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**AEROSPACE
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December 1965

**ROVER DESTRUCT TEST THREE
ABERDEEN PROVING GROUND
FINAL REPORT**

Prepared by
T. T. Castonguay
T. B. Anderson
R. C. Bower
University of New Mexico
Albuquerque, New Mexico

RELEASED FOR ANNOUNCEMENT
IN NUCLEAR SCIENCE ABSTRACTS

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T. T. Castonguay
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for
Sandia Corporation
Under
Contract 48-2512

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ABSTRACT

Particle collection and sizing reported in this document are partial fulfillment of Sandia Corporation's responsibility to the AEC for the safety evaluation of nuclear power supplies intended for space application.

These data are expected to provide a few of the inputs to a computer program designed to analyze particle distribution from a space destruct of the ROVER/NERVA propulsion engine.

These data were obtained from polystyrene blocks containing graphite particles, which were dissolved in trichloroethylene. The graphite particles were collected, cleaned and sized through a series of Tyler sieves.

Graphite particles embedded in rotating polystyrene plastic were also recovered and sized, but prior to dissolving, the angle of entry and depth of penetration were tabulated.

Procedures and equipment used for processing the polystyrene plastic are described in SC-DC-65-1758 "Development Report on the Rover Destruct Tests," dated November 1965.

December 1965

FOREWORD

Sandia Corporation assisted Aberdeen Proving Ground with the performance of a full scale mockup ROVER/NERVA propulsion engine destruct system test in June 1965. The data collected from this test are partial fulfillment of Sandia's responsibility to the AEC for the safety evaluation of nuclear power supplies intended for space application.

Graphite particle size data from fixed polystyrene plastic and rotating polystyrene plastic are presented in this report prepared by the University of New Mexico.

Although, the data are tabulated and plotted in this report, no attempt was made to evaluate the information presented.

SUMMARY

Data presented in this document on graphite particles are partial fulfillment of Sandia Corporation's responsibility to the AEC to provide information and analysis on the safety aspects of nuclear power supplies intended for space applications.

The particle size varies from 26.9 mm to less than 0.037 mm. The distribution presented agrees very well with similar distributions obtained during scale model testing with the exception that scale model particles were about 5.0 mm maximum size.

The particles collected were retrieved from fixed polystyrene plastic (size distribution sample) and from rotating polystyrene plastic (velocity measurement sample). These data are tabulated and the size distribution sample is plotted as weight percent versus screen size and accumulated weight percent versus screen size.

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INTRODUCTION

The Chemical Engineering Department of the University of New Mexico performed the collection and sizing of graphite particles from the scale model ROVER/NERVA propulsion engine destruct system tests and continued this work under Sandia Corporation contract to collect and size the graphite particles from the full scale mockup ROVER/NERVA propulsion engine destruct system test performed at Aberdeen Proving Ground under the direction of the joint AEC/NASA Space Nuclear Propulsion Office.

The work presented in this report includes those graphite particles embedded in fixed polystyrene plastic and those graphite particles embedded in rotating polystyrene plastic.

DISCUSSION OF RESULTS

Data from dissolving the polystyrene plastic are presented in tabular form and also are presented in plotted form. The weight percent and the accumulated weight percent are calculated, presented in the tables and plotted as a function of the Tyler screen sieves used for particle sizing.

These data are very similar to data obtained from scale model testing and the shape of the curve through the plotted data is similar. The presence of larger particles in the full scale data causes a lower percentage figures for weight percent of particles appearing in a specific screen size, but the shape of the accumulated weight percent curve is the same in both sets of data.

Data from the rotating polystyrene plastic parts are representative of other particle sizes but the penetration depth and angle of entry vary too much for a reasonable velocity analysis.

TABULATED DATA

Fixed Polystyrene Plastic Collection Media

Data presented on the following page represent the sample of graphite which was collected primarily for size distribution and total weight in each size class. The weight percent and accumulated weight percent were calculated based on the total graphite sample collected. These percent data are tabulated and also presented as plotted curves at the back of the document.

Rotating Polystyrene Plastic Collection Media

Data presented in the following tabulations are grouped according to the type of velocity measuring device which collected the particles. These data are tabulated, but not used in this report. Utilization of these data is described in SC-RR-65-620* dated December 1965.

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* Report SC-RR-65-620, R. E. Berry & J. P. Martin, ROVER/NERVA Destruct System Test Results - Aberdeen Proving Ground-3 (Final Report), Sandia Corporation, December 1965.

