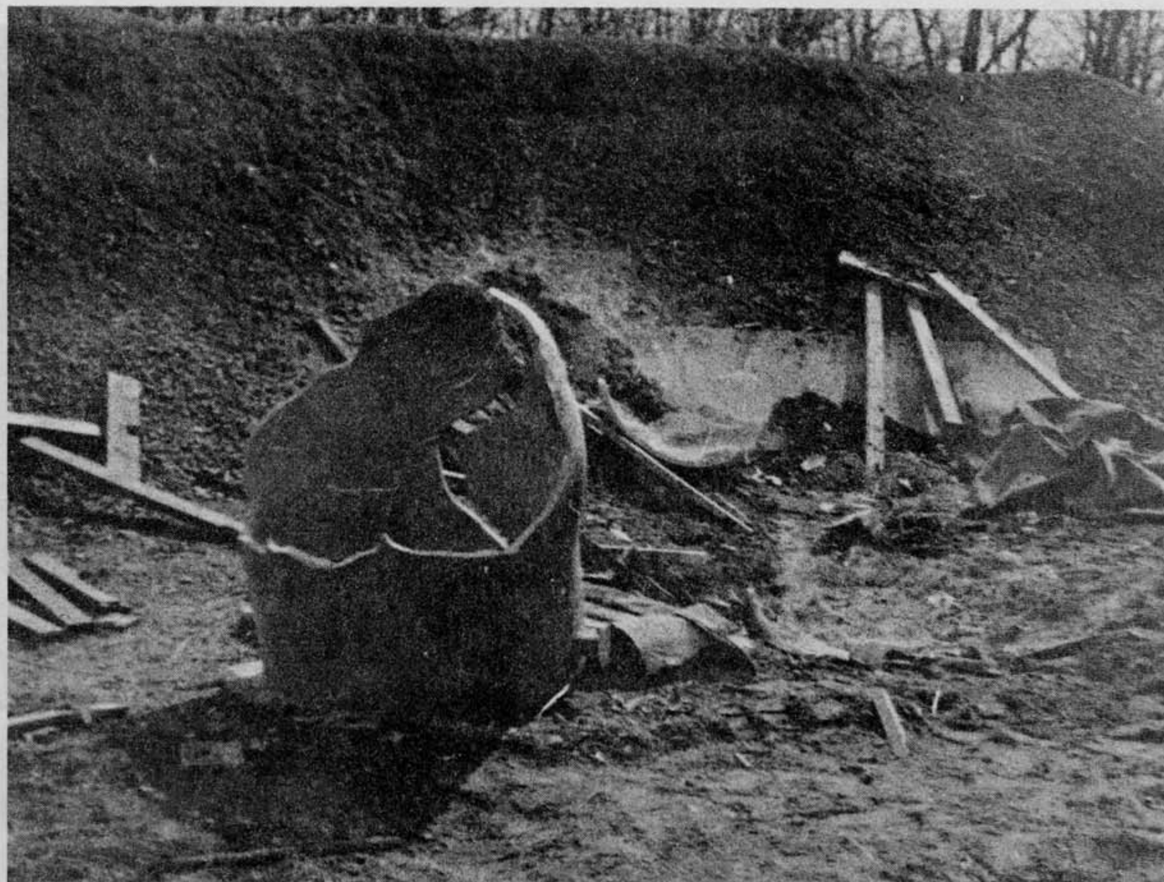

Figure 11. Fracture of Inner Liner After Third Test Using 20 Pounds of HDP1 Explosive

TNT Explosive

Test 1 - Two pounds of explosive. Upon detonation the gages recorded a slight deformation of the liner, with no bulging visually evident.

Test 2 - Two pounds of explosive. Upon detonation, although the gages again recorded a slight deformation of the liner, no bulging or fracture was visually evident.

Test 3 - Four pounds of explosive. Upon detonation, no bulging or fracture was evident.

Test 4 - Six pounds of explosive. Upon detonation, the bottom of the liner fractured with four cracks extending from the center of the contoured bottom out to the side. See figure 12 and refer to the Evaluation at the end of this bulletin.

Figure 12. Cracks in Bottom of Liner After Test Using 6 Pounds of TNT Explosive

Test Results for Trailers

For this series of tests, a new trailer was used for each type of explosive. The trailers were parked in an open field. A standard four door sedan was backed up to the trailer with its back bumper close to the trailer hitch. Additionally, near the rear end of the trailer a plywood structure was erected to simulate the size and general configuration of the cab of a standard 2-1/2 ton military truck with open side windows. See figure 13. The area around the trailer was instrumented with electronic blast gages.

