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

November 29, 2012

17 – Electronic Devices Factual Report

Specialist's Factual Report
by Bill Tuccio

1. EVENT

Location:	Cumming, Georgia
Date:	September 13, 2012
Aircraft:	Vans Aircraft RV-7
Registration:	N517DG
Operator:	Private
NTSB Number:	ERA12FA561

On September 13, 2012, about 1941 eastern daylight time (EDT), a Vans RV-7, N517DG, was substantially damaged following a collision with terrain at Cumming, Georgia. The certificated private pilot and one passenger were fatally injured. The airplane was registered to a corporation and was operated by the pilot under the provisions of 14 Code of Federal Regulations Part 91 as a personal flight. Day, visual meteorological conditions prevailed and no flight plan was filed. The local flight originated at Stoney Point Airfield (6GA0), Cumming, Georgia, at an undetermined time.

2. DETAILS OF DEVICE INVESTIGATION

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

Device 1:	Memsic Crossbow Magnetometer (2 units)
Device 1 Serial Number:	0701006337
Device 2:	Advanced Flight Systems Inc. Pilot
Device 2 Serial Number:	101214-8000-120-001
Device 3:	Advanced Flight Systems Inc. ARINC-429 Module
Device 3 Serial Number:	836
Device 4:	Advanced Flight Systems Inc. AF-5500EF
Device 4 Serial Number:	71029
Device 5:	Advanced Flight Systems Inc. AF-3500EE
Device 5 Serial Number:	60206

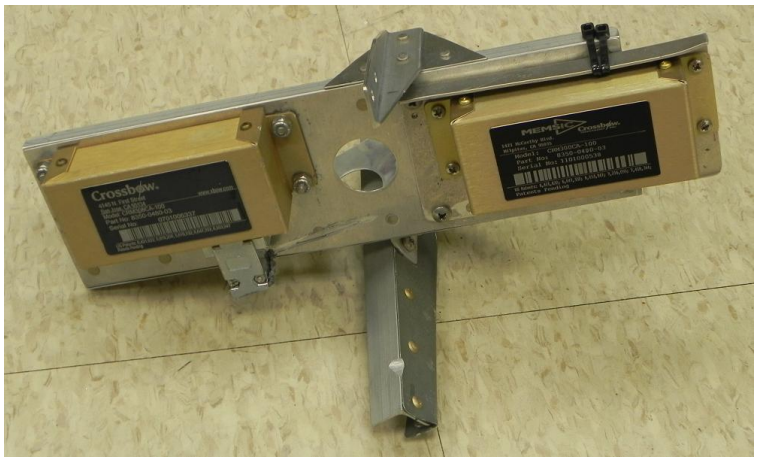
2.1. Memsic Crossbow Magnetometer Device Description

The Memsic Crossbow Magnetometer is a solid-state device used to measure magnetic heading. The device has outputs for use in cockpit display devices.

2.1.1. Memsic Crossbow Magnetometer Data Recovery

Upon arrival at the Vehicle Recorder Laboratory, an exterior examination revealed the two units had not sustained any damage, as shown in figure 1. No attempt was made to extract information from these devices, as heading information was available on the AF-3500EE.

Figure 1. Memsic Crossbow Magnetometer.



2.2. Advanced Flight Systems Inc. Pilot Device Description

The Advanced Flight Systems Inc. Pilot is a two axis autopilot. The device has a 2.25” compact user interface consisting of a LED display, two buttons, and a rotatable knob. The unit interfaces with a flight control servo, and also interfaces electronically with other devices, such as electronic flight information systems (EFIS).

2.2.1. Advanced Flight Systems Inc. Pilot Data Recovery

Upon arrival at the Vehicle Recorder Laboratory, an exterior examination revealed the unit had sustained minor damage, as shown in figure 2. No attempt was made to extract information from this device.

Figure 2. Advanced Flight Systems Inc. Pilot.

2.3. Advanced Flight Systems Inc. ARINC-429 Module Description

The Advanced Flight Systems Inc. ARINC-429 is an interface unit used to read and write ARINC-429 data.

2.3.1. Advanced Flight Systems Inc. ARINC-429 Module Data Recovery

Upon arrival at the Vehicle Recorder Laboratory, an exterior examination revealed the unit had not sustained any damage. No attempt was made to extract information from this device.

2.4. Advanced Flight Systems Inc. AF-5500EF Description

The Advanced Flight Systems Inc. AF-5500EF multifunction display is a liquid crystal (LCD) display that presents the pilot with aircraft attitude, altitude, heading, navigation, moving map, airway and approach database. When interfaced with other units, the unit can display engine and aircraft fuel status information. The AS-5500EF can record dynamic flight information on an internal solid state drive (SSD) at a pilot selectable interval. The unit records approximately 51 discrete data parameters to the internal SSD.

