

Alternative Communications Methods For Electronic Control Modules

ON-ENGINE EXPERIENCE

Background

NORTH BERWICK, Maine -- Police say safety lights were flashing and gates were down when a tractor-trailer crossed into the path of an Amtrak train that hit the truck in North Berwick, killing the driver, Peter Barnum, 35, of Farmington, N.H., and injuring the train engineer and several passengers. A witness told News 8's Jim Keithley that the driver of the truck slammed on the brakes and skidded into the intersection before being hit by the train around 11 a.m. Monday.

None of the train's 112 passengers or two crew members suffered life-threatening injuries. Police say the truck driver was hauling trash to an incinerator in Biddeford.

"For some unknown reason he did not stop at the railroad crossing. The gates were down; the lights were flashing," said North Berwick Police Chief Stephen Peasley.

Witnesses said both the truck and locomotive caught fire. "I heard the train coming. I looked down. I see the truck coming down. He had his breaks on, trying to stop; blue smoke blowing up from underneath the truck. He slid right through the train. They collided; just one big cloud of smoke, big ball of fire," said David Davis, who witnessed the crash.

Firefighters had to put out fires in the ditches. Officials credited the engineer for his quick action to save the passengers on board. "There was smoke, and the engine was on fire. He disconnected it from the remaining train to keep the fire from coming to the rest of the train. He took the reaction to stop the train, getting it separated, getting the people off. He did a real good job," said North Berwick Deputy Fire Chief Larry Straffin.

Patricia Quinn from the Northern New England Passenger Rail Authority told News 8 that train 681 was traveling northbound with 112 passengers on board when the collision happened. The Downeaster had left Boston's North Station just after 9 a.m. and was due to arrive in Portland at 11:35 a.m. Passengers were taken to Noble High School and later bused back to the train station in Portland.

When they returned to Portland, passengers spoke about what they experienced when the collision happened. "To tell you the truth, when I saw the flames, I thought I was a goner. When I saw the flames I really did, but I realized I was going through the smoke," said passenger Mary Ellen McCarthy. Kelly Greenough was coming up from Massachusetts to visit her three daughters for the week. She said she wanted to take the train to save gas, and now she has quite a story to tell:

"We saw sparks, flames; the cabin filled up with smoke. I was in the seat that had the exit window. I pushed it out and just waited until they got us off the train, and we sat there on the tracks after that," said Greenough.

Despite the initial shock and uncertainty following the crash, many said there was no real sense of panic. People were looking to assist others, and they were also amazed with the condition of the engineer. "He was shaken up and dirty and all of that, but not the injuries you would expect from someone coming out of that smoke-covered car," said passenger Marsha Fitzpatrick.

Downeaster officials report that the 11:20 p.m. train is expected to make all stops between Boston and Portland. Normal service is expected for Tuesday morning.

<http://www.wmtw.com/news/28509710/detail.html>

The Truck



The vehicle was a 2009 Kenworth W900 truck-tractor, towing a refuse compaction semi-trailer. Upon inspection, a significant portion of the locomotive's front walkway and handrail was intertwined with the remainder of the truck-tractor.





The ensuing fire consumed the anti-lock brake system's electronic control unit. Some remaining foundation brake components were sufficiently damaged to prevent pressure plate/pushrod movement, making assessment of brake performance complex.



The Engine



The ISX 07 Cummins engine was recovered approximately 200 feet from the area of initial impact.



Engine Type	ISX 07	ECM Code	AV1005125	Last Tool Used	Insite
Engine Serial Number	0	Software Phase	8.0.0.54	Customer Name	Customer Name**
Unit Number	0000000000	ECM Runtime hrs:mm:ss	7025:14:5	PowerSpec Version	4.2.3.6



The ECM was damaged. The cab wiring harness was pulled completely out of the connector. The engine harness was secured to its connector, but the connector was broken from the ECM housing.



The left side four-pin connector was intact. The corresponding connection of the 3164185 calibration adapter harness could be securely connected. The cab connector was sufficiently

damaged as to prevent a secure mount of the 3164185 calibration adapter harness' programming connection.

