Driving Pattern in Metro Manila

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Abstract: The Department of Energy(DOE) implemented a DOST-funded research project entitled *'Performance Testing of Selected Road Vehicles Using the Chassis Dynamometer Under Simulated Urban and Highway Traffic Conditions'* from 1994 to 1995. One of the target outputs under the subject project was a transport drive cycle which would simulate urban traffic conditions and would be used in the performance testing of passenger vehicles. The motivation behind the development of drive cycle is to provide a means of comparing fuel consumption of different vehicles and to measure exhaust emissions of vehicles in a fixed location. It would be based on collection of speed versus time data using a fully instrumented test car. The author was tasked to develop the said drive cycle for Metro Manila. A computer program package was developed to perform processing, statistical analysis, and evaluation of the drive cycle.

1. Introduction

A drive cycle is a speed-time history which forms the basis of reproducible measurements of vehicle performance and characteristics such as fuel consumption and exhaust emissions. Vehicle performance varies in different conditions of temperature, altitude, road and traffic. A localized drive cycle can be used as a basis for improving vehicle fuel utilization by changing driving patterns through traffic engineering and management including road alterations and computer control of traffic signals to minimize stops and thereby improving travel time.

Drive cycles have existed for several decades as a means of assessing fuel consumption. The growing concern on exhaust emissions has led to a proliferation of drive cycle emission measurement in the US, Europe, and Japan. The range of existing drive cycle reflects a variety of perceived needs:

a. The planning analyst would like to be able to devise statistically meaningful combinations of vehicles and driving patterns at various levels of aggregation to describe fuel use and population sources for particular geographic regions.
b. Vehicle manufacturers need cycles which are fixed and provide a long term basis for design, testing and marketing.

The problem in Los Angeles and San Francisco and later in Tokyo of increased smog levels made it imperative to test vehicles in a fixed location since it was impracticable to install a pollution measuring instrument in a vehicle tested on the track without altering its performance. Thus drive cycles which could be driven on a chassis dynamometer were developed.

2. Data Collection

Several possibilities exist for measuring driving patterns representative of a particular region. An ideal method would be the measurement of a range of patterns along selected routes of a population representative samples of drivers in a population representative set of vehicles. Such procedure is beyond our resources. Instead, the 'chase car' technique can be adopted(Figure 1). This technique involves random selection of a car in the traffic stream which is followed by the instrumented car along a particular route, and another vehicle selected when the vehicle being followed turns, behaves suspiciously, or following becomes too dangerous.

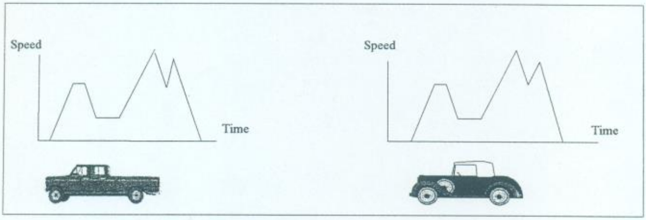

Figure 1. Chase Car Technique

In the survey of a city driving pattern, it is plainly not possible to consider every route. A rational approach is to survey routes in proportion to their usage. Based on the annual average daily traffic(AADT) flow map, routes to be included in the survey were selected(See Appendix 1).

The test car to be used has a fully automated on-board instrumentation. The system includes the following:

- On-board monitoring and data acquisition computer equipped with a 20 channel CF I/O board and disk drive for mass storage.
- Max series 210 positive displacement type flowmeter and transmitter for fuel flow measurement.
- Thermocouples for monitoring engine oil, gear box and final drive temperatures.
- Airpax magnetic pickup installed in the test car wheel to monitor vehicle speed, distance traveled, acceleration, and deceleration.

Data collection started on July 10 to August 16, 1996. Due to severe congestion during the morning peak period, data were collected between 9 A.M. and 11 A.M. From time to time, malfunctioning of the on-board monitoring instruments (particularly the sensitive magnetic sensors) occurred due to excessive shock and vibration attributed to bad road condition in some parts of Metro Manila. Because of time constraint, only one run(or pass) per selected route was conducted. The data gathered using the on-board data logging/acquisition system consisted of velocity measured every 1 second. These were lumped into a single data file with a name 'CUMM.BIN'. The total number of data points is about 23,000 representing roughly 6.4 hours of travel along the major thoroughfares of Metro Manila. Careful scanning of the data had to be done to eliminate erratic/noisy entries.