When power is removed from the unit, the internal clock time is not retained. When power is applied to the unit, if it is connected to a GPS, the internal clock will

automatically be set to GPS time when GPS time first becomes available. Thereafter, the clock will advance based on the internal microprocessor.

2.4.1. Advanced Flight Systems Inc. AF-5500EF Data Recovery

Upon arrival at the Vehicle Recorder Laboratory, an exterior examination revealed the unit had sustained significant impact damage, as shown in figure 3. Limited attempts were made to recover information from the device.

Figure 3. Advanced Flight Systems Inc. AF-5500EF.

2.4.2. Advanced Flight Systems Inc. AF-5500EF Data Description

No data was recovered from this particular device. However, much of the data was recovered from the Advanced Flight Systems Inc. AF-3500EE as described in the next section.

2.5. Advanced Flight Systems Inc. AF-3500EE Description

The Advanced Flight Systems Inc. AF-3500EE multifunction display is a liquid crystal (LCD) display that presents the pilot with aircraft attitude, altitude, heading, navigation, moving map, airway and approach database. The EE designation indicates the unit also has engine monitoring and fuel status capabilities. The AS-3500EE can record dynamic flight information on internal flash non-volatile memory at a pilot selectable

interval. The unit records approximately 51 discrete data parameters to the internal non-volatile memory.

The time in the AF-3500EE is set by the operator, and maintained by an internal lithium-ion battery between power cycles. When connected to another Advanced Flight Systems Inc. device, discrete data parameters are shared and recorded, except time. Displayed and recorded times are from the internal clock on the AF-3500EE.

2.5.1. Advanced Flight Systems Inc. AF-3500EE Data Recovery

Upon arrival at the Vehicle Recorder Laboratory, an exterior examination revealed the unit had sustained minor impact damage, as shown in figure 4. An internal examination revealed no significant damage. External power was applied to the unit and information was extracted normally, without difficulty.

Figure 4. Advanced Flight Systems Inc. AF-3500EE.

2.5.2. Advanced Flight Systems Inc. AF-3500EE Data Description

The unit contained 266 data points between September 5, 2012 and September 13, 2012 at 1914:09. The date and time accuracy could not be verified. Given the accident was reported at about 1941 EDT, times are assumed to be EDT for this report. Between device reported times of 1905:30 and 1907:52, the GPS latitude and longitude

did not update; during this period the recorded latitude and longitude remained the same as the 1905:30 values. During this time period, all other values appeared to change.

3. OVERLAYS AND TABULAR DATA

All graphical overlays generated in this report were generated using Google Earth.

Figure 5 is a graphical overlay of the GPS latitude and longitude as well as AF-3500EE reported altitude for the entire flight. The time period 1905:30 to 1907:52 is omitted from the overlay, as the latitude and longitude were not updating during this time period. The overlay shows the aircraft departed runway 33 at 6GA0 at about 1900:09.

Figure 6 shows the aircraft climbed towards the northwest, circled in a figure eight pattern, and then proceeded towards the east until the latitude/longitude recording became unreliable after 1905:24. Figure 7 shows the annotated path of the aircraft during the figure eight pattern. The aircraft first proceeded towards the east, towards the area annotated as “#1”, then turned to the south, then back to the west. Thereafter, the aircraft turned north, then back towards the easterly route of flight.

Figure 8 shows the second part of the flight after latitude and longitude began to change again. The path began at 1907:57 as the aircraft was proceeding south. At around 1909:14, the aircraft began to turn towards the north. Figure 9 shows all points recorded at the end of the flight. The aircraft descended on a northerly track over a lake. The last few points recorded may be unreliable due to the subsequent impact.

Figure 10 is a plot of basic parameters recorded by the AF-3500EE for the accident flight. The aircraft manifold pressure and RPM increased at 1900:06 while the aircraft was at an indicated altitude of 940 feet, followed shortly thereafter by increases in airspeed and altitude. As the aircraft climbed after departure, between 1900:36 and 1903:59, the roll angle changed direction 12 times with maximum roll angles between +/- 68 degrees. After the roll angle directional changes, the aircraft was heading easterly, climbing out of 2,200 feet. The aircraft climbed to a maximum altitude of 4,160 feet by 1910:42.

At 1905:30, when the latitude and longitude stopped changing, the fuel pressure and oil pressure recorded one sample of values inconsistent with the trend of other values surrounding that time period. The aircraft resumed an easterly heading until about 1907:20, at which time the aircraft turned right towards the south. The aircraft was heading southerly when latitude and longitude began to change again at 1907:51. At 1909:09, the aircraft turned left towards the north and remained in this direction until near the end of the recording.