DATA FOR
 GRAPHS I, II
 RUN NO. A. P. G. NO. 3
 (Particle Size Distribution and Weight)

<u>Screen Number (U. S. Standard)</u>	<u>Mesh Opening (inches)</u>	<u>Weight Carbon on Screens (grams)</u>	<u>Percent Carbon on Screen (%)</u>	<u>Accumulated Percent Carbon (%)</u>
1. 050	1. 050	48. 778	0. 56	100. 0
0. 742	0. 742	378. 750	4. 3	99. 4
0. 525	0. 525	618. 708	7. 2	95. 1
0. 371	0. 371	673. 144	7. 7	87. 9
0. 262	0. 262	891. 650	10. 2	80. 2
4	0. 185	1, 004. 104	11. 5	70. 0
6	0. 131	1, 859. 359	21. 3	58. 5
8	0. 0937	1, 008. 914	11. 6	37. 2
14	0. 0555	616. 708	7. 1	25. 6
18	0. 0394	222. 906	2. 6	18. 5
20	0. 0331	95. 649	1. 2	15. 9
30	0. 0232	145. 497	1. 7	14. 7
40	0. 0165	191. 141	2. 2	13. 0
45	0. 0139	64. 388	0. 7	10. 8
70	0. 0083	183. 533	2. 2	10. 1
100	0. 0058	126. 619	1. 4	7. 9
140	0. 0041	92. 128	1. 0	6. 5
200	0. 0025	59. 101	0. 7	5. 5
270	0. 0021	29. 730	0. 3	4. 8
400	0. 0015	63. 673	0. 7	4. 5
Less than 400		331. 766	3. 8	3. 8

2

DATA FOR
SINGLE DISC A-6

<u>Number of Particles</u>	<u>Distance from Time Zero (degrees)</u>	<u>Mass of Particles (grams)</u>	<u>Volume of Particles (cubic inches)</u>	<u>Depth into Disc (inches)</u>	<u>Approx. Angle of Deflection (degrees)</u>
1	32	0. 6316	broken by impact	14/16	36. 4
1	122	0. 2946	0. 02682	13/16	69
1	160	0. 0322	0. 001372	7/32	none
1	163	0. 0166	0. 0008235	7/32	none
1	168	0. 0158	0. 0008235	surface	none
1	207	0. 0035	0. 0001878	surface	none
1	230	0. 0252	0. 001098	4/32	29. 8

DATA FOR
SINGLE DISC A-7

<u>Number of Particles</u>	<u>Distance from Time Zero (inches)</u>	<u>Mass of Particles (grams)</u>	<u>Volume of Particles (cubic inches)</u>	<u>Depth into Disc (inches)</u>	<u>Approx. Angle of Deflection (degrees)</u>
1	1 3/8 L	0. 1965	0. 00640	7/16	70. 4
1	1 3/8 L	0. 0640	0. 00275	7/16	70. 4
1	4 7/8 R	0. 0114	0. 000244	1/16	none
1	5 7/8 R	0. 1135	0. 00384	9/16	56. 3
1	7 3/4 R	0. 1169	0. 00427	3/16	none

DATA FOR
SINGLE DISC B-8

<u>Number of Particles</u>	<u>Distance from Time Zero (inches)</u>	<u>Mass of Particles (grams)</u>	<u>Volume of Particles (cubic inches)</u>	<u>Depth into Disc (inches)</u>	<u>Approx. Angle of Deflection (degrees)</u>
1	7 7/16	0. 1482	broken by impact	surface	none
1	15 7/8	0. 0873	0. 003202	surface	none
1	17 2/8	0. 0289	0. 001372	7/32	none
1	18 1/8	0. 0629	0. 002742	surface	none

DATA FOR
SINGLE DISC E-5

<u>Number of Particles</u>	<u>Distance from Time Zero (inches)</u>	<u>Mass of Particles (grams)</u>	<u>Volume of Particles (cubic inches)</u>	<u>Depth into Disc (inches)</u>	<u>Approx. Angle of Deflection (degrees)</u>
1	14 1/16 L	0. 1687	0. 00604	3/16	23. 2
1	3/8 R	0. 0108	0. 000457	surface	none

DATA FOR
TWIN DISC A-4

<u>Screen Number (U S Standard)</u>	<u>Mesh Opening (inches)</u>	<u>Weight Carbon on Screen (grams)</u>	<u>Percent Carbon on Screen (percent)</u>
4	0.1850	1.002	8.05
6	0.1310	2.804	22.53
8	0.0937	4.384	35.22
14	0.0555	2.653	21.32
18	0.0394	0.602	4.84
20	0.0328	0.163	1.31
30	0.0232	0.206	1.65
40	0.0165	0.154	1.24
45	0.0139	0.103	0.83
70	0.0083	0.097	0.78
100	0.0058	0.127	1.02
140	0.0041	0.088	0.71
200	0.0029	0.044	0.35
270	0.0021	0.019	0.15
400	0.0015	none	0.00
Total		12.446	100.00