In our initial attempt at communications, specially constructed "Jumper" wires were used to connect the harness female pins to the appropriate ECM male pins to enable communications via the J1708/1939 data links. It was apparent switched power was available from the calibration adapter cable, as the Inline 5 Data Link Adapter was receiving electrical power.





However, communications with the ECM could not be achieved. It appeared switched power was being interrupted by the damage to the ECM's circuit board. Additional "Jumper" wires were employed to complete the calibration adapter harness' intended connections.





Upon completion of these connections, activity was evident across the data links as seen via the Inline 5's indicator lights.



[illegible]

Power Sports - Engine Diagnostic Information					
Engine Size	Year	Model Year	Model Year	Model Year	Model Year
100cc	1999	2000	2001	2002	2003
150cc	1999	2000	2001	2002	2003
200cc	1999	2000	2001	2002	2003
250cc	1999	2000	2001	2002	2003
300cc	1999	2000	2001	2002	2003
350cc	1999	2000	2001	2002	2003
400cc	1999	2000	2001	2002	2003
450cc	1999	2000	2001	2002	2003
500cc	1999	2000	2001	2002	2003
550cc	1999	2000	2001	2002	2003
600cc	1999	2000	2001	2002	2003
650cc	1999	2000	2001	2002	2003
700cc	1999	2000	2001	2002	2003
750cc	1999	2000	2001	2002	2003
800cc	1999	2000	2001	2002	2003
850cc	1999	2000	2001	2002	2003
900cc	1999	2000	2001	2002	2003
950cc	1999	2000	2001	2002	2003
1000cc	1999	2000	2001	2002	2003
1050cc	1999	2000	2001	2002	2003
1100cc	1999	2000	2001	2002	2003
1150cc	1999	2000	2001	2002	2003
1200cc	1999	2000	2001	2002	2003
1250cc	1999	2000	2001	2002	2003
1300cc	1999	2000	2001	2002	2003
1350cc	1999	2000	2001	2002	2003
1400cc	1999	2000	2001	2002	2003
1450cc	1999	2000	2001	2002	2003
1500cc	1999	2000	2001	2002	2003
1550cc	1999	2000	2001	2002	2003
1600cc	1999	2000	2001	2002	2003
1650cc	1999	2000	2001	2002	2003
1700cc	1999	2000	2001	2002	2003
1750cc	1999	2000	2001	2002	2003
1800cc	1999	2000	2001	2002	2003
1850cc	1999	2000	2001	2002	2003
1900cc	1999	2000	2001	2002	2003
1950cc	1999	2000	2001	2002	2003
2000cc	1999	2000	2001	2002	2003
2050cc	1999	2000	2001	2002	2003
2100cc	1999	2000	2001	2002	2003
2150cc	1999	2000	2001	2002	2003
2200cc	1999	2000	2001	2002	2003
2250cc	1999	2000	2001	2002	2003
2300cc	1999	2000	2001	2002	2003
2350cc	1999	2000	2001	2002	2003
2400cc	1999	2000	2001	2002	2003
2450cc	1999	2000	2001	2002	2003
2500cc	1999	2000	2001	2002	2003
2550cc	1999	2000	2001	2002	2003
2600cc	1999	2000	2001	2002	2003
2650cc	1999	2000	2001	2002	2003
2700cc	1999	2000	2001	2002	2003
2750cc	1999	2000	2001	2002	2003
2800cc	1999	2000	2001	2002	2003
2850cc	1999	2000	2001	2002	2003
2900cc	1999	2000	2001	2002	2003
2950cc	1999	2000	2001	2002	2003
3000cc	1999	2000	2001	2002	2003
3050cc	1999	2000	2001	2002	2003
3100cc	1999	2000	2001	2002	2003
3150cc	1999	2000	2001	2002	2003
3200cc	1999	2000	2001	2002	2003
3250cc	1999	2000	2001	2002	2003
3300cc	1999	2000	2001	2002	2003
3350cc	1999	2000	2001	2002	2003
3400cc	1999	2000	2001	2002	2003
3450cc	1999	2000	2001	2002	2003
3500cc	1999	2000	2001	2002	2003
3550cc	1999	2000	2001	2002	2003
3600cc	1999	2000	2001	2002	2003
3650cc	1999	2000	2001	2002	2003
3700cc	1999	2000	2001	2002	2003
3750cc	1999	2000	2001	2002	2003
3800cc	1999	2000	2001	2002	2003
3850cc	1999	2000	2001	2002	2003
3900cc	1999	2000	2001	2002	2003