The purpose of these tests was to determine if the trailer could successfully contain the lateral forces and vent 20 pounds of commercial or military explosive without contributing to the fragmentation. Additionally, blast pressures were measured to determine safety criteria for personnel and materials.

In all tests the explosives were placed equidistant from the sides of the liner.

Some of the tests were planned to include the use of Vermiculite[1] placed under and around the explosive. In earlier, unrelated tests, Vermiculite had proven effective in reducing blast pressure.

HDP1 Explosive

Three tests were made, each using the same trailer and 4 pounds of explosive. In the first test, the explosive was laid on the sand in the liner. In the second test, the explosive was laid on 4 cubic feet of Vermiculite previously spread on the sand in the liner. In the third test, 8 cubic feet of Vermiculite was spread on the sand, the explosive was laid on the Vermiculite, and two unopened bags of Vermiculite were laid on top of the explosive.

The blast pressures recorded for the second test were only slightly lower than those recorded for the first test. However, appreciable reductions in pressure were realized in the third test. No damage to either the container or trailer was evident.

A fourth test was made, again using the same trailer but with 20 pounds of explosive surrounded by Vermiculite as in the third test.

The trailer successfully contained the detonation of the fourth test, although the explosive forces caused a slight bulge in both the inner liner and the outer containers and bent the trailer axle.

TNT Explosive

Four tests were made, using 4, 8, 12, and 20 pounds, respectively, of explosive. For each test, 8 cubic feet of Vermiculite was spread on top of the sand inside the liner and three unopened bags of Vermiculite were laid on top of the explosive.

The trailer successfully contained the detonations of the first three tests, with no apparent damage. However, after the fourth test extensive damage was evident, including a crack in the liner at a point closest to the explosive charge, a bulge in the outer container, and a bent trailer axle.

Blast Pressures

Figures 14 through 19 show the peak incident pressures in pounds per square inch (psi) resulting from the trailer tests. The pressure lines shown are based on the pressures obtained for only one test for each explosive weight, and, therefore, must be considered as rough approximations of the ranges of pressures which could be encountered.

[1]Vermiculite is an air blown silica material ordinarily used for building insulation and for soil conditioning purposes, and is available from building and garden supply outlets in 4 cubic feet bags weighing approximately 18 pounds.

Figure 13. General View for Trailer Tests Showing 4 Door Sedan, Trailer, Simulated Truck Cab and Blast Gage Instrumentation

Peak incident pressures recorded inside the simulated truck cab did not approach the level which would cause damage to the driver's eardrums. As an example, in the test detonating 20 pounds of HDP1 explosive, the pressure recorded at the driver's ear was 2 psi, while 5 psi is the level at which eardrum damage could occur.

Figures 14 through 19 also depict a typical residential street 62 feet wide, and a typical city street 106 feet wide, with the trailer located in the center of each.

As indicated earlier, the pressures shown in figures 14 through 19 are incident pressures. When these pressures strike a flat surface in their line of travel they build up to produce a reflected pressure which is two to three times higher than the incident pressure. This higher reflected pressure can cause damage to buildings and material as shown below:

- At 1/2 to 1 psi pressure, single strength glass windows could shatter.
- At 1 to 2 psi pressure, asbestos siding of buildings could shatter, corrugated steel sheeting could buckle, and outside walls of wooden houses could fail.
- At 2 to 8 psi pressure, non-reinforced brick, concrete block, or cinder block walls could crack.
- At 5 to 10 psi pressure, safety glass in vehicles could shatter.

Evaluation

Inner Liners

The series of tests on the inner liners as individual items established that damage normally progresses from minor deformation through significant deformation to ultimate fracture and complete failure. Although permanent deformation of the inner liner occurred with a detonation of as little as 2 pounds of TNT, the tests indicated the liner could safely contain more powerful detonations. However, there is no means of predetermining when failure would occur. Ideally, the liner should be replaced after each detonation. In any event, uneven bulging or cracking of the liner should be cause for immediate replacement.

A failure did occur in one of the inner liner tests when 6 pounds of TNT caused the bottom of the liner to crack. However, investigation revealed that the sand in the bottom of the liner had absorbed moisture and had become relatively incompressible. When detonation occurred, the downward energy of the blast, instead of being partially absorbed by the sand, was transmitted through the sand to the liner, causing its failure.