3. Driving Cycle Development Technique

A variety of techniques are available to translate, compile and analyze traffic data into representative cycles. Some of which are:

a. ACDI(Acceleration, Cruise, Deceleration, and Idle) - this is a cycle comprised of constant acceleration, cruise, constant deceleration, and idle. This cycle is not designed to represent an actual road route but rather to portray a representative mode involving constant or 'straight line' rates of vehicle movement. This cycle could be repeated a number of times to form any required length of test cycle.

b. Step-wise Mode Form - this is another cycle that involves 'straight line' rates of vehicle movements but these modes vary in number to represent the input data. Construction of such a cycle involves reviewing the basic summary statistical information such as percentage of time in various speed bands, percentages of idle time, acceleration rates and trip length. With these data on hand, one could arbitrarily construct a cycle having the same average statistical characteristics as the input data.

c. Microtrip Accumulation - this technique involves the following steps:
   - Collected data from all runs are added together to form one file.
   - A joint velocity-acceleration probability density function matrix is produced for the overall data.
   - This matrix is normalized, i.e., each cell is divided by the number of samples.
   - The total data file is divided into a number of driving segments that start and end with zero velocity and are of over 2 minutes each duration (i.e., microtrips).
   - A number of microtrips are selected at random to form the required length of prospective cycle. A normalized joint velocity-acceleration probability density function matrix is produced for that record.

- Candidate cycles having similar characteristics with that of the overall data are saved for final selection.

The above steps can be done easily using microcomputers.

Other techniques used to develop and/or smoothen drive cycle are the following:

- Fourier series
- Time series analysis
- Curve fitting techniques using polynomial functions

The microtrip technique produces a representative cycle in a constrained form, i.e., the vehicle must be at a specific speed during the test. This results in a very precise and repeatable test on a fixed chassis dynamometer but has the drawback that it requires a strip chart recorder and possibly two operators (one steering and the other accelerating) if the cycle is to be driven on the test track in order to precisely follow the pattern.

4. The Drive Cycle Analysis Package

A computer program package based on the microtrip accumulation technique was developed in order to perform all the tasks necessary to produce a drive cycle. The package consists of the following modules: a)processing of the target cycle, b)microtrip generation, c)generation of candidate drive cycles, and d)processing/ evaluation of candidate drive cycles.

4.1. Processing of the Target Cycle

The time-velocity data contained in the file 'CUMM.BIN' represents the target cycle. The following statistics are computed: a)percentage distribution (joint velocity-acceleration probability density function), b)percentage idle, c)maximum and minimum speeds, d)maximum and minimum acceleration, e)average travel speed, f)average acceleration, and g)average running speed.

4.2. Microtrip Generation

From the file 'CUMM.BIN', 137 microtrips(small trips of at least 2 minutes in duration which have to start and end at zero velocity) were generated.

4.3. Generation of Candidate Drive Cycles

Candidate drive cycles were generated by combining the microtrips at random. It was decided to produce a 20 minute drive cycle. This duration is reasonable enough to be performed for dynamometer testing. (It was initially thought to base the duration of the drive cycle on the average trip time of more than 40 minutes but this will be impractically too long for testing on the chassis dynamometer.) More than 20,000 candidate cycles were generated.

4.4. Processing/Evaluation of Candidate Drive Cycles

Screening was performed using the joint velocity-acceleration probability density function as the initial criterion. The absolute difference between the probability density functions of the candidate and the target cycles was computed. This difference should be kept as small as possible for the candidate to be considered acceptable. (A difference of not more than 20% is generally acceptable.) The eight candidate cycles with the least absolute difference are shown in Table 1.

Table 1. Characteristics of Some Candidate Cycles

Criteria	Target	c1113	c1500	c3011	c3532	c3638	c5949	c6607	c8594
Absolute Difference	0.00	12.39	12.59	12.42	12.91	11.93	12.81	12.51	12.42
Idle, %.	33.33	30.00	33.10	34.10	33.10	33.72	32.60	33.90	32.50
Max.speed, kph.	76.40	66.00	60.80	66.00	57.90	66.00	56.40	56.40	71.20
Min. speed, kph.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Max. acceleration, m/s2.	2.10	1.90	1.70	1.90	2.10	1.90	1.70	1.90	1.70
Min. acceleration, m/s2.	-2.70	-2.10	-2.10	-2.50	-2.10	-2.10	-1.90	-2.10	-2.50
Ave. travel speed, kph.	14.60	14.20	14.30	14.60	13.30	14.30	13.60	12.70	14.80
Ave. acceleration, m/s2.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ave. running speed, kph.	22.49	21.90	21.99	22.93	20.36	22.14	20.74	19.83	22.83

5. Findings

Candidate #c3638 was found to be the most likely choice for the drive cycle to represent city driving in Metro Manila during morning peak. It has the least absolute difference of 11.93%(See Appendix 2 for details of computation). Except for the maximum velocity of 66kph.(which underestimates the target by 10kph.), almost all other parameters are similar to the target cycle. The maximum velocity is exceeded by a mere 0.72% of the data points in the target cycle. The time-velocity table for drive cycle #c3638 is given in Appendix 3. The graph of this drive cycle is illustrated in Figure 2.