3950cc	1999	2000	2001	2002	2003
4000cc	1999	2000	2001	2002	2003
4050cc	1999	2000	2001	2002	2003
4100cc	1999	2000	2001	2002	2003
4150cc	1999	2000	2001	2002	2003
4200cc	1999	2000	2001	2002	2003
4250cc	1999	2000	2001	2002	2003
4300cc	1999	2000	2001	2002	2003
4350cc	1999	2000	2001	2002	2003
4400cc	1999	2000	2001	2002	2003
4450cc	1999	2000	2001	2002	2003
4500cc	1999	2000	2001	2002	2003
4550cc	1999	2000	2001	2002	2003
4600cc	1999	2000	2001	2002	2003
4650cc	1999	2000	2001	2002	2003
4700cc	1999	2000	2001	2002	2003
4750cc	1999	2000	2001	2002	2003
4800cc	1999	2000	2001	2002	2003
4850cc	1999	2000	2001	2002	2003
4900cc	1999	2000	2001	2002	2003
4950cc	1999	2000	2001	2002	2003
5000cc	1999	2000	2001	2002	2003
5050cc	1999	2000	2001	2002	2003
5100cc	1999	2000	2001	2002	2003
5150cc	1999	2000	2001	2002	2003
5200cc	1999	2000	2001	2002	2003
5250cc	1999	2000	2001	2002	2003
5300cc	1999	2000	2001	2002	2003
5350cc	1999	2000	2001	2002	2003
5400cc	1999	2000	2001	2002	2003
5450cc	1999	2000	2001	2002	2003
5500cc	1999	2000	2001	2002	2003
5550cc	1999	2000	2001	2002	2003
5600cc	1999	2000	2001	2002	2003
5650cc	1999	2000	2001	2002	2003
5700cc	1999	2000	2001	2002	2003
5750cc	1999	2000	2001	2002	2003
5800cc	1999	2000	2001	2002	2003
5850cc	1999	2000	2001	2002	2003
5900cc	1999	2000	2001	2002	2003
5950cc	1999	2000	2001	2002	2003
6000cc	1999	2000	2001	2002	2003
6050cc	1999	2000	2001	2002	2003
6100cc	1999	2000	2001	2002	2003
6150cc	1999	2000	2001	2002	2003
6200cc	1999	2000	2001	2002	2003
6250cc	1999	2000	2001	2002	2003
6300cc	1999	2000	2001	2002	2003
6350cc	1999	2000	2001	2002	2003
6400cc	1999	2000	2001	2002	2003
6450cc	1999	2000	2001	2002	2003
6500cc	1999	2000	2001	2002	2003
6550cc	1999	2000	2001	2002	2003
6600cc	1999	2000	2001	2002	2003
6650cc	1999	2000	2001	2002	2003
6700cc	1999	2000	2001	2002	2003
6750cc	1999	2000	2001	2002	2003
6800cc	1999	2000	2001	2002	2003
6850cc	1999	2000	2001	2002	2003
6900cc	1999	2000	2001	2002	2003
6950cc	1999	2000	2001	2002	2003
7000cc	1999	2000	2001	2002	2003
7050cc	1999	2000	2001	2002	2003
7100cc	1999	2000	2001	2002	2003
7150cc	1999	2000	2001	2002	2003
7200cc	1999	2000	2001	2002	2003
7250cc	1999	2000	2001	2002	2003
7300cc	1999	2000	2001	2002	2003
7350cc	1999	2000	2001	2002	2003
7400cc	1999	2000	2001	2002	2003
7450cc	1999	2000	2001	2002	2003
7500cc	1999	2000	2001	2002	2003
7550cc	1999	2000	2001	2002	2003
7600cc	1999	2000	2001	2002	2003
7650cc	1999	2000	2001	2002	2003
7700cc	1999	2000	2001	2002	2003
7750cc	1999	2000	2001	2002	2003
7800cc	1999	2000	2001	2002	2003
7850cc	1999	2000	2001	2002	2003
7900cc	1999	2000	2001	2002	2003
7950cc	1999	2000	2001	2002	2003
8000cc	1999	2000	2001	2002	2003
8050cc	1999	2000	2001	2002	2003
8100cc	1999	2000	2001	2002	2003
8150cc	1999	2000	2001	2002	2003
8200cc	1999	2000	2001	2002	2003
8250cc	1999	2000	2001	2002	2003
8300cc	1999	2000	2001	2002	2003
8350cc	1999	2000	2001	2002	2003
8400cc	1999	2000	2001	2002	2003
8450cc	1999	2000	2001	2002	2003
8500cc	1999	2000	2001	2002	2003
8550cc	1999	2000	2001	2002	2003
8600cc	1999	2000	2001	2002	2003
8650cc	1999	2000	2001	2002	2003
8700cc	1999	2000	2001	2002	2003
8750cc	1999	2000	2001	2002	2003
8800cc	1999	2000	2001	2002	2003
8850cc	1999	2000	2001	2002	2003
8900cc	1999	2000	2001	2002	2003
8950cc	1999	2000	2001	2002	2003
9000cc	1999	2000	2001	2002	2003
9050cc	1999	2000	2001	2002	2003
9100cc	1999	2000	2001	2002	2003