In subsequent tests, a high grade 20-30[1] sand was used in the bottom of the liner and between the liner and the outer container. This type of sand has less tendency to become packed when exposed to humid conditions, and is considered better for use with this equipment.

[1] 20-30 sand is graded sand with all grains smaller than 20 mesh and larger than 30 mesh.

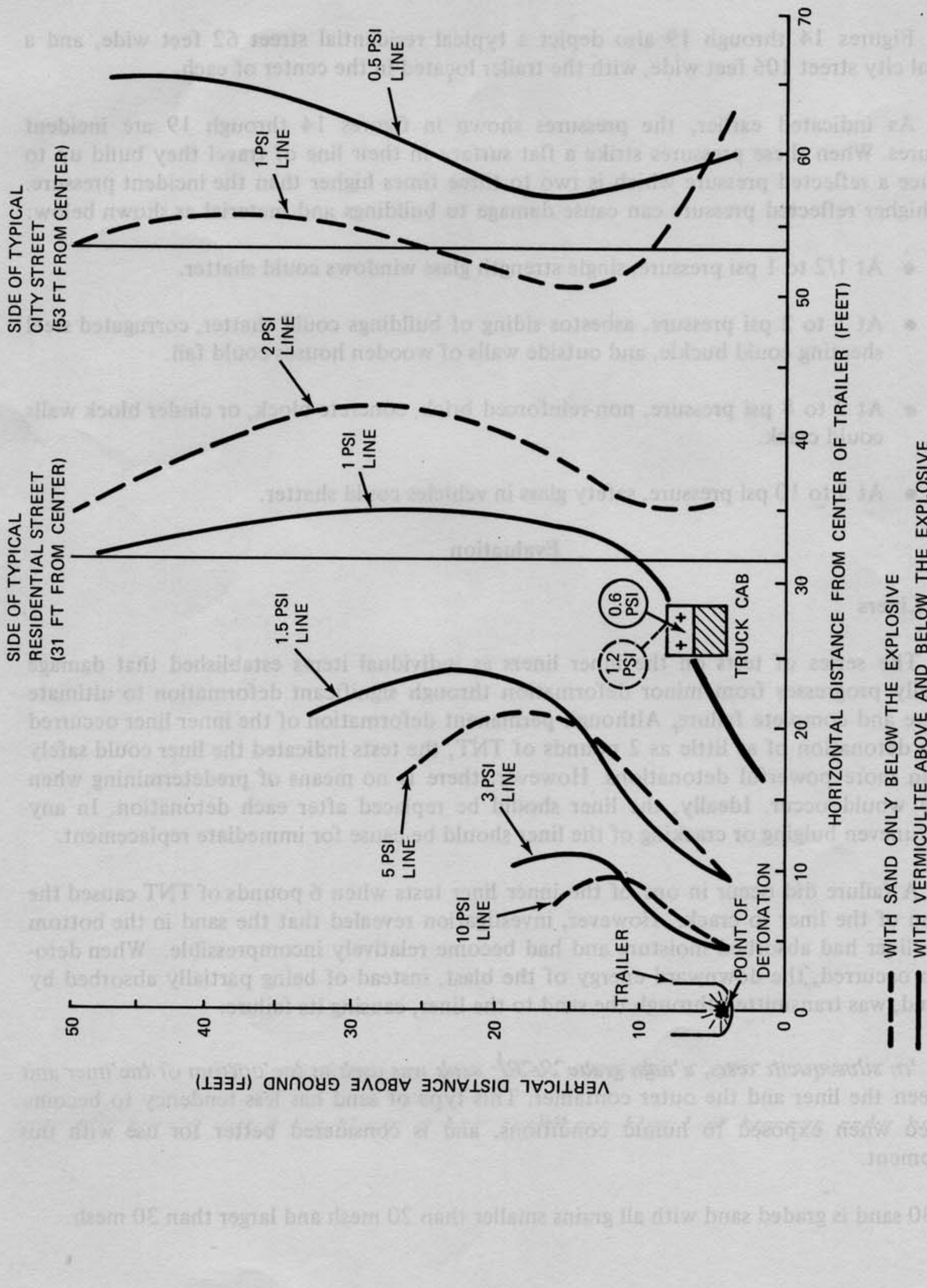

Figure 14. Peak Incident Pressures Resulting From Tests Detonating 4 Pounds of HDP1 in Trailer