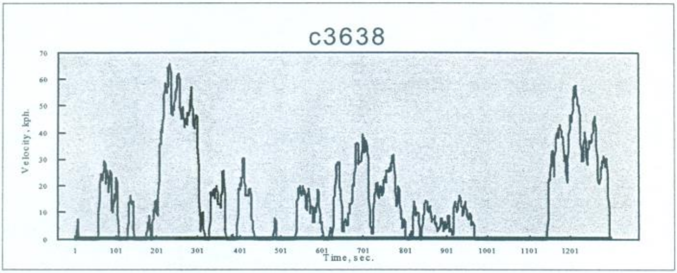

Figure 2. Candidate Drive Cycle #c3638

The similarity of this with the target cycle can be seen from their respective 3-dimensional graphs of the joint velocity and acceleration probability density function(Figures 3 & 4).

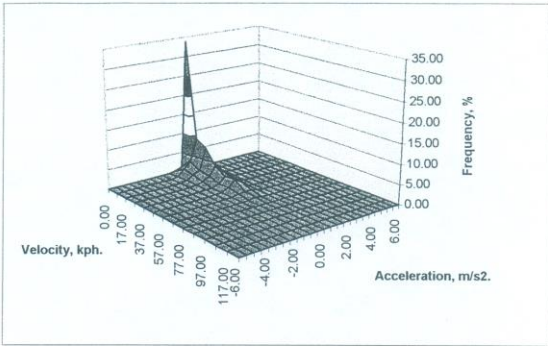

Figure 3. Joint Velocity and Acceleration Probability Density Function (Candidate Cycle #c3638)

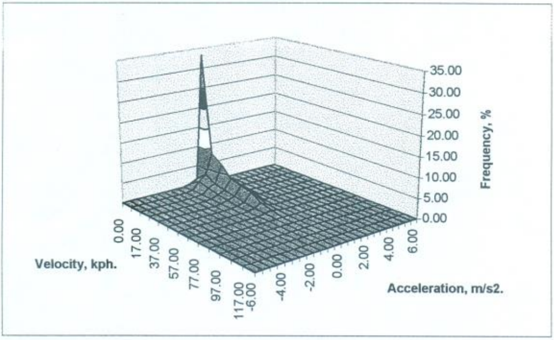

Figure 4. Joint Velocity and Acceleration Probability Density Function (Target Cycle)

6. Further Works

a. It is recommended that the pilot drive cycle model be demonstrated using the chassis dynamometer to find out how well the driver can trace the speed-time curve before making any revisions or simplifications.

b. It is suggested to conduct another round of data gathering activity, this time, increasing the number of test runs on each selected road depending on its relative traffic load. This will also enable to conduct a before and after study of the effects of the newly introduced unified vehicular volume reduction scheme within Metro Manila.

c. Continuous data gathering on speed, idle time, fuel consumption, etc. must be done on a regular basis for road segments in order to provide valuable information to properly assess and evaluate the impact of other traffic schemes and road improvement projects planned and/or being implemented.

7. References

Watson, H.C. The Development of the Melbourne Peak Cycle, University of Melbourne, Australia, 1985.

Khatib, E.T. Rigid Trucks Urban Driving Cycle, Report T75/85, Dept. of Mechanical and Industrial Engineering, University of Melbourne, Australia, 1985.

