VOLVO
Volvo Trucks North America
Greensboro, NC USA

Service Bulletin Trucks

This service bulletin replaces bulletin 371–53, “Data Links, Fault Tracing,” dated 12.2012.

Date	Group	No.	Release	Page
4.2013	**371**	**53**	**02**	1(22)

Data Links, Fault Tracing
VN, VHD, VAH
From build date 02.2013

Data Links, Fault Tracing

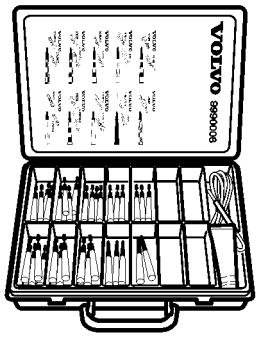
This bulletin provides fault tracing information for the vehicle communications data links associated with VOLVO VN, VHD and VAH vehicles.

Contents

Note: Information is subject to change without notice. Illustrations are used for reference only, and can differ slightly from the actual vehicle being serviced. However, key components addressed in this information are represented as accurately as possible.

Tools

Special Tools



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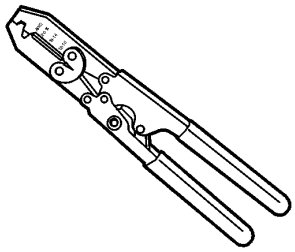
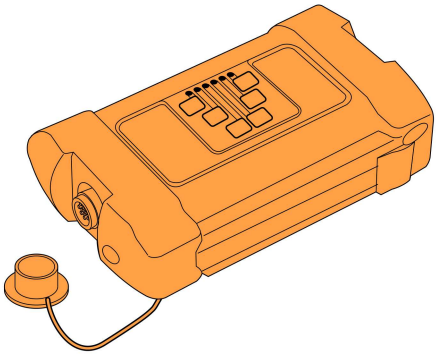
Set of Test Pins



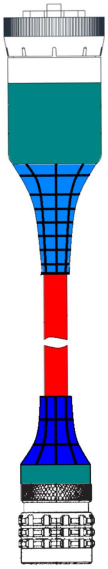
J-38125-8
Wire Crimpers

88890074
Digital Multimeter (DMM)



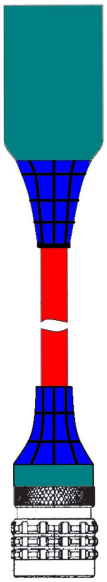
W308061

88890300
Vocom Unit



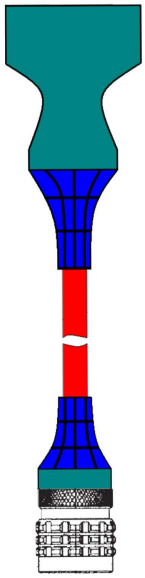
W3081494

88890302
9–pin Deutsch Cable



W3081495

88890306
FCI Cable



W3081496

88890304
ISO 14229 (OBD2013) Cable

Troubleshooting

Data Links, Fault Tracing

General Information

Note: For detailed fault tracing information refer to Tech Tool.

