

2010 ELECTRICAL

Wiring Systems and Power Management - Equinox & Terrain

DIAGNOSTIC INFORMATION AND PROCEDURES

DIAGNOSTIC CODE INDEX

DIAGNOSTIC CODE INDEX

DTC	Description
<u>DTC B1370-B1379, B1380-B1389, or B1440-B1443</u>	B1370 01: Control Module Ignition On and Start Circuit Short to Battery B1370 04: Control Module Ignition On and Start Circuit Open B1380 01: Control Module Ignition Accessory Circuit Short to Battery B1380 04: Control Module Ignition Accessory Circuit Open B1441 01: Control Module Ignition Off, Run, and Start Circuit Short to Battery B1441 04: Control Module Ignition Off, Run, and Start Circuit Open
<u>DTC B1445</u>	B1445 02: Control Module Voltage Output Circuit Short to Ground
<u>DTC B144A</u>	B144A 02: RUN Power Relay Circuit Short to Ground
<u>DTC B144B</u>	B144B 02: RUN/CRNK Relay Circuit Short to Ground
<u>DTC B147E</u>	B147E 02: Battery Saver Relay Set Secondary Circuit Short to Ground
<u>DTC B147F</u>	B147F 02: Battery Saver Relay Reset Secondary Circuit Short to Ground

DTC B1370-B1379, B1380-B1389, OR B1440-B1443

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B1370 01

Control Module Ignition On and Start Circuit Short to Battery

DTC B1370 04

Control Module Ignition On and Start Circuit Open

DTC B1380 01

Control Module Ignition Accessory Circuit Short to Battery

DTC B1380 04

Control Module Ignition Accessory Circuit Open

DTC B1441 01

Control Module Ignition Off, Run, and Start Circuit Short to Battery

DTC B1441 04

Control Module Ignition Off, Run, and Start Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	B1370 04, B1380 04	B1370 04, B1380 04	-	-
Ignition Terminal 1	B1370 04, B1380 04	B1370 04, B1380 04	B1370 01	-
Ignition Terminal 3	B1370 04, B1380 04	B1380 04	B1380 01	-
Ignition Terminal 4	B1370 04, B1380 04, B1441 04	B1441 04	B1441 01	-
5 V REF	-	1	-	-
1. Power Mode Mismatch				

Circuit/System Description

The vehicle power mode master is the body control module (BCM). The ignition switch is a low current switch with multiple discrete circuits to the BCM. The BCM logic uses the ignition switch positions to identify the operator's desired power mode and activate specific discrete signals, and serial data messages for the operation of different subsystems as necessary. Other modules which have switched voltage inputs may operate in a default mode if the power mode master serial data message does not match what the individual module can detect from its own connections.

The power mode master will activate relays and other direct outputs of the power mode master as needed according to the calculated power mode. Some relays controlled by the BCM are switched ignition voltage outputs that are pass through circuits within the BCM directly from the ignition switch. If these circuits short to ground, the B+ circuit fuse to the ignition switch will open.

Conditions for Running the DTC

B1370 01, B1370 04

Ignition switch is in the RUN or CRANK positions.

B1380 01, B1380 04

Ignition switch is in the RUN or ACCESSORY positions.

B1441 01, B1441 04

Ignition switch is in the CRANK position.

Conditions for Setting the DTC

B1370 01

Ignition circuit is shorted to voltage.

B1370 04

- Ignition circuit is open.
- Ignition, accessory, or off/run/crank circuit shorted to ground.
- B+ circuit of the ignition switch is open or shorted to ground.
- Ignition relay control circuit open, including relay coil and ground.

B1380 01

Ignition, accessory circuit is shorted to voltage.

B1380 04

- Ignition, accessory circuit is open.
- Ignition, accessory, or off/run/crank circuit shorted to ground.
- B+ circuit of the ignition switch is open or shorted to ground.

B1441 01

Ignition, off/run/crank signal circuit is shorted to voltage.

B1441 04

Ignition, off/run/crank signal circuit is open.

Actions Taken When the DTC Sets

- The BCM operates in a fail-safe power mode dependent on the last valid power mode detected and the state of the engine run flag data on the serial data communications circuits.
- The other modules on the vehicle operate in a fail-safe power mode dependent on the last valid power mode transmitted by the BCM and the state of the engine run flag on the serial data communications circuits.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 50 consecutive malfunction-free ignition cycles have occurred.

Reference Information

Schematic Reference

- **Body Control System Schematics**
- **Power Distribution Schematics**
- **Power Moding Schematics**

Connector End View Reference

Component Connector End Views

Description and Operation

Power Mode Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

With a scan tool, access Power Mode data display list and compare all parameters listed with the corresponding ignition key position. The Power Mode Parameters table below illustrates the correct state of these input parameters in correspondence to the S39 ignition switch position. The circuits which the individual parameters are related to are in parentheses.

Power Mode Parameters

Ignition Switch Position	5 V IGN (Ignition Switch, Terminal 4 and 6)	Accessory (Ignition Switch, Terminal 3)	Run/Crank (Ignition Switch, Terminal 1)
Off Key Out	Key Out/ACC	Inactive	Inactive
Off Key IN	Key In/Off	Inactive	Inactive
Accessory	Key Out/ACC	Active	Inactive
Run	Run	Active	Active

Start	Crank Request	Inactive	Active
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Circuit/System Testing

1. Disconnect the harness connector at the S39 ignition switch.
2. Verify that a test lamp illuminates between B+ circuit terminal 2 and ground.
 - If the test lamp does not illuminate, test the B+ circuit for a short to ground or an open/high resistance. If the circuit tests normal and the B+ circuit fuse is open, test the ignition circuits listed below for a short to ground.

NOTE: To help isolate a short to ground, it may be necessary to disconnect modules that are connected to the following circuits:

- terminal 1
 - terminal 3
 - terminal 4
 - terminal 6
3. Ignition ON, test for 4.8-5.2 V between the 5 V reference circuit terminal 6 and ground.
 - If less than 4.8 V, test the 5 V reference circuit for a short to ground or an open/high resistance. If the circuit tests normal, replace the BCM.
 - If greater than 5.2 V, test the 5 V reference circuit for a short to voltage. If the circuit tests normal, replace the BCM.
 4. Verify the scan tool ignition 5 V reference signal is less than 4.2 V.
 - If greater than 4.2 V, test the ignition signal circuit terminal 4 for a short to voltage. If the circuit tests normal, replace the BCM.
 5. Install a 3 A fused jumper wire between the ignition signal circuit terminal 4 and the 5 V reference circuit terminal 6. Verify the scan tool Ignition Signal Voltage parameter is greater than 4.2 V.
 - If less than 4 V, test the signal circuit for a short to ground or an open/high resistance. If the circuit tests normal, replace the BCM.
 6. Connect the harness connector at the S39 ignition switch.
 7. Ignition OFF, key out, disconnect the X3 harness connector at the K9 BCM. Verify that a test lamp does not illuminate between the ignition circuit terminals listed below and ground:
 - terminal 5
 - terminal 6
 - terminal 15
 - terminal 22
 - If the test lamp illuminates, test the ignition circuits for a short to voltage. If the circuit tests normal, replace the S39 ignition switch.
 8. Ignition in the ACCESSORY position, verify that a test lamp illuminates between the terminal 5 and ground.
 - If the test lamp does not illuminate, test the ignition circuit for an open/high resistance. If the circuit

tests normal, replace the S39 ignition switch.

9. Ignition in the CRANK position, verify that a test lamp illuminates between terminal 6 and ground.
 - If the test lamp does not illuminate, test the ignition circuit for an open/high resistance. If the circuit tests normal, replace the S39 ignition switch.
10. If all of the circuits test normal, replace the K9 BCM.

Component Testing

Ignition Switch

1. Ignition OFF, disconnect the harness connector at the S39 ignition switch.
2. Verify the resistance between the terminals listed below match for each S39 ignition switch position.
 - If not the specified value, replace the S39 ignition switch.

Resistance Test

Ignition Switch Position	Terminals 1 and 2	Terminals 2 and 3	Terminals 2 and 4	Terminals 2 and 6	Terminals 4 and 6
Off Key Out	Infinite	Infinite	Infinite	Infinite	Infinite
Off Key IN	Infinite	Infinite	< 5.0 ohms	Infinite	Infinite
Accessory	Infinite	< 5.0 ohms	Infinite	Infinite	Infinite
Run	< 5.0 ohms	< 5.0 ohms	Infinite	Infinite	< 5.0 ohms
Start	< 5.0 ohms	Infinite	Infinite	Infinite	1275-1325 ohms

Repair Procedures

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Ignition and Start Switch Replacement**
- **Control Module References** for BCM replacement, setup, and programming

DTC B1445

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B1445 02

Control Module Voltage Output Circuit Short to Ground

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Auxiliary Power Relay Switch B+	1	1	1	-
Auxiliary Power Relay Control	B1445 02	1	1	-
Auxiliary Power Relay Ignition	1	1	1	-
Auxiliary Power Relay Ground	-	1	-	-
1. Retained Accessory Power Malfunction				

Circuit/System Description

The body control module (BCM) controls the wired accessory power components by applying voltage to the ignition voltage circuit at harness connector X4 terminal 12. Voltage is applied when the ignition switch is in the ACCESSORY or the ON position.

Conditions for Running the DTC

- The system voltage is between 9-16 V.
- The DTC can only set when the output is actively being requested by the module. Refer to Circuit/System Description for specific conditions.

Conditions for Setting the DTC

The DTC will set only when the module requests the output and there is a short to ground in the ignition voltage circuit.

Action Taken When the DTC Sets

The module output driver will be shut down and not supply voltage to the circuit.

Conditions for Clearing the DTC

- The current DTC will clear when the malfunction is no longer present.
- A history DTC clears when the module ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Reference Information

Schematic Reference

Power Distribution Schematics

Power Moding Schematics

Connector End View Reference

Component Connector End Views

Description and Operation

Retained Accessory Power Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF, disconnect the KR70 auxiliary power relay.
2. Test for less than 10 ohms between the control circuit and ground.
 - If greater than the specified range, test the ground circuit for an open/high resistance.
3. Connect a test lamp between the relay control circuit terminal 2 and ground.
4. Cycle the ignition ON and OFF. The test lamp should turn ON and OFF when changing ignition switch positions.
 - If the test lamp is always ON, test the control circuit for a short to voltage. If the circuit tests normal, replace the K9 BCM.
 - If the test lamp is always OFF, test the control circuit for a short to ground or open/high resistance. If the circuit tests normal, replace the K9 BCM.
5. If all circuits test normal, test or replace the KR70 auxiliary power relay.

Component Testing

1. Ignition OFF, disconnect the KR70 auxiliary power relay.
2. Test for 70 - 150 ohms between terminals control circuit terminal 2 and ground terminal 1.
 - If not within the specified range, replace the KR70 auxiliary power relay.
3. Test for infinite resistance between the following terminals:
 - 1 and 3
 - 1 and 5
 - 2 and 3
 - 3 and 5
 - If not the specified value, replace the KR70 auxiliary power relay.
4. Install a 3 A fused jumper wire between relay terminal 1 and 12 V. Install a jumper wire between relay

terminal 2 and ground. Test for less than 2 ohms between terminals 3 and 5.

- If greater than the specified range, replace the KR70 auxiliary power relay.

Repair Procedures

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

Control Module References for BCM replacement, setup, and programming

DTC B144A

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B144A 02

RUN Power Relay Circuit Short to Ground

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Ignition 1 Relay Control	B144A 02	1	2	-
1. No Start. 2. Vehicle will start and continue to run after the ignition key is removed.				

Circuit/System Description

The body control module (BCM) controls the ignition 1 relay through the control circuit by applying voltage to the circuit. The ignition 1 relay is energized when the ignition switch is in ON or START, or when a remote start is requested.

Conditions for Running the DTC

- The system voltage is between 9-16 V.
- The DTC can only run when the output is activated.

Conditions for Setting the DTC

The BCM detects a short to ground in the ignition 1 relay control circuit.

Action Taken When the DTC Sets

The module output driver will be shut down and not supply voltage to the ignition 1 relay control circuit.

Conditions for Clearing the DTC

- The current DTC will clear when the module request for the output is removed or the malfunction is no longer present.
- A history DTC clears when the module ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Diagnostic Aids

Short to voltage in the ignition 1 relay control circuit will cause the malfunction indicator lamp (MIL) to illuminate with the ignition key OFF, and the engine will remain running if started and the ignition key is removed.

Reference Information

Schematic Reference

- **Body Control System Schematics**
- **Power Distribution Schematics**

Connector End View Reference

Component Connector End Views

Description and Operation

Power Mode Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF, disconnect the KR73 ignition main relay.
2. Connect a test lamp between the relay control circuit terminal 1 and ground.
3. Cycle the ignition ON and OFF. The test lamp should turn ON and OFF when changing S39 ignition

switch positions.

- If the test lamp is always ON, test the control circuit for a short to voltage. If the circuit tests normal, replace the K9 BCM.
 - If the test lamp is always OFF, test the control circuit for a short to ground or open/high resistance. If the circuit tests normal, replace the K9 BCM.
4. If all circuits test normal, test or replace the KR73 ignition main relay.

Component Testing

1. Ignition OFF, disconnect the KR73 ignition main relay.
2. Test for 70-150 ohms between terminals 1 and 2.
 - If the resistance is not within the specified range, replace the KR73 ignition main relay.
3. Test for infinite resistance between the following terminals:
 - 1 and 3
 - 2 and 3
 - 2 and 5
 - 3 and 5
 - If less than specified, replace the KR73 ignition main relay.
4. Install a 3 A fused jumper wire between relay terminal 2 and 12 V. Install a jumper wire between relay terminal 1 and ground. Measure for less than 5 ohms between terminals 3 and 5.
 - If greater than specified, replace the KR73 ignition main relay.

Repair Procedures

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Relay Replacement (Attached to Wire Harness)** or **Relay Replacement (Within an Electrical Center)**
- **Control Module References** for BCM replacement, setup, and programming

DTC B144B

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B144B 02

RUN/CRNK Relay Circuit Short to Ground

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
RUN/CRNK Relay Control	B144B 02	1	2	-
1. No Start. 2. Vehicle will start and continue to run after the ignition key is removed.				

Circuit/System Description

The body control module (BCM) controls the RUN/CRNK relay through the control circuit by applying voltage to the circuit. The ignition RUN/CRNK is energized when the ignition switch is in ON or START, or when a remote start is requested.

Conditions for Running the DTC

- The system voltage is between 9-16 V.
- The DTC can only run when the output is activated.

Conditions for Setting the DTC

The BCM detects a short to ground in the RUN/CRNK relay control circuit.

Action Taken When the DTC Sets

The module output driver will be shut down and not supply voltage to the RUN/CRNK relay control circuit.

Conditions for Clearing the DTC

- The current DTC will clear when the module request for the output is removed or the malfunction is no longer present.
- A history DTC clears when the module ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Diagnostic Aids

Short to voltage in the RUN/CRNK relay control circuit will cause the malfunction indicator lamp (MIL) to illuminate with the ignition key OFF, and the engine will remain running if started and the ignition key is removed.

Reference Information

Schematic Reference

- Body Control System Schematics
- Power Distribution Schematics

Connector End View Reference

Component Connector End Views

Description and Operation

Power Mode Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF, disconnect the KR73 RUN/CRNK relay.
2. Connect a test lamp between the relay control circuit terminal 85 and terminal 86.
3. Cycle the ignition ON and OFF. The test lamp should turn ON and OFF when changing S39 ignition switch positions.
 - If the test lamp is always ON, test the control circuit for a short to voltage. If the circuit tests normal, replace the K9 BCM.
 - If the test lamp is always OFF, test the control circuit for a short to ground or open/high resistance. If the circuit tests normal, replace the K9 BCM.
4. If all circuits test normal, test or replace the KR73 RUN/CRNK relay.

Component Testing

1. Ignition OFF, disconnect the KR73 RUN/CRNK relay.
2. Test for 70-150 ohms between terminals 85 and 86.
 - If the resistance is not within the specified range, replace the KR73 RUN/CRNK relay.
3. Test for infinite resistance between the following terminals:
 - 30 and 86
 - 30 and 87
 - 30 and 85
 - 85 and 87
 - If less than specified, replace the KR73 RUN/CRNK relay.
4. Install a 3 A fused jumper wire between relay terminal 86 and 12 V. Install a jumper wire between relay

terminal 85 and 86. Measure for less than 5 ohms between terminals 87 and 85.

- If greater than specified, replace the KR73 RUN/CRNK relay.

Repair Procedures

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Relay Replacement (Attached to Wire Harness)** or **Relay Replacement (Within an Electrical Center)**
- **Control Module References** for BCM replacement, setup, and programming

DTC B147E

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B147E 02

Battery Saver Relay Set Secondary Circuit Short to Ground

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Battery Saver Relay - Control Circuit	B147E 02	-	-	-

Circuit/System Description

The battery saver mode reduces the parasitic load of some modules during overseas shipment or during vehicle storage conditions. This improves the drain time on the battery of up to 70 days without the battery going dead. When the vehicle is in transport/storage, some features may have reduce functionality as a result being in the battery saver mode, such as disabling the Remote Function Actuator or content theft features.

The battery saver mode incorporates a latching relay that when enabled disconnects some modules from their ignition off power or memory power sources. Battery saver mode is initiated by starting the vehicle and then turning the ignition key into the crank position for greater than 15 seconds. The mode is disengaged by repeating the previous process causing the relay to latch in the other direction. This feature can be used as many times as necessary if the vehicle is to be stored for an extended period of time.

Conditions for Running the DTC

- The system voltage is between 9-16 V.

- The DTC can only run when the output is activated.

Conditions for Setting the DTC

The BCM detects a short to ground in the battery saver relay set circuit.

Action Taken When the DTC Sets

The module output driver will be shut down and not supply voltage to the battery saver relay set circuit.

Conditions for Clearing the DTC

- The current DTC will clear when the module request for the output is removed or the malfunction is no longer present.
- A history DTC clears when the module ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Reference Information

Schematic Reference

- **Body Control System Schematics**
- **Power Distribution Schematics**

Connector End View Reference

Component Connector End Views

Description and Operation

Power Mode Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF, disconnect the KR104A battery saver relay.

2. Connect a test lamp between the relay control circuit and ground.
3. Enable and disable the batter saver mode. The test lamp should turn ON and OFF when changing the relay latch positions.
 - If the test lamp is always ON, test the control circuit for a short to voltage. If the circuit tests normal, replace the K9 BCM.
 - If the test lamp is always OFF, test the control circuit for a short to ground or open/high resistance. If the circuit tests normal, replace the K9 BCM.
4. If all circuits test normal, test or replace the KR104A battery saver relay.

Repair Procedures

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Relay Replacement (Attached to Wire Harness)** or **Relay Replacement (Within an Electrical Center)**
- **Control Module References** for BCM replacement, setup, and programming

DTC B147F

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptor

DTC B147F 02

Battery Saver Relay Reset Secondary Circuit Short to Ground

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Battery Saver Relay - Control Circuit	B147F 02	-	-	-

Circuit/System Description

The battery saver mode reduces the parasitic load of some modules during overseas shipment or during vehicle storage conditions. This improves the drain time on the battery of up to 70 days without the battery going dead. When the vehicle is in transport/storage, some features may have reduce functionality as a result being in the battery saver mode, such as disabling the Remote Function Actuator or content theft features.

The battery saver mode incorporates a latching relay that when enabled disconnects some modules from their

ignition off power or memory power sources. Battery saver mode is initiated by starting the vehicle and then turning the ignition key into the crank position for greater than 15 seconds. The mode is disengaged by repeating the previous process causing the relay to latch in the other direction. This feature can be used as many times as necessary if the vehicle is to be stored for an extended period of time.

Conditions for Running the DTC

- The system voltage is between 9-16 V.
- The DTC can only run when the output is activated.

Conditions for Setting the DTC

The BCM detects a short to ground in the battery saver relay reset circuit.

Action Taken When the DTC Sets

The module output driver will be shut down and not supply voltage to the battery saver relay reset circuit.

Conditions for Clearing the DTC

- The current DTC will clear when the module request for the output is removed or the malfunction is no longer present.
- A history DTC clears when the module ignition cycle counter reaches the reset threshold of 50, without a repeat of the malfunction.

Reference Information

Schematic Reference

- **Body Control System Schematics**
- **Power Distribution Schematics**

Connector End View Reference

Component Connector End Views

Description and Operation

Power Mode Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

1. Ignition OFF, disconnect the KR104A battery saver relay.
2. Connect a test lamp between the relay control circuit and ground.
3. Enable and disable the batter saver mode. The test lamp should turn ON and OFF when changing the battery saver relay latch positions.
 - If the test lamp is always ON, test the control circuit for a short to voltage. If the circuit tests normal, replace the K9 BCM.
 - If the test lamp is always OFF, test the control circuit for a short to ground or open/high resistance. If the circuit tests normal, replace the K9 BCM.
4. If all circuits test normal, test or replace the KR104A battery saver relay.

Repair Procedures

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Relay Replacement (Attached to Wire Harness)** or **Relay Replacement (Within an Electrical Center)**
- **Control Module References** for BCM replacement, setup, and programming

SYMPTOMS - WIRING SYSTEMS

NOTE: The following steps must be completed before using the symptom tables.

1. Perform the **Diagnostic System Check - Vehicle** before using the symptom tables in order to verify that all of the following are true:
 - There are no DTCs set.
 - The control modules can communicate via the serial data links.
2. Review the system operation in order to familiarize yourself with the system functions. Refer to:
 - **Power Mode Description and Operation**
 - **Retained Accessory Power Description and Operation**

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the systems. Refer to **Checking Aftermarket Accessories**.
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to **Testing for Intermittent Conditions and Poor Connections**.

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- **Power Mode Mismatch**
- **Retained Accessory Power Malfunction**

IGNITION CAN/CANNOT BE TURNED OFF WITH TRANSMISSION IN ANY GEAR

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Accessory Voltage	2	2	-	-
Steering Column Key Cylinder Lock Solenoid Control	2	1	1	-
1. Ignition key will not turn to OFF with vehicle in park. 2. Ignition key will turn to OFF with vehicle out of park.				

Circuit/System Description

If the vehicle is equipped with automatic transmission and a floor mounted console gear shift, it has an electronic park lock (EPL) system. The EPL system purpose is to prevent the ignition key from being turned to the OFF position when the transmission is in any position other than PARK and the vehicle may still be moving. The EPL system consists of an ignition lock cylinder solenoid, and a park position switch that is located in the A/T shift lock control switch. The ignition lock cylinder solenoid contains a pin that is spring loaded to mechanically prevent the ignition key cylinder from being turned to the lock position when it is not energized. The park position switch receives voltage from the body control module (BCM) when the ignition is turned ON. When the transmission shift selector is in PARK, the park position switch closes and energizes the ignition lock cylinder solenoid (actuator) retracting the pin, allowing the ignition switch to be turned OFF. If vehicle power is lost, and/or the transmission is not in the Park position the operator will not be able to turn the ignition key to the lock position and will not be able to remove the ignition key from the column.

Diagnostic Aids

Verify that the transmission shift selector indicator matches the position of the gear shift lever while selecting between the Park, Reverse, Drive and Low positions.

Reference Information

Schematic Reference

Ignition Lock Schematics

Connector End View Reference

Component Connector End Views

Description and Operation

Electronic Park Lock Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Circuit/System Verification

1. Ignition OFF, with the gear shift selector in the PARK position, turn the ignition to the ON position. The automatic transmission shift lock control solenoid should allow the ignition to be turned to the ON position.
2. Ignition ON, with the gear shift selector in any position except the PARK position, turn the ignition to the OFF and to the LOCK positions. The automatic transmission shift lock control solenoid should not allow the ignition to be turned to the LOCK position.

Circuit/System Testing

1. Ignition OFF, disconnect the harness connector at the M93 ignition cylinder lock control actuator.
2. Ignition ON, verify that a test lamp illuminates between the ignition circuit terminal 1 and ground.
 - If the test lamp does not illuminate, test the ignition circuit for a short to ground or an open/high resistance. If the circuit tests normal, replace the K9 BCM.
3. With the gear shift selector in any position except the PARK position, verify that a test lamp does not illuminate between the ignition circuit terminal 1 and the control circuit terminal 2.
 - If the test lamp illuminates, test the control circuit for a short to ground. If the circuit tests normal, test or replace the S3 transmission shift lever.
4. With the gear shift selector in the PARK position, verify that a test lamp illuminates between the ignition circuit terminal 1 and the control circuit terminal 2.
 - If the test lamp does not illuminate, test the control circuit for a short to voltage or open/high resistance. If the circuit tests normal, test or replace the S3 transmission shift lever.
5. If all circuits test normal, test or replace the M93 ignition cylinder lock control actuator.

Repair Procedures

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

- **Ignition and Start Switch Replacement**
- **Automatic Transmission Range Selector Lever Replacement**
- **Control Module References** for the BCM replacement, setup, and programming

POWER MODE MISMATCH

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC B1370 01

Control Module Ignition On and Start Circuit Short to Battery

DTC B1370 04

Control Module Ignition On and Start Circuit Open

DTC B1380 01

Control Module Ignition Accessory Circuit Short to Battery

DTC B1380 04

Control Module Ignition Accessory Circuit Open

DTC B1441 01

Control Module Ignition Off, Run, and Start Circuit Short to Battery

DTC B1441 04

Control Module Ignition Off, Run, and Start Circuit Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance

B+	B1370 04, B1380 04	B1370 04, B1380 04	-	-
5 V REF	-	1	-	-
Ignition Terminal 1	B1370 04, B1380 04	B1370 04, B1380 04	B1370 01	-
Ignition Terminal 3	B1370 04, B1380 04	B1380 04	B1380 01	-
Signal Terminal 4	B1370 04, B1380 04, B1441 04	B1441 04	B1441 01	-
1. Power Mode Mismatch				

Circuit/System Description

The vehicle power mode master is the body control module (BCM). The ignition switch is a low current switch with multiple discrete circuits to the BCM. The BCM logic uses the ignition switch positions to identify the operator's desired power mode and activate specific discrete signals, and serial data messages for the operation of different subsystems as necessary. Other modules which have switched voltage inputs may operate in a default mode if the power mode master serial data message does not match what the individual module can detect from its own connections.

The power mode master will activate relays and other direct outputs of the power mode master as needed according to the calculated power mode. Some relays controlled by the BCM are switched ignition voltage outputs that are pass through circuits within the BCM directly from the ignition switch. If these circuits short to ground, the B+ circuit fuse to the ignition switch will open.

Conditions for Running the DTC

B1370 01, B1370 04

Ignition switch is in the RUN or CRANK positions.

B1380 01, B1380 04

Ignition switch is in the RUN or ACCESSORY positions.

B1441 01, B1441 04

Ignition switch is in the CRANK position.

Conditions for Setting the DTC

B1370 01

Ignition circuit is shorted to voltage.

B1370 04

- Ignition circuit is open.
- Ignition, accessory, or off/run/crank circuit shorted to ground.
- B+ circuit of the ignition switch is open or shorted to ground.
- Ignition relay control circuit open, including relay coil and ground.

B1380 01

Accessory circuit is shorted to voltage.

B1380 04

- Accessory circuit is open.
- Ignition, accessory, or off/run/crank circuit shorted to ground.
- B+ circuit of the ignition switch is open or shorted to ground.

B1441 01

Off/run/crank signal circuit is shorted to voltage.

B1441 04

Off/run/crank signal circuit is open.

Actions Taken When the DTC Sets

- The BCM operates in a fail-safe power mode dependent on the last valid power mode detected and the state of the engine run flag data on the serial data communications circuits.
- The other modules on the vehicle operate in a fail-safe power mode dependent on the last valid power mode transmitted by the BCM and the state of the engine run flag on the serial data communications circuits.

Conditions for Clearing the DTC

- The condition responsible for setting the DTC no longer exists.
- A history DTC will clear once 50 consecutive malfunction-free ignition cycles have occurred.

Reference Information

Schematic Reference

- **Body Control System Schematics**
- **Power Distribution Schematics**
- **Power Moding Schematics**

Connector End View Reference

Component Connector End Views

Description and Operation

Power Mode Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

With a scan tool, access Power Mode data display list and compare all parameters listed with the corresponding ignition key position. The Power Mode Parameters table below illustrates the correct state of these input parameters in correspondence to the S39 ignition switch position. The circuits which the individual parameters are related to are in parentheses.

Power Mode Parameters

Ignition Switch Position	5 V IGN (Ignition Switch, Terminal 4 and 6)	Accessory (Ignition Switch, Terminal 3)	Run/Crank (Ignition Switch, Terminal 1)
Off Key Out	Key Out/ACC	Inactive	Inactive
Off Key IN	Key In/Off	Inactive	Inactive
Accessory	Key Out/ACC	Active	Inactive
Run	Run	Active	Active
Start	Crank Request	Inactive	Active

Circuit/System Testing

1. Disconnect the harness connector at the S39 ignition switch.
2. Verify that a test lamp illuminates between B+ circuit terminal 2 and ground.
 - If the test lamp does not illuminate, test the B+ circuit for a short to ground or an open/high resistance. If the circuit tests normal and the B+ circuit fuse is open, test the ignition circuits listed below for a short to ground.

NOTE: To help isolate a short to ground, it may be necessary to disconnect modules that are connected to the following circuits:

- Terminal 1
 - Terminal 3
 - Terminal 4
 - Terminal 6
3. Ignition ON, test for 4.8-5.2 V between the 5 V reference circuit terminal 6 and ground.
 - If less than 4.8 V, test the 5 V reference circuit for a short to ground or an open/high resistance. If the circuit tests normal, replace the BCM.
 - If greater than 5.2 V, test the 5 V reference circuit for a short to voltage. If the circuit tests normal, replace the BCM.
 4. Verify the scan tool ignition switch signal voltage is less than 4.2 V.
 - If greater than 4.2 V, test the ignition switch signal circuit terminal 4 for a short to voltage. If the circuit tests normal, replace the BCM.
 5. Install a 3 A fused jumper wire between the ignition switch signal circuit terminal 4 and the 5 V reference circuit terminal 6. Verify the scan tool Ignition Switch Signal Voltage parameter is greater than 3 V.
 - If less than 3 V, test the signal circuit for a short to ground or an open/high resistance. If the circuit tests normal, replace the BCM.
 6. Connect the harness connector at the S39 ignition switch.
 7. Ignition OFF, key out, disconnect the X3 harness connector at the K9 BCM. Verify that a test lamp does not illuminate between the ignition circuit terminals listed below and ground:
 - Terminal 5
 - Terminal 6
 - Terminal 15
 - Terminal 22
 - If the test lamp illuminates, test the ignition circuits for a short to voltage. If the circuit tests normal, replace the S39 ignition switch.
 8. Ignition in the ACCESSORY position, verify that a test lamp illuminates between the terminal 5 and ground.
 - If the test lamp does not illuminate, test the ignition circuit for an open/high resistance. If the circuit tests normal, replace the S39 ignition switch.
 9. Ignition in the CRANK position, verify that a test lamp illuminates between terminal 6 and ground.
 - If the test lamp does not illuminate, test the ignition circuit for an open/high resistance. If the circuit tests normal, replace the S39 ignition switch.
 10. If all of the circuits test normal, replace the K9 BCM.

Component Testing

Ignition Switch

1. Ignition OFF, disconnect the harness connector at the S39 ignition switch.
2. Verify the resistance between the terminals listed below match for each S39 ignition switch position.
 - If not the specified value, replace the S39 ignition switch.

Resistance Test

S39 Ignition Switch Position	Terminals 1 and 2	Terminals 2 and 3	Terminals 2 and 4	Terminals 2 and 6	Terminals 4 and 6
Off Key Out	Infinite	Infinite	Infinite	Infinite	Infinite
Off Key IN	Infinite	Infinite	< 5.0 ohms	Infinite	Infinite
Accessory	Infinite	< 5.0 ohms	Infinite	Infinite	Infinite
Run	< 5.0 ohms	< 5.0 ohms	Infinite	Infinite	< 5.0 ohms
Start	< 5.0 ohms	Infinite	Infinite	Infinite	1275-1325 ohms

Repair Procedures

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Ignition and Start Switch Replacement**
- **Control Module References** for BCM replacement, setup, and programming

RETAINED ACCESSORY POWER MALFUNCTION

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
RAP/ACCY Relay Switch B+	3	4	2	-
RAP/ACCY Relay Control	B1445 02	1	1	-
RAP/ACCY Relay Ignition	3	4	2	-
RAP/ACCY Relay Ground	-	1	-	-

1. All relay controlled retained power accessory functions inoperative.
2. Relay retained power accessory remains on past the timer limit after key out and will not turn off when a vehicle door is opened.
3. Partial relay controlled retained power accessory functions inoperative with open fuse.
4. Partial relay controlled retained power accessory functions inoperative with fuse OK.

Circuit/System Description

The retained accessory power system allows specific vehicle functions to operate after the ignition is turned OFF for a predetermined time. Relay retained accessory power is controlled by the body control module (BCM) using inputs from the door ajar switches to determine control of the relay when the ignition is turned OFF. Serial data controlled retained accessory power is controlled by a serial data message from the BCM using

inputs from the driver door open switch. Refer to **Retained Accessory Power Description and Operation** for more detail on subsystems using retained accessory power.

Diagnostic Aids

The serial data controlled retained accessory power mode is a separate function and will still operate properly. The serial data controlled retained accessory power function is controlled by serial data and the specific module. These functions are not affected by the BCM retained accessory power relay circuits.

Reference Information

Schematic Reference

- **Power Distribution Schematics**
- **Power Moding Schematics**

Connector End View Reference

Component Connector End Views

Description and Operation

Retained Accessory Power Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE: **Battery voltage must remain above 9.6 V for retained accessory power to operate properly.**

Serial Data Controlled Retained Accessory Power

1. With all passenger doors closed, observe the courtesy lamps while opening and closing the driver door. The courtesy lamps should illuminate when the door is opened and turn off approximately 30 seconds after closing the door.
 - If the courtesy lamp operation is incorrect from the drivers door, refer to **Courtesy Lamps**

Malfunction

2. Close all vehicle doors.
3. Turn the ignition to RUN and then to OFF. The serial data controlled retained accessory power components should enter into accessory power mode for 10 minutes. Attempt to operate any serial data controlled retained accessory power component within the 10 minute operation time. The component should operate. During the 10 minute operation, open the drivers door. The component should not operate.
 - If one component does not respond as specified, replace the component.
 - If all the components do not respond as specified, replace the K9 BCM.

Relay Retained Accessory Power

1. Ignition ON, observe the appropriate scan tool parameters listed below while opening and closing each vehicle door. The reading should change between Door Closed/Door Ajar.
 - Driver Door Ajar Switch
 - Left Rear Door Ajar Switch
 - Passenger Door Ajar Switch
 - Right Rear Door Ajar Switch
 - If any parameter does not change as specified, refer to **Door Ajar Indicator Malfunction**.
2. Command the scan tool Accessory/Retained Accessory Power Relay Command OFF. Attempt to operate any retained accessory power relay controlled component within 5 seconds. The component should not operate.
3. Command the scan tool Accessory/Retained Accessory Power Relay Command ON. Attempt to operate any retained accessory power relay controlled component within 5 seconds. The component should operate.
4. Ignition ON, all doors closed. Observe the scan tool parameter Accessory/Retained Accessory Power Relay Command. Ignition OFF, key removed, the reading should be ON for approximately 10 minutes then change to OFF.
 - If the parameter does not respond as specified, replace the K9 BCM.

Circuit/System Testing

1. Ignition OFF, disconnect the KR70 RAP/ACCY relay.
2. Test for less than 10 ohms between the ground control circuit terminal 86 and ground.
 - If greater than the specified range, test the ground circuit for an open/high resistance.
3. Verify that a test lamp illuminates between the B+ circuit terminal 30 and ground.
 - If the test does not illuminate, test the B+ circuit for short to ground or an open/high resistance.
4. Connect a test lamp between the control circuit terminal 85 and the ground circuit terminal 86.
5. Command the RAP/ACCY relay ON and OFF with a scan tool. The test lamp should turn ON and OFF when changing between the command states.
 - If the test lamp is always ON, test the control circuit for a short to voltage. If the circuit tests normal, replace the K9 BCM.

- If the test lamp is always OFF, test the control circuit for a short to ground or an open/high resistance. If the circuit tests normal, replace the BCM.
- 6. Connect the RAP/ACCY relay. Disconnect the harness connector at the center console accessory power outlet.
- 7. Connect a test lamp between the ignition circuit terminal A and ground.
- 8. Command the RAP/ACCY relay ON and OFF with a scan tool. The test lamp should turn ON and OFF when changing between the command states.
 - If the test lamp is always ON, test the control circuit for a short to voltage. If the circuit tests normal, test or replace the KR70 RAP/ACCY relay.
 - If the test lamp is always OFF, test the control circuit for a short to ground or an open/high resistance. If the circuit tests normal, test or replace the KR70 RAP/ACCY relay.

Component Testing

1. Ignition OFF, disconnect the KR70 RAP/ACCY relay.
2. Test for 70-150 ohms between terminals control circuit terminal 85 and ground terminal 86.
 - If not within the specified range, replace the KR70 RAP/ACCY relay.
3. Test for infinite resistance between the following terminals:
 - 30 and 86
 - 30 and 87
 - 30 and 85
 - 85 and 87
 - If not the specified value, replace the KR70 RAP/ACCY relay.
4. Install a 2 A fused jumper wire between relay terminal 85 and 12 V. Install a jumper wire between relay terminal 86 and ground. Test for less than 2 ohms between terminals 30 and 87.
 - If greater than the specified range, replace the KR70 RAP/ACCY relay.

Repair Procedures

Perform the **Diagnostic Repair Verification** after completing the repair.

- **Relay Replacement (Attached to Wire Harness)** or **Relay Replacement (Within an Electrical Center)**
- **Control Module References** for module replacement, setup, and programming

GENERAL ELECTRICAL DIAGNOSIS

Basic Knowledge Required

Without a basic knowledge of electricity, it will be difficult to use the diagnostic procedures contained in the service manual. You should understand the basic theory of electricity, and know the meaning of voltage (V), current (A), and resistance (ohms). You should also be able to read and understand a wiring diagram, as well as understand what happens in a circuit with an open or a shorted wire.

CHECKING AFTERMARKET ACCESSORIES

WARNING: Refer to SIR Warning .

CAUTION: The OBD II symbol is used on the circuit diagrams in order to alert the technician that the circuit is essential for proper OBD II emission control circuit operation. Any circuit which fails and causes the malfunction indicator lamp (MIL) to turn ON, or causes emissions-related component damage, is identified as an OBD II circuit.

Do not connect aftermarket accessories into the following circuits:

- SIR circuits, all such circuits are indicated on circuit diagrams with the SIR symbol.
- OBD II circuits, all such circuits are indicated on circuit diagrams with the OBD II symbol.

Always check for aftermarket accessories (non-OEM) as the first step in diagnosing electrical problems. If the vehicle is so equipped, disconnect the system to verify that these add-on accessories are not the cause of the problems.

Possible causes of vehicle problems related to aftermarket accessories include:

- Power feeds connected to points other than the battery
- Antenna location
- Transceiver wiring located too close to vehicle electronic modules or wiring
- Poor shielding or poor connectors on antenna feed line
- Check for recent service bulletins detailing installation guidelines for aftermarket accessories.

CIRCUIT TESTING

The Circuit Testing section contains the following diagnostic testing information. Using this information along with the diagnostic procedures will identify the cause of the electrical malfunction.

- Using Connector Test Adapters
- Probing Electrical Connectors
- Troubleshooting with a Digital Multimeter
- Troubleshooting with a Test Lamp
- Using Fused Jumper Wires
- Measuring Voltage
- Measuring Voltage Drop
- Measuring Frequency
- Testing Ground and Low Reference Circuits
- Testing for Continuity

- Testing for Short to Ground
- Testing for a Short to Voltage
- Testing for Intermittent Conditions and Poor Connections
- Inducing Intermittent Fault Conditions
- Testing for Electrical Intermittents
- Scan Tool Snapshot Procedure
- Circuit Protection - Fuses
- Circuit Protection - Circuit Breakers
- Circuit Protection - Fusible Links

BASIC DIGITAL MULTIMETER REQUIREMENTS

Digital Multimeter (DMM) Basic Requirements

Service information is validated using digital multimeters that meet or exceed the following requirements. Using a multimeter that does not meet these basic requirements may give inaccurate readings which could lead to an incorrect diagnosis.

Display and Settings

1. Four digits displayed
2. Voltage, amperage, resistance, frequency, diode test settings, and min-max function
3. Display positive and negative values

Voltage

1. Have at least 10 Mohms input impedance
2. Test a DC voltage range of 0.1-1000 V.
3. Test an AC voltage range of 0.1-1000 V.

Amperage

1. Test a DC amperage range of 0.1 μ A-10 A.
2. Test an AC amperage range of 0.1 μ A-10 A.

Resistance

Test a resistance range of 0.1 ohms-40 Mohms and displays infinite for a value greater than 40 Mohms (O.L. (Over-load))

Frequency

Test for a frequency range of 0.5 HZ-199 K HZ

Diode Test

1. Apply at least 1 mA when performing the diode bias test
2. Display the break over voltage drop (0-3 V) of a forward biased diode
3. Display infinite (O.L. (Over-load)) when a diode is reverse biased

Min-Max Readings

1. Can update at a 1 ms sample rate
2. Saves and displays minimum and maximum values

USING CONNECTOR TEST ADAPTERS

Special Tools

EL 35616: Terminal Test Probe Kit

For equivalent regional tools, refer to **Special Tools** .

CAUTION: Do not insert test equipment probes (DMM etc.) into any connector or fuse block terminal. The diameter of the test probes will deform most terminals. A deformed terminal will cause a poor connection, which will result in a system failure. Always use the EL-38125-580 GM Approved Terminal Release Tool Kit in order to front probe terminals. Do not use paper clips or other substitutes to probe terminals.

When using the EL-38125-580 GM Approved Terminal Release Tool Kit, ensure the terminal test adapter choice is the correct size for the connector terminal. Do not visually choose the terminal test adapter because some connector terminal cavities may appear larger than the actual terminal in the cavity. Using a larger terminal test adapter will damage the terminal. Refer to the EL-38125-580 GM Approved Terminal Release Tool Kit label on the inside of the EL-38125-580 GM Approved Terminal Release Tool Kit for the correct adapter along with the connector end view for terminal size.

PROBING ELECTRICAL CONNECTORS

NOTE: Always be sure to reinstall the connector position assurance (CPA) and terminal position assurance (TPA) when reconnecting connectors or replacing terminals.

Front probe

Disconnect the connector and probe the terminals from the mating side (front) of the connector.