Appendix 1. Metro Manila Area Traffic Flow Map
1992 Average Annual Daily Traffic
(*Source: TEC, DPWH*)

Appendix 2. Joint Velocity-Acceleration Probability Density Function

Joint Velocity and Acceleration Probability Density Function Matrix
Metro Manila Morning Peak Driving [Target Cycle]

PERCENTAGE DISTRIBUTION

Accn.,m/s2 \ Velocity, kph	0.00	7.00	17.00	27.00	37.00	47.00	57.00	67.00	77.00	87.00	97.00	107.00	117.00	127.00	Total
6.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.00	0.00	0.00	0.02	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04
1.50	0.00	0.15	0.22	0.10	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50
1.00	0.00	2.31	1.76	1.29	0.76	0.25	0.10	0.03	0.00	0.00	0.00	0.00	0.00	0.00	6.50
0.50	0.34	3.74	3.02	2.26	1.64	1.24	0.53	0.22	0.02	0.00	0.00	0.00	0.00	0.00	13.01
0.00	33.33	8.83	6.90	4.15	3.34	2.86	1.26	0.66	0.11	0.00	0.00	0.00	0.00	0.00	61.44
-0.50	1.31	3.73	2.23	1.64	1.10	0.71	0.41	0.22	0.01	0.00	0.00	0.00	0.00	0.00	11.36
-1.00	0.46	2.14	1.42	0.84	0.54	0.24	0.06	0.01	0.00	0.00	0.00	0.00	0.00	0.00	5.71
-1.50	0.03	0.33	0.28	0.22	0.11	0.05	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.04
-2.00	0.01	0.08	0.07	0.07	0.03	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.27
-2.50	0.00	0.02	0.02	0.04	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09
-3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-3.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-4.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-4.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-5.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-6.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	35.48	21.33	15.94	10.62	7.56	5.36	2.39	1.14	0.14	0.00	0.00	0.00	0.00	0.00	99.96

Joint Velocity and Acceleration Probability Density Function Matrix
Metro Manila Morning Peak Driving [Candidate c3636]

PERCENTAGE DISTRIBUTION

Accn.,m/s2 \ Velocity, kph.	0.00	7.00	17.00	27.00	37.00	47.00	57.00	67.00	77.00	87.00	97.00	107.00	117.00	127.00	Total
6.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08
1.50	0.00	0.08	0.31	0.31	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.85
1.00	0.00	2.16	1.23	0.92	0.77	0.31	0.31	0.08	0.00	0.00	0.00	0.00	0.00	0.00	5.78
0.50	0.46	3.54	3.93	2.62	1.46	1.54	0.69	0.08	0.00	0.00	0.00	0.00	0.00	0.00	14.32
0.00	33.72	9.16	7.78	4.00	2.46	2.62	0.69	0.38	0.00	0.00	0.00	0.00	0.00	0.00	60.81
-0.50	1.00	3.62	2.16	1.77	0.92	1.00	0.54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.01
-1.00	0.38	1.85	1.39	0.69	0.15	0.23	0.15	0.08	0.00	0.00	0.00	0.00	0.00	0.00	4.92
-1.50	0.08	0.38	0.46	0.38	0.23	0.23	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.84
-2.00	0.00	0.00	0.15	0.15	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.38
-2.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-3.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-4.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-4.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-5.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-6.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	35.64	20.79	17.41	10.84	6.22	5.93	2.54	0.62	0.00	0.00	0.00	0.00	0.00	0.00	99.99

Difference Matrix (Candidate c3636)

Accn.,m/s2 \ Velocity, kph.	0.00	7.00	17.00	27.00	37.00	47.00	57.00	67.00	77.00	87.00	97.00	107.00	117.00	127.00	Total
6.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.00	0.00	0.00	0.02	0.01	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10
1.50	0.00	0.07	0.09	0.21	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.49
1.00	0.00	0.15	0.53	0.37	0.01	0.06	0.21	0.05	0.00	0.00	0.00	0.00	0.00	0.00	1.38
0.50	0.12	0.20	0.91	0.36	0.18	0.30	0.16	0.14	0.02	0.00	0.00	0.00	0.00	0.00	2.39
0.00	0.39	0.33	0.88	0.15	0.88	0.24	0.57	0.28	0.11	0.00	0.00	0.00	0.00	0.00	3.83
-0.50	0.31	0.11	0.07	0.13	0.18	0.29	0.13	0.22	0.01	0.00	0.00	0.00	0.00	0.00	1.45
-1.00	0.08	0.29	0.03	0.15	0.39	0.01	0.09	0.07	0.00	0.00	0.00	0.00	0.00	0.00	1.11
-1.50	0.05	0.05	0.18	0.16	0.12	0.18	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.80
-2.00	0.01	0.08	0.08	0.08	0.05	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.31
-2.50	0.00	0.02	0.02	0.04	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09
-3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-3.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-4.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-4.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-5.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-6.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	0.96	1.30	2.81	1.66	1.94	1.09	1.29	0.76	0.14	0.00	0.00	0.00	0.00	0.00	11.95