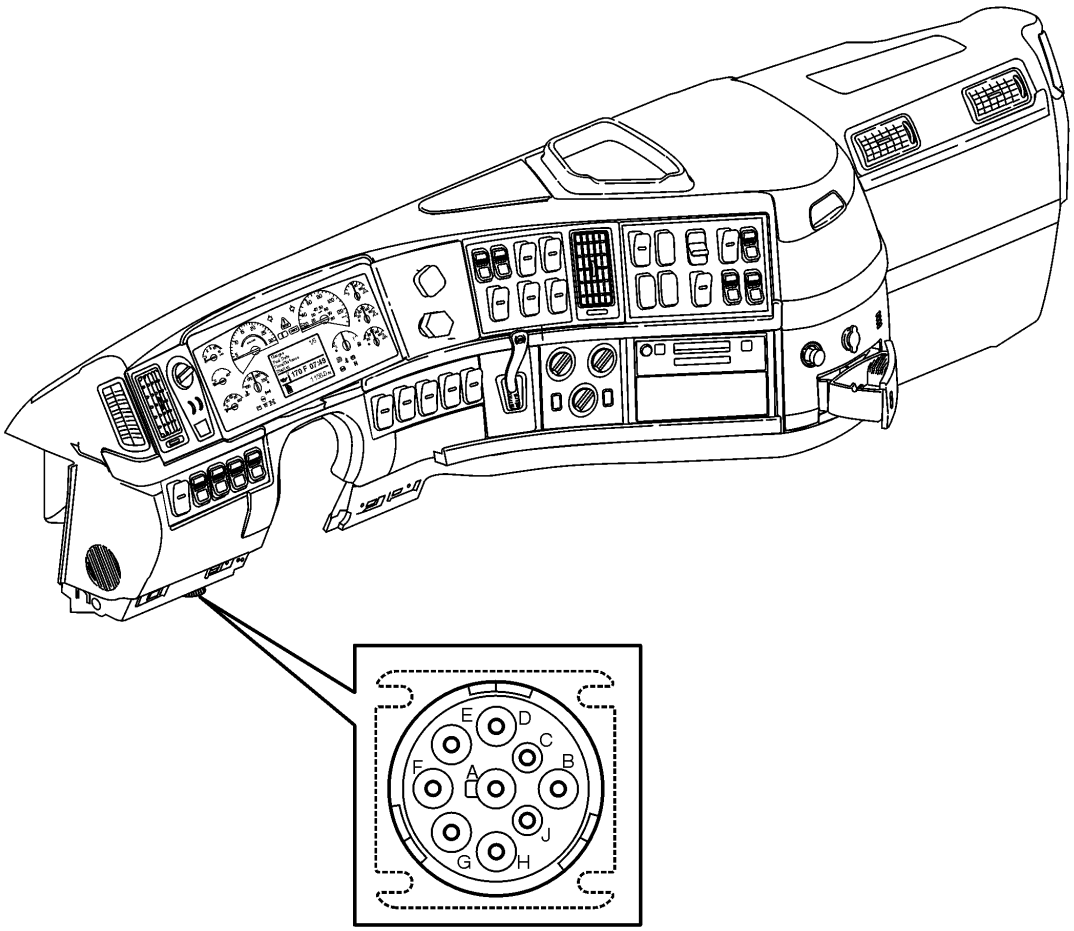
This bulletin provides information on the troubleshooting of the vehicle communications data links. These communication links are based on SAE J1587, J1708 and J1939 Recommended Practices and the ISO 14229 Standard. For more specific information about the ISO 14229 Standard, please refer to the ISO website (www.iso.org).

The data links are used to relay shared vehicle information between control modules and diagnostic, service and (in the case of onboard diagnostic (OBD) information) scan tools. The three datalink types used are SAE J1939, SAE J1587/J1708 and ISO 14229.

The Premium Tech Tool (PTT) is the preferred tool for diagnostic work for all data link faults. See your local dealer for more information.

Diagnostic Connector, 9–Pin

Since the Cummins engine does not use the ISO 14229 data link, the data link connector (DLC) for Cummins engines is the 9–pin connector. This connector is used for system diagnostics and reprogramming. The connector is located under the dashboard to the left of the steering column..