CAUTION: Refer to **Test Probe Caution** .

NOTE: When probing female 0.64 terminals, it is important to use the correct adapter. There have been some revisions to the test adapter for 0.64 terminals. The proper adapter for 0.64 terminals is the EL-35616-64B which has a gold terminal and a black wire between the base and tip. Failure to use the proper test adapter may result in damage to the terminal being tested and improper diagnosis.

NOTE: The proper adapter for probing the terminals for fuses, relays, or diodes in an electrical center is EL-35616-35. Using any other tool or adapter may damage the terminal being tested.

Refer to the following table as a guide in selecting the correct test adapter for front probing connectors:

Test Adapter	Description
J-35616-2A	150 Male Probe Adapter (gray)
J-35616-3	150 Female Probe Adapter (gray)
J-35616-4A	280 Male Probe Adapter (purple)
J-35616-5	280 Female Probe Adapter (purple)
J-35616-6	100W Male (round) Probe Adapter (brown)
J-35616-7	100W Female (round) Probe Adapter (brown)
J-35616-8	Weather Pack Male Probe Adapter (orange)
J-35616-9	Weather Pack Female Probe Adapter (orange)
J-35616-10	100W Male (round) Probe Adapter (green)
J-35616-11	100W Female (round) Probe Adapter (green)
J-35616-12	130 Male Probe Adapter (blue)
J-35616-13	130 Female Probe Adapter (blue)
J-35616-14	150 Male Probe Adapter (green)
J-35616-16	100 Male Probe Adapter (lt green)
J-35616-17	100 Female Probe Adapter (lt green)
J-35616-18	220 Male Probe Adapter (black)
J-35616-19	220 Female Probe Adapter (black)
J-35616-21	950 Female Probe Adapter (red)
J-35616-22	950 Male Probe Adapter (red)
J-35616-31	500 Male Probe Adapter (orange)
J-35616-32	500 Female Probe Adapter (orange)
J-35616-33	160/180 Male Probe Adapter (yellow)
J-35616-34	160/180 Female Probe Adapter (yellow)
J-35616-35	280 Male Probe Adapter (violet)
J-35616-40	480 Male Probe Adapter (dk blue)
J-35616-41	480 Female Probe Adapter (dk blue)
J-35616-42	630 Male Probe Adapter (red)
J-35616-43	630 Female Probe Adapter (red)
J-35616-44	800 Male Probe Adapter (yellow)

J-35616-45	800 Female Probe Adapter (yellow)
J-35616-54	280 Male (round) Probe Adapter (tan)
J-35616-55	280 Female (round) Probe Adapter (tan)
J-35616-64B	0.64 Male Probe Adapter (lt blue)
J-35616-65B	0.64 Female Probe Adapter (lt blue)
J-35616-66	150 Male (round) Probe Adapter (yellow)
J-35616-67	150 Female (round) Probe Adapter (yellow)

Backprobe

NOTE:

- **Backprobe connector terminals only when specifically required in diagnostic procedures.**
- **Do not backprobe a sealed (Weather Pack®) connector, less than a 280 series Metri-Pack connector, a Micro-Pack connector, or a flat wire (dock and lock) connector.**
- **Backprobing can be a source of damage to connector terminals. Use care in order to avoid deforming the terminal, either by forcing the test probe too far into the cavity or by using too large of a test probe.**
- **After backprobing any connector, inspect for terminal damage. If terminal damage is suspected, test for proper terminal contact.**

Do not disconnect the connector and probe the terminals from the harness side (back) of the connector.

TROUBLESHOOTING WITH A DIGITAL MULTIMETER

Special Tools

EL 39200: Digital Multimeter (DMM)

For equivalent regional tools, refer to **Special Tools** .

CAUTION: Refer to **Test Probe Caution** .

Digital Multimeter (DMM) Basic Requirements

Service information is validated using digital multimeters that meet or exceed the following requirements. Using a multimeter that does not meet these basic requirements may give inaccurate readings which could lead to an incorrect diagnosis.

Display and Settings

1. Four digits displayed
2. Voltage, amperage, resistance, frequency, diode test settings, and min-max function

3. Display positive and negative values

Voltage

1. Have at least 10 Mohms input impedance
2. Test a DC voltage range of 0.1-1000 V.
3. Test an AC voltage range of 0.1-1000 V.

Amperage

1. Test a DC amperage range of 0.1 μ A-10 A.
2. Test an AC amperage range of 0.1 μ A-10 A.

Resistance

Test a resistance range of 0.1 ohms-40 Mohms and displays infinite for a value greater than 40 Mohms (O.L. (Over-load))

Frequency

Test for a frequency range of 0.5 HZ-199 K HZ

Diode Test

1. Apply at least 1 mA when performing the diode bias test
2. Display the break over voltage drop (0-3 V) of a forward biased diode
3. Display infinite (O.L. (Over-load)) when a diode is reverse biased

Min-Max Readings

1. Can update at a 1 ms sample rate
2. Saves and displays minimum and maximum values

Supplemental Information

NOTE: **Circuits which include any solid state control modules, such as the engine control module (ECM), should only be tested with a 10 Mohms or higher impedance digital multimeter such as the EL-39200.**

The EL-39200 instruction manual is a good source of information and should be read thoroughly upon receipt of the DMM as well as kept on hand for future reference.

A DMM should be used instead of a test lamp in order to test for voltage in high impedance circuits. While a test lamp shows whether voltage is present if the impedance is low enough, a DMM indicates how much voltage is present. In other words, if there is not enough current, the test lamp will not illuminate even though voltage is present.

The ohmmeter function on a DMM shows how much resistance exists between 2 points along a circuit. Low resistance in a circuit means good continuity.

NOTE: **Disconnect the power feed from the suspect circuit when measuring resistance with a DMM. This prevents incorrect readings. DMMs apply such a small voltage to measure resistance that the presence of voltages can upset a resistance reading.**

Diodes and solid state components in a circuit can cause a DMM to display a false reading. To find out if a component is affecting a measurement take a reading once, then reverse the leads and take a second reading. If the readings differ the solid state component is affecting the measurement.

Following are examples of the various methods of connecting the DMM to the circuit to be tested:

- Probe both ends of the connector and either hold the leads in place while manipulating the connector or tape the leads to the harness for continuous monitoring while you perform other operations or test driving. Refer to [Probing Electrical Connectors](#).
- Disconnect the harness at both ends of the suspected circuit where it connects either to a component or to other harnesses.
- If the system that is being diagnosed has a specified pinout or breakout box, it may be used in order to simplify connecting the DMM to the circuit or for testing multiple circuits quickly.

TROUBLESHOOTING WITH A TEST LAMP

Special Tools

EL-35616-200: Test Light - Probe Kit

For equivalent regional tools, refer to [Special Tools](#) .

CAUTION: Refer to [Test Probe Caution](#) .

A test lamp can simply and quickly test a low impedance circuit for voltage. A Digital Multimeter (DMM) should be used instead of a test lamp in order to test for voltage in high impedance circuits. While a test lamp shows whether voltage is present if the impedance is low enough, a DMM indicates how much voltage is present. In other words, if there is not enough current, the test lamp will not illuminate even though voltage is present.

The **EL-35616-200:** kit is Micro-Pack compatible and comprised of a 12-volt light bulb with an attached pair of leads.

To properly operate this tool use the following procedures.

When testing for voltage:

1. Attach one lead to ground.
2. Touch the other lead to various points along the circuit where voltage should be present.
3. When the bulb illuminates, there is voltage at the point being tested.

When testing for ground:

1. Attach one lead to battery positive voltage.
2. Touch the other lead to various points along the circuit where ground should be present.
3. When the bulb illuminates, there is ground at the point being tested.

USING FUSED JUMPER WIRES

Special Tools

J 36169-A Fused Jumper Wire. See **Special Tools** .

NOTE: **A fused jumper may not protect solid state components from being damaged.**

The **J 36169-A** includes small clamp connectors that provide adaptation to most connectors without damage. See **Special Tools** . This fused jumper wire is supplied with a 20-A fuse which may not be suitable for some circuits. Do not use a fuse with a higher rating than the fuse that protects the circuit being tested.

MEASURING VOLTAGE

Special Tools

EL 39200: Digital Multimeter (DMM)

For equivalent regional tools, refer to **Special Tools** .

CAUTION: Refer to Test Probe Caution .

The following procedure measures the voltage at a selected point in a circuit.

1. Disconnect the electrical harness connector for the circuit being tested, if necessary.
2. Enable the circuit and/or system being tested. Use the following methods:
 - Turn ON the ignition, with the engine OFF.
 - Turn ON the engine.
 - Turn ON the circuit and/or system with a scan tool in Output Controls.
 - Turn ON the switch for the circuit and/or system being tested.
3. Select the V (AC) or V (DC) position on the Digital Multimeter (DMM).
4. Connect the positive lead of the DMM to the point of the circuit to be tested.

5. Connect the negative lead of the DMM to a good ground.
6. The DMM displays the voltage measured at that point.

MEASURING VOLTAGE DROP

Special Tools

EL 39200: Digital Multimeter (DMM)

For equivalent regional tools, refer to **Special Tools** .

CAUTION: Refer to **Test Probe Caution** .

The following procedure determines the difference in voltage potential between 2 points.

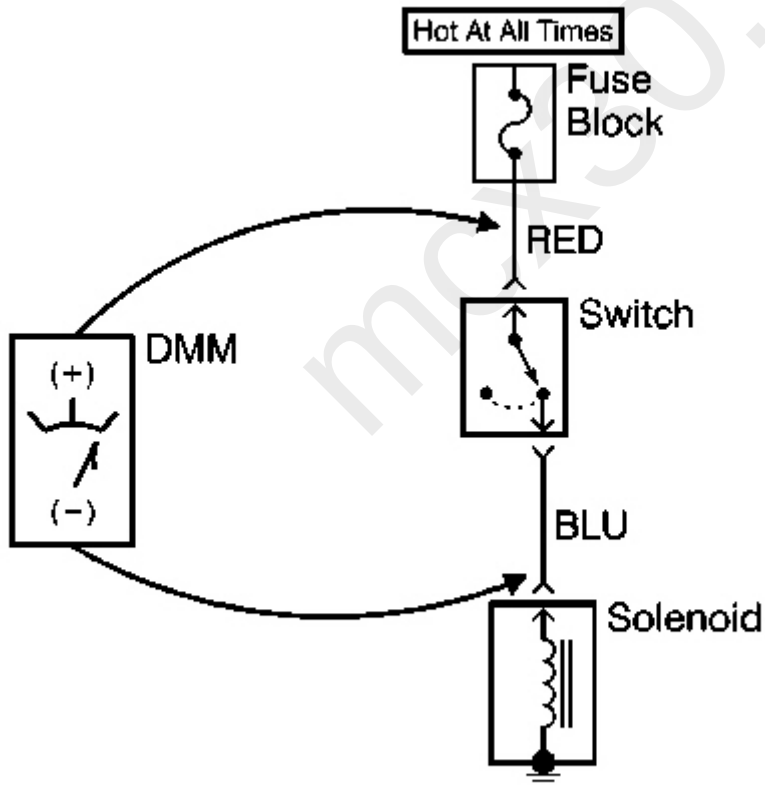


Fig. 1: Measuring Voltage Drop

Courtesy of GENERAL MOTORS CORP.

1. Set the rotary dial of the Digital Multimeter (DMM) to the V (DC) position.
2. Connect the positive lead of the DMM to one point of the circuit to be tested.
3. Connect the negative lead of the DMM to the other point of the circuit.
4. Operate the circuit.
5. The DMM displays the difference in voltage between the 2 points.

MEASURING FREQUENCY

Special Tools

EL 39200: Digital Multimeter (DMM)

For equivalent regional tools, refer to **Special Tools** .

CAUTION: Refer to **Test Probe Caution** .

The following procedure determines the frequency of a signal.

NOTE: **Connecting the Digital Multimeter (DMM) to the circuit before pressing the Hz button will allow the DMM to autorange to an appropriate range.**

1. Apply power to the circuit.
2. Set the rotary dial of the DMM to the V (AC) position.
3. Connect the positive lead of the DMM to the circuit to be tested.
4. Connect the negative lead of the DMM to a good ground.
5. Press the Hz button on the DMM.
6. The DMM will display the frequency measured.

TESTING GROUND AND LOW REFERENCE CIRCUITS

Because a test lamp can light with up to 200 ohms in a ground or low reference circuit they are not recommended to be used for this type of test. A low impedance test lamp can light and indicate the circuit is good when there is as much as 20-30 ohms present, while a high impedance test lamp can light with up to 200 ohms present in the circuit. This is why the Digital Multi-Meter (DMM) is used when validating a ground or low reference circuit continuity.

When using the DMM there are many vehicle conditions that can affect the ground and low reference continuity testing. If these conditions are not met, a ground or low reference circuit test can fail on a good circuit. This may cause longer diagnosis time and incorrect component replacement.

Any current flow through a ground or low reference circuit, while being tested, will skew the DMM continuity reading, or display a reading higher than when there is no current flowing. Performing a ground or low reference circuit continuity test, in reference to the vehicles battery negative terminal, will have the highest risk of failing a good ground or low reference circuit test than any other ground reference point. The best ground test points would be a control module housing (if the control modules housing is metal and grounded), door jamb striker (if attached to metal), under dash metal frame work, engine block, or body ground studs (other than where the negative battery cable is attached).

A typical DMM ground or low reference circuit continuity reading can be as high as 100 ohms with the ignition ON, and drop to 15-25 ohms after the ignition is turned OFF. The reading will drop below 10 ohms after 30-40 seconds, then below 5 ohms after 60 seconds. Once the vehicle completely goes to sleep (generally 3-10 minutes) the reading will drop below 0.3 ohms.

The following list of conditions may need to be met to ensure a valid continuity reading on a ground or low reference circuit:

- Ignition OFF
- Key out of the ignition switch (when not equipped with keyless entry and remote start)
- Retained Accessory Power (RAP) OFF (open and close the driver door after ignition OFF)
- Battery charger set at a 2 A or less charge rate
- Scan tool not communicating with any vehicle control module (in some cases it may need to be disconnected from the DLC)
- All entry doors closed
- Headlamps OFF (auto headlamps disabled)
- Any delay lighting OFF
- HVAC after blow OFF
- Any accessory that can work when the ignition is OFF
- Wait up to 60 seconds (after all other listed conditions are met)

Activating the DOOR LOCK function with a key fob can greatly reduce the time to achieve a valid ground or low reference continuity test result.

TESTING FOR CONTINUITY

Special Tools

EL 39200: Digital Multimeter (DMM)

For equivalent regional tools, refer to **Special Tools** .

CAUTION: Refer to Test Probe Caution .

The following procedures verify good continuity in a circuit.

With a Digital Multimeter (DMM)

1. Set the rotary dial of the DMM to the ohms position.
2. Disconnect the power feed (i.e. fuse, control module) from the suspect circuit.
3. Disconnect the load.
4. Press the MIN MAX button on the DMM.
5. Connect one lead of the DMM to one end of the circuit to be tested.
6. Connect the other lead of the DMM to the other end of the circuit.
7. If the DMM displays low or no resistance, the circuit has good continuity.

With a Test Lamp

NOTE: **Only use the test lamp procedure on low impedance power and ground circuits.**

1. Remove the power feed (i.e. fuse, control module) from the suspect circuit.
2. Disconnect the load.
3. Connect one lead of the test lamp to one end of the circuit to be tested.
4. Connect the other lead of the test lamp to battery positive voltage.
5. Connect the other end of the circuit to ground.
6. If the test lamp illuminates (full intensity), then the circuit has good continuity.

TESTING FOR SHORT TO GROUND

Special Tools

- **EL 39200:** Digital Multimeter (DMM)
- **EL 35616-200:** Test Light-Probe Kit

For equivalent regional tools, refer to **Special Tools** .

CAUTION: Refer to **Test Probe Caution** .

The following procedures test for a short to ground in a circuit.

With a Digital Multimeter (DMM)

1. Remove the power feed (i.e. fuse, control module) from the suspect circuit.
2. Disconnect the load.
3. Set the rotary dial of the DMM to the ohms position.
4. Connect one lead of the DMM to one end of the circuit to be tested.
5. Connect the other lead of the DMM to a good ground.

6. If the DMM does NOT display infinite resistance (OL), there is a short to ground in the circuit.

With a Test Lamp

1. Remove the power feed (i.e. fuse, control module) from the suspect circuit.
2. Disconnect the load.
3. Connect one lead of the test lamp to battery positive voltage.
4. Connect the other lead of the test lamp to one end of the circuit to be tested.
5. If the test lamp illuminates, there is a short to ground in the circuit.

Fuse Powering Several Loads

1. Review the system schematic and locate the fuse that is open.
2. Open the first connector or switch leading from the fuse to each load.
3. Connect a DMM across the fuse terminals (be sure that the fuse is powered).
 - When the DMM displays voltage the short is in the wiring leading to the first connector or switch.
 - If the DMM does not display voltage refer to the next step.
4. Close each connector or switch until the DMM displays voltage in order to find which circuit is shorted.

TESTING FOR A SHORT TO VOLTAGE

Special Tools

EL 39200: Digital Multimeter (DMM)

For equivalent regional tools, refer to **Special Tools** .

CAUTION: Refer to **Test Probe Caution** .

The following procedure tests for a short to voltage in a circuit.

1. Remove the power feed (i.e. fuse, control module) from the suspect circuit.
2. Disconnect the load.
3. Set the rotary dial of the Digital Multimeter (DMM) to the V (DC) position.
4. Connect the positive lead of the DMM to one end of the circuit to be tested.
5. Connect the negative lead of the DMM to a good ground.
6. Turn ON the ignition and operate all accessories.
7. If the voltage measured is greater than 1 V, there is a short to voltage in the circuit.

TESTING FOR INTERMITTENT CONDITIONS AND POOR CONNECTIONS

Special Tools

For equivalent regional tools, refer to **Special Tools** .

When the condition is not currently present, but is indicated in DTC history, the cause may be intermittent. An intermittent may also be the cause when there is a customer complaint, but the symptom cannot be duplicated. Refer to the Symptom Table of the system that is suspect of causing the condition before trying to locate an intermittent condition.

Most intermittent conditions are caused by faulty electrical connections or wiring. Inspect for the following items:

- Wiring broken inside the insulation
- Poor connection between the male and female terminal at a connector
- Poor terminal to wire connection-Some conditions which fall under this description are poor crimps, poor solder joints, crimping over the wire insulation rather than the wire itself, and corrosion in the wire to terminal contact area, etc.
- Pierced or damaged insulation can allow moisture to enter the wiring causing corrosion. The conductor can corrode inside the insulation, with little visible evidence. Look for swollen and stiff sections of wire in the suspect circuits.
- Wiring which has been pinched, cut, or its insulation rubbed through may cause an intermittent open or short as the bare area touches other wiring or parts of the vehicle.
- Wiring that comes in contact with hot or exhaust components
- Refer to **Inducing Intermittent Fault Conditions** in order to duplicate the conditions required, in order to verify the customer concern.
- Refer to **Testing for Electrical Intermittents** for test procedures to detect intermittent open, high resistance, short to ground, and short to voltage conditions.
- Refer to **Scan Tool Snapshot Procedure** for advanced intermittent diagnosis and Vehicle Data Recorder operation.

Testing for Terminal Fretting

Some intermittent conditions can be caused by wire terminal fretting corrosion. Fretting corrosion is a build-up of insulating, oxidized wear debris that can form when there is a small motion between electrical contacts. The oxidized wear debris can pile up enough at the electrical contact spots that the electrical resistance across the connection increases. Movement between the contacting surfaces as small as 10 to 100 microns can cause fretting. To put this in perspective, a sheet of paper is about 100 microns thick, so fretting motion is small and hard to see. Vibration and thermal expansion/contraction are the main sources that create fretting motion. Since vehicles vibrate and can experience large temperature swings, they are a good source for fretting motion. Tin, copper, nickel, and iron surfaces are all susceptible to fretting corrosion. Fretting corrosion can be difficult to see but it looks like small, dark smudges on the terminals contact surface.

To correct a fretting condition disconnect the suspect connector and add Nyogel lubricant 760G (dielectric grease) to both sides of the connector terminals. Then reconnect the connector and wipe away any excess lubricant. This will correct the additional terminal contact resistance due to the terminal fretting corrosion.

Testing for Proper Terminal Contact

It is important to test terminal contact at the component and any inline connectors before replacing a suspect component. Mating terminals must be inspected to ensure good terminal contact. A poor connection between the male and female terminal at a connector may be the result of contamination or deformation.

Contamination may be caused by the connector halves being improperly connected. A missing or damaged connector seal, damage to the connector itself, or exposing the terminals to moisture and dirt can also cause contamination. Contamination, usually in the underhood or underbody connectors, leads to terminal corrosion, causing an open circuit or intermittently open circuit.

Deformation is caused by probing the mating side of a connector terminal without the proper adapter. Always use the EL-35616 when probing connectors. Other causes of terminal deformation are improperly joining the connector halves, or repeatedly separating and joining the connector halves. Deformation, usually to the female terminal contact tang, can result in poor terminal contact causing an open or intermittently open circuit.

Testing for Proper Terminal Contact in Bussed Electrical Centers

It is very important to use the correct test adapter when testing for proper terminal contact of fuses and relays in a bussed electrical center. Use EL-35616-35 to test for proper terminal contact. Failure to use EL-35616-35 can result in improper diagnosis of the bussed electrical center.

Follow the procedure below in order to test terminal contact:

1. Separate the connector halves.
2. Visually inspect the connector halves for contamination. Contamination may result in a white or green build-up within the connector body or between terminals. This causes high terminal resistance, intermittent contact, or an open circuit. An underhood or underbody connector that shows signs of contamination should be replaced in its entirety: terminals, seals, and connector body.
3. Using an equivalent male terminal / terminated lead, verify that the retention force is significantly different between a known good terminal and the suspect terminal. Replace the female terminal in question.

Flat Wire (Dock and Lock) Connectors

There are no serviceable parts for flat wire (dock and lock) connectors on the harness side or the component side.

Follow the procedure below in order to test terminal contact:

1. Remove the component in question.
2. Visually inspect each side of the connector for signs of contamination. Avoid touching either side of the connector as oil from your skin may be a source of contamination as well.
3. Visually inspect the terminal bearing surfaces of the flat wire circuits for splits, cracks, or other imperfections that could cause poor terminal contact. Visually inspect the component side connector to ensure that all of the terminals are uniform and free of damage or deformation.
4. Insert the appropriate adapter from the on the flat wire harness connector in order to test the circuit in

question.

Control Module/Component Voltage and Grounds

Poor voltage or ground connections can cause widely varying symptoms.

- Test all control module voltage supply circuits. Many vehicles have multiple circuits supplying voltage to a control module. Other components in the system may have separate voltage supply circuits that may also need to be tested. Inspect connections at the module/component connectors, fuses, and any intermediate connections between the voltage source and the module/component. A test lamp or a DMM may indicate that voltage is present, but neither tests the ability of the circuit to carry sufficient current. Ensure that the circuit can carry the current necessary to operate the component. Refer to **Circuit Testing** and **Power Distribution Schematics**.
- Test all control module ground and system ground circuits. The control module may have multiple ground circuits. Other components in the system may have separate grounds that may also need to be tested. Inspect grounds for clean and tight connections at the grounding point. Inspect the connections at the component and in splice packs, where applicable. Ensure that the circuit can carry the current necessary to operate the component. Refer to **Circuit Testing** and **Ground Distribution Schematics**.

Temperature Sensitivity

- An intermittent condition may occur when a component/connection reaches normal operating temperature. The condition may occur only when the component/connection is cold, or only when the component/connection is hot.
- Freeze Frame, Failure Records, Snapshot, or Vehicle Data Recorder data may help with this type of intermittent condition, where applicable.
- If the intermittent is related to heat, review the data for a relationship with the following:
 - High ambient temperatures
 - Underhood/engine generated heat
 - Circuit generated heat due to a poor connection, or high electrical load
 - Higher than normal load conditions, towing, etc.
- If the intermittent is related to cold, review the data for the following:
 - Low ambient temperatures-In extremely low temperatures, ice may form in a connection or component. Inspect for water intrusion.
 - The condition only occurs on a cold start.
 - The condition goes away when the vehicle warms up.
- Information from the customer may help to determine if the trouble follows a pattern that is temperature related.
- If temperature is suspected of causing an intermittent fault condition, attempt to duplicate the condition. Refer to **Inducing Intermittent Fault Conditions** in order to duplicate the conditions required.

Electromagnetic Interference and Electrical Noise

Some electrical components/circuits are sensitive to electromagnetic interference or other types of electrical noise. Inspect for the following conditions:

- A misrouted harness that is too close to high voltage/high current devices such as secondary ignition components, motors, generator etc.-These components may induce electrical noise on a circuit that could interfere with normal circuit operation.
- Electrical system interference caused by a malfunctioning relay, or a control module driven solenoid or switch-These conditions can cause a sharp electrical surge. Normally, the condition will occur when the malfunctioning component is operating.
- Improper installation of non-factory or aftermarket add on accessories such as lights, 2-way radios, amplifiers, electric motors, remote starters, alarm systems, cell phones, etc.-These accessories may lead to interference while in use, but do not fail when the accessories are not in use. Refer to **Checking Aftermarket Accessories**.
- Test for an open diode across the A/C compressor clutch and for other open diodes. Some relays may contain a clamping diode.
- The generator may be allowing AC noise into the electrical system.

Incorrect Control Module

- There are only a few situations where reprogramming a control module is appropriate:
 - A new service control module is installed.
 - A control module from another vehicle is installed.
 - Revised software/calibration files have been released for this vehicle.

NOTE: DO NOT re-program the control module with the SAME software/calibration files that are already present in the control module. This is not an effective repair for any type of concern.

- Verify that the control module contains the correct software/calibration. If incorrect programming is found, reprogram the control module with the most current software/calibration. Refer to **Control Module References** for replacement, setup, and programming.

INDUCING INTERMITTENT FAULT CONDITIONS

Special Tools

J-25070: Heat Gun

For equivalent regional tools, refer to **Special Tools** .

Many intermittent open or shorted circuits are affected by harness/connector movement that is caused by vibration, engine torque, bumps/rough pavement, etc. In order to duplicate the customer's concern, it may be necessary to manipulate the wiring harness if the malfunction appears to be vibration related. Manipulation of a circuit can consist of a wide variety of actions, including:

- Wiggling the harness
- Disconnecting a connector and reconnecting
- Stressing the mechanical connection of a connector

- Pulling on the harness or wire in order to identify a separation/break inside the insulation
- Relocating a harness or wires

All these actions should be performed with some goal in mind. For instance, with a scan tool connected, wiggling the wires may uncover a faulty input to the control module. The snapshot option would be appropriate here. Refer to **Scan Tool Snapshot Procedure**. Another option is, with the component commanded ON and OFF by the scan tool, move related connectors and wiring and observe the component operation. With the engine running, move related connectors and wiring while monitoring engine operation. If harness or connector movement affects the data displayed, component/system operation, or engine operation, inspect and repair the harness/connections as necessary.

You may need to load the vehicle in order to duplicate the concern. This may require the use of weights, floor jacks, jackstands, frame machines, etc. In these cases you are attempting to duplicate the concern by manipulating the suspension or frame. This method is useful in finding harnesses that are too short and their connectors pull apart enough to cause a poor connection. A DMM set to Peak Min/Max mode and connected to the suspect circuit while testing can yield desirable results. Refer to **Testing for Electrical Intermittents**.

Certainly, using the senses of sight, smell, and hearing while manipulating the circuit can provide good results as well.

There may be instances where circuit manipulation alone will not meet the required criteria for the fault condition to appear. In such cases it may be necessary to expose the suspect circuit to other conditions while manipulating the harness. Such conditions would include high moisture conditions, along with exceptionally high or low temperatures. The following discusses how to expose the circuit to these kinds of conditions.

Salt Water Spray

Some compounds possess the ability to conduct electricity when dissolved in water such as ordinary salt. By mixing table salt with water in sufficient quantities, you can enhance the conductive properties of water so that any circuit which may be sensitive to moisture will more readily fail when liberally sprayed with this mixture.

Mixing 0.35L (12 oz) of water with approximately 1 tablespoon of salt will yield a salt solution of 5 percent. Fill a normal spray bottle with this mixture. This mixture is sufficient to enhance the water's own conductivity. This may cause the circuit to fail more easily when sprayed. Once the mixture is completed, spray the suspect area liberally with the solution. Then, while monitoring either a scan tool or DMM, manipulate the harness as discussed previously.

High Temperature Conditions

If the complaint tends to be heat related, you can simulate the condition using the **J-25070**: heat gun.

Using the heat gun, you can heat up the suspected area or component. Manipulate the harnesses under high temperature conditions while monitoring the scan tool or DMM to locate the fault condition.

The high temperature condition may be achieved simply by test driving the vehicle at normal operating temperature. If a heat gun is unavailable, consider this option to enhance your diagnosis. This option does not allow for the same control, however.

Low Temperature Conditions

Depending on the nature of the fault condition, placing a fan in front of the vehicle while the vehicle is in the shade can have the desired effect.

If this is unsuccessful, use local cooling treatments such as ice or a venturi type nozzle (one that provides hot or cold air). This type of tool is capable of producing air stream temperatures down to -18°C (0°F) from one end and $+71^{\circ}\text{C}$ (160°F) from the other. This is ideally suited for localized cooling needs.

Once the vehicle, component, or harness has been sufficiently cooled, manipulate the harness or components in an effort to duplicate the concern.

Duplicating Failure Conditions

- If none of the previous tests are successful, attempt to duplicate and/or capture the failure conditions.
- Freeze Frame/Failure Records data, where applicable, contains the conditions that were present when the DTC set.
 1. Review and record Freeze Frame/Failure Records data.
 2. Clear the DTCs using the scan tool.
 3. Turn the key to OFF and wait 15 seconds.
 4. Operate the vehicle under the same conditions that were noted in Freeze Frame/Failure Records data, as closely as possible. The vehicle must also be operating within the Conditions for Running the DTC. Refer to Conditions for Running the DTC in the supporting text if a DTC is being diagnosed.
 5. Monitor DTC Status for the DTC being tested. The scan tool will indicate Ran, when the enabling conditions have been satisfied long enough for the DTC to run. The scan tool will also indicate whether the DTC passed or failed.
- An alternate method is to drive the vehicle with the DMM connected to a suspected circuit. An abnormal reading on the DMM when the concern occurs, may help you locate the concern.

TESTING FOR ELECTRICAL INTERMITTENTS

Special Tools

EL-39200 Digital Multimeter

For equivalent regional tools, refer to **Special Tools** .

Perform the following procedures while wiggling the harness from side to side. Continue this at convenient points (about 6 inches apart) while watching the test equipment.

- **Testing for Short to Ground**
- **Testing for Continuity**
- **Testing for a Short to Voltage**

If the fault is not identified, perform the procedure below using the MIN MAX feature on the EL-39200 DMM. This feature allows you to manipulate the circuit without having to watch the EL-39200. The EL-39200 will generate an audible tone when a change is detected.

NOTE: **The EL-39200 must be used in order to perform the following procedure since the EL-39200 can monitor current, resistance or voltage while recording the minimum (MIN), and maximum (MAX) values measured.**

1. Connect the EL-39200 to both sides of a suspected connector (still connected), or from one end of a suspected circuit to the other. Refer to **Troubleshooting with a Digital Multimeter** for information on connecting the EL-39200 to the circuit.
2. Set the rotary dial of the EL-39200 to the V (AC) or V (DC) position.
3. Press the range button of the EL-39200 in order to select the desired voltage range.
4. Press the MIN MAX button of the EL-39200. The EL-39200 displays 100 ms RECORD and emits an audible tone (beep).

NOTE: **The 100 ms RECORD mode is the length of time an input must stay at a new value in order to record the full change.**

5. Simulate the condition that is potentially causing the intermittent connection, either by wiggling the connections or the wiring, test driving, or performing other operations. Refer to **Inducing Intermittent Fault Conditions**.
6. Listen for the audible Min Max Alert which indicates that a new minimum or maximum value has been recorded.
7. Press the MIN MAX button once in order to display the MAX value and note the value.
8. Press the MIN MAX button again in order to display the MIN value and note the value.
9. Determine the difference between the MIN and MAX values.
 - If the variation between the recorded MIN and MAX voltage values is 1 V or greater an intermittent open or high resistance condition exists. Repair the condition as necessary.
 - If the variation between the recorded MIN and MAX voltage values is less than 1 V, an intermittent open or high resistance condition does not exist.

SCAN TOOL SNAPSHOT PROCEDURE

Using Snapshots in Global Diagnostic System (GDS)

Overview

A snapshot is a recording of what a control module on the vehicle was receiving for information while the snapshot is being made. A snapshot may be used to analyze the data during the time a vehicle condition is current. This allows you to concentrate on making the condition occur, rather than trying to view all the data in anticipation of the fault. To record a snapshot in GDS, select, Record Snapshot, from the options at the top right portion of any of the various pages that allow snapshots to be taken (e.g. Data Display, Control Functions, etc.). When you are finished recording, select, Stop Snapshot recording. The snapshot will now be available for replay.

Snapshot Replay

The Snapshot Replay function allows reviews of previously recorded vehicle snapshot data. This information can be used in analysis of vehicle problems and detection of trigger error conditions. The graph function can be used to compare parameters to see if a component is functioning properly. Recorded snapshots can be selected for viewing by the following three methods:

- Selecting a snapshot file from the Vehicle Home Page and clicking on the Review selection.
- Double clicking on the selected snapshot from the Vehicle Home Page.
- Entering the Tools selection from the Menu selection and selecting Snapshot replay. Next, open the Snapshot Manager. Double click on the snapshot file you wish to view or click on the Load Snapshot selection and select a snapshot file.

Regardless of selection method, a File Loaded pop-up window will be displayed from the Snapshot Replay screen. Select OK from the pop-up window.

Snapshot Play Functions

There are several snapshot play functions that are used to replay recorded snapshots

- The Play function is used to play the snapshot forward by clicking on this selection. A marker will move across the screen when this selection is used. All selections in this area turn grey when they are active.
- The Pause function is used to pause play of the snapshot. When this selection is clicked a second time the snapshot will start playing where it left off.
- The Stop function is used to stop playing the snapshot. The snapshot will start from the beginning, if Play is selected after using the Stop function.

Time Control

Time control is used to control the snapshot replay. This function allows selection of a specific time frame, display of different views, and control of display speed. The following functions can be selected directly under Time Control.

- The Bookmark selection allows you to add a specific comment in the current display and return to this point in the future. When this option is selected, a pop-up window is displayed. Enter a bookmark name and select OK.
- The Note Pad can be selected to add comments to the snapshot replay file at the current point of time. When this option is selected, a pop-up window is displayed. Enter a comment for the snapshot file and select OK.
- The Load Snapshot (blue folder) opens a snapshot file and makes it ready for further analysis. This function is also available by clicking on an available snapshot file from the Snapshot Manager.
- The Down Arrow displays all Time Control options when selected. Individual options can also be selected by clicking on the item you want.
- The Snapshot Display Speed can be controlled by selecting this option. Slow speeds of 1/8X, 1/4X, and 1/2X can be selected. The real time speed can also be selected at 1. Faster speeds of 2X, 4X, and 8X can also be obtained by using this selection.

View Selections

Each View Selection provides a different way of displaying vehicle data for analysis. The following functions can be selected under Available Views:

NOTE: **The parameter name will be shown in the original language used for capture if no translation is available for the name.**

- Parameter List View - Displays incoming information from the snapshot file. The current value of the parameters is displayed on the screen.
- Log View - Contains all the information from the snapshot file. All parameter values are listed in the order they were recorded. Specific parameters can be added or removed from a watchlist by clicking on the appropriate item.
- State View - Shows the values of all parameters in a specific time frame. These values can be used for comparison with the trigger view.
- Trigger View - Displays all system and user defined triggers. This function can be used when there is a combination of factors involved in a diagnostic problem. When a Trigger condition is met a caution triangle will be displayed on the screen.

Triggers:

- Load Triggers - Allows you to load a file containing trigger definitions.
- Save Triggers - Allows you to save the trigger to your computer's hard drive.
- Remove Trigger - Allows you to remove the current trigger. It will no longer be present.
- Edit Trigger - Displays a pop-up window where you can modify the limits and parameters contained within a trigger.
- Adds Trigger - Displays a pop-up window to configure a trigger.
- DTC View - After the Play function is selected and this option is selected this function opens the list of recorded DTCs.
- Line Graph View - Displays data that can be visualized against the time-axis. From this view, specific parameters can be selected for graphing by checking the box under Selected. At the bottom of the graph there are four functions Zoom In (increase size), Zoom Out (decrease size), Bookmarks, and Pause Scrolling. Each of these functions can be accessed by clicking on them.

CIRCUIT PROTECTION - FUSES

Special Tools

EL 39200: Digital Multimeter (DMM)

For equivalent regional tools, refer to Special Tools.

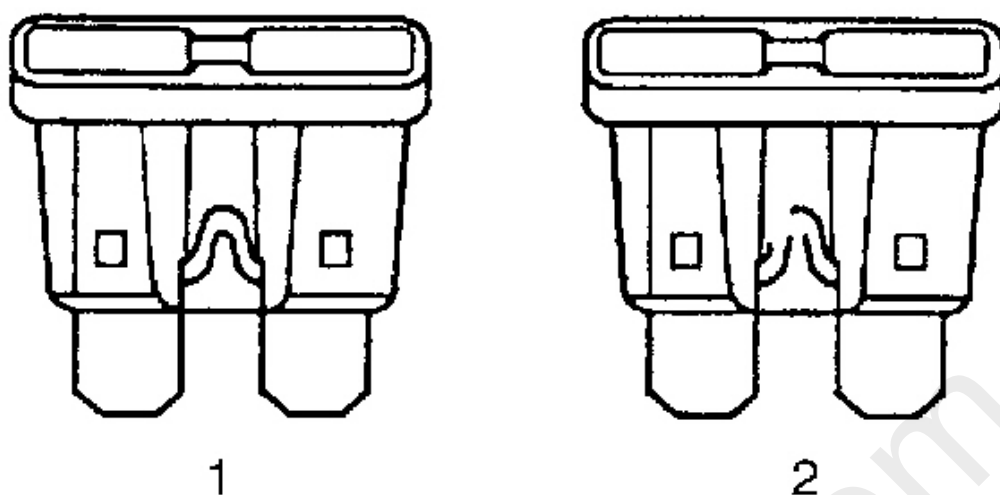


Fig. 2: Identifying Open Fuse Element
Courtesy of GENERAL MOTORS CORP.

The fuse is the most common method of an automotive wiring circuit protection. Whenever there is an excessive amount of current flowing through a circuit the fusible element will melt and create an open or incomplete circuit. Fuses are a one time protection device and must be replaced each time the circuit is overloaded. To determine if a fuse is open, remove the suspected fuse and examine if the element in the fuse is broken (2). If not broken (1), also check for continuity using a Digital Multimeter (DMM) or a continuity tester. If the element is broken or continuity is suspect, replace the fuse with one of equal current rating.

Fuse Types

Current Rating Amperes	Color
Auto Fuses, Mini Fuses	
2	Gray
3	Violet
5	Tan
7.5	Brown
10	Red
15	Blue
20	Yellow
25	White or Natural
30	Green
Maxi Fuses	
20	Yellow

30	Light Green
40	Orange or Amber
60	Blue
50	Red
J-Case Fuses	
20	Blue
30	Pink
40	Green
50	Red
60	Yellow

CIRCUIT PROTECTION - CIRCUIT BREAKERS

A circuit breaker is a protective device that is designed to open the circuit when a current load is in excess of the rated breaker capacity. If there is a short or other type of overload condition in the circuit, the excessive current will open the circuit between the circuit breaker terminals. Two types of circuit breakers are used.

Circuit Breaker

This type opens when excessive current passes through it for a period of time. It closes again after a few seconds, and if the cause of the high current is still present, it will open again. The circuit breaker will continue to cycle open and closed until the condition causing the high current is removed.

Positive Temperature Coefficient (PTC) Circuit Breaker

This type greatly increases its resistance when excessive current passes through it. The excessive current heats the PTC device, as the device heats its resistance increases. Eventually the resistance gets so high that the circuit is effectively open. Unlike the ordinary circuit breaker the PTC unit will not reset until the circuit is opened, by removing the voltage from its terminals. Once the voltage is removed the circuit breaker will re-close within a second or 2.

CIRCUIT PROTECTION - FUSIBLE LINKS

Special Tools

EL 39200: Digital Multimeter (DMM)

For equivalent regional tools, refer to **Special Tools** .

Fusible link is wire designed to melt and break continuity when excessive current is applied. It is often located between or near the battery and starter or electrical center. Use a continuity tester or a Digital Multimeter (DMM) at each end of the wire containing the fusible link in order to determine if it is broken. If broken, it must be replaced with fusible link of the same gauge size.

Repairing a Fusible Link

NOTE: Fusible links cut longer than 225 mm (approximately 9 in) will not provide sufficient overload protection.

WIRING REPAIRS

The Wiring Repairs section contains the following types of wiring repair information. Using these elements together will make wiring repair faster and easier:

- Testing for Intermittent Conditions and Poor Connections
- Flat Wire Repairs
- GMLAN Wiring Repairs
- High Temperature Wiring Repairs
- Heated Oxygen Sensor Wiring Repairs
- Splicing Copper Wire Using Splice Sleeves
- Splicing Twisted or Shielded Cable
- Splicing Inline Harness Diodes
- SIR/SRS Wiring Repairs

REPAIRING DAMAGED WIRE INSULATION

If the wire insulation has been chafed, or broken, enough to show the conductive portion of the wire, and the wire is not damaged, determine the length of insulation that needs to be repaired. If the repair is less than 280 mm (11 in), cut the wire within the damaged area. Then slide the appropriate heat shrink tubing (listed below) over the wire, and repair the wire by splicing the wires together. Refer to Splicing Copper Wire Using Splice Sleeves. Once the wire is spliced together slide heat shrink tubing over the damaged area and apply heat to seal the repaired wire.

If the wire is damaged, or the damaged area is larger than 280 mm (11 in), than replace the damaged wire by splicing in a new section of wire. Refer to Splicing Copper Wire Using Splice Sleeves.

