PORT NO. UMTA-MA-06-0044-77-2

A COMPUTER PROGRAM (POWREQ) FOR POWER REQUIREMENTS OF MASS TRANSIT VEHICLES

C.H. Spenny
J.M. Clarke

U.S. Department of Transportation
Transportation Systems Center
Kendall Square
Cambridge MA 02142

AUGUST 1977

FINAL REPORT

DOCUMENT IS AVAILABLE TO THE U.S. PUBLIC THROUGH THE NATIONAL TECHNICAL INFORMATION SERVICE, SPRINGFIELD, VIRGINIA 22161

Prepared for

U.S. DEPARTMENT OF TRANSPORTATION
URBAN MASS TRANSPORTATION ADMINISTRATION
Office of Technology Development and Deployment
Washington DC 20590

TECHNICAL REPORT STANDARD TITLE PAGE

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
UMTA-MA-06-0044-77-2		

4. Title and Subtitle	5. Report Date
A COMPUTER PROGRAM (POWREQ) FOR POWER REQUIREMENTS OF MASS TRANSIT VEHICLES	August 1977
	6. Performing Organization Code
7. Author(s)	8. Performing Organization Report No.
C.H. Spenny and J.M. Clarke	DOT-TSC-UMTA-76-2
9. Performing Organization Name and Address	10. Work Unit No.
U.S. Department of Transportation Transportation Systems Center Kendall Square Cambridge MA 02142	UM630/R7724
	11. Contract or Grant No.
	13. Type of Report and Period Covered
12. Sponsoring Agency Name and Address	Final Report Nov. 1974 — April 1975
U.S. Department of Transportation Urban Mass Transportation Administration Office of Tech. Development and Deployment Washington DC 20590	14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract

The Computer Program (POWREQ) described herein has been developed as a tool to be used in systematic analyses requiring the estimation of energy requirements of mass transit vehicles as a function of driving schedules and vehicle size, shape and gross weight. POWREQ can be employed for systematic analyses of road/rail vehicles.

17. Key Words	18. Distribution Statement
Power Requirements, Vehicle Energy Requirements, Propulsion Sizing, Transit Vehicles	DOCUMENT IS AVAILABLE TO THE U.S. PUBLIC THROUGH THE NATIONAL TECHNICAL INFORMATION SERVICE, SPRINGFIELD, VIRGINIA 22161

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	68	

Form DOT F 1700.7 (8-69)

PREFACE

This project was performed by the Power and Propulsion Branch of the Transportation Systems Center (TSC) under the sponsorship of the Office of Technology Development and Deployment, Urban Mass Transportation Administration, U.S. Department of Transportation. The objective was to develop a computer program suitable for use in analyses requiring estimates of the energy requirements of transit vehicles. The Power Requirements (POWREQ) simulation model was designed to operate on the DEC-10 System by Dr. H. Zuckerberg and R. Flanders of Kentron Hawaii, Limited, under contract to TSC.

METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
in	inches	2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
		AREA		
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
		MASS (weight)		
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
		VOLUME		
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	6/9 (after subtracting 32)	Celsius temperature	°C

Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
		AREA		
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
		MASS (weight)		
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
		VOLUME		
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
		TEMPERATURE (exact)		
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F

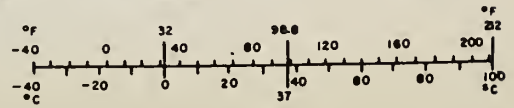


TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

1. PROGRAM DISCUSSION

1.1 INTRODUCTION

The Power Requirements Simulation Model (POWREQ) is a computer program that simulates the energy requirements of a transit vehicle during its execution of a given driving schedule. The user is provided the capability of analyzing the effects of various types of driving schedules and road profiles on energy requirements.

POWREQ was designed to execute on the DEC-10 Operating System either in batch mode or time-sharing mode via remote terminals. A CALCOMP plotting routine is provided so that the user, if desired, can request graphs illustrating the time variation of the important parameters. The graphs will be generated off-line.

1.2 ASSUMPTIONS AND INPUT DATA

1.2.1 Route-Control Data

From a general layout of the roadway, the following input data are prepared: (1) velocity time profile and (2) grade profile ((3) direction profile may also be prepared).

The velocity profile of the route for the problem submitted was specified in the form:

$$\dot{x} = f(t)$$

where $\dot{x}$ is the velocity at a particular time (time measured from a fixed origin). The profile was assumed to be piecewise linear and describable in terms of breakpoints.

The grade profile of the route was specified as

$$G = g(t)$$

where G is the grade expressed as a percentage. The grade was also assumed to be piecewise linear and describable in terms of breakpoints.

1.2.2 Vehicle Data

This includes the weight of a fully loaded vehicle, outside dimensions of the vehicle, aerodynamic drag coefficient, wind velocity and direction, rolling resistance coefficient, and where applicable, tire coulomb friction.

1.3 COMPUTER MODEL

Estimation of Functions

Let

$x(t)$: Time variation of the vehicle position

$\dot{x}(t)$: Time variation of the vehicle velocity

$\ddot{x}(t)$: Time variation of the vehicle acceleration

$g(t)$: Time variation of the grade

By assuming a constant acceleration value equivalent to a given acceleration profile, and given a distance and velocity profile, the time elapsed between any two consecutive velocity breakpoints can be written as:

$$t_{i,i+1} = \frac{(x_{i+1} - x_i)}{(\dot{x}_{i+1} + \dot{x}_i)/2}$$

where t_i, $i + 1$ is the time elapsed traversing the distance between x_i and x_{i+1}.

The acceleration between two velocity breakpoints is given by:

$$\ddot{x}(t) = \frac{\dot{x}(t_{i+1}) - \dot{x}(t_i)}{(t_{i+1} - t_i)} \quad \text{for } t_i < t < t_{i+1}.$$

Utilizing the previous equations, velocity at time t is evaluated in terms of acceleration in the following manner:

$$\dot{x}(t) = \dot{x}(t_i) + \ddot{x}\ (t)(t - t_i) \quad \text{for } t_i < t_{i+1}$$

Position x(t)

$$x(t) = x(t-\Delta t) + \dot{x}(t)\Delta t + 1/2\ \ddot{x}(t)\Delta t^2$$

where Δt is the time step size used in the simulation.

The grade g(t) may be evaluated in a similar manner.

If the head direction of the vehicle (with respect to a fixed coordinate, i.e., North) on the road at position x is considered as a function of time or distance, then the head direction, $\emptyset(t)$, may also be estimated in a similar manner at the grade.

1.4 EQUATIONS OF MOTION

The total thrust required, F(t), at any time (t) has to balance the resistive forces of acceleration, air drag, grade, and rolling friction:

$$F(t) = M\ddot{x}(t) + .002556\ C_d\ A_F\ [\dot{x}(t) + V\ \text{Cos}\ (\emptyset\ (t) - \theta)]^2$$
$$+ Mg\ [g(t)] + \mu\ Mg\ [1 + C_f(\dot{x}(t)] \quad \text{for } \dot{x}\ (t) > 0$$

where M = Effective Mass of the Vehicle including inertia of rotating parts

Mg: Gross Weight of Vehicle (lb)

A_f: Frontal Area of the Vehicle (ft^2)

C_d: Aerodynamic Drag Coefficient

V: Wind Velocity (mph)

$(\phi(t) - \theta)$: Angular Difference between wind direction and head direction of vehicle

μ: Rolling Friction Coefficient

C_f: Coulomb Friction Coefficient

The horsepower is given by:

$$hp(t) = [F(t)\dot{x}(t)]/375.$$

The corresponding power in kilowatts is given by:

$$kW(t) = [hp(t)].746.$$

1.5 OVERVIEW

The computer program was designed for the case where the given input was in the form of velocity-time profile, grade time profile, gross weight, frontal area, drag coefficient, and rolling coefficient.

The program can be readily adapted to accept the following cases:

Given Input: velocity distance profile; grade distance profile, direction distance profile; constant acceleration-constant velocity-constant deceleration profile; variations in drag coefficient due to multiple vehicles attached together as a train.

2. PROGRAM DOCUMENTATION

GENERAL USER INFORMATION

The POWREQ Simulation Program was programmed in the FORTRAN IV compiler language for execution on the TSC DEC-10 Operating System in either the batch mode or time-sharing mode. A logic flow diagram is illustrated in Figure 1.

The minimal amount of data required for any given simulation is:

a. Driving Schedule Data

b. Road Profile Data

c. Vehicle Data

    1) Gross Weight

    2) Vehicle Frontal Area

    3) Air Drag Coefficient

    4) Rolling Resistance Coefficient

d. Total Time of Driving Cycle

POWREQ is designed to function by executing a series of commands input by the user. Typical commands using the time-sharing mode are shown in Figure 2. The first command is the login command as required by the DEC-10 system. The second command calls the first program PROFS. The PROFS program converts the input driving schedule data and the road profile data into arrays for use in determining the power requirements.

The format of the input driving schedule data and the road profile data is shown in Figure 3. Additional inputs are the total time span of the driving schedule data and the number of ordinates representing the input date. This procedure is also directly applicable to the road profile data. Appendix A illustrates an example of the input data to the PROFS program. The first line

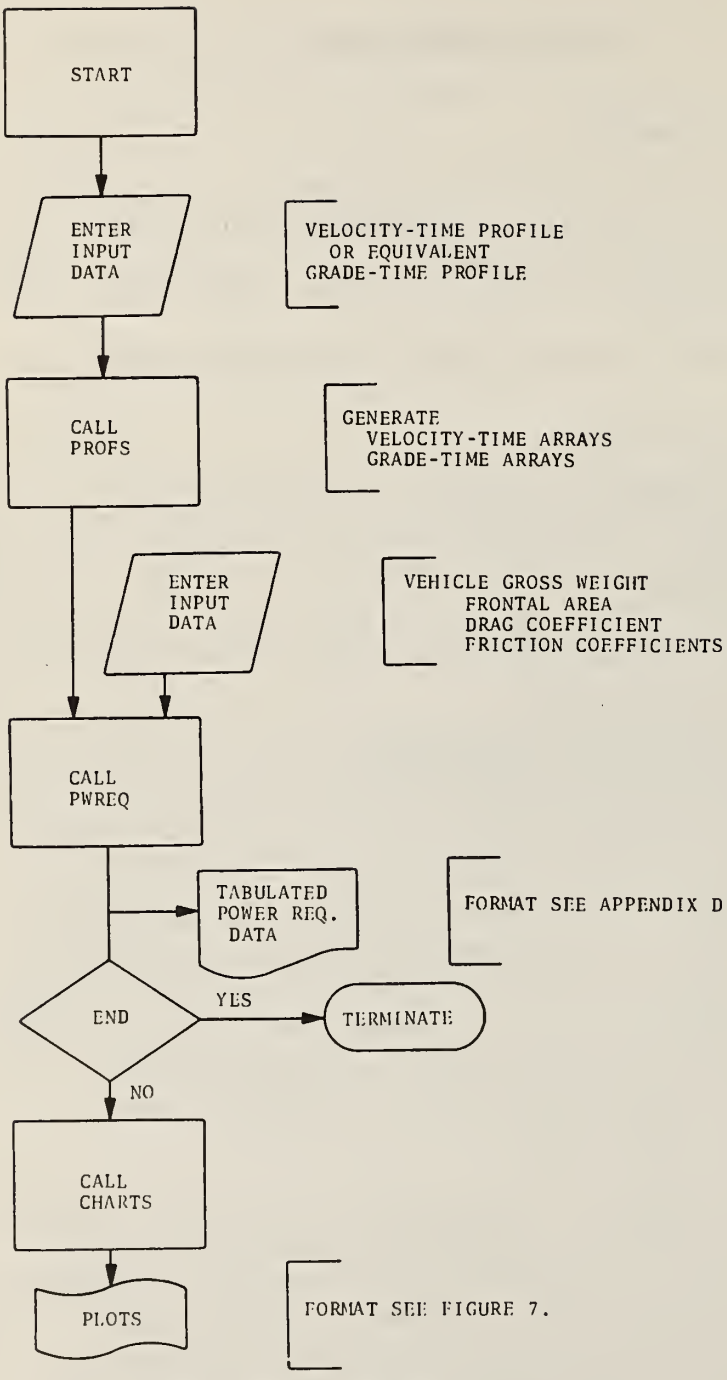


Figure 1. Logic Flow Diagram – POWREQ

```
.LOGIN 4066,146
JOB 2 TSC DECSYSTEM-10 507/00 TTY41
NAME: PASSWORD:
114919-MAR-75WED




.EXECUTE PROFS.REL
LOADING

PROFS 5K CORE
EXECUTION


CPU TIME: 5.31ELAPSED TIME: 13.58
NO EXECUTION ERRORS DETECTED

EXIT

.EXECUTE PWREQ.REL
LOADING

PWREQ 11K CORE
EXECUTION
```

Figure 2. Input Commands for POWREQ Operation (Time-Sharing Mode) – Velocity-Grade-Time Relationships

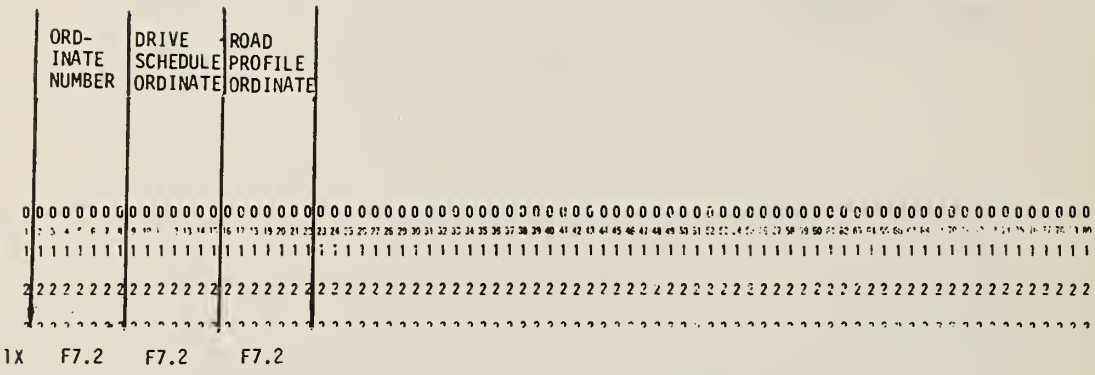


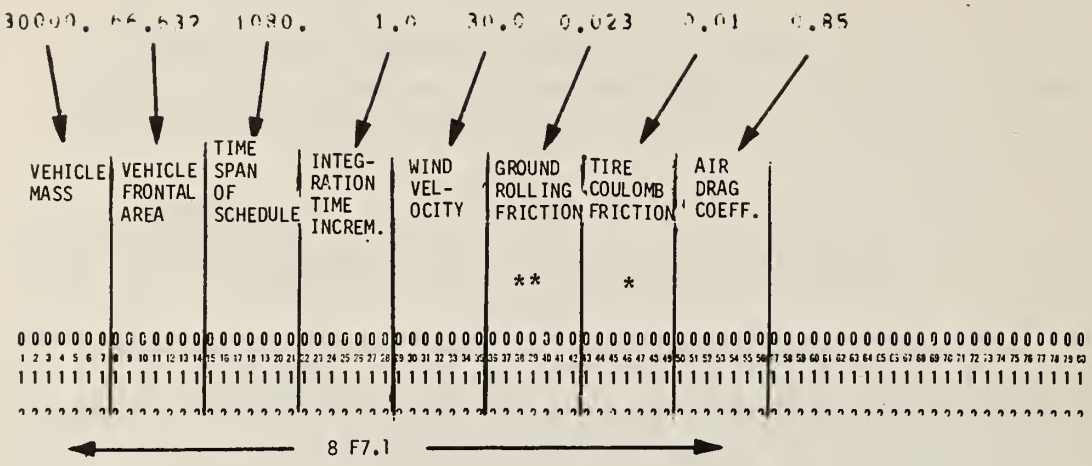
Figure 3. Input Commands for POWREQ Operation (Time-Sharing Mode) – Parametric Data

is the total time span of the driving schedule in seconds and the number of ordinates. The following three columns are the listing of the input data. A listing of the computer program is presented in Appendix B.

The third command calls the PWREQ Computer Program which utilizes the PROFS arrays to calculate the instantaneous vehicle resistive forces and corresponding power requirements.

The format for the input data to PWREQ and the corresponding values for the sample problem are illustrated in Figure 4. A typical program listing for PWREQ appears in Appendix C. A typical output of the PWREQ program is shown in Appendix D.

The fourth command , if desired, calls the CHART program. It will be necessary for the user to select maximum values for the plot scales. One of the outputs of PWREQ routed to the Time-Share Console will contain the maximum values of the calculated data (see Figure 5). The user will round the values upward and enter the selected values in the appropriate areas. An example of the calling sequence and requests for data insertion is illustrated in Figure 6. A listing of the CHART program is presented in Appendix E. Figure 7 shows a typical plot.



* To be used for rubber-tired vehicles in the automobile weight category.

** For heavy-weight vehicle (transit bus) category the ground rolling resistance coefficient may be defined as

$$\mu = .005 + 1.43 \times 10^{-6} V^{2.5} \quad \dagger$$

(V in mph).

† Subsequently revised to

$$\mu = .005 + 1.25 \times 10^{-6} V^{2}$$

Figure 4. Typical Format of Input Data to PWREQ (Sample Problem)

```
AVERAGES DO NOT INCLUDE NEGATIVE VALUES

AVG. THRUST=  1474.23 LBS.

AVG. H.P.=   45.58 H.P.

AVG. KWATTS=  33.99 KWTS

TOTAL DISTANCE=   3.11 MI.

AVG. THRUST PER MILE=   474.70 LBS/MI

AVG. H.P. PER MILE=   14.68

AVG. KILOWATTS PER MILE=   10.94

MAX VEL.=  25.00 MPH

MAX GRADE=   0.05 RAD

MAX ACCEL.=   6.20 MPH/SEC

MAX THRUST=  7636. LBS

MAX H.P.=  301.4

MAX K.W.=  224.8

CPU TIME: 30.80ELAPSED TIME: 4:53.10
NO EXECUTION ERRORS DETECTED

EXIT
```

Figure 5. PWREQ Output to be Used as Input to CHART Program

```
.MOUNT MTA:16/VID:'SCRATCH PLOT TAPE - WEN'/WEN
OPERATOR NOTIFIED
WAITING...
16 (MTA0)  MOUNTED

.ASSIGN MTA0:16
MTA0 ASSIGNED

.EXECUTE CHART.REL,XL SYS:94PLT
LOADING

CHART 13K CORE
EXECUTION

ENTER MAX VALUES FOR PLOT SCALES:

MAX VELOCITY (MPH)=
30.0

MAX ACCELERATION (MPH/SEC)=
7.0

MAX GRADE (RAD)=
0.08

MAX THRUST (LBS)=
8000.0

MAX H.P.=
400.0

MAX KILOWATTS=
400.0

ARE ALL ENTRIES CORRECT?
TYPE "1" FOR YES, "2" FOR NO :
1

EXECUTION IN PROGRESS..


CPU TIME: 00.04ELAPSED TIME: 3:27.08
NO EXECUTION ERRORS DETECTED

EXIT

.DISMOUNT MTA0:/REMOVE




[MTA0/ READ (W/H/S)= 41596/0/0 WRITE (W/H/S)= 28375/0/0]
OPERATOR NOTIFIED
WAITING...

MTA0 DISMOUNTED

.K/F
Job 14, User [44066,146]  Logged off TTY41     1455  19-Mar-75
Saved all files (420 blocks)
Runtime 35.14 Sec
```

Figure 6. Instruction Sequence for CHART Program

VEHICLE POWER REQUIREMENTS

GROSS WEIGHT IN LBS=30000.
FRONTAL AREA IN SQ-FT=56.63
HEAD WIND IN MPH=30.0
DRAG COEFF.=0.8500
TIRE COUL. FRICT. COEFF.=0.0100
ROLLING FRICT. COEFF.=0.0230

AVGS. DON'T INCLUDE NEG. VALUES

AVG. THRUST=1474.23 LBS
AVG. H.P.=45.58
AVG. K.W.=33.99

TOTAL DIST.=3.11 MI.