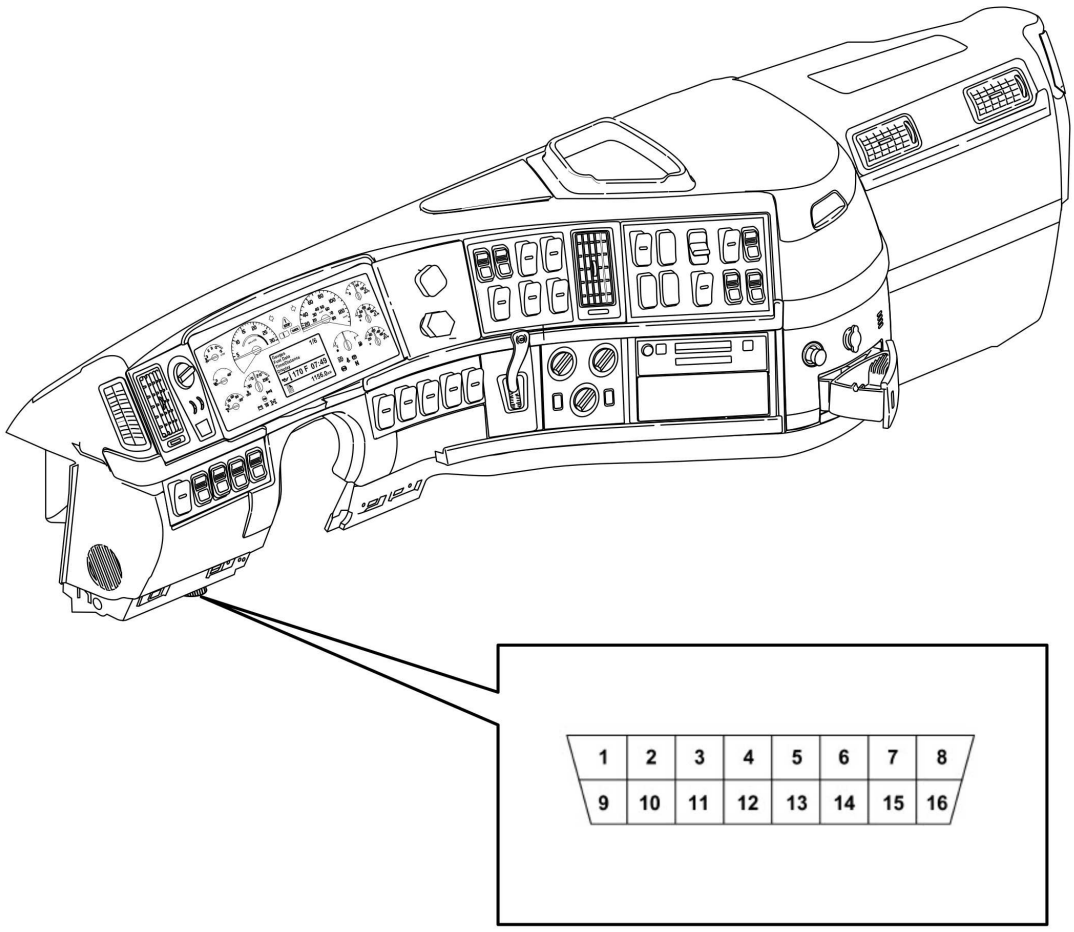
W3005648

9–pin Diagnostic Connector	
Cavity Position	**Circuit Description**
A	X03DA11 (GROUND), Gray
B	F12A1 (BATT), White with Orange Stripes
C	DL1HN4 (J1939 YELLOW 250kbps)
D	DL1LN4 (J1939 GREEN 250kbps)
E	N/A
F	DL4HN2 (J1587/J1708 H), White with Orange Stripes
G	DL4LN2 (J1587/J1708 L) , White with Orange Stripes
H	N/A
J	F15D5 (IGN), White with Orange Stripes

Note: The SAE J1939 and J1587 data links can be accessed via the 9–pin diagnostic connector.

16–Pin Data Link Connector (DLC), For Vehicles Built from January 2013

The data link connector (DLC) for vehicles built with Volvo engines is the 16 pin connector. This connector is used for system diagnostics and reprogramming. It is located under the dashboard to the left of the steering column. This port is used for connecting the diagnostic computer.



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16–pin Diagnostic Connector	
Cavity Position	**Description**
1	F7D7 (IGN) , White with Orange Stripes
2	N/A
3	DL1HN1 (J1939 YELLOW 250kbps), Yellow
4	XC1B51 (GROUND), Gray
5	XC1B52 (GROUND), Gray
6	DL2HN4 (ISO 14229 H, 500kbps) , White with Orange Stripes
7	N/A
8	N/A
9	N/A
10	N/A
11	DL1LN1 (J1939 GREEN 250kbps), Green

16–pin Diagnostic Connector	
Cavity Position	**Description**
12	DL4HN2 (J1587/J1708 H), White with Orange Stripes
13	DL4LN2 (J1587/J1708 L), White with Orange Stripes
14	DL2LN4 (ISO 14229 L, 500kbps) , White with Orange Stripes
15	N/A
16	F10A1 (BATT), White with Orange Stripes

Note: The SAE J1939 and J1587 data links can be accessed via the 16–pin DLC.

Data Link Faults

W3005017

Whenever a data link fault is present, refer to diagnostics found in the Tech Tool (TT).

- The type of FMI that an individual ECU can monitor is dependent on the software in the ECU. All FMIs cannot be recognized by all ECUs.
- The ECU reporting the fault may not be the ECU that is involved at the site of the specific failure. For example, The Engine ECU may report a data link fault that is actually at the VECU. The VECU would not be able to report if the data link is broken between the VECU and data link backbone. The usual area where a broken or damaged data link is found near the non-reporting ECU.

General Troubleshooting

Visual Inspection

Before beginning electrical checks, visually inspect the wiring and connectors.

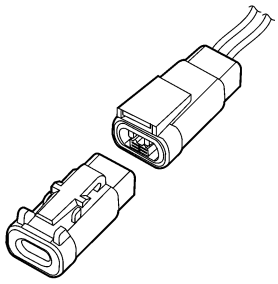
- Inspect for corrosion in wiring or connectors.
- Check for vendor installed components connected to the data link(s). If vendor components are connected, disconnect them before performing any data link fault tracing. If vendor components are connected during data link fault tracing, faulty or missing signals can occur.
- Check that terminal pins are not bent or damaged, and are locked into their connectors and properly crimped.
- Check that the terminal pins make good mechanical contact with their mating pin.
- To help locate intermittent faults, wiggle the wire and connector while testing.