At about 1911:06, the manifold pressure decreased from 26 inHg to about 11 inHg, coincident with a reduction in fuel flow and reduction in airspeed. The altitude began to decrease at about 1911:30, and continued to decrease until the end of the recording. At

1912:21, the manifold pressure further reduced, and the oil pressure began to reduce from 72 psi to about 55 psi by about 1913.

At about 1913:46, 23 seconds before the end of the recording, the manifold pressure, fuel flow, oil pressure, and airspeed increased. During this 23 second period, the altitude decreased from 3,030 feet to a last recorded value of 1,290 feet at 1914:09.

Figure 11 is a plot of engine parameters for the accident flight. The engine parameters show one sample of volt, amps, and fuel tank values inconsistent with the trended values around 1905:30, the time latitude and longitude stopped changing. At about 1911:18, the EGT values increased for about 1 minute. After 1911:18, CHT decreased until 1913:58, when CHT started to increase along with the manifold pressure and fuel flow until the end of the recording at 1914:09.

Figure 12 is a plot of miscellaneous parameters for the accident flight. The plot shows vertical accelerations early in the flight consistent with roll angles in Figure 10. The groundspeed showed a value of 0 during the time period when latitude and longitude were not updating; also during this period, the true track indicated 0, inconsistent with the easterly and southerly headings during this same period. At 1905:30 (the time when the latitude and longitude stopped changing), the elevator and aileron trim recorded one sample of values inconsistent with trended values surrounding that time period.

Tabular data used to generate figures 5 through 12 are included as Attachment 1. Attachment 1 includes all latitude and longitude values. These attachments are provided in electronic comma-delimited (.CSV) format.

Figure 5. Graphical overlay of ground track from accident flight.