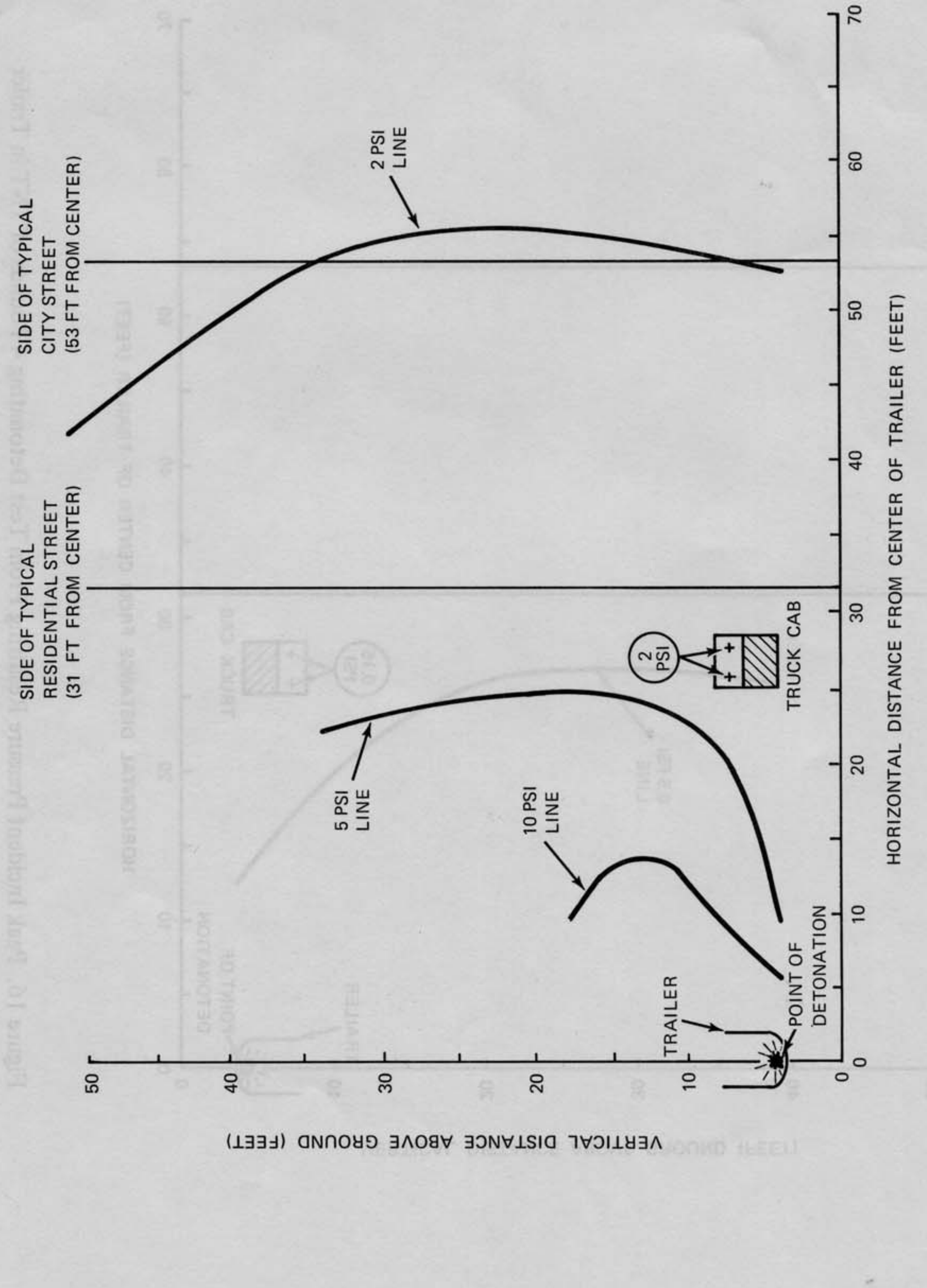

Figure 15. Peak Incident Pressure Resulting From Test Detonating 20 Pounds of HDP1 in Trailer