Wiring and Connectors

Troubleshooting data link wiring is no different than troubleshooting any other wiring. A DMM is used to take measurements for resistance or voltage at various points in the circuit. Based on those readings and working with wiring schematics, the technician can narrow the search area until the exact cause of a wiring failure is determined.

For general information about how to troubleshoot the wiring and connectors see "Troubleshooting Wiring and Connectors" found in the "Electrical General, VN and VHD" manual in group 30.

Terminating Resistor, Checking



W3005518

Terminating Resistor, 2–pin

Terminating resistors are wired to each end of the data links to prevent signal reflections. They must remain connected for the data link to function properly. The resistance value of each terminating resistor is 110–130 Ω. When properly installed in the data link, their combined resistance is 50–70 Ω since they are connected in parallel.

The terminating resistor at one end of the data link is located in the Fuse/Relay Center near the VECU and the other near the engine ECU. On vehicles equipped with Volvo engines, the terminating resistor at the engine end is located inside the ECM. On vehicles equipped with Cummins engine, the terminating resistor is located in the harness area just outside of the Engine ECU.

A data link connection is located at the transmission area in the chassis harness. On vehicles equipped with an electronically controlled transmission (Allison/Autoshift II/Meritor Freedom Line), the connection to the transmission is located at the chassis harness. On vehicles equipped with a manual non-electronically controlled transmission - the connector stub will have an un-terminated blanking plug installed.

Only two terminating resistors are used in each data link. Never install more than two terminator resistors in one data link. If more than two terminating resistors exist in the data link circuit, damage to the ECU electronics can occur over time. For the J1939 data link, you can check to see if you have two resistors by measuring the resistance between pin C and pin D, at the diagnostic connector, with the ignition OFF. For the ISO 14229 data link, You can check to see if you have two resistors by measuring the resistance between pin 3 and 11 for the 16 pin diagnostic connector, with the ignition key in OFF position. The correct resistance for both data links is 50 – 70 Ω. The terminating resistors should each have a resistance of 110 — 130 ohms when tested individually.

If by chance a vehicle has more terminating resistors installed in the link than required, the resistance value between DL (DL1 for J1939, DL2 for ISO 14229) and DH (DH1 for J1939, DH2 for ISO 14229) will be approx. 40 ohms. This would give an indication to go and check the locations mentioned above and remove the plugs one at a time until the correct resistance reading is obtained. You should then find that you have more than one installed. To fix the problem order a blanking plug and install in the appropriate location, depending on vehicle transmission type.

To check the terminating resistors, the J1939 data link can be accessed at the 9 pin diagnostic connector.

Use a DMM to check the following:

9-pin Diagnostic Connector				
Function	**Key Position**	**Measuring Point (Diagnostic Connector)**	**Expected Value**	**If Expected Value not met, check**
Terminating Resistor Check	Off	Pin D - Pin C	50–70 Ω	1. If 110–130 Ω, one terminating resistor missing or wiring fault. 2. If >1kΩ, both terminating resistor missing or wiring fault. 3. If OLΩ (infinite), open circuit. 4. If <1Ω, short circuit in data link wires.

16-pin Diagnostic Connector for ISO 14229				
Function	**Key Position**	**Measuring Point (Diagnostic Connector)**	**Expected Value**	**If Expected Value not met, check**
Terminating Resistor Check	Off	Pin 3 – 11	50–70 Ω	1. If 110–130 Ω, one terminating resistor missing or wiring fault. 2. If >1kΩ, both terminating resistor missing or wiring fault or IGN power is on. 3. If OLΩ (infinite), open circuit. 4. If <1Ω, short circuit in data link wires.

3711-21-03-01
J1708 Information Link, Fault Tracing

Other special equipment 88890074

NOTE!

- During fault-tracing check the relevant connectors. Check for loose connections, contact resistance and oxidation. For a more detailed description of fault-tracing cables and connectors, see separate service information under group 37.
- Do not use the chassis as a ground when taking readings. Use ground studs located as close to components as possible.
- For measurement points and values refer to page 12

Additional information

When checking the data link measurement and the values are outside of the given ranges, there are several possible explanations.

1

If the voltage is approximately, greater than 5 V DC the data link is possibly shorted to a higher voltage and must be inspected to find the cause.

