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Development and Proof Services

REPORT NO. DPS/TW-510/1

REFERENCE COPY

AUTOMOTIVE DIVISION

REPORT ON

GOER TYPE TIRE VERSUS M15 LAND MINE (U)

First Report on Ordnance Project No. TW-510

(D. A. Project No. 548-09-036

(AD-1288)

C. L. DEMAREE

FEBRUARY 1960

CODE SHEET INCLUDED

Aberdeen Proving Ground
Maryland

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ABERDEEN PROVING GROUND
MARYLAND

AUTHORITY: AOS-20

CLDemaree/tsp

GOER TYPE TIRE VERSUS M15 LAND MINE (U)

First Report on Ordnance Project No. TW-510

(AD-1288)

Date of Test: 8 December 1959

(C) ABSTRACT

A 29.5 x 29 GOER type tire, with rim assembly welded to a modified hub, was mounted on a 240-mm howitzer carriage. Tests were conducted using an electronic mine to establish the ground pressures produced by the GOER tire loaded with 16,250 pounds. Later the tire was towed over an M15 land mine under the same load condition. All tests proved conclusively that tires of this type, when loaded with 16,250 pounds, will produce ample pressure to detonate an M15 mine, and that the vehicle using this tire would be immobilized by the resulting detonation. E C D

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Figure 1 (U): GOER Tire Mounted on Test Rim with Modified 240-mm Hub Assembly.



Figure 2 (C): GOER Tire after Detonation of M15 Land Mine.

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1. (U) INTRODUCTION

The Ordnance Tank-Automotive Command authorized the shipment of six 29.5 x 29 earthmover tires from Code A to Development and Proof Services for testing. These types of tires are used on the Truck, Cargo, Logistical, High Mobility, 15-Ton, 4 x 4, XM347 and the Truck, Tank, Fuel, Logistical, High Mobility, 15-Ton, 4 x 4, XM348 GCER vehicle manufactured by Code B.

Generally these vehicles were constructed from commercial earth-moving equipment components except for the cargo bodies and sufficient sheet metal to produce flotation in water. Each vehicle consists of two units: the tractor and a trailer cargo or tank body.

The purpose of this test was two-fold:

- a. To determine the ground pressure exerted by the GOER tire when loaded with 16,250 pounds.
- b. To move the GOER tire, loaded with 16,250 pounds, over an M15 mine and evaluate the damage produced.

2. (U) DESCRIPTION OF MATERIEL

Earthmover tires as manufactured by Code A are fabricated in two general types: nylon rock grip excavator, wide base, and nylon ground grip, wide base. These tires are readily identified by the appearance of the tread.

Statistics for earthmover tires (Code A) are given in Table I.

Tires received for testing were in various degrees of wear and all appeared to have survived severe usage. The tire selected for testing was a 16-ply nylon ground grip (wide base). It was chosen because the tread was more even and the casing was in good condition. Two rim assemblies, tube type, for 29.5 x 25.00 earthmover tires, six tubes and six flaps completed the test equipment from Code A.

Other test equipment consisted of the following: Mine, AT, HE, Composition B-Loaded, Heavy, M15, Fuze, Mine, AT, M503; Activator, M1, Lot LOP-14-150; Mine, electronic - a special instrument for recording pressures exerted on mine; towing vehicle, M48 tank.

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Table I. Earthmover Tires

Size of Tire	Fly Rating	Size of Rim, in.	Flange Height, in.	Max. Speed, 30 mph		Dimensions, New Tires, in.		Worn Tire Width at Rated Load
				Max. Load, lb	Inflation Pressure, lb	Max. Over-all Width	Over-all Diameter	Static Loading Radius
a29.5 x 29	22	25.00	3.5	22620	35	30.10	77.9	34.6
a29.5 x 29	28	25.00	3.5	26200	45	30.10	77.9	34.6
a29.5 x 29	34	25.00	3.5	29490	55	30.10	77.9	34.6
b29.5 x 29	16	25.00	3.5	18600	25	29.93	77.4	34.4
b29.5 x 29	22	25.00	3.5	22620	35	29.93	77.4	34.4
b29.5 x 29	28	25.00	3.5	26200	45	29.93	77.4	34.4
b29.5 x 29	34	25.00	3.5	29490	55	29.93	77.4	34.4

Notes: a) Nylon rock grip excavator, wide base.
b) Nylon ground grip, wide base.