GM Part Number	Diameter		Description	Color	Length	
	Metric	English			Metric	English
12355003	9.5 mm	0.375 in	Tubing, Shrink 3/8	Black	305 mm	12 in
12355005	12.7 mm	0.5 in	Tubing, Shrink 1/2	Black	305 mm	12 in
12355011	19.1 mm	0.75 in	Tubing, Shrink 3/4	Black	305 mm	12 in
12355008	25.4 mm	1.0 in	Tubing, Shrink 1.00	Black	305 mm	12 in

Wire Size Conversion

Metric Wire Sizes (mm 2)	AWG Sizes
0.13	26
0.21	24
0.32	22
0.52	20

0.83	18
1.31	16
2.09	14
3.31	12
5.27	10
8.37	8
13.3	6
21.2	4
33.6	2
53.5	1/0

FLAT WIRE REPAIRS

The flat wire within the flex wiring harness is not serviceable. If an open or short exists within the flex wiring harness the complete harness must be replaced.

GMLAN WIRING REPAIRS

Special Tools

- **EL-38125-10:** Splice Sleeve Crimping Tool
- **J 38125-5:** Ultra Torch Special Tool
- DuraSeal splice sleeves
- A wire stripping tool

For equivalent regional tools, refer to **Special Tools** .

The DuraSeal splice sleeves have the following 2 critical features:

- A special heat shrink sleeve environmentally seals the splice. The heat shrink sleeve contains a sealing adhesive inside.
- A cross hatched (knurled) core crimp provides necessary contact integrity for the sensitive, low energy circuits.

The GM Local Area Network (GMLAN) System requires special wiring repair procedures due to the sensitive nature of the circuitry. Follow the specific procedures and instructions when working on GMLAN connectors and terminals.

GMLAN Repairs

NOTE: When making a repair to any GMLAN network, the original wire length after the repair must be the same length as before the repair. If the network is a twisted pair, the twist must be maintained after the repair is completed.

GMLAN has 2 types of networks, low speed and high speed. Low speed GMLAN has a single wire and works at slow speeds. High speed GMLAN has 2 wires in a twisted pair and works at higher speeds. For more information on GMLAN, refer to **Data Link Communications Description and Operation** .

GMLAN Connector Terminal Repair

NOTE: **A terminated lead can be used to replace damaged connector terminals for both high speed and low speed GMLAN systems. When making a connector terminal repair on a GMLAN high speed system with twisted pair wires, do not untwist the wires more than necessary to make the repair.**

If the individual terminals are damaged on any GMLAN connection, use the appropriate connector repair procedure in order to repair the terminal. Refer to **Connector Repairs** for the appropriate connector repair procedure.

GMLAN Wire Repair

NOTE: **Refer to Wiring Repairs in order to determine the correct wire size for the circuit you are repairing. You must obtain this information in order to ensure circuit integrity.**

If any wire except the pigtail is damaged, repair the wire by splicing in a new section of wire of the same gauge size (0.5 mm, 0.8 mm, 1.0 mm etc.). Use the DuraSeal splice sleeves and **EL-38125-10**: tool. Use the following wiring repair procedures in order to ensure the integrity of the DuraSeal splice sleeves.

Splice Sleeve Color	Crimp Tool Nest Color	Wire Gauge mm ² / (AWG)
Salmon (Yellow-Pink) 12089189	Red (1)	0.035-0.8/(18-20)
Blue 12089190	Blue (2)	1-2/(14-16)
Yellow 12089191	Yellow (3)	3-5/(10-12)
Green 88988379	Red (1)	0.22-0.35/(22-26)

NOTE: **You must perform the following procedures in the listed order. Repeat the procedure if any wire strands are damaged. You must obtain a clean strip with all of the wire strands intact.**

1. Open the harness by removing any tape:
 - Use a sewing seam ripper, available from sewing supply stores, in order to cut open the harness in order to avoid wire insulation damage.
 - Use the DuraSeal splice sleeves on all types of insulation except tefzel and coaxial.
 - Do not use the crimp and DuraSeal splice sleeve to form a splice with more than 2 wires coming together.

2. Cut as little wire off the harness as possible. You may need the extra length of wire in order to change the location of a splice.

Adjust splice locations so that each splice is at least 40 mm (1.5 in) away from the other splices, harness branches, or connectors.

3. Strip the insulation:

- When adding a length of wire to the existing harness, use the same size wire as the original wire.
- Perform one of the following items in order to find the correct wire size:
 - Find the wire on the schematic and convert to regional wiring gauge size.
 - If you are unsure of the wire size, begin with the largest opening in the wire stripper and work down until achieving a clean strip of the insulation.
- Strip approximately 7.5 mm (0.313 in) of insulation from each wire to be spliced.
- Do not nick or cut any of the strands. Inspect the stripped wire for nicks or cut strands.
- If the wire is damaged, repeat this procedure after removing the damaged section.

4. Select the proper DuraSeal splice sleeve according to the wire size. Refer to the above table at the beginning of the repair procedure for the color coding of the DuraSeal splice sleeves and the crimp tool nests.

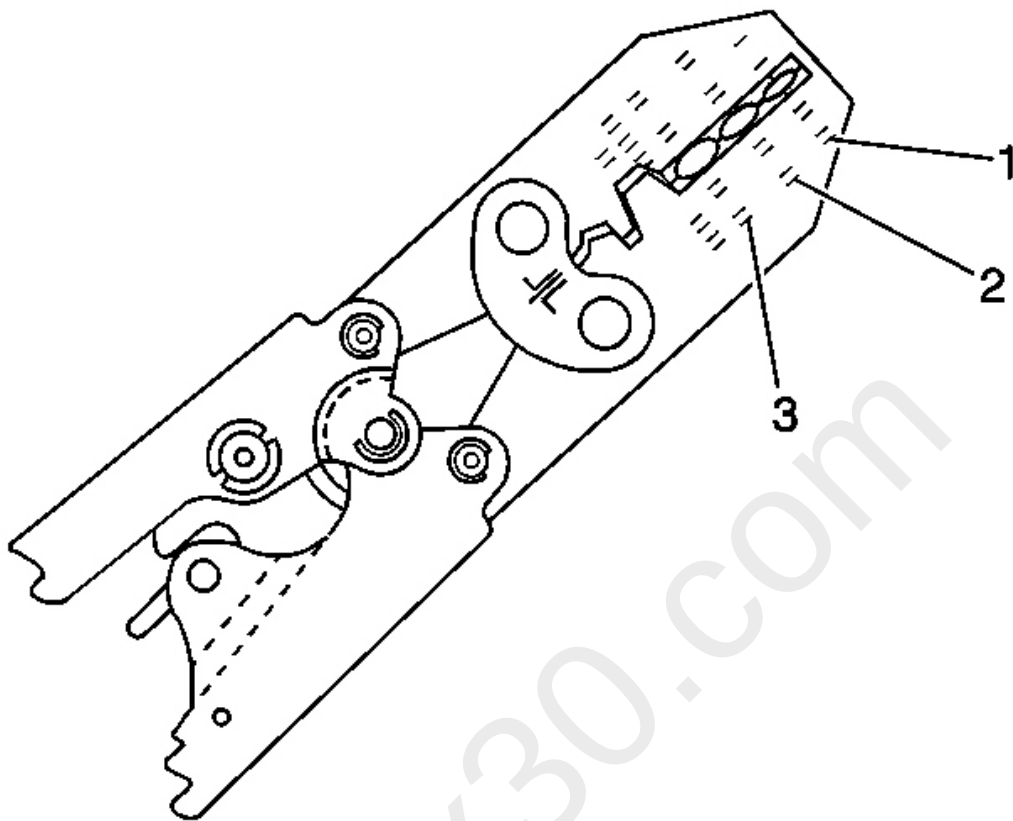


Fig. 3: Identifying Splice Crimp Tool Nests Terminal Identification
Courtesy of GENERAL MOTORS CORP.

5. Use the **EL-38125-10**: tool in order to position the DuraSeal splice sleeve in the proper color nest of the splice sleeve crimp tool. The crimp tool has four nests, one for each color.

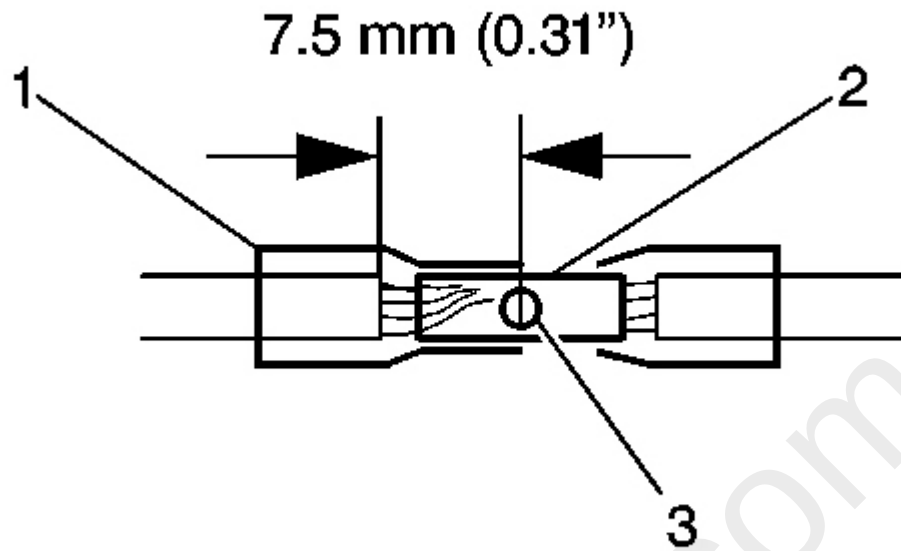


Fig. 4: Identifying Duraseal Splice Sleeve
Courtesy of GENERAL MOTORS CORP.

6. Place the DuraSeal splice sleeve in the nest. Ensure that the crimp falls midway between the end of the barrel and the stop. The sleeve has a stop (3) in the middle of the barrel (2) in order to prevent the wire (1) from going further. Close the hand crimper handles slightly in order to firmly hold the DuraSeal splice sleeve in the proper nest.



Fig. 5: Identifying Crimped Duraseal Splice Sleeve
Courtesy of GENERAL MOTORS CORP.

7. Insert the wire into the splice sleeve barrel until the wire hits the barrel stop.

8. Tightly close the handles of the crimp tool until the crimper handles open when released.

The crimper handles will not open until you apply the proper amount of pressure to the DuraSeal splice sleeve. Repeat steps 4 and 5 for the opposite end of the splice.



Fig. 6: Identifying Heated Splice Sleeve
Courtesy of GENERAL MOTORS CORP.

9. Using the heat torch, apply heat to the crimped area of the barrel.
10. Start in the middle and gradually move the heat barrel to the open ends of the tubing:
 - The tubing will shrink completely as the heat is moved along the insulation.
 - A small amount of sealant will come out of the end of the tubing when sufficient shrinkage is achieved.

HIGH TEMPERATURE WIRING REPAIRS

Special Tools

- **EL-38125-10:** Splice Sleeve Crimping Tool
- **J 38125-5:** Ultra Torch
- DuraSeal splice sleeves, in order to repair the SIR/SRS wiring

For equivalent regional tools, refer to **Special Tools** .

High Temperature Wiring

Wiring that is exposed to high temperatures, 135°C (275°F) or higher, for prolonged periods of time may use materials i.e. wires, connectors, and shielding that has a higher heat rating than typical wiring. When making a repair in a high temperature area observe the following:

- Use high temperature bulk wire rated at 150°C (302°F) continuous temperature to replace any damaged wire.
- Replace any heat shielding that is removed.
- Cover any DuraSeal splice sleeves with SCT1 shrink tubing.

- After making a wiring repair, ensure that the location of the wiring is not moved closer to the heat source.

Identifying High Temperature Wiring

Wiring that is exposed to high temperature, 135°C (275°F) or higher, for prolonged periods of time need special considerations when making wiring repairs. Areas that may be exposed to higher temperatures can be identified by heat resistant materials that are being used in those areas. These materials may include heat reflective tape, moon tape, and high temperature shrink tubing. Also conduit and other protective coverings may be used. Because conduit or similar coverings are used throughout the vehicle regardless of the temperature, it may be necessary for the technician to determine if an area is exposed to excessive heat before making a wiring repair. Obvious areas of consideration would be any area located near the exhaust manifolds, catalytic converter, and exhaust pipes.

Items Required

- DuraSeal splice sleeves to crimp and seal connections
- High temperature SCT1 shrink tubing to protect the splice sleeves
- Terminated leads or pigtails
- The correct tools to remove the terminals from the connectors

Use high temperature bulk wire rated at 150°C (302°F) continuous temperature of the same or larger gauge size as the original wire when repair damage wire. Also replace any reflective tape that you remove during the repair.

High Temperature Wire Repair

NOTE: Refer to Wiring Repairs in order to determine the correct wire size for the circuit you are repairing. You must obtain this information in order to ensure circuit integrity.

If any wire except the pigtail is damaged, repair the wire by splicing in a new section of wire rated at 150°C (302°F) continuous temperature rating of the same gauge size (0.5 mm, 0.8 mm, 1.0 mm etc.). Use the DuraSeal splice sleeves and the **EL-38125-10**: tool and then encapsulate the splice sleeve using the high temperature SCT1 shrink tubing. Use the following wiring repair procedures in order to ensure the integrity of the sealed splice.

Splice Sleeve Color	Crimp Tool Nest Color	Wire Gauge mm ² / (AWG)
Salmon (Yellow-Pink) 12089189	Red (1)	0.035-0.8/(18-20)
Blue 12089190	Blue (2)	1-2/(14-16)
Yellow 12089191	Yellow (3)	3-5/(10-12)
Green 88988379	Red (1)	0.22-0.35/(22-26)

NOTE: **You must perform the following procedures in the listed order. Repeat the procedure if any wire strands are damaged. You must obtain a clean strip with all of the wire strands intact.**

1. Open the harness by removing any tape:
 - Use a sewing seam ripper, available from sewing supply stores, in order to cut open the harness in order to avoid wire insulation damage.
 - Use the DuraSeal splice sleeves on all types of insulation except tefzel and coaxial.
 - Do not use the crimp and DuraSeal splice sleeve to form a splice with more than 2 wires coming together.
2. Cut as little wire off the harness as possible. You may need the extra length of wire in order to change the location of a splice.

Adjust splice locations so that each splice is at least 40 mm (1.5 in) away from the other splices, harness branches, or connectors.

3. Strip the insulation:
 - When adding a length of wire to the existing harness, use the same size wire as the original wire.
 - Perform one of the following items in order to find the correct wire size:
 - Find the wire on the schematic and convert to regional wiring gauge size.
 - If you are unsure of the wire size, begin with the largest opening in the wire stripper and work down until achieving a clean strip of the insulation.
 - Strip approximately 7.5 mm (0.313 in) of insulation from each wire to be spliced.
 - Do not nick or cut any of the strands. Inspect the stripped wire for nicks or cut strands.
 - If the wire is damaged, repeat this procedure after removing the damaged section.
4. Slide a section of high temperature SCT1 shrink tubing down the length of wire to be spliced. Ensure that the shrink tubing will not interfere with the splice procedure.
5. Select the proper DuraSeal splice sleeve according to the wire size. Refer to the above table at the beginning of the repair procedure for the color coding of the DuraSeal splice sleeves and the crimp tool nests.

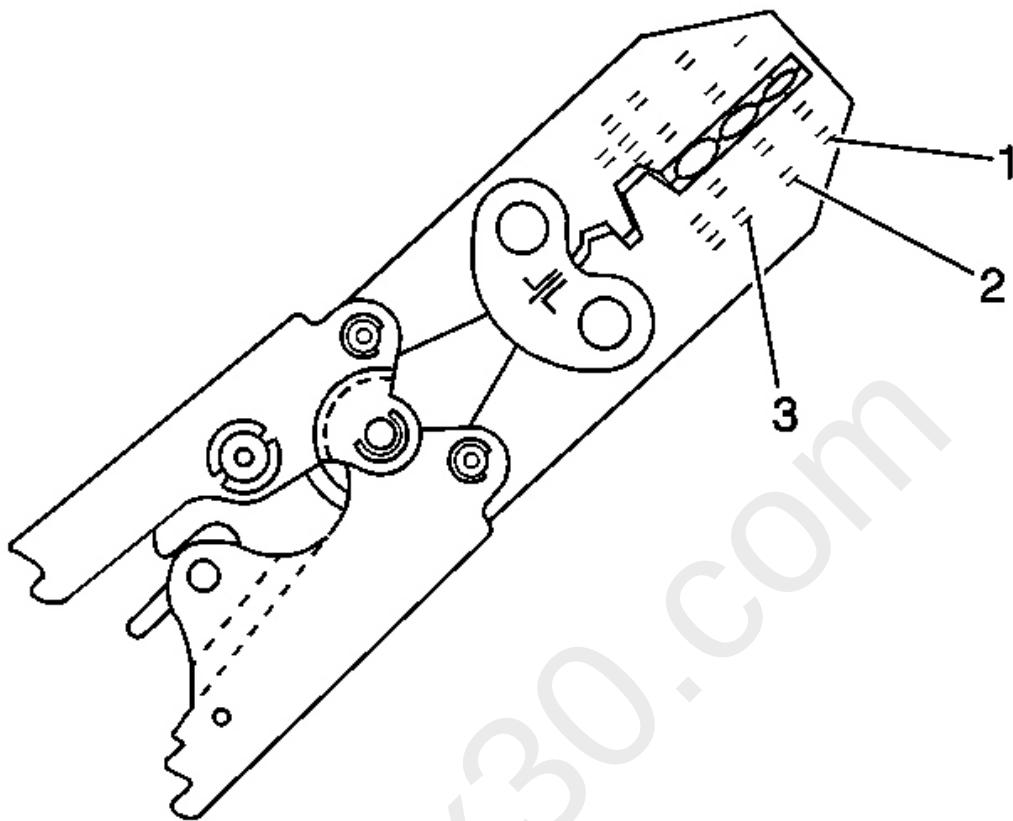


Fig. 7: Identifying Splice Crimp Tool Nests Terminal Identification
Courtesy of GENERAL MOTORS CORP.

6. Use the **EL-38125-10** tool in order to position the DuraSeal splice sleeve in the proper color nest of the splice sleeve crimp tool. The crimp tool has four nests, one for each color.

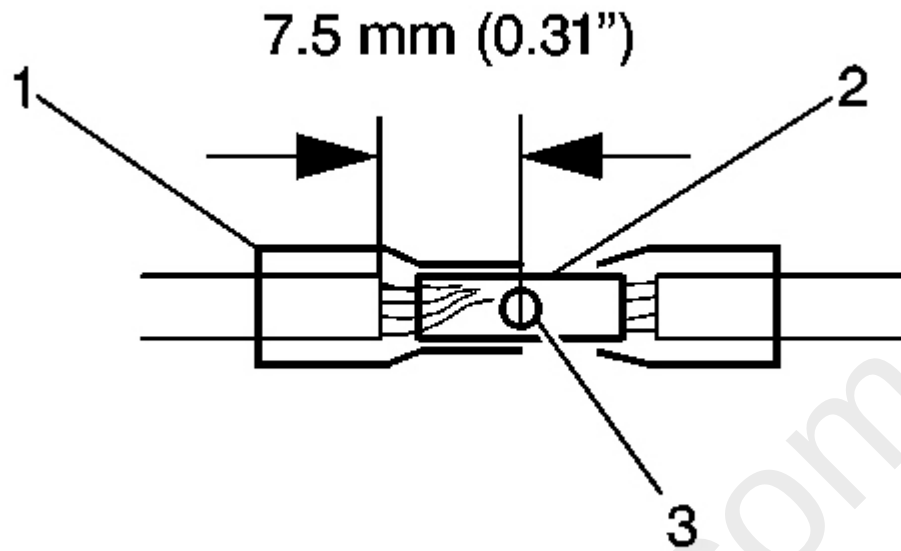


Fig. 8: Identifying Duraseal Splice Sleeve
Courtesy of GENERAL MOTORS CORP.

7. Place the DuraSeal splice sleeve in the nest. Ensure that the crimp falls midway between the end of the barrel and the stop. The sleeve has a stop (3) in the middle of the barrel (2) in order to prevent the wire (1) from going further. Close the hand crimper handles slightly in order to firmly hold the DuraSeal splice sleeve in the proper nest.



Fig. 9: Identifying Crimped Duraseal Splice Sleeve
Courtesy of GENERAL MOTORS CORP.

8. Insert the wire into the splice sleeve barrel until the wire hits the barrel stop.

9. Tightly close the handles of the crimp tool until the crimper handles open when released.

The crimper handles will not open until you apply the proper amount of pressure to the DuraSeal splice sleeve. Repeat steps 4 and 5 for the opposite end of the splice.



Fig. 10: Identifying Heated Splice Sleeve
Courtesy of GENERAL MOTORS CORP.

10. Using the heat torch, apply heat to the crimped area of the barrel.
11. Start in the middle and gradually move the heat barrel to the open ends of the tubing:
 - The tubing will shrink completely as the heat is moved along the insulation.
 - A small amount of sealant will come out of the end of the tubing when sufficient shrinkage is achieved.

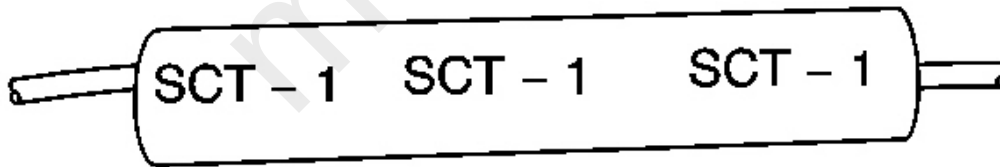


Fig. 11: View Of High Temperature SCT1 Shrink Tube
Courtesy of GENERAL MOTORS CORP.

12. Center the high temperature SCT1 shrink tube over the DuraSeal splice sleeve.
13. Using the heat torch, apply heat to the high temperature heat shrink tubing.
14. Gradually move the heat from the center to the open end of the tubing:
 - The tubing will shrink completely as the heat is moved along the insulation.
 - A small amount of sealant will come out of the end of the tubing when sufficient shrinkage is

achieved.

15. Replace any reflective tape and clips that may have been removed during the repair.

HEATED OXYGEN SENSOR WIRING REPAIRS

CAUTION: Do not solder repairs under any circumstances as this could result in the air reference being obstructed.

If the heated oxygen sensor pigtail wiring, connector, or terminal is damaged the entire oxygen sensor assembly must be replaced. Do not attempt to repair the wiring, connector, or terminals. In order for the sensor to function properly it must have a clean air reference. This clean air reference is obtained by way of the oxygen sensor signal and heater wires. Any attempt to repair the wires, connectors or terminals could result in the obstruction of the air reference and degrade oxygen sensor performance.

The following guidelines should be used when servicing the heated oxygen sensor:

- Do not apply contact cleaner or other materials to the sensor or vehicle harness connectors. These materials may get into the sensor, causing poor performance. Also, the sensor pigtail and harness wires must not be damaged in such a way that the wires inside are exposed. This could provide a path for foreign materials to enter the sensor and cause performance problems.
- Neither the sensor nor vehicle lead wires should be bent sharply or kinked. Sharp bends, kinks, etc., could block the reference air path through the lead wire.
- Do not remove or defeat the oxygen sensor ground wire (where applicable). Vehicles that utilize the ground wire sensor may rely on this ground as the only ground contact to the sensor. Removal of the ground wire will also cause poor engine performance.
- To prevent damage due to water intrusion, be sure that the peripheral seal remains intact on the vehicle harness connector.

SPLICING COPPER WIRE USING SPLICE SLEEVES

Special Tools

- **EL-38125-10:** Splice Sleeve Crimping Tool
- **J 38125-5:** Ultra Torch
- DuraSeal splice sleeves, in order to repair the SIR/SRS wiring

For equivalent regional tools, refer to **Special Tools**.

NOTE: Use only DuraSeal splice sleeves. Other splice sleeves may not protect the splice from moisture or provide a good electrical connection.

Use DuraSeal splice sleeves to form a one-to-one splice on all types of insulation except tefzel and coaxial. Use DuraSeal splice sleeves where there are special requirements such as moisture sealing. Follow the instructions below in order to splice copper wire using DuraSeal splice sleeves.

Splice Sleeve Color	Crimp Tool Nest Color	Wire Gauge mm ² / (AWG)
Salmon (Yellow-Pink) 12089189	Red (1)	0.35-0.8/(18-20)
Blue 12089190	Blue (2)	1-2/(14-16)
Yellow 12089191	Yellow (3)	3-5/(10-12)
Green 88988379	Red (1)	0.22-0.35/(22-26)

NOTE: You must perform the following procedures in the listed order. Repeat the procedure if any wire strands are damaged. You must obtain a clean strip with all of the wire strands intact.

1. Open the harness by removing any tape:
 - Use a sewing seam ripper, available from sewing supply stores, in order to cut open the harness in order to avoid wire insulation damage.
 - Use the DuraSeal splice sleeves on all types of insulation except tefzel and coaxial.
 - Do not use the crimp and DuraSeal splice sleeve to form a splice with more than 2 wires coming together.
2. Cut as little wire off the harness as possible. You may need the extra length of wire in order to change the location of a splice.

Adjust splice locations so that each splice is at least 40 mm (1.5 in) away from the other splices, harness branches, or connectors.

3. Strip the insulation:
 - When adding a length of wire to the existing harness, use the same size wire as the original wire.
 - Perform one of the following items in order to find the correct wire size:
 - Find the wire on the schematic and convert to regional wiring gauge size.
 - If you are unsure of the wire size, begin with the largest opening in the wire stripper and work down until achieving a clean strip of the insulation.
 - Strip approximately 7.5 mm (0.313 in) of insulation from each wire to be spliced.
 - Do not nick or cut any of the strands. Inspect the stripped wire for nicks or cut strands.
 - If the wire is damaged, repeat this procedure after removing the damaged section.
4. Select the proper DuraSeal splice sleeve according to the wire size. Refer to the above table at the beginning of the repair procedure for the color coding of the DuraSeal splice sleeves and the crimp tool nests.

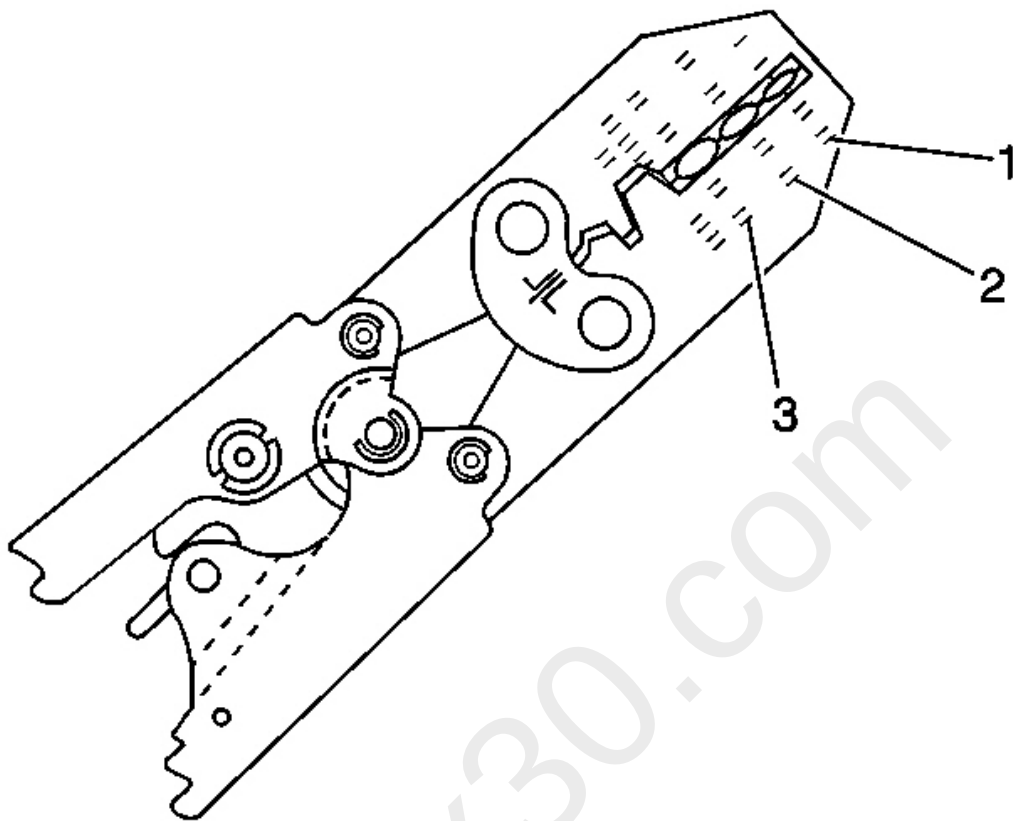


Fig. 12: Identifying Splice Crimp Tool Nests Terminal Identification
Courtesy of GENERAL MOTORS CORP.

5. Use the **EL-38125-10**: tool in order to position the DuraSeal splice sleeve in the proper color nest of the splice sleeve crimp tool. The crimp tool has four nests, one for each color.

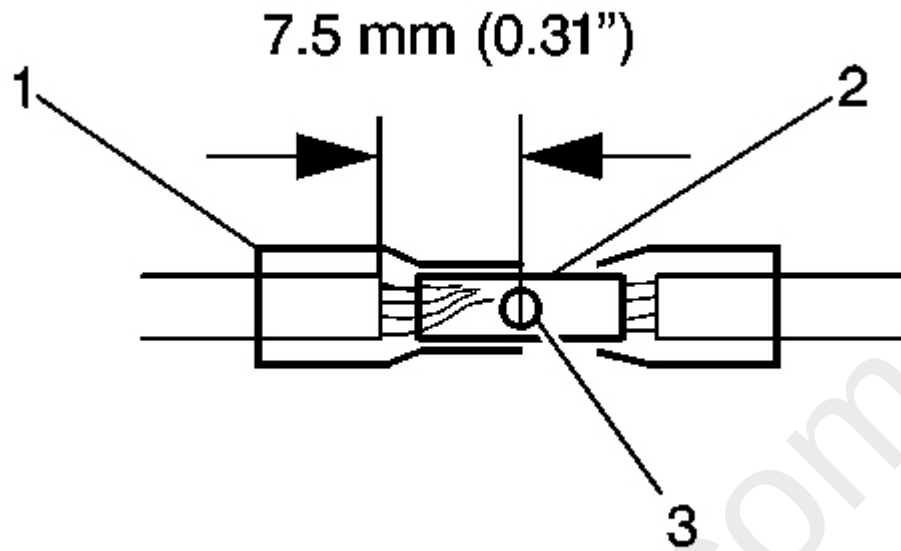


Fig. 13: Identifying Duraseal Splice Sleeve
 Courtesy of GENERAL MOTORS CORP.

6. Place the DuraSeal splice sleeve in the nest. Ensure that the crimp falls midway between the end of the barrel and the stop. The sleeve has a stop (3) in the middle of the barrel (2) in order to prevent the wire (1) from going further. Close the hand crimper handles slightly in order to firmly hold the DuraSeal splice sleeve in the proper nest.



Fig. 14: Identifying Crimped Duraseal Splice Sleeve
 Courtesy of GENERAL MOTORS CORP.

7. Insert the wire into the splice sleeve barrel until the wire hits the barrel stop.

8. Tightly close the handles of the crimp tool until the crimper handles open when released.

The crimper handles will not open until you apply the proper amount of pressure to the DuraSeal splice sleeve. Repeat steps 4 and 5 for the opposite end of the splice.



Fig. 15: Identifying Heated Splice Sleeve
Courtesy of GENERAL MOTORS CORP.

9. Using the heat torch, apply heat to the crimped area of the barrel.
10. Start in the middle and gradually move the heat barrel to the open ends of the tubing:
 - The tubing will shrink completely as the heat is moved along the insulation.
 - A small amount of sealant will come out of the end of the tubing when sufficient shrinkage is achieved.

SPLICING TWISTED OR SHIELDED CABLE

Twisted/shielded cable is used in order to protect wiring from electrical noise. Two-conductor cable of this construction is used between the radio and the Delco-Bose® speaker/amplifier units and other applications where low level, sensitive signals must be carried. Follow the instructions below in order to repair the twisted/shielded cable.

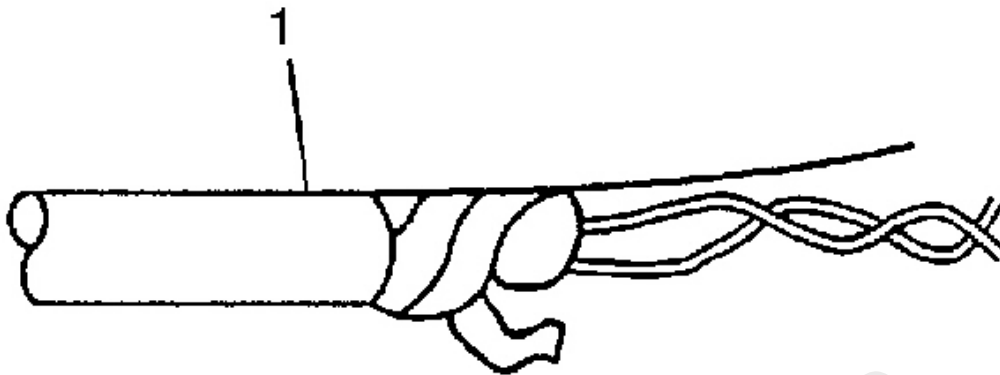


Fig. 16: View Of Outer Wiring Jacket
Courtesy of GENERAL MOTORS CORP.

1. Remove the outer jacket (1). Use care not to cut into the drain wire of the mylar tape.
2. Unwrap the tape. Do not remove the tape. Use the tape in order to rewrap the twisted conductors after the splice is made.



Fig. 17: Preparing The Splice
Courtesy of GENERAL MOTORS CORP.

3. Prepare the splice. Untwist the conductors and follow the instructions for **Splicing Copper Wire Using Splice Sleeves**. Staggering the splices by 65 mm (2.5 in) is recommended.

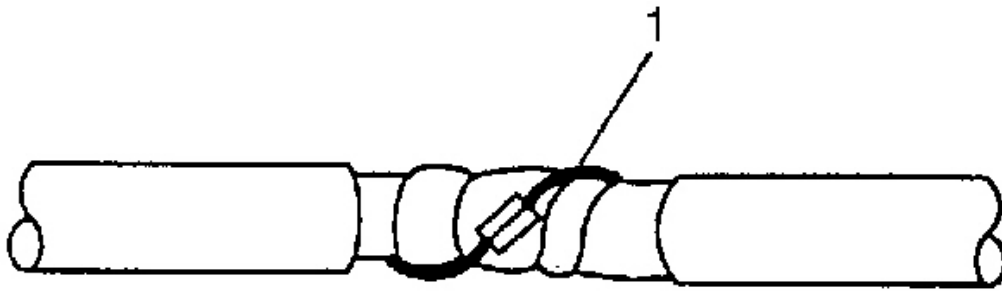


Fig. 18: Identifying Diode On Wire
Courtesy of GENERAL MOTORS CORP.

NOTE: Apply the mylar tape with the aluminum side inward. This ensures good electrical contact with the drain wire.

4. Re-assemble the cable.
 - Rewrap the conductors with the mylar tape. If the mylar tape is damaged, use 3M product AL-36FR to replace the damaged mylar tape.
 - Use caution not to wrap the drain wire in the tape (1).
 - Follow the splicing instructions for copper wire and splice the drain wire.
 - Wrap the drain wire around the conductors and tape with electrical tape to replace the outer insulation.



Fig. 19: View Of Repaired Wire Covered With Electrical Tape
Courtesy of GENERAL MOTORS CORP.

5. Tape over the entire cable. Use a winding motion when you apply the tape.

SPLICING INLINE HARNESS DIODES

Many vehicle electrical systems use a diode to isolate circuits and protect the components from voltage spikes. When installing a new diode use the following procedure.

1. Open the harness.
 - If the harness is taped, remove the tape.
 - To avoid wiring insulation damage, use a sewing seam ripper (available from sewing supply stores) in order to cut open the harness.
 - If the harness has a black plastic conduit, pull out the diode.
2. If the diode is taped to the harness, remove all of the tape.
3. Check and record the current flow direction and orientation of diode.
4. Remove the inoperative diode from the harness with a suitable soldering tool.

NOTE: **If the diode is located next to a connector terminal remove the terminal(s) from the connector to prevent damage from the soldering tool.**

5. Carefully strip away a section of insulation next to the old soldered portion of the wire(s). Do not remove any more than is needed to attach the new diode.
6. Check current flow direction of the new diode, being sure to install the diode with correct bias. Reference the appropriate service manual wiring schematic to obtain the correct diode installation position.
7. Attach the new diode to the wire(s) using 60/40 rosin core solder. Before soldering attach some heat sinks (aluminum alligator clips) across the diode wire ends to protect the diode from excessive heat. Follow the manufacturer's instruction for the soldering equipment.
8. Reinstall terminal(s) into the connector body if previously removed.

NOTE: **To prevent shorts to ground and water intrusion, completely cover all exposed wire and diode attachment points with tape.**

9. Tape the diode to the harness or connector using electrical tape.

SIR/SRS WIRING REPAIRS

Special Tools

- **EL-38125-10:** Splice Sleeve Crimping Tool
- **J 38125-5:** Ultra Torch
- DuraSeal splice sleeves, in order to repair the SIR/SRS wiring

For equivalent regional tools, refer to **Special Tools** .

The DuraSeal splice sleeves have the following 2 critical features:

- A special heat shrink sleeve environmentally seals the splice. The heat shrink sleeve contains a sealing

adhesive inside.

- A cross hatched (knurled) core crimp provides the necessary low resistance contact integrity for these sensitive, low energy circuits.

The Supplemental Inflatable Restraint (SIR) System/Supplemental Restraint System (SRS) requires special wiring repair procedures due to the sensitive nature of the circuitry. Follow the specific procedures and instructions when working with the SIR/SRS, and the wiring components, such as connectors and terminals.

SIR/SRS Connector Repair (Plastic Body and Terminal Metal Pin)

NOTE: Do not use the terminals in the kit in order to replace damaged SIR/SRS system terminals. Use either an SIR/SRS pigtail or a terminated lead from the SIR Repair Kit Tray.

The terminals in the SIR/SRS system are made with a special plating. This plating provides the necessary contact integrity for the sensitive, low energy circuits.

Pigtail repair packs are available for SIR/SRS connectors with eight or less terminals. Only the connector body is available for connectors with more than eight terminals. Terminated leads can be used to replace damaged terminals when replacing the connector body.

SIR/SRS Component Wire Pigtail Repair

NOTE: Do not make wire, connector, or terminal repairs on components with wire pigtails.

A wire pigtail is a wire or wires attached directly to the device, not by a connector. If a wiring pigtail is damaged, you must replace the entire component, with pigtail. The inflatable restraint steering wheel module coil is an example of a pigtail component.

SIR/SRS Wire Repair

NOTE: Refer to Wiring Repairs in order to determine the correct wire size for the circuit you are repairing. You must obtain this information in order to ensure circuit integrity.

If any wire except the pigtail is damaged, repair the wire by splicing in a new section of wire of the same gauge size (0.5 mm, 0.8 mm, 1.0 mm etc.). Use the DuraSeal splice sleeves and **EL-38125-10** tool. Use the following wiring repair procedures in order to ensure the integrity of the DuraSeal splice sleeves.

Splice Sleeve Color	Crimp Tool Nest Color	Wire Gauge mm² / (AWG)
Salmon (Yellow-Pink) 12089189	Red (1)	0.035-0.8/(18-20)
Blue 12089190	Blue (2)	1-2/(14-16)
Yellow		

12089191	Yellow (3)	3-5/(10-12)
Green 88988379	Red (1)	0.22-0.35/(22-26)

NOTE: You must perform the following procedures in the listed order. Repeat the procedure if any wire strands are damaged. You must obtain a clean strip with all of the wire strands intact.

1. Open the harness by removing any tape:
 - Use a sewing seam ripper, available from sewing supply stores, in order to cut open the harness in order to avoid wire insulation damage.
 - Use the DuraSeal splice sleeves on all types of insulation except tefzel and coaxial.
 - Do not use the crimp and DuraSeal splice sleeve to form a splice with more than 2 wires coming together.
2. Cut as little wire off the harness as possible. You may need the extra length of wire in order to change the location of a splice.

Adjust splice locations so that each splice is at least 40 mm (1.5 in) away from the other splices, harness branches, or connectors.

3. Strip the insulation:
 - When adding a length of wire to the existing harness, use the same size wire as the original wire.
 - Perform one of the following items in order to find the correct wire size:
 - Find the wire on the schematic and convert to regional wiring gauge size.
 - If you are unsure of the wire size, begin with the largest opening in the wire stripper and work down until achieving a clean strip of the insulation.
 - Strip approximately 7.5 mm (0.313 in) of insulation from each wire to be spliced.
 - Do not nick or cut any of the strands. Inspect the stripped wire for nicks or cut strands.
 - If the wire is damaged, repeat this procedure after removing the damaged section.
4. Select the proper DuraSeal splice sleeve according to the wire size. Refer to the above table at the beginning of the repair procedure for the color coding of the DuraSeal splice sleeves and the crimp tool nests.

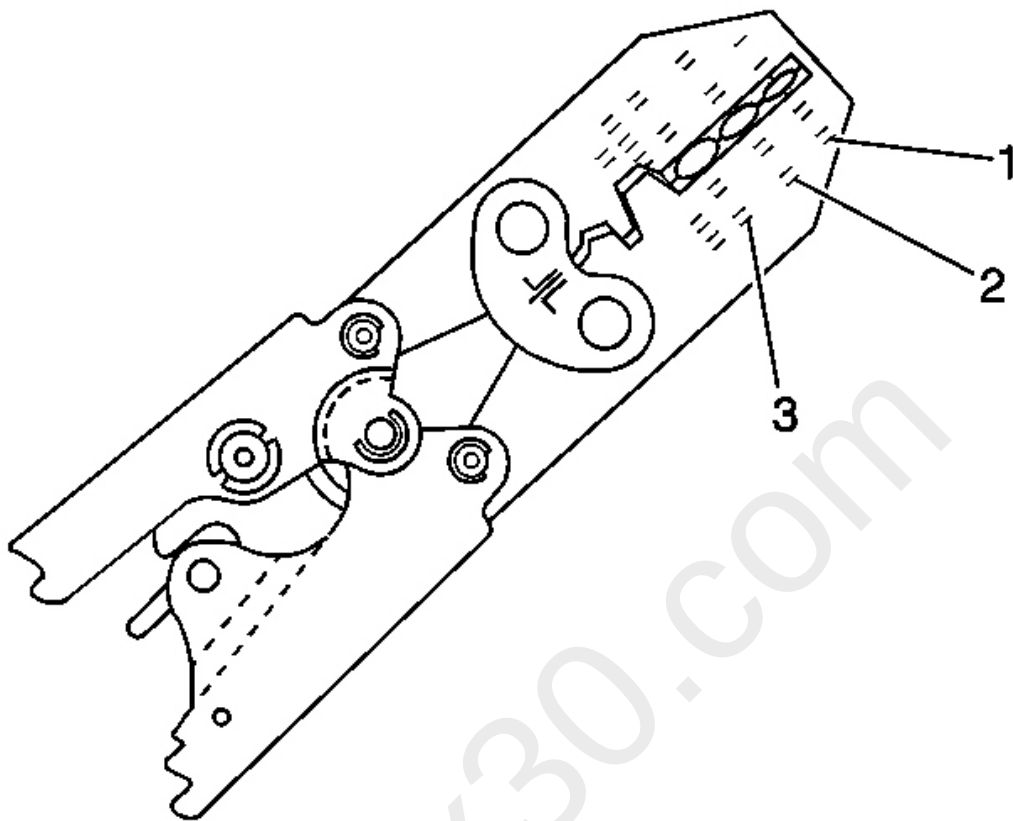


Fig. 20: Identifying Splice Crimp Tool Nests Terminal Identification
Courtesy of GENERAL MOTORS CORP.