A wire of higher voltage could be cross connected to the data link via chaffing or pin misalignment at connectors or control units, etc.

A second, but least likely, possibility is that the internal data bus of an ECU has failed in some way causing an interruption of messaging on the link. If this is suspected, disconnect the suspect ECU temporarily or either connect a spare ECU to check if the problem goes away.

2

If the voltage is approximately less than 2 V DC the data link is possibly shorted to ground and must be inspected to find the cause.

A wire of lower voltage or ground type could be cross connected to the data link via chaffing or pin misalignment at connectors or control units, etc.

Either one or both of the data link wires are shorted to ground via a rub through (chaff). Inspect the entire data link for possible signs of abrasion. Repair according to guidelines outlined in this manual.

A third, but least likely, possibility is that the internal data bus of an ECU has failed in some way causing an interruption of messaging on the link. If this is suspected, disconnect the suspect ECU temporarily or connect a spare ECU to check if the problem goes away.

Checking Sub-Systems

1

Conditions:

- Measurement box with adapter connected between the relevant control unit and cable harness.
- Measuring voltage using the multimeter with the MIN / MAX- function engaged.
- Control unit connected.
- The ignition key in the drive position.

Measuring points	**Desired value**
J1708/J1587 A and ground	V ≈ 0 - 5 V DC[1]
J1708/J1587B and ground	V ≈ 0 - 5 V DC[1]
J1708/J1587 A and J1708/J1587 B	V ≈ 2 - 5 V DC

Note: The voltage on the information link varies and is dependent on the number of control units and traffic on the information link.

88890074

3711-21-03-02
J1939 Control Link, Fault Tracing

You must read and understand the precautions and guidelines in Service Information, group 30, "General Safety Practices", before performing this procedure. If you are not properly trained and certified in this procedure, ask your supervisor for training before you perform it.

Other special equipment 88890074

NOTE!

- During fault-tracing check the relevant connectors. Check for loose connections, contact resistance and oxidation. For a more detailed description of fault-tracing cables and connectors, see separate service information under group 37.
- Do not use the chassis as a ground when taking readings. Use ground studs located as close to components as possible.
- For measurement points and values refer to page 13

Checking Sub-Systems

1

Conditions:

- Measurement box with adapter connected between the relevant control unit and cable harness.
- Control unit connected.
- Measuring voltage using multi meter 88890074 with the MIN MAX-function connected.
- Ignition key in the drive position.

Note: The voltage of the control link varies and depends on the number of control units and the traffic on the control link.

Measuring points	Desired value
DL1H yellow and ground	V ≈ 2 - 5 V DC
DL1L green and ground	V ≈ 0 - 3 V DC
DL1H and DL1L green	V ≈ 0 - 1 V DC

88890074

2

Conditions:

- Measurement box with adapter connected between the relevant control unit and cable harness.
- Control unit connected.
- Measuring resistance using a multimeter.
- Ignition key in stop position.

Measuring points	Desired value
DL1L - DL1H Two terminations	R = 50 - 70 Ω
DL1L - DL1H One termination	R = 110 – 130 Ω

Comments:

When the resistance R ≈ 50–70 Ω the cable harness is probably fault free from the particular connector to two terminating resistors.

If the resistance R ≈ 110–130 Ω from the relevant connector then measuring is only conducted to the terminating resistor.

88890074

3711-21-03-03
ISO 14229 Control Link, Fault Tracing

You must read and understand the precautions and guidelines in Service Information, group 30, "General Safety Practices", before performing this procedure. If you are not properly trained and certified in this procedure, ask your supervisor for training before you perform it.

Other special equipment 88890074

NOTE!

- During fault-tracing check the relevant connectors. Check for loose connections, contact resistance and oxidation. For a more detailed description of fault-tracing cables and connectors, see separate service information under group 37.
- Do not use the chassis as a ground when taking readings. Use ground studs located as close to components as possible.
- For measurement points and values refer to page 13

Checking Sub-Systems

1

Conditions:

- Measurement box with adapter connected between the relevant control unit and cable harness.
- Control unit connected.
- Measuring voltage using multi meter 88890074 with the MIN MAX-function connected.
- Ignition key in the drive position.

Note: The voltage of the control link varies and depends on the number of control units and the traffic on the control link.

Measuring points	Desired value
DL2H white with orange and ground	V ≈ 2 - 5 V DC
DL2L white with orange and ground	V ≈ 0 - 3 V DC
DL2H and DL2L white with orange	V ≈ 0 - 1 V DC

88890074

2

Conditions:

- Measurement box with adapter connected between the relevant control unit and cable harness.
- Control unit connected.
- Measuring resistance using a multimeter.
- Ignition key in stop position.