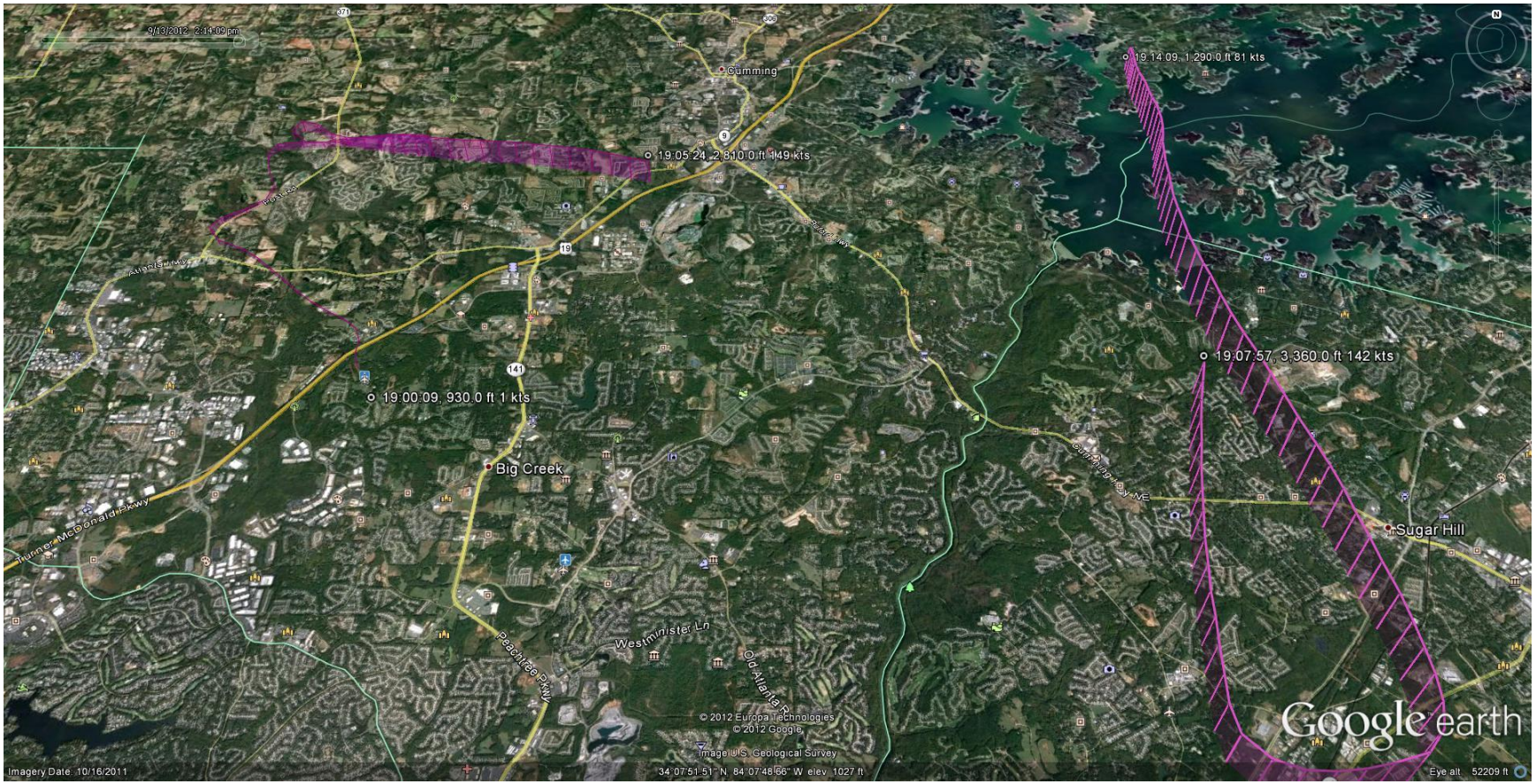


Figure 6. Graphical overlay of first part of accident flight before latitude/longitude stopped updating.

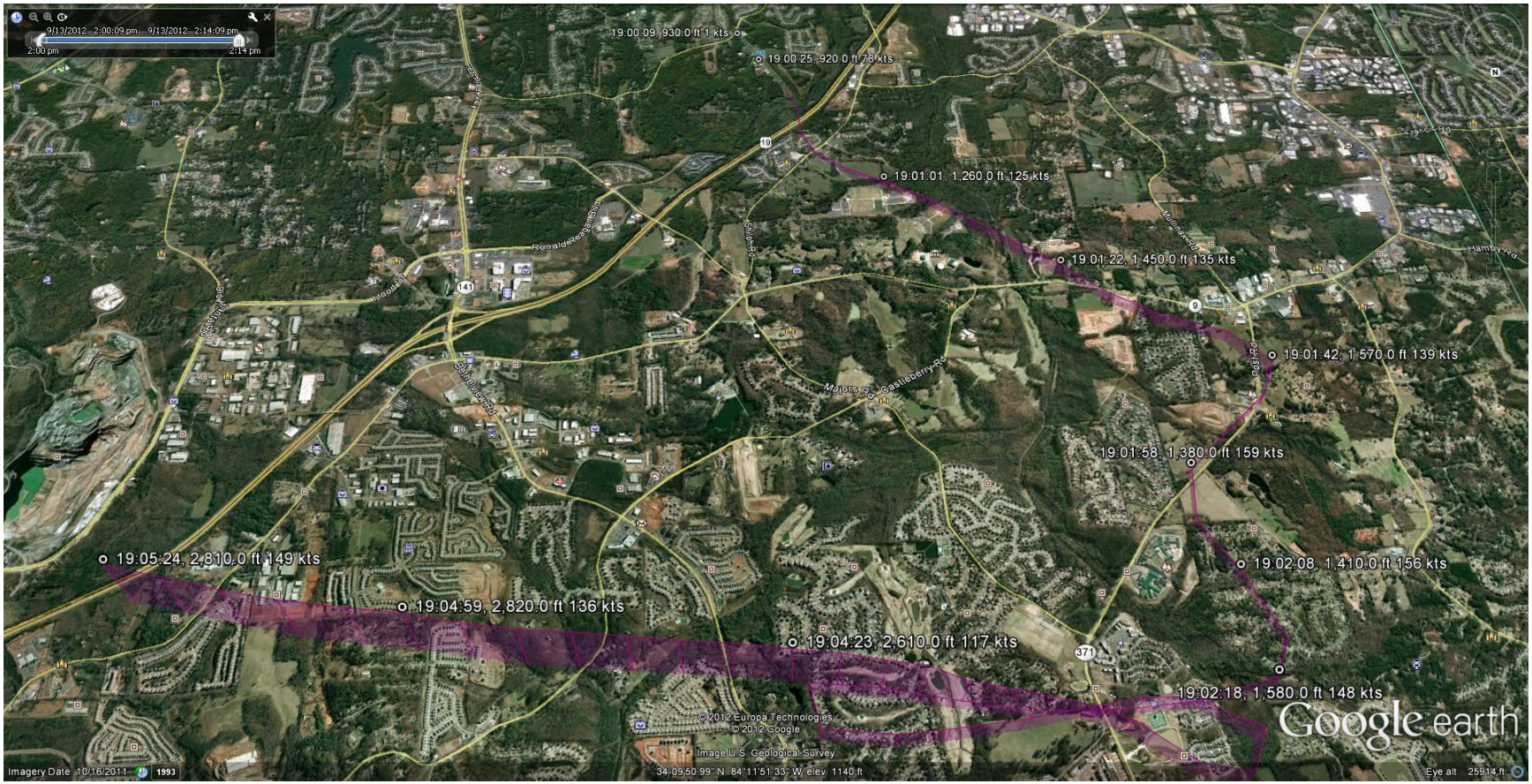


Figure 7. Graphical overlay of figure eight flight pattern in first part of flight.