AVG. THRUST PER MI.=474.70
AVG. H.P. PER MI.=14.68
AVG. H.P.-HRS/MI.=4.403
AVG. K.W. PER MI.=10.94
AVG. K.W.-HRS/MI.=3.283

MAX VEL.=25.00 MPH
MAX GRADE=0.050 RAD
MAX ACEL.=6.2CMPH/S
MAX THRST=7636.00 LBS
MAX H.P.=301.40
MAX K.W.=224.80

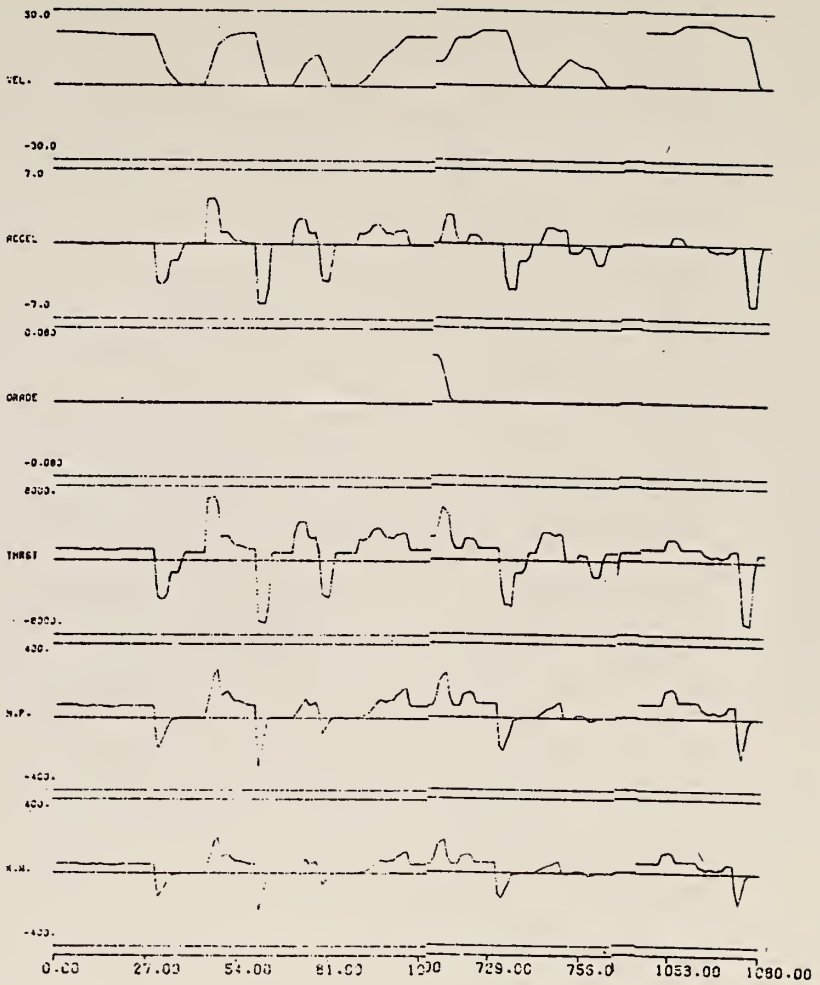


Figure 7. Typical Plot Generated by CHART Program (Sample Problem)

3. PROGRAM OVERVIEW

The PROFS, PWREQ, and CHART programs are stored on a disk file. Any change to the programs can be made using the TECO utility of the DEC-10 (see appropriate DEC-10 Operating System Manual).

The data files for the sample example are also stored on the disk file. These can easily be deleted and replaced with new data files, which must be compatible with the format requirements of the computer programs.

APPENDIX A
TYPICAL FORMAT OF INPUT DATA TO PROFS (SAMPLE PROBLEM)

(A)	(B)	(C)
1080.00	288.00	
0.00	21.00	0.00
1.00	21.00	0.00
2.00	21.00	0.00
3.00	20.60	0.00
4.00	20.40	0.00
5.00	20.00	0.00
6.00	20.00	0.00
7.00	20.00	0.00
8.00	20.00	0.00
9.00	6.00	0.00
10.00	0.00	0.00
11.00	0.00	0.00
12.00	0.00	0.00
13.00	16.00	0.00
14.00	20.00	0.00
15.00	21.00	0.00
16.00	21.00	0.00
17.00	0.00	0.00
18.00	0.00	0.00
19.00	0.00	0.00
20.00	9.00	0.00
21.00	13.00	0.00
22.00	0.00	0.00
23.00	0.00	0.00
24.00	0.00	0.00
25.00	4.00	0.00
26.00	11.00	0.00
27.00	15.00	0.00
28.00	20.00	0.00
29.00	20.00	0.00
30.00	20.00	0.00
31.00	20.00	0.00
32.00	20.00	0.00
33.00	20.00	0.00
34.00	20.00	0.00
35.00	20.00	0.00
36.00	20.00	0.00
37.00	20.00	0.00
38.00	20.00	0.00
39.00	20.00	0.00
40.00	0.00	0.00
41.00	0.00	0.00
42.00	0.00	0.00
43.00	0.00	0.00
44.00	0.00	0.00
45.00	2.00	0.00
46.00	10.00	0.00
47.00	15.00	0.00
48.00	17.00	0.00
49.00	20.00	0.00
50.00	20.00	0.00
51.00	20.00	0.00
52.00	20.00	0.00
53.00	0.00	0.00
54.00	0.00	0.00
55.00	0.00	0.00
56.00	0.00	0.00
57.00	2.00	0.00
58.00	11.00	0.00

NOTATION - COLUMN HEADINGS

(A) TIME INCREMENT
(B) VELOCITY INCREMENT
(C) GRADE INCREMENT

(A)	(B)	(C)
59.00	10.00	0.00
59.00	8.00	0.00
60.00	0.00	0.00
61.00	0.00	0.00
62.00	0.00	0.00
63.00	0.00	0.00
64.00	0.00	0.00
65.00	3.00	0.00
66.00	10.00	0.00
67.00	15.00	0.00
68.00	20.00	0.00
69.00	21.00	0.00
70.00	21.00	0.00
72.00	21.00	0.00
73.00	22.00	0.00
74.00	24.00	0.00
75.00	10.00	0.00
76.00	8.00	0.00
77.00	0.00	0.00
78.00	0.00	0.00
79.00	0.00	0.00
80.00	10.00	0.00
81.00	16.00	0.00
82.00	17.00	0.00
83.00	20.00	0.00
84.00	24.00	0.00
85.00	6.00	0.00
86.00	0.00	0.00
87.00	0.00	0.00
88.00	8.00	0.00
89.00	14.00	0.00
90.00	20.00	0.00
91.00	20.00	0.00
92.00	20.00	0.00
93.00	20.00	0.00
94.00	20.00	0.00
95.00	20.00	0.00
96.00	20.00	0.00
97.00	0.00	0.00
98.00	0.00	0.00
99.00	0.00	0.00
100.00	3.00	0.00
101.00	12.00	0.00
102.00	22.00	0.00
103.00	22.00	0.00
104.00	22.00	0.00
105.00	22.00	0.00
106.00	4.00	0.00
107.00	0.00	0.00
108.00	0.00	0.00
109.00	10.00	0.00
110.00	15.00	0.00
111.00	21.00	0.00
112.00	23.00	0.00
113.00	23.00	0.00
114.00	23.00	0.00
115.00	0.00	0.00
116.00	0.00	0.00
117.00	0.00	0.00
118.00	0.00	0.00
119.00	3.00	0.00

NOTATION - COLUMN HEADINGS

(A) TIME INCREMENT
(B) VELOCITY INCREMENT
(C) GRADE INCREMENT

(A)	(B)	(C)
120.00	7.00	0.00
121.00	11.00	0.00
122.00	14.00	0.00
123.00	16.00	0.00
124.00	16.00	0.00
125.00	16.00	0.00
126.00	9.00	0.00
127.00	4.00	0.00
128.00	0.00	0.00
129.00	0.00	0.00
130.00	0.00	0.00
131.00	0.00	0.00
132.00	0.00	0.00
133.00	0.00	0.00
134.00	1.00	0.00
135.00	11.00	0.00
136.00	12.00	0.00
137.00	11.00	0.00
138.00	9.00	0.00
139.00	9.00	0.00
140.00	9.00	0.00
141.00	4.00	0.00
142.00	0.00	0.00
143.00	0.00	0.00
144.00	0.00	0.00
145.00	3.00	0.00
146.00	3.00	0.00
147.00	5.00	0.00
148.00	0.00	0.00
149.00	0.00	0.00
150.00	0.00	0.00
151.00	2.00	0.00
152.00	2.00	0.00
153.00	7.00	0.00
154.00	7.00	0.00
155.00	7.00	0.00
156.00	12.00	0.00
157.00	12.00	0.00
158.00	12.00	0.00
159.00	12.00	0.00
160.00	14.00	0.00
161.00	13.00	0.00
162.00	13.00	0.00
163.00	12.00	0.00
164.00	3.00	0.00
165.00	0.00	0.00
166.00	0.00	0.00
167.00	5.00	0.00
168.00	9.00	0.05
169.00	9.00	0.05
170.00	9.00	0.05
171.00	9.00	0.05
172.00	9.00	0.05
173.00	9.00	0.05
174.00	9.00	0.05
175.00	9.00	0.05
176.00	9.00	0.05
177.00	0.00	0.00
178.00	0.00	0.00
179.00	3.00	0.00
180.00	12.00	0.00

NOTATION - COLUMN HEADINGS

(A) TIME INCREMENT
(B) VELOCITY INCREMENT
(C) GRADE INCREMENT

(A)	(B)	(C)
181.00	15.00	0.00
182.00	16.00	0.00
183.00	17.00	0.00
184.00	21.00	0.00
185.00	22.00	0.05
186.00	22.00	0.05
187.00	22.00	0.05
188.00	22.00	0.05
189.00	9.00	0.05
190.00	9.00	0.05
191.00	19.00	0.00
192.00	19.00	0.00
193.00	22.00	0.00
194.00	22.00	0.00
195.00	22.00	0.00
196.00	6.00	0.00
197.00	0.00	0.00
198.00	0.00	0.00
199.00	6.00	0.00
200.00	10.00	0.00
201.00	5.00	0.00
202.00	7.00	0.00
203.00	0.00	0.00
204.00	0.00	0.00
205.00	0.00	0.00
206.00	0.00	0.00
207.00	5.00	0.00
208.00	17.00	0.00
209.00	20.00	0.00
210.00	23.00	0.00
211.00	23.00	0.00
212.00	23.00	0.00
213.00	23.00	0.00
214.00	0.00	0.00
215.00	0.00	0.00
216.00	0.00	0.00
217.00	0.00	0.00
218.00	0.00	0.00
219.00	0.00	0.00
220.00	2.00	0.00
221.00	0.00	0.00
222.00	0.00	0.00
223.00	12.00	0.00
224.00	18.00	0.00
225.00	19.00	0.00
226.00	21.00	0.00
227.00	21.00	0.00
228.00	23.00	0.00
229.00	21.00	0.00
230.00	16.00	0.00
231.00	16.00	0.00
232.00	16.00	0.00
233.00	12.00	0.00
234.00	0.00	0.00
235.00	0.00	0.00
236.00	0.00	0.00
237.00	0.00	0.00
238.00	6.00	0.00
239.00	8.00	0.00
240.00	6.00	0.00
241.00	0.00	0.00

NOTATION - COLUMN HEADINGS

(A) TIME INCREMENT
(B) VELOCITY INCREMENT
(C) GRADE INCREMENT

(A)	(B)	(C)
242.00	0.00	0.00
243.00	0.00	0.00
244.00	1.00	0.00
245.00	9.00	0.00
246.00	17.00	0.00
247.00	16.00	0.00
248.00	16.00	0.00
249.00	16.00	0.00
250.00	0.00	0.00
251.00	0.00	0.00
252.00	0.00	0.00
253.00	0.00	0.00
254.00	9.00	0.05
255.00	9.00	0.05
256.00	9.00	0.05
257.00	9.00	0.05
258.00	8.00	0.05
259.00	8.00	0.05
260.00	9.00	0.05
261.00	12.00	0.00
262.00	19.00	0.00
263.00	19.00	0.00
264.00	19.00	0.00
265.00	19.00	0.00
266.00	14.00	0.00
267.00	0.00	0.00
268.00	0.00	0.00
269.00	0.00	0.00
270.00	3.00	0.00
271.00	7.00	0.00
272.00	10.00	0.00
273.00	13.00	0.00
274.00	17.00	0.00
275.00	22.00	0.00
276.00	22.00	0.00
277.00	22.00	0.00
278.00	22.00	0.00
279.00	22.00	0.00
280.00	22.00	0.00
281.00	25.00	0.00
282.00	25.00	0.00
283.00	25.00	0.00
284.00	23.00	0.00
285.00	21.00	0.00
286.00	21.00	0.00
287.00	0.00	0.00
288.00	0.00	0.00

NOTATION - COLUMN HEADINGS

(A) TIME INCREMENT
(B) VELOCITY INCREMENT
(C) GRADE INCREMENT

APPENDIX B
PROFS COMPUTER PROGRAM

```
C**PROGRAM TO CONVERT VELOCITIES IN ODD SEC. SEGMENTS TO 1 SEC. SEGMENTS
C**
C---- PROGRAM READIN
C---- READ IN GIVEN VELOCITY-TIME AND GRADE-TIME PROFILES.
C---- FACTOR = THE MOST CONVENIENT NUMBER OF EQUITIME SUBDIVISIONS
C----        OF A GIVEN PROFILE WHICH WILL ENCOMPASS AS MANY OF THE
C----        BREAKS IN THE PROFILE CURVE AS POSSIBLE.
C---- TTIME = TOTAL TIME SPAN OF THE PROFILE.
      DIMENSION Z(291,3),SPEED(54,20),GRADE(54,20)
      READ(20,100) TTIME,FACTOR
      PFAC=TTIME/FACTOR
      KK=TTIME/20
      PRFO=0
      PROO=0
      INIT=0
      READ(20,100) DELT,VELOS,ANGLE
      IF(INIT)2,2,5
    2 PRFO=VELOS
      PROO=ANGLE
      INIT=1.0
      NFACT=FACTOR
    5 DO 10 I=1,NFACT,1
      READ(20,100) (Z(I,J),J=1,3)
  100 FORMAT(1X,3F7.2)
   10 CONTINUE
      I=1
      K=1
      L=1
      M=1.0
      NTIME=TTIME
      DO 60 MM=1,NTIME,1
   15 IK=PFAC*M
      IF (MM-IK)20,20,50
   20 M=MM*1.0
      PRF1=PRFO+((Z(I,2)-PRFO)/PFAC)*(MM-PFAC*(M-1.0))
      SPEED(K,L)=PRF1
      PRF2=PROO+((Z(I,3)-PROO)/PFAC)*(MM-PFAC*(M-1.0))
      GRADE(K,L)=PRF2
      IF(L-20)30,40,40
   30 L=L+1
      GO TO 60
   40 L=1
      K=K+1
      GO TO 60
   50 M=M+1.0
      PRFO=Z(I,2)
      PROO=Z(I,3)
      I=I+1
      GO TO 15
   60 CONTINUE
      DO 110 K=1,54,1
      WRITE(21,300),(SPEED(K,L),L=1,20)
  300 FORMAT(1X,10F7.1)
  110 CONTINUE
      DO 170 K=1,54,1
      WRITE(21,500),(GRADE(K,L),L=1,20)
  500 FORMAT(1X,10F7.3)
  170 CONTINUE
      STOP
      END
Spooler runtime 1 Seconds, 8 KCS, 6 disk reads, 3 disk writes, 1 pages
```