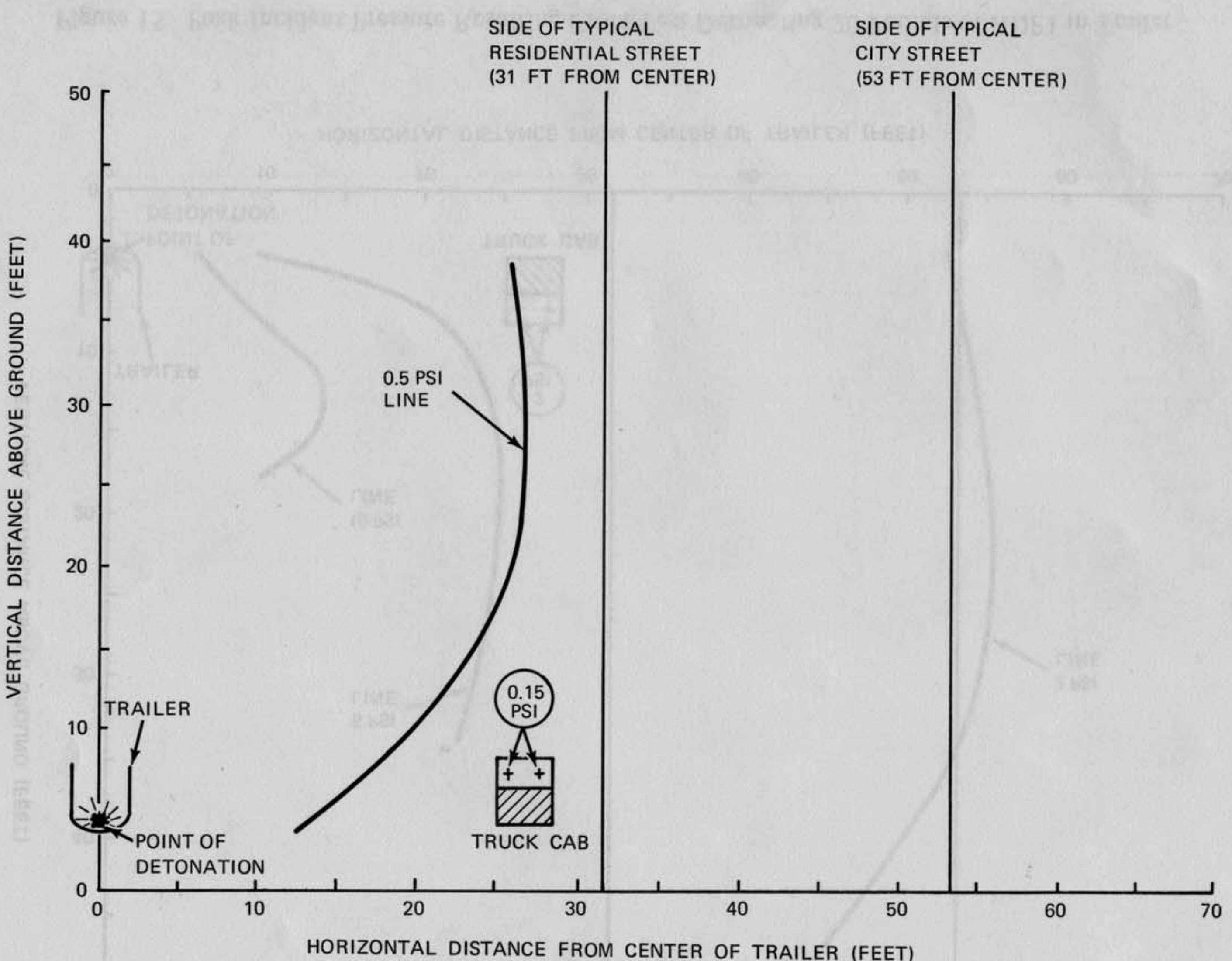

Figure 16. Peak Incident Pressure Resulting From Test Detonating 4 Pounds of TNT in Trailer

