

LA-7887-M

Manual

0.3

**User's Manual for
LASL Shock Hugoniot Data File**

University of California

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User's Manual for LASL Shock Hugoniot Data File

Martha S. Hoyt



USER'S MANUAL FOR LASL SHOCK HUGONIOT DATA FILE

by

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ABSTRACT

Tape, photostore, and Common File System access instructions for the equation-of-state file HUGDATA are given. The data format is described, and an example shows how to extract data on specific materials for use as code input.

I. INTRODUCTION

The LASL Data Center for Dynamic Material Properties is collecting and publishing dynamic material property data generated at Los Alamos Scientific Laboratory over the last twenty-five years. Stanley P. Marsh has collected data on the single-shocked state (the Hugoniot locus) of many materials in the 10- to 50-GPa pressure range, and they are being published by the University of California Press. The collection is titled "LASL Shock Hugoniot Data."

The data also are available from tape, photostore, and Common File System files. This report describes the data format and how the data on specific materials may be extracted.

II. THE FILE

The file HUGDATA contains tables of Hugoniot data on 486 materials. Each line in the file corresponds to a punched card. For each material, the data are given as follows

Card 1	Column 10	0 - no fit requested for handbook 1 - linear fit requested for handbook
Card 2		Material name including formatting characters
Card 3		Material name continued or blank
Card 4	Columns 1-6	Longitudinal velocity (F6.2)
	Columns 7-12	Shear velocity (F6.2)
		Blank if no velocities given

Card 5 Reference (14I5) or blank
 Card 6 and following are data cards
 Columns 1-14 Description
 Columns 17-18 Experimental method (I2)
 Columns 20-29 ρ_o (E10.3)
 Columns 30-39 Data not used in this handbook
 Columns 40-45 \dot{U}_s (F6.3)
 Columns 46-51 U_p (F6.3)
 Columns 52-72 Data not used in this handbook
 End-of-data card 99 in Columns 15-18
 End-of-all-data card 9999 in Columns 15-18

III. FILE ACCESS

HUGDATA is an unclassified file written to photostore, the Common File System (CFS), and tape from Machine U, a CDC 7600. Photostore access is:

```
XPOR T14KER GET HUGDATA, HP
```

CFS access is:

```
MASS GET /DATACTR/HUGDATA
```

The file is also on tapes BG039 and CH086 for LASL and tape MH001 for LLL. These are seven-track, 800-bpi, odd-parity tapes. They are written with the ADT utility (UR-401) using the 2R option; that is, there are two copies of the file on each tape. The tapes must be read using the utility RDFILES (UR-402). The execute line is:

```
RDFILES BG039 HUGDATA END
```

IV. HOW TO EXTRACT A PARTICULAR MATERIAL FROM THE DATA FILE

Particular materials may be extracted from the data file and put on a new file that can be used as input to a processing code. The Appendix lists all the materials, including formatting characters, in the order in which they appear in the file. Use TRIX AC to find the name of the desired material and the end of data on that material. All other lines in the file can be deleted. Example:

Let us make a file called TAPE1 that will contain:

```
Argon, solid
Lithium-6 Deuteride,  $\rho_o = 0.74$ 
Phenolic Refrasil, multiple-warp
```

Find the materials in the Appendix. Note the order in which they appear and the formatting characters, such as *,), and (. Then use TRIX AC, as shown on Page 3, to establish the file TAPE1, to locate the title card and end of each material, and to delete unwanted lines.

```

TRIX AC
.D!HUGDATA!NF(TAPE1)
11932 LINES. (80A)
11932 LINES. (80A)
FP!(ARGON); SOLID!L
. 44 (ARGON); SOLID; (T)0 = 75 (K)$
.DL1;43
.FP! 99 !L
  18          99
.FP18!(LITHIUM)-6 (DEUTERIDE)!L
  5323 (LITHIUM)-6 (DEUTERIDE); PRESSED$          0.80
.FP5323!0.74!L
  5390 (LITHIUM)-6 (DEUTERIDE); PRESSED$          0.74
.DL19;5389
.FP19! 99 !L
  43          99
.FP43!(PHENOLIC REFRASIL); MULTIPLE-WARP!L
4479 (PHENOLIC REFRASIL); MULTIPLE-WARP; (GE 2B)-3057$
.DL44;4478
.FP44! 99 !L
  54          99
.FP55! 9999 !L
2082          9999
.DL55;2081
.END

```

```

ALL DONE
ALLOUT TTY TAPE1
LINES?
1 54

```

```

(ARGON); SOLID; (T)0 = 75 (K)$
!!!!!!!!!!
!!!!!!!!!!
  9 19

```

RR	52	1.65E+00	2.00	0.56
RR	52	1.65E+00	2.44	0.78
RR	52	1.65E+00	2.68	0.94
RR	52	1.65E+00	3.53	1.29
RR	52	1.65E+00	4.17	1.78
RR	52	1.65E+00	5.02	2.28
RR	52	1.65E+00	5.31	2.35
RR	52	1.65E+00	5.69	2.49
RR	52	1.65E+00	6.13	3.02
RR	52	1.65E+00	6.75	3.32
RR	52	1.65E+00	7.21	3.60
RR	52	1.65E+00	7.65	3.99
RR	52	1.65E+00	8.49	4.60

```

          99
(LITHIUM)-6 (DEUTERIDE); PRESSED$          0.74
!!!!!!!!!!
!!!!!!!!!!
  36

```

8c1981	COMP	L	3	1	7.391E-01	2.786E+00	10.210	3.894	8.898	1.015	1.005
8c1982	COMP	L	3	1	7.435E-01	2.786E+00	11.340	4.732	9.701	1.009	1.004
8c1983	COMP	L	3	1	7.379E-01	2.786E+00	11.560	4.816	9.784	1.009	1.010
8c1984	COMP	L	3	1	7.365E-01	2.786E+00	11.450	4.829	9.784	1.005	1.001
8c1985	COMP	L	3	1	7.381E-01	2.786E+00	10.460	4.147	9.123	1.005	1.010
8c1986	COMP	L	3	1	7.399E-01	2.786E+00	10.550	4.182	9.162	1.007	1.003

8c1987	COMP	L	3	1	7.390E-01	2.786E+00	10.840	4.326	9.307	1.008	1.005
8c1988	COMP	L	3	1	7.401E-01	2.786E+00	11.060	4.495	9.471	1.006	1.029
8c1989	COMP	L	3	1	7.417E-01	2.786E+00	11.090	4.483	9.465	1.001	1.001
8c1990	COMP	L	3	1	7.410E-01	2.786E+00	10.300	3.906	8.907	1.007	1.004
8c1992	COMP	L	3	1	7.332E-01	2.785E+00	6.700	1.390	6.535	1.017	1.006
8c1993	COMP	L	3	1	7.361E-01	2.785E 00	5.35	0.753	5.959	1.003	1.004
8c1994	COMP	L	3	1	7.367E-01	2.785E 00	5.96	0.984	6.167	1.002	1.000
8c1995	COMP	L	3	1	7.389E-01	2.785E+00	8.410	2.522	7.589	1.003	1.010
8c1996	COMP	L	3	1	7.335E-01	2.785E+00	8.760	2.760	7.811	1.001	1.003
8c1997	COMP	L	3	1	7.368E-01	2.785E+00	8.980	2.901	7.948	1.000	1.007
8c1998	COMP	L	3	1	7.405E-01	2.785E+00	9.340	3.233	8.260	1.000	1.006
8c1999	COMP	L	3	1	7.309E-01	2.785E+00	7.380	1.803	6.915	1.004	1.001
8c2000	COMP	L	3	1	7.381E-01	2.785E+00	9.820	3.580	8.589	1.002	1.004
8c2001	COMP	L	3	1	7.355E-01	2.785E+00	9.470	3.407	8.414	1.004	1.000

99

(PHENOLIC REFRASIL); MULTIPLE-WARP; (GE 23)-3057\$

!!!!!!!
 !!!!!!!!
 !!!!!!!!

8c2056	MWIREF	3	1	1.382E 00	2.784E 00	5.472	2.400	7.585	1.009	1.002
8c2059	MWIREF	3	1	1.353E 00	2.784E 00	4.509	1.814	6.969	1.002	1.001
8c2060	MWIREF	3	1	1.371E 00	2.784E 00	3.984	1.430	6.598	1.004	1.000
8c2061	MWIREF	3	1	1.442E 00	2.784E 00	6.635	3.503	8.738	1.008	1.007
8c2062	MWIREF	3	1	1.384E 00	2.780E 00	8.916	5.005	10.363	1.013	1.008
8c2068	MWIREF	3	1	1.361E 00	2.784E 00	5.680	2.583	7.761	1.007	1.004

99

LINES?

END

ALL DONE

APPENDIX
THE MATERIALS

(ANTIMONY)\$	
(ANTIMONY), FINE-GRAIN, CHILL-CAST\$	
(ARGON), LIQUID\$	
(ARGON), LIQUID\$	
(R)EFLECTED-SHOCK DATA\$	
(ARGON), SOLID, (T)*0 = 75 (K)\$	
(BARIUM)\$	
(BERYLLIUM), SINTERED\$	
(BISMUTH)\$	
(BORON)\$	
(CADMIUM)\$	
(CALCIUM)\$	
(CARBON), DIAMOND, PRESSED\$	3.20
(CARBON), FIBERS WOVEN THREE-DIMENSIONALLY\$	
(CARBON), FOAMED\$	0.56
(CARBON), FOAMED\$	0.48
(CARBON), FOAMED\$	0.32
(CARBON), FOAMED\$	0.29
(CARBON), FOAMED\$	0.27
(CARBON), GRAPHITE, PYROLYTIC\$	2.21
(CARBON), GRAPHITE, PRESSED\$	2.13
(CARBON), GRAPHITE, PRESSED\$	2.03
(CARBON), GRAPHITE, (ZTA)\$	1.95
(CARBON), GRAPHITE, PRESSED\$	1.93
(CARBON), GRAPHITE, PRESSED\$	1.88
(CARBON), GRAPHITE, (ATJ)\$	1.77
(CARBON), GRAPHITE, (PT) 0173\$	1.54
(CARBON), GRAPHITE\$	1.0
(CARBON), GRAPHITE, POWDERED, UNPRESSED\$	
(CARBON), VITREOUS\$	
(CERIUM)\$	
(CESIUM)\$	

(CHROMIUM)\$	
(COBALT)\$	
(COPPER)\$	
(COPPER), SINTERED\$	7.9
(COPPER), SINTERED\$	7.3
(COPPER), SINTERED\$	6.3
(COPPER), SINTERED\$	5.7
(COPPER), SINTERED\$	4.5
(COPPER), POWDERED, UNPRESSED\$	
(DEUTERIUM), LIQUID, (T)*0 = 20 (K)\$	
(DEUTERIUM), LIQUID, (T)*0 = 20 (K)\$	
(REFLECTED-SHOCK DATA\$	
(DYSPROSIUM)\$	
(ERBIUM)\$	
(ERBIUM), COLD-PRESSED\$	8.3
(ERBIUM), COLD-PRESSED\$	7.8
(ERBIUM), COLD-PRESSED\$	7.2
(EUROPIUM)\$	
(GADOLINIUM)\$	
(GERMANIUM)\$	
(GOLD)\$	
(HAFNIUM)\$	
(HOLMIUM)\$	
(HYDROGEN), LIQUID, (T)*0 = 20 (K)\$	
(HYDROGEN), LIQUID, (T)*0 = 20 (K)\$	
(REFLECTED-SHOCK DATA\$	
(INDIUM)\$	
(IRIDIUM)\$	
(IRON)\$	
(IRON), SINTERED\$	7.0
(IRON), SINTERED\$	6.0
(IRON), SINTERED\$	4.7
(IRON), SINTERED\$	3.4
(LANTHANUM)\$	
(LEAD)\$	
(LEAD), POWDERED, UNPRESSED\$	

(LITHIUM)\$
 (MAGNESIUM)\$
 (MERCURY)\$
 (MOLYBDENUM)\$
 (NEODYMIUM)\$
 (NICKEL)\$
 (NIOBIUM)\$
 (NITROGEN), LIQUID, (T)*0 = 75 (K)\$
 (OXYGEN), LIQUID\$
 (OXYGEN), LIQUID\$
 (R)EFLECTED-SHOCK DATA\$
 (PALLADIUM)\$
 (PLATINUM)\$
 (POTASSIUM)\$
 (PRASEODYMIUM)\$
 (RHENIUM)\$ 21.0
 (RHENIUM)\$ 20.5
 (RHODIUM)\$
 (RUBIDIUM)\$
 (SAMARIUM)\$
 (SCANDIUM)\$
 (SILVER)\$
 (SODIUM)\$
 (STRONTIUM)\$
 (SULFUR), RHOMBIC\$
 (TANTALUM)\$
 (TERBIUM)\$
 (THALLIUM)\$
 (THORIUM)\$
 (THULIUM)\$
 (TIN)\$
 (TITANIUM)\$
 (TUNGSTEN)\$ 19.2
 (TUNGSTEN)\$ 18.7
 (URANIUM)\$
 (VANADIUM)\$

(YTTERBIUM)\$
 (YTTRIUM)\$
 (ZINC)\$
 (ZIRCONIUM)\$
 (ALUMINUM), 921(T)\$
 (ALUMINUM), 1100\$
 (ALUMINUM), 2024\$
 (ALUMINUM), 2024, SINTERED\$ 2.6
 (ALUMINUM), 2024, SINTERED\$ 2.2
 (ALUMINUM), 2024, SINTERED\$ 2.0
 (ALUMINUM), 2024, SINTERED\$ 1.7
 (ALUMINUM), 3003\$
 (ALUMINUM), 6061\$
 (ALUMINUM), 7075\$
 (BRASS), FREE-MACHINING, HIGH-LEADED\$
 61.5/36.0/2.5 WT% (C)U/(Z)N/(P)B\$
 (BRASS), MUNTZ METAL\$
 60.6/39.3 WT% (C)U/(Z)N\$
 (GOLD)-5.8 WT% (GERMANIUM)\$
 (GOLD)-7.9 WT% (GERMANIUM)\$
 (GOLD)-9.3 WT% (GERMANIUM)\$
 (GOLD)-20.6 WT% (LEAD)\$
 (GOLD)-33.5 WT% (LEAD)\$
 (IRON), CAST\$
 (IRON)-40.0 WT% (COBALT)\$
 (IRON)-10.0 WT% (NICKEL)\$
 (IRON)-17.9 WT% (NICKEL)\$
 (IRON)-26.2 WT% (NICKEL)\$
 (IRON)-2.9 WT% (SILICON)\$
 (IRON)-3.3 WT% (SILICON)\$
 (IRON)-4.6 WT% (SILICON)\$
 (IRON)-6.9 WT% (SILICON)\$
 (IRON)-20 WT% (SILICON)\$
 (IRON)-25 WT% (SILICON)\$
 (IRON)-10.0 WT% (VANADIUM)\$
 (MAGNESIUM, AZ31B)\$