APPENDIX C
PWREQ COMPUTER PROGRAM

```
      REAL DIST(1100),ACCEL(1100),VFORCE(1100),TIME(1100)
      REAL HPREQ(1100),KWREQ(1100),SPEED(1100),GRADE(1100)
C****
C---- INPUT DATA REQUIRED FOR COMPUTATION OF POWER REQUIREMENT.
C----    WIND = WIND SPEED ALONG PROFILE IN MPH.
C----    TTIME = VEHICLE TIME TO TRANSVERSE PROFILE.
C----    VMASS = VEHICLE MASS IN LBS.
C----    VAREA = VEHICLE FRONTAL AREA IN SQ. FT.
C----    DRAGC = VEHICLE AERODYNAMIC DRAG COEFFICIENT.
C----    ROLLC = VEHICLE GROUND ROLLING FRICTION COEFFICIENT.
C----    COULC= TIRE COULOMB FRICTION COEFFICIENT.
C****
C---- OUTPUT DATA GENERATED BY COMPUTER PROGRAM.
C----    GRADE = ROAD GRADE IN RADIANS.
C----    ACCEL=VEHICLE ACCELERATION IN MPH/SEC.
C----    SPEED = VEHICLE SPEED IN MPH.
C----    RFORCE = RESISTIVE FORCE ACTING ON VEHICLE IN LBS.
C----    VFORCE= THRUST REQUIRED IN LBS.
C----    HPREQ = HORSEPOWER REQUIRED.
C----    KWREQ = KILOWATT POWER REQUIRED.
C****
C---- READ IN INPUT DATA.
C****
C----    VEHICLE MASS,VEHICLE FRONTAL AREA,
C----    LENGTH OF DRIVING CYCLE,TIME INCREMENT,
C----    WIND SPEED ALONG PROFILE,VEHICLE GROUND ROLLING FRICTION
C----    COEFFICIENT,TIRE COULOMB FRICTION,AIR DRAG COEFF.
      READ(23,100) VMASS,VAREA,TTIME,DT,WIND,ROLLC,COULC,DRAGC
C****
  100 FORMAT(8F7.1)
      T=TTIME
      READ(21,350) (SPEED(K),K=1,I)
      READ(21,351) (GRADE(K),K=1,I)
  350 FORMAT(1X,10F7.1)
  351 FORMAT(1X,10F7.3)
      TFORCE=0.0
      THPREQ=0.0
      TKWREQ=0.0
      NLINE=41
      MAXLIN=40
      WRITE(22,85)
   85 FORMAT(1H1,25X,26HVEHICLE POWER REQUIREMENTS)
      WRITE(22,86)
   86 FORMAT(/,4X,11HGIVEN DATA-)
      WRITE(22,87) VMASS,WIND
   87 FORMAT(/,5X,21HVEHICLE GROSS WEIGHT=,F7.0,4H LBS,7X,
     *18HVEHICLE HEAD WIND=,F5.1,4H MPH)
      WRITE(22,88) VAREA,DRAGC
   88 FORMAT(5X,21HVEHICLE FRONTAL AREA=,F6.2,5H SQFT,5X,
     *25HVEHICLE DRAG COEFFICIENT=,F5.4)
      WRITE(22,89) ROLLC,COULC
   89 FORMAT(5X,29HROLLING FRICTION COEFFICIENT=,F5.4,
     1  3X,25HTIRE COUL. FRICT. COEFF.=,F5.4)
      IOSW=0
      NT=TTIME
      DO 900 N=1,NT,1
      TIME(N)=N
      IF(NLINE-MAXLIN)20,15,15
   15 CONTINUE
      NLINE=0
      IF(IOSW.EQ.0) WRITE(22,101)
```

```
      IF(INSW.GT.0) WRITE(22,109)
  101 FORMAT(/,2X,4HTIME,5X,4HVEL.,4X,5HGRADE,4X,5HDIST.,
     1  3X,6HACCEL.,3X,6HTHRUST,4X,5HHORSE,4X,5HKILO-)
  109 FORMAT(1H1,////////,2X,4HTIME,5X,4HVEL.,4X,5HGRADE,4X,5HDIST.,
     1  3X,6HACCEL.,3X,6HTHRUST,4X,5HHORSE,4X,5HKILO-)
      WRITE(22,105)
  105 FORMAT(1X,5H(SEC),4X,5H(MPH),4X,5H(RAD),2X,7H(MILES),
     1  1X,9H(MPH/SEC),2X,6H(LBS.),4X,5HPOWER,4X,5HWATTS)
   20 CONTINUE
      NLINE=NLINE+1
      IF(INSW)5,5,10
    5 SPEEDX=SPEED(N)
      INSW=1
   10 CONTINUE
      SINAVG=GRADE(N)*(1.-(GRADE(N))**2/6.0)
      RFORCE=0.002556*DRAGC*VAREA*((SPEED(N)+WIND)**2)+
     1  ROLLC*VMASS*(1.0+COULC*SPEED(N))+VMASS*SINAVG
      ACCEL(N)=SPEED(N)-SPEEDX
      SPEEDX=SPEED(N)
      VFORCE(N)=RFORCE+VMASS*ACCEL(N)/32.17*(22.0/15.0)
      XFORCE=VFORCE(N)
      IF(XFORCE.LE.0.0) XFORCE=0.0
      TFORCE=TFORCE+XFORCE
      HPREQ(N)=VFORCE(N)*SPEED(N)/375.0
      XHPREQ=XFORCE*SPEED(N)/375.0
      THPREQ=THPREQ+XHPREQ
      KWREQ(N)=HPREQ(N)/1.341
      XKWREQ=XHPREQ/1.341
      TKWREQ=TKWREQ+XKWREQ
      DISTX=DISTX+(1.0/3600.0)*(SPEED(N))*DT
      DIST(N)=DISTX
      IF(SPEED(N).GT.ZSPEED) ZSPEED=SPEED(N)
      IF(GRADE(N).GT.0.0) YGRADE=GRADE(N)
      IF(GRADE(N).LT.0.0) YGRADE=GRADE(N)*(-1.0)
      IF(YGRADE.GT.ZGRADE) ZGRADE=YGRADE
      IF(ACCEL(N).GT.0.0) YACCEL=ACCEL(N)
      IF(ACCEL(N).LT.0.0) YACCEL=ACCEL(N)*(-1.0)
      IF(YACCEL.GT.ZACCEL) ZACCEL=YACCEL
      IF(VFORCE(N).GT.0.0) YVFORCE=VFORCE(N)
      IF(VFORCE(N).LT.0.0) YVFORCE=VFORCE(N)*(-1.0)
      IF(YVFORCE.GT.ZVFORCE) ZVFORCE=YVFORCE
      IF(HPREQ(N).GT.0.0) YHPREQ=HPREQ(N)
      IF(HPREQ(N).LT.0.0) YHPREQ=HPREQ(N)*(-1.0)
      IF(YHPREQ.GT.ZHPREQ) ZHPREQ=YHPREQ
      IF(KWREQ(N).GT.0.0) YKWREQ=KWREQ(N)
      IF(KWREQ(N).LT.0.0) YKWREQ=KWREQ(N)*(-1.0)
      IF(YKWREQ.GT.ZKWREQ) ZKWREQ=YKWREQ
      WRITE(22,106) TIME(N),SPEED(N),GRADE(N),DIST(N),
     1  ACCEL(N),VFORCE(N),HPREQ(N),KWREQ(N)
      WRITE(24,107) TIME(N),SPEED(N),GRADE(N),
     1  ACCEL(N),VFORCE(N),HPREQ(N),KWREQ(N)
  106 FORMAT(1X,F5.0,F9.1,F9.3,F9.2,4F9.1)
  107 FORMAT(1X,F5.0,F9.1,F9.3,4F9.1)
  900 CONTINUE
      AVFORCE=TFORCE/TTIME
      AVHP=THPREQ/TTIME
      AVKW=TKWREQ/TTIME
      DTPM=AVFORCE/DIST(NT)
      DHPPM=AVHP/DIST(NT)
      DKWPM=AVKW/DIST(NT)
      WRITE(22,122)
```

```
      WRITE(1,122)
      WRITE(5,122)
  122 FORMAT(1H1,///,1X,39HAVERAGES DO NOT INCLUDE NEGATIVE VALUES)
      WRITE(22,115) AVFORCE
      WRITE(1,115) AVFORCE
      WRITE(5,115) AVFORCE
  115 FORMAT(/,1X,12HAVG. THRUST=,F9.2,5H LBS.)
      WRITE(22,116) AVHP
      WRITE(1,116) AVHP
      WRITE(5,116) AVHP
  116 FORMAT(/,1X,10HAVG. H.P.=,F8.2,5H H.P.)
      WRITE(22,117) AVKW
      WRITE(1,117) AVKW
      WRITE(5,117) AVKW
  117 FORMAT(/,1X,12HAVG. KWATTS=,F7.2,5H KWTS)
      WRITE(22,121) DIST(NT)
      WRITE(1,121) DIST(NT)
      WRITE(5,121) DIST(NT)
  121 FORMAT(/,1X,15HTOTAL DISTANCE=,F7.2,4H MI.)
      WRITE(22,118) DTPM
      WRITE(1,118) DTPM
      WRITE(5,118) DTPM
  118 FORMAT(/,1X,21HAVG. THRUST PER MILE=,F9.2,7H LBS/MI)
      WRITE(22,119) DHPPM
      WRITE(1,119) DHPPM
      WRITE(5,119) DHPPM
  119 FORMAT(/,1X,19HAVG. H.P. PER MILE=,F8.2)
      WRITE(22,120) DKWPM
      WRITE(1,120) DKWPM
      WRITE(5,120) DKWPM
  120 FORMAT(/,1X,24HAVG. KILOWATTS PER MILE=,F8.2)
      WRITE(22,130) ZSPEED
      WRITE(1,130) ZSPEED
      WRITE(5,130) ZSPEED
  130 FORMAT(/,1X,9HMAX VEL.=,F7.2,4H MPH)
      WRITE(22,131) ZGRADE
      WRITE(1,131) ZGRADE
      WRITE(5,131) ZGRADE
  131 FORMAT(/,1X,10HMAX GRADE=,F7.2,4H RAD)
      WRITE(22,132) ZACCEL
      WRITE(1,132) ZACCEL
      WRITE(5,132) ZACCEL
  132 FORMAT(/,1X,11HMAX ACCEL.=,F7.2,8H MPH/SEC)
      WRITE(22,133) ZVFORCE
      WRITE(1,133) ZVFORCE
      WRITE(5,133) ZVFORCE
  133 FORMAT(/,1X,11HMAX THRUST=,F7.0,4H LBS)
      WRITE(22,134) ZHPREQ
      WRITE(1,134) ZHPREQ
      WRITE(5,134) ZHPREQ
  134 FORMAT(/,1X,9HMAX H.P.=,F7.1)
      WRITE(22,135) ZKWREQ
      WRITE(1,135) ZKWREQ
      WRITE(5,135) ZKWREQ
  135 FORMAT(/,1X,9HMAX K.W.=,F7.1)
      STOP
      END
```

APPENDIX D
TYPICAL OUTPUT GENERATED BY PWREQ
(SAMPLE PROBLEM)

VEHICLE POWER REQUIREMENTS

GIVEN DATA-

VEHICLE GROSS WEIGHT= 30000. LBS VEHICLE HEAD WIND= 30.0 MPH
VEHICLE FRONTAL AREA= 66.63 SQFT VEHICLE DRAG COEFFICIENT=.8500
ROLLING FRICTION COEFFICIENT=.0230 TIRE COUL. FRICT. COEFF.=.0100

TIME (SEC)	VEL. (MPH)	GRADE (RAD)	DIST. (MILES)	ACCEL. (MPH/SEC)	THRUST (LBS.)	HORSE POWER	KILO-WATTS
1.	21.0	0.000	0.01	0.0	1211.4	67.8	50.6
2.	21.0	0.000	0.01	0.0	1211.4	67.8	50.6
3.	21.0	0.000	0.02	0.0	1211.4	67.8	50.6
4.	21.0	0.000	0.02	0.0	1211.4	67.8	50.6
5.	21.0	0.000	0.03	0.0	1211.4	67.8	50.6
6.	21.0	0.000	0.03	0.0	1211.4	67.8	50.6
7.	21.0	0.000	0.04	0.0	1211.4	67.8	50.6
8.	20.9	0.000	0.05	-0.1	1072.5	59.8	44.6
9.	20.8	0.000	0.05	-0.1	1070.3	59.4	44.3
10.	20.7	0.000	0.06	-0.1	1068.2	59.0	44.0
11.	20.6	0.000	0.06	-0.1	1066.0	58.6	43.7
12.	20.6	0.000	0.07	0.0	1202.8	66.1	49.3
13.	20.5	0.000	0.08	-0.1	1063.9	58.2	43.4
14.	20.5	0.000	0.08	0.0	1200.6	65.6	48.9
15.	20.4	0.000	0.09	-0.1	1061.7	57.8	43.1
16.	20.3	0.000	0.09	-0.1	1059.6	57.4	42.8
17.	20.2	0.000	0.10	-0.1	1057.4	57.0	42.5
18.	20.1	0.000	0.10	-0.1	1055.3	56.6	42.2
19.	20.0	0.000	0.11	-0.1	1053.1	56.2	41.9
20.	20.0	0.000	0.11	0.0	1189.9	63.5	47.3
21.	20.0	0.000	0.12	0.0	1189.9	63.5	47.3
22.	20.0	0.000	0.13	0.0	1189.9	63.5	47.3
23.	20.0	0.000	0.13	0.0	1189.9	63.5	47.3
24.	20.0	0.000	0.14	0.0	1189.9	63.5	47.3
25.	20.0	0.000	0.14	0.0	1189.9	63.5	47.3
26.	20.0	0.000	0.15	0.0	1189.9	63.5	47.3
27.	20.0	0.000	0.15	0.0	1189.9	63.5	47.3
28.	20.0	0.000	0.16	0.0	1189.9	63.5	47.3
29.	20.0	0.000	0.16	0.0	1189.9	63.5	47.3
30.	20.0	0.000	0.17	0.0	1189.9	63.5	47.3
31.	16.3	0.000	0.17	-3.7	-3947.8	-171.6	-128.0
32.	12.5	0.000	0.18	-3.8	-4159.7	-138.7	-103.4
33.	8.9	0.000	0.18	-3.7	-4092.0	-96.0	-71.6
34.	5.6	0.000	0.18	-3.2	-3464.6	-51.7	-38.6
35.	4.0	0.000	0.18	-1.6	-1303.4	-13.9	-10.4
36.	2.4	0.000	0.18	-1.6	-1329.8	-8.5	-6.3
37.	0.9	0.000	0.18	-1.6	-1355.5	-2.9	-2.2
38.	0.0	0.000	0.18	-0.8	-273.9	0.0	0.0
39.	0.0	0.000	0.18	0.0	820.3	0.0	0.0
40.	0.0	0.000	0.18	0.0	820.3	0.0	0.0

TIME (SEC)	VEL. (MPH)	GRADE (RAD)	DIST. (MILES)	ACCEL. (MPH/SEC)	THRUST (LBS.)	HORSE POWER	KILO-WATTS
41.	0.0	0.000	0.18	0.0	820.3	0.0	0.0
42.	0.0	0.000	0.18	0.0	820.3	0.0	0.0
43.	0.0	0.000	0.18	0.0	820.3	0.0	0.0
44.	0.0	0.000	0.18	0.0	820.3	0.0	0.0
45.	0.0	0.000	0.18	0.0	820.3	0.0	0.0
46.	4.3	0.000	0.19	4.3	6771.2	77.6	57.9
47.	8.5	0.000	0.19	4.2	6707.7	152.0	113.4
48.	12.8	0.000	0.19	4.3	6924.8	236.4	176.3
49.	16.3	0.000	0.20	3.5	5899.9	256.4	191.2
50.	17.3	0.000	0.20	1.0	2501.0	115.4	86.0
51.	18.4	0.000	0.21	1.1	2660.6	130.5	97.3
52.	19.5	0.000	0.21	1.1	2683.8	139.6	104.1
53.	20.1	0.000	0.22	0.6	2012.7	107.9	80.4
54.	20.4	0.000	0.22	0.3	1608.8	87.5	65.3
55.	20.7	0.000	0.23	0.3	1615.3	89.2	66.5
56.	20.9	0.000	0.23	0.2	1482.8	82.6	61.6
57.	21.0	0.000	0.24	0.1	1348.2	75.5	56.3
58.	21.0	0.000	0.25	0.0	1211.4	67.8	50.6
59.	21.0	0.000	0.25	0.0	1211.4	67.8	50.6
60.	21.0	0.000	0.26	0.0	1211.4	67.8	50.6
61.	15.4	0.000	0.26	-5.6	-6564.7	-269.6	-201.0
62.	9.8	0.000	0.26	-5.6	-6672.4	-174.4	-130.0
63.	4.2	0.000	0.27	-5.6	-6771.0	-75.8	-56.6
64.	0.0	0.000	0.27	-4.2	-4924.2	0.0	0.0
65.	0.0	0.000	0.27	0.0	820.3	0.0	0.0
66.	0.0	0.000	0.27	0.0	820.3	0.0	0.0
67.	0.0	0.000	0.27	0.0	820.3	0.0	0.0
68.	0.0	0.000	0.27	0.0	820.3	0.0	0.0
69.	0.0	0.000	0.27	0.0	820.3	0.0	0.0
70.	0.0	0.000	0.27	0.0	820.3	0.0	0.0
71.	0.0	0.000	0.27	0.0	820.3	0.0	0.0
72.	1.9	0.000	0.27	1.8	3310.7	15.9	11.9
73.	4.2	0.000	0.27	2.4	4170.9	46.7	34.8
74.	6.6	0.000	0.27	2.4	4212.0	74.1	55.3
75.	9.0	0.000	0.27	2.4	4254.8	102.1	76.1
76.	10.1	0.000	0.27	1.1	2497.0	67.3	50.2
77.	11.1	0.000	0.28	1.0	2378.9	70.4	52.5
78.	12.2	0.000	0.28	1.1	2536.5	82.5	61.5
79.	12.1	0.000	0.28	-0.1	893.3	28.8	21.5
80.	8.7	0.000	0.29	-3.4	-3683.5	-85.5	-63.7

TIME (SEC)	VEL. (MPH)	GRADE (RAD)	DIST. (MILES)	ACCEL. (MPH/SEC)	THRUST (LBS.)	HORSE POWER	KILO-WATTS
81.	5.2	0.000	0.29	-3.5	-3861.8	-53.8	-40.1
82.	1.7	0.000	0.29	-3.5	-3939.9	-17.9	-13.3
83.	0.0	0.000	0.29	-1.7	-1504.9	0.0	0.0
84.	0.0	0.000	0.29	0.0	820.3	0.0	0.0
85.	0.0	0.000	0.29	0.0	820.3	0.0	0.0
86.	0.0	0.000	0.29	0.0	820.3	0.0	0.0
87.	0.0	0.000	0.29	0.0	820.3	0.0	0.0
88.	0.0	0.000	0.29	0.0	820.3	0.0	0.0
89.	0.0	0.000	0.29	0.0	820.3	0.0	0.0
90.	0.7	0.000	0.29	0.0	820.3	0.0	0.0
91.	1.1	0.000	0.29	1.1	2342.1	6.9	5.1
92.	2.1	0.000	0.29	1.0	2221.4	12.4	9.3
93.	3.2	0.000	0.29	1.1	2376.2	20.3	15.1
94.	4.5	0.000	0.29	1.3	2671.4	32.1	23.9
95.	6.3	0.000	0.29	1.8	3386.1	56.9	42.4
96.	8.2	0.000	0.30	1.9	3556.5	77.8	58.0
97.	10.1	0.000	0.30	1.9	3591.2	96.7	72.1
98.	11.5	0.000	0.30	1.4	2933.5	90.0	67.1
99.	12.6	0.000	0.30	1.1	2544.2	85.5	63.7
100.	13.7	0.000	0.31	1.1	2565.5	93.7	69.9
101.	14.7	0.000	0.31	1.0	2448.4	96.0	71.6
102.	16.0	0.000	0.32	1.3	2984.8	123.1	91.8
103.	17.3	0.000	0.32	1.3	2911.3	134.3	100.2
104.	18.7	0.000	0.33	1.4	3077.2	153.4	114.4
105.	20.0	0.000	0.33	1.3	2968.0	158.3	118.0
106.	20.0	0.000	0.34	0.0	1189.9	63.5	47.3
107.	20.0	0.000	0.34	0.0	1189.9	63.5	47.3
108.	20.0	0.000	0.35	0.0	1189.9	63.5	47.3
109.	20.0	0.000	0.36	0.0	1189.9	63.5	47.3
110.	20.0	0.000	0.36	0.0	1189.9	63.5	47.3
111.	20.0	0.000	0.37	0.0	1189.9	63.5	47.3
112.	20.0	0.000	0.37	0.0	1189.9	63.5	47.3
113.	20.0	0.000	0.38	0.0	1189.9	63.5	47.3
114.	20.0	0.000	0.38	0.0	1189.9	63.5	47.3
115.	20.0	0.000	0.39	0.0	1189.9	63.5	47.3
116.	20.0	0.000	0.39	0.0	1189.9	63.5	47.3
117.	20.0	0.000	0.40	0.0	1189.9	63.5	47.3
118.	20.0	0.000	0.41	0.0	1189.9	63.5	47.3
119.	20.0	0.000	0.41	0.0	1189.9	63.5	47.3
120.	20.0	0.000	0.42	0.0	1189.9	63.5	47.3