Appendix 3. Time-Velocity Table for #c3638

1	0	101	21.52	201	10.39	301	34.87	401	18.55	501	0	601	3.71	701	38.58	801	6.68	901	4.45	1001	0	1101	0	1201	44.52
2	0	102	23	202	8.9	302	27.45	402	18.55	502	0	602	1.48	702	37.84	802	2.97	902	5.19	1002	0	1102	0	1202	46.74
3	0	103	21.52	203	11.87	303	20.03	403	20.77	503	0	603	0	703	35.61	803	0.74	903	5.94	1003	0	1103	0	1203	46.74
4	0	104	18.55	204	12.61	304	14.1	404	20.77	504	0	604	0	704	32.65	804	0	904	8.16	1004	0	1104	0	1204	46
5	0	105	13.36	205	16.32	305	8.16	405	20.03	505	0	605	0	705	33.39	805	0	905	8.9	1005	0	1105	0	1205	44.52
6	0	106	8.9	206	22.26	306	5.19	406	21.52	506	0	606	0	706	35.61	806	0	906	8.9	1006	0	1106	0	1206	46.74
7	2.23	107	5.19	207	27.45	307	2.97	407	23	507	0	607	0	707	37.1	807	0	907	5.94	1007	0	1107	0	1207	48.23
8	5.94	108	3.71	208	32.65	308	4.45	408	23	508	0	608	0	708	34.87	808	0	908	3.71	1008	0	1108	0	1208	48.97
9	7.42	109	2.23	209	35.61	309	5.94	409	26.71	509	0	609	0	709	34.87	809	0	909	2.97	1009	0	1109	0	1209	51.2
10	5.94	110	0	210	35.61	310	7.42	410	30.42	510	0	610	0	710	34.13	810	0	910	3.71	1010	0	1110	0	1210	52.68
11	2.97	111	0	211	37.84	311	9.65	411	30.42	511	0	611	0	711	32.65	811	0	911	3.71	1011	0	1111	0	1211	57.13
12	0.74	112	0	212	40.81	312	10.39	412	28.94	512	0	612	0	712	30.42	812	0	912	2.97	1012	0	1112	0	1212	53.42
13	0	113	0	213	42.29	313	9.65	413	25.97	513	0	613	0	713	23	813	0	913	2.97	1013	0	1113	0	1213	57.13
14	0	114	0	214	42.29	314	6.68	414	21.52	514	0	614	0	714	19.29	814	1.48	914	2.97	1014	0	1114	0	1214	57.13
15	0	115	0	215	40.07	315	3.71	415	20.03	515	0	615	0	715	15.58	815	2.23	915	2.23	1015	0	1115	0	1215	57.87
16	0	116	0	216	43.03	316	2.23	416	18.55	516	0	616	0	716	11.13	816	2.97	916	1.48	1016	0	1116	0	1216	56.39
17	0	117	0	217	46.74	317	0	417	16.32	517	0	617	0	717	7.42	817	1.48	917	1.48	1017	0	1117	0	1217	54.91
18	0	118	0	218	50.45	318	0	418	16.32	518	0	618	0	718	5.19	818	0.74	918	2.97	1018	0	1118	0	1218	52.68
19	0	119	0	219	54.16	319	0	419	16.32	519	0	619	1.48	719	3.71	819	3.71	919	7.42	1019	0	1119	0	1219	51.94
20	0	120	0	220	56.39	320	0	420	16.32	520	0	620	3.71	720	2.23	820	6.68	920	11.87	1020	0	1120	0	1220	52.68
21	0	121	0	221	57.87	321	0	421	16.32	521	0	621	4.45	721	2.23	821	8.9	921	14.1	1021	0	1121	0	1221	51.2
22	0	122	0	222	58.61	322	0	422	16.32	522	0	622	4.45	722	2.23	822	12.61	922	13.36	1022	0	1122	0	1222	49.71
23	0	123	0	223	57.13	323	0	423	17.81	523	0	623	1.48	723	5.19	823	14.1	923	12.61	1023	0	1123	0	1223	48.97
24	0	124	0	224	55.65	324	0	424	18.55	524	0	624	0	724	8.16	824	13.36	924	11.87	1024	0	1124	0	1224	48.97
25	0	125	0	225	54.91	325	0	425	19.29	525	0	625	0.74	725	11.87	825	11.87	925	11.13	1025	0	1125	0	1225	46.74
26	0	126	0	226	57.13	326	0	426	19.29	526	0	626	2.23	726	14.84	826	11.13	926	10.39	1026	0	1126	0	1226	41.55