Figure 8. Graphical overlay of second part of flight until end of recording.

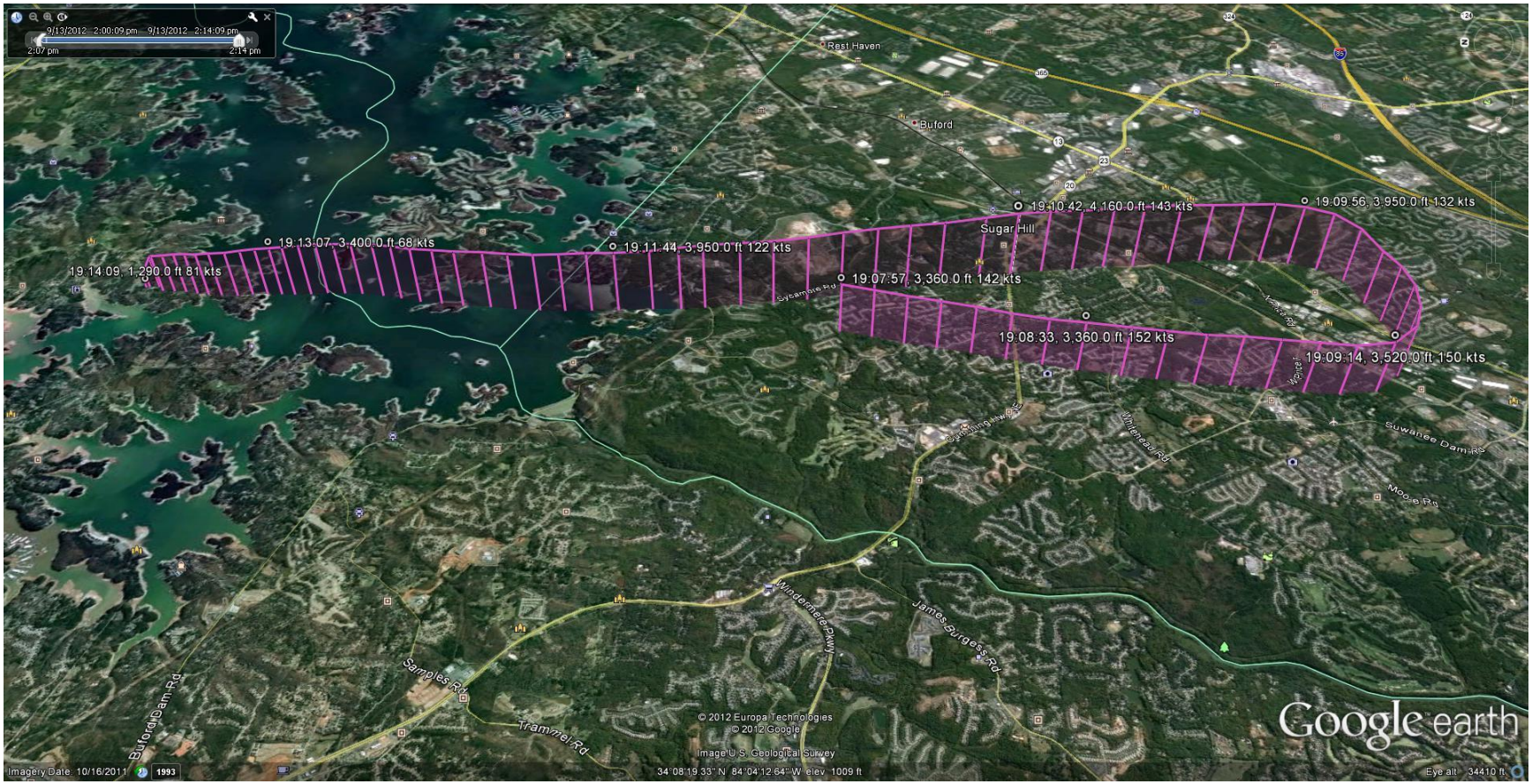


Figure 9. Graphical overlay of all points at the end of the flight.

Figure 10. Plot of basic parameters for accident flight.