PowerSpec - Current Engine Feature Settings		PowerSpec - Current Engine Feature Settings	
Feature Name	Feature Description	Feature Name	Feature Description
Engine Type	Gasoline	Engine Type	Gasoline
Engine Model	4-cylinder, 1600 cc	Engine Model	4-cylinder, 1600 cc
Engine Year	2000	Engine Year	2000
Engine Serial	123456789	Engine Serial	123456789
Engine Power	100 HP	Engine Power	100 HP
Engine Torque	100 lb-ft	Engine Torque	100 lb-ft
Engine RPM	6000	Engine RPM	6000
Engine Oil	5W-30	Engine Oil	5W-30
Engine Filter	Standard	Engine Filter	Standard
Engine Air	Standard	Engine Air	Standard
Engine Spark	Standard	Engine Spark	Standard
Engine Timing	Standard	Engine Timing	Standard
Engine Valve	Standard	Engine Valve	Standard
Engine Piston	Standard	Engine Piston	Standard
Engine Ring	Standard	Engine Ring	Standard
Engine Block	Standard	Engine Block	Standard
Engine Head	Standard	Engine Head	Standard
Engine Crank	Standard	Engine Crank	Standard
Engine Cam	Standard	Engine Cam	Standard
Engine Belt	Standard	Engine Belt	Standard
Engine Pulley	Standard	Engine Pulley	Standard
Engine Bracket	Standard	Engine Bracket	Standard
Engine Mount	Standard	Engine Mount	Standard
Engine Support	Standard	Engine Support	Standard
Engine Base	Standard	Engine Base	Standard
Engine Flange	Standard	Engine Flange	Standard
Engine Gasket	Standard	Engine Gasket	Standard
Engine Seal	Standard	Engine Seal	Standard
Engine O-ring	Standard	Engine O-ring	Standard
Engine Pin	Standard	Engine Pin	Standard
Engine Bolt	Standard	Engine Bolt	Standard
Engine Nut	Standard	Engine Nut	Standard
Engine Washer	Standard	Engine Washer	Standard
Engine Lock	Standard	Engine Lock	Standard
Engine Key	Standard	Engine Key	Standard
Engine Pinion	Standard	Engine Pinion	Standard
Engine Gear	Standard	Engine Gear	Standard
Engine Shaft	Standard	Engine Shaft	Standard
Engine Axle	Standard	Engine Axle	Standard
Engine Hub	Standard	Engine Hub	Standard
Engine Drum	Standard	Engine Drum	Standard
Engine Brake	Standard	Engine Brake	Standard
Engine Caliper	Standard	Engine Caliper	Standard
Engine Piston	Standard	Engine Piston	Standard
Engine Ring	Standard	Engine Ring	Standard
Engine Block	Standard	Engine Block	Standard
Engine Head	Standard	Engine Head	Standard
Engine Crank	Standard	Engine Crank	Standard
Engine Cam	Standard	Engine Cam	Standard
Engine Belt	Standard	Engine Belt	Standard
Engine Pulley	Standard	Engine Pulley	Standard
Engine Bracket	Standard	Engine Bracket	Standard
Engine Mount	Standard	Engine Mount	Standard
Engine Support	Standard	Engine Support	Standard
Engine Base	Standard	Engine Base	Standard
Engine Flange	Standard	Engine Flange	Standard
Engine Gasket	Standard	Engine Gasket	Standard
Engine Seal	Standard	Engine Seal	Standard
Engine O-ring	Standard	Engine O-ring	Standard
Engine Pin	Standard	Engine Pin	Standard
Engine Bolt	Standard	Engine Bolt	Standard
Engine Nut	Standard	Engine Nut	Standard
Engine Washer	Standard	Engine Washer	Standard
Engine Lock	Standard	Engine Lock	Standard
Engine Key	Standard	Engine Key	Standard
Engine Pinion	Standard	Engine Pinion	Standard
Engine Gear	Standard	Engine Gear	Standard
Engine Shaft	Standard	Engine Shaft	Standard
Engine Axle	Standard	Engine Axle	Standard
Engine Hub	Standard	Engine Hub	Standard
Engine Drum	Standard	Engine Drum	Standard
Engine Brake	Standard	Engine Brake	Standard
Engine Caliper	Standard	Engine Caliper	Standard