(MAGNESIUM)-14 WT% (L)I-1 WT% (A)LS
 (STEEL), 304\$
 (STEEL), 304(L)\$
 (STEEL), 304, FERRITIC PHASE\$
 (STEEL), 347\$
 (STEEL), 348\$
 (STEEL), MARAGING, (A)LMAR\$
 (STEEL), MARAGING, (HP) 9-4-20\$
 (STEEL), MARAGING, (V)ASCOMAX 250\$
 (STEEL), MARAGING, (V)ASCOMAX 300\$
 (TUNGSTEN CARBIDE)-5 WT% (COBALT)\$
 (URANIUM)-2.0 WT% (MOLYBDENUM)\$
 (URANIUM)-3.0 WT% (MOLYBDENUM)\$
 (URANIUM)-8.3 WT% (MOLYBDENUM)\$
 (URANIUM)-4.7 WT% (NIOBIUM)\$
 (URANIUM)-6.0 WT% (NIOBIUM)\$
 (URANIUM)-1.0 WT% (RHODIUM)\$
 (URANIUM)-5.4 WT% (RHODIUM)\$
 (URANIUM)-13.4 WT% (RHODIUM)\$
 (URANIUM)-0.6 WT% (TITANIUM)\$
 (URANIUM)-2.5 WT% (N)B-1.3 WT% (T)I\$
 (ANDALUSITE), CHIASTOLITE, (S)OUTH (A)USTRALIA\$
 (ANTHRACENE), REAGENT-GRADE, POLYCRYSTALLINE, PRESSED\$
 (BARIUM TITANATE)\$
 (BERYLLIUM OXIDE)\$ 3.0
 (BERYLLIUM OXIDE)\$ 2.8
 (BERYLLIUM OXIDE)\$ 2.4
 (BORIC ACID)\$
 (BORON CARBIDE)\$ 2.4
 (BORON CARBIDE)\$ 1.9
 (BORON NITRIDE), PRESSED\$ 2.15
 (BORON NITRIDE), PRESSED\$ 2.12
 (BORON NITRIDE), PRESSED\$ 2.08
 (BORON NITRIDE), PRESSED\$ 1.95
 (BORON NITRIDE), PRESSED\$ 1.88

(BORON NITRIDE), PRESSED\$	1.81
(CALCIUM OXIDE), PRESSED\$	
(CASSITERITE), (S)AN (L)UIS (P)OTOSI, (M)EXICO\$	
(CESIUM BROMIDE), SINGLE-CRYSTAL, 100\$	
(CESIUM FLUORIDE), SINGLE-CRYSTAL, 100\$	
(CESIUM IODIDE), SINGLE-CRYSTAL, 100\$	
(CERIUM OXIDE), POWDERED, UNPRESSED\$	
(CORUNDUM)\$	
(CORUNDUM), CERAMIC\$	3.83
(CORUNDUM), CERAMIC\$	3.74
(ENSTATITE), CERAMIC\$	3.01
(ENSTATITE), CERAMIC\$	2.95
(ENSTATITE), CERAMIC\$	2.83
(ENSTATITE), CERAMIC\$	2.76
(ENSTATITE), CERAMIC\$	2.71
(FAYALITE), (R)OCKPORT, (M)ASSACHUSETTS\$	
(FORSTERITE), CERAMIC\$	3.20
(FORSTERITE), CERAMIC\$	3.06
(GARNET), GROSSULARITE\$	
(HAFNIUM TITANATE)\$	6.93
(HAFNIUM TITANATE)\$	5.60
(HAFNIUM TITANATE)\$	4.37
(HEMATITE)\$	
(ILMENITE), (K)RAGEROE, (N)ORWAY\$	
(IRON MAGNESIUM OXIDE), (F)E*90, (M)G*10(O)\$	
(KYANITE), CERAMIC\$	3.6
(KYANITE), CERAMIC\$	2.9
(LEAD ZIRCONIUM TITANATE, PZT)\$	
(LITHIUM BROMIDE), SINGLE-CRYSTAL, 100\$	
(LITHIUM CHLORIDE), SINGLE-CRYSTAL, 100\$	
(LITHIUM DEUTERIDE), SINGLE-CRYSTAL\$	
(LITHIUM DEUTERIDE), PRESSED\$	0.84
(LITHIUM)-6 (DEUTERIDE), PRESSED\$	0.80
(LITHIUM)-6 (DEUTERIDE), PRESSED\$	0.76
(LITHIUM)-6 (DEUTERIDE), PRESSED\$	0.74