TIME (SEC)	VEL. (MPH)	GRADE (RAD)	DIST. (MILES)	ACCEL. (MPH/SEC)	THRUST (LBS.)	HORSE POWER	KILO-WATTS
121.	20.0	0.000	0.42	0.0	1189.9	63.5	47.3
122.	20.0	0.000	0.43	0.0	1189.9	63.5	47.3
123.	20.0	0.000	0.43	0.0	1189.9	63.5	47.3
124.	20.0	0.000	0.44	0.0	1189.9	63.5	47.3
125.	20.0	0.000	0.44	0.0	1189.9	63.5	47.3
126.	20.0	0.000	0.45	0.0	1189.9	63.5	47.3
127.	20.0	0.000	0.46	0.0	1189.9	63.5	47.3
128.	20.0	0.000	0.46	0.0	1189.9	63.5	47.3
129.	20.0	0.000	0.47	0.0	1189.9	63.5	47.3
130.	20.0	0.000	0.47	0.0	1189.9	63.5	47.3
131.	20.0	0.000	0.48	0.0	1189.9	63.5	47.3
132.	20.0	0.000	0.48	0.0	1189.9	63.5	47.3
133.	20.0	0.000	0.49	0.0	1189.9	63.5	47.3
134.	20.0	0.000	0.49	0.0	1189.9	63.5	47.3
135.	20.0	0.000	0.50	0.0	1189.9	63.5	47.3
136.	20.0	0.000	0.51	0.0	1189.9	63.5	47.3
137.	20.0	0.000	0.51	0.0	1189.9	63.5	47.3
138.	20.0	0.000	0.52	0.0	1189.9	63.5	47.3
139.	20.0	0.000	0.52	0.0	1189.9	63.5	47.3
140.	20.0	0.000	0.53	0.0	1189.9	63.5	47.3
141.	20.0	0.000	0.53	0.0	1189.9	63.5	47.3
142.	20.0	0.000	0.54	0.0	1189.9	63.5	47.3
143.	20.0	0.000	0.54	0.0	1189.9	63.5	47.3
144.	20.0	0.000	0.55	0.0	1189.9	63.5	47.3
145.	20.0	0.000	0.56	0.0	1189.9	63.5	47.3
146.	20.0	0.000	0.56	0.0	1189.9	63.5	47.3
147.	15.0	0.000	0.57	-4.0	-4364.2	-186.2	-138.9
148.	10.7	0.000	0.57	-5.3	-6245.4	-178.2	-132.9
149.	5.3	0.000	0.57	-5.4	-6478.8	-91.6	-68.3
150.	0.0	0.000	0.57	-5.3	-6428.7	0.0	0.0
151.	0.0	0.000	0.57	0.0	820.3	0.0	0.0
152.	0.0	0.000	0.57	0.0	820.3	0.0	0.0
153.	0.0	0.000	0.57	0.0	820.3	0.0	0.0
154.	0.0	0.000	0.57	0.0	820.3	0.0	0.0
155.	0.0	0.000	0.57	0.0	820.3	0.0	0.0
156.	0.0	0.000	0.57	0.0	820.3	0.0	0.0
157.	0.0	0.000	0.57	0.0	820.3	0.0	0.0
158.	0.0	0.000	0.57	0.0	820.3	0.0	0.0
159.	0.0	0.000	0.57	0.0	820.3	0.0	0.0
160.	0.0	0.000	0.57	0.0	820.3	0.0	0.0

TIME (SEC)	VEL. (MPH)	GRADE (RAD)	DIST. (MILES)	ACCEL. (MPH/SEC)	THRUST (LBS.)	HORSE POWER	KILO-WATTS
161.	0.0	0.000	0.57	0.0	820.3	0.0	0.0
162.	0.0	0.000	0.57	0.0	820.3	0.0	0.0
163.	0.0	0.000	0.57	0.0	820.3	0.0	0.0
164.	0.0	0.000	0.57	0.0	820.3	0.0	0.0
165.	0.0	0.000	0.57	0.0	820.3	0.0	0.0
166.	0.5	0.000	0.57	0.5	1512.0	2.0	1.5
167.	1.1	0.000	0.57	0.6	1658.2	4.9	3.6
168.	1.6	0.000	0.57	0.5	1529.5	6.5	4.9
169.	2.5	0.000	0.57	0.9	2091.1	13.9	10.4
170.	4.7	0.000	0.57	2.2	3905.8	49.0	36.5
171.	6.8	0.000	0.57	2.1	3805.2	69.0	51.5
172.	8.9	0.000	0.58	2.1	3842.7	91.2	68.0
173.	10.7	0.000	0.58	1.8	3465.6	98.9	73.7
174.	12.0	0.000	0.58	1.3	2906.2	89.8	67.0
175.	13.3	0.000	0.59	1.3	2831.2	100.4	74.9
176.	14.7	0.000	0.59	1.4	2995.5	117.4	87.6
177.	15.4	0.000	0.60	0.7	2052.1	84.3	62.8
178.	15.9	0.000	0.60	0.5	1786.6	75.8	56.6
179.	16.5	0.000	0.60	0.6	1937.5	85.3	63.6
180.	17.0	0.000	0.61	0.5	1811.0	82.1	61.2
181.	17.8	0.000	0.61	0.8	2237.8	106.2	79.2
182.	18.6	0.000	0.62	0.8	2254.5	111.8	83.4
183.	19.4	0.000	0.62	0.8	2271.3	117.5	87.6
184.	20.0	0.000	0.63	0.6	2010.6	107.2	80.0
185.	20.0	0.000	0.64	0.0	1189.9	63.5	47.3
186.	20.0	0.000	0.64	0.0	1189.9	63.5	47.3
187.	20.0	0.000	0.65	0.0	1189.9	63.5	47.3
188.	20.0	0.000	0.65	0.0	1189.9	63.5	47.3
189.	20.0	0.000	0.66	0.0	1189.9	63.5	47.3
190.	20.0	0.000	0.66	0.0	1189.9	63.5	47.3
191.	20.0	0.000	0.67	0.0	1189.9	63.5	47.3
192.	20.0	0.000	0.67	0.0	1189.9	63.5	47.3
193.	20.0	0.000	0.68	0.0	1189.9	63.5	47.3
194.	20.0	0.000	0.69	0.0	1189.9	63.5	47.3
195.	20.0	0.000	0.69	0.0	1189.9	63.5	47.3
196.	14.7	0.000	0.70	-5.3	-6168.3	-241.8	-180.3
197.	9.3	0.000	0.70	-5.4	-6408.0	-158.9	-118.5
198.	4.0	0.000	0.70	-5.3	-6364.0	-67.9	-50.6
199.	0.0	0.000	0.70	-4.0	-4650.6	0.0	0.0
200.	0.0	0.000	0.70	0.0	820.3	0.0	0.0

TIME (SEC)	VEL. (MPH)	GRADE (RAD)	DIST. (MILES)	ACCEL. (MPH/SEC)	THRUST (LBS.)	HORSE POWER	KILO-WATTS
201.	0.0	0.000	0.70	0.0	820.3	0.0	0.0
202.	0.0	0.000	0.70	0.0	820.3	0.0	0.0
203.	0.0	0.000	0.70	0.0	820.3	0.0	0.0
204.	0.0	0.000	0.70	0.0	820.3	0.0	0.0
205.	0.0	0.000	0.70	0.0	820.3	0.0	0.0
206.	0.0	0.000	0.70	0.0	820.3	0.0	0.0
207.	0.0	0.000	0.70	0.0	820.3	0.0	0.0
208.	0.0	0.000	0.70	0.0	820.3	0.0	0.0
209.	0.0	0.000	0.70	0.0	820.3	0.0	0.0
210.	0.0	0.000	0.70	0.0	820.3	0.0	0.0
211.	0.5	0.000	0.70	0.5	1512.0	2.0	1.5
212.	1.1	0.000	0.70	0.6	1658.2	4.9	3.6
213.	1.6	0.000	0.70	0.5	1529.5	6.5	4.9
214.	2.6	0.000	0.70	1.0	2279.5	15.5	11.5
215.	5.0	0.000	0.70	2.4	4184.4	55.8	41.6
216.	7.4	0.000	0.70	2.4	4226.1	83.4	62.2
217.	9.8	0.000	0.71	2.4	4269.5	111.6	83.2
218.	10.9	0.000	0.71	1.1	2511.9	73.0	54.4
219.	10.6	0.000	0.71	-0.3	591.4	16.7	12.5
220.	10.3	0.000	0.72	-0.3	585.9	16.1	12.0
221.	10.1	0.000	0.72	-0.2	718.9	19.4	14.4
222.	9.6	0.000	0.72	-0.5	299.4	7.7	5.7
223.	9.1	0.000	0.72	-0.5	290.2	7.0	5.3
224.	8.5	0.000	0.73	-0.6	142.6	3.2	2.4
225.	8.0	0.000	0.73	-0.5	270.4	5.8	4.3
226.	5.9	0.000	0.73	-2.1	-1955.0	-30.8	-22.9
227.	3.7	0.000	0.73	-2.2	-2129.1	-21.0	-15.7
228.	1.6	0.000	0.73	-2.1	-2026.6	-8.6	-6.4
229.	0.0	0.000	0.73	-1.6	-1368.1	0.0	0.0
230.	0.0	0.000	0.73	0.0	820.3	0.0	0.0
231.	0.0	0.000	0.73	0.0	820.3	0.0	0.0
232.	0.0	0.000	0.73	0.0	820.3	0.0	0.0
233.	0.0	0.000	0.73	0.0	820.3	0.0	0.0
234.	0.0	0.000	0.73	0.0	820.3	0.0	0.0
235.	0.0	0.000	0.73	0.0	820.3	0.0	0.0
236.	0.0	0.000	0.73	0.0	820.3	0.0	0.0
237.	0.0	0.000	0.73	0.0	820.3	0.0	0.0
238.	0.0	0.000	0.73	0.0	820.3	0.0	0.0
239.	0.0	0.000	0.73	0.0	820.3	0.0	0.0
240.	0.0	0.000	0.73	0.0	820.3	0.0	0.0

TIME (SEC)	VEL. (MPH)	GRADE (RAD)	DIST. (MILES)	ACCEL. (MPH/SEC)	THRUST (LBS.)	HORSE POWER	KILO-WATTS
241.	0.0	0.000	0.73	0.0	820.3	0.0	0.0
242.	0.0	0.000	0.73	0.0	820.3	0.0	0.0
243.	0.0	0.000	0.73	0.0	820.3	0.0	0.0
244.	0.2	0.000	0.73	0.2	1097.0	0.6	0.4
245.	1.0	0.000	0.73	0.8	1930.2	5.1	3.8
246.	1.8	0.000	0.73	0.8	1943.0	9.3	7.0
247.	2.6	0.000	0.73	0.8	1956.0	13.6	10.1
248.	3.9	0.000	0.73	1.3	2661.3	27.7	20.6
249.	5.8	0.000	0.74	1.9	3514.3	54.4	40.5
250.	7.7	0.000	0.74	1.9	3547.6	72.8	54.3
251.	9.5	0.000	0.74	1.8	3443.3	87.2	65.0
252.	11.0	0.000	0.74	1.5	3060.9	89.8	67.0
253.	12.3	0.000	0.75	1.3	2812.0	92.2	68.8
254.	13.7	0.000	0.75	1.4	2975.8	108.7	81.1
255.	15.0	0.000	0.75	1.3	2864.7	114.6	85.4
256.	16.3	0.000	0.76	1.3	2890.9	125.7	93.7
257.	17.7	0.000	0.76	1.4	3056.3	144.3	107.6
258.	19.0	0.000	0.77	1.3	2946.7	149.3	111.3
259.	20.1	0.000	0.77	1.1	2696.6	144.5	107.8
260.	20.3	0.000	0.78	0.2	1469.9	79.6	59.3
261.	20.6	0.000	0.79	0.3	1613.1	88.6	66.1
262.	20.9	0.000	0.79	0.3	1619.6	90.3	67.3
263.	21.0	0.000	0.80	0.1	1348.2	75.5	56.3
264.	21.0	0.000	0.80	0.0	1211.4	67.8	50.6
265.	21.0	0.000	0.81	0.0	1211.4	67.8	50.6
266.	21.0	0.000	0.82	0.0	1211.4	67.8	50.6
267.	21.0	0.000	0.82	0.0	1211.4	67.8	50.6
268.	21.0	0.000	0.83	0.0	1211.4	67.8	50.6
269.	21.0	0.000	0.83	0.0	1211.4	67.8	50.6
270.	21.0	0.000	0.84	0.0	1211.4	67.8	50.6
271.	21.3	0.000	0.84	0.3	1628.3	92.5	69.0
272.	21.5	0.000	0.85	0.2	1495.8	85.8	64.0
273.	21.8	0.000	0.86	0.3	1639.2	95.3	71.1
274.	22.1	0.000	0.86	0.3	1645.8	97.0	72.3
275.	22.7	0.000	0.87	0.6	2069.3	125.3	93.4
276.	23.2	0.000	0.88	0.5	1943.7	120.2	89.7
277.	23.7	0.000	0.88	0.5	1954.9	123.5	92.1
278.	22.1	0.000	0.89	-1.6	-952.9	-56.2	-41.9
279.	18.4	0.000	0.89	-3.7	-3904.5	-191.6	-142.9
280.	14.7	0.000	0.90	-3.7	-3979.9	-156.0	-116.3

TIME (SEC)	VEL. (MPH)	GRADE (RAD)	DIST. (MILES)	ACCEL. (MPH/SEC)	THRUST (LBS.)	HORSE POWER	KILO-WATTS
281.	10.9	0.000	0.90	-3.8	-4190.0	-121.8	-90.8
282.	9.6	0.000	0.90	-1.3	-794.8	-20.3	-15.2
283.	9.1	0.000	0.91	-0.5	290.2	7.0	5.3
284.	8.5	0.000	0.91	-0.6	142.6	3.2	2.4
285.	8.0	0.000	0.91	-0.5	270.4	5.8	4.3
286.	5.9	0.000	0.91	-2.1	-1955.0	-30.8	-22.9
287.	3.7	0.000	0.91	-2.2	-2129.1	-21.0	-15.7
288.	1.6	0.000	0.91	-2.1	-2026.6	-8.6	-6.4
289.	0.0	0.000	0.91	-1.6	-1368.1	0.0	0.0
290.	0.0	0.000	0.91	0.0	820.3	0.0	0.0
291.	0.0	0.000	0.91	0.0	820.3	0.0	0.0
292.	0.0	0.000	0.91	0.0	820.3	0.0	0.0
293.	0.0	0.000	0.91	0.0	820.3	0.0	0.0
294.	0.0	0.000	0.91	0.0	820.3	0.0	0.0
295.	0.0	0.000	0.91	0.0	820.3	0.0	0.0
296.	0.0	0.000	0.91	0.0	820.3	0.0	0.0
297.	2.0	0.000	0.91	2.0	3587.5	19.1	14.3
298.	4.7	0.000	0.92	2.7	4589.6	57.5	42.9
299.	7.3	0.000	0.92	2.6	4497.9	87.6	65.3
300.	10.0	0.000	0.92	2.7	4683.5	124.9	93.1
301.	11.6	0.000	0.92	1.6	3208.9	99.3	74.0
302.	13.2	0.000	0.93	1.6	3239.6	114.0	85.0
303.	14.8	0.000	0.93	1.6	3271.0	129.1	96.3
304.	16.1	0.000	0.94	1.3	2886.8	123.9	92.4
305.	16.3	0.000	0.94	0.2	1386.3	60.3	44.9
306.	16.6	0.000	0.94	0.3	1529.2	67.7	50.5
307.	16.9	0.000	0.95	0.3	1535.4	69.2	51.6
308.	17.4	0.000	0.95	0.5	1819.2	84.4	62.9
309.	18.2	0.000	0.96	0.8	2246.1	109.0	81.3
310.	19.0	0.000	0.96	0.8	2262.9	114.7	85.5
311.	19.8	0.000	0.97	0.8	2279.8	120.4	89.8
312.	20.2	0.000	0.98	1.0	2574.8	142.8	106.5
313.	21.9	0.000	0.98	1.1	2735.6	159.8	119.1
314.	22.9	0.000	0.99	1.0	2620.9	160.0	119.3
315.	24.0	0.000	0.99	1.1	2782.2	178.1	132.8
316.	19.2	0.000	1.00	-4.8	-5392.2	-276.1	-205.9
317.	14.4	0.000	1.00	-4.8	-5490.4	-210.8	-157.2
318.	9.6	0.000	1.01	-4.8	-5581.9	-142.9	-106.6
319.	5.6	0.000	1.01	-4.0	-4558.8	-66.1	-50.8
320.	4.0	0.000	1.01	-1.6	-1303.4	-13.9	-10.4

TIME (SEC)	VEL. (MPH)	GRADE (RAD)	DIST. (MILES)	ACCEL. (MPH/SEC)	THRUST (LBS.)	HORSE POWER	KILO-WATTS
321.	2.4	0.000	1.01	-1.6	-1329.8	-8.5	-6.3
322.	0.8	0.000	1.01	-1.6	-1355.5	-2.9	-2.2
323.	0.0	0.000	1.01	-0.8	-273.9	0.0	0.0
324.	0.0	0.000	1.01	0.0	820.3	0.0	0.0
325.	0.0	0.000	1.01	0.0	820.3	0.0	0.0
326.	0.0	0.000	1.01	0.0	820.3	0.0	0.0
327.	1.6	0.000	1.01	1.6	3034.0	12.9	9.7
328.	3.7	0.000	1.01	2.1	3752.2	37.0	27.6
329.	5.9	0.000	1.01	2.2	3926.3	61.8	46.1
330.	8.0	0.000	1.02	2.1	3826.5	81.6	60.9
331.	9.6	0.000	1.02	1.6	3171.6	81.2	60.5
332.	11.2	0.000	1.02	1.6	3201.4	95.6	71.3
333.	12.8	0.000	1.03	1.6	3231.9	110.3	82.3
334.	14.4	0.000	1.03	1.6	3263.1	125.3	93.4
335.	16.0	0.000	1.03	1.6	3295.1	140.6	104.8
336.	17.6	0.000	1.04	1.6	3327.8	156.2	116.5
337.	19.2	0.000	1.04	1.6	3361.3	172.1	128.3
338.	20.0	0.000	1.05	0.8	2284.1	121.8	90.8
339.	20.0	0.000	1.05	0.0	1189.9	63.5	47.3
340.	20.0	0.000	1.06	0.0	1189.9	63.5	47.3
341.	20.0	0.000	1.07	0.0	1189.9	63.5	47.3
342.	20.0	0.000	1.07	0.0	1189.9	63.5	47.3
343.	20.0	0.000	1.08	0.0	1189.9	63.5	47.3
344.	20.0	0.000	1.08	0.0	1189.9	63.5	47.3
345.	20.0	0.000	1.09	0.0	1189.9	63.5	47.3
346.	20.0	0.000	1.09	0.0	1189.9	63.5	47.3
347.	20.0	0.000	1.10	0.0	1189.9	63.5	47.3
348.	20.0	0.000	1.10	0.0	1189.9	63.5	47.3
349.	20.0	0.000	1.11	0.0	1189.9	63.5	47.3
350.	20.0	0.000	1.12	0.0	1189.9	63.5	47.3
351.	20.0	0.000	1.12	0.0	1189.9	63.5	47.3
352.	20.0	0.000	1.13	0.0	1189.9	63.5	47.3
353.	20.0	0.000	1.13	0.0	1189.9	63.5	47.3
354.	20.0	0.000	1.14	0.0	1189.9	63.5	47.3
355.	20.0	0.000	1.14	0.0	1189.9	63.5	47.3
356.	20.0	0.000	1.15	0.0	1189.9	63.5	47.3
357.	20.0	0.000	1.15	0.0	1189.9	63.5	47.3
358.	20.0	0.000	1.16	0.0	1189.9	63.5	47.3
359.	20.0	0.000	1.17	0.0	1189.9	63.5	47.3
360.	20.0	0.000	1.17	0.0	1189.9	63.5	47.3