Page 1 of 2

PowerSpec - Engine Fault Report

Page 1 of 2

Page 1 of 2

PowerSpec - Engine Trip Information Report

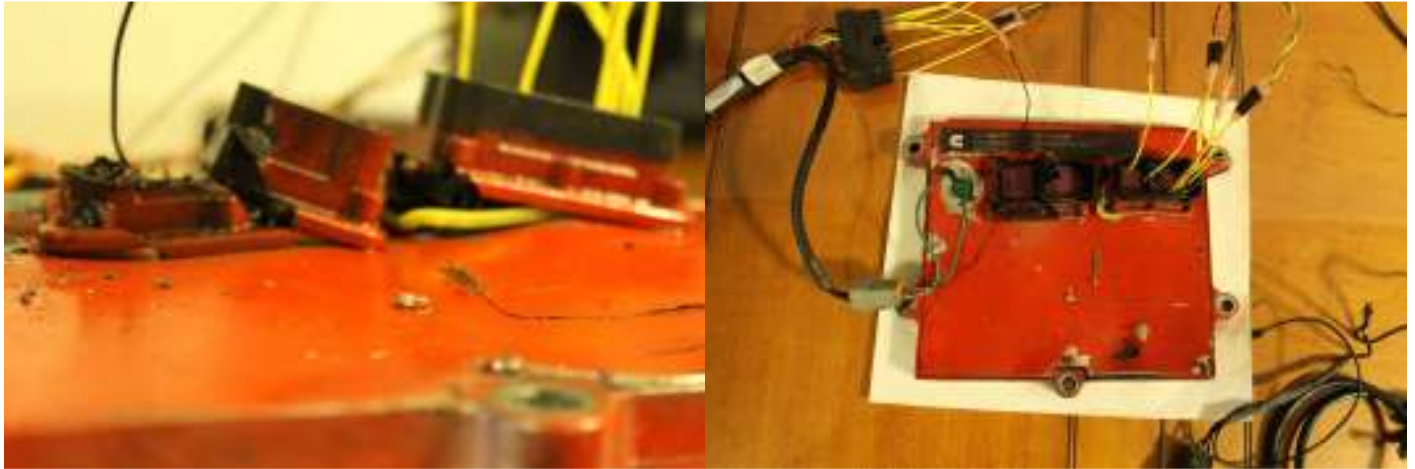
Page 1 of 2

After retrieving the available PowerSpec reports, Insite was again employed to preserve each individual report directly from the ECM. However, after retrieving slightly more than half of the available reports, communications was lost with the ECM. Having the ability to access the remaining reports from the ECM Image, no additional attempts were made to re-establish communications.