27	0	127	0	227	57.13	327	0.74	427	19.29	527	0	627	5.19	727	15.58	827	9.65	927	11.13	1027	0	1127	0	1227	36.36
28	0	128	0	228	60.1	328	1.48	428	18.55	528	0	628	8.16	728	17.07	828	8.9	928	11.87	1028	0	1128	0	1228	33.39
29	0	129	0.74	229	63.07	329	3.71	429	16.32	529	0	629	11.13	729	17.07	829	10.39	929	11.13	1029	0	1129	0	1229	31.9
30	0	130	2.23	230	64.55	330	7.42	430	13.36	530	0	630	15.58	730	18.55	830	10.39	930	13.36	1030	0	1130	0	1230	31.16
31	0	131	3.71	231	65.29	331	11.13	431	10.39	531	0	631	16.32	731	20.77	831	10.39	931	15.58	1031	0	1131	0	1231	29.68
32	0	132	6.68	232	66.03	332	16.32	432	8.16	532	0	632	16.32	732	20.03	832	9.65	932	16.32	1032	0	1132	0	1232	29.68
33	0	133	10.39	233	65.29	333	17.81	433	6.68	533	0	633	19.29	733	21.52	833	8.16	933	16.32	1033	0	1133	0	1233	31.16
34	0	134	13.36	234	62.32	334	17.07	434	4.45	534	0	634	23	734	20.77	834	6.68	934	16.32	1034	0	1134	0	1234	33.39
35	0	135	14.84	235	56.39	335	16.32	435	3.71	535	0	635	25.23	735	19.29	835	5.94	935	14.84	1035	0	1135	0	1235	35.61
36	0	136	15.58	236	51.2	336	17.07	436	1.48	536	0	636	26.71	736	17.07	836	4.45	936	14.1	1036	0	1136	0	1236	37.84
37	0	137	16.32	237	47.49	337	17.81	437	0	537	1.48	637	28.19	737	15.58	837	0	937	12.61	1037	0	1137	0	1237	40.07
38	0	138	15.58	238	46.74	338	18.55	438	0	538	2.97	638	28.19	738	16.32	838	0	938	11.87	1038	0	1138	0	1238	39.32
39	0	139	14.1	239	47.49	339	17.81	439	0	539	5.94	639	28.94	739	18.55	839	0	939	10.39	1039	0	1139	0	1239	37.1
40	0	140	13.36	240	49.71	340	15.58	440	0	540	11.13	640	28.19	740	17.81	840	1.48	940	9.65	1040	0	1140	0	1240	34.87
41	0	141	14.1	241	48.97	341	16.32	441	0	541	14.1	641	28.94	741	19.29	841	1.48	941	8.9	1041	0	1141	0	1241	31.16
42	0	142	14.1	242	48.23	342	18.55	442	0	542	15.58	642	26.71	742	19.29	842	3.71	942	10.39	1042	0	1142	0	1242	28.19
43	0	143	11.13	243	48.97	343	19.29	443	0	543	17.07	643	25.23	743	20.03	843	5.94	943	12.61	1043	0	1143	0	1243	29.68
44	0	144	7.42	244	51.2	344	19.29	444	0	544	19.29	644	20.03	744	19.29	844	7.42	944	12.61	1044	0	1144	0	1244	32.65
45	0	145	3.71	245	52.68	345	20.03	445	0	545	18.55	645	17.81	745	17.07	845	8.9	945	13.36	1045	0	1145	1.48	1245	34.13
46	0	146	0	246	52.68	346	19.29	446	0	546	18.55	646	18.55	746	16.32	846	9.65	946	14.1	1046	0	1146	2.97	1246	34.13
47	0	147	0	247	53.42	347	18.55	447	0	547	20.03	647	15.58	747	17.81	847	11.87	947	13.36	1047	0	1147	7.42	1247	35.61
48	0	148	0	248	54.91	348	17.81	448	0	548	19.29	648	12.61	748	19.29	848	13.36	948	11.87	1048	0	1148	10.39	1248	37.1
49	0	149	0	249	57.13	349	15.58	449	0	549	16.32	649	8.9	749	20.77	849	13.36	949	11.13	1049	0	1149	16.32	1249	37.1
50	0	150	0	250	59.36	350	13.36	450	0	550	17.07	650	5.19	750	22.26	850	14.1	950	9.65	1050	0	1150	21.52	1250	36.36
51	0	151	0	251	61.58	351	13.36	451	0	551	16.32	651	2.97	751	22.26	851	14.84	951	9.65	1051	0	1151	23.74	1251	37.1