3. (C) DETAILS OF TEST

3.1 Procedure

3.1.1 Modification of the 240-mm Mount. The 240-mm mount was a six-wheeled vehicle with trails and chassis structure intact. It was originally used as a carriage and mount for the 240-mm howitzer and was manufactured in 1942 (Figure 3).

The two existing tires for the 240-mm carriage were removed and the flanges and wheel disks were reassembled. These flanges, after being valded to the wheel disk to provide a stable base, were machined to diameters of 27.76 inches on the inside flange and 26.58 inches on the outside flange (Figures 4 and 5).

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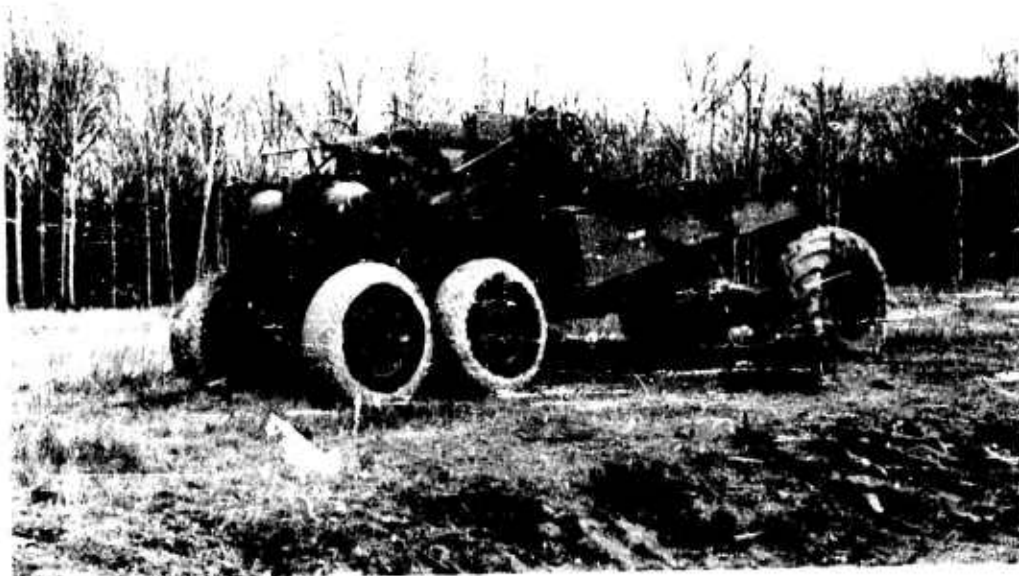


Figure 3 (U): 240-mm Howitzer Carriage Modified to Use as Test Vehicle.

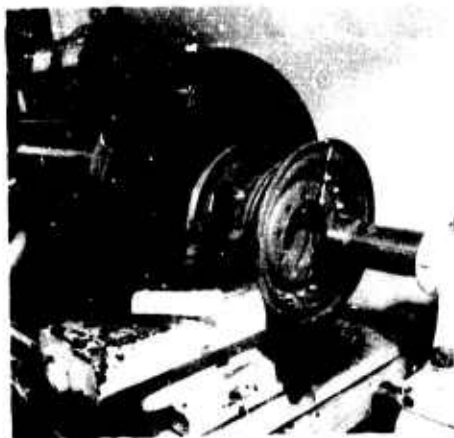


Figure 4 (U): Machining Operation on Modification of 240-mm Wheel Disk and Flanges.



Figure 5 (U): GOER Test Rim Base.

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This unit was then welded 1/2 inch from the inside edge of the GOER test rim base, allowing it to extend approximately 12 inches beyond the outer edge of the 240-mm flange. There were no modifications on the test rim except the above-mentioned welds.

Tubes, flaps and tires were easily installed on the rim (Figure 6) by two men using a fork lift. The tires were then inflated to 20 psi air pressure and the wheels were installed on the 240-mm carriage.