(LITHIUM)-6 (DEUTERIDE), PRESSED\$	0.66
(LITHIUM)-6 (DEUTERIDE), PRESSED\$	0.58
(LITHIUM)-6 (DEUTERIDE), PRESSED\$	0.51
(LITHIUM)-6 (DEUTERIDE), PRESSED\$	0.45
(LITHIUM FLUORIDE), SINGLE-CRYSTAL, 100\$	
(LITHIUM HYDRIDE), SINGLE-CRYSTAL AND PRESSED\$	
(LITHIUM)-6 (HYDRIDE), PRESSED\$	0.67
(MAGNETITE)\$	
(MULLITE), CERAMIC\$	3.15
(MULLITE), CERAMIC\$	2.67
(NIOBIUM CARBIDE)\$	7.5
(NIOBIUM CARBIDE)\$	7.2
(OLIVINE)\$	
(PERICLASE), SINGLE-CRYSTAL\$	
(PERICLASE), CERAMIC\$	3.34
(PERICLASE), CERAMIC\$	3.0
(PERICLASE), CERAMIC\$	2.8
(PHENANTHRENE), REAGENT-GRADE, POLYCRYSTALLINE, PRESSED\$	
(POTASSIUM BROMIDE), SINGLE-CRYSTAL, 100\$	
(PYRENE), REAGENT-GRADE, POLYCRYSTALLINE, PRESSED\$	
(PYROLUSITE), (I)RONTON, (M)INNESOTA\$	
(QUARTZ), SINGLE-CRYSTAL\$	
(QUARTZ), FUSED\$	
(QUARTZ), CERAMIC\$	2.1
(QUARTZ), CERAMIC\$	1.9
(QUARTZ), SPUN\$	0.15
(RUTILE)\$	
(SERPENTINE), (V)ER-MYEN, (I)TALY\$	
(SILICON CARBIDE)\$	3.1
(SILICON CARBIDE)\$	3.0
(SILICON CARBIDE)\$	2.3
(SILLIMANITE), (D)ILLON, (M)ONTANA\$	
(SODIUM CHLORIDE), SINGLE-CRYSTAL, 100\$	
(SODIUM CHLORIDE), SINGLE-CRYSTAL, 110\$	
(SODIUM CHLORIDE), SINGLE-CRYSTAL, 111\$	

(SODIUM CHLORIDE), PRESSED\$	2.14
(SODIUM CHLORIDE), POWDERED, UNPRESSED\$	
(SODIUM FLUORIDE), SINGLE-CRYSTAL, 100\$	
(SPINEL), SINGLE-CRYSTAL\$	
(SPINEL), HOT-PRESSED\$	3.56
(SPINEL), CERAMIC\$	3.48
(SPINEL), CERAMIC\$	3.42
(SPINEL), CERAMIC\$	3.0
(TANTALUM CARBIDE)\$	14.1
(TANTALUM CARBIDE)\$	12.6
(TITANIUM CARBIDE)\$	
(TITANIUM DIBORIDE)\$	4.5
(TOURMALINE)\$	
(URANIUM DIOXIDE)\$	10.3
(URANIUM DIOXIDE)\$	6.3
(URANIUM DIOXIDE)\$	4.3
(URANIUM DIOXIDE)\$	3.1
(URANIUM HYDRIDE)\$	
(WOLLASTONITE)\$	2.89
(WOLLASTONITE)\$	2.82
(ZIRCONIUM DIBORIDE)\$	
(ZIRCONIUM DIOXIDE)\$	
(ALBITITE), (S)YLMAR, (P)ENNSYLVANIA\$	
(ALLUVIUM), (N)EVADA (T)EST (S)ITES	1.80
(ALLUVIUM), (N)EVADA (T)EST (S)ITES	1.54
(ANORTHOSITE), (T)AHAWUS, (N)EW (Y)ORK\$	
(BRONZITITE), (B)USHVELD (C)OMPLEX, (T)RANSVAAL\$	
(BRONZITITE), (S)TILLWATER (C)OMPLEX, (M)ONTANA\$	
(CORUNDUM MIXTURE)\$	
85.2/9.7/2.7/2.4 WT% (A)L*2(O)*3/(S)I(O)*2/(M)G(O)/(C)A(O)-(B)A(O)\$	
(DIABASE), (C)ENTREVILLE, (V)IRGINIA\$	
(DIABASE), (F)REDERICK, (M)ARYLAND\$	
(DUNITITE), (J)ACKSON (C)OUNTY, (N)ORTH (C)AROLINA\$	
(DUNITITE), (M)OOIHOEK (M)INE, (T)RANSVAAL\$	
(DUNITITE), (T)WIN (S)ISTERS (P)EAKS, (W)ASHINGTON\$	
(ECLOGITE), (H)EALDSBURG, (C)ALIFORNIA\$	

(ECLOGITE), (S)UNNMOORE, (N)ORWAYS
 (GABRO), (B)YTOWNITE, (D)ULUTH, (M)INNESOTA\$
 (GABRO), (S)AN (M)ARCOS, (E)SCONDIDO, (C)ALIFORNIA\$
 (GAS SHALE), (D)EVONIAN, (L)INCOLN (C)OUNTY,\$
 (W)EST (V)IRGINIA\$
 (GLASS), HIGH-DENSITY, (N)UCLEAR (P)ACIFIC X-RAY PLATES
 (GLASS), HIGH-DENSITY, (S)HOTT (O)PTICAL (C)OMPANY\$
 (GLASS), (P)YREX\$
 (GRANITE), (W)ESTERLY, (R)HODE (I)SLAND\$
 (JADEITE), (9)URMA\$
 (OIL SHALE), (G)REEN (R)IVER, (R)IFLE, (C)OLORADO\$
 (PERICLASE MIXTURE)\$
 50/50 MOL% (M)G(O)/(A)L*2(O)*3\$
 (PERICLASE MIXTURE)\$
 50/50 MOL% (M)G(O)/FUSED (S)I(O)*2\$
 (PERICLASE MIXTURE)\$ 1.89
 67/33 MOL% (M)G(O)/FUSED (S)I(O)*2\$
 (PERICLASE MIXTURE)\$ 1.69
 67/33 MOL% (M)G(O)/FUSED (S)I(O)*2\$
 (TUFF), (N)EVADA (T)EST (S)ITE\$ 1.7
 (TUFF), (N)EVADA (T)EST (S)ITE\$ 1.3
 (TUFF), UNPRESSED POWDER\$
 (TUFF), (N)EVADA (T)EST (S)ITE, WATER-SATURATED\$ 1.9
 (TUFF), (N)EVADA (T)EST (S)ITE, WATER-SATURATED\$ 1.7
 (ADIPRENE)\$
 (CELLULOSE ACETATE)\$
 (EPOXY), (E)PON 828\$
 (ESTANE)\$
 (MELMAC)\$
 (MICARTA)\$
 (NEOPRENE)\$
 (PARAFFIN)\$
 (PHENOLIC), (D)URITE (HR) 300\$
 (PHENOLIC), FURFURAL-FILLED\$
 (PHENOXY), (PRDA) 8060\$
 (POLYAMIDE), (N)YLON\$
 (POLYCARBONATE), (L)EXAN AND (M)ERLON\$