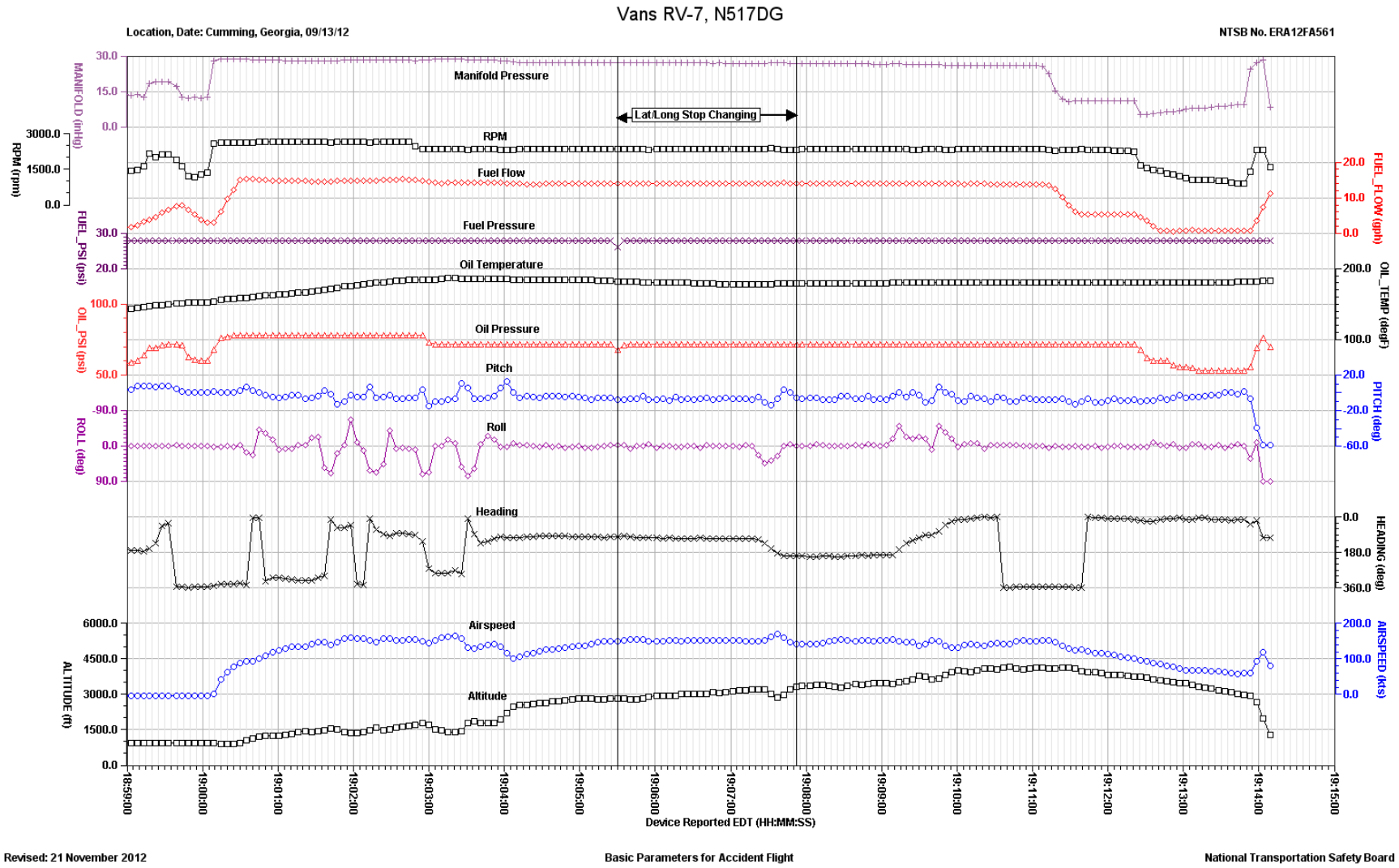


Figure 11. Plot of engine parameters for accident flight.