Figure 6 (U): Mounting of GOER Test Rim and 240-mm Wheel.

A bar clevis, detachable at both ends, was welded to the front axle housing at one point and to the main structure of the 240-mm carriage at the other end. This was done to maintain rigidity for the front wheels while the vehicle was towed rearward.

The right front wheel, mounting the GOER test tire, was placed on a Fairbanks platform scale. Load weight on this tire, before additional weight was added, was 9,500 pounds. A 96- by 72- by 10-inch armor plate was loaded onto the trails of the carriage and adjusted to produce 16,250 pounds of weight on the test tire. This plate was then welded to the trails to insure load stability.

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3.1.2 Employment of the Electronic Test Mine. The electronic test mine is an instrument used to measure and record pressures exerted on the mine (Figures 7 and 8). The device utilized for this test was a duplicate of an M15 mine. Nine individual readings were taken, eight of which were with the top of the mine 3 inches below ground level. Loose earth was placed over the mine to fill the 3-inch space. The ninth measurement was taken at a 1-inch depth, with 1 inch of loose dirt over the mine. Tire pressure at the start of this testing was 20 psi but after the fourth recording the air pressure was reduced to 17 psi. This was done with the approval of the Ordnance Tank-Automotive representatives who were witnessing the test.

Towing the 240-mm carriage was accomplished by an M48 tank using a 60-foot cable.

3.1.3 Employment of the M15 Mine. An M15 mine is a heavy antitank service mine intended for use against heavy tanks. The complete mine consists of a high-explosive-loaded mine body fitted with an M120 booster and M603 fuze. The M603 antitank mine fuze functions when the pressure plate depresses, thereby reversing the Belleville springs and causing the firing pin to be driven into the high-explosive detonator. An electric detonator was assembled into the activation well, in the event of a misfire. The force (pressure in pounds) needed to activate the M15 antitank mine is approximately 350/ 50 pounds.

The GOER test tire was towed over the mine so that the center of the tire tread was aligned with the center of the mine.

3.1.4 Photography. Ordnance Tank-Automotive Command furnished a photographer to film the events in motion. In addition to the actual testing another M15 mine was detonated electrically and its functioning recorded by the camera for use as a comparison of the explosive forces exerted when the functioning was unimpeded by the tire or other material. These motion pictures were retained by Ordnance Tank-Automotive Command personnel. Still photographs were taken throughout the preparation and testing by Development and Proof Services. These may be found throughout this report.

3.1.5 Soil Samples. Soil samples were taken at three points along a line where testing was conducted, to give a general idea of the terrain and soil conditions.

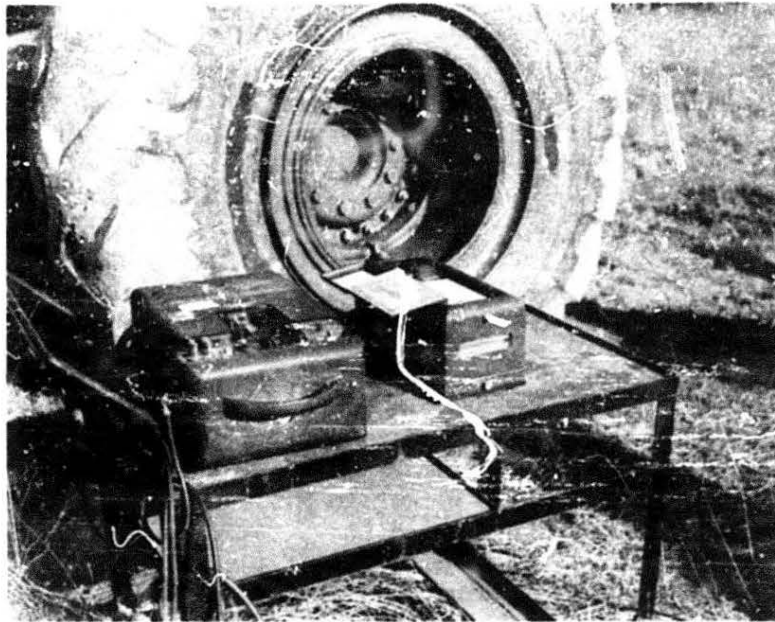


Figure 7 (U): Recording Equipment used in Conjunction with the Electronic Test Mine.