(POLYCHLOROTRIFLUOROETHYLENE), (K)EL-(F)\$
 (POLYESTER), (C)LEAR (C)AST, (S)ELECTRON\$
 (POLYESTER), FIBER-GLASS REINFORCED, (D)ORON\$
 (POLYETHYLENE)\$
 (POLYETHYLENE), HIGH-DENSITY, (M)ARLEX 50\$
 (POLYETHYLENE), HIGH-DENSITY, (M)ARLEX (EMN) 6065\$
 (POLYIMIDE)\$
 (POLYMETHYLMETHACRYLATE), ACRYLIC, (P)LEXIGLASS\$
 (POLYPHENYLQUINOXALINE)\$
 (POLYPROPYLENE)\$
 (POLYSTYRENE), (S)TYROLUX\$
 (POLYSTYRENE), FOAMED, PRESSED\$ 0.30
 (POLYSTYRENE), FOAMED, PRESSED\$ 0.20
 (POLYSTYRENE), FOAMED, PRESSED\$ 0.15
 (POLYSTYRENE), FOAMED, PRESSED\$ 0.10
 (POLYSTYRENE), FOAMED, PRESSED\$ 0.08
 (POLYSTYRENE), FOAMED\$ 0.06
 (POLYSULFONE)\$
 (POLYTETRAFLUOROETHYLENE), (T)EFLON\$
 (POLYURETHANE)\$
 (POLYURETHANE), FOAMED\$ 0.32
 (POLYURETHANE), FOAMED\$ 0.28
 (POLYURETHANE), FOAMED\$ 0.16
 (POLYURETHANE), FOAMED\$ 0.09
 (POLYVINYL CHLORIDE), (B)OLTRON\$
 (POLYVINYLIDENE FLUORIDE), (K)YNAR\$
 (POLY 4-METHYL-1-PENTENE), (TPX)\$
 (RUBBER), (S)ILASTIC, (RTV)-521\$
 (SYLGARD)\$
 (COPPER-27.2 WT% BORON CARBIDE)\$
 (COPPER OXIDE-56 WT% EPOXY)\$
 (TUNGSTEN, SINTERED-24 WT% INFILTRATED COPPER), \$
 (E)LKONITE 10(W)3\$
 (TUNGSTEN, SINTERED-32 WT% INFILTRATED COPPER), \$
 (E)LKONITE 3(W)3\$
 (TUNGSTEN, SINTERED-45 WT% INFILTRATED COPPER), \$
 (E)LKONITE 1(W)3\$

(TUNGSTEN, SINTERED-75 WT% INFILTRATED COPPER), \$ (E)LKONITE 2125(C) \$	
(TUNGSTEN CARBIDE, SINTERED-44 WT% INFILTRATED COPPER), \$ (E)LKONITE (TC)10 \$	
(TUNGSTEN CARBIDE, SINTERED-60 WT% INFILTRATED SILVER), \$ (E)LKONITE (G)-12 \$	
(EPOXY-40 VOL% CORUNDUM) \$	
(EPOXY-40 VOL% ENSTATITE) \$	
(EPOXY-40 VOL% FORSTERITE) \$	2.2
(EPOXY-40 VOL% FORSTERITE) \$	2.0
(EPOXY-40 VOL% PERICLASE) \$	
(EPOXY-40 VOL% QUARTZ) \$	
(EPOXY-40 VOL% SPINEL) \$	
(EPOXY-40 VOL% WOLLASTONITE) \$	
(EPOXY-71 WT% LITHIUM ALUMINUM SILICATE) \$	
(POLYURETHANE, FOAMED-50 WT% LITHIUM ALUMINUM SILICATE) \$	
(EPOXY-90 WT% LITHIUM TETRABORATE) \$	
(NIOBIUM CARBIDE-50 WT% CARBON) \$	
(NIOBIUM CARBIDE-70 WT% CARBON) \$	
(PARAFFIN-81.3 WT% ALPHA QUARTZ) \$	
(PARAFFIN-65.6 WT% CORUNDUM) \$	
(PARAFFIN-90.2 WT% ENSTATITE) \$	
(PARAFFIN-85.3 WT% FORSTERITE) \$	
(PARAFFIN-61.0 WT% HEMATITE) \$	
(PARAFFIN-84.2 WT% PERICLASE) \$	
(PHENOLIC REFRASIL), ONE-DIMENSIONAL WEAVE, (A)VCOS	
(PHENOLIC REFRASIL), THREE-DIMENSIONAL WEAVE, (A)VCOS	
(PHENOLIC REFRASIL), LOW-DENSITY PHENOLIC, (GE M)-3057 \$	
(PHENOLIC REFRASIL), MULTIPLE-WARP, (GE 2B)-3057 \$	
(PHENOLIC REFRASIL), (M)C(D)ONNELL-(D)OUGLASS	
(SILICON CARBIDE-50 WT% CARBON) \$	
(SILICON CARBIDE-80 WT% CARBON) \$	
(SILICON NITRIDE-5 WT% PERICLASE) \$	
(TANTALUM CARBIDE-70 WT% CARBON) \$	4.4
(TANTALUM CARBIDE-70 WT% CARBON) \$	2.0
(TANTALUM CARBIDE-85 WT% CARBON) \$	1.9
(TANTALUM CARBIDE-85 WT% CARBON) \$	1.8