TIME (SEC)	VEL. (MPH)	GRADE (RAD)	DIST. (MILES)	ACCEL. (MPH/SEC)	THRUST (LBS.)	HORSE POWER	KILO-WATTS
361.	14.7	0.000	1.18	-5.3	-6168.3	-241.8	-180.3
362.	9.3	0.000	1.18	-5.4	-6408.0	-158.9	-118.5
363.	4.0	0.000	1.18	-5.3	-6364.0	-67.9	-50.6
364.	0.0	0.000	1.18	-4.0	-4650.6	0.0	0.0
365.	0.0	0.000	1.18	0.0	820.3	0.0	0.0
366.	0.0	0.000	1.18	0.0	820.3	0.0	0.0
367.	0.0	0.000	1.18	0.0	820.3	0.0	0.0
368.	0.0	0.000	1.18	0.0	820.3	0.0	0.0
369.	0.0	0.000	1.18	0.0	820.3	0.0	0.0
370.	0.0	0.000	1.18	0.0	820.3	0.0	0.0
371.	0.0	0.000	1.18	0.0	820.3	0.0	0.0
372.	0.6	0.000	1.18	0.6	1650.3	2.6	2.0
373.	1.4	0.000	1.18	0.8	1936.6	7.2	5.4
374.	2.2	0.000	1.18	0.8	1949.5	11.4	8.5
375.	3.0	0.000	1.18	0.8	1962.5	15.7	11.7
376.	5.4	0.000	1.18	2.4	4191.2	60.4	45.0
377.	7.8	0.000	1.19	2.4	4233.2	88.1	65.7
378.	10.2	0.000	1.19	2.4	4276.9	116.3	86.7
379.	12.7	0.000	1.19	2.5	4460.9	151.1	112.7
380.	15.3	0.000	1.20	2.6	4648.7	189.7	141.4
381.	18.0	0.000	1.20	2.7	4840.6	232.3	173.3
382.	20.7	0.000	1.21	2.7	4897.8	270.4	201.6
383.	22.0	0.000	1.21	1.3	3011.3	176.7	131.7
384.	22.0	0.000	1.22	0.0	1233.2	72.4	54.0
385.	22.0	0.000	1.22	0.0	1233.2	72.4	54.0
386.	22.0	0.000	1.23	0.0	1233.2	72.4	54.0
387.	22.0	0.000	1.24	0.0	1233.2	72.4	54.0
388.	22.0	0.000	1.24	0.0	1233.2	72.4	54.0
389.	22.0	0.000	1.25	0.0	1233.2	72.4	54.0
390.	22.0	0.000	1.26	0.0	1233.2	72.4	54.0
391.	22.0	0.000	1.26	0.0	1233.2	72.4	54.0
392.	22.0	0.000	1.27	0.0	1233.2	72.4	54.0
393.	22.0	0.000	1.27	0.0	1233.2	72.4	54.0
394.	20.8	0.000	1.28	-1.2	-434.2	-24.1	-18.0
395.	16.0	0.000	1.28	-4.8	-5458.4	-232.9	-173.7
396.	11.2	0.000	1.29	-4.8	-5552.1	-165.8	-123.7
397.	6.4	0.000	1.29	-4.8	-5639.2	-96.2	-71.8
398.	3.5	0.000	1.29	-2.9	-3089.8	-28.8	-21.5
399.	2.4	0.000	1.29	-1.1	-646.0	-4.1	-3.1
400.	1.3	0.000	1.29	-1.1	-663.7	-2.3	-1.7

TIME (SEC)	VEL. (MPH)	GRADE (RAD)	DIST. (MILES)	ACCEL. (MPH/SEC)	THRUST (LBS.)	HORSE POWER	KILO-WATTS
401.	0.3	0.000	1.29	-1.0	-542.8	-0.4	-0.3
402.	0.0	0.000	1.29	-0.3	410.0	0.0	0.0
403.	0.0	0.000	1.29	0.0	820.3	0.0	0.0
404.	0.0	0.000	1.29	0.0	820.3	0.0	0.0
405.	0.0	0.000	1.29	0.0	820.3	0.0	0.0
406.	2.7	0.000	1.29	2.7	4556.3	32.8	24.5
407.	5.3	0.000	1.29	2.6	4463.1	63.1	47.0
408.	8.0	0.000	1.30	2.7	4647.1	99.1	73.9
409.	10.3	0.000	1.30	2.3	4142.0	113.8	84.9
410.	11.7	0.000	1.30	1.4	2937.3	91.6	68.3
411.	13.0	0.000	1.30	1.3	2825.4	97.9	73.0
412.	14.3	0.000	1.31	1.3	2850.8	108.7	81.1
413.	15.9	0.000	1.31	1.5	3154.3	132.9	99.1
414.	17.4	0.000	1.32	1.6	3323.7	154.2	115.0
415.	19.0	0.000	1.32	1.6	3357.1	170.1	126.8
416.	20.6	0.000	1.33	1.6	3391.2	186.3	138.9
417.	21.4	0.000	1.34	0.8	2314.3	132.1	98.5
418.	21.9	0.000	1.34	0.5	1914.9	111.8	83.4
419.	22.5	0.000	1.35	0.6	2064.9	123.9	92.4
420.	23.0	0.000	1.35	0.5	1939.2	118.9	88.7
421.	23.0	0.000	1.36	0.0	1255.3	77.0	57.4
422.	23.0	0.000	1.37	0.0	1255.3	77.0	57.4
423.	23.0	0.000	1.37	0.0	1255.3	77.0	57.4
424.	23.0	0.000	1.38	0.0	1255.3	77.0	57.4
425.	23.0	0.000	1.39	0.0	1255.3	77.0	57.4
426.	23.0	0.000	1.39	0.0	1255.3	77.0	57.4
427.	23.0	0.000	1.40	0.0	1255.3	77.0	57.4
428.	18.9	0.000	1.40	-3.1	-3052.2	-162.0	-120.8
429.	13.8	0.000	1.41	-6.1	-7280.2	-267.9	-199.8
430.	7.7	0.000	1.41	-6.1	-7394.3	-151.8	-113.2
431.	1.5	0.000	1.41	-6.2	-7636.0	-30.5	-22.8
432.	0.0	0.000	1.41	-1.5	-1231.3	0.0	0.0
433.	0.0	0.000	1.41	0.0	820.3	0.0	0.0
434.	0.0	0.000	1.41	0.0	820.3	0.0	0.0
435.	0.0	0.000	1.41	0.0	820.3	0.0	0.0
436.	0.0	0.000	1.41	0.0	820.3	0.0	0.0
437.	0.0	0.000	1.41	0.0	820.3	0.0	0.0
438.	0.0	0.000	1.41	0.0	820.3	0.0	0.0
439.	0.0	0.000	1.41	0.0	820.3	0.0	0.0
440.	0.0	0.000	1.41	0.0	820.3	0.0	0.0

TIME (SEC)	VEL. (MPH)	GRADE (RAD)	DIST. (MILES)	ACCEL. (MPH/SEC)	THRUST (LBS.)	HORSE POWER	KILO-WATTS
441.	0.0	0.000	1.41	0.0	820.3	0.0	0.0
442.	0.0	0.000	1.41	0.0	820.3	0.0	0.0
443.	0.4	0.000	1.41	0.4	1373.6	1.5	1.1
444.	1.2	0.000	1.41	0.8	1933.4	6.2	4.6
445.	2.0	0.000	1.41	0.8	1946.2	10.4	7.7
446.	2.8	0.000	1.41	0.8	1959.3	14.6	10.9
447.	3.8	0.000	1.41	1.0	2249.3	22.8	17.0
448.	4.9	0.000	1.41	1.1	2404.6	31.4	23.4
449.	5.9	0.000	1.42	1.0	2285.0	36.0	26.8
450.	7.0	0.000	1.42	1.1	2441.0	45.6	34.0
451.	8.1	0.000	1.42	1.1	2460.5	53.1	39.6
452.	9.1	0.000	1.42	1.0	2341.8	56.8	42.4
453.	10.2	0.000	1.43	1.1	2498.8	68.0	50.7
454.	11.2	0.000	1.43	1.0	2380.7	71.1	53.0
455.	12.0	0.000	1.43	0.8	2122.4	67.9	50.6
456.	12.8	0.000	1.44	0.8	2137.7	73.0	54.4
457.	13.6	0.000	1.44	0.8	2153.2	78.1	58.2
458.	14.3	0.000	1.44	0.7	2030.2	77.4	57.7
459.	14.8	0.000	1.45	0.5	1766.5	69.7	52.0
460.	15.3	0.000	1.45	0.5	1776.5	72.5	54.1
461.	15.9	0.000	1.46	0.6	1925.3	81.6	60.9
462.	16.0	0.000	1.46	0.1	1243.5	53.1	39.6
463.	16.3	0.000	1.47	0.0	1106.7	47.2	35.2
464.	16.0	0.000	1.47	0.0	1106.7	47.2	35.2
465.	16.0	0.000	1.47	0.0	1106.7	47.2	35.2
466.	16.0	0.000	1.48	0.0	1106.7	47.2	35.2
467.	16.0	0.000	1.48	0.0	1106.7	47.2	35.2
468.	16.0	0.000	1.49	0.0	1106.7	47.2	35.2
469.	15.5	0.000	1.49	-0.5	412.8	17.1	12.7
470.	13.7	0.000	1.50	-1.8	-1400.9	-51.2	-38.2
471.	11.8	0.000	1.50	-1.9	-1574.3	-49.5	-36.9
472.	9.9	0.000	1.50	-1.9	-1609.9	-42.5	-31.7
473.	8.3	0.000	1.50	-1.6	-1228.8	-27.2	-20.3
474.	7.0	0.000	1.51	-1.3	-841.6	-15.7	-11.7
475.	5.7	0.000	1.51	-1.3	-864.2	-13.1	-9.8
476.	4.3	0.000	1.51	-1.4	-1024.8	-11.8	-8.8
477.	3.2	0.000	1.51	-1.1	-632.9	-5.4	-4.0
478.	2.1	0.000	1.51	-1.1	-650.9	-3.6	-2.7
479.	1.1	0.000	1.51	-1.0	-530.1	-1.6	-1.2
480.	0.0	0.000	1.51	-1.1	-684.2	0.0	0.0

TIME (SEC)	VEL. (MPH)	GRADE (RAD)	DIST. (MILES)	ACCEL. (MPH/SEC)	THRUST (LBS.)	HORSE POWER	KILO-WATTS
481.	0.0	0.000	1.51	0.0	820.3	0.0	0.0
482.	0.0	0.000	1.51	0.0	820.3	0.0	0.0
483.	0.0	0.000	1.51	0.0	820.3	0.0	0.0
484.	0.0	0.000	1.51	0.0	820.3	0.0	0.0
485.	0.0	0.000	1.51	0.0	820.3	0.0	0.0
486.	0.0	0.000	1.51	0.0	820.3	0.0	0.0
487.	0.0	0.000	1.51	0.0	820.3	0.0	0.0
488.	0.0	0.000	1.51	0.0	820.3	0.0	0.0
489.	0.0	0.000	1.51	0.0	820.3	0.0	0.0
490.	0.0	0.000	1.51	0.0	820.3	0.0	0.0
491.	0.0	0.000	1.51	0.0	820.3	0.0	0.0
492.	0.0	0.000	1.51	0.0	820.3	0.0	0.0
493.	0.0	0.000	1.51	0.0	820.3	0.0	0.0
494.	0.0	0.000	1.51	0.0	820.3	0.0	0.0
495.	0.0	0.000	1.51	0.0	820.3	0.0	0.0
496.	0.0	0.000	1.51	0.0	820.3	0.0	0.0
497.	0.0	0.000	1.51	0.0	820.3	0.0	0.0
498.	0.0	0.000	1.51	0.0	820.3	0.0	0.0
499.	0.1	0.000	1.51	0.1	958.6	0.3	0.2
500.	0.3	0.000	1.51	0.2	1098.5	0.9	0.7
501.	0.6	0.000	1.51	0.3	1240.0	2.0	1.5
502.	0.9	0.000	1.51	0.3	1244.8	3.0	2.2
503.	2.3	0.000	1.51	1.4	2771.7	17.0	12.7
504.	5.0	0.000	1.51	2.7	4594.7	61.3	45.7
505.	7.7	0.000	1.52	2.7	4641.8	95.3	71.1
506.	10.3	0.000	1.52	2.6	4552.3	125.0	93.2
507.	11.2	0.000	1.52	0.9	2244.0	67.0	50.0
508.	11.5	0.000	1.52	0.3	1429.0	43.8	32.7
509.	11.7	0.000	1.53	0.2	1296.0	40.4	30.2
510.	12.0	0.000	1.53	0.3	1438.5	46.0	34.3
511.	11.7	0.000	1.53	-0.3	612.1	19.1	14.2
512.	11.5	0.000	1.54	-0.2	745.1	22.9	17.0
513.	11.2	0.000	1.54	-0.3	602.7	18.0	13.4
514.	10.9	0.000	1.54	-0.3	597.1	17.4	12.9
515.	10.3	0.000	1.55	-0.6	175.5	4.8	3.6
516.	9.8	0.000	1.55	-0.5	303.1	7.9	5.9
517.	9.3	0.000	1.55	-0.5	293.9	7.3	5.4
518.	9.0	0.000	1.55	-0.3	562.0	13.5	10.1
519.	9.0	0.000	1.56	0.0	972.3	23.3	17.4
520.	9.0	0.000	1.56	0.0	972.3	23.3	17.4

TIME (SEC)	VEL. (MPH)	GRADE (RAD)	DIST. (MILES)	ACCEL. (MPH/SEC)	THRUST (LBS.)	HORSE POWER	KILO-WATTS
521.	9.0	0.000	1.56	0.0	972.3	23.3	17.4
522.	9.0	0.000	1.56	0.0	972.3	23.3	17.4
523.	9.0	0.000	1.57	0.0	972.3	23.3	17.4
524.	9.0	0.000	1.57	0.0	972.3	23.3	17.4
525.	9.0	0.000	1.57	0.0	972.3	23.3	17.4
526.	7.7	0.000	1.57	-1.3	-829.2	-17.0	-12.7
527.	6.3	0.000	1.58	-1.4	-990.6	-16.6	-12.4
528.	5.0	0.000	1.58	-1.3	-876.2	-11.7	-8.7
529.	3.7	0.000	1.58	-1.3	-898.1	-8.9	-6.6
530.	2.7	0.000	1.58	-1.0	-504.3	-3.6	-2.7
531.	1.6	0.000	1.58	-1.1	-658.9	-2.8	-2.1
532.	0.5	0.000	1.58	-1.1	-676.4	-0.9	-0.7
533.	0.0	0.000	1.58	-0.5	136.4	0.0	0.0
534.	0.0	0.000	1.58	0.0	820.3	0.0	0.0
535.	0.0	0.000	1.58	0.0	820.3	0.0	0.0
536.	0.0	0.000	1.58	0.0	820.3	0.0	0.0
537.	0.0	0.000	1.58	0.0	820.3	0.0	0.0
538.	0.0	0.000	1.58	0.0	820.3	0.0	0.0
539.	0.0	0.000	1.58	0.0	820.3	0.0	0.0
540.	0.0	0.000	1.58	0.0	820.3	0.0	0.0
541.	0.8	0.000	1.58	0.8	1927.0	4.1	3.1
542.	1.6	0.000	1.58	0.8	1939.8	8.3	6.2
543.	2.1	0.000	1.58	0.8	1952.7	12.5	9.3
544.	3.0	0.000	1.58	0.6	1689.0	13.5	10.1
545.	3.0	0.000	1.58	0.0	868.3	6.9	5.2
546.	3.0	0.000	1.58	0.0	868.3	6.9	5.2
547.	3.0	0.000	1.58	0.0	868.3	6.9	5.2
548.	3.3	0.000	1.58	0.3	1283.6	11.3	8.4
549.	3.8	0.000	1.59	0.5	1565.5	15.9	11.8
550.	4.3	0.000	1.59	0.5	1573.9	18.0	13.5
551.	4.9	0.000	1.59	0.6	1720.8	22.5	16.8
552.	4.0	0.000	1.59	-0.9	-346.0	-3.7	-2.8
553.	2.7	0.000	1.59	-1.3	-914.6	-6.6	-4.9
554.	1.3	0.000	1.59	-1.4	-1074.0	-3.7	-2.8
555.	0.0	0.000	1.59	-1.3	-957.8	0.0	0.0
556.	0.0	0.000	1.59	0.0	820.3	0.0	0.0
557.	0.0	0.000	1.59	0.0	820.3	0.0	0.0
558.	0.0	0.000	1.59	0.0	820.3	0.0	0.0
559.	0.0	0.000	1.59	0.0	820.3	0.0	0.0
560.	0.0	0.000	1.59	0.0	820.3	0.0	0.0