52	0	152	0	252	62.32	352	13.36	452	0	552	17.07	652	2.97	752	23.74	852	14.84	952	8.9	1052	0	1152	22.26	1252	36.36
53	0	153	0	253	62.32	353	13.36	453	0	553	18.55	653	3.71	753	22.26	853	14.1	953	8.16	1053	0	1153	25.23	1253	37.1
54	0	154	0	254	61.58	354	12.61	454	0	554	20.03	654	6.68	754	21.52	854	14.1	954	8.16	1054	0	1154	28.94	1254	37.1
55	0	155	0	255	60.1	355	11.87	455	0	555	20.03	655	6.68	755	23	855	12.61	955	7.42	1055	0	1155	29.68	1255	37.84
56	0	156	0	256	57.87	356	13.36	456	0	556	17.07	656	6.68	756	24.48	856	11.13	956	8.16	1056	0	1156	31.9	1256	39.32
57	0	157	0	257	54.91	357	16.32	457	0	557	17.81	657	6.68	757	25.97	857	10.39	957	8.9	1057	0	1157	31.9	1257	40.07
58	1.48	158	0	258	49.71	358	17.81	458	0	558	18.55	658	7.42	758	25.97	858	11.13	958	9.65	1058	0	1158	33.39	1258	41.55
59	5.94	159	0	259	46.74	359	20.03	459	0	559	18.55	659	5.94	759	25.97	859	11.13	959	8.9	1059	0	1159	31.9	1259	43.78
60	10.39	160	0	260	45.26	360	23	460	0	560	15.58	660	5.19	760	25.23	860	12.61	960	7.42	1060	0	1160	29.68	1260	46
61	15.58	161	0	261	46.74	361	25.23	461	0	561	13.36	661	5.19	761	25.23	861	12.61	961	5.94	1061	0	1161	26.71	1261	45.26
62	19.29	162	0	262	48.23	362	25.97	462	0	562	11.87	662	5.19	762	26.71	862	12.61	962	5.19	1062	0	1162	23.74	1262	44.52
63	19.29	163	0	263	49.71	363	25.23	463	0	563	11.13	663	6.68	763	26.71	863	11.13	963	5.94	1063	0	1163	25.97	1263	43.78
64	20.77	164	0	264	48.97	364	23.74	464	0	564	12.61	664	8.16	764	26.71	864	8.16	964	5.94	1064	0	1164	31.16	1264	41.55
65	23.74	165	0	265	46.74	365	17.07	465	0	565	14.84	665	9.65	765	25.97	865	6.68	965	6.68	1065	0	1165	33.39	1265	40.07
66	24.48	166	0	266	44.52	366	11.13	466	0	566	16.32	666	9.65	766	26.71	866	7.42	966	5.94	1066	0	1166	34.87	1266	34.87
67	24.48	167	0	267	42.29	367	5.94	467	0	567	17.81	667	9.65	767	27.45	867	8.16	967	5.19	1067	0	1167	37.84	1267	30.42
68	23	168	0	268	42.29	368	2.97	468	0	568	19.29	668	11.13	768	28.19	868	7.42	968	3.71	1068	0	1168	40.07	1268	26.71
69	22.26	169	0	269	43.78	369	0.74	469	0	569	18.55	669	13.36	769	29.68	869	7.42	969	0.74	1069	0	1169	38.58	1269	23.74
70	24.48	170	0	270	44.52	370	0	470	0	570	13.36	670	13.36	770	29.68	870	7.42	970	0	1070	0	1170	39.32	1270	22.26
71	25.97	171	0	271	45.26	371	0	471	0	571	9.65	671	13.36	771	31.16	871	8.16	971	0	1071	0	1171	39.32	1271	20.77
72	28.19	172	0	272	43.78	372	0.74	472	0	572	11.13	672	13.36	772	30.42	872	8.9	972	0	1072	0	1172	38.58	1272	20.77
73	29.68	173	0	273	43.03	373	0.74	473	0	573	12.61	673	14.84	773	31.9	873	8.16	973	0	1073	0	1173	37.84	1273	21.52
74	29.68	174	0	274	44.52	374	0.74	474	0	574	11.87	674	16.32	774	30.42	874	5.94	974	0	1074	0	1174	41.55	1274	23
75	28.19	175	0.74	275	46.74	375	0	475	0	575	12.61	675	18.55	775	28.94	875	5.19	975	0	1075	0	1175	42.29	1275	26.71