Measuring points	Desired value
DL2L - DL2H Two terminations	R = 50 - 70 Ω
DL2L - DL2H One termination	R = 110 – 130 Ω

Comments:

When the resistance R ≈ 50–70 Ω the cable harness is probably fault free from the particular connector to two terminating resistors.

If the resistance R ≈ 110–130 Ω from the relevant connector then measuring is only conducted to the terminating resistor.

88890074

J1939/ ISO 14229 Data Link Troubleshooting Example

Note: Always refer to vehicle-specific wiring schematics found in Group 37 when performing vehicle troubleshooting.

1

Begin by visually verifying that the two terminating resistors are in place:

1a. One at the engine ECU. Vehicle equipped with the VOLVO engine, the terminating resistor is built into the ECM and is not visible. Vehicles with Cummins engines the terminating resistor is located on the engine harness.

1b. One inside the cab, forward of the fuse/relay panel (visible when the fuse/relay cover is removed).

2

Using an ohmmeter with the ignition key switch in the OFF position, check the resistance between CAN_H yellow and CAN_L green at the diagnostic connector.

2a. If 50–70 Ω resistance is measured, it is likely that the backbone circuit is intact, since the 50–70 Ω represents the two 120 Ω terminating resistors in parallel. If trouble is still present, it is most likely in one of the ECU stub circuits or at the ECU terminal themselves. Go to Step 6.

2b. If approximately 110–130 Ω resistance is measured, this indicates that one of the terminating resistors is missing, poorly connected or else there is an open circuit in the backbone at some point. Use the fault codes (if present) to narrow down the likely location based on which ECU's are complaining about missing data from other ECU's. Go to Step 3.

2c. If approximately 40 Ω resistance is measured, there are more than 2 terminating resistors installed. To fix the problem order a blanking plug and install in the appropriate location, depending on vehicle transmission type.

3

Disconnect the Cab-chassis/pass-through connector (item 6) at the bulkhead and re-test the resistance of CAN_H and CAN_L at the diagnostic connector.

3a. If the resistance is the same as that measured in Step 2b, then that means the trouble is likely on the chassis side of the cab-chassis pass-through, since the 110–130 Ω being measured must be terminating resistor located in the cab. Go to Step 4.

3b. If the resistance is greater than what was measured in Step 2b, then the trouble is likely on the cab side of the harness, since the different reading means you can no longer 'see' the engine side terminating resistor. Go to Step 5.

4
With the pass-through (item 6) still disconnected, check the resistance between circuit CAN_H and CAN_L on the chassis harness side of the pass-through, 'looking' towards the engine (110–130 Ω should be present). While shaking/moving the harnesses to look for an intermittent connection, check the following items:

- Check for continuity between all CAN_H points — pass-though, ECM, terminating resistor, and transmission (if automated/automatic transmission)
- Check for continuity between all CAN_L points — pass-though, ECM, terminating resistor, and transmission (if automated/automatic transmission)

The CAN_H and CAN_L backbone circuits can, also, be disconnected at the engine-to-chassis harness in-line connector (item 5 — located near the starter relay breakout, near the bulkhead) to further isolate whether the problem exists on the 'engine' side or the 'chassis' side.

5
With the pass-through (item 6) still disconnected, check the resistance between circuit CAN_H and CAN_L on the cab side of the pass-through, 'looking' into the cab (110–130 Ω should be present). While shaking/moving the harnesses to look for an intermittent connection, check the following items:

- Check for continuity between all CAN_H points.
- Check for continuity between all CAN_L points.

6
Check for continuity between CAN_H at the diagnostic connector and all CAN_H points at the ECU's and terminating resistors. All CAN_H points should have continuity to all other ECU's. Perform the same tests for all CAN_L points.
If continuity is not found at all points, the trouble is most likely in the stub to that ECU, or the ECU connector/terminal itself.

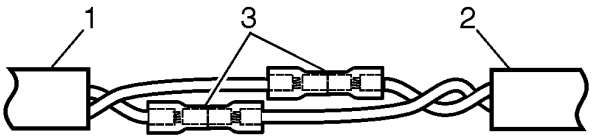
Service Procedures

3711-16-02-06
J1939/ISO 14229 Data Link Wiring (Unshielded), Repair

You must read and understand the precautions and guidelines in Service Information, group 30, "General Safety Practices", before performing this procedure. If you are not properly trained and certified in this procedure, ask your supervisor for training before you perform it.