TIME (SEC)	VEL. (MPH)	GRADE (RAD)	DIST. (MILES)	ACCEL. (MPH/SEC)	THRUST (LBS.)	HORSE POWER	KILO-WATTS
561.	0.0	0.000	1.59	0.0	820.3	0.0	0.0
562.	0.0	0.000	1.59	0.0	820.3	0.0	0.0
563.	0.3	0.000	1.59	0.3	1235.3	1.0	0.7
564.	0.8	0.000	1.59	0.5	1516.7	3.2	2.4
565.	1.3	0.000	1.59	0.5	1524.7	5.3	3.9
566.	1.9	0.000	1.59	0.6	1671.1	8.5	6.3
567.	2.1	0.000	1.59	0.1	988.8	5.3	3.9
568.	2.0	0.000	1.59	0.0	852.0	4.5	3.4
569.	2.0	0.000	1.59	0.0	852.0	4.5	3.4
570.	2.0	0.000	1.59	0.0	852.0	4.5	3.4
571.	3.3	0.000	1.60	1.3	2651.4	23.3	17.4
572.	4.7	0.000	1.60	1.4	2811.6	35.2	26.3
573.	6.0	0.000	1.60	1.3	2697.1	43.2	32.2
574.	7.0	0.000	1.60	1.0	2304.2	43.0	32.1
575.	7.0	0.000	1.60	0.0	936.5	17.5	13.0
576.	7.0	0.000	1.60	0.0	936.5	17.5	13.0
577.	7.0	0.000	1.61	0.0	936.5	17.5	13.0
578.	7.0	0.000	1.61	0.0	936.5	17.5	13.0
579.	7.0	0.000	1.61	0.0	936.5	17.5	13.0
580.	7.0	0.000	1.61	0.0	936.5	17.5	13.0
581.	7.0	0.000	1.61	0.0	936.5	17.5	13.0
582.	8.0	0.000	1.62	1.0	2322.0	49.5	36.9
583.	9.3	0.000	1.62	1.3	2755.6	68.3	51.0
584.	10.7	0.000	1.62	1.4	2918.5	83.3	62.1
585.	12.0	0.000	1.62	1.3	2806.2	89.8	67.0
586.	12.0	0.000	1.63	0.0	1028.2	32.9	24.5
587.	12.0	0.000	1.63	0.0	1028.2	32.9	24.5
588.	12.0	0.000	1.63	0.0	1028.2	32.9	24.5
589.	12.0	0.000	1.64	0.0	1028.2	32.9	24.5
590.	12.0	0.000	1.64	0.0	1028.2	32.9	24.5
591.	12.0	0.000	1.64	0.0	1028.2	32.9	24.5
592.	12.0	0.000	1.65	0.0	1028.2	32.9	24.5
593.	12.0	0.000	1.65	0.0	1028.2	32.9	24.5
594.	12.0	0.000	1.65	0.0	1028.2	32.9	24.5
595.	12.0	0.000	1.66	0.0	1028.2	32.9	24.5
596.	12.0	0.000	1.66	0.0	1028.2	32.9	24.5
597.	12.4	0.000	1.66	0.4	1582.9	52.3	39.0
598.	12.9	0.000	1.67	0.5	1729.3	59.5	44.4
599.	13.5	0.000	1.67	0.6	1877.7	67.6	50.4
600.	14.0	0.000	1.68	0.5	1750.7	65.4	48.7

TIME (SEC)	VEL. (MPH)	GRADE (RAD)	DIST. (MILES)	ACCEL. (MPH/SEC)	THRUST (LBS.)	HORSE POWER	KILO-WATTS
601.	13.7	0.000	1.68	-0.3	650.7	23.8	17.7
602.	13.5	0.000	1.68	-0.2	783.5	28.2	21.0
603.	13.2	0.000	1.69	-0.3	640.9	22.6	16.8
604.	13.0	0.000	1.69	-0.2	773.8	26.8	20.0
605.	13.0	0.000	1.69	0.0	1047.4	36.3	27.1
606.	13.0	0.000	1.70	0.0	1047.4	36.3	27.1
607.	13.0	0.000	1.70	0.0	1047.4	36.3	27.1
608.	12.9	0.000	1.71	-0.1	908.7	31.3	23.3
609.	12.6	0.000	1.71	-0.3	629.3	21.1	15.8
610.	12.3	0.000	1.71	-0.3	623.6	20.5	15.3
611.	12.1	0.000	1.72	-0.2	756.5	24.4	18.2
612.	10.2	0.000	1.72	-1.9	-1604.4	-43.6	-32.5
613.	7.8	0.000	1.72	-2.4	-2331.9	-48.5	-36.2
614.	5.4	0.000	1.72	-2.4	-2373.9	-34.2	-25.5
615.	3.0	0.000	1.72	-2.4	-2414.2	-19.3	-14.4
616.	2.2	0.000	1.72	-0.8	-238.9	-1.4	-1.0
617.	1.4	0.000	1.72	-0.8	-251.8	-0.9	-0.7
618.	0.6	0.000	1.72	-0.8	-264.5	-0.4	-0.3
619.	0.0	0.000	1.72	-0.6	-9.4	0.0	0.0
620.	0.0	0.000	1.72	0.0	820.3	0.0	0.0
621.	0.0	0.000	1.72	0.0	820.3	0.0	0.0
622.	0.0	0.000	1.72	0.0	820.3	0.0	0.0
623.	0.7	0.000	1.72	0.7	1788.7	3.3	2.5
624.	2.0	0.000	1.72	1.3	2630.1	14.0	10.5
625.	3.3	0.000	1.73	1.3	2651.4	23.3	17.4
626.	4.7	0.000	1.73	1.4	2811.6	35.2	26.3
627.	5.8	0.010	1.73	1.1	2720.1	42.1	31.4
628.	6.9	0.023	1.73	1.1	3129.2	57.6	42.9
629.	7.9	0.037	1.73	1.0	3429.9	72.3	53.9
630.	9.0	0.050	1.74	1.1	3976.2	95.4	71.2
631.	9.0	0.050	1.74	0.0	2471.7	59.3	44.2
632.	9.0	0.050	1.74	0.0	2471.7	59.3	44.2
633.	9.0	0.050	1.74	0.0	2471.7	59.3	44.2
634.	9.0	0.050	1.75	0.0	2471.7	59.3	44.2
635.	9.0	0.050	1.75	0.0	2471.7	59.3	44.2
636.	9.0	0.050	1.75	0.0	2471.7	59.3	44.2
637.	9.0	0.050	1.75	0.0	2471.7	59.3	44.2
638.	9.0	0.050	1.76	0.0	2471.7	59.3	44.2
639.	9.0	0.050	1.76	0.0	2471.7	59.3	44.2
640.	9.0	0.050	1.76	0.0	2471.7	59.3	44.2

TIME (SEC)	VEL. (MPH)	GRADE (RAD)	DIST. (MILES)	ACCEL. (MPH/SEC)	THRUST (LBS.)	HORSE POWER	KILO-WATTS
641.	9.0	0.050	1.76	0.0	2471.7	59.3	44.2
642.	9.0	0.050	1.77	0.0	2471.7	59.3	44.2
643.	9.0	0.050	1.77	0.0	2471.7	59.3	44.2
644.	9.0	0.050	1.77	0.0	2471.7	59.3	44.2
645.	9.0	0.050	1.77	0.0	2471.7	59.3	44.2
646.	9.0	0.050	1.78	0.0	2471.7	59.3	44.2
647.	9.0	0.050	1.78	0.0	2471.7	59.3	44.2
648.	9.0	0.050	1.78	0.0	2471.7	59.3	44.2
649.	9.0	0.050	1.78	0.0	2471.7	59.3	44.2
650.	9.0	0.050	1.79	0.0	2471.7	59.3	44.2
651.	9.0	0.050	1.79	0.0	2471.7	59.3	44.2
652.	9.0	0.050	1.79	0.0	2471.7	59.3	44.2
653.	9.0	0.050	1.79	0.0	2471.7	59.3	44.2
654.	9.0	0.050	1.80	0.0	2471.7	59.3	44.2
655.	9.0	0.050	1.80	0.0	2471.7	59.3	44.2
656.	9.0	0.050	1.80	0.0	2471.7	59.3	44.2
657.	9.0	0.050	1.80	0.0	2471.7	59.3	44.2
658.	9.0	0.050	1.81	0.0	2471.7	59.3	44.2
659.	9.0	0.050	1.81	0.0	2471.7	59.3	44.2
660.	9.0	0.050	1.81	0.0	2471.7	59.3	44.2
661.	6.6	0.037	1.81	-2.4	-1243.4	-21.9	-16.3
662.	4.2	0.023	1.81	-2.4	-1704.3	-19.1	-14.2
663.	1.8	0.010	1.81	-2.4	-2133.8	-10.2	-7.6
664.	0.0	0.000	1.81	-1.8	-1641.6	0.0	0.0
665.	0.0	0.000	1.81	0.0	820.3	0.0	0.0
666.	0.0	0.000	1.81	0.0	820.3	0.0	0.0
667.	0.0	0.000	1.81	0.0	820.3	0.0	0.0
668.	0.4	0.000	1.81	0.4	1373.6	1.5	1.1
669.	1.2	0.000	1.81	0.8	1933.4	6.2	4.6
670.	2.0	0.000	1.81	0.8	1946.2	10.4	7.7
671.	2.8	0.000	1.82	0.8	1959.3	14.6	10.9
672.	4.8	0.000	1.82	2.0	3633.9	46.5	34.7
673.	7.2	0.000	1.82	2.4	4222.6	81.1	60.5
674.	9.6	0.000	1.82	2.4	4265.8	109.2	81.4
675.	12.0	0.000	1.82	2.4	4310.7	137.9	102.9
676.	12.8	0.000	1.83	0.8	2137.7	73.0	54.4
677.	13.6	0.000	1.83	0.8	2153.2	78.1	58.2
678.	14.4	0.000	1.84	0.8	2168.9	83.3	62.1
679.	15.1	0.000	1.84	0.7	2046.1	82.4	61.4
680.	15.3	0.000	1.84	0.2	1366.2	55.7	41.6

TIME (SEC)	VEL. (MPH)	GRADE (RAD)	DIST. (MILES)	ACCEL. (MPH/SEC)	THRUST (LBS.)	HORSE POWER	KILO-WATTS
681.	15.6	0.000	1.85	0.3	1509.0	62.8	46.8
682.	15.9	0.000	1.85	0.3	1515.0	64.2	47.9
683.	16.1	0.000	1.86	0.2	1382.3	59.3	44.3
684.	16.4	0.000	1.86	0.3	1525.2	66.7	49.7
685.	16.7	0.000	1.87	0.3	1531.3	68.2	50.9
686.	16.9	0.000	1.87	0.2	1398.6	63.0	47.0
687.	17.8	0.000	1.88	0.9	2374.5	112.7	84.1
688.	18.9	0.000	1.88	1.1	2671.1	134.6	100.4
689.	19.9	0.000	1.89	1.0	2555.5	135.6	101.1
690.	21.0	0.000	1.89	1.1	2715.9	152.1	113.4
691.	21.3	0.013	1.90	0.3	2018.3	114.6	85.5
692.	21.5	0.027	1.91	0.2	2305.8	132.2	98.6
693.	21.8	0.040	1.91	0.3	2838.9	165.0	123.1
694.	22.0	0.050	1.92	0.2	3006.2	176.4	131.5
695.	22.0	0.050	1.92	0.0	2732.6	160.3	119.5
696.	22.0	0.050	1.93	0.0	2732.6	160.3	119.5
697.	22.0	0.050	1.94	0.0	2732.6	160.3	119.5
698.	22.0	0.050	1.94	0.0	2732.6	160.3	119.5
699.	22.0	0.050	1.95	0.0	2732.6	160.3	119.5
700.	22.0	0.050	1.95	0.0	2732.6	160.3	119.5
701.	22.0	0.050	1.96	0.0	2732.6	160.3	119.5
702.	22.0	0.050	1.97	0.0	2732.6	160.3	119.5
703.	22.0	0.050	1.97	0.0	2732.6	160.3	119.5
704.	22.0	0.050	1.98	0.0	2732.6	160.3	119.5
705.	22.0	0.050	1.98	0.0	2732.6	160.3	119.5
706.	18.5	0.050	1.99	-3.5	-2129.5	-105.1	-78.3
707.	15.1	0.050	1.99	-3.4	-2062.3	-83.0	-61.9
708.	11.6	0.050	2.00	-3.5	-2267.1	-70.1	-52.3
709.	9.0	0.050	2.00	-2.6	-1084.4	-26.0	-19.4
710.	9.0	0.050	2.00	0.0	2471.7	59.3	44.2
711.	9.0	0.050	2.00	0.0	2471.7	59.3	44.2
712.	9.0	0.050	2.01	0.0	2471.7	59.3	44.2
713.	10.3	0.043	2.01	1.3	4063.8	111.6	83.2
714.	13.0	0.030	2.01	2.7	5640.1	195.5	145.8
715.	15.7	0.017	2.02	2.7	5303.5	222.0	165.6
716.	18.3	0.003	2.02	2.6	4800.1	234.2	174.7
717.	19.0	0.000	2.03	0.7	2126.1	107.7	80.3
718.	19.0	0.000	2.03	0.0	1168.7	59.2	44.2
719.	19.0	0.000	2.04	0.0	1168.7	59.2	44.2
720.	19.0	0.000	2.04	0.0	1168.7	59.2	44.2

TIME (SEC)	VEL. (MPH)	GRADE (RAD)	DIST. (MILES)	ACCEL. (MPH/SEC)	THRUST (LBS.)	HORSE POWER	KILO-WATTS
721.	19.8	0.000	2.05	0.8	2279.8	120.4	89.8
722.	20.6	0.000	2.06	0.8	2297.0	126.2	94.1
723.	21.4	0.000	2.06	0.8	2314.3	132.1	98.5
724.	22.0	0.000	2.07	0.6	2053.9	120.5	89.9
725.	22.0	0.000	2.07	0.0	1233.2	72.4	54.0
726.	22.0	0.000	2.08	0.0	1233.2	72.4	54.0
727.	22.0	0.000	2.09	0.0	1233.2	72.4	54.0
728.	22.0	0.000	2.09	0.0	1233.2	72.4	54.0
729.	22.0	0.000	2.10	0.0	1233.2	72.4	54.0
730.	22.0	0.000	2.10	0.0	1233.2	72.4	54.0
731.	22.0	0.000	2.11	0.0	1233.2	72.4	54.0
732.	18.8	0.000	2.12	-3.2	-3212.3	-161.0	-120.1
733.	14.5	0.000	2.12	-4.3	-4804.5	-185.8	-138.5
734.	10.3	0.000	2.12	-4.2	-4746.3	-130.4	-97.3
735.	6.0	0.000	2.12	-4.3	-4962.2	-79.4	-59.2
736.	4.4	0.000	2.13	-1.6	-1796.7	-15.2	-11.3
737.	2.8	0.000	2.13	-1.6	-1823.3	-9.9	-7.4
738.	1.2	0.000	2.13	-1.6	-1849.2	-4.3	-3.2
739.	0.0	0.000	2.13	-1.2	-821.0	0.0	0.0
740.	0.0	0.000	2.13	0.0	820.3	0.0	0.0
741.	0.0	0.000	2.13	0.0	820.3	0.0	0.0
742.	0.0	0.000	2.13	0.0	820.3	0.0	0.0
743.	0.8	0.000	2.13	0.8	1927.0	4.1	3.1
744.	2.4	0.000	2.13	1.6	3046.9	19.5	14.5
745.	4.0	0.000	2.13	1.6	3073.3	32.8	24.4
746.	5.6	0.000	2.13	1.6	3100.5	46.3	34.5
747.	7.0	0.000	2.13	1.4	2851.3	53.2	39.7
748.	8.3	0.000	2.13	1.3	2737.7	60.6	45.2
749.	9.7	0.000	2.14	1.4	2899.9	75.0	55.9
750.	11.0	0.000	2.14	1.3	2787.3	81.8	61.0
751.	10.2	0.000	2.14	-0.8	-99.9	-2.7	-2.0
752.	9.4	0.000	2.15	-0.8	-114.6	-2.9	-2.1
753.	8.6	0.000	2.15	-0.8	-129.2	-3.0	-2.2
754.	7.9	0.000	2.15	-0.7	-5.0	-0.1	-0.1
755.	7.7	0.000	2.15	-0.2	675.3	13.9	10.3
756.	7.4	0.000	2.15	-0.3	533.2	10.5	7.8
757.	7.1	0.000	2.16	-0.3	527.9	10.0	7.5
758.	6.1	0.000	2.16	-1.0	-447.0	-7.3	-5.4
759.	4.2	0.000	2.16	-1.9	-1710.4	-19.2	-14.3
760.	2.3	0.000	2.16	-1.9	-1741.8	-10.7	-8.0

TIME (SEC)	VEL. (MPH)	GRADE (RAD)	DIST. (MILES)	ACCEL. (MPH/SEC)	THRUST (LBS.)	HORSE POWER	KILO-WATTS
761.	0.5	0.000	2.16	-1.8	-1633.8	-2.2	-1.6
762.	0.0	0.000	2.16	-0.5	136.4	0.0	0.0
763.	0.0	0.000	2.16	0.0	820.3	0.0	0.0
764.	0.0	0.000	2.16	0.0	820.3	0.0	0.0
765.	0.0	0.000	2.16	0.0	820.3	0.0	0.0
766.	0.0	0.000	2.16	0.0	820.3	0.0	0.0
767.	0.0	0.000	2.16	0.0	820.3	0.0	0.0
768.	0.0	0.000	2.16	0.0	820.3	0.0	0.0
769.	0.0	0.000	2.16	0.0	820.3	0.0	0.0
770.	0.0	0.000	2.16	0.0	820.3	0.0	0.0
771.	0.0	0.000	2.16	0.0	820.3	0.0	0.0
772.	0.0	0.000	2.16	0.0	820.3	0.0	0.0
773.	0.7	0.000	2.16	0.7	1788.7	3.3	2.5
774.	2.0	0.000	2.16	1.3	2630.1	14.0	10.5
775.	3.3	0.000	2.16	1.3	2651.4	23.3	17.4
776.	4.7	0.000	2.16	1.4	2811.6	35.2	26.3
777.	6.4	0.000	2.16	1.7	3251.1	55.5	41.4
778.	8.3	0.000	2.17	1.9	3558.3	78.8	59.7
779.	10.1	0.000	2.17	1.8	3454.4	93.0	69.4
780.	12.0	0.000	2.17	1.9	3626.9	116.1	86.5
781.	14.1	0.000	2.18	2.1	3941.1	148.2	110.5
782.	16.3	0.000	2.18	2.2	4121.8	179.2	133.6
783.	18.4	0.000	2.19	2.1	4028.3	197.7	147.4
784.	20.2	0.000	2.19	1.8	3656.1	196.9	146.9
785.	21.0	0.000	2.20	0.8	2305.6	129.1	96.3
786.	21.8	0.000	2.20	0.8	2323.0	135.0	100.7
787.	22.6	0.000	2.21	0.8	2340.7	141.1	105.2
788.	23.0	0.000	2.22	0.4	1802.4	110.5	82.4
789.	23.0	0.000	2.22	0.0	1255.3	77.0	57.4
790.	23.0	0.000	2.23	0.0	1255.3	77.0	57.4
791.	23.0	0.000	2.24	0.0	1255.3	77.0	57.4
792.	23.0	0.000	2.24	0.0	1255.3	77.0	57.4
793.	23.0	0.000	2.25	0.0	1255.3	77.0	57.4
794.	23.0	0.000	2.25	0.0	1255.3	77.0	57.4
795.	23.0	0.000	2.26	0.0	1255.3	77.0	57.4
796.	23.0	0.000	2.27	0.0	1255.3	77.0	57.4
797.	23.0	0.000	2.27	0.0	1255.3	77.0	57.4
798.	23.0	0.000	2.28	0.0	1255.3	77.0	57.4
799.	21.5	0.000	2.29	-1.5	-829.3	-47.5	-35.5
800.	15.3	0.000	2.29	-6.2	-7387.3	-301.4	-224.8