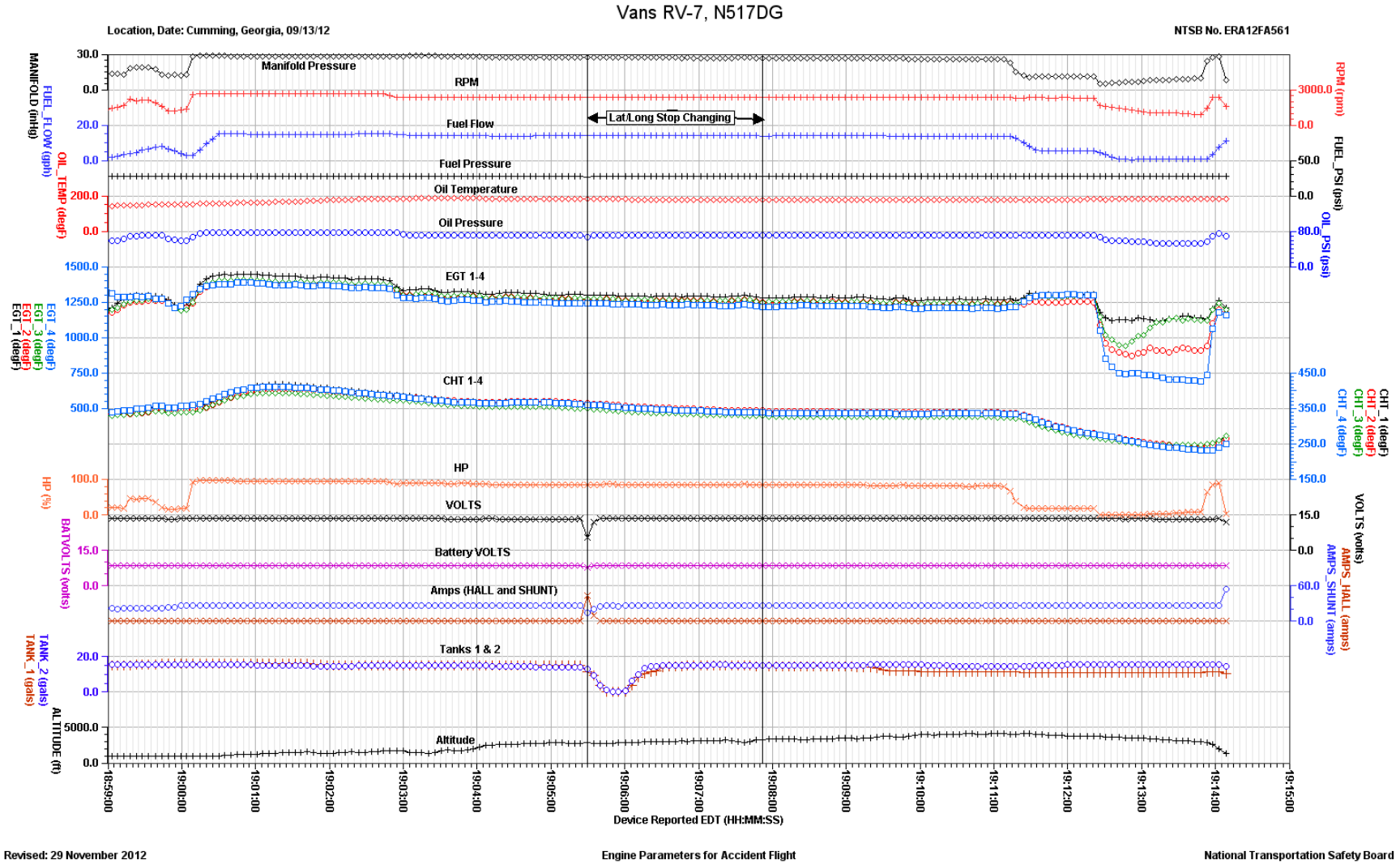
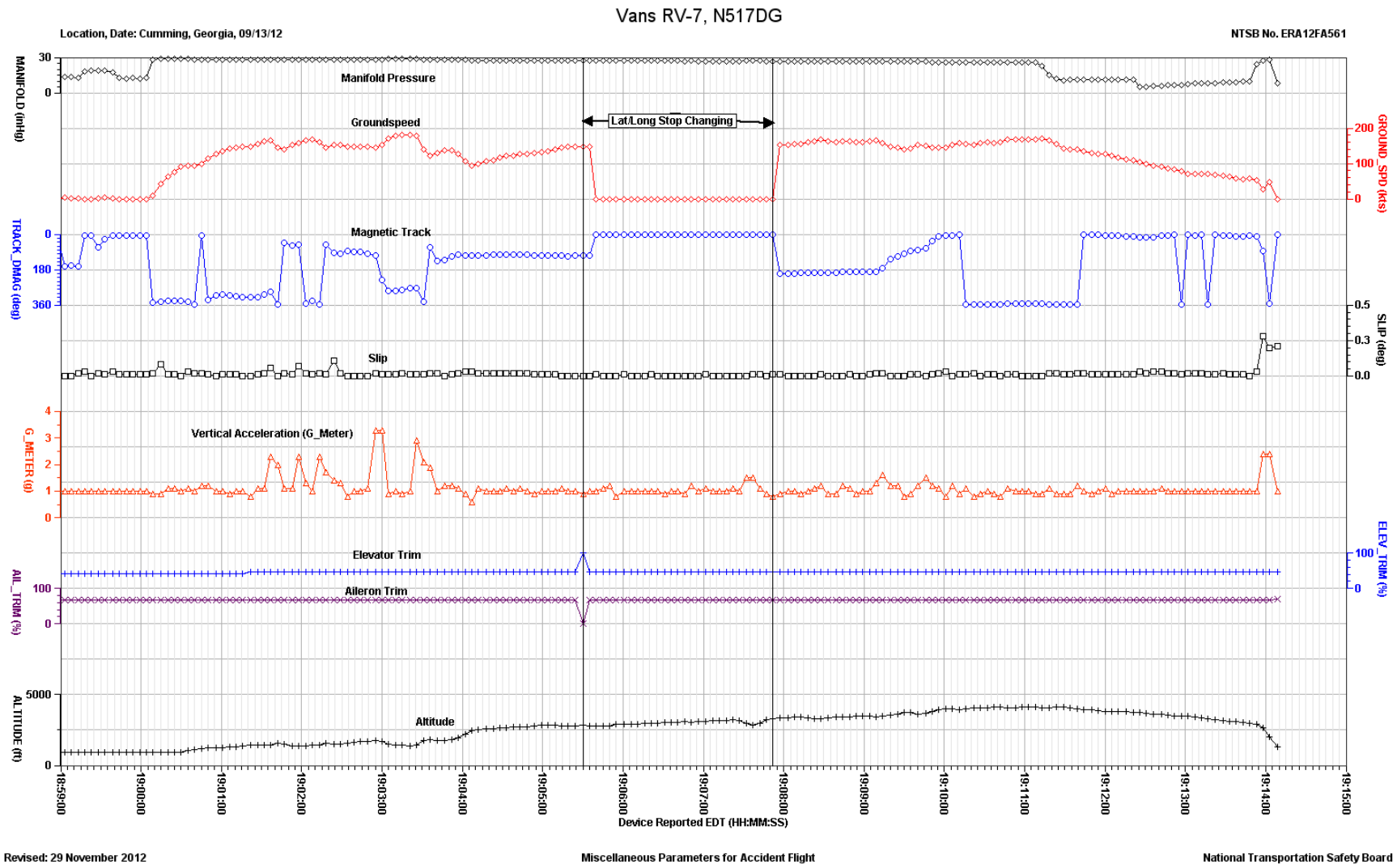