5. Use the **EL-38125-10**: tool in order to position the DuraSeal splice sleeve in the proper color nest of the splice sleeve crimp tool. The crimp tool has four nests, one for each color.

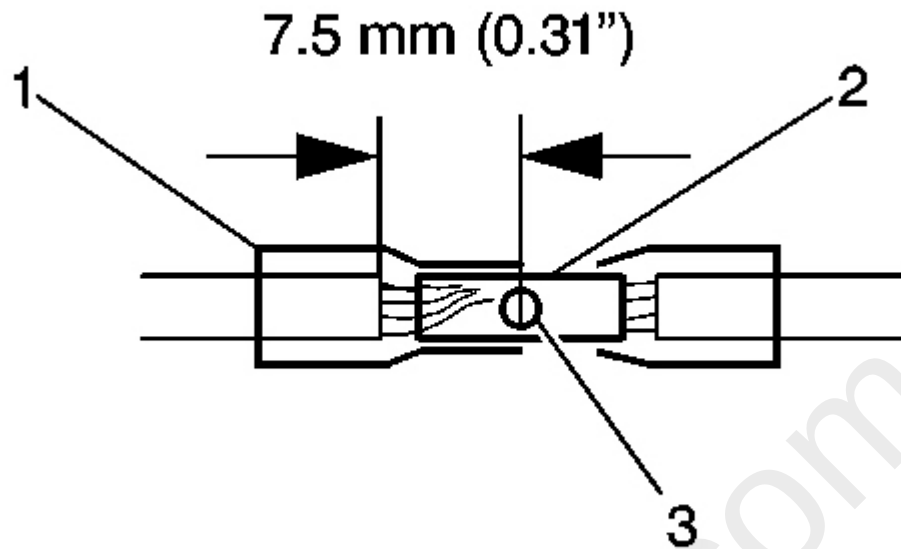


Fig. 21: Identifying Duraseal Splice Sleeve
 Courtesy of GENERAL MOTORS CORP.

6. Place the DuraSeal splice sleeve in the nest. Ensure that the crimp falls midway between the end of the barrel and the stop. The sleeve has a stop (3) in the middle of the barrel (2) in order to prevent the wire (1) from going further. Close the hand crimper handles slightly in order to firmly hold the DuraSeal splice sleeve in the proper nest.



Fig. 22: Identifying Crimped Duraseal Splice Sleeve
 Courtesy of GENERAL MOTORS CORP.

7. Insert the wire into the splice sleeve barrel until the wire hits the barrel stop.

8. Tightly close the handles of the crimp tool until the crimper handles open when released.

The crimper handles will not open until you apply the proper amount of pressure to the DuraSeal splice sleeve. Repeat steps 4 and 5 for the opposite end of the splice.



Fig. 23: Identifying Heated Splice Sleeve
Courtesy of GENERAL MOTORS CORP.

9. Using the heat torch, apply heat to the crimped area of the barrel.
10. Start in the middle and gradually move the heat barrel to the open ends of the tubing:
 - The tubing will shrink completely as the heat is moved along the insulation.
 - A small amount of sealant will come out of the end of the tubing when sufficient shrinkage is achieved.

Connector Position Assurance (CPA)

The connector position assurance (CPA) is a small plastic insert that fits through the locking tabs of a connector. CPAs are used in all SIR System connectors and also in some connectors of other systems. The CPA ensures that the connector halves cannot vibrate apart. You must have the CPA in place in order to ensure good contact between the mating terminals of a connection.

Terminal Position Assurance (TPA)

The terminal position assurance (TPA) insert resembles the plastic combs used in the control module connectors. The TPA keeps the terminal securely seated in the connector body. Do not remove the TPA from the connector body unless you remove a terminal for replacement.

CONNECTOR REPAIRS

Connector Repairs contains a list of all connector repairs. The connector repairs are listed by the connector manufacturer and then by connector type. If the technician cannot identify the manufacturer of the connector, refer to Identifying Connectors below. Knowing the connector manufacturer will assist in finding the correct connector repair from the following list:

- **Connector Position Assurance Locks**

- Terminal Position Assurance Locks
- AFL/EPC Connectors
- Bosch Connectors (BSK) or Bosch Connectors (0.64) or Bosch Connectors (2.8 JPT) or Bosch Connectors (ECM)
- Delphi Connectors (Weather Pack) or Delphi Connectors (Push To Seat) or Delphi Connectors (Pull To Seat) or Delphi Connectors (Micro-Pack 100W) or Delphi Connectors (Micro .64) or Delphi Connectors (12-Way) or Delphi Connectors (Steering Gear)
- FCI Connectors (Lever Lock) or FCI Connectors (SIR)
- FEP Connectors (Steering Gear)
- JST Connectors
- Kostal Connectors (Glow Plug Control Module) or Kostal Connectors (Transmission)
- Molex Connectors
- Sumitomo Connectors
- Tyco/AMP Connectors (CM 42-Way) or Tyco/AMP Connectors (Sensor) or Tyco/AMP Connectors (0.25 Cap) or Tyco/AMP Connectors (43-Way) or Tyco/AMP Connectors (Door Module)
- Yazaki Connectors (2-Way) or Yazaki Connectors (16-Way)
- Repairing Connector Terminals

Connector Anatomy

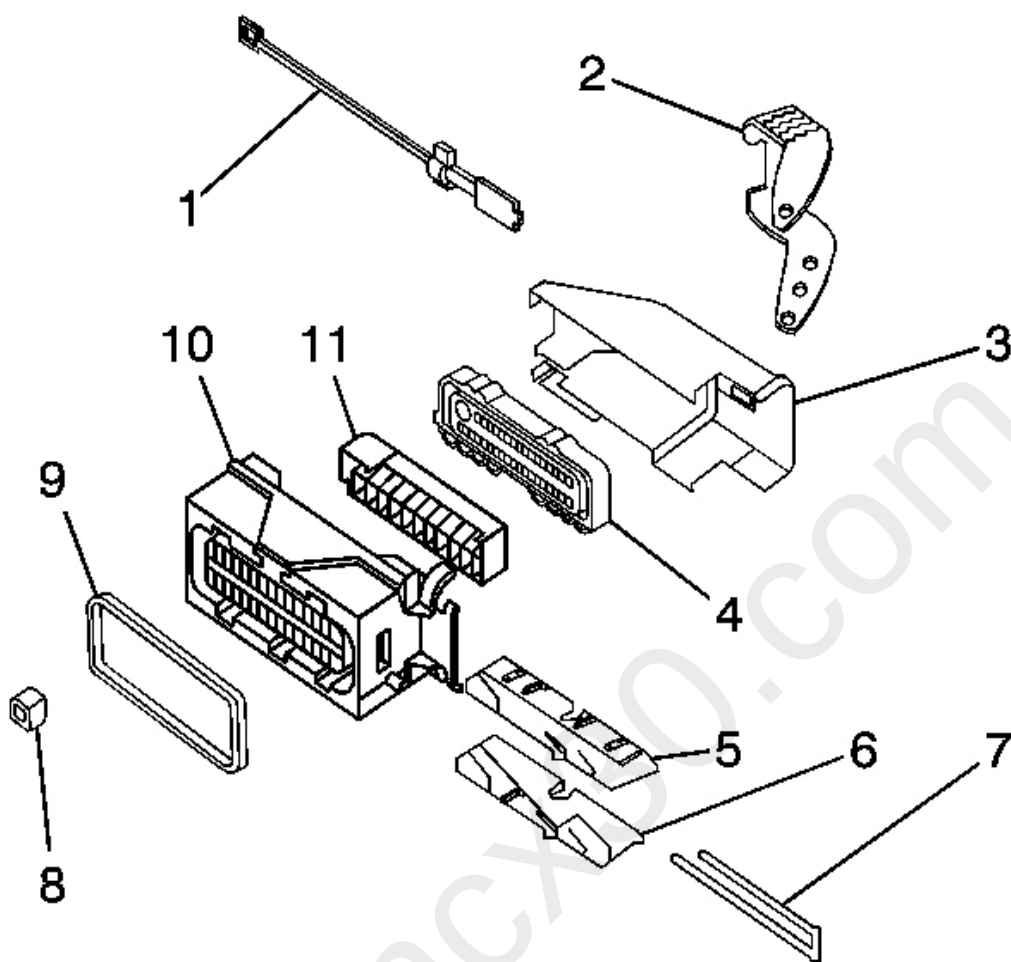


Fig. 24: Connector Components
 Courtesy of GENERAL MOTORS CORP.

Callout	Component Name
1	Connector Positive Assurance (CPA)
2	Assist Lever
3	Wiredress Cover
4	Seal Strain/Relief
5	Slide Left Hand
6	Slide Right Hand
7	Terminal Positive Assurance (TPA)
8	Terminal Positive Assurance (TPA)

9	Connector Seal
10	Connector Housing
11	Inner Connector

Identifying Connectors

Knowing the connector manufacturer is helpful when trying to locating the correct connector repair procedure. There are many different connector designs used on GM vehicles and it is sometimes difficult to identify the connector manufacturer. The information in this document should help with the identification of connector manufactures.

The following connector manufacturers make most of the connectors found in GM vehicles:

- AFL/EPC (Alcoa Fujikura Ltd./Engineered Plastics Components)
- Bosch
- Delphi
- FCI (Framatome Connectors International)
- JAE (Japan Aviation Electronics)
- JST (Japan Solderless Terminals)
- Kostel
- Molex
- Sumitomo
- Tyco/AMP
- Yazaki

Identifying the manufacturer of a connector is often difficult. When trying to determine the manufacturer of a connector, look for specific identifying marks that are unique to that connector supplier. Most of these identify marks are hard to find or see. Check the connector carefully and refer to the information below for pictures and descriptions of connector identification markings.

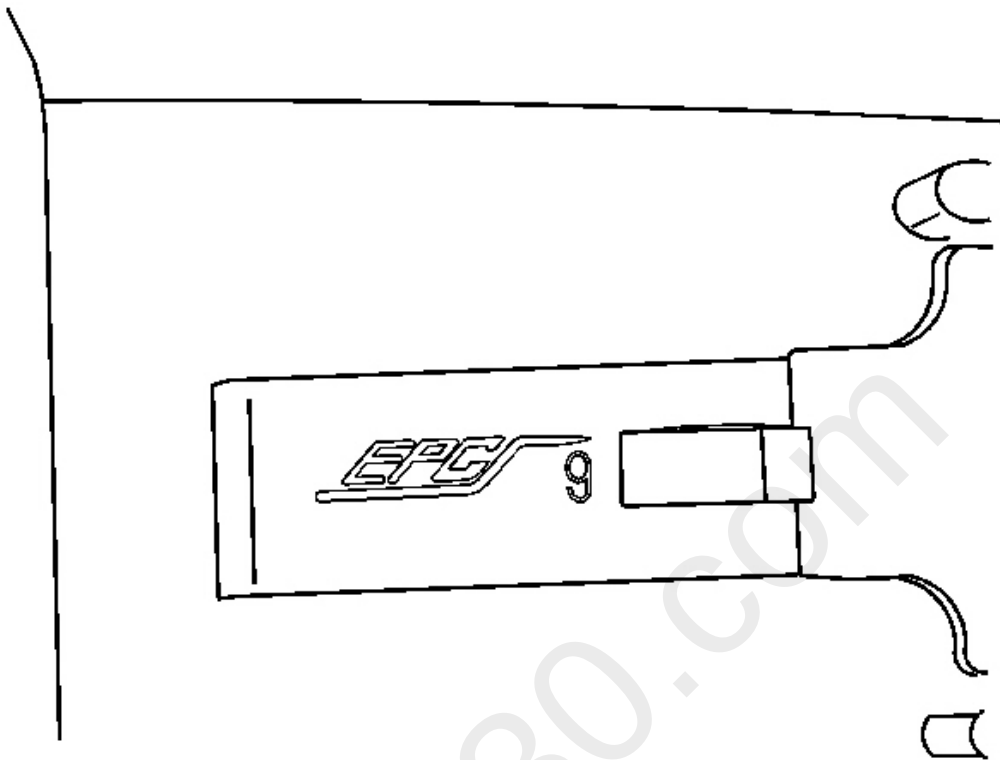


Fig. 25: View Of EPC Identification On Connector Body
Courtesy of GENERAL MOTORS CORP.

- Most of AFLs connectors have EPC on their connector body. Some of the smaller connectors will not have any markings on them.

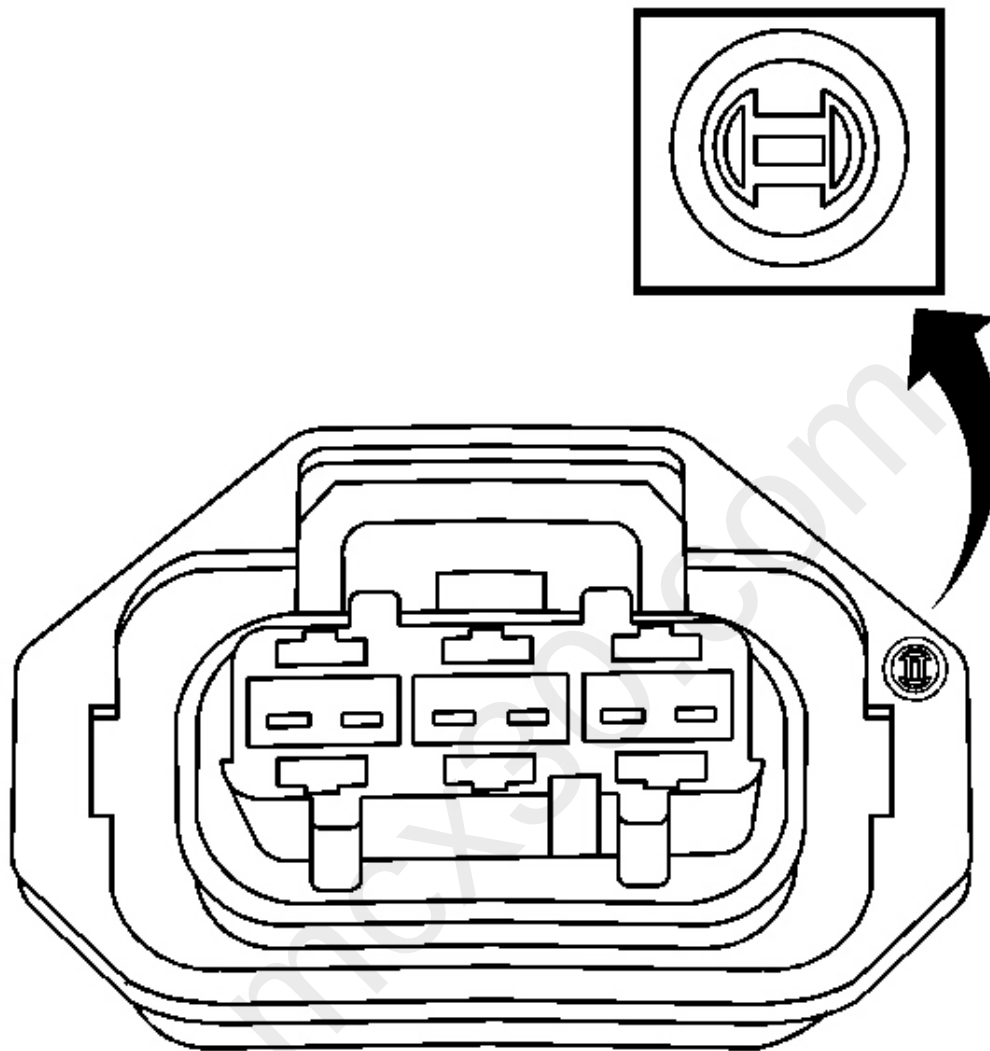


Fig. 26: View Of Bosch Identification On Connector Body
Courtesy of GENERAL MOTORS CORP.

- In some cases Bosch will actually be printed on the connector. If Bosch does not appear on the connector, look for the Bosch logo. The Bosch logo is a circle with a blunted arrow inside. This logo can appear anywhere on the connector and is often very small.

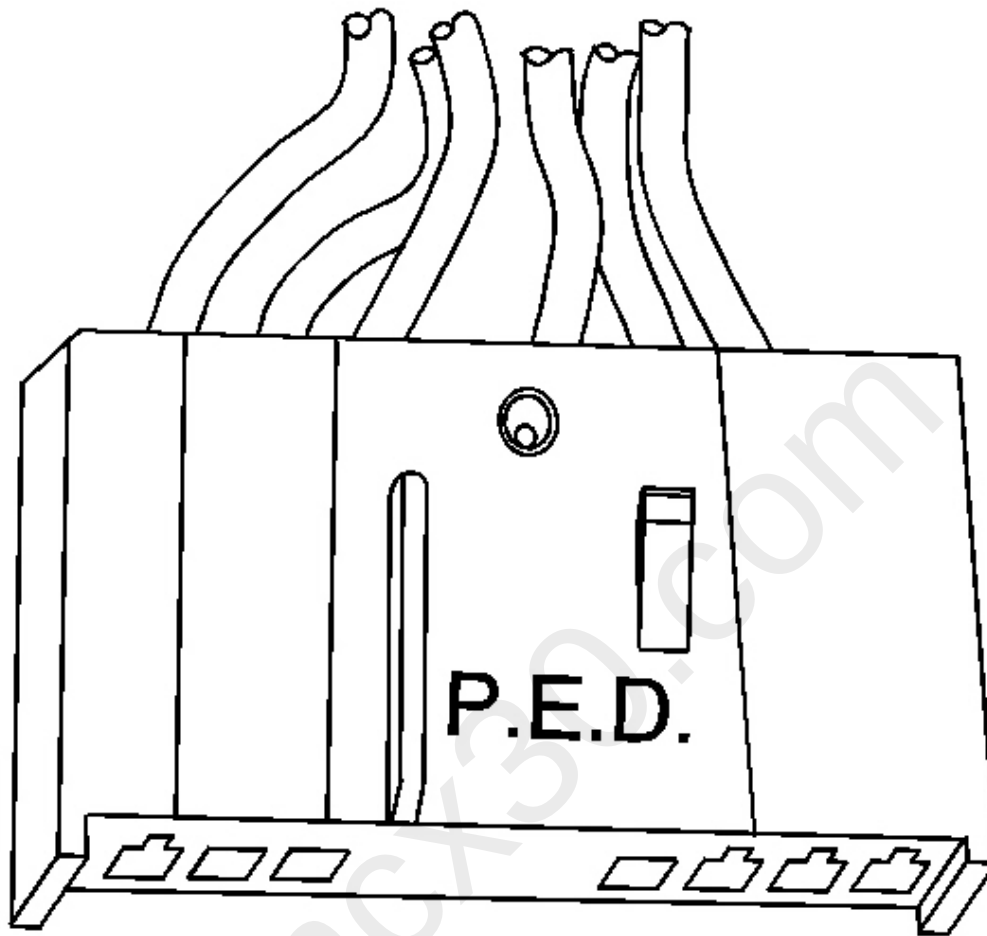


Fig. 27: View Of PED Identification On Connector Body
Courtesy of GENERAL MOTORS CORP.

- In some cases Delphi will actually be printed on the connector. If Delphi is not printed on the connector, look for PED. In both cases there is no specific orientation for Delphi or PED and they can appear anywhere on the connector.

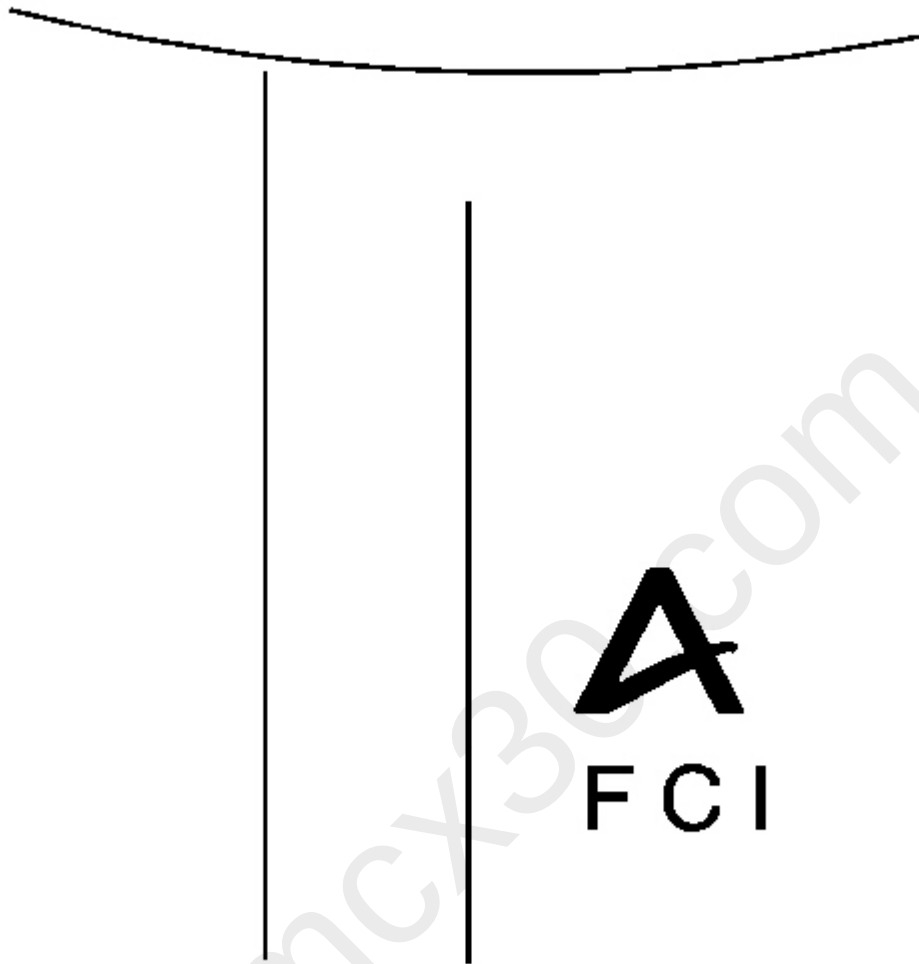


Fig. 28: View Of FCI Identification On Connector Body
Courtesy of GENERAL MOTORS CORP.

- FCI connectors may have the FCI logo on their connectors. The logo is the letters FCI with an "A" above it.

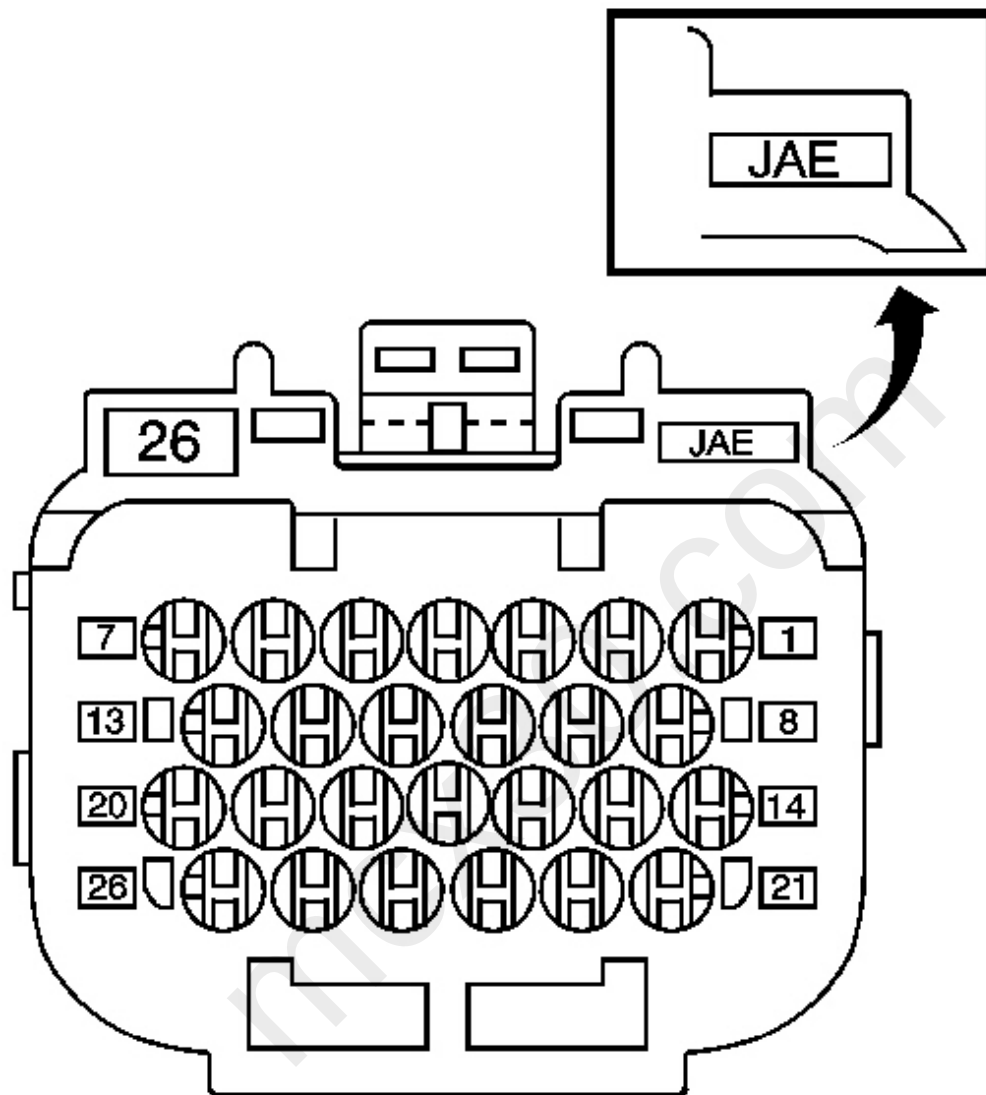


Fig. 29: View Of JAF Identification On Connector Body
Courtesy of GENERAL MOTORS CORP.

- JAE connector have JAE in small letters on their connectors.

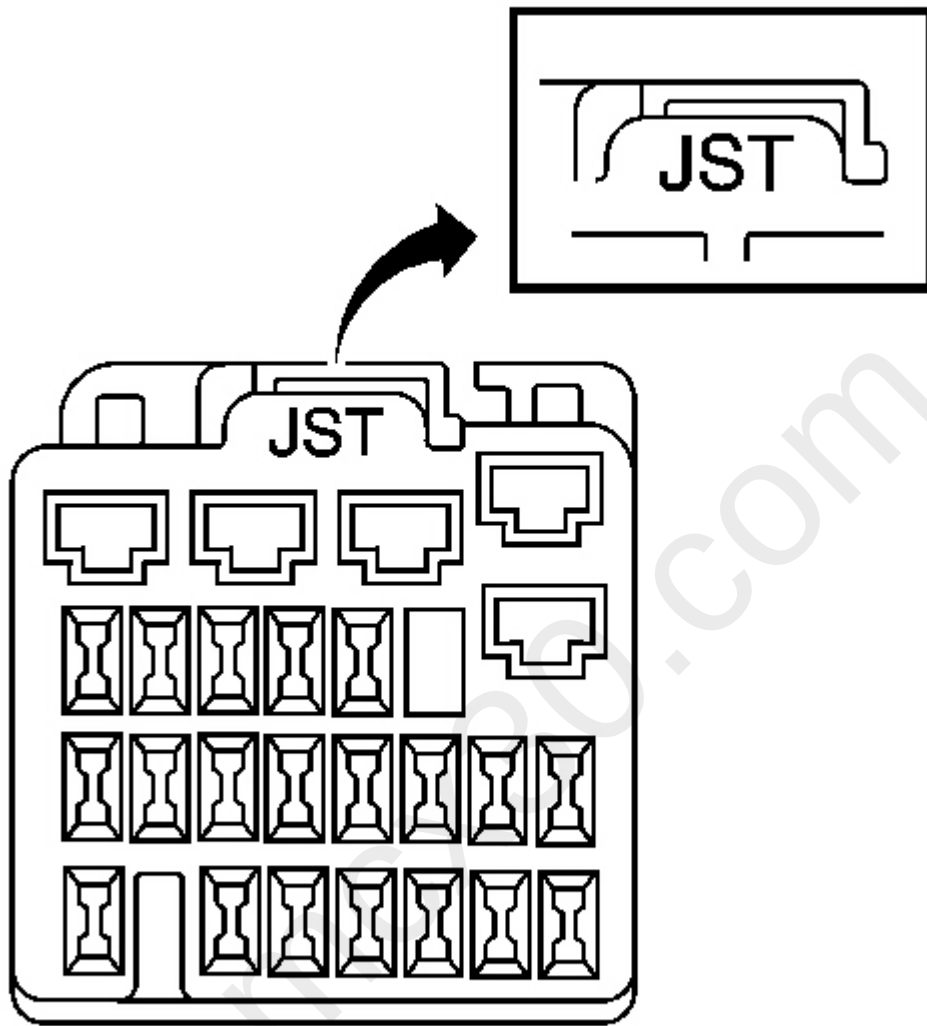


Fig. 30: View Of JST Identification On Connector Body
Courtesy of GENERAL MOTORS CORP.

- JST connectors have JST in small letters on their connectors, similar to that above. The location of the logo will vary with the connector size and style.

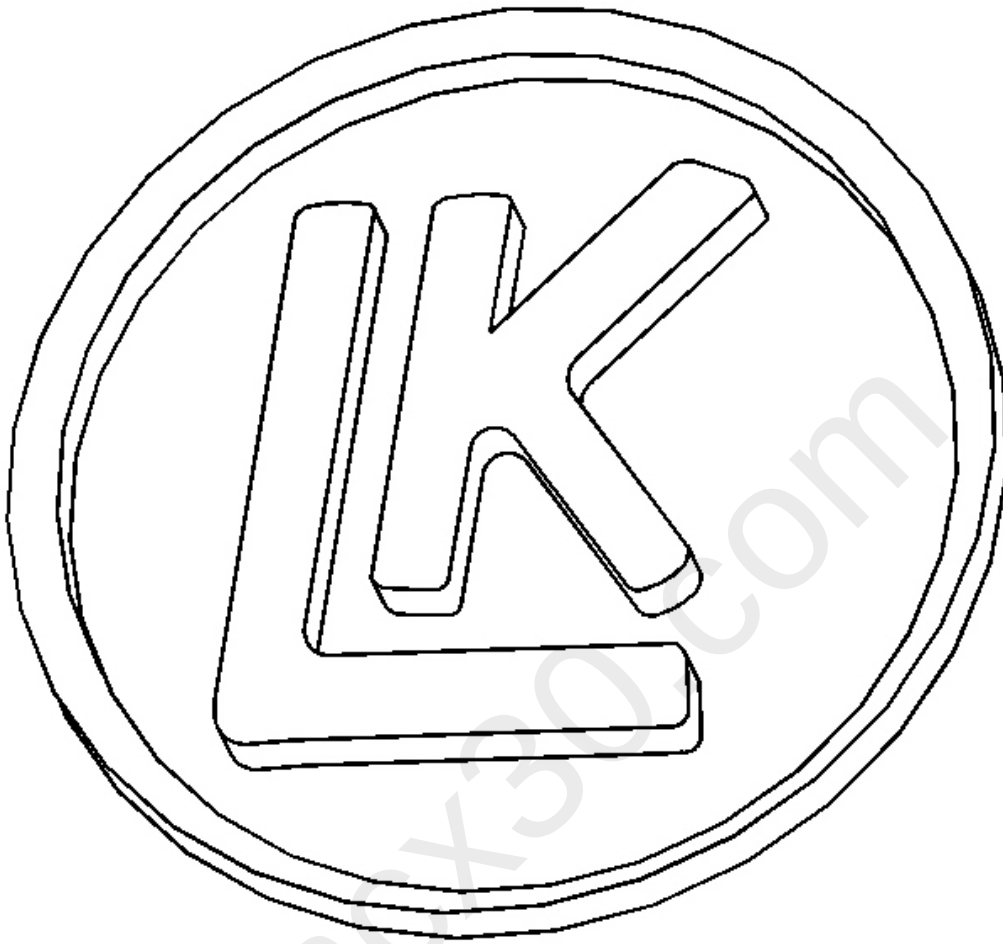


Fig. 31: View Of Kostel Connector Identifier
Courtesy of GENERAL MOTORS CORP.

- Kostel has an "LK" with a circle around it. These connector are usually used as a transmissions connection.

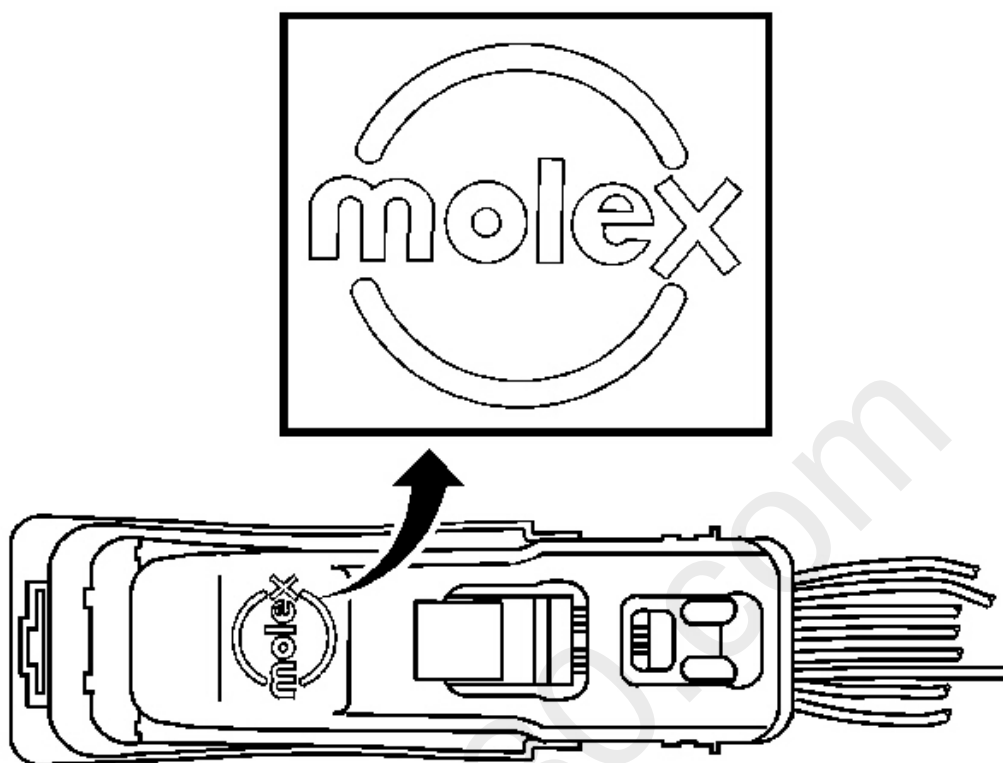


Fig. 32: View Of Molex Identification On Connector Body
Courtesy of GENERAL MOTORS CORP.

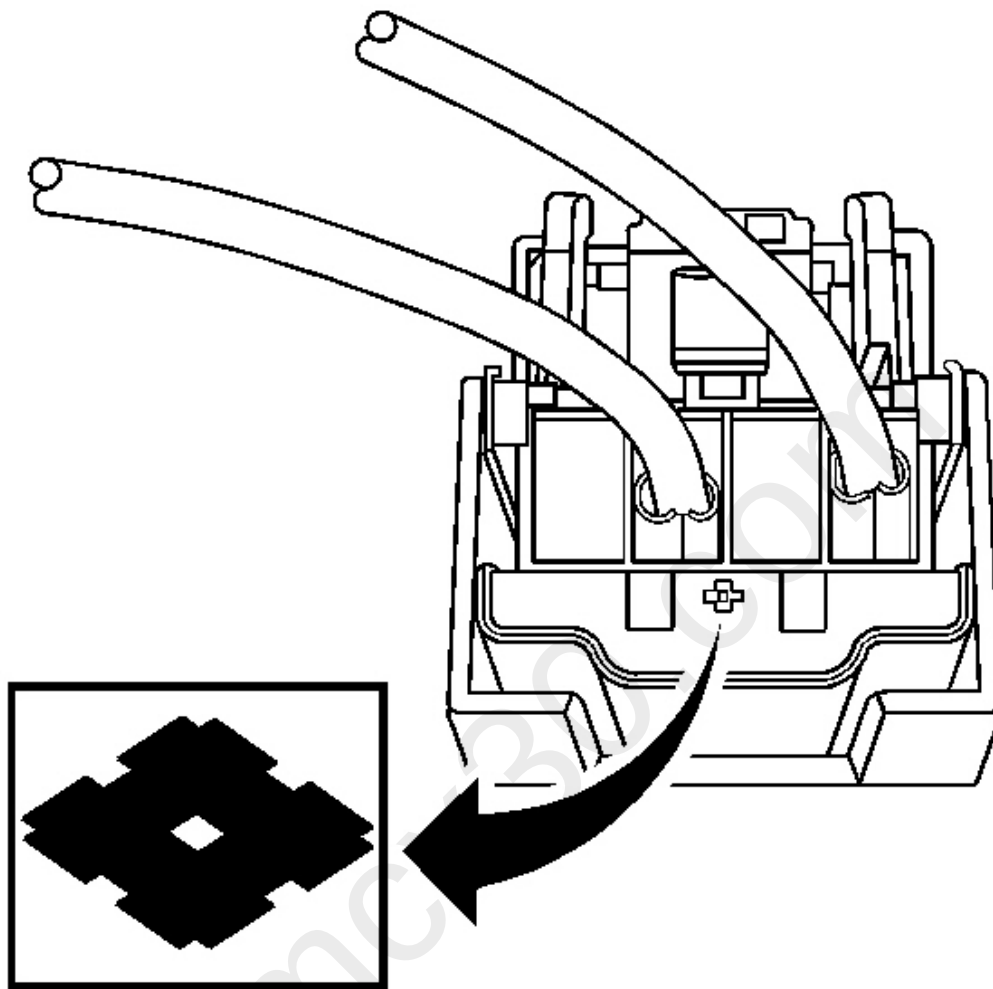


Fig. 33: View Of Sumitono Identification On Connector Body
Courtesy of GENERAL MOTORS CORP.

- Most Molex connectors will have the Molex logo on the dresscover of the connector. In some cases the connectors may have MX followed by another letter. The third letter indicates where the connector was made. A connector with MXD is a Molex connector made in Detroit.

Sumitomo has a unique symbol on their connector and possibly a part number. The symbol is similar to that of a diamond lying on its side, similar to that shown. The logo could appear anywhere but the most common place is at the wire side of the housing.

- Tyco/AMP has many different and unique connector designs. Some may or may not have identifiable marks on them.

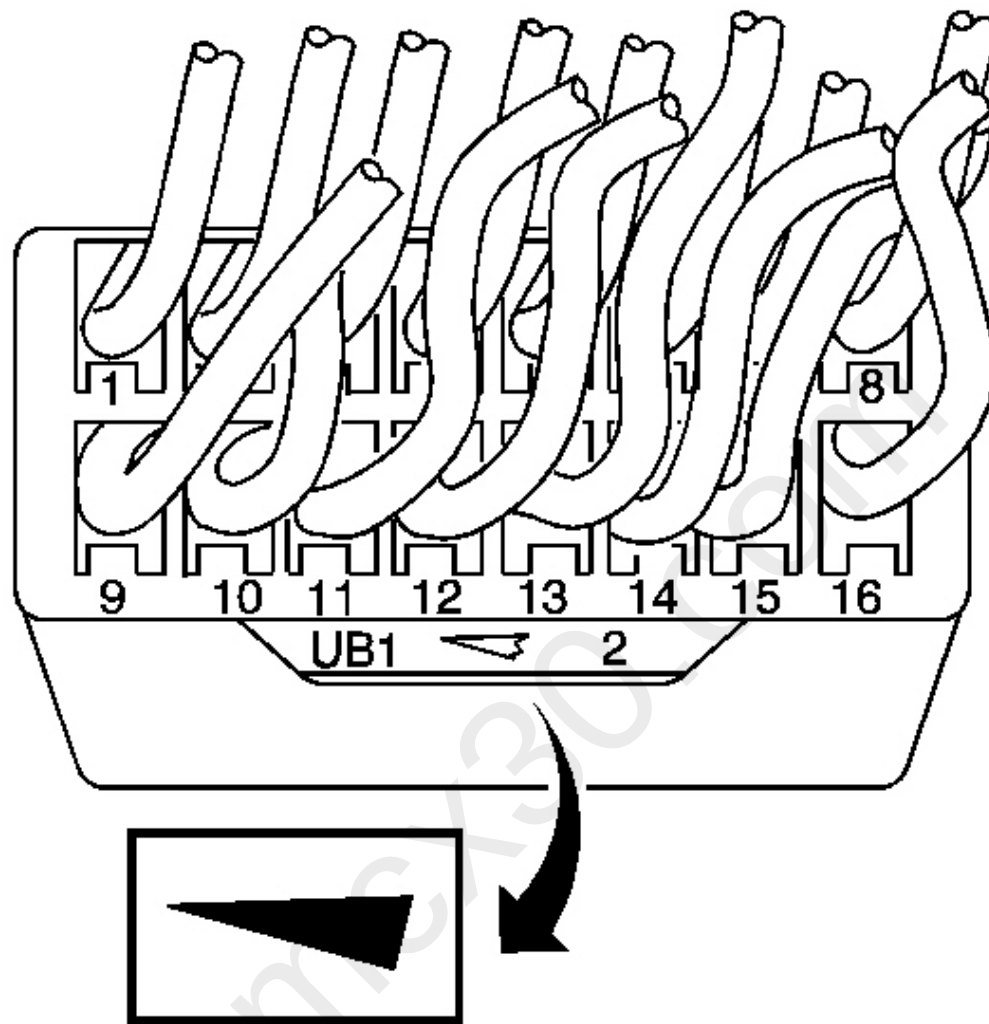


Fig. 34: View Of Yazaki Identification On Connector Body
Courtesy of GENERAL MOTORS CORP.