TIME (SEC)	VEL. (MPH)	GRADE (RAD)	DIST. (MILES)	ACCEL. (MPH/SEC)	THRUST (LBS.)	HORSE POWER	KILO-WATTS
801.	9.2	0.000	2.29	-6.1	-7367.2	-180.7	-134.8
802.	3.1	0.000	2.29	-6.1	-7473.2	-61.8	-46.1
803.	0.0	0.000	2.29	-3.1	-3419.7	0.0	0.0
804.	0.0	0.000	2.29	0.0	820.3	0.0	0.0
805.	0.0	0.000	2.29	0.0	820.3	0.0	0.0
806.	0.0	0.000	2.29	0.0	820.3	0.0	0.0
807.	0.0	0.000	2.29	0.0	820.3	0.0	0.0
808.	0.0	0.000	2.29	0.0	820.3	0.0	0.0
809.	0.0	0.000	2.29	0.0	820.3	0.0	0.0
810.	0.0	0.000	2.29	0.0	820.3	0.0	0.0
811.	0.0	0.000	2.29	0.0	820.3	0.0	0.0
812.	0.0	0.000	2.29	0.0	820.3	0.0	0.0
813.	0.0	0.000	2.29	0.0	820.3	0.0	0.0
814.	0.0	0.000	2.29	0.0	820.3	0.0	0.0
815.	0.0	0.000	2.29	0.0	820.3	0.0	0.0
816.	0.0	0.000	2.29	0.0	820.3	0.0	0.0
817.	0.0	0.000	2.29	0.0	820.3	0.0	0.0
818.	0.0	0.000	2.29	0.0	820.3	0.0	0.0
819.	0.0	0.000	2.29	0.0	820.3	0.0	0.0
820.	0.0	0.000	2.29	0.0	820.3	0.0	0.0
821.	0.0	0.000	2.29	0.0	820.3	0.0	0.0
822.	0.4	0.000	2.29	0.4	1373.6	1.5	1.1
823.	0.9	0.000	2.29	0.5	1518.3	3.6	2.7
824.	1.5	0.000	2.29	0.6	1664.6	6.7	5.0
825.	2.0	0.000	2.30	0.5	1535.9	8.2	6.1
826.	1.5	0.000	2.30	-0.5	160.1	0.6	0.5
827.	0.9	0.000	2.30	-0.6	13.8	0.0	0.0
828.	0.4	0.000	2.30	-0.5	142.7	0.2	0.1
829.	0.0	0.000	2.30	-0.4	273.2	0.0	0.0
830.	0.0	0.000	2.30	0.0	820.3	0.0	0.0
831.	0.0	0.000	2.30	0.0	820.3	0.0	0.0
832.	0.0	0.000	2.30	0.0	820.3	0.0	0.0
833.	1.6	0.000	2.30	1.6	3034.0	12.9	9.7
834.	4.8	0.000	2.30	3.2	5275.2	67.5	50.4
835.	8.0	0.000	2.30	3.2	5331.0	113.7	84.8
836.	11.2	0.000	2.30	3.2	5389.8	161.0	120.0
837.	13.2	0.000	2.31	2.0	3786.7	133.3	99.4
838.	14.8	0.000	2.31	1.6	3271.0	129.1	96.3
839.	16.4	0.000	2.32	1.6	3303.2	144.5	107.7
840.	18.0	0.000	2.32	1.6	3336.1	160.1	119.4

TIME (SEC)	VEL. (MPH)	GRADE (RAD)	DIST. (MILES)	ACCEL. (MPH/SEC)	THRUST (LBS.)	HORSE POWER	KILO-WATTS
841.	18.3	0.000	2.33	0.3	1564.3	76.3	56.9
842.	18.5	0.000	2.33	0.2	1431.7	70.6	52.7
843.	18.8	0.000	2.34	0.3	1574.8	78.9	58.9
844.	19.1	0.000	2.34	0.3	1581.1	80.5	60.1
845.	19.7	0.000	2.35	0.6	2004.2	105.3	78.5
846.	20.2	0.000	2.35	0.5	1878.1	101.2	75.4
847.	20.7	0.000	2.36	0.5	1888.8	104.3	77.7
848.	21.0	0.000	2.36	0.3	1621.8	90.8	67.7
849.	21.0	0.000	2.37	0.0	1211.4	67.8	50.6
850.	21.0	0.000	2.38	0.0	1211.4	67.8	50.6
851.	21.0	0.000	2.38	0.0	1211.4	67.8	50.6
852.	21.4	0.000	2.39	0.4	1767.2	100.9	75.2
853.	21.9	0.000	2.39	0.5	1914.9	111.8	83.4
854.	22.5	0.000	2.40	0.6	2064.9	123.9	92.4
855.	23.0	0.000	2.41	0.5	1939.2	118.9	88.7
856.	22.5	0.000	2.41	-0.5	560.4	33.6	25.1
857.	21.9	0.000	2.42	-0.6	410.4	24.0	17.9
858.	21.4	0.000	2.42	-0.5	536.3	30.6	22.8
859.	20.7	0.000	2.43	-0.7	247.5	13.7	10.2
860.	19.3	0.000	2.44	-1.4	-739.8	-38.1	-28.4
861.	18.0	0.000	2.44	-1.3	-630.3	-30.3	-22.6
862.	16.7	0.000	2.45	-1.3	-657.1	-29.3	-21.8
863.	16.0	0.000	2.45	-0.7	149.3	6.4	4.8
864.	16.0	0.000	2.45	0.0	1106.7	47.2	35.2
865.	16.0	0.000	2.46	0.0	1106.7	47.2	35.2
866.	16.0	0.000	2.46	0.0	1106.7	47.2	35.2
867.	16.0	0.000	2.47	0.0	1106.7	47.2	35.2
868.	16.0	0.000	2.47	0.0	1106.7	47.2	35.2
869.	16.0	0.000	2.48	0.0	1106.7	47.2	35.2
870.	16.0	0.000	2.48	0.0	1106.7	47.2	35.2
871.	14.9	0.000	2.49	-1.1	-419.9	-16.7	-12.4
872.	13.9	0.000	2.49	-1.0	-302.8	-11.2	-8.4
873.	12.8	0.000	2.49	-1.1	-461.0	-15.7	-11.7
874.	11.2	0.000	2.50	-1.6	-1175.4	-35.1	-26.2
875.	8.0	0.000	2.50	-3.2	-3422.5	-73.0	-54.4
876.	4.8	0.000	2.50	-3.2	-3478.3	-44.5	-33.2
877.	1.6	0.000	2.50	-3.2	-3531.2	-15.1	-11.2
878.	0.0	0.000	2.50	-1.6	-1368.1	0.0	0.0
879.	0.0	0.000	2.50	0.0	820.3	0.0	0.0
880.	0.0	0.000	2.50	0.0	820.3	0.0	0.0

TIME (SEC)	VEL. (MPH)	GRADE (RAD)	DIST. (MILES)	ACCEL. (MPH/SEC)	THRUST (LBS.)	HORSE POWER	KILO-WATTS
881.	0.0	0.000	2.50	0.0	820.3	0.0	0.0
882.	0.0	0.000	2.50	0.0	820.3	0.0	0.0
883.	0.0	0.000	2.50	0.0	820.3	0.0	0.0
884.	0.0	0.000	2.50	0.0	820.3	0.0	0.0
885.	0.0	0.000	2.50	0.0	820.3	0.0	0.0
886.	0.0	0.000	2.50	0.0	820.3	0.0	0.0
887.	0.0	0.000	2.50	0.0	820.3	0.0	0.0
888.	0.0	0.000	2.50	0.0	820.3	0.0	0.0
889.	0.5	0.000	2.50	0.5	1512.0	2.0	1.5
890.	2.7	0.000	2.50	2.2	3872.4	27.9	20.8
891.	4.8	0.000	2.50	2.1	3770.7	48.3	36.0
892.	6.9	0.000	2.50	2.1	3807.0	70.0	52.2
893.	8.0	0.000	2.51	1.1	2459.7	52.5	39.1
894.	8.0	0.000	2.51	0.0	954.2	20.4	15.2
895.	8.0	0.000	2.51	0.0	954.2	20.4	15.2
896.	8.0	0.000	2.51	0.0	954.2	20.4	15.2
897.	7.6	0.000	2.51	-0.4	400.0	8.1	6.0
898.	7.1	0.000	2.52	-0.5	254.4	4.8	3.6
899.	6.5	0.000	2.52	-0.6	107.1	1.9	1.4
900.	6.0	0.000	2.52	-0.5	235.1	3.8	2.8
901.	4.4	0.000	2.52	-1.6	-1296.7	-15.2	-11.3
902.	2.8	0.000	2.52	-1.6	-1323.3	-9.9	-7.4
903.	1.2	0.000	2.52	-1.6	-1349.2	-4.1	-3.2
904.	0.0	0.000	2.52	-1.2	-991.0	0.0	0.0
905.	0.0	0.000	2.52	0.0	820.3	0.0	0.0
906.	0.0	0.000	2.52	0.0	820.3	0.0	0.0
907.	0.0	0.000	2.52	0.0	820.3	0.0	0.0
908.	0.0	0.000	2.52	0.0	820.3	0.0	0.0
909.	0.0	0.000	2.52	0.0	820.3	0.0	0.0
910.	0.0	0.000	2.52	0.0	820.3	0.0	0.0
911.	0.0	0.000	2.52	0.0	820.3	0.0	0.0
912.	0.2	0.000	2.52	0.2	1097.0	0.6	0.4
913.	0.5	0.000	2.52	0.3	1238.4	1.7	1.2
914.	0.7	0.000	2.52	0.2	1104.9	2.1	1.5
915.	1.0	0.000	2.52	0.3	1246.3	3.3	2.5
916.	3.1	0.000	2.52	2.1	3742.2	30.9	23.1
917.	5.3	0.000	2.53	2.2	3916.0	55.3	41.3
918.	7.4	0.000	2.53	2.1	3815.8	75.3	56.2
919.	9.5	0.000	2.53	2.1	3853.7	97.6	72.8
920.	11.7	0.000	2.53	2.2	4031.5	125.8	93.8

TIME (SEC)	VEL. (MPH)	GRADE (RAD)	DIST. (MILES)	ACCEL. (MPH/SEC)	THRUST (LBS.)	HORSE POWER	KILO-WATTS
921.	13.8	0.000	2.54	2.1	3935.2	144.8	108.0
922.	15.9	0.000	2.54	2.1	3976.9	168.6	125.7
923.	16.9	0.000	2.55	1.0	2492.8	112.3	83.8
924.	16.6	0.000	2.55	-0.3	708.6	31.4	23.4
925.	16.3	0.000	2.56	-0.3	702.5	30.5	22.8
926.	16.1	0.000	2.56	-0.2	835.2	35.9	26.7
927.	16.0	0.000	2.56	-0.1	969.9	41.4	30.9
928.	16.0	0.000	2.57	0.0	1106.7	47.2	35.2
929.	16.0	0.000	2.57	0.0	1106.7	47.2	35.2
930.	16.0	0.000	2.58	0.0	1106.7	47.2	35.2
931.	16.0	0.000	2.58	0.0	1106.7	47.2	35.2
932.	16.0	0.000	2.59	0.0	1106.7	47.2	35.2
933.	16.0	0.000	2.59	0.0	1106.7	47.2	35.2
934.	14.9	0.000	2.60	-1.1	-419.9	-16.7	-12.4
935.	10.7	0.000	2.60	-4.2	-4740.9	-135.3	-100.9
936.	6.4	0.000	2.60	-4.3	-4955.3	-84.6	-63.1
937.	2.1	0.000	2.60	-4.3	-5027.6	-28.2	-21.0
938.	0.0	0.000	2.60	-2.1	-2052.0	0.0	0.0
939.	0.0	0.000	2.60	0.0	820.3	0.0	0.0
940.	0.0	0.000	2.60	0.0	820.3	0.0	0.0
941.	0.0	0.000	2.60	0.0	820.3	0.0	0.0
942.	0.0	0.000	2.60	0.0	820.3	0.0	0.0
943.	0.0	0.000	2.60	0.0	820.3	0.0	0.0
944.	0.0	0.000	2.60	0.0	820.3	0.0	0.0
945.	0.0	0.000	2.60	0.0	820.3	0.0	0.0
946.	0.0	0.000	2.60	0.0	820.3	0.0	0.0
947.	0.0	0.000	2.60	0.0	820.3	0.0	0.0
948.	0.0	0.000	2.60	0.0	820.3	0.0	0.0
949.	0.6	0.003	2.60	0.6	1740.3	2.8	2.1
950.	3.0	0.017	2.60	2.4	4660.9	37.3	27.8
951.	5.4	0.030	2.60	2.4	5091.1	73.3	54.7
952.	7.8	0.043	2.61	2.4	5522.8	114.9	85.7
953.	9.0	0.050	2.61	1.2	4112.9	98.7	73.6
954.	9.0	0.050	2.61	0.0	2471.7	59.3	44.2
955.	9.0	0.050	2.61	0.0	2471.7	59.3	44.2
956.	9.0	0.050	2.62	0.0	2471.7	59.3	44.2
957.	9.0	0.050	2.62	0.0	2471.7	59.3	44.2
958.	9.0	0.050	2.62	0.0	2471.7	59.3	44.2
959.	9.0	0.050	2.62	0.0	2471.7	59.3	44.2
960.	9.0	0.050	2.63	0.0	2471.7	59.3	44.2

TIME (SEC)	VEL. (MPH)	GRADE (RAD)	DIST. (MILES)	ACCEL. (MPH/SEC)	THRUST (LBS.)	HORSE POWER	KILO-WATTS
961.	9.0	0.050	2.63	0.0	2471.7	59.3	44.2
962.	9.0	0.050	2.63	0.0	2471.7	59.3	44.2
963.	9.0	0.050	2.63	0.0	2471.7	59.3	44.2
964.	8.9	0.050	2.64	-0.1	2333.1	55.4	41.3
965.	8.7	0.050	2.64	-0.2	2192.7	50.9	37.9
966.	8.4	0.050	2.64	-0.3	2050.5	45.9	34.3
967.	8.1	0.050	2.64	-0.3	2045.1	44.2	32.9
968.	8.0	0.050	2.64	-0.1	2316.8	49.4	36.9
969.	8.0	0.050	2.65	0.0	2453.6	52.3	39.0
970.	8.0	0.050	2.65	0.0	2453.6	52.3	39.0
971.	8.0	0.050	2.65	0.0	2453.6	52.3	39.0
972.	8.2	0.050	2.65	0.2	2730.7	59.7	44.5
973.	8.5	0.050	2.66	0.3	2872.9	65.1	48.6
974.	8.7	0.050	2.66	0.2	2739.8	63.6	47.4
975.	9.0	0.050	2.66	0.3	2882.0	69.2	51.6
976.	9.8	0.037	2.66	0.8	3190.9	83.4	62.2
977.	10.6	0.023	2.67	0.8	2785.9	78.7	58.7
978.	11.4	0.010	2.67	0.8	2411.0	73.3	54.7
979.	12.5	0.000	2.67	1.1	2542.2	84.7	63.2
980.	14.3	0.000	2.68	1.8	3534.7	134.8	100.5
981.	16.2	0.000	2.68	1.9	3709.5	160.2	119.5
982.	18.1	0.000	2.69	1.9	3748.5	180.9	134.9
983.	19.0	0.000	2.69	0.9	2399.6	121.6	90.7
984.	19.0	0.000	2.70	0.0	1168.7	59.2	44.2
985.	19.0	0.000	2.70	0.0	1168.7	59.2	44.2
986.	19.0	0.000	2.71	0.0	1168.7	59.2	44.2
987.	19.0	0.000	2.71	0.0	1168.7	59.2	44.2
988.	19.0	0.000	2.72	0.0	1168.7	59.2	44.2
989.	19.0	0.000	2.72	0.0	1168.7	59.2	44.2
990.	19.0	0.000	2.73	0.0	1168.7	59.2	44.2
991.	19.0	0.000	2.73	0.0	1168.7	59.2	44.2
992.	19.0	0.000	2.74	0.0	1168.7	59.2	44.2
993.	19.0	0.000	2.74	0.0	1168.7	59.2	44.2
994.	18.7	0.000	2.75	-0.3	752.0	37.5	28.0
995.	17.3	0.000	2.75	-1.4	-781.6	-36.1	-26.9
996.	16.0	0.000	2.76	-1.3	-671.3	-28.6	-21.4
997.	14.7	0.000	2.76	-1.3	-697.4	-27.3	-20.4
998.	12.1	0.000	2.77	-2.6	-2526.0	-81.5	-60.8
999.	8.4	0.000	2.77	-3.7	-4099.2	-91.8	-68.5
1000.	4.7	0.000	2.77	-3.7	-4163.9	-52.2	-38.9

TIME (SEC)	VEL. (MPH)	GRADE (RAD)	DIST. (MILES)	ACCEL. (MPH/SEC)	THRUST (LBS.)	HORSE POWER	KILO-WATTS
1001.	0.3	0.000	2.77	-3.8	-4363.0	-10.5	-7.8
1002.	0.0	0.000	2.77	-0.9	-410.7	0.0	0.0
1003.	0.0	0.000	2.77	0.0	820.3	0.0	0.0
1004.	0.0	0.000	2.77	0.0	820.3	0.0	0.0
1005.	0.0	0.000	2.77	0.0	820.3	0.0	0.0
1006.	0.0	0.000	2.77	0.0	820.3	0.0	0.0
1007.	0.0	0.000	2.77	0.0	820.3	0.0	0.0
1008.	0.0	0.000	2.77	0.0	820.3	0.0	0.0
1009.	0.2	0.000	2.77	0.2	1097.0	0.6	0.4
1010.	1.0	0.000	2.77	0.8	1930.2	5.1	3.8
1011.	1.8	0.000	2.77	0.8	1943.0	9.3	7.0
1012.	2.6	0.000	2.77	0.8	1956.0	13.6	10.1
1013.	3.5	0.000	2.77	0.9	2107.6	19.7	14.7
1014.	4.6	0.000	2.77	1.1	2399.6	29.4	21.9
1015.	5.7	0.000	2.78	1.1	2418.3	36.8	27.4
1016.	6.7	0.000	2.78	1.0	2298.9	41.1	30.6
1017.	7.6	0.000	2.78	0.9	2178.1	44.1	32.9
1018.	8.4	0.000	2.78	0.8	2055.6	46.0	34.3
1019.	9.2	0.000	2.78	0.8	2070.1	50.8	37.9
1020.	10.0	0.000	2.79	0.8	2084.8	55.6	41.5
1021.	10.8	0.000	2.79	0.8	2099.7	60.5	45.1
1022.	11.6	0.000	2.79	0.8	2114.8	65.4	48.8
1023.	12.4	0.000	2.80	0.8	2130.0	70.4	52.5
1024.	13.3	0.000	2.80	0.9	2284.1	81.0	60.4
1025.	14.3	0.000	2.80	1.0	2440.5	93.1	69.4
1026.	15.4	0.000	2.81	1.1	2599.2	106.7	79.6
1027.	16.5	0.000	2.81	1.1	2621.4	115.3	86.0
1028.	17.7	0.000	2.82	1.2	2782.8	131.3	97.9
1029.	19.0	0.000	2.82	1.3	2946.7	149.3	111.3
1030.	20.3	0.000	2.83	1.3	2974.4	161.0	120.1
1031.	21.7	0.000	2.84	1.4	3141.5	181.8	135.6
1032.	22.0	0.000	2.84	0.3	1643.6	96.4	71.9
1033.	22.0	0.000	2.85	0.0	1233.2	72.4	54.0
1034.	22.0	0.000	2.85	0.0	1233.2	72.4	54.0
1035.	22.0	0.000	2.86	0.0	1233.2	72.4	54.0
1036.	22.0	0.000	2.87	0.0	1233.2	72.4	54.0
1037.	22.0	0.000	2.87	0.0	1233.2	72.4	54.0
1038.	22.0	0.000	2.88	0.0	1233.2	72.4	54.0
1039.	22.0	0.000	2.88	0.0	1233.2	72.4	54.0
1040.	22.0	0.000	2.89	0.0	1233.2	72.4	54.0