Note: This procedure complies with TMC RP142 “High-Speed Data Link Repair Guidelines.”

Note: Stagger wire cuts and splices to minimize bulges in data link cable.



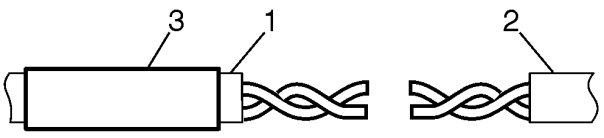
W3004993

1 Cable bundle, existing
2 Cable bundle, new
3 Heat-shrinkable connector

1
Make certain the vehicles ignition is OFF before beginning this procedure.

2
Remove the data link from the wiring harness as necessary and cut out the damaged section of cable. Note: The replacement section of cable (P/N 982689) must be somewhat longer than the original to allow for staggering of the splices.

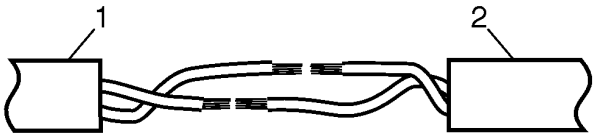
3
Strip approximately 50 mm (2 in.) of cable jacket and shield at each end of the splices to expose the wiring. Use caution not to cut the wire insulation.



W3004994

4
Slide a piece of heat-shrink tubing over each end of the cut cable bundle to seal the data link after the wires have been spliced. The tubing should be approximately 50 mm (2 in.) longer than the repair area.

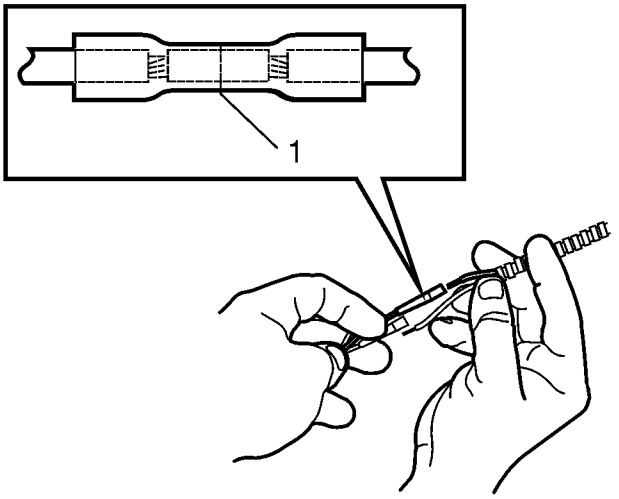
1 Cable bundle, existing
2 Cable bundle, new
3 Heat-shrink tubing



W3004995

1 Cable bundle, existing
2 Cable bundle, new

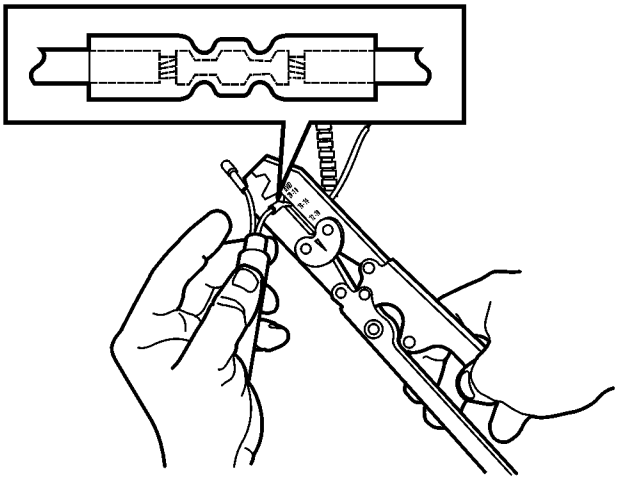
5
Stagger cut the wiring to minimize bulges in the data link cable. Strip approximately 6.3 mm (0.25 in.) of wiring insulation at each wire end. Use caution not to cut the wire strands.



W3004996

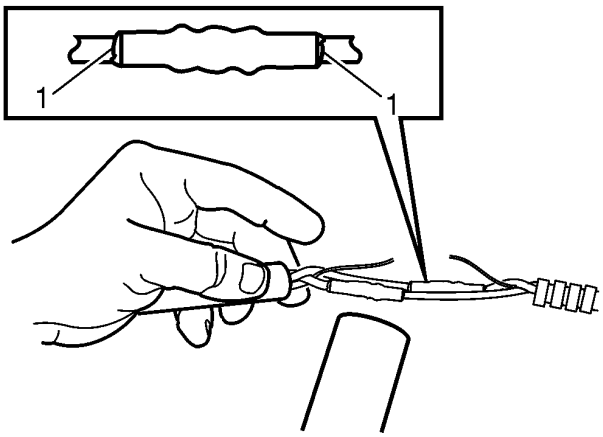
1 Wire stop

6
Observe polarity when connecting the CAN-H, yellow and CAN-L, green wires. Use a heat shrinkable wiring connector to splice the wires together. Insert each end of the wire into the connector until it hits the wire stop.