- Yazaki has a wedge or arrow shape, similar to that shown.

CONNECTOR POSITION ASSURANCE LOCKS

The connector position assurance (CPA) is a small plastic insert that fits through the locking tabs of the connector. CPAs are used in various connectors throughout the vehicle. CPAs are also used in all SIR system electrical connectors. The CPA ensures that the connector halves cannot vibrate apart. You must have the CPA in place in order to ensure good contact between the mating terminals, of the connector.

TERMINAL POSITION ASSURANCE LOCKS

The terminal position assurance (TPA) insert resembles the plastic combs used in the control module connectors. The TPA keeps the terminal securely seated in the connector body. Do not remove the TPA from the connector body unless you remove a terminal for replacement.

AFL/EPC CONNECTORS

Special Tools

J-38125 Terminal Repair Kit

Removal Procedure

Follow the steps below in order to remove terminals from the connector.

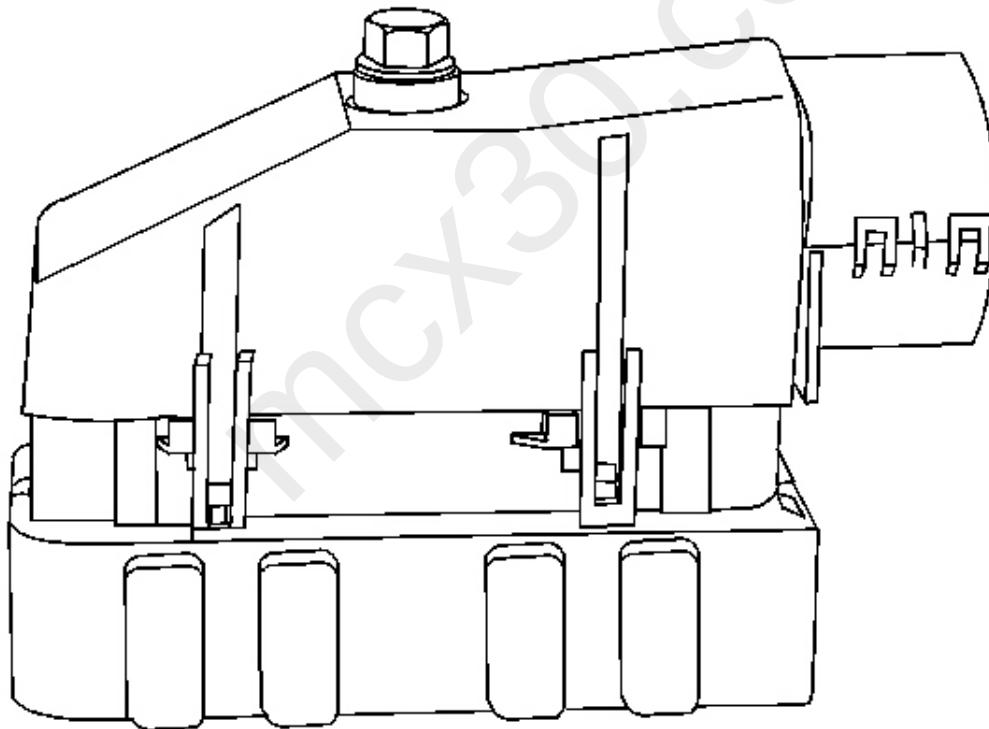


Fig. 35: View Of Bolt On Connector Cover
Courtesy of GENERAL MOTORS CORP.

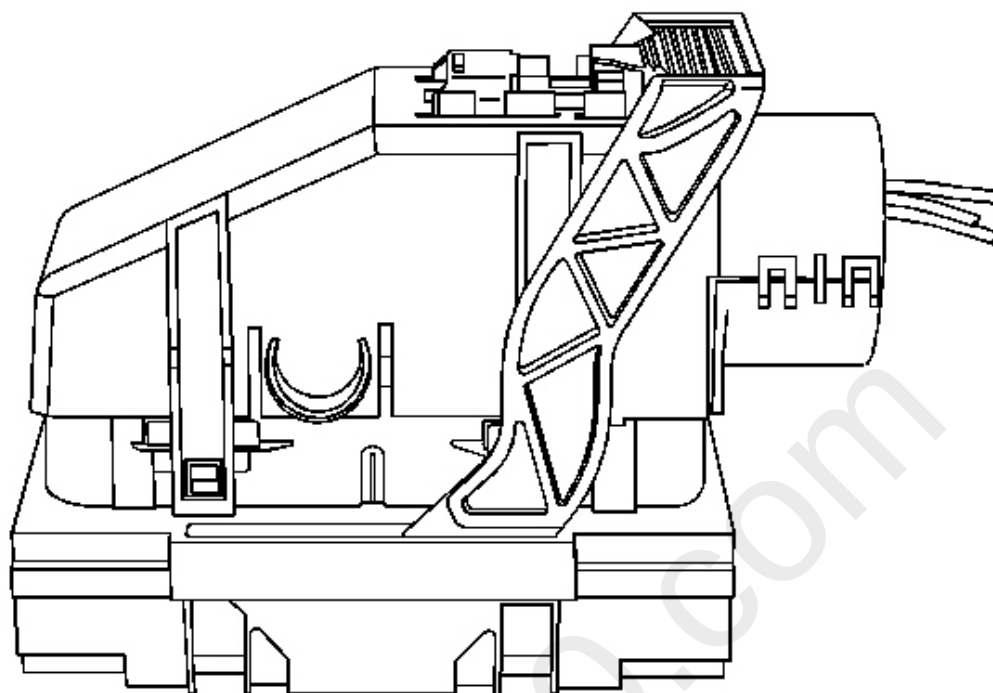


Fig. 36: Identifying Connector Position Assurance (CPA)
Courtesy of GENERAL MOTORS CORP.

1. For connectors with a bolt in the dress cover, turn the bolt counterclockwise to remove the connector from the component.
2. Locate the connector position assurance (CPA) on the top of the wire dress cover. Slide the CPA forward.

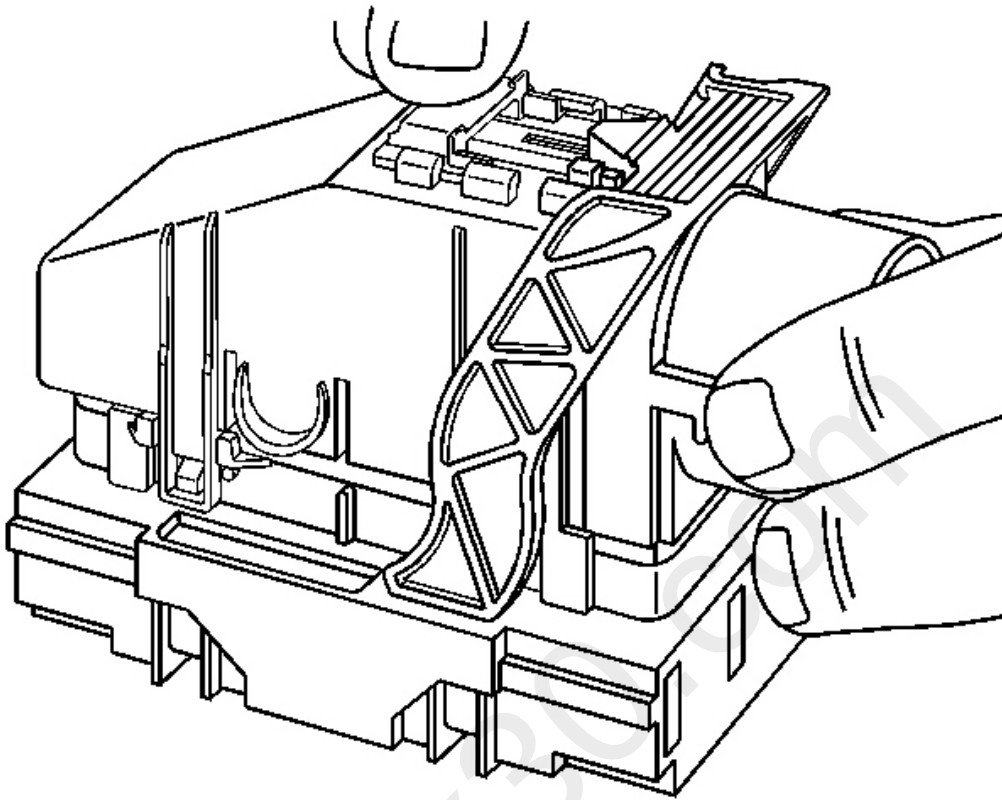


Fig. 37: Identifying Lever Lock & Lever Lock Release Tab
Courtesy of GENERAL MOTORS CORP.

3. Slide the lever lock forward while pressing down on the lever lock release tab.

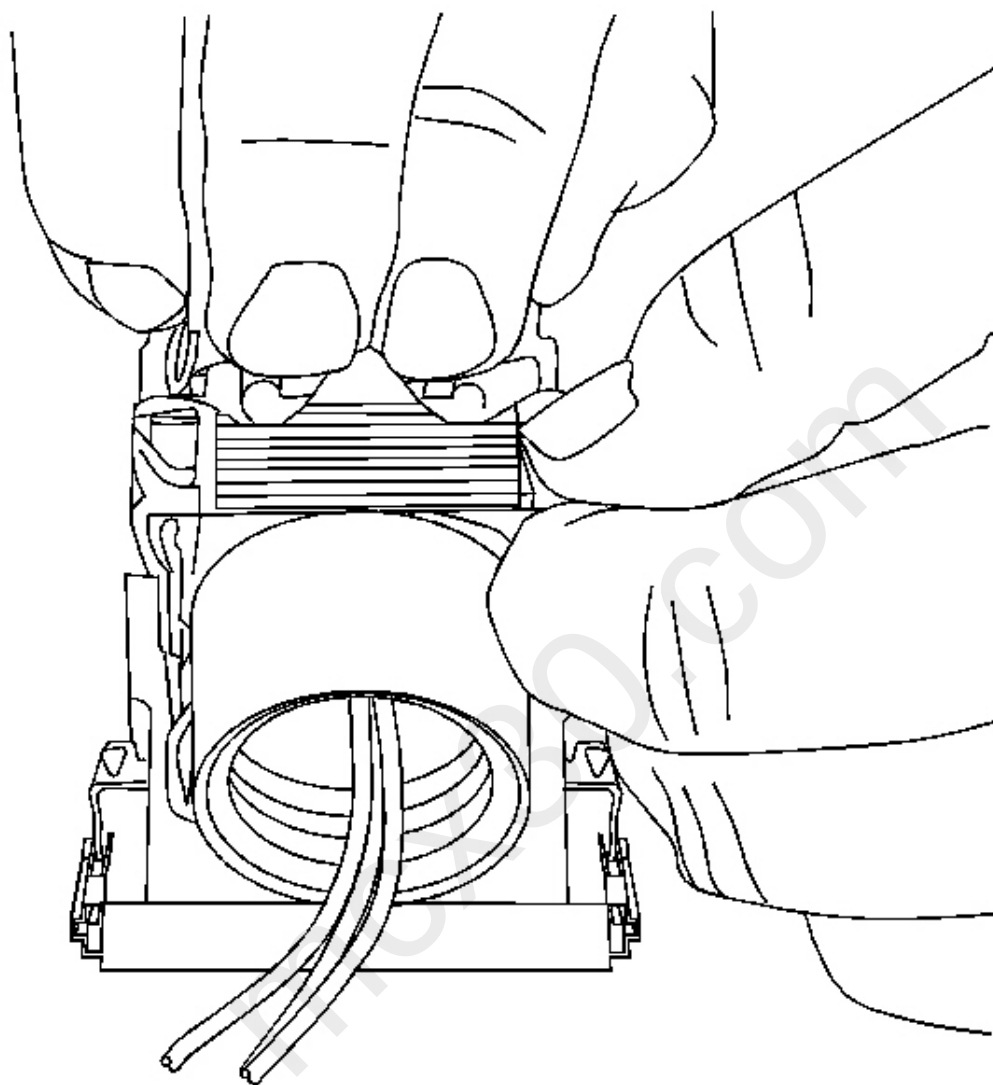


Fig. 38: Depressing Lever Lock Release Tab
Courtesy of GENERAL MOTORS CORP.

View showing depressing of the lever lock release tab.

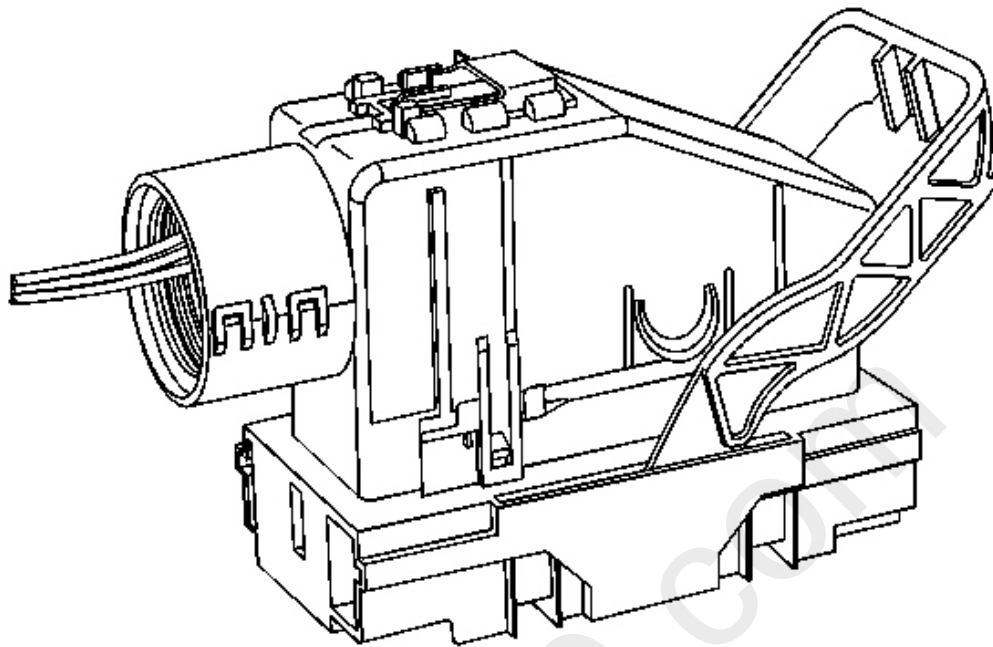


Fig. 39: View Of Connector In Released Position
Courtesy of GENERAL MOTORS CORP.

View of connector in released position.

4. Disconnect the connector from the component.
5. Locate the dress cover locking tabs at the corners of the dress cover. Use a small flat-blade tool to release the locking tabs and remove the dress cover.

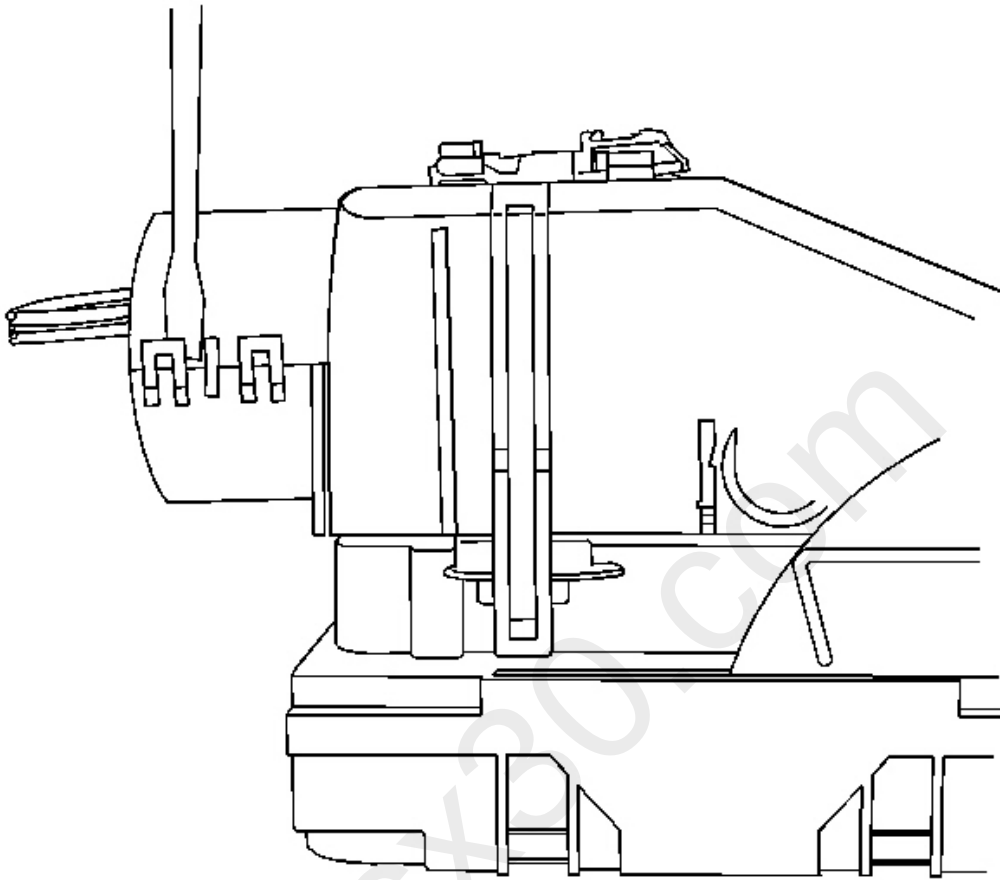


Fig. 40: View Of Connector In Released Position
Courtesy of GENERAL MOTORS CORP.

6. Release the rear lower half of the wiredress cover.

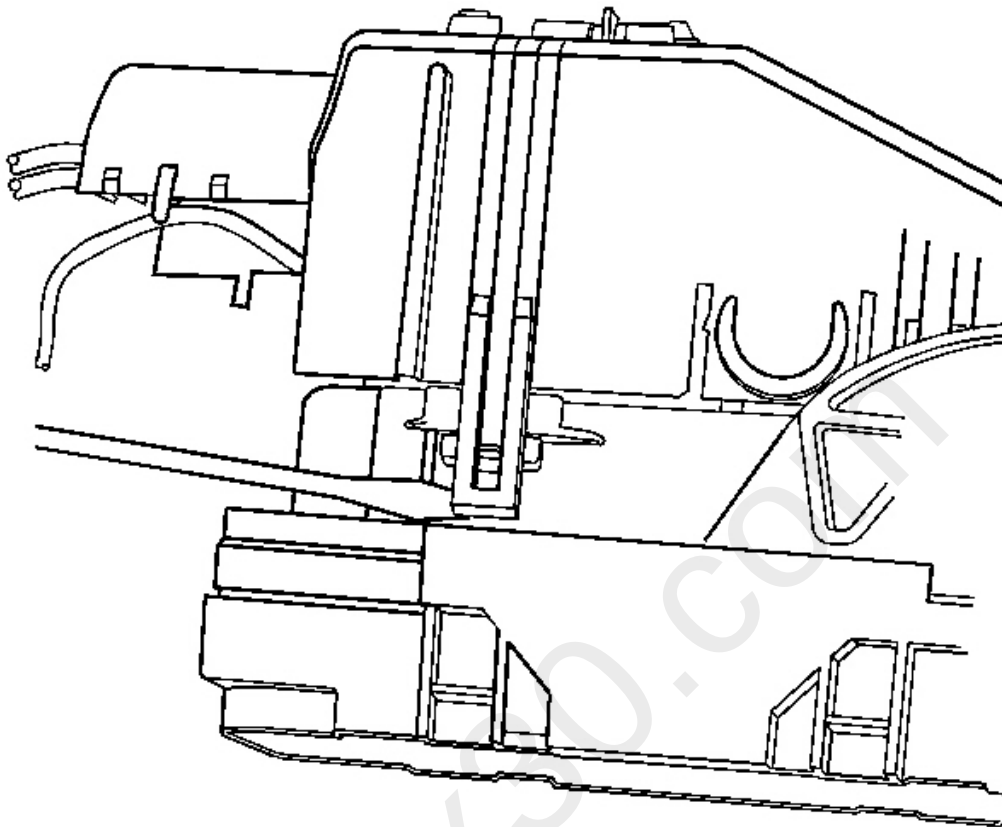


Fig. 41: Identifying Tabs Holding Wiredress Cover
Courtesy of GENERAL MOTORS CORP.

7. Release the tabs that are holding the wiredress cover to the connector body.
8. Remove the nose piece by inserting a small flat-blade tool into the slots on both ends of the connector body. Gently pry the nose piece out of the connector. J 38125-216 can also be used to remove the nose piece.

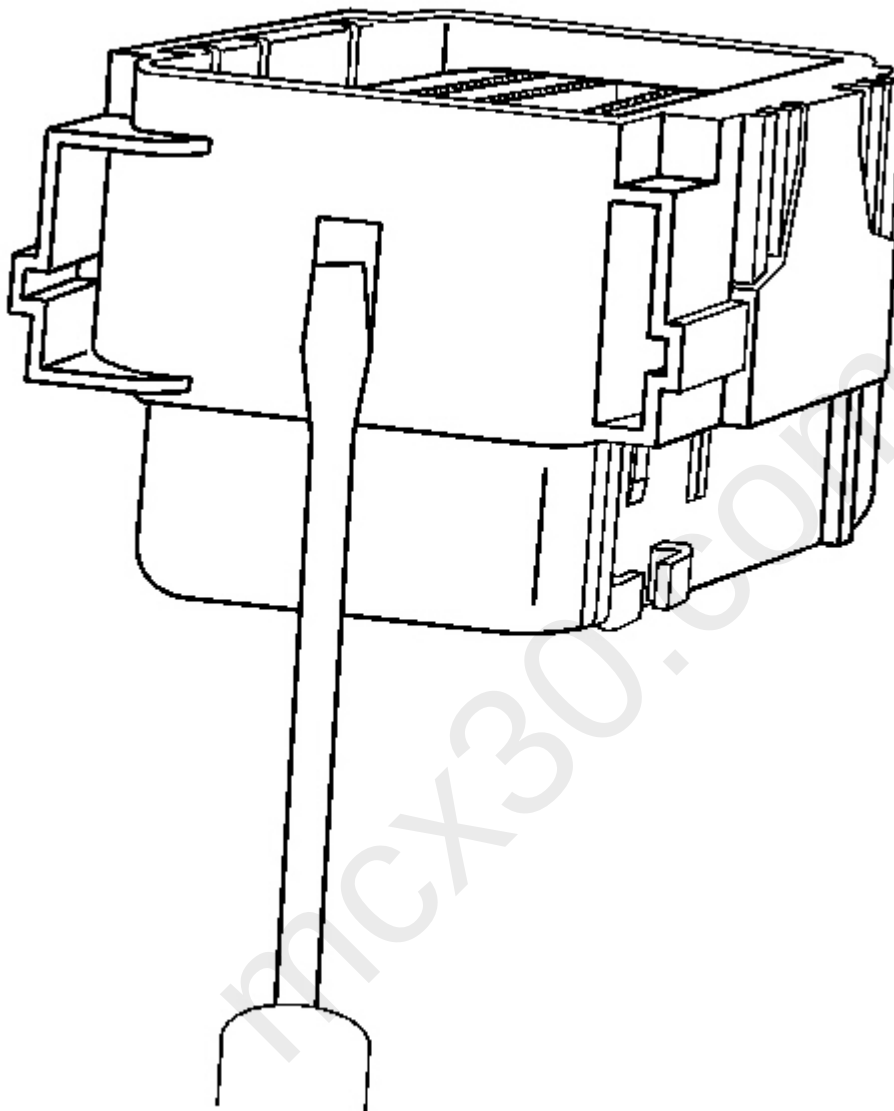


Fig. 42: Identifying Special Tool - J 38125-12A
Courtesy of GENERAL MOTORS CORP.

9. Use the J 38125-12A tool to release the terminals by lifting the terminal retaining tabs on the inside of the connector. See the release tool cross reference in the Reference Guide of the **J-38125** to ensure that the correct release tool is used.

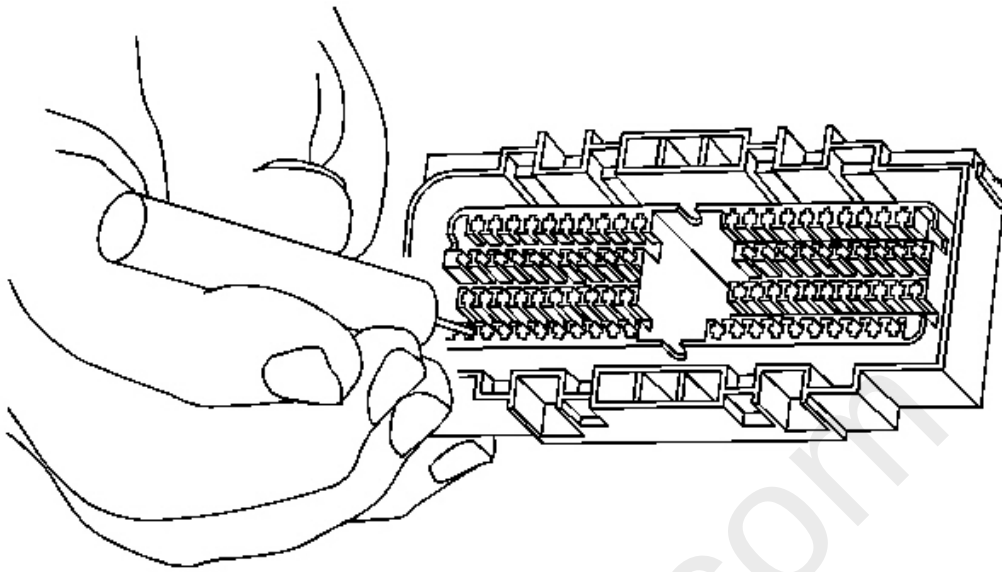


Fig. 43: J-38125-12A Removal Tool
Courtesy of GENERAL MOTORS CORP.

10. While holding the removal tool in place, gently pull the wire out of the back of the connector. Always remember never use force when pulling a terminal out of a connector.

Repair Procedure

Use the appropriate terminal and follow the instructions in the **J-38125** .

Location of the terminal in the repair tray and the proper crimp tool can be found in the appropriate connector end view.

BOSCH CONNECTORS (BSK)

Special Tools

J-38125 Terminal Repair Kit

Terminal Removal Procedure

1. Disconnect the connector from the component.
2. Remove the wire dress cover, if necessary.
3. Push the wire side of the terminal that is being removed toward the connector and hold it in position.

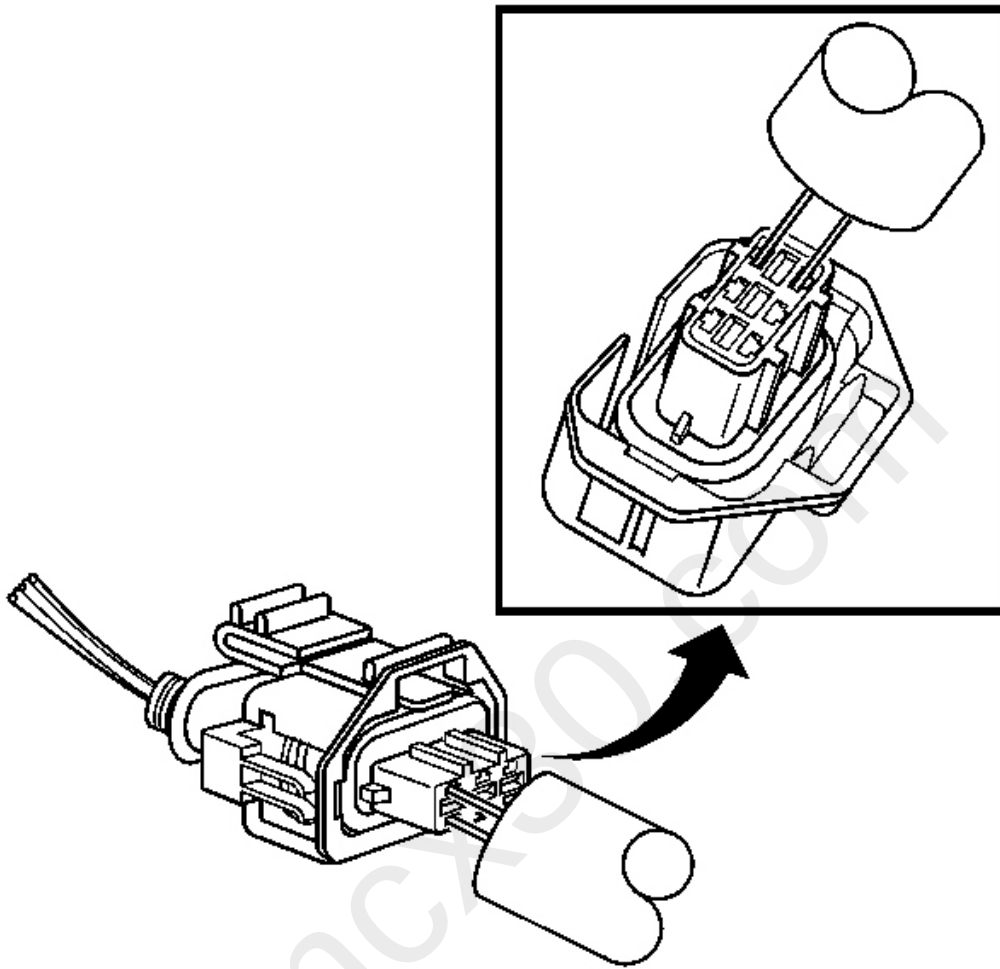


Fig. 44: View Of Bosch Connector Terminals (BSK)
Courtesy of GENERAL MOTORS CORP.

4. Insert the J 38125-561 tool into the 2 cavities on each side of the terminal at the front of the connector and push until you feel the tool disengage the terminal retainers. See the release tool cross reference in the Reference Guide of the **J-38125** to ensure that the correct release tool is used.
5. Carefully pull the terminal out of the connector. Always remember never use force when pulling a terminal out of a connector. If the terminal is difficult to remove, repeat the entire procedure.

Terminal Repair Procedure

Use the appropriate terminal and follow the instructions in the **J-38125** .

BOSCH CONNECTORS (0.64)

Special Tools

J-38125 Terminal Repair Kit

Terminal Removal Procedure

1. Locate the lever lock on the wire dress cover. While pressing the lock, pull the lever over and past the lock until the lever is at the end of its travel.
2. Disconnect the connector from the component.
3. Pull the rubber boot that covers the wires back to expose the end of the connector dress cover.
4. Place the connector locking lever in the center of the connector.

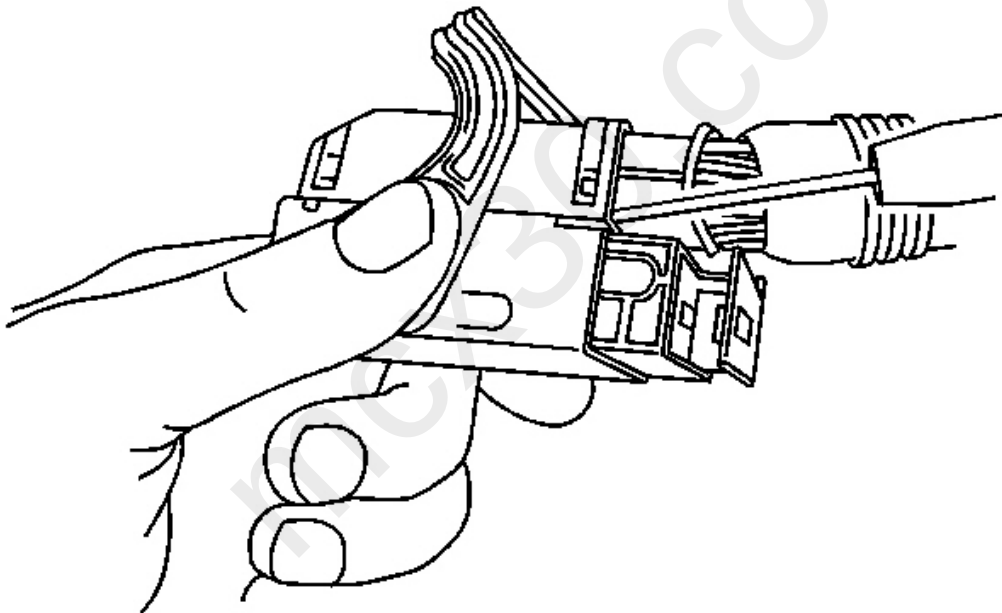


Fig. 45: Inserting Flat-Bladed Tool Between Cover And Connector Body
Courtesy of GENERAL MOTORS CORP.

5. Locate the 2 dress cover locking tabs that are on the wire end of the connector. Insert a small flat-bladed tool between the cover and connector body and pry up.

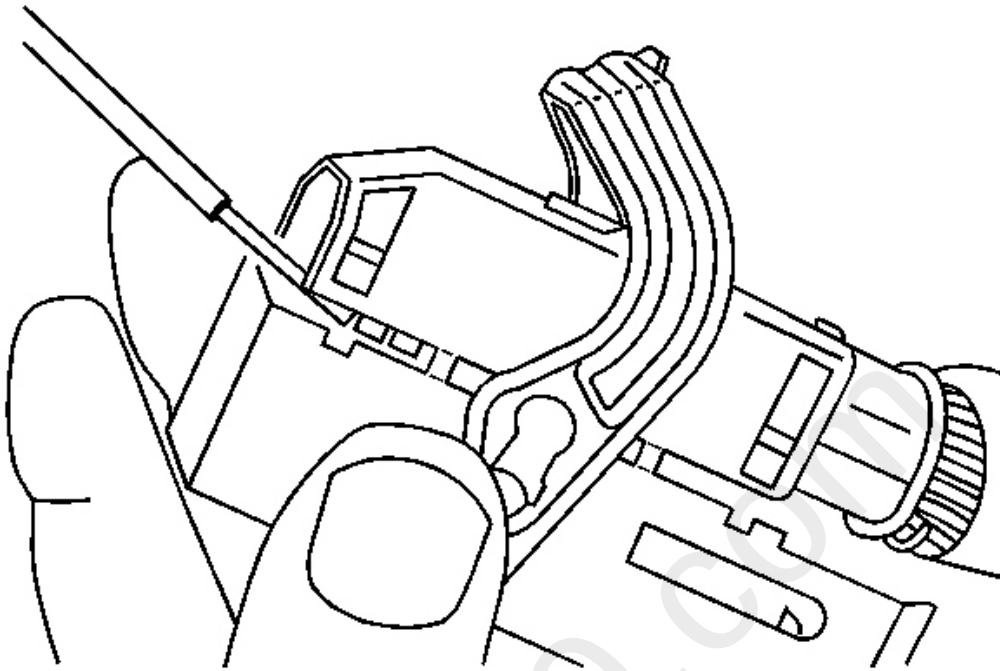


Fig. 46: Inserting Flat-Bladed Tool Between Cover & Connector End
Courtesy of GENERAL MOTORS CORP.

6. Locate the 2 dress cover locking tabs located on the opposite side of the connector. Insert a small flat-bladed tool between the cover at the connector end and pry up.
7. Remove the dress cover.
8. Cut the tie wrap on the wire bundle.

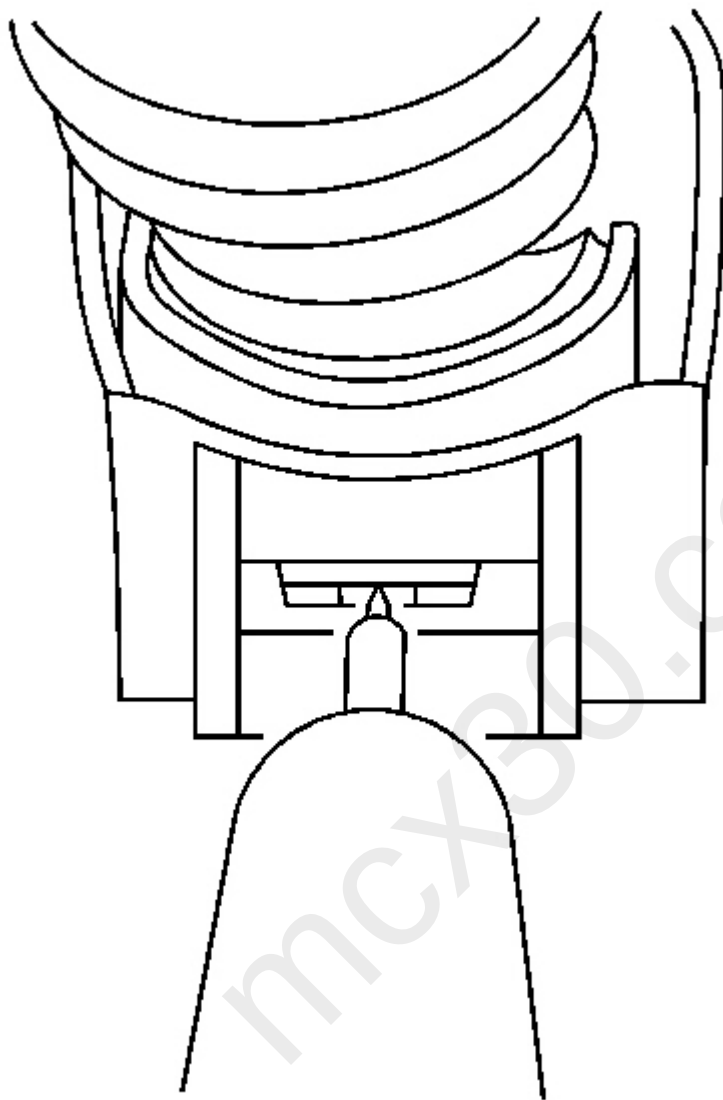


Fig. 47: View Of Terminal Position Assurance (TPA)
Courtesy of GENERAL MOTORS CORP.

9. Remove the terminal position assurance (TPA) by inserting a small flat-bladed tool into the small slot in the end of the slider and pushing on the TPA until it comes out of the connector. When the TPA exits the opposite side of the connector, gasp the TPA and pull it completely out of the connector.
10. Push the wire side of the terminal that is being removed toward the connector and hold it in position.

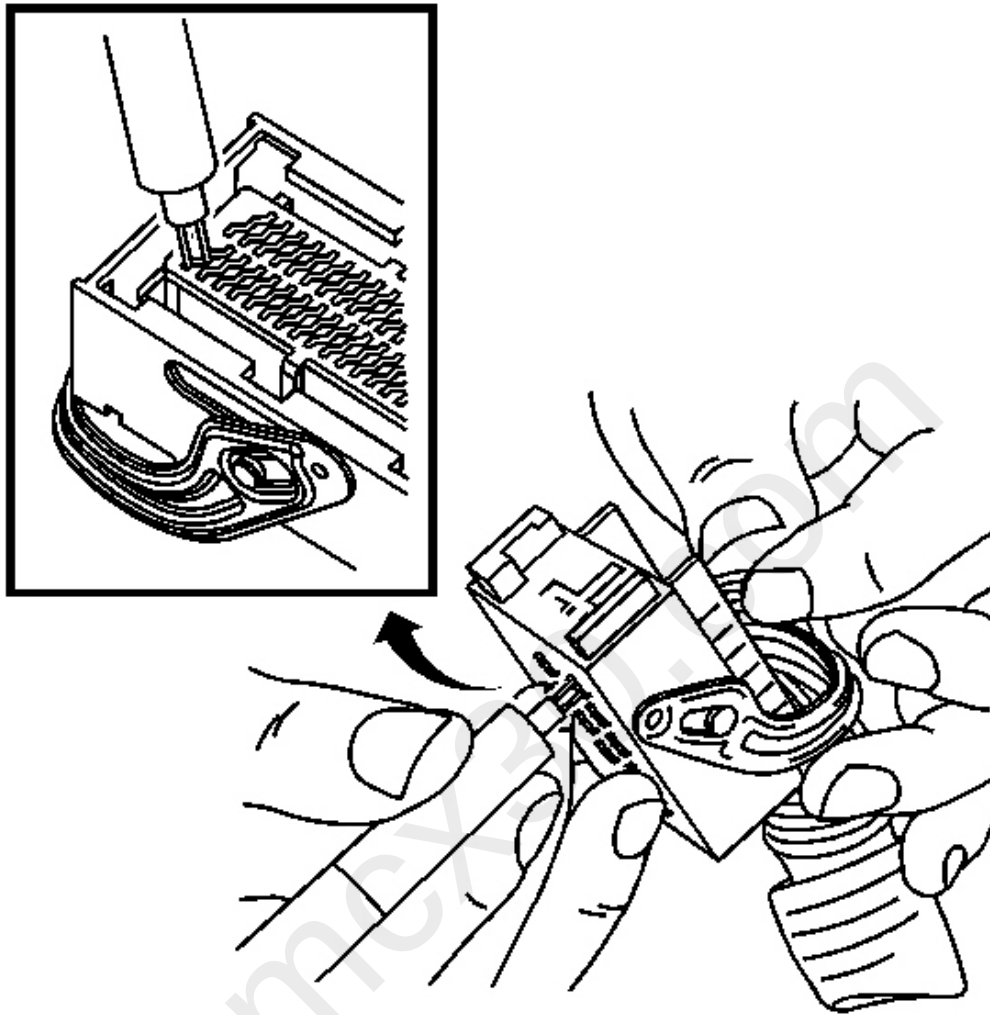


Fig. 48: Pulling Terminal Out Of Connector
Courtesy of GENERAL MOTORS CORP.

11. Insert the J 38125-560 into the 2 triangular cavities on each side of the terminal at the front of the connector. See the release tool cross reference in the Reference Guide of the **J-38125** to ensure that the correct release tool is used.
12. Carefully pull the terminal out of the connector. Always remember never use force when pulling a terminal out of a connector. If the terminal is difficult to remove, repeat the entire procedure.

Use the appropriate terminal and follow the instructions in the **J-38125** .