TIME (SEC)	VEL. (MPH)	GRADE (PAL)	DIST. (MILES)	ACCEL. (MPH/SEC)	THRUST (LBS.)	HORSE POWER	KILO-WATTS
1041.	22.0	0.000	2.90	0.0	1233.2	72.4	54.0
1042.	22.0	0.000	2.90	0.0	1233.2	72.4	54.0
1043.	22.0	0.000	2.91	0.0	1233.2	72.4	54.0
1044.	22.0	0.000	2.91	0.0	1233.2	72.4	54.0
1045.	22.0	0.000	2.92	0.0	1233.2	72.4	54.0
1046.	22.0	0.000	2.93	0.0	1233.2	72.4	54.0
1047.	22.0	0.000	2.93	0.0	1233.2	72.4	54.0
1048.	22.0	0.000	2.94	0.0	1233.2	72.4	54.0
1049.	22.0	0.000	2.95	0.0	1233.2	72.4	54.0
1050.	22.0	0.000	2.95	0.0	1233.2	72.4	54.0
1051.	22.8	0.000	2.96	0.8	2345.1	142.6	106.3
1052.	23.6	0.000	2.96	0.8	2362.9	148.7	110.9
1053.	24.4	0.000	2.97	0.8	2381.0	154.9	115.5
1054.	25.1	0.000	2.98	0.6	2121.1	141.4	105.4
1055.	25.0	0.000	2.99	0.0	1300.4	86.7	64.6
1056.	25.0	0.000	2.99	0.0	1300.4	86.7	64.6
1057.	25.0	0.000	3.00	0.0	1300.4	86.7	64.6
1058.	25.0	0.000	3.01	0.0	1300.4	86.7	64.6
1059.	25.0	0.000	3.01	0.0	1300.4	86.7	64.6
1060.	25.0	0.000	3.02	0.0	1300.4	86.7	64.6
1061.	25.0	0.000	3.03	0.0	1300.4	86.7	64.6
1062.	24.6	0.000	3.03	-0.4	744.2	48.8	36.4
1063.	24.1	0.000	3.04	-0.5	596.1	38.3	28.6
1064.	23.5	0.000	3.05	-0.6	445.9	27.9	20.8
1065.	23.0	0.000	3.05	-0.5	571.5	35.1	26.1
1066.	22.5	0.000	3.06	-0.5	560.4	33.6	25.1
1067.	21.9	0.000	3.07	-0.6	410.4	24.0	17.9
1068.	21.4	0.000	3.07	-0.5	536.3	30.6	22.8
1069.	21.0	0.000	3.08	-0.4	664.3	37.2	27.7
1070.	21.0	0.000	3.09	0.0	1211.4	67.8	50.6
1071.	21.0	0.000	3.09	0.0	1211.4	67.8	50.6
1072.	21.0	0.000	3.09	0.0	1211.4	67.8	50.6
1073.	19.2	0.000	3.10	-7.8	-2677.8	-130.0	-96.9
1074.	12.6	0.000	3.10	-5.6	-6619.7	-222.4	-165.9
1075.	7.0	0.000	3.11	-5.6	-5722.8	-125.5	-93.6
1076.	1.4	0.000	3.11	-5.6	-6816.9	-25.4	-19.0
1077.	0.0	0.000	3.11	-1.4	-1094.5	0.0	0.0
1078.	0.0	0.000	3.11	0.0	820.3	0.0	0.0
1079.	0.0	0.000	3.11	0.0	820.3	0.0	0.0
1080.	0.0	0.000	3.11	0.0	820.3	0.0	0.0

AVERAGES DO NOT INCLUDE NEGATIVE VALUES

AVG. THRUST= 1474.23 LBS.

AVG. H.P.= 45.58 H.P.

AVG. KWATTS= 33.99 KWTS

TOTAL DISTANCE= 3.11 MI.

AVG. THRUST PER MILE= 474.70 LBS/MI

AVG. H.P. PER MILE= 14.68

AVG. KILOWATTS PER MILE= 10.94

MAX VEL.= 25.00 MPH

MAX GRADE= 0.05 RAD

MAX ACCEL.= 6.20 MPH/SEC

MAX THRUST= 7636. LBS

MAX H.P.= 301.4

MAX K.W.= 224.8

AVERAGES DO NOT INCLUDE NEGATIVE VALUES

AVG. THRUST= 1474.23 LBS.

AVG. H.P.= 45.58 H.P.

AVG. KWATTS= 33.99 KWTS

TOTAL DISTANCE= 3.11 MI.

AVG. THRUST PER MILE= 474.70 LBS/MI

AVG. H.P. PER MILE= 14.68

AVG. KILOWATTS PER MILE= 10.94

MAX VEL.= 25.00 MPH

MAX GRADE= 0.05 RAD

MAX ACCEL.= 6.20 MPH/SEC

MAX THRUST= 7636. LBS

MAX H.P.= 301.4

MAX K.W.= 224.8

APPENDIX E
CHART COMPUTER PROGRAM

```
      REAL TIME(1100),SPEED(1100),GRADE(1100),
     *  ACCEL(1100),VFORCE(1100),HPREQ(1100),KWREQ(1100)
      DIMENSION D1(6),D2(4),D3(5),D4(4),D5(3),D6(5),D7(5),
     *  D8(7),D9(3),D10(2),D11(2),D12(3),D13(4),D14(4),
     *  D15(4),D16(2),D17(2),D18(2),D19(2),D20(2),D21(2)
      DATA D1/5HVEHIC,5HLE PO,5HWER R,5HEQUIR,5HEMENT,1HS/
      DATA D2/5HGROSS,5H WEIG,5HHT IN,5H LBS=/
      DATA D3/5HFRONT,5HAL AR,5HEA IN,5H SQ-F,2HT=/
      DATA D4/5HHEAD ,5HWIND ,5HIN MP,2HH=/
      DATA D5/5HDRAG ,5HCOEFF,2H,=/
      DATA D6/5HTIRE ,5HCOUL,,5H FRIC,5HT, CO,5HEFF,=/
      DATA D7/5HROLLI,5HNG FR,5HICT, ,5HCOEFF,2H,=/
      DATA D8/5HAVGS,,5H DOWN,5HT INC,5HLUDE ,5HNEG, ,5HVALUE,1HS/
      DATA D9/5HAVG, ,5HTHRUS,2HT=/
      DATA D10/5HAVG, ,5HH.P.=/
      DATA D11/5HAVG, ,5HK.W.=/
      DATA D12/5HTOTAL,5H DIST,2H,=/
      DATA D13/5HAVG, ,5HTHRUS,5HT PER,5H MI,=/
      DATA D14/5HAVG, ,5HH.P. ,5HPER M,3HI,=/
      DATA D15/5HAVG, ,5HK.W. ,5HPER M,3HI,=/
      DATA D16/5HMAX V,4HEL,=/
      DATA D17/5HMAX G,5HRADE=/
      DATA D18/5HMAX A,5HCEL,=/
      DATA D19/5HMAX T,5HHRST=/
      DATA D20/5HMAX H,4H.P.=/
      DATA D21/5HMAX K,4H.W.=/
      READ MAXV,MAXA,MAXG,MAXT,MAXHP,MAXKW
      READ(23,500) VMASS,VAREA,ITIME,DT,WIND,ROLLC,COULC,DRAGC
  500 FORMAT(8F7.1)
      READ(1,1000) AF,AHP,AKW,TC,ATM,AHPM,AKWM,VM,GM,AM,TM,HPM,XKWM
 1000 FORMAT(////,13X,F9.2,//,11X,F8.2,//,13X,F7.2,//
     *   ,16X,F7.2,//,22X,F9.2,//,20X,F8.2,//,25X,F8.2,
     *   //,10X,F7.2,//,11X,F7.2,//,12X,F7.2,//,12X,F7.0,
     *  //,10X,F7.1,//,10X,F7.1)
      N1=ITIME
      DO 501 N=1,NT,1
      READ(24,502) TIME(N),SPEED(N),GRADE(N),
     *  ACCEL(N),VFORCE(N),HPREQ(N),KWREQ(N)
  502 FORMAT(1X,F5.0,F9.1,F9.3,4F9.1)
  501 CONTINUE
   15 CONTINUE
      WRITE(5,9)
    9 FORMAT(1X,33HENTER MAX VALUES FOR PLOT SCALES:,/)
      WRITE(5,10)
   10 FORMAT(1X,19HMAX VELOCITY (MPH)=,/)
      READ(5,11) MAXV
   11 FORMAT(F10.0)
      WRITE(5,20)
   20 FORMAT(1X,27HMAX ACCELERATION (MPH/SEC)=,/)
      READ(5,11) MAXA
      WRITE(5,30)
   30 FORMAT(1X,16HMAX GRADE (PAD)=,/)
      READ(5,11) MAXG
      WRITE(5,40)
   40 FORMAT(1X,17HMAX THRUST (LBS)=,/)
      READ(5,11) MAXT
      WRITE(5,50)
   50 FORMAT(1X,9HMAX H.P.=,/)
      READ(5,11) MAXHP
      WRITE(5,60)
   60 FORMAT(1X,14HMAX KILOWATTS=,/)
```

```
      READ(5,11) MAXKW
      WRITE(5,70)
   70 FORMAT(1X,24HARE ALL ENTRIES CORRECT?,/,
     *  1X,30HTYPE "1" FOR YES, "2" FOR NO :,/)
      READ(5,12) ITRY
   12 FORMAT(I1)
      IF(ITRY.EQ.2) GO TO 13
      GO TO 100
   13 WRITE(5,80)
   80 FORMAT(1X,23HYOU MUST START ALL OVER,/)
      GO TO 15
  100 CONTINUE
      WRITE(5,81)
   81 FORMAT(1X,23HEXECUTION IN PROGRESS...,/)
      SPEED(NT+1)=-(MAXV)/0.8
      SPEED(NT+2)=MAXV/0.8
      ACCEL(NT+1)=-(MAXA)/0.8
      ACCEL(NT+2)=MAXA/0.8
      GRADE(NT+1)=-(MAXG)/0.8
      GRADE(NT+2)=MAXG/0.8
      VFORCE(NT+1)=-(MAXT)/0.8
      VFORCE(NT+2)=MAXT/0.8
      HPREQ(NT+1)=-(MAXHP)/0.8
      HPREQ(NT+2)=MAXHP/0.8
      KWREQ(NT+1)=-(MAXKW)/0.8
      KWREQ(NT+2)=MAXKW/0.8
      TIME(NT+1)=0.0
      TIME(NT+2)=27.0
      CALL PLOTS(0,0,16,0)
      CALL PLOT(0.0,-11.0,-3)
      CALL PLOT(0.0,0.5,-3)
      CALL SYMBOL(0.0,9.0,.14,D1,0.0,26)
      CALL SYMBOL(0.0,8.0,.14,D2,0.0,20)
      CALL NUMBER(999.,999.,.14,VMASS,0.0,0)
      CALL SYMBOL(0.0,7.75,.14,D3,0.0,22)
      CALL NUMBER(999.,999.,.14,VAREA,0.0,2)
      CALL SYMBOL(0.0,7.5,.14,D4,0.0,17)
      CALL NUMBER(999.,999.,.14,WIND,0.0,1)
      CALL SYMBOL(0.0,7.25,.14,D5,0.0,12)
      CALL NUMBER(999.,999.,.14,DRAGC,0.0,4)
      CALL SYMBOL(0.0,7.0,.14,D6,0.0,25)
      CALL NUMBER(999.,999.,.14,COULC,0.0,4)
      CALL SYMBOL(0.0,6.75,.14,D7,0.0,22)
      CALL NUMBER(999.,999.,.14,ROLLC,0.0,4)
      CALL SYMBOL(0.0,6.25,.14,D8,0.0,31)
      CALL SYMBOL(0.0,5.75,.14,D9,0.0,12)
      CALL NUMBER(999.,999.,.14,AF,0.0,2)
      CALL SYMBOL(999.,999.,.14,4H LBS,0.0,4)
      CALL SYMBOL(0.0,5.5,.14,D10,0.0,10)
      CALL NUMBER(999.,999.,.14,AHP,0.0,2)
      CALL SYMBOL(0.0,5.25,.14,D11,0.0,10)
      CALL NUMBER(999.,999.,.14,AKW,0.0,2)
      CALL SYMBOL(0.0,5.0,.14,D12,0.0,12)
      CALL NUMBER(999.,999.,.14,TD,0.0,2)
      CALL SYMBOL(999.,999.,.14,4H MI.,0.0,4)
      CALL SYMBOL(0.0,4.75,.14,D13,0.0,20)
      CALL NUMBER(999.,999.,.14,ATM,0.0,2)
      CALL SYMBOL(0.0,4.5,.14,D14,0.0,18)
      CALL NUMBER(999.,999.,.14,AHPM,0.0,2)
      CALL SYMBOL(0.0,4.25,.14,D15,0.0,18)
      CALL NUMBER(999.,999.,.14,AKWM,0.0,2)
```

```
      CALL SYMBOL(0.0,4.0,.14,D16,0.0,9)
      CALL NUMBER(999.,999.,.14,VM,0.0,2)
      CALL SYMBOL(999.,999.,.14,4H MPH,0.0,4)
      CALL SYMBOL(0.0,3.75,.14,D17,0.0,10)
      CALL NUMBER(999.,999.,.14,GM,0.0,3)
      CALL SYMBOL(999.,999.,.14,4H RAD,0.0,4)
      CALL SYMBOL(0.0,3.5,.14,D18,0.0,10)
      CALL NUMBER(999.,999.,.14,AM,0.0,2)
      CALL SYMBOL(999.,999.,.14,5HMPH/S,0.0,5)
      CALL SYMBOL(0.0,3.25,.14,D19,0.0,10)
      CALL NUMBER(999.,999.,.14,TM,0.0,2)
      CALL SYMBOL(999.,999.,.14,4H LBS,0.0,4)
      CALL SYMBOL(0.0,3.0,.14,D20,0.0,9)
      CALL NUMBER(999.,999.,.14,HPM,0.0,2)
      CALL SYMBOL(0.0,2.75,.14,D21,0.0,9)
      CALL NUMBER(999.,999.,.14,XKWM,0.0,2)
      CALL PLOT(5.0,0.0,-3)
      CALL NUMBER(0.2,0.2,.07,-MAXKW,0.0,0)
      CALL SYMBOL(0.0,0.9,.07,5HK.W. ,0.0,5)
      CALL NUMBER(0.2,1.6,.07,MAXKW,0.0,0)
      CALL NUMBER(0.2,1.9,0.07,-MAXHP,0.0,0)
      CALL SYMBOL(0.0,2.6,0.07,5HH.P. ,0.0,5)
      CALL NUMBER(0.2,3.3,.07,MAXHP,0.0,0)
      CALL NUMBER(0.2,3.6,.07,-MAXT,0.0,0)
      CALL SYMBOL(0.0,4.3,.07,5HTHRST,0.0,5)
      CALL NUMBER(0.2,5.0,.07,MAXT,0.0,0)
      CALL NUMBER(0.2,5.3,.07,-MAXG,0.0,3)
      CALL SYMBOL(0.0,6.0,.07,5HGRADE,0.0,5)
      CALL NUMBER(0.2,6.7,.07,MAXG,0.0,3)
      CALL NUMBER(0.2,7.0,.07,-MAXA,0.0,1)
      CALL SYMBOL(0.0,7.7,.07,5HACCEL,0.0,5)
      CALL NUMBER(0.2,8.4,.07,MAXA,0.0,1)
      CALL NUMBER(0.2,8.7,.07,-MAXV,0.0,1)
      CALL SYMBOL(0.0,9.4,.07,5HVEL. ,0.0,5)
      CALL NUMBER(0.2,10.1,.07,MAXV,0.0,1)
      CALL PLOT(0.5,0.0,-3)
      CALL AXIS(0.0,0.0,4HTIME,-4,40.0,0.0,0.0,0.0,27.0)
      DO 600 N=1,6,1
      IF(N.EQ.1) CALL PLOT(0.0,0.1,-3)
      IF(N.NE.1) CALL PLOT(0.0,1.7,-3)
      CALL PLOT(40.0,0.0,2)
      CALL PLOT(40.0,0.8,3)
      CALL PLOT(0.0,0.8,2)
      CALL PLOT(0.0,1.6,3)
      CALL PLOT(40.0,1.6,2)
  600 CONTINUE
      CALL PLOT(0.0,-8.7,-3)
      CALL LINE(TIME,KWREQ,NT,1,0,0)
      CALL PLOT(0.0,1.7,-3)
      CALL LINE(TIME,HPREQ,NT,1,0,0)
      CALL PLOT(0.0,1.7,-3)
      CALL LINE(TIME,VFORCE,NT,1,0,0)
      CALL PLOT(0.0,1.7,-3)
      CALL LINE(TIME,GRADE,NT,1,0,0)
      CALL PLOT(0.0,1.7,-3)
      CALL LINE(TIME,ACCEL,NT,1,0,0)
      CALL PLOT(0.0,1.7,-3)
      CALL LINE(TIME,SPEED,NT,1,0,0)
      CALL PLOT(50.0,0.0,999)
      STOP
      END
```

U. S. DEPARTMENT OF TRANSPORTATION
TRANSPORTATION SYSTEMS CENTER
KENDALL SQUARE, CAMBRIDGE, MA. 02142

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE, $300

POSTAGE AND FEES PAID
U. S. DEPARTMENT OF TRANSPORTATION
518