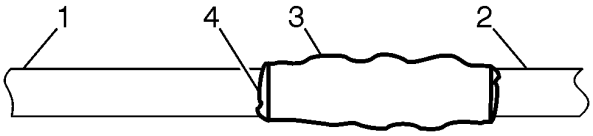
W3004997

7
Insert the connector into the proper anvil on the crimping tool and crimp. Gently tug on the spliced connection to be sure the wire is secure.



W3004889

1 Visible sealant



W3004883

1 Cable bundle, existing
2 Cable bundle, new
3 Heat shrink tubing
4 Visible sealant

8

Use a heat gun to activate the heat shrink. Look for sealant at each end of the connector as evidence of a good application. Note: Do not use an open flame to apply heat shrink.

9

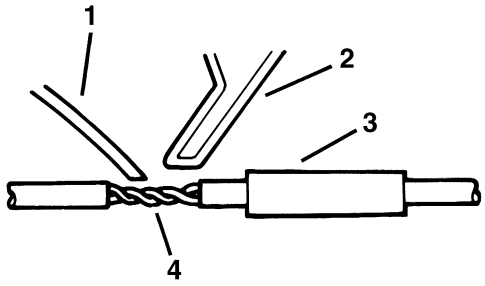
Center the piece of heat shrinkable tubing installed in step 5 over the entire splice area. There should be approximately 25 mm (1 in.) overlap at each end of the splice area. Starting at the center, use a heat gun to shrink the tubing. Look for sealant at each end of the connector as evidence of a good application. Note: Do not use an open flame to apply heat shrink.

10

After both ends of the cable are spliced, install the data link back into the wiring harness and secure as necessary.

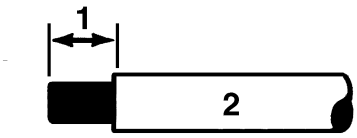
Wire Splice, Solder and Seal

You must read and understand the precautions and guidelines in Service Information, group 30, "General Safety Practices", before performing this procedure. If you are not properly trained and certified in this procedure, ask your supervisor for training before you perform it.



W3000568

Fig. 1 Wire splicing
1 Solder
2 Soldering iron
3 Heat shrink tubing with sealant
4 Wires twisted



W3000569

1 Strip as necessary
2 Wire

Soldering Procedure

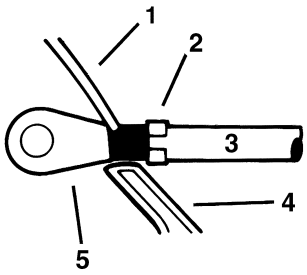
1
Clean and tin the soldering iron tip.

2
Clean the terminal to be soldered.

3
Strip the wire as necessary to fit the terminal. Do not cut or nick the wire when stripping. Note: The replacement section of cable (P/N 982689) must be somewhat longer than the original to allow for staggering of the splices.

4
Slide a piece of sealant shrink tubing onto the wire.

5
Insert the wire in the terminal and, with a pair of crimpers (as recommended by the connector manufacturer), squeeze the small tabs onto the wire insulation. Not all types of terminals have these tabs. Be certain to use the crimpers recommended by the connector manufacturer. With a blunt instrument, form the bare wire so that it will lay against the soldering area of the terminal.



W3000571

1 Solder
2 Tabs (crimp over wire insulation)
3 Wire
4 Soldering iron
5 Terminal

6

Using the soldering iron, apply heat to the outside of the terminal while holding the solder on the wire on the inside of the terminal. When a sufficient amount of heat has been transferred from the gun through the terminal and into the wire, the solder will be melted by the wire. Melt a sufficient amount of solder on the wire and withdraw the solder and the tip of the iron.

NOTE: Do not hold the terminal with pliers or anything metal during the solder operation, as heat will be conducted away from the terminal.

7

Slide the sealant shrink tubing over the soldered connection, making sure all exposed wire is covered. Heat the tubing with a heat gun to shrink. Shrink until the tubing is tight around the wire and the sealant is visible out of both ends of the tubing.