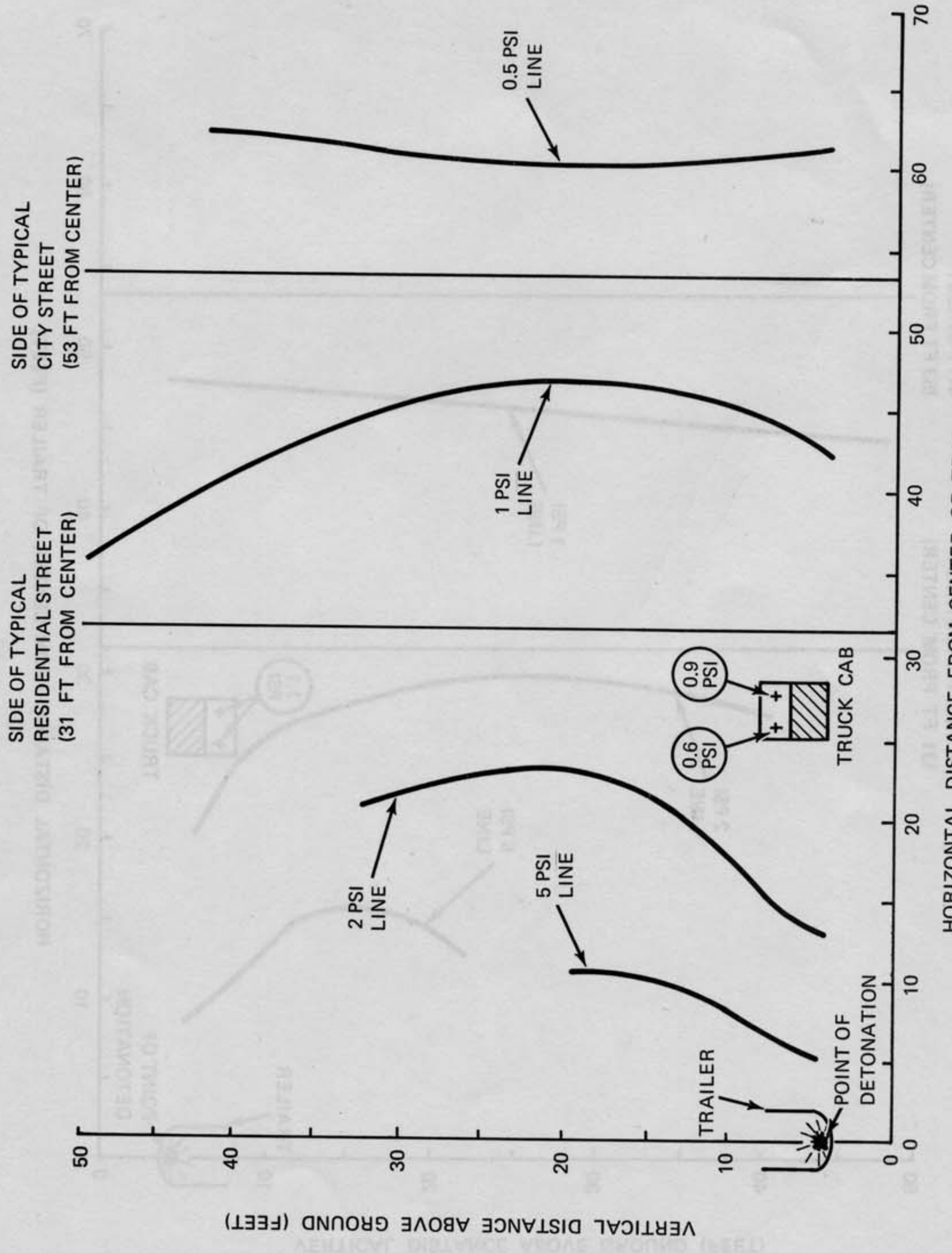

Figure 17. Peak Incident Pressure Resulting From Test Detonating 8 Pounds of TNT in Trailer