Terminal Replacement Procedure

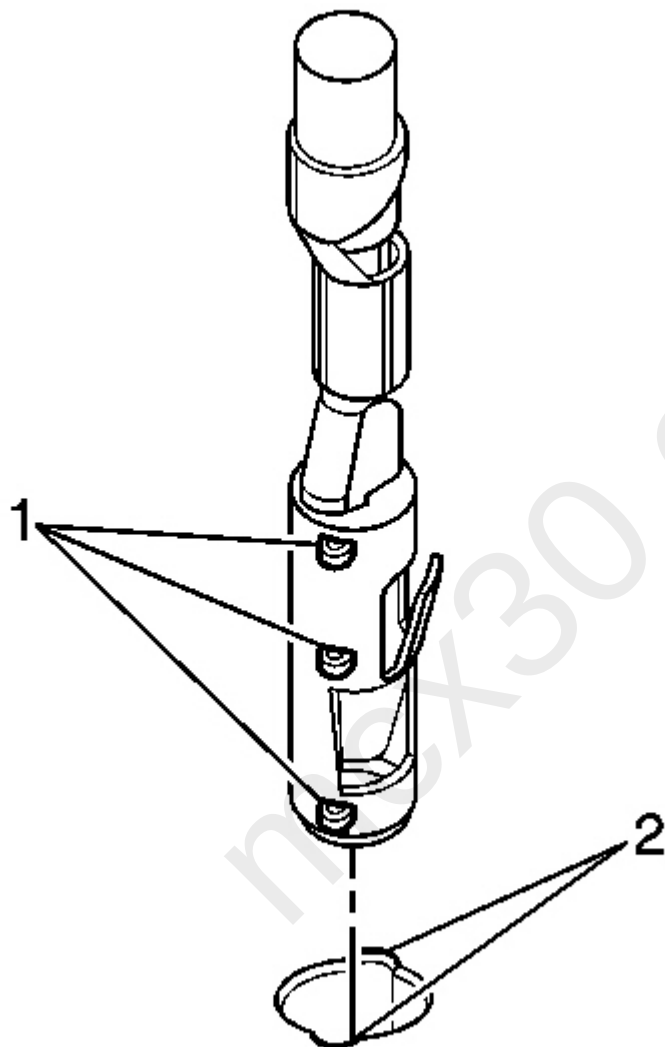


Fig. 49: Aligning Coding Lugs With Connector Coding Grooves
Courtesy of GENERAL MOTORS CORP.

1. Prior to installation the terminal must be aligned so the (1) coding lugs align with the (2) coding grooves on the connector.
2. Once the terminal is aligned, slide the terminal into the cavity until the retainer has engaged in the cavity

of the connector.

3. Slide the TPA in the connector body and seat it using a small flat bladed tool. The TPA is seated when it is flush with the contact housing.
4. Secure the wires to the connector body using a tie wrap and replace the dress cover and grommet.

BOSCH CONNECTORS (2.8 JPT)

Special Tools

J-38125 Terminal Repair Kit

Terminal Removal Procedure

1. Pull out the slider on the connector position assurance (CPA) until it is at the end of its travel.
2. Disconnect the connector from the component.
3. Remove the wire dress cover, if necessary.
4. Push the wire side of the terminal that is being removed toward the connector and hold it in position.

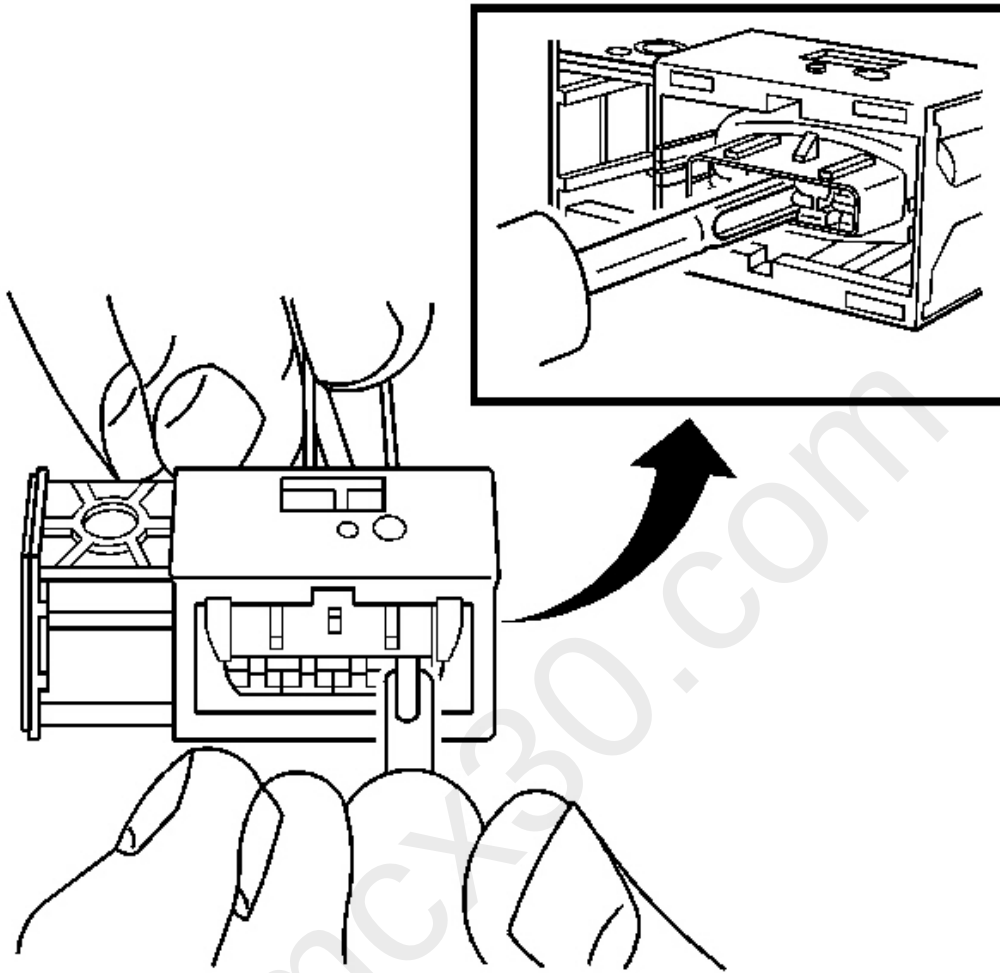


Fig. 50: View Of Bosch Connector Terminals (2.8 JPT)
Courtesy of GENERAL MOTORS CORP.

5. Insert the J 38125-557 into the 2 cavities on each side of the terminal at the front of the connector and push until you feel the tool disengage the terminal retainers. See the release tool cross reference in the Reference Guide of the **J-38125** to ensure that the correct release tool is used.
6. Carefully pull the terminal out of the connector. Always remember never use force when pulling a terminal out of a connector. If the terminal is difficult to remove, repeat the entire procedure.

Terminal Repair Procedure

Use the appropriate terminal and follow the instructions in the **J-38125** .

BOSCH CONNECTORS (ECM)

Special Tools

J-38125 Terminal Repair Kit

Removal Procedure

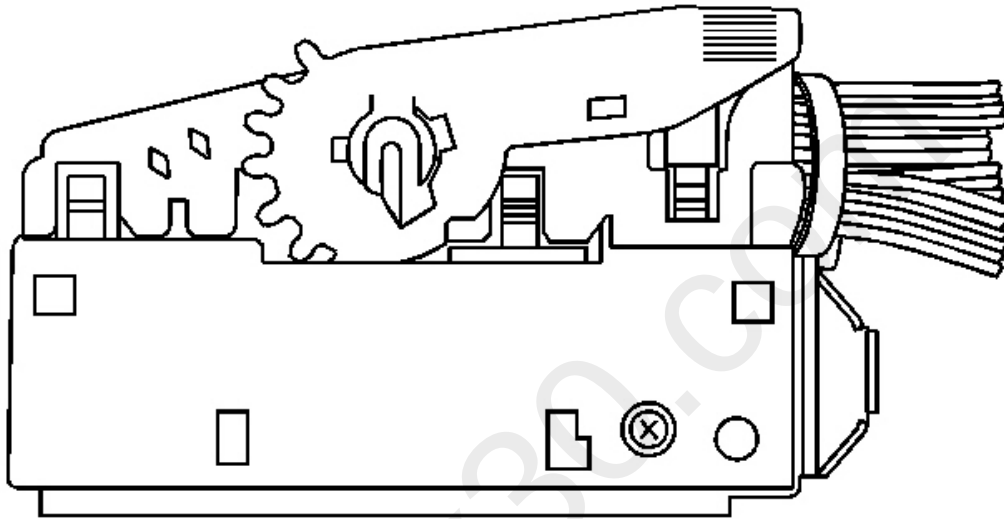


Fig. 51: View Of Bosch Connectors
Courtesy of GENERAL MOTORS CORP.

1. Locate the assist lever on the top of the connector. Move the assist lever to the forward position.

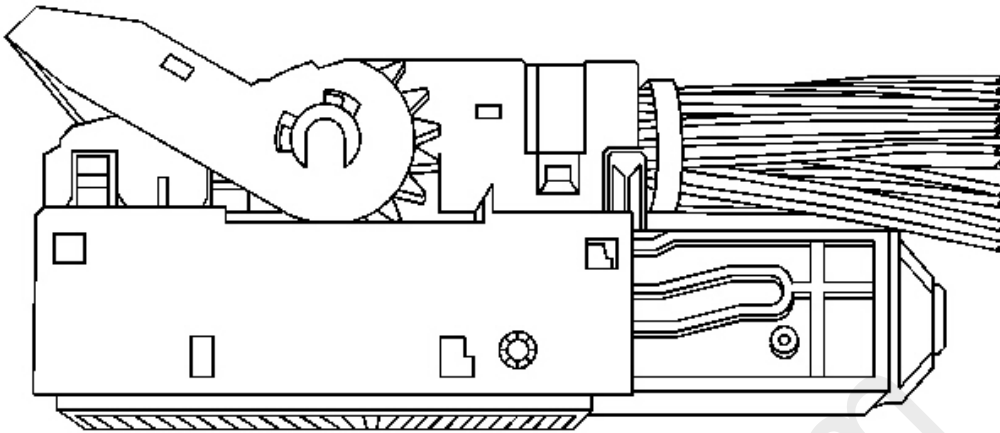


Fig. 52: Identifying Assist Lever In Forward Position
Courtesy of GENERAL MOTORS CORP.

2. Disconnect the connector from the component.

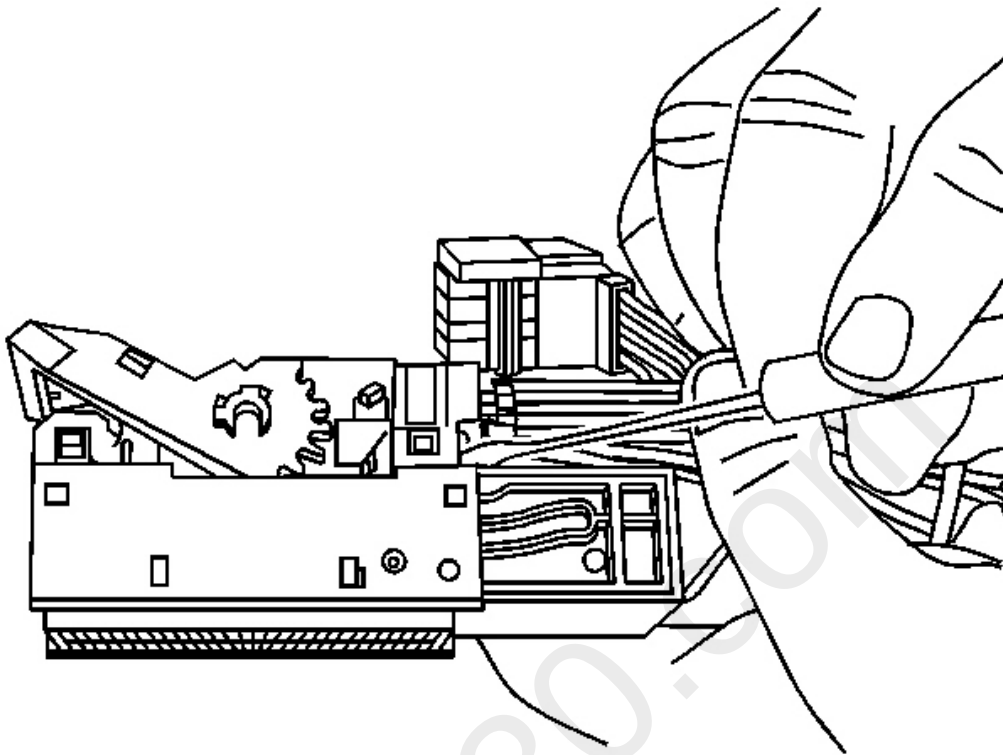


Fig. 53: Releasing Locking Tabs
Courtesy of GENERAL MOTORS CORP.

3. Locate the dress cover locking tabs at the corners of the connector. Use a small flat-bladed tool to release the locking tabs and remove the dress cover.

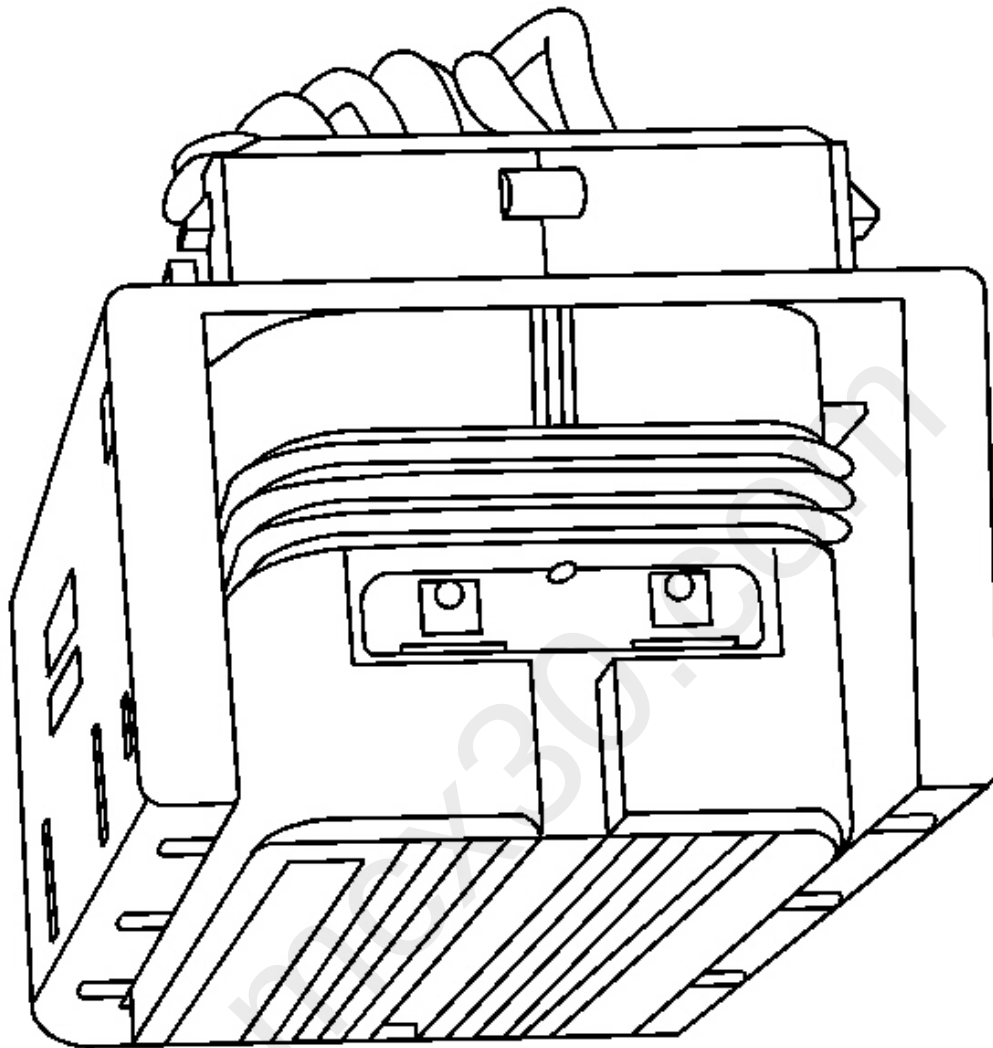


Fig. 54: View Of Terminal Positive Assurance (TPA) Connector
Courtesy of GENERAL MOTORS CORP.

4. The terminal positive assurance (TPA) is located in the front of the connector.

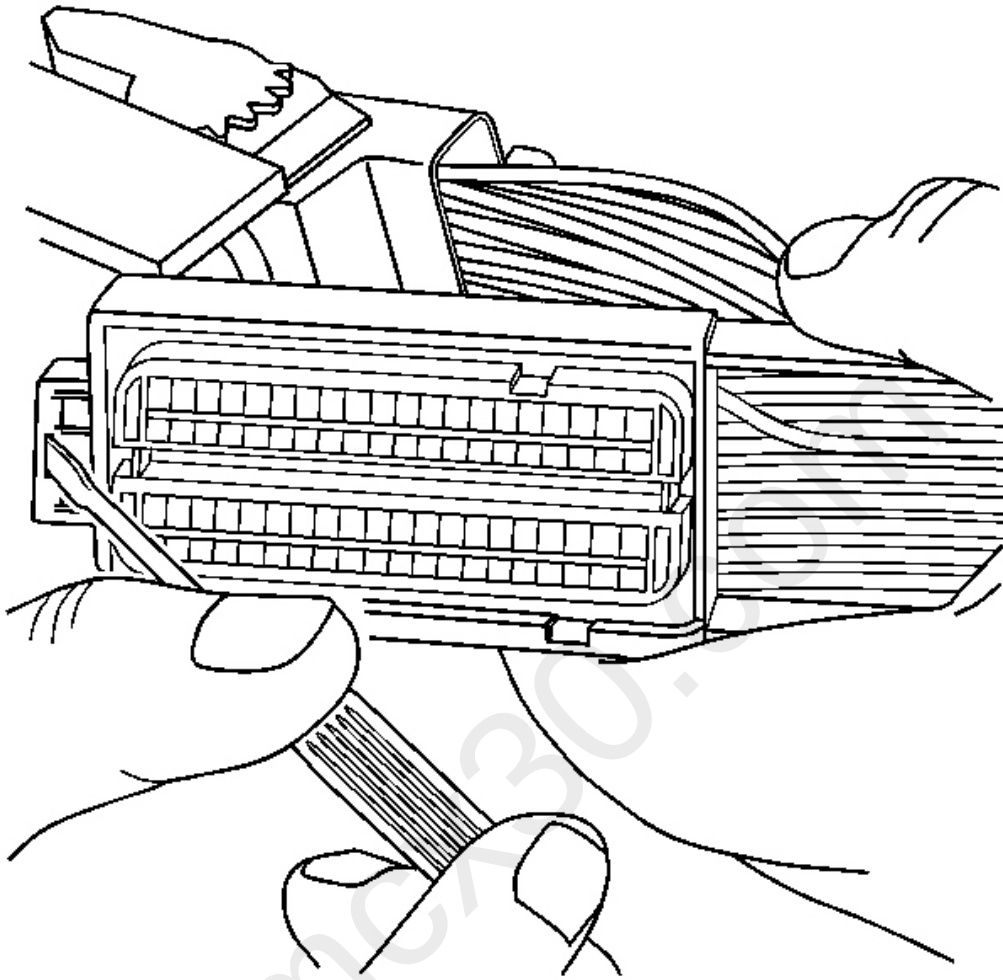


Fig. 55: View Of Removing TPA From Connector
Courtesy of GENERAL MOTORS CORP.

5. Use a small flat-blade tool to remove TPA from the connector.

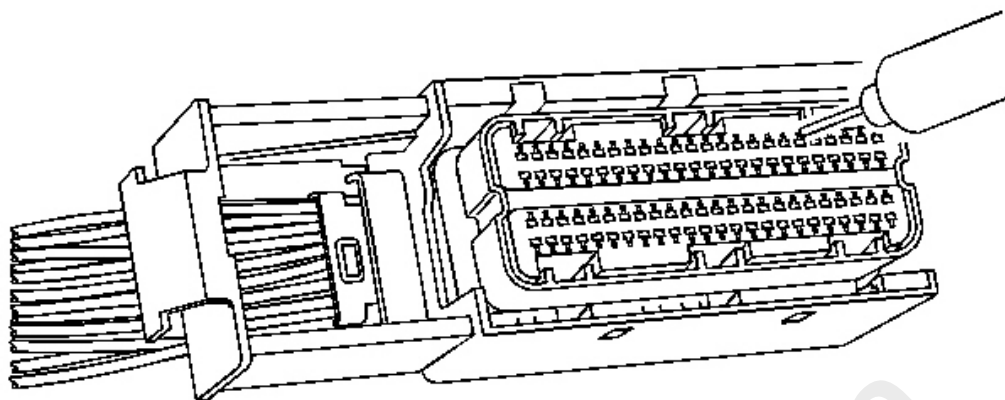


Fig. 56: View Of Special Tools And Terminals
Courtesy of GENERAL MOTORS CORP.

6. Use the J 38125-213 or the J 38125-556 tool to release the terminals by inserting the tool into the terminal release cavity. See the release tool cross reference in the Reference Guide of the **J-38125** to ensure that the correct release tool is used.
7. While holding the removal tool in place, gently pull the wire out of the back of the connector. Always remember never use force when pulling a terminal out of a connector.

Repair Procedure

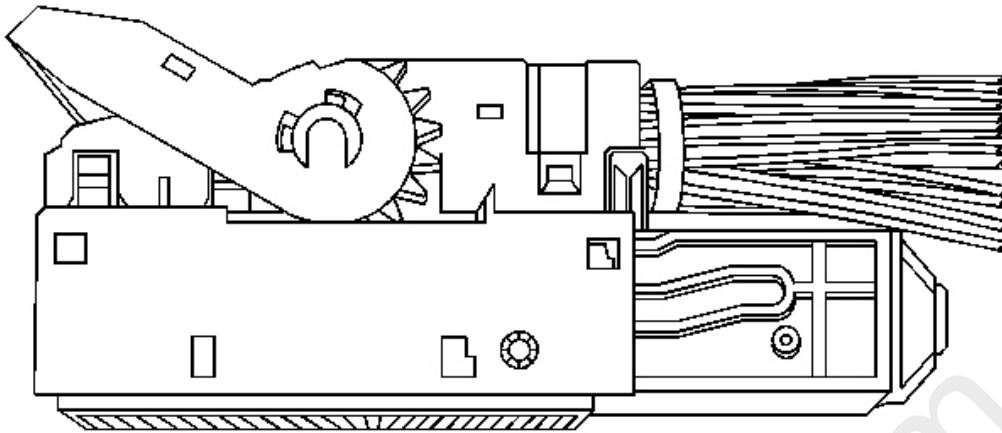


Fig. 57: Identifying Assist Lever In Forward Position
Courtesy of GENERAL MOTORS CORP.

NOTE: Ensure that the dress cover and connector body are both in the released position before reassembling. Failure to do so may cause damage to the connector and component.

Use the appropriate terminal and follow the instructions in the **J-38125** .

Location of the terminal in the repair tray and the proper crimp tool can be found in the appropriate connector end view.

DELPHI CONNECTORS (WEATHER PACK)

Special Tools

J-38125 Terminal Repair Kit

The following is the proper procedure for the repair of Weather Pack® Connectors.

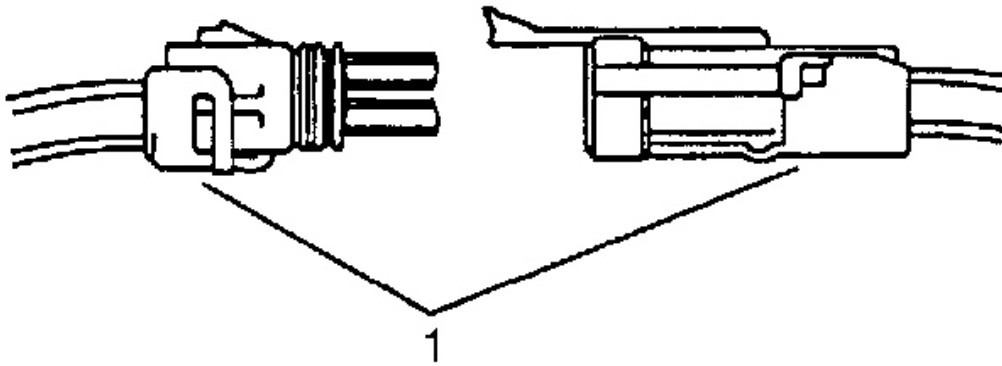


Fig. 58: View Of Connector Halves
Courtesy of GENERAL MOTORS CORP.

1. Separate the connector halves (1).
2. Open the secondary lock. A secondary lock aids in terminal retention and is usually molded to the connector (1).
3. Grasp the wire and push the terminal to the forward most position. Hold the wire in this position.

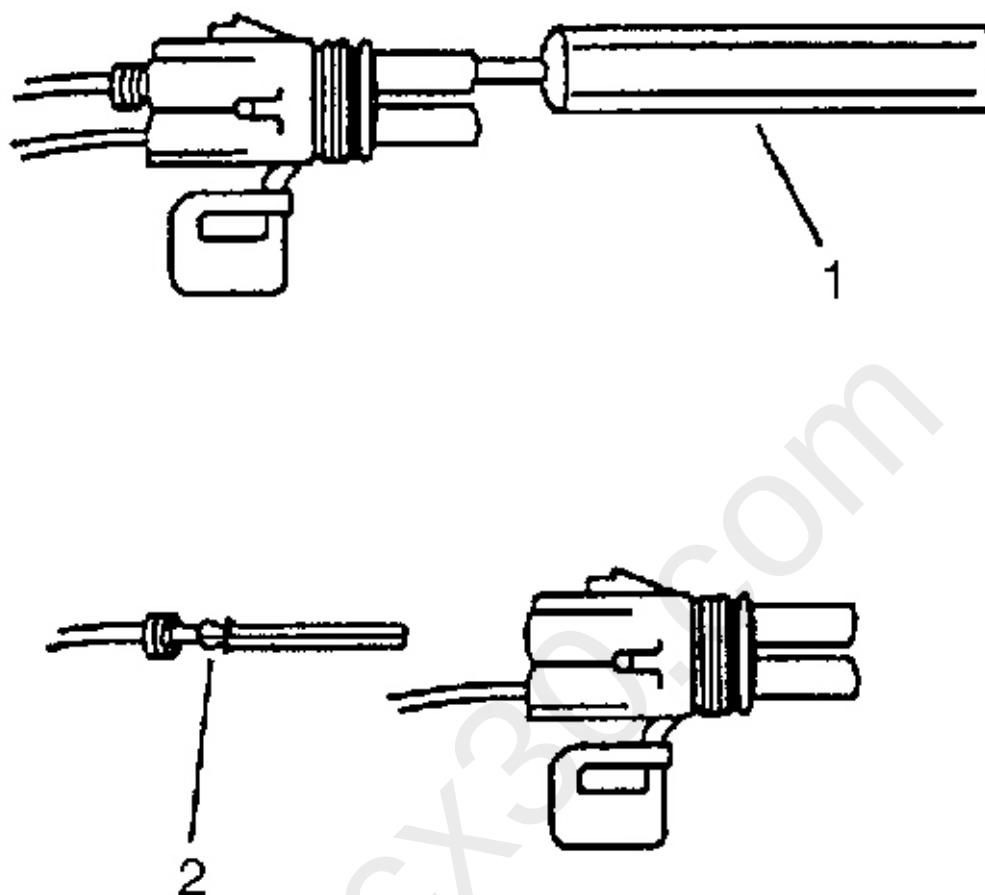


Fig. 59: Identifying Removal Tool & Terminal
Courtesy of GENERAL MOTORS CORP.

4. Insert the Weather Pack® terminal removal tool J 38125-10A into the front (mating end) of the connector cavity until it rests on the cavity shoulder (1).
5. Gently pull on the wire to remove the terminal through the back of the connector (2).

NOTE: **Never use force to remove a terminal from a connector.**

6. Inspect the terminal and connector for damage. Repair as necessary. Refer to **Repairing Connector Terminals**.
7. Reform the lock tang (2) and reset terminal in connector body.
8. Close secondary locks and join connector halves.

9. Verify that circuit is complete and working satisfactorily.
10. Perform system check.

DELPHI CONNECTORS (PUSH TO SEAT)

Special Tools

J-38125 Terminal Repair Kit

Terminal Removal

Follow the steps below in order to repair push to seat connectors.

1. Remove the terminal position assurance (TPA) device, the connector position assurance (CPA) device, and/or the secondary lock.

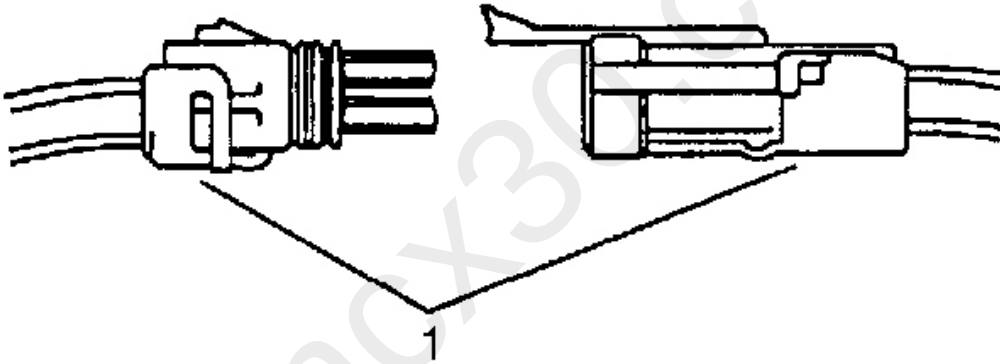


Fig. 60: View Of Connector Halves

Courtesy of GENERAL MOTORS CORP.

2. Separate the connector halves (1).

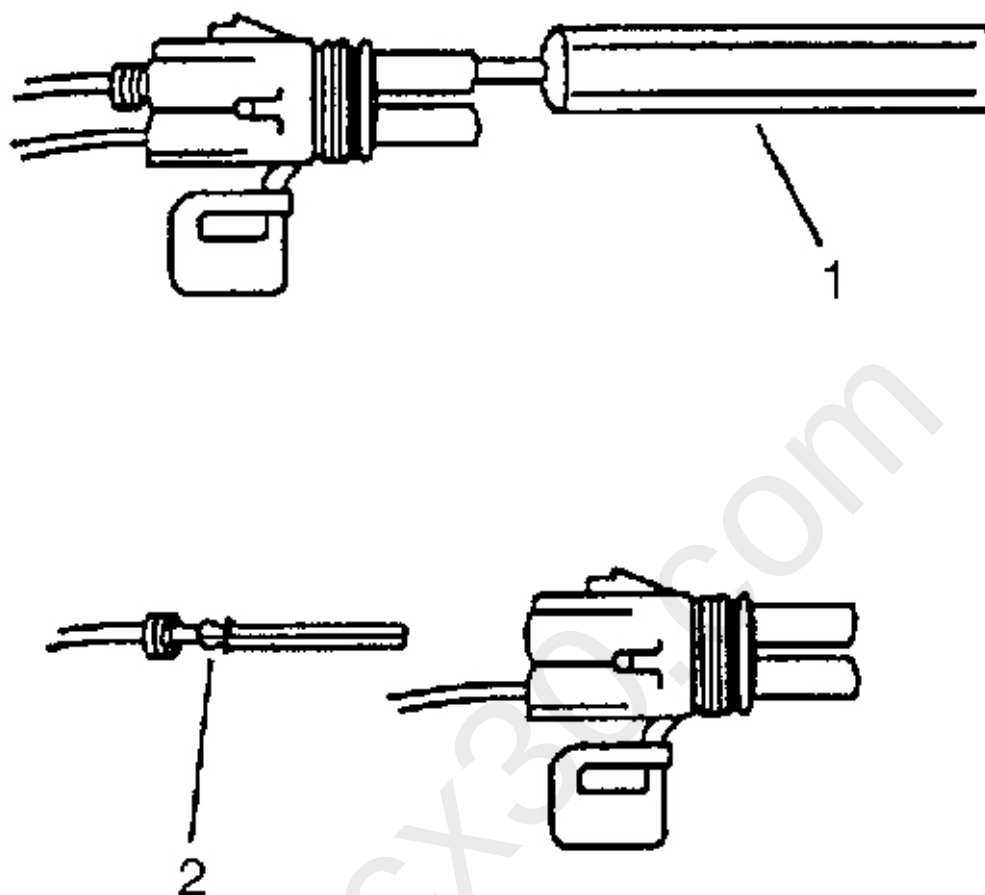


Fig. 61: Identifying Removal Tool & Terminal
Courtesy of GENERAL MOTORS CORP.

3. Use the proper pick or removal tool (1) in order to release the terminal. See the release tool cross reference in the Reference Guide of the **J-38125** to ensure that the correct release tool is used.
4. Gently pull the cable and the terminal (2) out of the back of the connector.

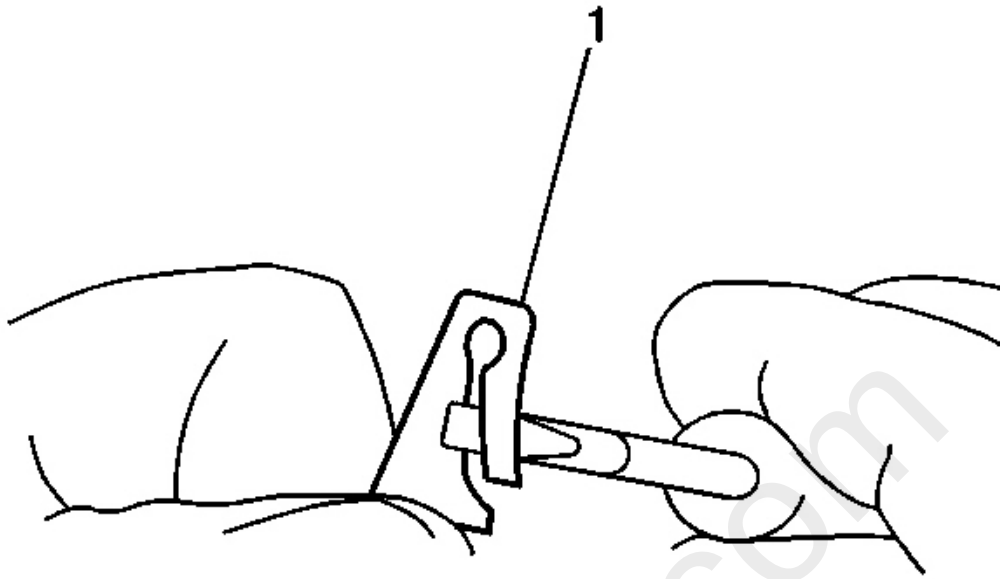


Fig. 62: Identifying Locking Device
Courtesy of GENERAL MOTORS CORP.

5. Re-form the locking device if you are going to reuse the terminal (1).
6. To repair the terminal, refer to Terminal Repair.

Terminal Repair

1. Slip the cable seal away from the terminal.
2. Cut the wire as close to the terminal as possible.
3. Slip a new cable seal onto the wire.
4. Strip 5 mm (3/16 in) of insulation from the wire.
5. Crimp a new terminal to the wire.
6. Solder the crimp with rosin core solder.
7. Slide the cable seal toward the terminal.
8. Crimp the cable seal and the insulation.
9. If the connector is outside of the passenger compartment, apply grease to the connector.

Reinstalling Terminal

1. In order to reuse a terminal or lead assembly, refer to **Wiring Repairs**.
2. Ensure that the cable seal is kept on the terminal side of the splice.

3. Insert the lead from the back until it catches.
4. Install the TPA, CPA, and/or the secondary locks.

Terminated Lead Repair

1. Remove the terminal.
2. Find the appropriate terminated lead.
3. Use the appropriate splice sleeves depending on the gauge size.
4. Refer to **Splicing Copper Wire Using Splice Sleeves**.

DELPHI CONNECTORS (PULL TO SEAT)

Special Tools

J-38125 Terminal Repair Kit

Terminal Removal

If the terminal is visibly damaged or is suspected of having a faulty connection, the terminal should be replaced.

Follow the steps below in order to repair pull-to-seat connectors:

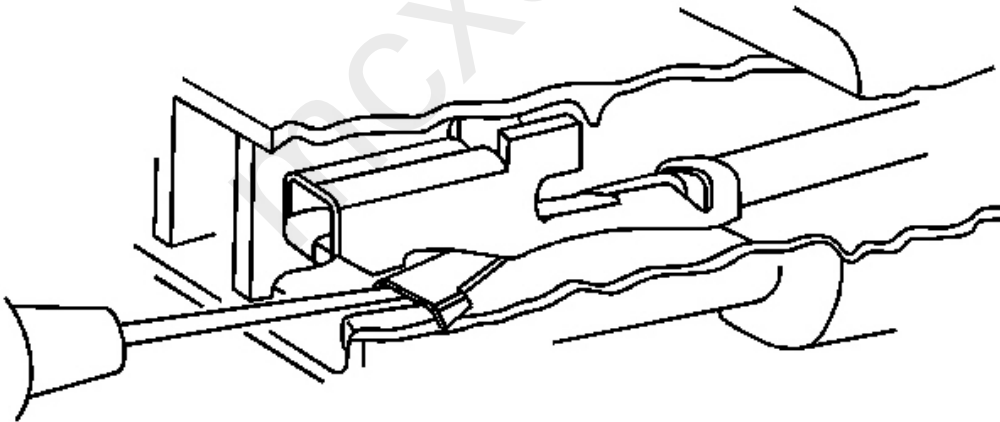


Fig. 63: Aligning Removal Tool
Courtesy of GENERAL MOTORS CORP.

1. Remove the connector position assurance (CPA) device and/or the secondary lock.
2. Disconnect the connector from the component or separate the connectors for in-line connectors.

3. Remove the terminal position assurance (TPA) device.
4. Insert the proper pick or removal tool into the front of the connector body.

NOTE: On connectors with more than one terminal the service loop may not be large enough to remove the terminal and crimp on a new one. If the terminal wire does not have a large enough service loop for removal, cut the wire 5 cm (2 in) behind the connector before removal.

5. Grasp the wire at the back of the connector body and gently push the terminal out the front of the connector body.

Terminal Repair

1. If the wire needed to be cut in order to remove the terminal, gently push a small length of the same size wire through the back of the connector cavity until there is enough wire exposed in order to crimp on a new terminal. If the wire was not cut, cut the existing wire as close to the old terminal as possible.
2. Strip 5 mm (3/16 in) of insulation from the wire.
3. Crimp a new terminal to the wire.
4. Solder the crimp with rosin core solder.

Terminal Installation

1. Align the terminal and pull the wire from the back of the connector in order to seat the terminal.
2. If necessary, cut the new wire to proper length and splice with existing circuit. Refer to **Splicing Copper Wire Using Splice Sleeves**.
3. If the connector is outside of the passenger compartment, apply dielectric grease to the connector.
4. Install the TPA, CPA, and/or the secondary locks.

DELPHI CONNECTORS (MICRO-PACK 100W)

Special Tools

J-38125 Terminal Repair Kit

Terminal Removal Procedure

There are 2 styles of Micro-Pack 100W connectors. These connectors are very similar but use different terminals and have some minor physical differences also.

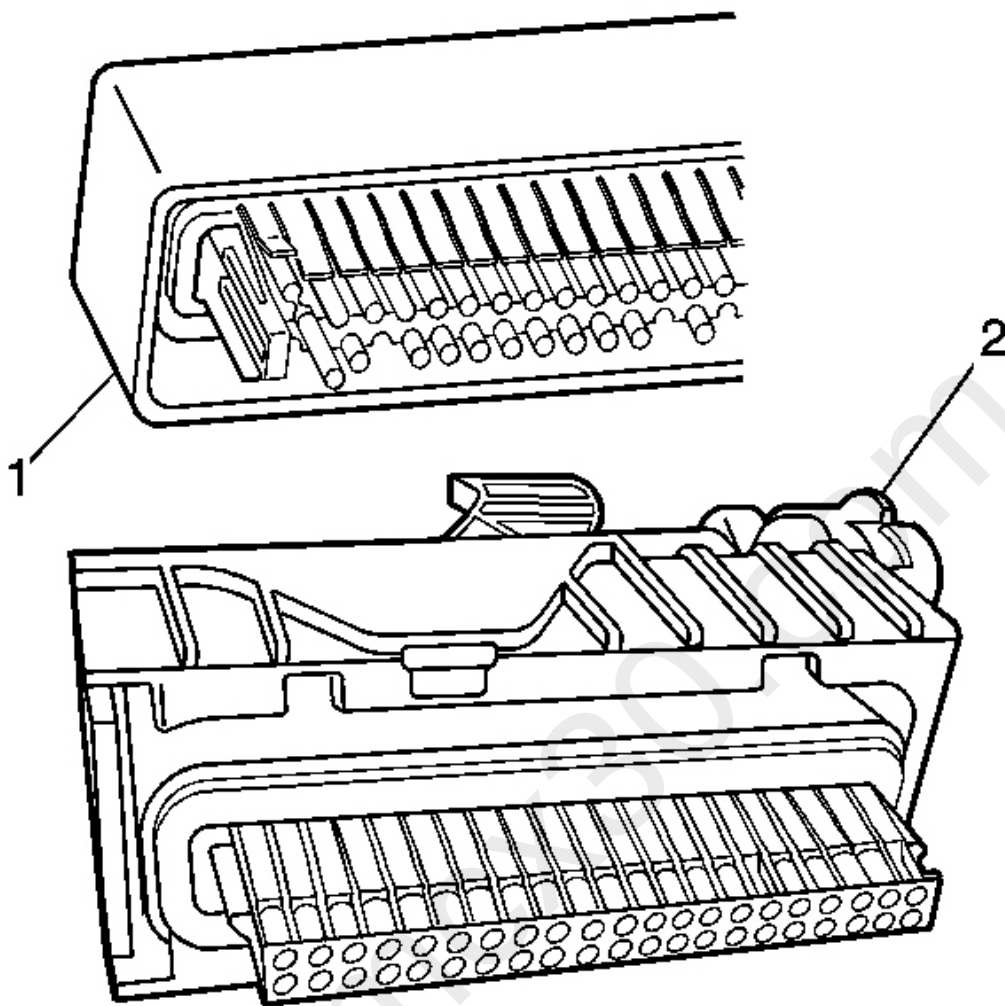


Fig. 64: Identifying Micro-Pack 100W First & Second Connector Designs
Courtesy of GENERAL MOTORS CORP.

The first connector design of the Micro-Pack 100W (1) has a white connector interface that holds the terminals. The second design of the Micro-Pack 100W (2) has a gray interface to hold the terminals. Also, the first design has terminal cavities that are further apart (3 mm centerline) and offset from the other row of terminal cavities in the connector. The second design has terminals cavities that are closer together (2.54 mm centerline) and aligned vertically. One other way to identify the second design is the thin strip of material that runs along the outside of the cavities.