(TITANIUM CARBIDE-50 WT% CARBON)\$
 (TITANIUM CARBIDE-90 WT% CARBON)\$
 (BALSA)\$
 (BIRCH)\$
 (CHERRY)\$ 0.60
 (CHERRY)\$ 0.51
 (FIR), (D)DOUGLASS
 (FIR), WHITES
 (MAHOGANY), (H)ONDURASS
 (MAHOGANY), (P)HILIPPINES
 (MAPLE)\$
 (OAK), WHITES
 (PINE), SUGARS
 (WALNUT)\$
 (ACETONE), (C)*3(H)*6(O)\$
 (ALCOHOL), ETHYL, (C)*2(H)*6(O)\$
 (ALCOHOL), METHYL, (CH)*4(O)\$
 (ALCOHOL), N-AMYL, (C)*5(H)*12(O)\$
 (AMMONIA), LIQUID, (T)*0 = 203 (K), (NH)*3\$
 (BENZENE), (C)*6(H)*6\$
 (BROMOETHANE), (C)*2(H)*5(BR)\$
 (BROMOFORM), (CHB)R*3\$
 (CARBON DISULFIDE), (CS)*2\$
 (CARBON TETRACHLORIDE), (CC)L*4\$
 (CYCLOHEXADIENE), 1-3, (C)*6(H)*8\$
 (CYCLOHEXADIENE), 1-4, (C)*6(H)*8\$
 (CYCLOHEXANE), (C)*6(H)*12\$
 (CYCLOHEXENE), (C)*6(H)*10\$
 (ETHER), ETHYL, (C)*4(H)*10(O)\$
 (ETHYLENE GLYCOL), (C)*2(H)*6(O)*2\$
 (GLYCEROL), (C)*3(H)*8(O)*3\$
 (HEXANE), (C)*6(H)*14\$
 (N)-(HEXANE), (C)*6(H)*14\$
 (METHANE), TRICHLORO-, CHLOROFORM, (CHC)L*3\$
 (METHANE), DICHLORO-, (CH)*2(C)L*2\$

(METHANE), DIBROMO-, (CH)*2(B)R*2\$
 (METHANE), DIIODO-, (CH)*2(I)*2\$
 (MONONITROTOLUENE)\$
 (TOLUENE), (C)*6(H)*5(CH)*3\$
 (WATER), (H)*2(O)\$
 (WATER)\$
 (REFLECTED-SHOCK DATA)\$
 (CESIUM CHLORIDE), 7.0 MOLAR AQUEOUS SOLUTIONS
 (CESIUM CHLORIDE), 7.0 MOLAR AQUEOUS SOLUTIONS
 (REFLECTED-SHOCK DATA)\$
 (CESIUM CHLORIDE), 4.7 MOLAR AQUEOUS SOLUTIONS
 (CESIUM CHLORIDE), 4.7 MOLAR AQUEOUS SOLUTIONS
 (REFLECTED-SHOCK DATA)\$
 (CESIUM CHLORIDE), 2.4 MOLAR AQUEOUS SOLUTIONS
 (CESIUM CHLORIDE), 2.4 MOLAR AQUEOUS SOLUTIONS
 (REFLECTED-SHOCK DATA)\$
 (ZINC CHLORIDE), 9.1 MOLAR AQUEOUS SOLUTIONS
 (ZINC CHLORIDE), 9.1 MOLAR AQUEOUS SOLUTIONS
 (REFLECTED-SHOCK DATA)\$
 (ZINC CHLORIDE), 6.2 MOLAR AQUEOUS SOLUTIONS
 (ZINC CHLORIDE), 6.2 MOLAR AQUEOUS SOLUTIONS
 (REFLECTED-SHOCK DATA)\$
 (ZINC CHLORIDE), 4.3 MOLAR AQUEOUS SOLUTIONS
 (ZINC CHLORIDE), 4.3 MOLAR AQUEOUS SOLUTIONS
 (REFLECTED-SHOCK DATA)\$
 (BARATOL), BARIUM NITRATE-24 WT% (TNT)\$
 (COMPOSITION B), (RDX)-36 WT% (TNT)-1 WT% WAX\$
 (FKM PROPELLANT)\$
 (HMX), SINGLE-CRYSTALS
 (HMX), SOLVENT-PRESSED\$
 (HMX)-40 WT% (TATB)-10 WT% (K)EL (F) 800\$
 (LX)-04, (HMX)-15 WT% (V)ITON, SOLVENT-PRESSED,\$
 FINE-GRAIN (HMX)\$
 (NITROMETHANE)\$
 (NQ), COMMERCIAL-GRAINS
 (NQ), 1964 COMMERCIAL-GRAINS
 (NQ)-2 WT% (B) SQUARE WAX-2 WT% (E)LVAX, LARGE-GRAIN (NQ)\$
 (NQ)-5 WT% (E)STANE, 1968 COMMERCIAL-GRAIN (NQ)\$ 1.70
 (NQ)-5 WT% (E)STANE, 1968 COMMERCIAL-GRAIN (NQ)\$ 1.66