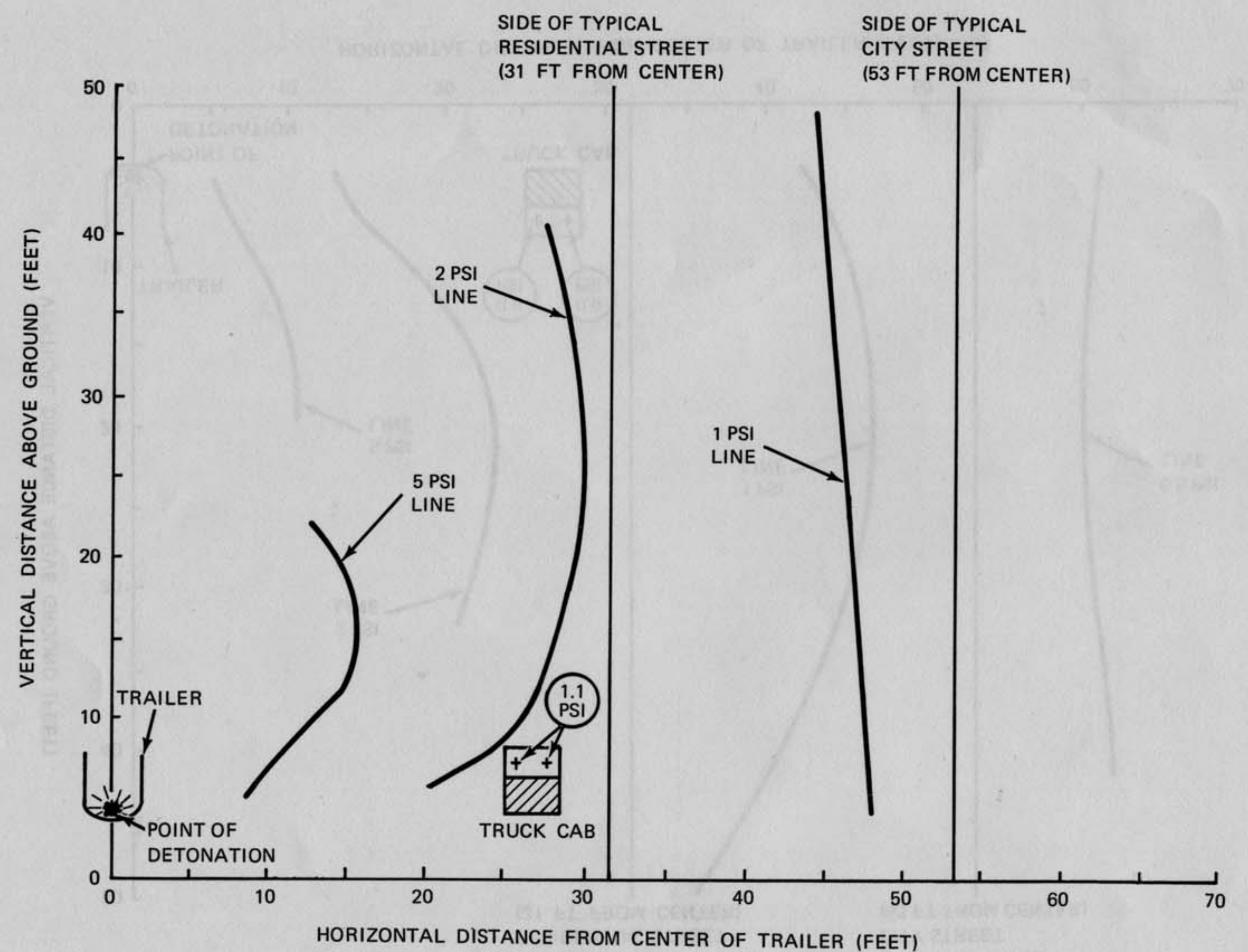

Figure 18. Peak Incident Pressure Resulting From Test DEtonating 12 Pounds of TNT in Trailer

