

HP-67/97 Program Form

Title MRP Data Card Generator Page 1 of 5

Programmer John Garza (3665) Date 07 Nov 2025

Program Description

Program generates engine data cards for use with MRP3 and MRP4 (Model Rocket Performance) programs. Using the NAR spec sheets, the user can create a data card to be used in the simulation.

Inputs:

- A: Engine total mass
- B: Engine propellant mass
- C: Delay Zero engine total mass
- D: Thrust curve data points 1..9 (Mission time seconds, Newtons)
and after data is entered: adds grams burned via integration of thrust curve
- E: Generate - ask for data card

Procedure:

- 1) Calculate delay charge mass:
delay mass = engine total mass - delay zero engine total mass
- 2) Determine segment portions of grams burned
Calculate total area under thrust curve via Trapezoid rule
Calculate percentage of total area for each segment
Calculate grams burned per segment from percentage * propellant mass
- 3) For each thrust curve data point:
build NNN from packed NN.N newtons this segment
calculate segment time = current mission time - previous mission time
build SSS from packed S.SS segment time
if delay flag not set
calculate cumulative grams burned = previous total + segment portion
if delay flag set
calculate cumulative grams burned = previous total + delay mass
build GGG from packed GG.G cumulative grams burned
if NNN = 0 then set delay flag
(to be used next pass, as it flags the previous segment)
Build NNNSSSGGG and store in appropriate register Rx..R1
Store total engine mass in R0
Store count of thrust curve data points in RI
Write Data 'Crd'

Register usage:

- (primary registers R0-R9, RI are to be recorded on the mag card)
(Label registers RA-RE are the working registers in the program)
- R0: engine mass
 - R1--R9: packed thrust curve data
 - RI: index of thrust curve data points (variable)
 - RA: previous mission time; then cumulative mission time
 - RB: Engine propellant mass
 - RC: Delay Zero engine total mass; then delay mass
 - RD: temp
 - RE: count of thrust curve data points (constant)

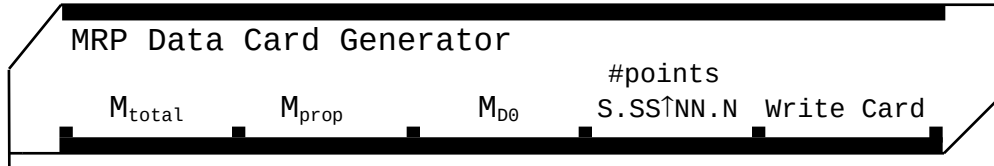
Operating Limits and Warnings

- 1) Engines have significant variation in manufacture; both current batches and differences between the same engine types across the years.
- 2) The data generated works with 3 digit times (S.SS) only.

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User Instructions				
STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS	OUTPUT DATA/UNITS
1	Load Program Card, 2 sides			
2	Enter engine total mass	grams	A	
3	Enter engine propellant mass	grams	B	
4	Enter delay zero engine mass	grams	C	
5	Enter number of thrust curve data points (less than 10)	integer	f D	
6	Enter data points:			
	Mission Time in S.SS format	seconds	ENT [↑]	
	Thrust in NN.N format	Newtons	D	(countdown)
	Repeat step 6 until all points entered			
	Program will then automatically integrate the thrust curve			
7	Create the data card		E	'Crd'
	At this point feed in the card. Program will write data to it.			
	Data card is now ready for use.			

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Program Listing							
LINE	KEY CODE	KEY ENTRY	COMMENTS	LINE	KEY CODE	KEY ENTRY	COMMENTS
01		* LBL A		57		EEX	
02		STO 0		58		3	
03		RTN		59		x	
04		* LBL B		60		ENT ↑	
05		STO B		61		INT	
06		RTN		62		EEX	
07		* LBL C		63		1	
08		STO C		64		÷	
09		RTN		65		X↔Y	
10		* LBL d		66		FRC	
11		STO I		67		EEX	
12		STO E		68		1	
13		RCL 0		69		x	
14		RCL C		70		X↔Y	
15		-		71		RCL D	
16		STO C		72		X↔Y	
17		CLX		73		STO D	
18		STO A		74		+	
19		RCLI		75		2	
20		RTN		76		÷	
21		* LBL D		77		x	
22		ENT ↑		78		P↔S	
23		EEX		79		STO i	
24		2		80		P↔S	
25		÷		81		DSZI	
26		STO i		82		GTO 1	
27		R↓		83		RCL E	
28		ENT ↑		84		STO I	
29		ENT ↑		85		CLX	
30		RCL A		86		STO D	
31		X=0?		87		P↔S	
32		GTO 9		88		* LBL 2	
33		-		89		RCL i	
34		ENT ↑		90		RCL D	
35		* LBL 9		91		+	
36		R↓		92		STO D	
37		EEX		93		DSZI	
38		4		94		GTO 2	
39		÷		95		RCL E	
40		ST + i		96		STO I	
41		R↓		97		* LBL 3	
42		STO A		98		RCL D	
43		DSZI		99		ST ÷ i	
44		GTO 6		100		RCL B	
45		GTO 0		101		ST x i	
46		* LBL 6		102		DSZI	
47		RCLI		103		GTO 3	
48		R/S		104		RCL E	
49		GTO D		105		STO I	
50		* LBL 0		106		CLX	
51		RCL E		107		STO D	
52		STO I		108		* LBL 4	
53		CLX		109		RCL i	
54		STO D		110		RCL D	
55		* LBL 1		111		+	
56		RCL i		112		STO D	

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Program Listing							
LINE	KEY CODE	KEY ENTRY	COMMENTS	LINE	KEY CODE	KEY ENTRY	COMMENTS
113		STO i					
114		DSZI					
115		GTO 4					
116		RCL C					
117		+					
118		STO 1					
119		RCL E					
120		STO I					
121		* LBL 5					
122		RCL i					
123		EEX					
124		8					
125		÷					
126		P↔S					
127		ST + i					
128		P↔S					
129		DSZI					
130		GTO 5					
131		RTN					
132		* LBL E					
133		RCL E					
134		CLRG					
135		P↔S					
136		STO I					
137		WDTA					
138		RTN					
139		R/S					
140							

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Additional Notes

Example:

Create a data card for an Estes C6-5 engine.
Use the NAR spec sheet from the 25 March 1995 test.

C6-5 Engine Mass: 24.0g
Average measured delay: 4.28s
Propellant mass: 10.8g
C6-0 Engine Mass: 20.2g
Selected data points from C6 thrust curve:

Time	Thrust
0.19	14.1
0.25	06.2
0.47	04.4
1.82	04.4
1.86	00.0

Running the program:

```
1) Enter total engine mass      24    A
2) Enter propellant mass       10.8  B
3) Enter D0 mass (C6-0)       20.2  C
4) Enter TC count (incl delay) 6    f D
5) Enter TC:
   0.19 Enter 14.1 D
   0.25 Enter 6.2  D
   0.47 Enter 4.4  D
   1.82 Enter 4.4  D
   1.86 Enter 0    D
```

<now enter the 4.28sec delay by adding it to current mission time>
< 1.86 + 4.28 = 6.14 >

```
6.14 Enter 0    D
```

< program will now process the curve >
< when display stabilizes...>

```
6) write to the card    E
   Registers should be ----->
```

C6-5

```
R0: 24.0
R1: 0.000428146
R2: 0.000004108
R3: 0.044135107
R4: 0.044022037
R5: 0.062006023
R6: 0.141019016
R7:
R8:
R9:
R1: 6
```