Figure 8 (U): The Electronic Test Mine.

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3.2 Results

3.2.1 Electronic Mine. The electronic mine indicated that the pressures exerted by the GOER tire were as given in Table II.

Table II. Pressures Exerted by Tire

Test Run	Depth, in.	Tire Pressure, psi	Pressure Exerted on Mine, psi
1	3	20	810
2	3	20	915
3	3	20	800
b ₄	3	20	870
5	3	17	760
6	3	17	775
7	3	17	745
8	3	17	Lost ^a
9	1	17	Lost ^a

Notes: ^aInstrument failure.

^bRun No. 4 had side walls of the hole essentially vertical.

All other emplacements were sloped at an angle of 45 degrees.

3.2.2 M15 Mine. The M15 mine detonated from pressure exerted by the GOER tire, which was destroyed beyond use. The crater made by this detonation was 10-1/2 feet in diameter and 44 inches at the deepest point. The bottom third of the tire nearest the blast was shredded and torn into many small pieces while the two-thirds remaining was thrown 107 yards to the rear (Figure 2). The rim base, including the 240-mm disk, was torn from the vehicle and was thrown 28 feet from the point of detonation (Figures 9, 10 and 11).

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Figure 9 (C): Damaged Flange in Crater and GOER Test Rim 28 feet from Crater.



Figure 10 (C): Slight Damage Incurred by other GOER Tire and Test Carriage.

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Figure 11 (C): GOER Test Rim Base with Part of 240-mm Disk.

3.2.3 Soil Samples. Soil sample data are given in Table III.

Table III. Soil Sample Data

<u>Sample</u>	<u>Tare Weight, grams</u>	<u>Gross Weight, grams</u>	<u>Dry Weight, grams</u>	<u>% Moisture</u>
1	1.04	59.82	49.96	20.1
2	1.08	59.59	40.52	48.2
3	0.84	59.46	49.33	20.8

3.3 Observations

A GOER tire on the left front wheel approximately seven feet from the blast remained serviceable. The 240-mm howitzer carriage, except that area adjacent to the test wheel, showed very little damage. This seems to indicate that the test tire absorbed much of the shock of the explosion.

4. (C) CONCLUSION

It is concluded that a GOER tire, when loaded with 16,250 pounds, will exert ample pressure to detonate an M15 mine and that any vehicle using this type tire would be immobilized by the resulting detonation.

SUBMITTED:

C. L. Demaree
C. L. DEMAREE
Test Director

REVIEWED:

W. C. Pless
W. C. PLESS
Chief, Armor Branch

C. D. Montgomery
for W. A. GROSS
Chief, Automotive Division

APPROVED:

H. A. Noble
H. A. NOBLE
Assistant Deputy Director
for Engineering Testing
Development and Proof Services

APPENDICES

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Test Authority

WORK ORDER		DJKew/jar/20240		Date:	
1. TO:		2. FROM:		14 October 1959	
Aberdeen Proving Ground Aberdeen, Maryland		CTAC, ORDMC-RP.4		4. Document Control No. 0-1-0-052-041-041-1	
5. QMS CODE AND TITLE:					
5510.12.240A0.01 Truck, Cargo, 15 Ton, XM437					
6. Appropriate Accounting Class. of Funds (to be) Made Available:		7.a. Elements	b. Quantity Unit	c. Unit Cost	d. Total Cost
21X2040 005-4211 P5510		Prior			
		Increase	N/A	N/A	8,000.00
		Decrease			
		Current	N/A	N/A	8,000.00
Tolerance Per Para 186					
8. Performance of the Following Work is Authorized (Subject to Availability of Funds)					
This AOS is issued to Authorize Testing Conducted by Development and Proof Services, ORDBG-DPS-TV in accordance with the following Test Directive. TEST DIRECTIVE TITLE. Mine Evaluation of a GOER Tire. OBJECTIVE: The determination of the effects of the M15 Mine on a moving GOER vehicle with the GOER Tires. DESCRIPTION: Code A, Akron, Ohio, will ship six GOER tires, six tubes, two rims and one rim and lug drawing to Aberdeen Proving Ground for use on the mine program. PROCEDURE: Aberdeen Proving Ground will perform the following:					
9. DELIVERY SCHEDULE & INSTRUCTIONS					
10. ENCLOSURES:		11. AUTHORIZED BY:			
FOR USE BY ADDRESSEE		14 October 1959 W. R. SWENOR			
12. CONTRACT ACTIONS		DATE Typed Name			
a. DATE		/s/ W. R. Swenor.			
b. NUMBER		Signature			
c. AMOUNT		Chief, ORDMC-RP.4			