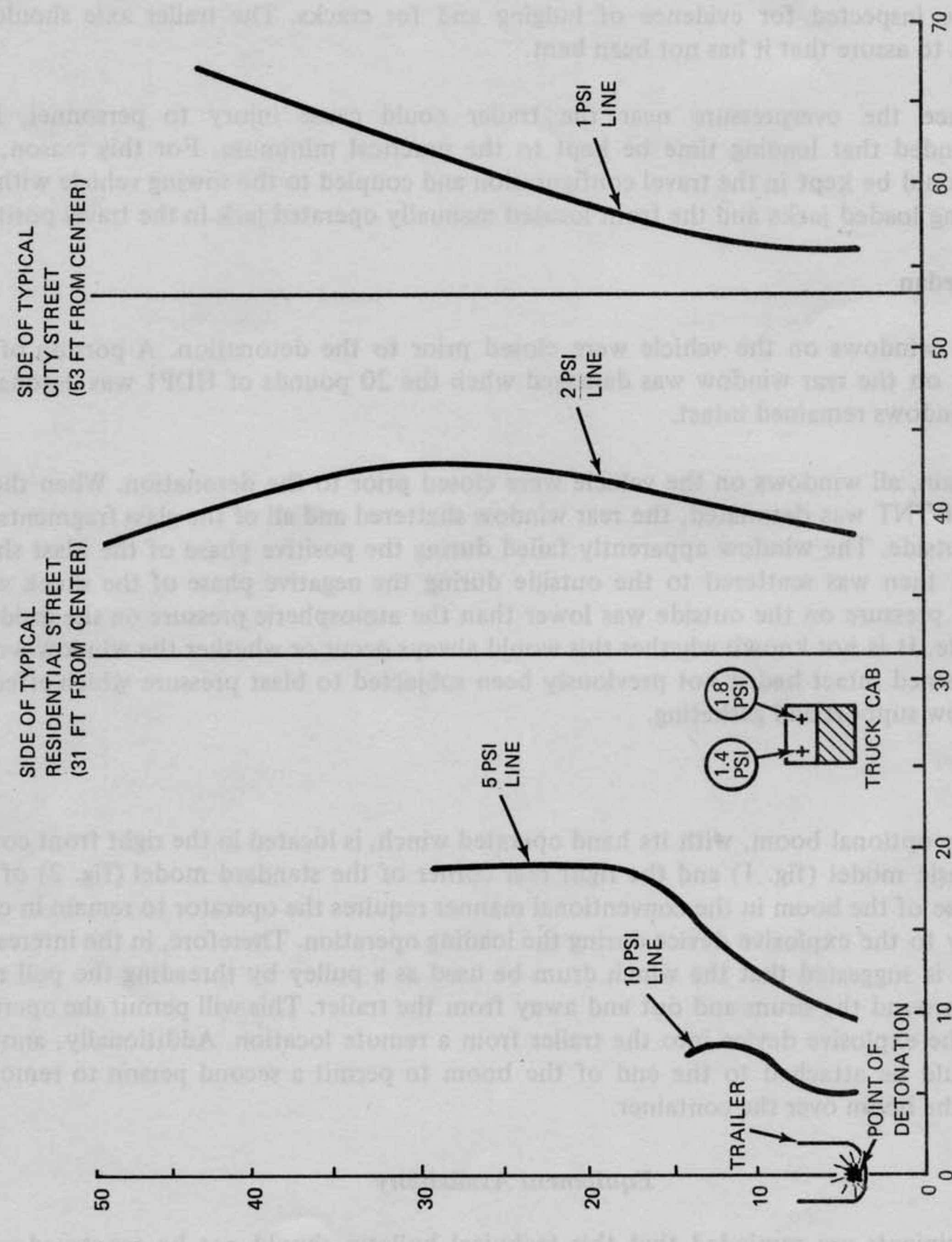

Figure 19. Peak Incident Pressure Resulting From Test Detonating 20 Pounds of TNT in Trailer

Trailers

The series of tests on the trailers established that damage is incurred when as little as 2 pounds of TNT is detonated. Therefore after each use, the inner liner and container should be inspected for evidence of bulging and for cracks. The trailer axle should be inspected to assure that it has not been bent.

Since the overpressure near the trailer could cause injury to personnel, it is recommended that loading time be kept to the practical minimum. For this reason, the trailer should be kept in the travel configuration and coupled to the towing vehicle with the four spring loaded jacks and the front located manually operated jack in the travel position.

4 Door Sedan

All windows on the vehicle were closed prior to the detonation. A portion of the gasketing on the rear window was damaged when the 20 pounds of HDP1 was detonated, but all windows remained intact.

Again, all windows on the vehicle were closed prior to the detonation. When the 20 pounds of TNT was detonated, the rear window shattered and all of the glass fragments fell to the outside. The window apparently failed during the positive phase of the blast shock wave and then was scattered to the outside during the negative phase of the shock wave when the pressure on the outside was lower than the atmospheric pressure on the inside of the vehicle. It is not known whether this would always occur or whether the window would have remained intact had it not previously been subjected to blast pressure which effected the window support and gasketing.

Boom

The optional boom, with its hand operated winch, is located in the right front corner of the basic model (fig. 1) and the right rear corner of the standard model (fig. 2) of the trailer. Use of the boom in the conventional manner requires the operator to remain in close proximity to the explosive device during the loading operation. Therefore, in the interest of safety, it is suggested that the winch drum be used as a pulley by threading the pull rope partially around the drum and out and away from the trailer. This will permit the operator to load the explosive device into the trailer from a remote location. Additionally, another rope should be attached to the end of the boom to permit a second person to remotely position the boom over the container.

Equipment Availability

Recipients are reminded that this technical bulletin should not be construed as an endorsement or approval of the items covered. Its objective is merely to report the information derived from testing in order to assist interested public safety officials in determining whether or not this equipment will fill the requirements of their particular situation. Information regarding prices of the tested items can be obtained from the Suspected Item Disposal Corporation, P.O. Box 363, Opa-Locka, Florida 33054, upon request.