DATA FOR
TWIN DISC B-10

<u>Number of Particles</u>	<u>Distance from Time Zero (inches)</u>	<u>Mass of Particles (grams)</u>	<u>Volume of Particles (cubic inches)</u>	<u>Depth into Disc (inches)</u>	<u>Approx. Angle of Deflection (degrees)</u>
1	0	0.0087	0.000366	surface	none
1	1/2	0.0327	0.001463	6/32	28.6
1	1 1/4	0.0083	0.000366	5/32	29.1
1	1 1/4	0.0046	0.0000915	5/32	29.1
1	1 13/16	0.0731	0.00256	surface	none
1	4 7/16	0.0032	0.0000915	surface	none
1	4 15/16	0.0130	0.000488	1/16	none
1	24 3/16	0.0022	0.0000611	surface	none
1	28	0.0230	0.000915	5/32	none

DATA FOR
TWIN DISC D-2

<u>Number of Particles</u>	<u>Distance from Time Zero (inches)</u>	<u>Mass of Particles (grams)</u>	<u>Volume of Particles (cubic inches)</u>	<u>Depth into Disc (inches)</u>	<u>Approx. Angle of Deflection (degrees)</u>
1	0	0. 0146	0. 0005490	surface	none
1	0	0. 0197	0. 0009150	surface	none
1	9/16	0. 0526	0. 003904	surface	none
1	1 2/16	0. 0484	0. 001829	3/16	16. 7
1	12	0. 0111	0. 0003050	1/16	none
1	24 7/16	0. 0096	0. 0004570	surface	none

DATA FOR
DRUM E-C

<u>Number of Particles</u>	<u>Distance from Time Zero (inches)</u>	<u>Mass of Particles (grams)</u>	<u>Volume of Particles (cubic inches)</u>	<u>Depth into Disc (inches)</u>	<u>Approx. Angle of Deflection (degrees)</u>
1	4 3/4	0. 0188	0. 000356	9/32	52. 1

DATA FOR

DRUM A-H

<u>Screen Size U.S. No.</u>	<u>Number of Particles</u>	<u>Distance from Time Zero (inches)</u>	<u>Mass of Particle, Weight of Carbon (grams)</u>	<u>Volume of Particle (cubic inches)</u>	<u>Depth into Drum (inches)</u>	<u>Percent Carbon on Screen (percent)</u>	<u>Approx Angle of Deflection (degrees)</u>
4	-	-	73.818	-	-	27.48	-
6	-	-	38.630	-	-	14.38	-
8	-	-	48.727	-	-	18.14	-
14	-	-	34.806	-	-	12.96	-
18	-	-	17.043	-	-	6.34	-
20	-	-	8.123	-	-	3.02	-
30	-	-	12.545	-	-	4.67	-
40	-	-	9.318	-	-	3.47	-
45	-	-	6.263	-	-	2.33	-
70	-	-	5.133	-	-	1.91	-
100	-	-	3.933	-	-	1.46	-
140	-	-	1.872	-	-	0.07	-
200	-	-	0.604	-	-	0.22	-
270	-	-	0.131	-	-	0.05	-
400	-	-	0.090	-	-	0.03	-
-	1	6 3/4	3.071	0.2242	surface	1.14	none
-	1	7 1/4	0.720	0.0714	surface	0.27	none
-	1	9	3.256	0.2051	5/8	1.21	46.5
-	1	44 1/2	0.098	0.0033	surface	0.04	none
-	1	46 3/4	0.044	0.0011	surface	0.02	none
-	1	48	0.189	0.0069	surface	0.07	none
-	1	54 1/8	0.181	0.0055	surface	0.07	none

DATA FOR

DRUM D-A

<u>Number of Particles</u>	<u>Distance from Time Zero (inches)</u>	<u>Mass of Particles (grams)</u>	<u>Volume of Particles (cubic inches)</u>	<u>Depth into Disc (inches)</u>	<u>Approx. Angle of Deflection (degrees)</u>
1	35 5/8	0.9307	0.0782	1 5/16	51.0
1	36 7/16	1.0648	0.0923	6/8	63.4
1	43 1/4	0.0468	0.00322	7/32	none
1	44 3/4	0.0113	0.00109	surface	none
1	44 3/4	0.0348	0.00152	surface	none

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Attn P M Ordin

U S Naval Radiological Laboratory
San Francisco, California 94135
Attn J D Connor Code 935

Aberdeen Proving Ground
Aberdeen, Maryland
Attn H Bechtol

Picatinny Arsenal
Dover, New Jersey
Attn P Sadlon

Watervliet Arsenal
Watervliet, N Y
Attn A Muzicka

Los Alamos Scientific Laboratory
P O Box 1663
Los Alamos, New Mexico 87544
Attn E E Campbell

S McAlees 9314
J D Appel 9319 (2)
R C Maydew, 9320
H R Vaughn, 9321
W H Curry, 9322
E C Rightley, 9323
W R Barton, 9324
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