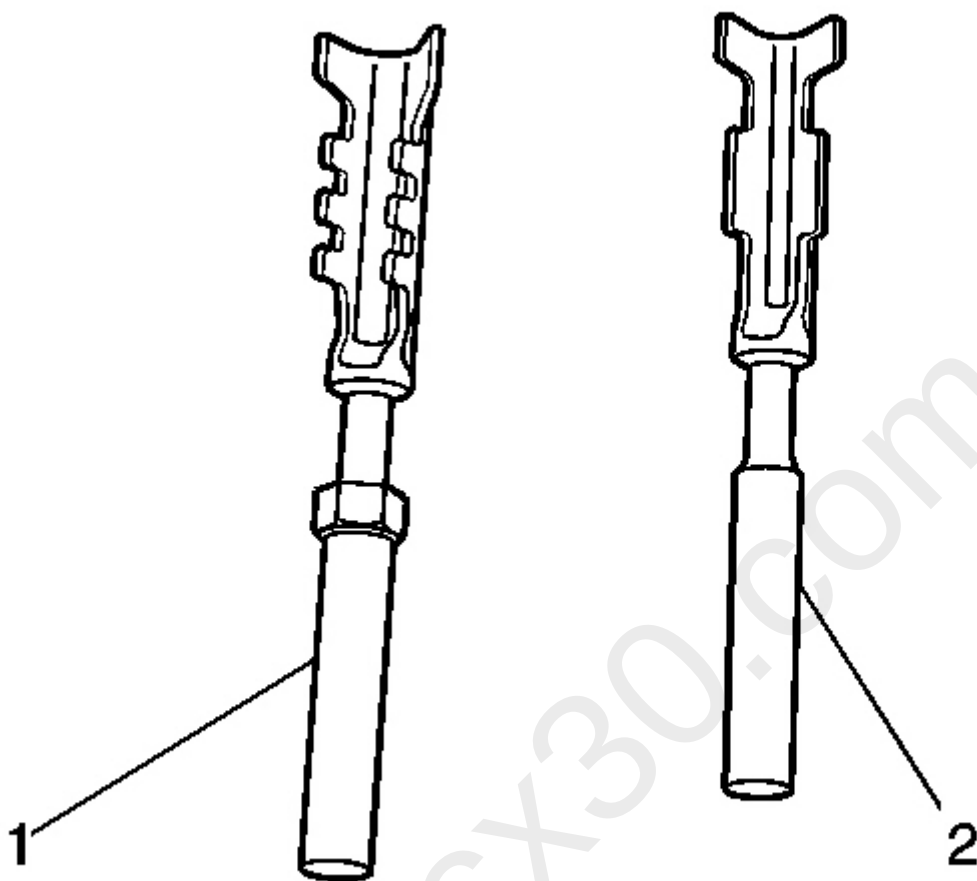


Fig. 65: Identifying Micro-Pack 100W Short & Long Terminals
Courtesy of GENERAL MOTORS CORP.

NOTE: There are 2 styles of Micro-Pack 100W terminals which are very similar. Ensure that you have the correct terminal before crimping the new terminal to the wire. The first design connector uses the longer terminal (1) that has a raised area in front of the recess in the terminal. The second design connector uses the shorter terminal without the raised area.

Follow the steps below in order to remove terminals from Micro-Pack 100W connectors. Some Micro-Pack 100W connector disassembly procedures will vary. Use this procedure as a guide.

1. Disconnect the connector from the component.

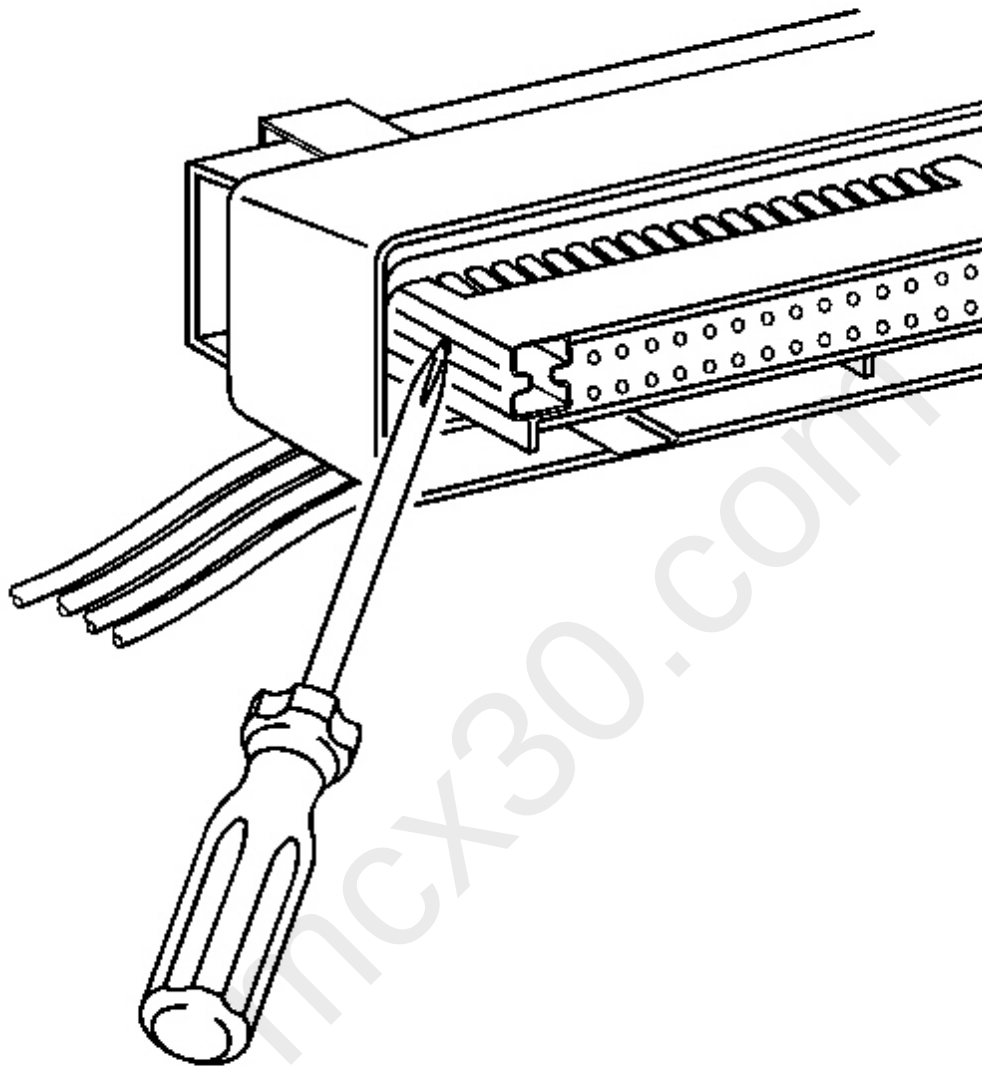


Fig. 66: Locating Nose Piece Locking Tabs
Courtesy of GENERAL MOTORS CORP.

2. Locate the nose piece locking tabs that are positioned on the side of the connector nose piece. The connector nose piece acts as a terminal positive assurance (TPA) and may be referred to as such.

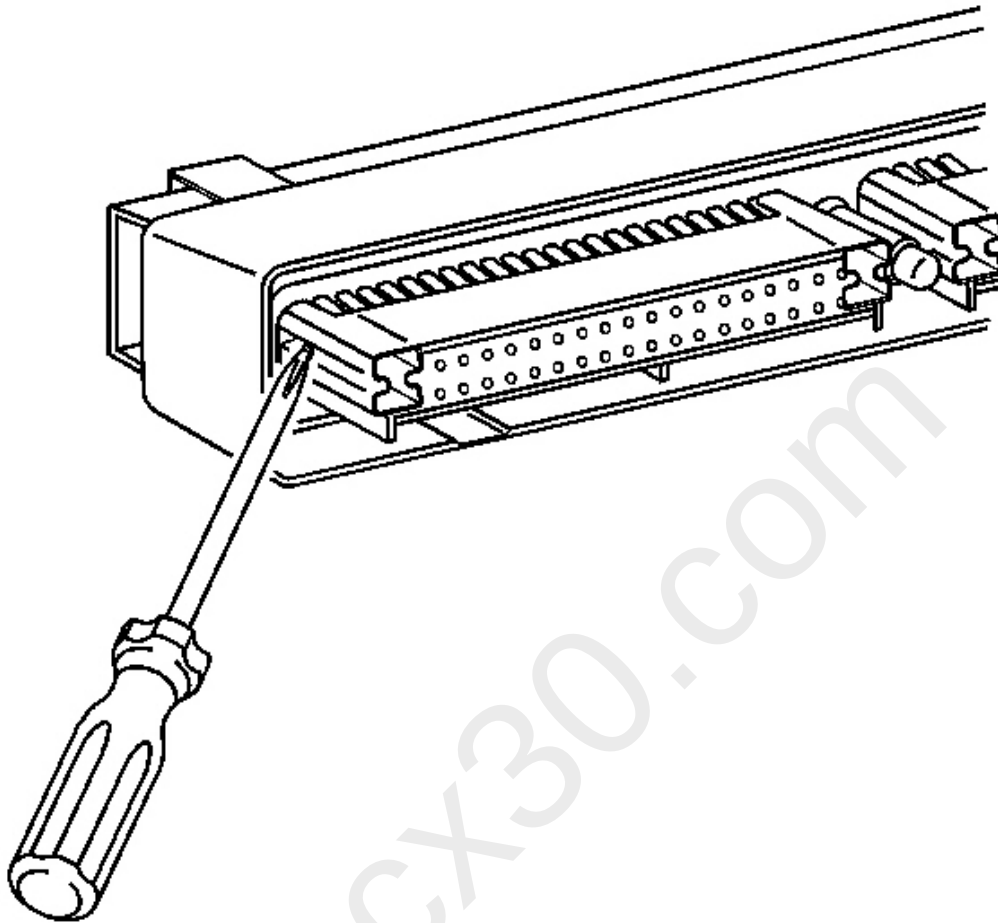


Fig. 67: Loosening Nose Piece Locking Tabs
Courtesy of GENERAL MOTORS CORP.

3. Use a small flat-blade tool to push in one of the locking tabs while gently pulling on the same side of the nose piece.
4. Repeat the procedure for the other locking tab and remove the nose piece.
5. Remove the wire dress cover. The following is a general procedure for wire dress cover removal. Use this procedure as a guide, some dress cover removal procedures may vary.

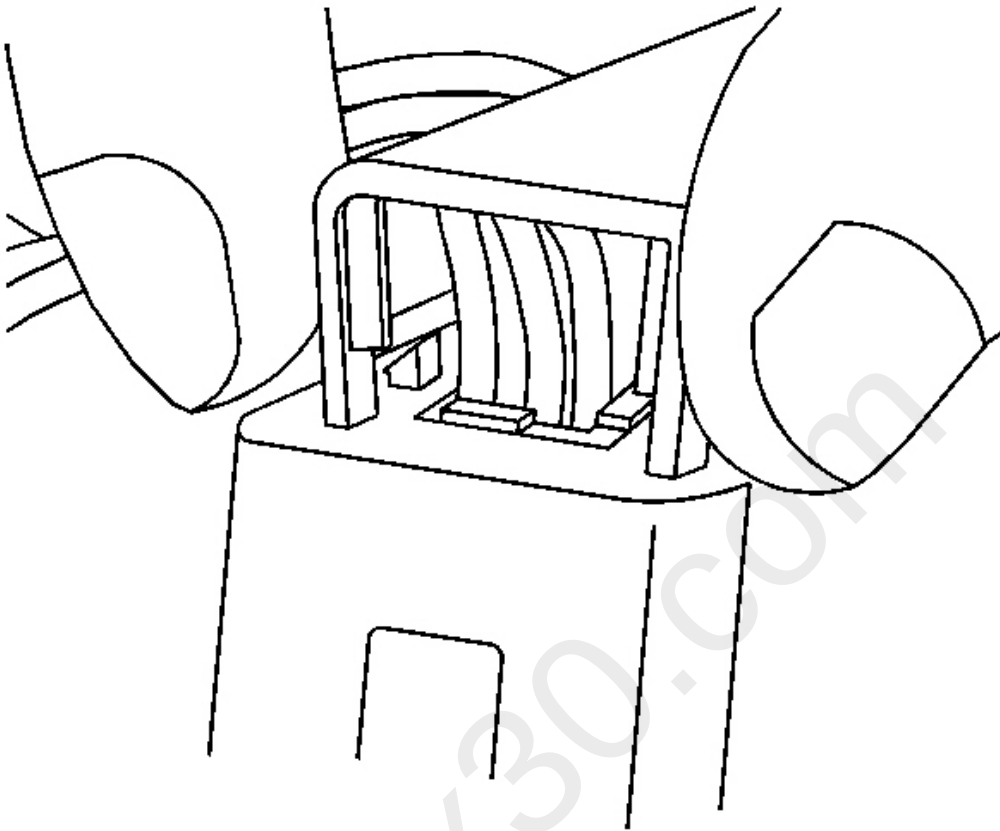


Fig. 68: Squeezing Cover Locking Legs
Courtesy of GENERAL MOTORS CORP.

6. Use fingers to squeeze the 2 locking legs of the cover.

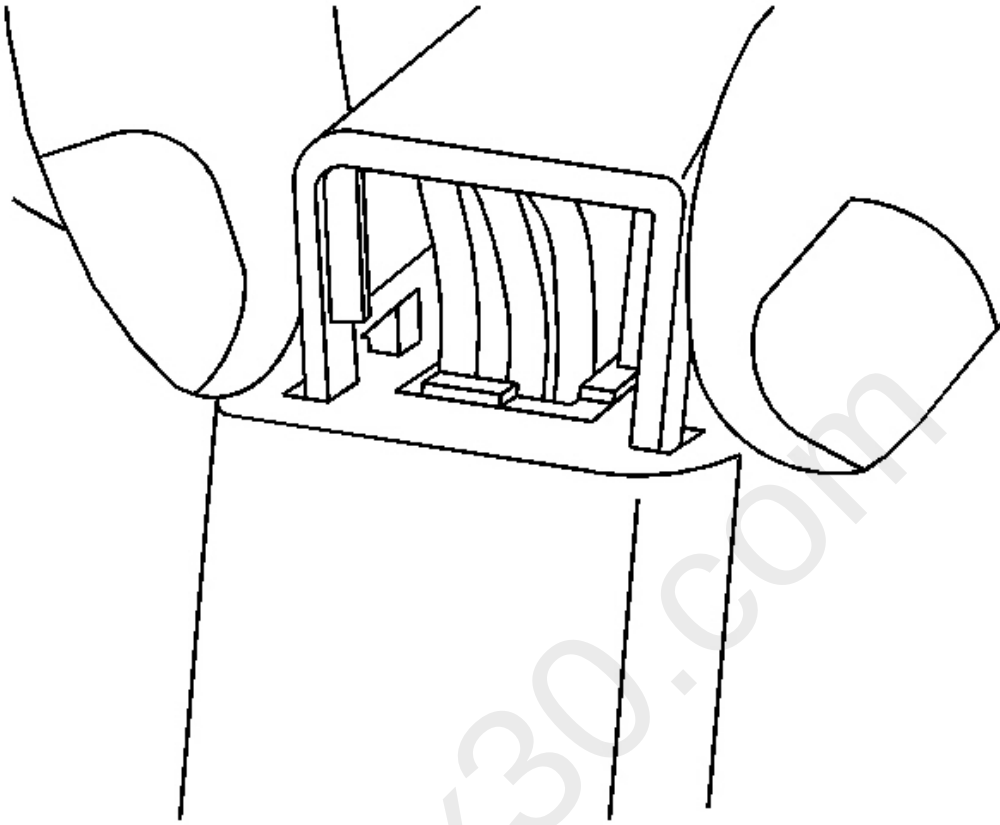


Fig. 69: Unseating Locking Leg
Courtesy of GENERAL MOTORS CORP.

7. Apply pressure and gently rock the cover until one locking leg is unseated.

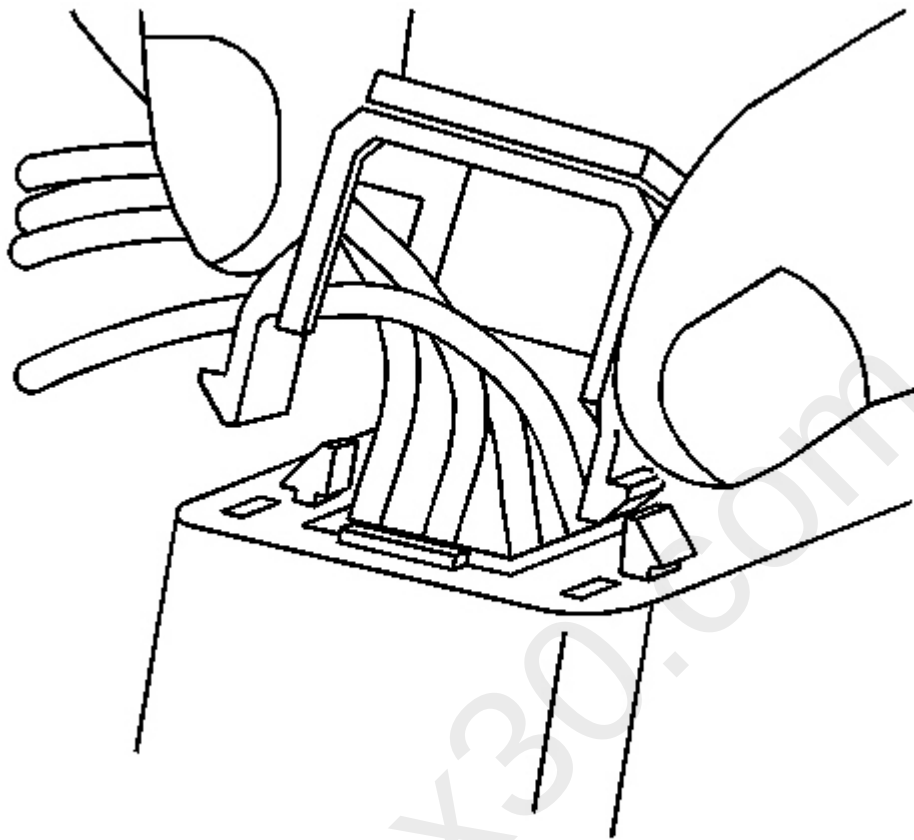


Fig. 70: Removing Cover

Courtesy of GENERAL MOTORS CORP.

8. Continue to apply pressure and rock the cover until the second locking leg is unseated. Repeat procedure for the other side of the dress cover and remove the cover.

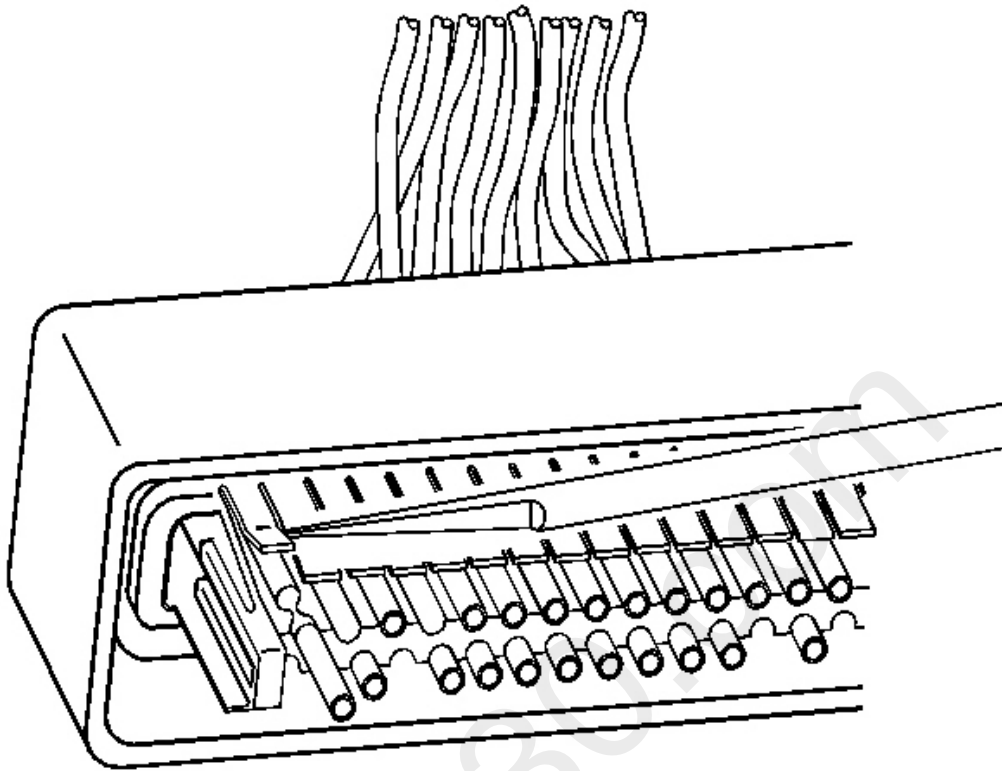


Fig. 71: Identifying Terminal Retaining Tab
Courtesy of GENERAL MOTORS CORP.

9. Use J 38125-12A to gently lift the terminal retaining tab while gently pulling the wire out of the back of the connector. Always remember never use force when pulling a terminal out of a connector. See the release tool cross reference in the Reference Guide of the J-38125 to ensure that the correct release tool is used.
10. If the terminal is severely bent or damaged, it may be possible on some connectors to push the wire out of the front of the connector instead of pulling it through. This will prevent damage to the internal seals of the connector. Once the terminal is pushed out of the connector, cut the wire as close to the terminal as possible and pull the wire through the connector.

Terminal Repair Procedure

The Micro-Pack 100W connectors have small terminals that are difficult to handle and hold when crimping. In order to aid the technician when crimping these terminals, a new crimping tool was developed. The J 38125-101 (W jaw) crimping tool was developed to crimp Micro-Pack 100W terminals. The J 38125-101 (W jaw) crimping tool has a terminal holding block that will hold the terminal in place while the terminal is being crimped. After the terminal is removed from the connector perform the following procedure in order to repair

Micro-Pack 100 terminals.

1. Cut the wire as close to the terminal as possible.

NOTE: After cutting the damaged terminal from the wire, determine if the remaining wire is long enough to reach the connector without putting a strain on the wire. If the wire is not long enough, splice a small length of the same gauge wire to the existing wire, then crimp the new terminal on the added wire.

2. Strip 5 mm (3/16 in) of insulation from the wire.

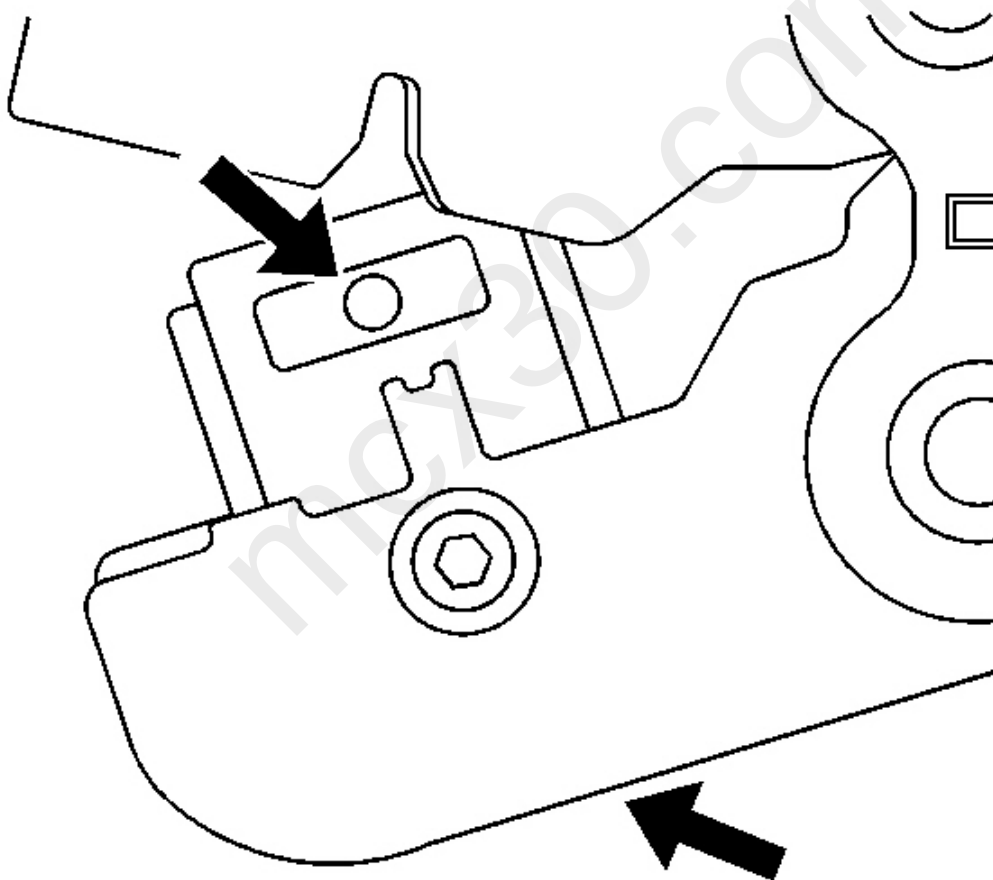


Fig. 72: Identifying Crimping Tool Spring Loaded Locator
Courtesy of GENERAL MOTORS CORP.

3. Depress the spring loaded locator of the J 38125-101 (W jaw) crimping tool until the terminal holder is completely visible.

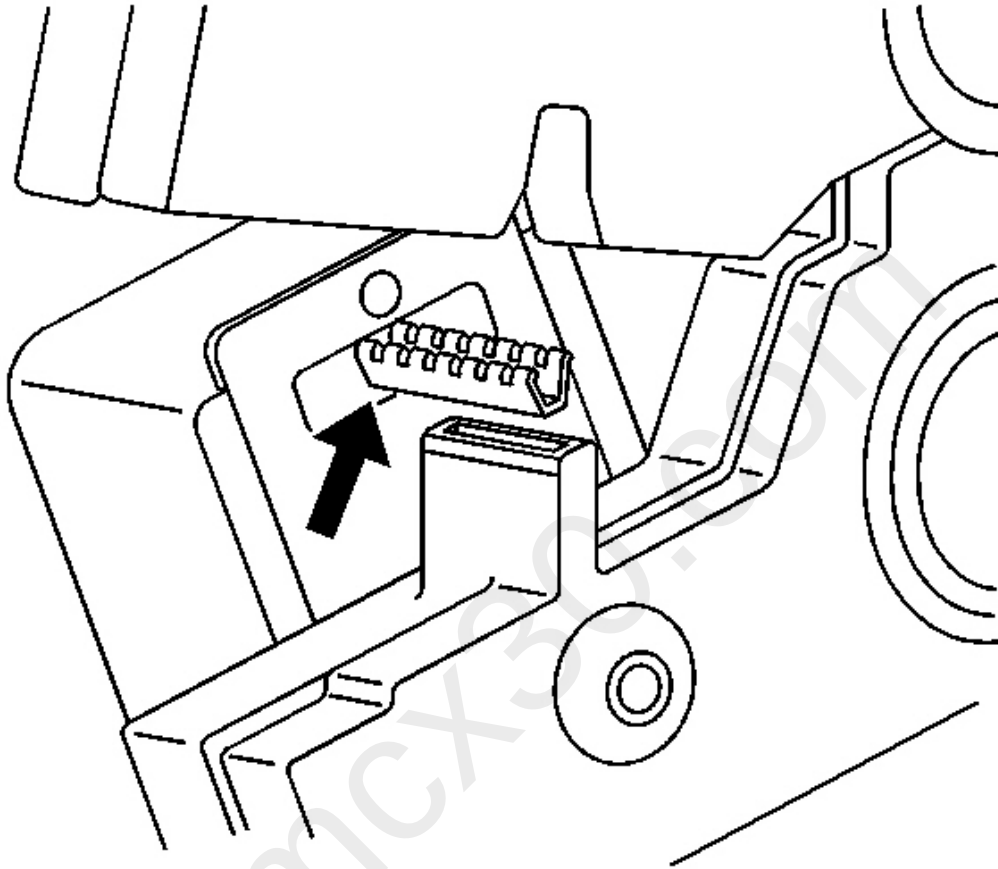


Fig. 73: Locating Terminal In Crimping Tool
Courtesy of GENERAL MOTORS CORP.

4. Insert the terminal into the crimp tool until the core wings are flush with the anvil on the crimp tool. Be sure that the wings are pointed toward the crimp tool former and release the spring locator. The locator will hold the terminal in place. Inspect the alignment of the terminal wings with the crimp tool former. If the terminal wings are wider than the crimp tool former, remove the terminal and bend the terminal wings in slightly.
5. Place stripped wire into terminal.
6. Crimp the new terminal to the wire. If a jam occurs, press the emergency release to open applicator.

Terminal Replacement Procedure

After the terminal is crimped to the wire perform the following procedure in order to replace Micro-Pack 100 terminals.

1. Slide the new terminal into the correct cavity at the back of the connector.
2. Push the terminal into the connector until it locks into place. The new terminal should be even with the other terminals. Ensure that the terminal is locked in place by gently pulling on the wire.
3. To assemble the connector, reverse the Terminal Removal Procedure.

DELPHI CONNECTORS (MICRO .64)

Special Tools

J-38125 Terminal Repair Kit

Removal Procedure

Follow the steps below in order to remove terminals from Micro .64 connectors.

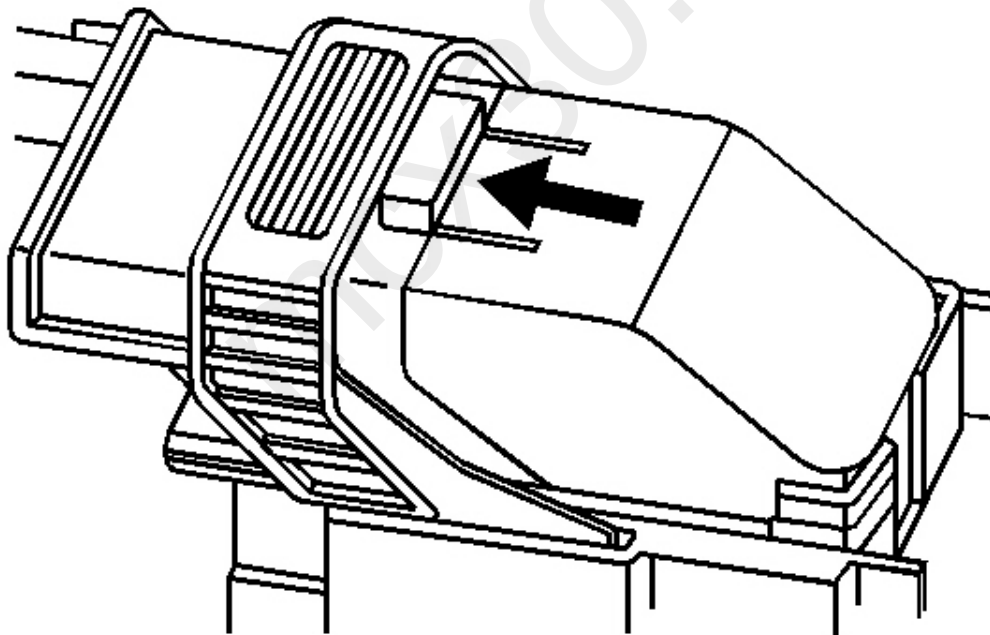


Fig. 74: Identifying Wire Dress Cover Lever Lock
Courtesy of GENERAL MOTORS CORP.

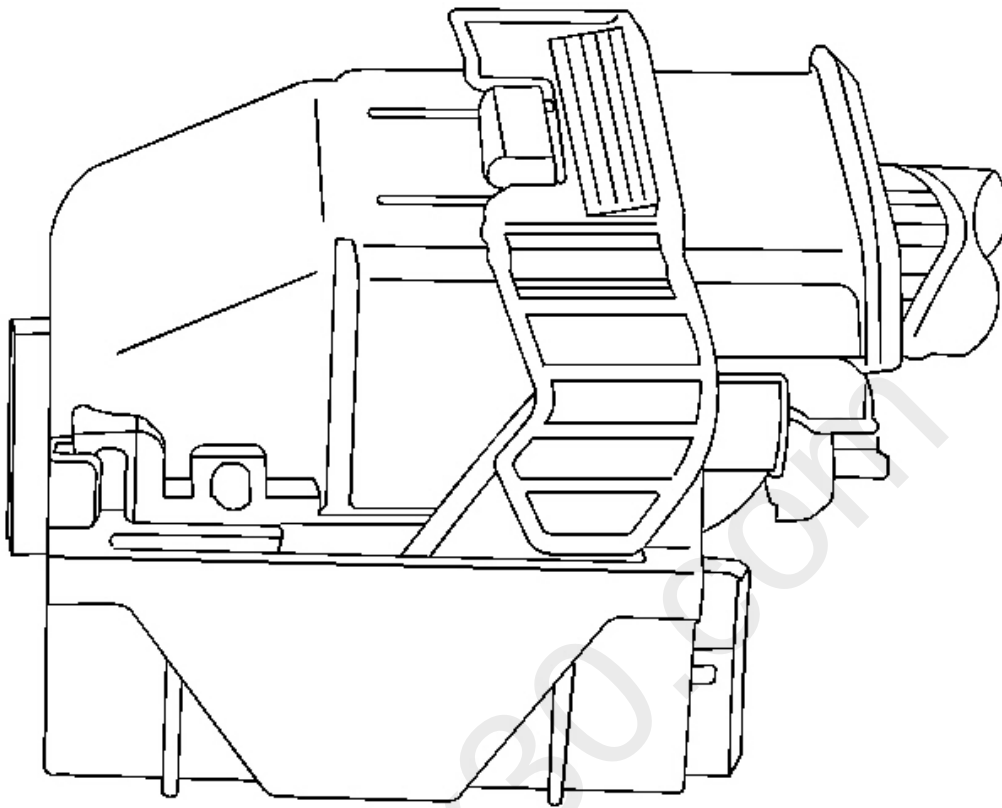


Fig. 75: View Of Typical Micro 64 Connector
Courtesy of GENERAL MOTORS CORP.

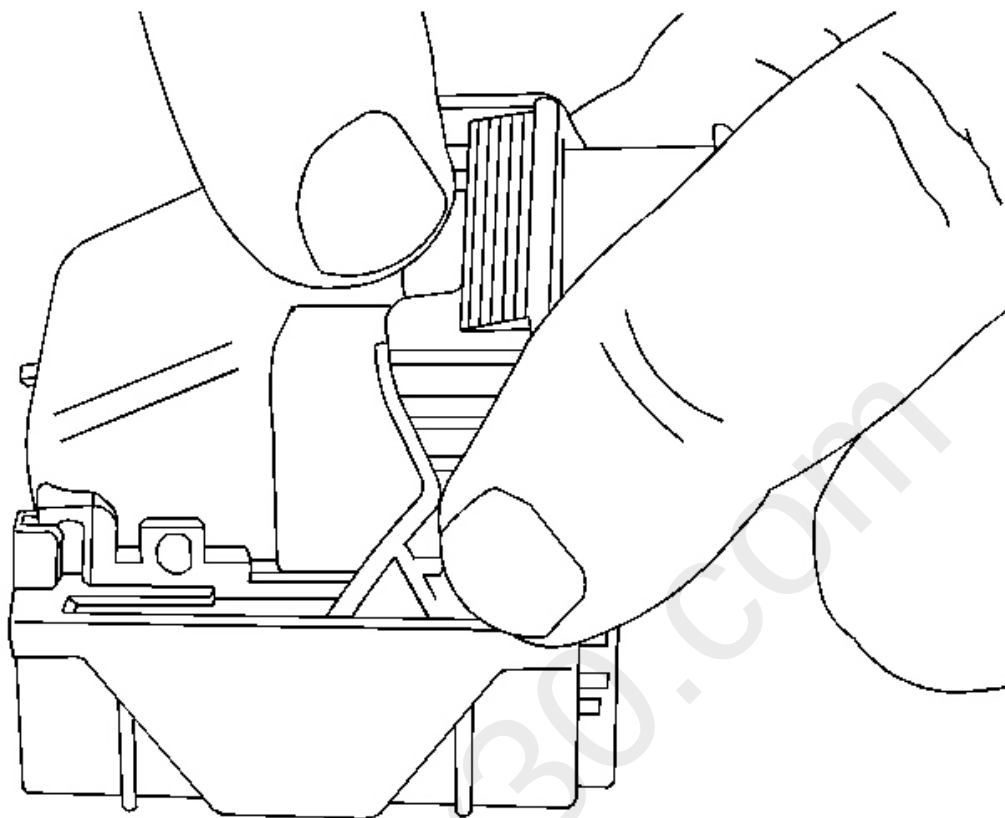


Fig. 76: Depressing Lock And Pulling Lever
Courtesy of GENERAL MOTORS CORP.

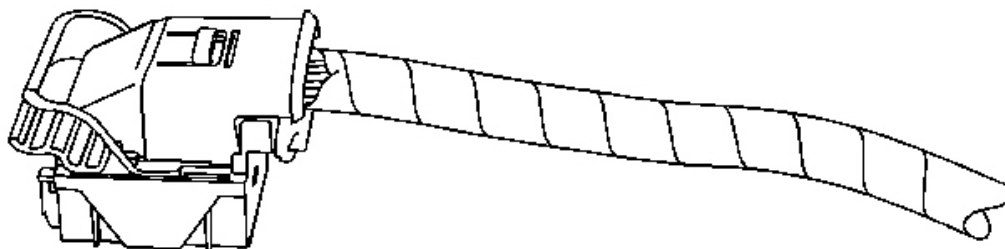


Fig. 77: View Of Connector When Released From Component

Courtesy of GENERAL MOTORS CORP.

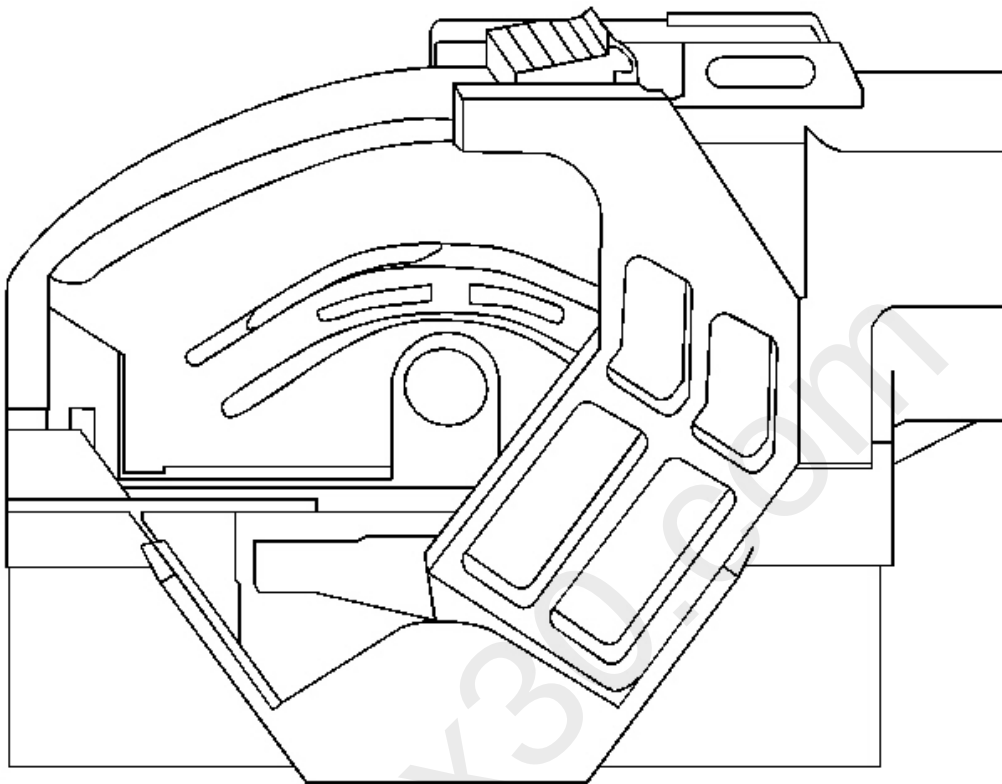


Fig. 78: View Of Another Type Of Micro 64 Connector
Courtesy of GENERAL MOTORS CORP.

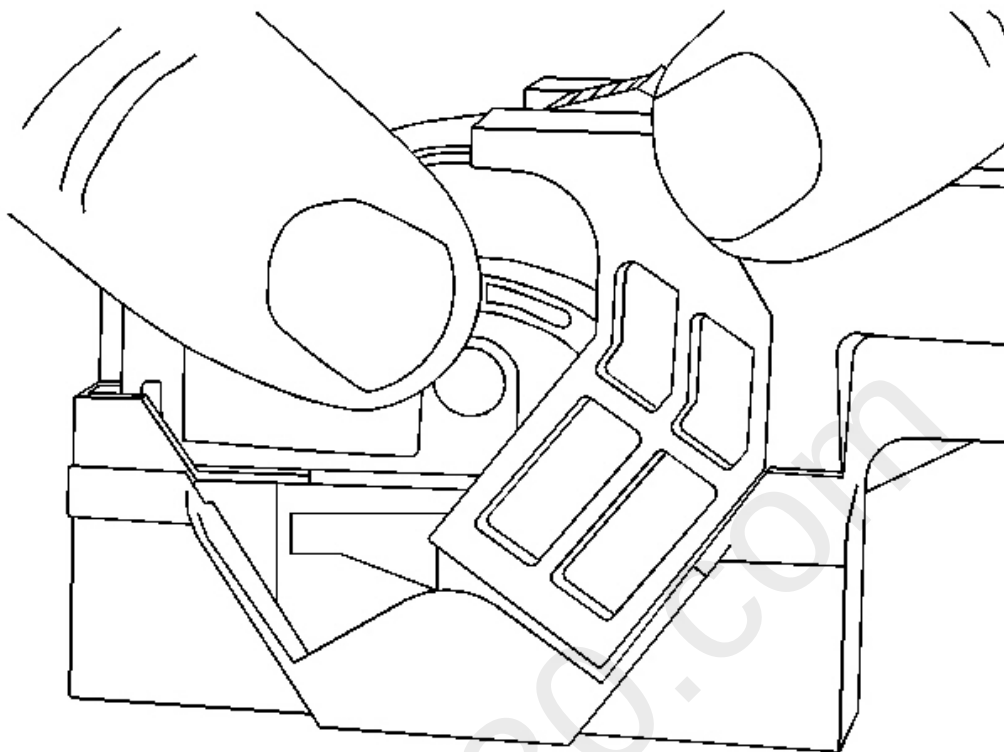


Fig. 79: Locating Locks On Both Sides Of Wireless Cover
Courtesy of GENERAL MOTORS CORP.