C O P Y/tsp

OMS CODE 5510.12.240AO.01

DCN 0-1-0-052-041,041-1

Page 2 of 2 Pages

- a. Insert one tube inside of one GOER tire and place on rim.
- b. Modify one 240M trailer and install GOER tire assembly on wheel
- c. Tire will be inflated to 20 pounds psi pressure.
- d. Simulate GOER Tire loading of 16,250 pounds (one tire).
- e. Take pictures of test rig prior to testing.
- f. Determine the ground pressure of the GOER tire utilizing electric mine equipment.
- g. Make necessary fixtures to move the vehicle so that GOER tire will pass over an M15 mine located on the ground.
- h. Move GOER tire over M15 mine. Evaluate damage and take pictures.

OTAC will send photographer to Aberdeen Proving Ground to take moving pictures of complete tests.

The extra GOER tires, tubes and rim are to be held at Aberdeen Proving Ground pending additional testing.

It is requested that this office be notified in advance of scheduled firings to permit attendance by the Project Engineer and photographer.

C O P Y/tsp

DATE: 27 NOV 59
ACTION: D&PS

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RR RUETGH

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DA GRNC

BT

UNCLAS TT22400 FOR ORDBG-DPS-TU W PLESS FROM ORDMC-REML SPIRO
REF TELEPHONE CONVERSATION BETWEEN W PLESS OF ABERDEEN PROVING
GROUND AND H SPIRO OF OTAC ON 26 NOVEMBER 1959, REGARDING GOER TIRE
TEST DIRECTIVE.

PARAGRAPH F SHOULD BE REVISED TO READ, "DETERMINE THE GROUND
PRESSURES OF THE GOER TIRE WITH ELECTRIC MINIAENT PLACED 3 INCHES,
2 INCHES, 1 INCH AND 0 INCHES BELOW GROUND SURFACE

PARAGRAPH G LOCATION OF M15 MINE SHOULD READ 3 INCHES BELOW SURFACE

ADD PARAGRAPH I IF MINE DOES NOT DAMAGE TIRE REPEAT PARA H

ADD PARAGRAPH J IF TIRE IS STILL INTACT, REPEAT PARA H WITH MINE
2 INCHES THEN 1 INCH AND FINALLY 0 INCHES BELOW SURFACE.

BT

CFM TT22400 ORDBG-DPS-TU ORDMC-REML 26 1959 3 2 1 0 M15 3 2 1 0

27/1548Z

APPENDIX B

Letter Report

Mr White/vm/42255

ORDRG-DPS-T

100 6 1959

SUBJECT: Determination of Loads Imposed on the M15 Mine by GOER-Type Low Pressure Tires

TO: Chief of Ordnance
Department of the Army
Washington 25, D. C.
ATTN: ORDTS

1. On 8 December 1959 personnel of the Infantry and Aircraft Weapons Division participated in tests of GOER-Type tires by obtaining loads imposed on the pressure plate of the instrumented M15 antitank mine. This information was obtained at the request of personnel of Automotive Division, Development and Proof Services. Personnel of the Physical Test Laboratory provided the instrumented mine and associated recorder, operated the instrumentation, and reduced the data.