Figure 12. Plot of miscellaneous parameters for accident flight.



APPENDIX A

This appendix describes the parameters provided and verified in this report. Table A-1 lists the parameters and table A-2 describes the unit abbreviations used in this report.

Table A-1. Verified and provided FDR parameters.

Parameter Name	Parameter Description
AIL_TRIM (%)	Aileron Trim
AIRSPEED (kts)	Indicated Airspeed
ALTITUDE (ft)	Indicated Altitude
AMPS_HALL (amps)	"Hall" amps[1]
AMPS_SHUNT (amps)	"Shunt" amps[1]
BATVOLTS (volts)	Battery Volts
CHT_1 (degF)	Cylinder Head Temperature 1
CHT_2 (degF)	Cylinder Head Temperature 2
CHT_3 (degF)	Cylinder Head Temperature 3
CHT_4 (degF)	Cylinder Head Temperature 4
EGT_1 (degF)	Exhaust Gas Temperature 1
EGT_2 (degF)	Exhaust Gas Temperature 2
EGT_3 (degF)	Exhaust Gas Temperature 3
EGT_4 (degF)	Exhaust Gas Temperature 4
ELEV_TRIM (%)	Elevator Trim
FUEL_FLOW (gph)	Fuel Flow
FUEL_PSI (psi)	Fuel Pressure
G_METER (g)	Vertical Acceleration
GROUND_SPD (kts)	GPS Ground speed
HEADING (deg)	Magnetic Heading
HP (%)	Horsepower
LATITUDE (deg)	GPS Latitude
LONGITUDE (deg)	GPS Longitude
MANIFOLD (inHg)	Manifold Pressure
OIL_PSI (psi)	Oil Pressure
OIL_TEMP (degF)	Oil Temperature
PITCH (deg)	Pitch Angle
ROLL (deg)	Roll Angle
RPM (rpm)	Propeller Revolutions per Minute
SLIP (deg)	Slip Angle
TANK_1 (gals)	Tank 1 fuel
TANK_2 (gals)	Tank 2 fuel
TRACK_DMAG (deg)	GPS Magnetic Track
VOLTS (volts)	Voltage[1]

[1] The source of the recorded parameter was not determined.

Table A-2. Unit abbreviations.

Units Abbreviation	Description
%	percent
amps	Amps
deg	degrees
degF	degrees Fahrenheit
ft	feet
g	g
gals	gallons
gph	gallons per hour
inHg	inches of Mercury
kts	knots
psi	pounds per square inch
volts	Volts