(NQ)-5 WT% (E)STANE, 1968 LARGE-GRAIN (NQ)\$
 (NQ)-10 WT% (E)STANE, COMMERCIAL-GRAIN (NQ)\$
 (NQ)-10 WT% (E)STANE, LARGE-GRAIN (NQ)\$
 (PBX)-9011-06, (HMX)-10 WT% (E)STANE\$
 (PBX)-9404-03, (HMX)-3 WT% (NC)-3 WT% (CEF)\$ 1.84
 (PBX)-9404-03, (HMX)-3 WT% (NC)-3 WT% (CEF)\$ 1.72
 (PBX 9404 NEUTRONIC MOCKUP), 905-03\$
 (PBX 9404 DENSITY MOCKUP), 900-10\$
 (PBX)-9405-01, (RDX)-3 WT% (NC)-3 WT% (CEF)\$
 (PBX) 9407, 94/6 WT% (RDX)/(E)XON\$
 (PBX)-9501-01, (HMX)-2.5 WT% (E)STANE-2.5 WT% (BONPF),\$
 (3DNPF)- BISDINITROPROPYL FORMAL\$
 (PBX)-9502, (TATB)-5 WT% (K)EL (F) 800,\$
 (P)ANTEX STANDARD (TATB)\$
 (PETN), SINGLE-CRYSTAL\$
 (PETN), PRESSED\$ 1.75
 (PETN), PRESSED\$ 1.72
 (PETN), PRESSED\$ 1.60
 (RDX)-2.5 WT% (B) SQUARE WAX-2.5 WT% (E)LVAX\$
 (RDX)-20 WT% ALUMINUM-6 WT% WAX, 30-MICRON ALUMINUM\$
 (RDX)-40.4 WT% CYANURIC ACID-19.4 WT% (S)YLGARD\$
 (TATB), PURIFIED 1972\$
 (TATB)-3 WT% (B) SQUARE WAX-3 WT% (E)LVAX, 1968 (TATB)\$
 (TATB)-5 WT% (B) SQUARE WAX-5 WT% (E)LVAX, 1968 (TATB)\$
 (TATB)-6 WT% (E)STANE, BIMODAL 1968 (TATB)\$
 (TATB)-6 WT% (E)STANE, COARSE 1968 (TATB)\$
 (TATB)-10 WT% (E)STANE, 1968 (TATB)\$
 (TATB)-5 WT% (K)EL (F) 800\$
 (TATB)-10 WT% (K)EL (F) 800, 1968 (TATB)\$
 (TATB)-10 WT% (K)EL (F) 800, (P)ANTEX FINE (TATB)\$
 (TATB)-10 WT% (K)EL (F) 800, (P)ANTEX STANDARD (TATB)\$
 (TATB)-10 WT% (K)EL (F) 800, REPROCESSED (TATB)\$
 (TATB)-15 WT% (K)EL (F) 800, 1968 (TATB)\$
 (TATB)-2.5 WT% (K)EL (F) 800-2.5 WT% (K)EL (F) B27,\$
 1968 (TATB)\$
 (TATB)-5 WT% (K)EL (F) 800-5 WT% (K)EL (F) B20, 1968 (TATB)\$

(TATB)-7.5 WT% (K)EL (F) 800-7.5 WT% (K)EL (F) 827,\$
 1968 (TATB)\$

(TATB)-4.5 WT% POLYSTYRENE-1.5 WT% (DOP), 1968 (TATB)\$

(TATB)-6 WT% POLYSTYRENE-2 WT% (DOP), 1968 (TATB)\$

(TETRYL), PRESSED\$ 1.7

(TETRYL), PRESSED\$ 1.6

(TETRYL), PRESSED\$ 1.5

(TETRYL), PRESSED\$ 1.4

(TETRYL), PRESSED\$ 1.3

(TNT), CREAMED, CAST\$

(TNT), LIQUID, (T)*0 = B1 (C)\$

(VOP-7 PROPELLANT)\$

(XTX)-8003,\$
 80/20 WT% SUPERFINE (PETN)/(S)YLGARDS

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