2. The tire utilized for the tests was a 29.5 x 29 size of 16-ply rating which is normally inflated to 25 psi and rated to carry a maximum payload of 18,600 pounds. The diameter of a new tire of this type is approximately 74 inches. Nine test runs were made over the instrumented mine; four at a tire pressure of 20 psi, and five at a pressure of 17 psi. Only the first seven runs are here considered, because an instrumentation failure occurred after the seventh run. The mine was emplaced in a hole approximately eight inches deep to provide three inches of earth cover over the mine pressure plate. For Run Number 4, the mine was emplaced in a hole with essentially vertical sidewalls. The sidewalls of all other emplacements were sloped at an angle of approximately 45 degrees. Gross load on the tire for these tests was 16,250 pounds. The following load data was recorded:

<u>Test Run No.</u>	<u>Tire Pressure (psi)</u>	<u>Pressure Plate Load (pounds)</u>
1	20	810
2	20	915
3	20	800
4	20	870
5	17	760
6	17	775
7	17	745

ORNDG-DPS-TT

SUBJECT: Determination of Loads Imposed on the M15 Mine by GOER-Type
Low Pressure Tires

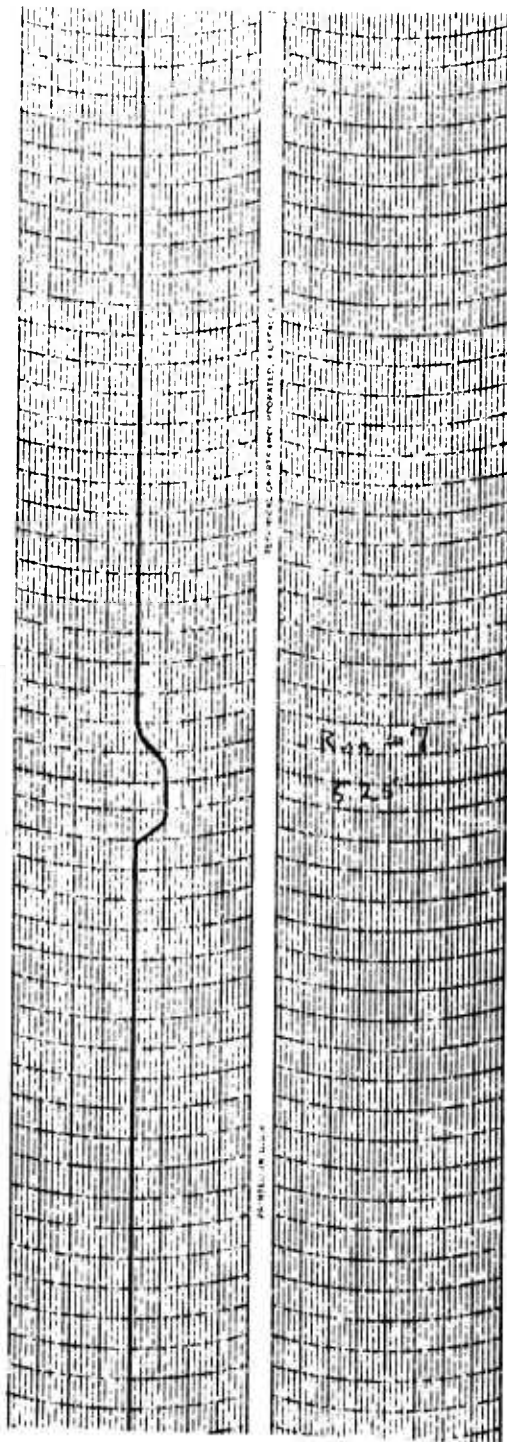
3. A sample recorded trace is included as Inclosure 1. It is of interest to note that the pressure plate load rises to a maximum and remains there for an appreciable period of time. This time appears to be the total time that the pressure plate of the mine is fully covered by the tire. At higher inflation pressures, the duration of the maximum load should decrease (for any specific vehicle speed).

FOR THE DIRECTOR:

1 Incl
a/s

H. A. NOBLE
Acting Deputy Director
for Engineering Testing

Copy furnished:
Picatinny Arsenal, CRDEB
Automotive Division, D&PS



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