76	22.26	176	0	276	47.49	376	0	476	0	576	12.61	676	20.03	776	23.74	876	5.94	976	0	1076	0	1176	43.03	1276	27.45
77	20.77	177	2.23	277	47.49	377	0.74	477	0	577	11.87	677	21.52	777	20.77	877	5.19	977	0	1077	0	1177	42.29	1277	27.45
78	22.26	178	3.71	278	46.74	378	0	478	0	578	10.39	678	20.03	778	17.81	878	3.71	978	0	1078	0	1178	41.55	1278	26.71
79	24.48	179	5.94	279	47.49	379	0	479	0	579	8.16	679	23.74	779	15.58	879	2.97	979	0	1079	0	1179	40.81	1279	27.45
80	25.97	180	5.94	280	48.97	380	0	480	0	580	6.68	680	27.45	780	13.36	880	3.71	980	0	1080	0	1180	40.07	1280	28.19
81	25.23	181	6.68	281	50.45	381	0	481	0	581	6.68	681	32.65	781	13.36	881	4.45	981	0.74	1081	0	1181	38.58	1281	29.68
82	23	182	8.9	282	48.97	382	0.74	482	0	582	9.65	682	35.61	782	12.61	882	3.71	982	0.74	1082	0	1182	38.58	1282	28.94
83	19.29	183	8.16	283	50.45	383	1.48	483	0	583	11.87	683	35.61	783	14.84	883	3.71	983	0	1083	0	1183	38.58	1283	31.16
84	17.81	184	5.94	284	57.13	384	0	484	0.74	584	11.13	684	35.61	784	18.55	884	4.45	984	0	1084	0	1184	38.58	1284	31.16
85	19.29	185	2.23	285	51.2	385	0	485	1.48	585	11.13	685	36.36	785	20.03	885	5.19	985	0	1085	0	1185	36.36	1285	29.68
86	23	186	0	286	50.45	386	0	486	3.71	586	10.39	686	36.36	786	18.55	886	6.68	986	0	1086	0	1186	31.16	1286	27.45
87	25.23	187	0	287	48.97	387	0	487	5.19	587	11.87	687	35.61	787	17.81	887	8.16	987	0	1087	0	1187	29.68	1287	27.45
88	25.97	188	0	288	46	388	0	488	8.16	588	14.1	688	30.42	788	16.32	888	8.16	988	0	1088	0	1188	31.16	1288	28.94
89	24.48	189	0.74	289	43.78	389	0	489	6.68	589	17.07	689	28.19	789	13.36	889	8.16	989	0	1089	0	1189	31.9	1289	30.42
90	18.55	190	2.97	290	43.03	390	0	490	4.45	590	17.81	690	28.94	790	11.13	890	8.16	990	0	1090	0	1190	31.16	1290	29.68
91	12.61	191	5.94	291	42.29	391	0	491	2.97	591	18.55	691	28.94	791	10.39	891	6.68	991	0	1091	0	1191	31.16	1291	28.19
92	11.13	192	8.16	292	41.55	392	0	492	0	592	17.81	692	29.68	792	8.16	892	5.19	992	0	1092	0	1192	25.23	1292	24.48
93	10.39	193	11.13	293	42.29	393	0	493	0	593	17.07	693	28.94	793	7.42	893	2.97	993	0	1093	0	1193	21.52	1293	20.77
94	10.39	194	10.39	294	44.52	394	0	494	0	594	12.61	694	29.68	794	6.68	894	4.45	994	0	1094	0	1194	22.26	1294	19.29
95	11.87	195	10.39	295	46	395	2.23	495	0	595	9.65	695	30.42	795	5.94	895	5.94	995	0	1095	0	1195	27.45	1295	16.32
96	15.58	196	11.87	296	46	396	5.19	496	0	596	6.68	696	31.16	796	4.45	896	6.68	996	0	1096	0	1196	30.42	1296	11.13
97	17.07	197	12.61	297	46.74	397	9.65	497	0	597	5.94	697	31.16	797	5.19	897	6.68	997	0	1097	0	1197	33.39	1297	5.94
98	16.32	198	14.1	298	46	398	13.36	498	0	598	6.68	698	34.13	798	6.68	898	3.71	998	0	1098	0	1198	37.1	1298	0.74
99	14.1	199	14.84	299	43.78	399	17.07	499	0	599	6.68	699	37.1	799	7.42	899	3.71	999	0	1099	0	1199	39.32	1299	0
100	17.07	200	14.84	300	41.55	400	19.29	500	0	600	4.45	700	39.32	800	7.42	900	4.45	1000	0	1100	0	1200	41.55		