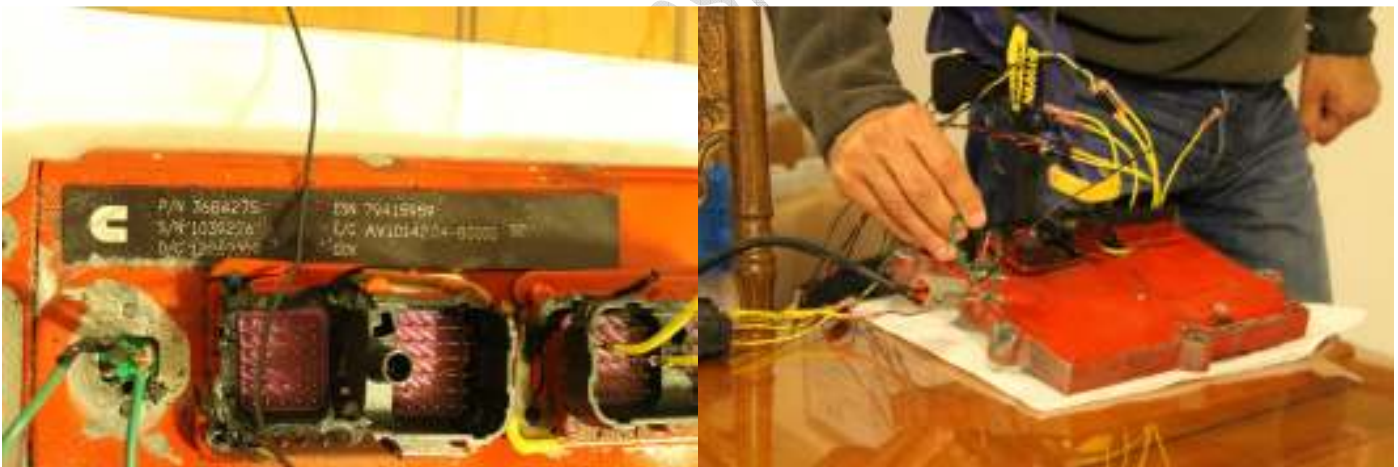
The three Sudden Deceleration Records appear to have been created over 27,000 miles prior to the instant collision. Record 1 bears an odometer stamp of 133,050.7. Records 2 and 3 bear odometers stamps of 136,862.1 and 147,252.8, respectively. With a current reported mileage of 174,989.4, it is clear these records are unrelated to the instant collision. The ECM writes the data from the circular buffer to electronically erasable programmable read-only memory (EEPROM) when the ignition key is turned off. This would constitute a loss of switched power, while unswitched power was still available to the ECM. The circumstances of this collision apparently created a loss of unswitched power, before the ECM detected the loss of switched power, which would have commanded the writing of data.

BENCH-TOP EXPERIENCE

We have had a number of opportunities to acquire data from Cummins ECMs on the workbench. Due to their forward position on the upper left side of the engine, Cummins ECMs are susceptible to damage from direct contact.



The leading four pin connector and front seventy-two pin connector are the most at risk, but the rearmost seventy-two pin connector is not immune. In this case, the housing of the four pin connector was destroyed and had to be removed to access the pins. Also, a clamp was needed to push the rearmost seventy-two pin connector back onto the circuit board. Once the connector was back in contact with the circuit board, jumpers were installed to achieve communications.



Once communications were established, the activity on the comm adapter increased and was a key indicator we had completed our connections.

In another case, the four pin connector appeared to simply have been pulled away from the circuit board. However, upon closer examination, the connector required removal, as its only connection to the ECM were the mounting screws. Careful work with a Dremel tool severed the screws, which could then be removed to prevent shorting.



Once the four pin connector was removed, special jumpers were constructed to allow clips to grasp the pins' connections on the terminal ribbon built into the circuit board.



Because of the close proximity of the ECM's aluminum housing, it was necessary to insulate the housing with electrical tape. As the clips had a tendency to twist toward each other, an index card was used to keep them separated, since it would not conduct electricity. With communications achieved, data began to flow:

