NATIONAL TRANSPORTATION SAFETY BOARD
Vehicle Recorder Division
Washington, D.C. 20594

August 29, 2012

Global Positioning System Device

Specialist's Factual Report
By Ben Xu

1. EVENT

Location:	Chesterfield, New Jersey
Date/Time:	February 16, 2012 / 0800 EST
Vehicle/ID:	2004 Mack CV713 / 1M2AG11C54M012315
Operator:	Herman's Trucking Inc.
NTSB Number:	HWY12MH007

2. DETAILS OF DEVICE INVESTIGATION

The Safety Board's Vehicle Recorder Division received the following device:

Device:	Garmin nüvi 1390
Device Serial Number:	1T1039750

The Global Positioning System (GPS) device arrived in good condition (Figure 1). Power was applied normally and data was downloaded using laboratory software.

Figure 1: Garmin nüvi 1390 (S/N 1T1039750)

2.1. Device Description

The Garmin nüvi 1390 is a portable GPS unit designed for use in automotive environments. It is capable of storing a detailed tracklog within the unit whenever the receiver has a lock on the GPS navigation signal. All recorded data is stored in non-volatile[1] memory. Communication to the device is provided by a built-in USB port.

2.2. Parameters Provided

Table 1 describes data parameters provided by the GPS device. Date, Time, Latitude, and Longitude are recorded by the device. Average Speed is derived from the recorded parameters.

Parameter Name	Parameter Description
Date	Date for recorded data point (MM/DD/YYYY)
Time	Time (UTC) for recorded data point (HH:MM:SS)
Latitude	Recorded Latitude (degrees)
Longitude	Recorded Longitude (degrees)
Average Speed	Average speed between current and previous data point (MPH)

Table 1: GPS Data Parameters Provided

2.3. Data Extracted

The data extracted included 16 sessions from February 8, 2012[2] to February 16, 2012. Data points from February 16, 2012 were determined to be related to the accident and are summarized in Table 2.

Date	Time (UTC)	Latitude (deg)	Longitude (deg)	Average Speed (MPH)
2/16/2012	13:14:59	40.134606	-74.668713	
2/16/2012	13:15:16	40.132617	-74.665385	47.3
2/16/2012	13:15:30	40.130896	-74.662456	50.2
2/16/2012	13:15:35	40.130315	-74.66148	47.0
2/16/2012	13:15:36	40.130214	-74.661311	40.8

Table 2: GPS Data related to the accident

In addition, the vehicle crossed the accident intersection three times previous to the accident at approximately 12:05:44, 12:20:51, and 12:57:42. The vehicle's calculated average speeds at these times were 49.0 MPH, 43.4 MPH, and 48.1 MPH respectively.

[1] Non-volatile memory is semiconductor memory that does not require external power for data retention.
[2] All dates and times are referenced to Coordinated Universal Time (UTC).

2.4. Calculation of Average Speed

The average speed of the vehicle was calculated using data recorded from the GPS device. Distance traveled between each data point was calculated using the following formula:

$$R = 20{,}902{,}231\ ft \quad Average\ Radius\ of\ the\ Earth$$
$$\Delta Lat = Lat_2 - Lat_1$$
$$\Delta Lon = Lon_2 - Lon_1$$
$$a = sin^2\ \frac{\Delta Lat}{2}\ + cos\ Lat_1\ cos\ Lat_2\ sin^2\ \frac{\Delta Lon}{2}$$
$$c = 2atan2\ \overline{a},\ \overline{1-a}$$
$$d = R \cdot c$$

The calculated value *d* is the great-circle distance in feet between two points with latitudes and longitudes defined by Lat_1, Lon_1 and Lat_2, Lon_2. The average speed between the points was calculated by combining this distance with the timestamps recorded for each point. This calculated speed represents the average speed of the vehicle over the specified time period. It does not represent the instantaneous speed of the vehicle.

3. GRAPHICAL OVERLAYS

Figure 2 is a graphical overlay generated using Google Earth of the data points related to the accident.

4. ATTACHMENTS

The full dataset recorded on February 16, 2012 is included as Attachment 1. This attachment is provided in electronic comma-separated value (CSV) format.

Figure 2: Data recorded on February 16, 2012 related to the accident