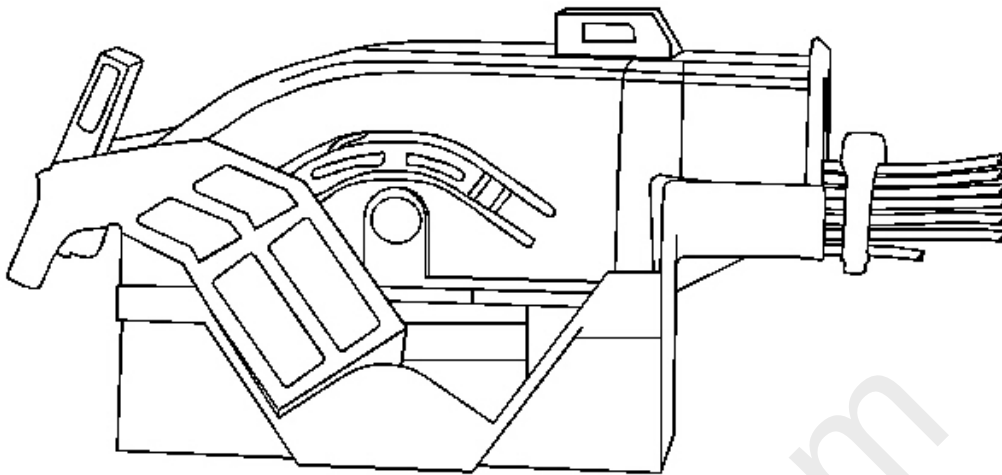


Fig. 80: View Of Connector When Released From Component
Courtesy of GENERAL MOTORS CORP.

1. Locate the lever lock on the wire dress cover. While depressing the lock, pull the lever over and past the lock. The lever lock may be located on the top or sides of the wire dress cover.

View of a typical Micro 64 connector.

Depress the lock and pull the lever over and past the lock.

View of the connector when released from the component.

View of another type of Micro 64 connector.

Depress the locks that are located on both sides of the wiredress cover and pull the lever over and past the locks.

View of the connector when released from the component.

2. Disconnect the connector from the component.

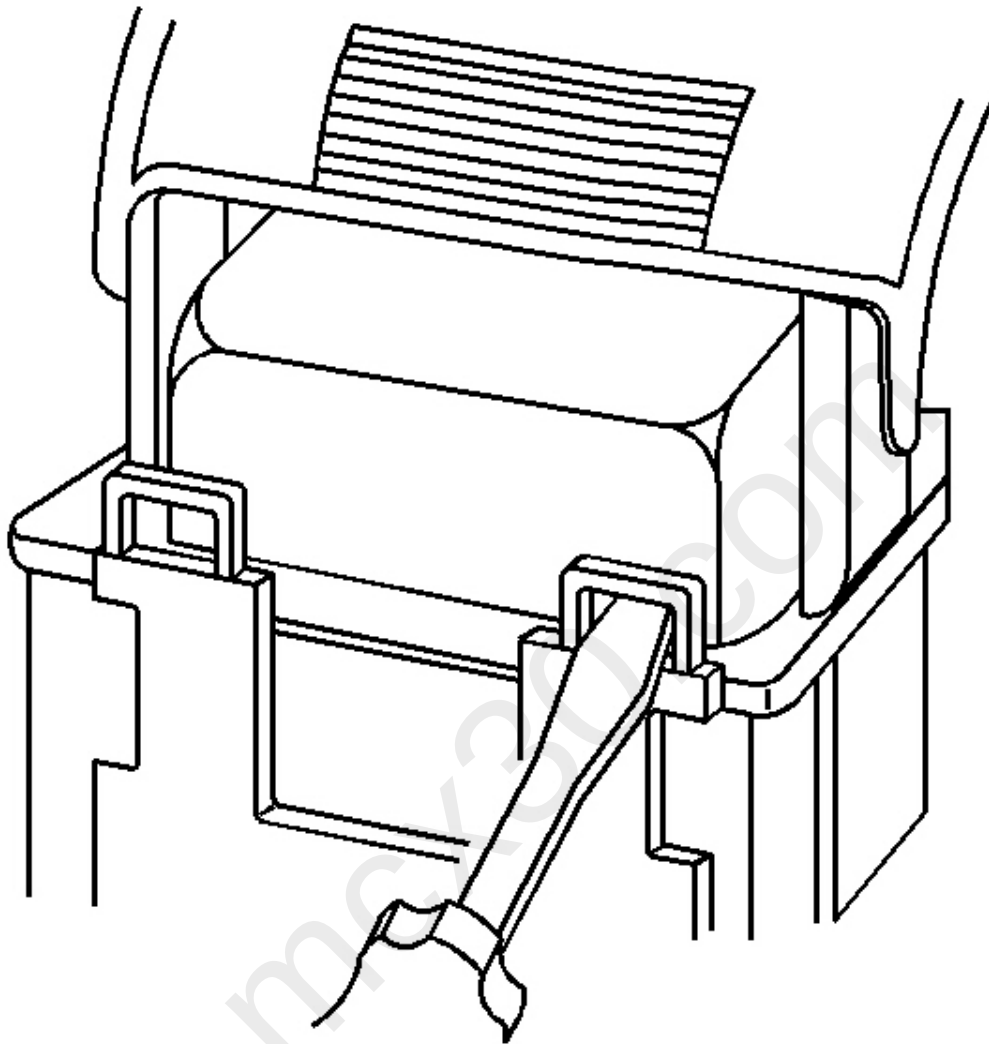


Fig. 81: View Of Releasing Locking Tabs
Courtesy of GENERAL MOTORS CORP.

3. Locate the dress cover locking tabs at the front of the connector. Using a small flat-blade tool push down on one of the locking tabs and pull the cover up until the dress cover releases. Repeat this procedure for the other locking tab.
4. Once the front 2 locks are unlocked, lift the front of the dress cover and pull it forward.

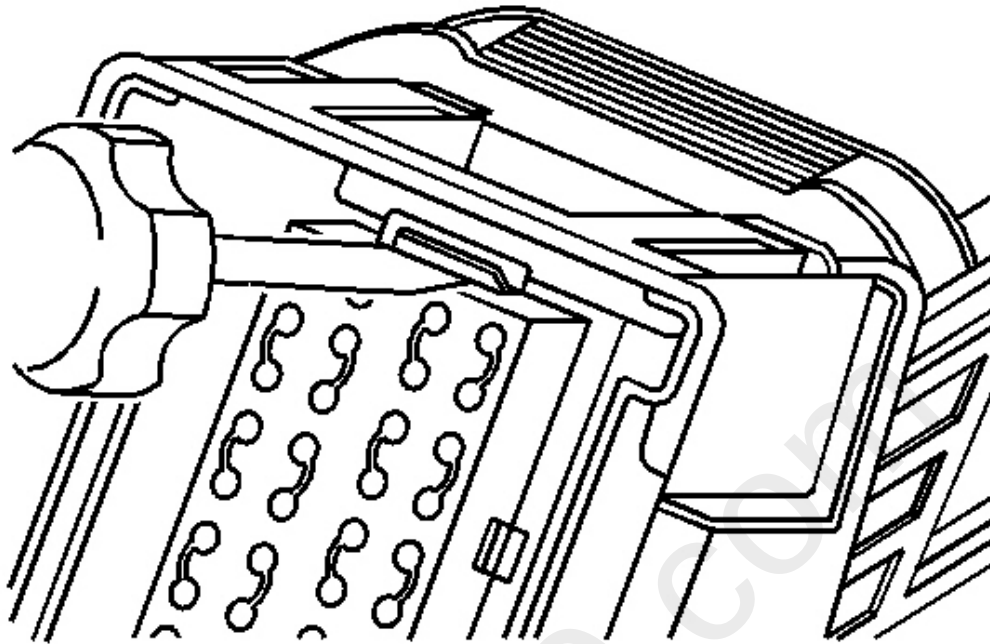


Fig. 82: View Of Removing Terminal Position Assurance
Courtesy of GENERAL MOTORS CORP.

NOTE: Always use care when removing a terminal position assurance (TPA) in order to avoid damaging it.

5. Remove the TPA by inserting a small flat-blade tool into the small slot on the TPA and pushing down until the TPA releases. Gently pry the TPA out of the connector.

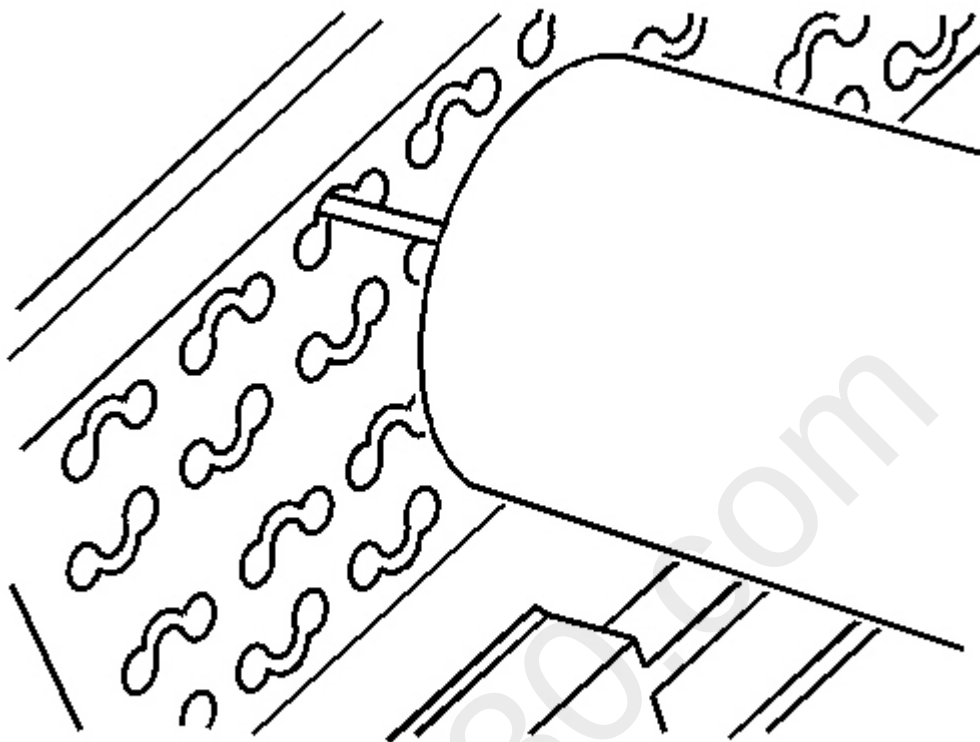


Fig. 83: Identifying Terminal Release Tool
Courtesy of GENERAL MOTORS CORP.

NOTE: Be careful not to angle or rock the J 38125-21 tool when inserting it into the connector or the tool may break.

6. Insert the J 38125-21 tool into the round canal between the terminals cavities at the front of the connector. See the release tool cross reference in the Reference Guide of the **J-38125** to ensure that the correct release tool is used.

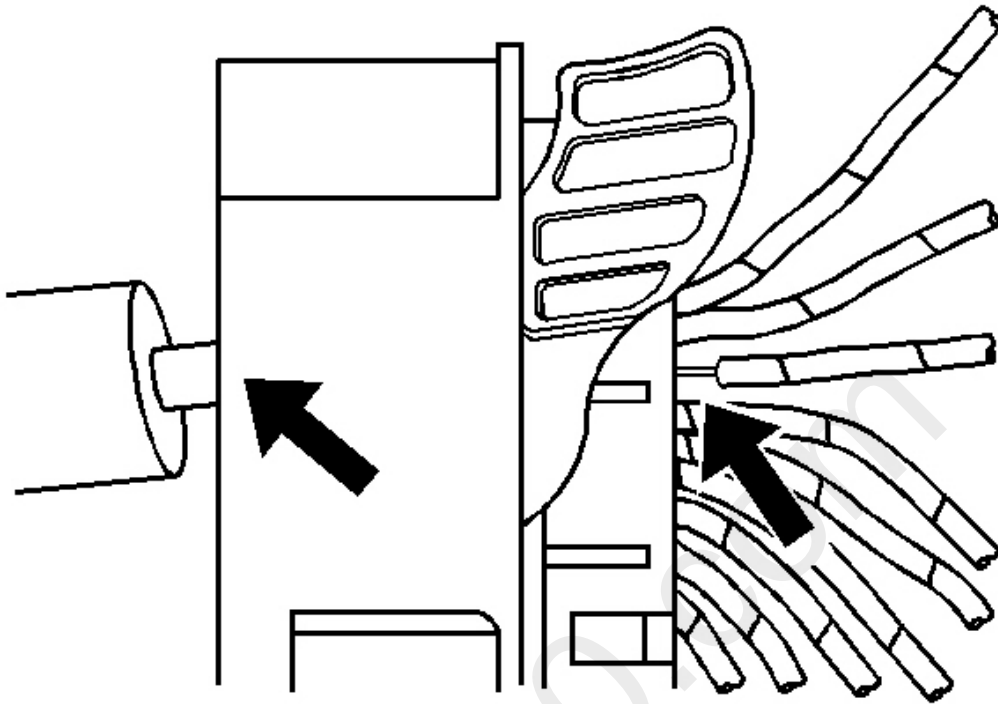


Fig. 84: Removing Wire From Back Of Connector
Courtesy of GENERAL MOTORS CORP.

7. While holding the removal tool in place, gently pull the wire out of the back of the connector. Always remember never use force when pulling a terminal out of a connector.

Repair Procedure

Follow the steps below in order to repair Micro 64 connector terminals.

The Micro 64 connectors have small terminals that are difficult to handle and hold when crimping. In order to aid the technician when crimping these terminals, a new crimping tool was developed. The J 38125-64 (M jaw) was developed to crimp Micro 64 terminals. The J 38125-64 crimping tool has a terminal holding block that will hold the terminal in place while the terminal is being crimped. The J 38125-64 crimping tool is also designed to crimp both the wire and the insulation at the same time.

After the terminal is removed from the connector perform the following procedure in order to repair Micro 64 terminals.

NOTE: After cutting the damaged terminal from the wire, determine if the remaining

wire is long enough to reach the connector without putting a strain on the wire. If the wire is not long enough, splice a small length of the same gauge wire to the existing wire, then crimp the new terminal on the added wire.

1. Cut the wire as close to the damaged terminal as possible.
2. Strip 5 mm (3/16 in) of insulation from the wire.

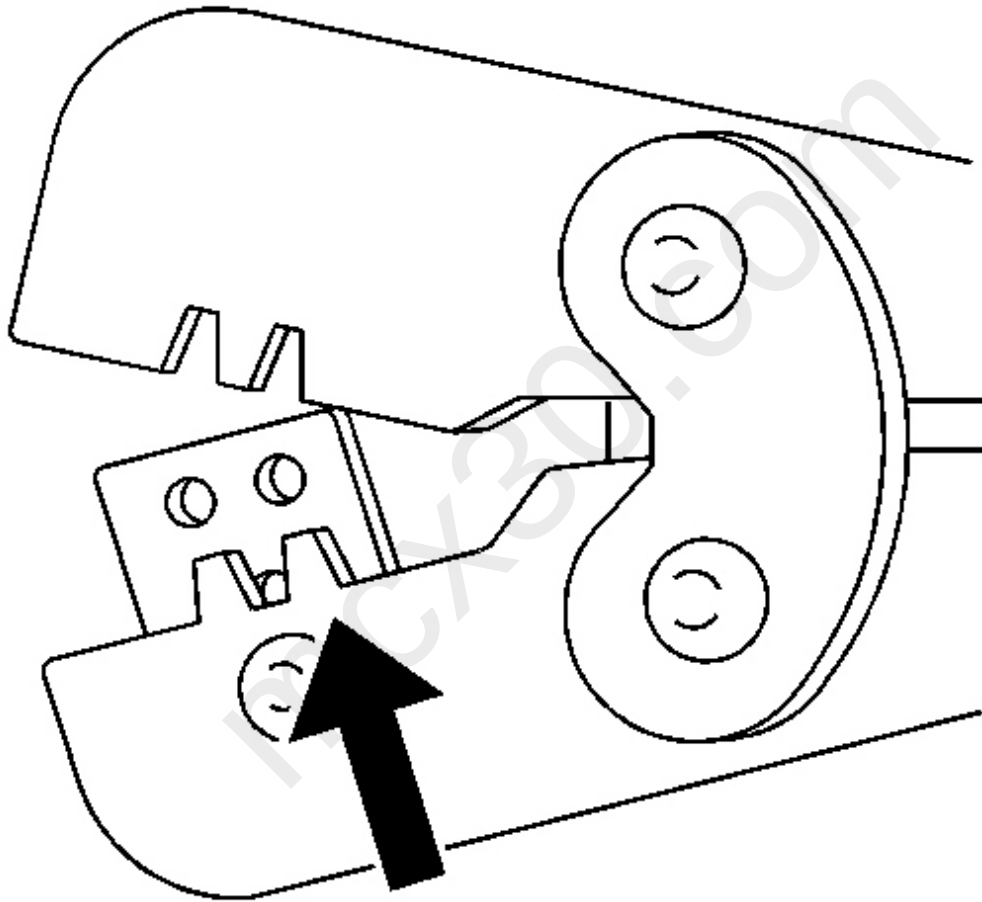


Fig. 85: Identifying Crimping Tool Spring Loaded Locator
Courtesy of GENERAL MOTORS CORP.

3. Depress the spring loaded locator of the crimping tool until the terminal holder is completely visible.

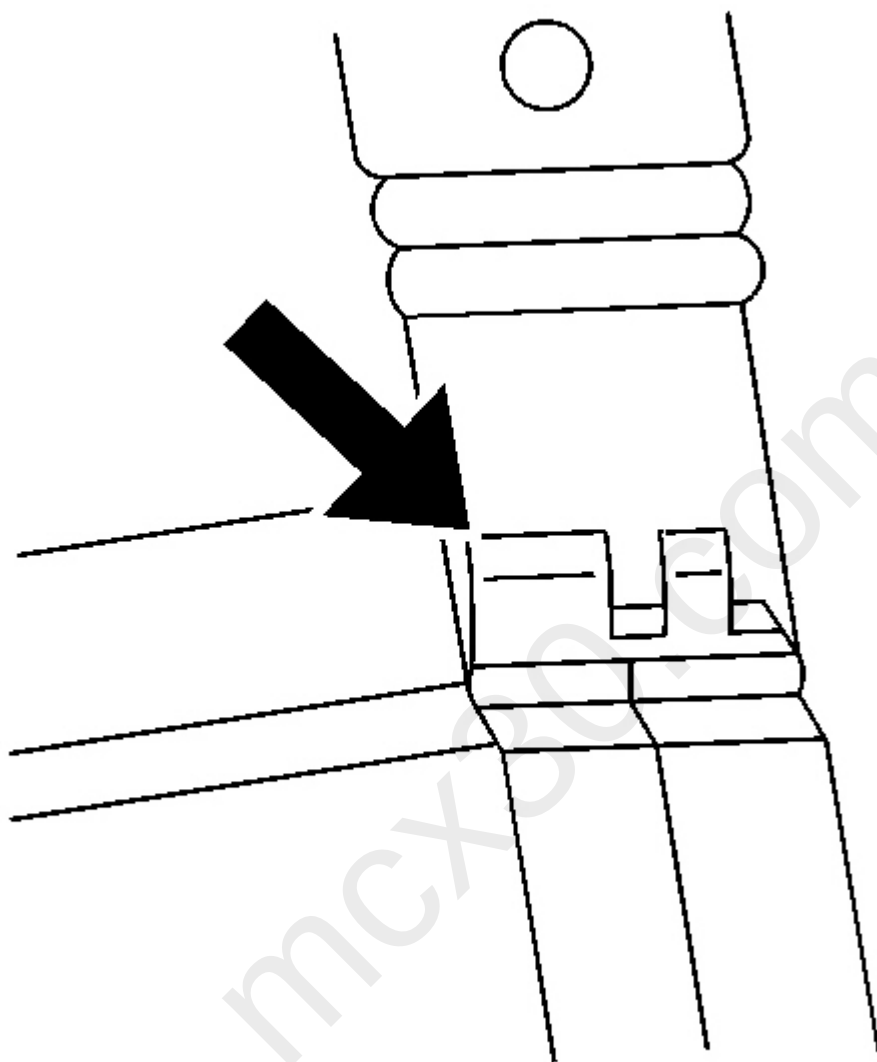


Fig. 86: Identifying Terminal Holder
Courtesy of GENERAL MOTORS CORP.

4. Insert terminal into the appropriate terminal holder until it hits bottom and stops. The correct terminal holder is determined by the wire size. Also ensure that the terminal wings are pointing towards the former on the tool and the release locator.
5. Insert the stripped cable into the terminal. Insulation should be visible on both sides of the terminal insulation wings.
6. Compress the handles until the ratchet automatically releases.

7. Place the terminal into the appropriate cavity and assemble the connector.

DELPHI CONNECTORS (12-WAY)

Special Tools

J-38125 Terminal Repair Kit

Removal Procedure

Follow the steps below in order to remove terminals from the connector.

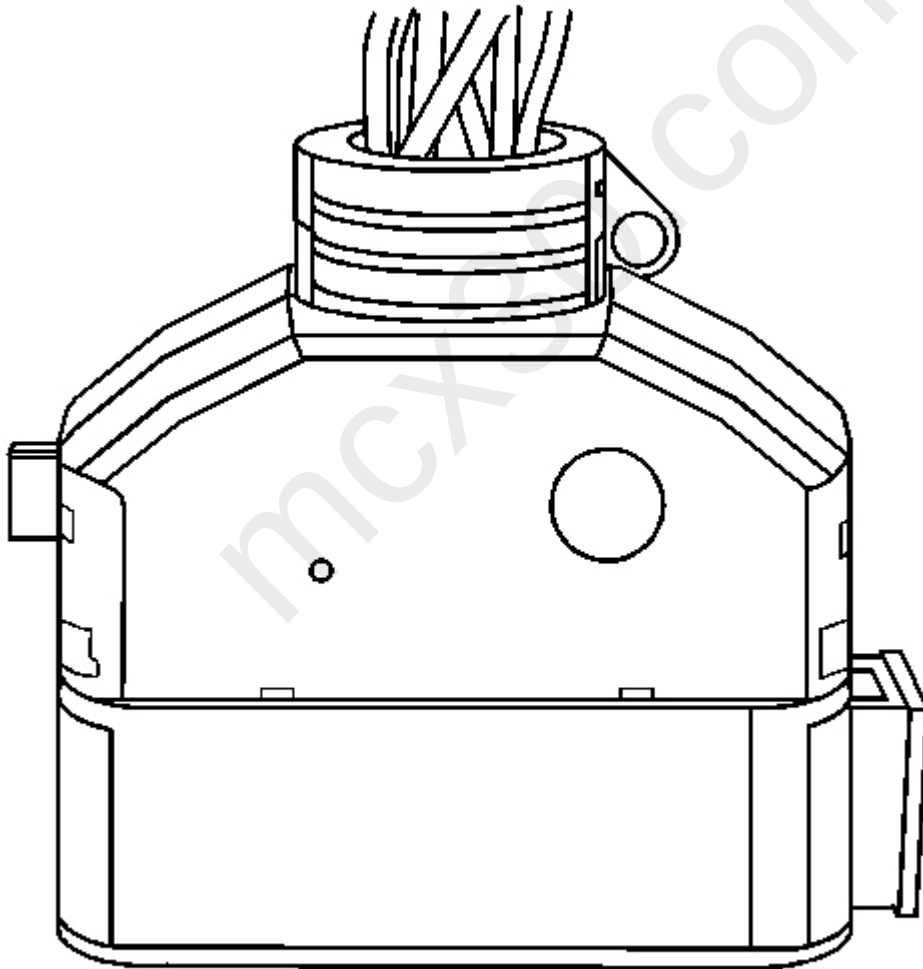


Fig. 87: Identifying Lever Lock
Courtesy of GENERAL MOTORS CORP.

1. Locate the lever lock on the wire dress cover. Remove the connector position assurance (CPA) and slide the lever lock away from the connector body.
2. Disconnect the connector from the component.

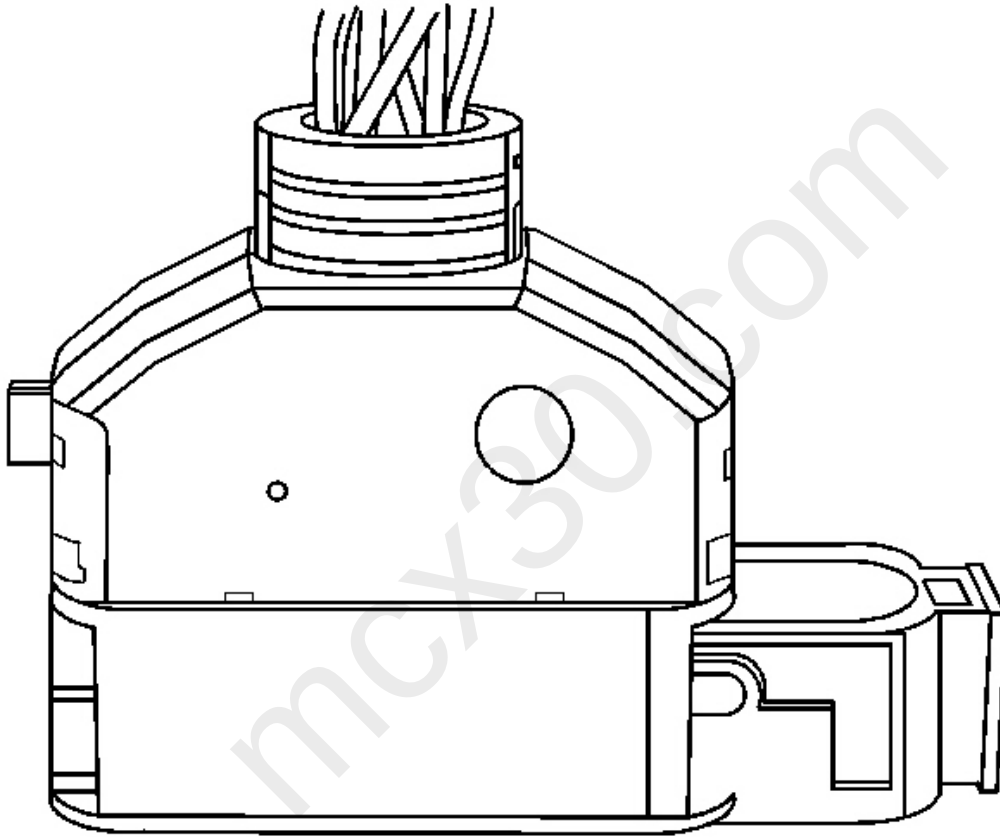


Fig. 88: Identifying Dress Cover Locking Tabs
Courtesy of GENERAL MOTORS CORP.

3. Locate the dress cover locking tabs on the dress cover of the connector. Using a small flat-blade tool release all of the locking tabs.

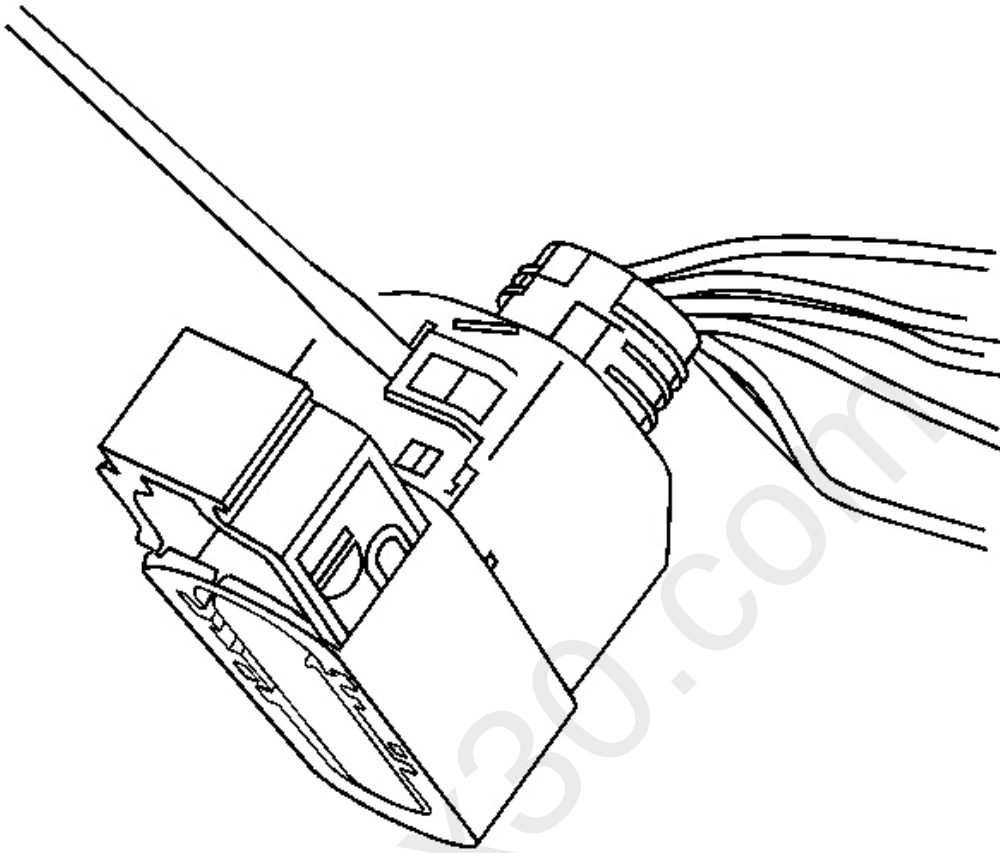


Fig. 89: Identifying Lower Wire Dress Cover Locking Tab
Courtesy of GENERAL MOTORS CORP.

4. Release the lower wire dress cover locking tab.

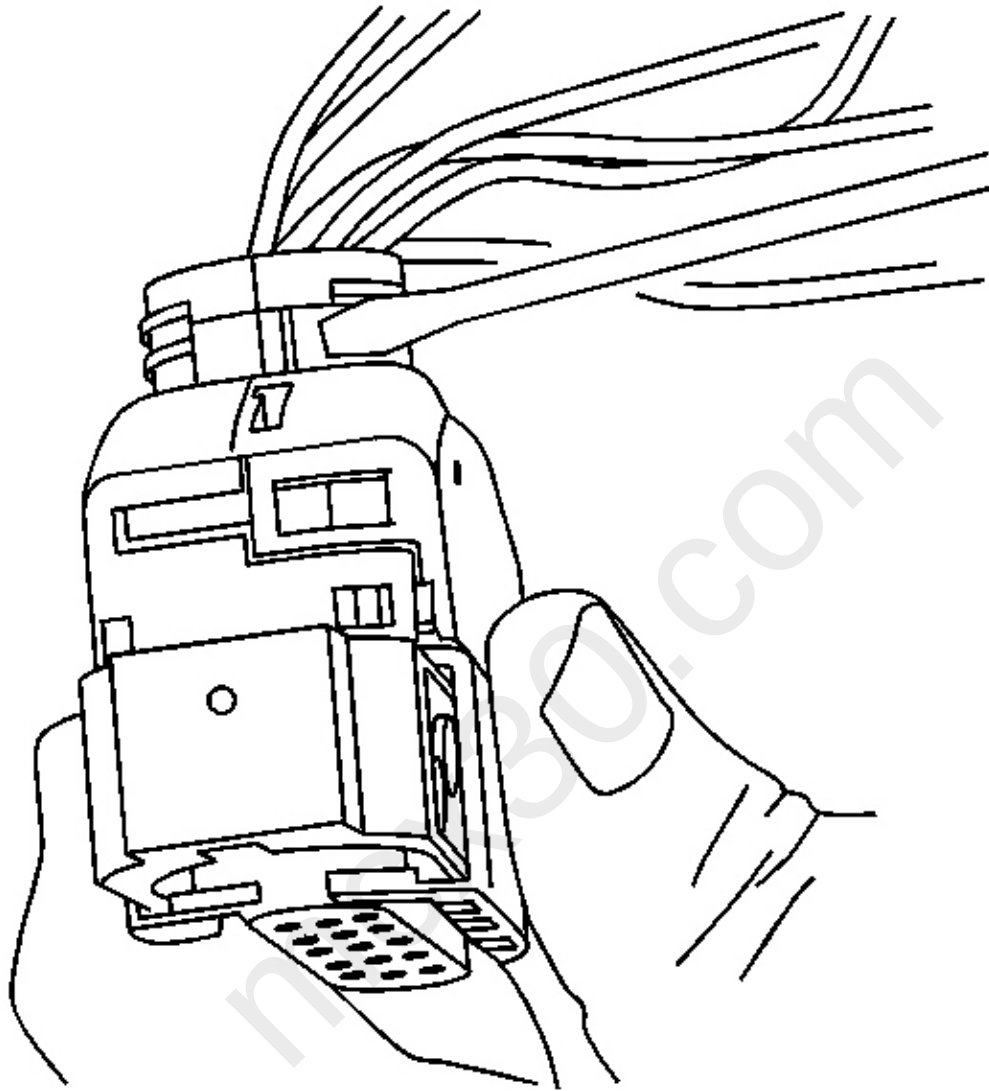


Fig. 90: Identifying Upper Wire Dress Cover Locking Tab
Courtesy of GENERAL MOTORS CORP.

5. Release the upper wire dress cover locking tab.
6. Once the locks are unlocked, lift the dress cover off.

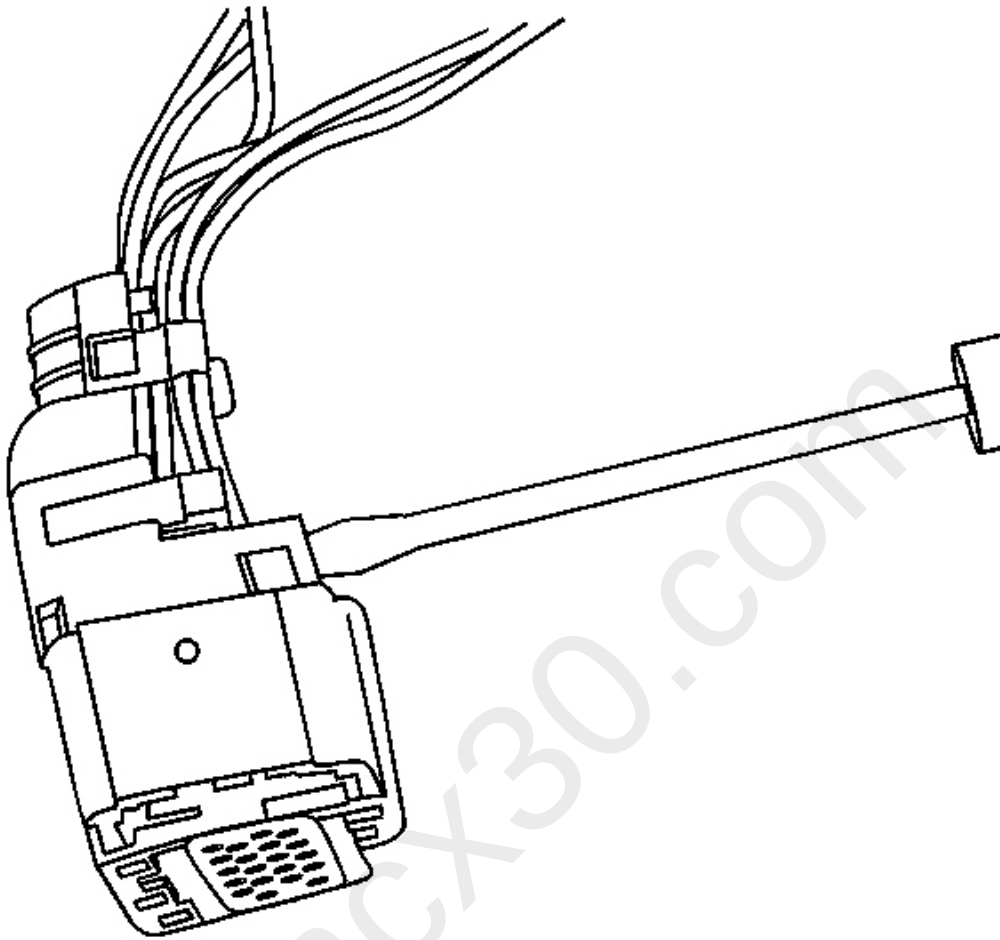


Fig. 91: Prying TPA Out Of Connector
Courtesy of GENERAL MOTORS CORP.

NOTE: Always use care when removing a terminal position assurance (TPA) in order to avoid damaging it.

7. Remove the TPA by inserting a small flat-blade tool into the locking tabs on both sides of the TPA. Gently pry the TPA out of the connector.

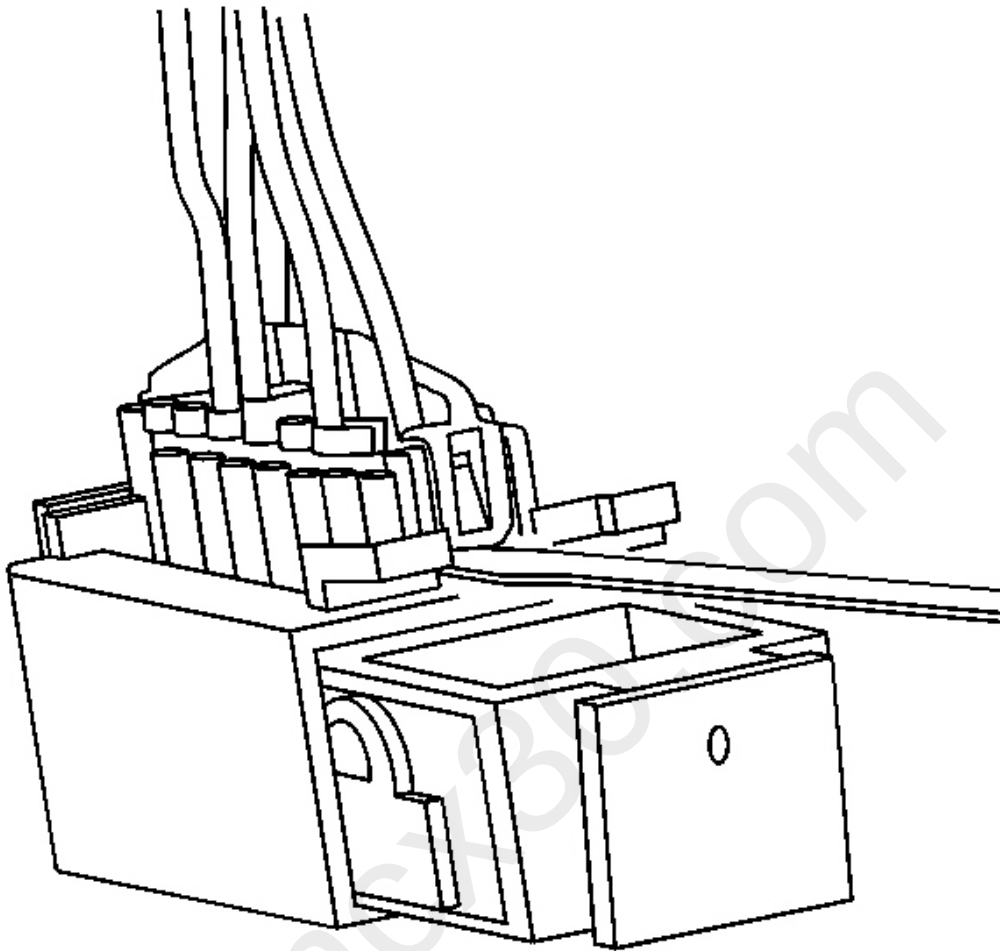


Fig. 92: Removing Nose Piece

Courtesy of GENERAL MOTORS CORP.

8. Remove the nose piece by inserting a small flat-blade tool into the locking tabs on both sides of the nose piece. Gently pry the nose piece out of the connector.

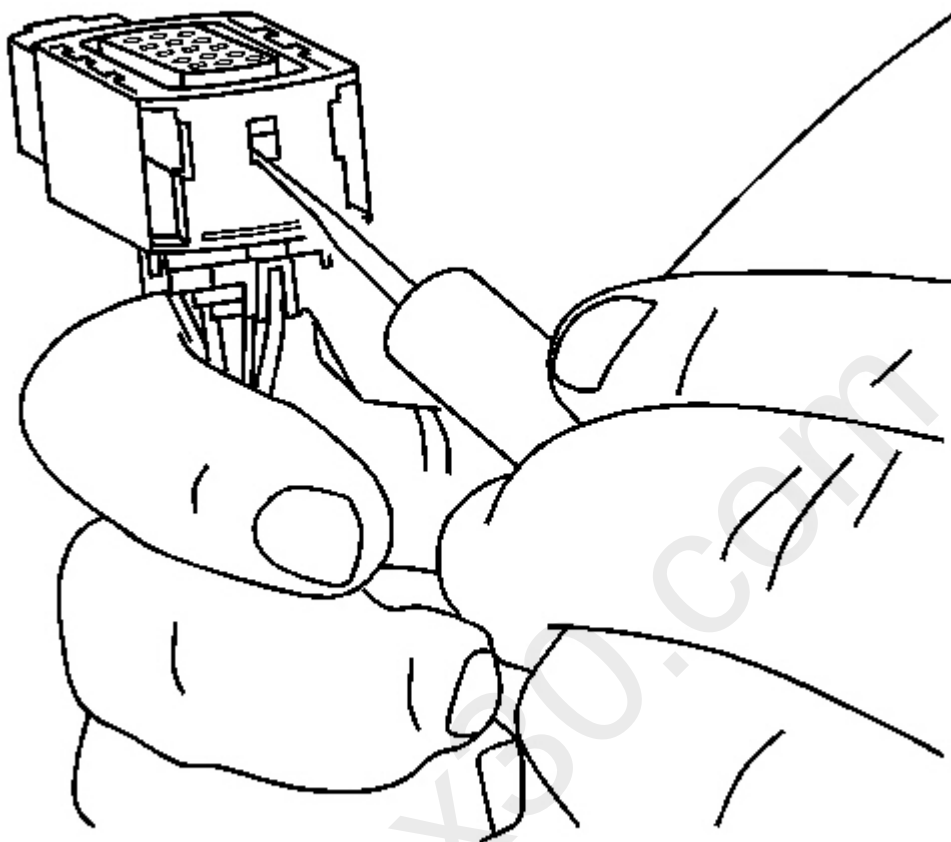


Fig. 93: Inserting J 38125-12A Into Terminal Release Cavity
Courtesy of GENERAL MOTORS CORP.

9. Insert the J 38125-12A tool to release the terminals by inserting the tool into the terminal release cavity. See the release tool cross reference in the Reference Guide of the **J-38125** to ensure that the correct release tool is used.

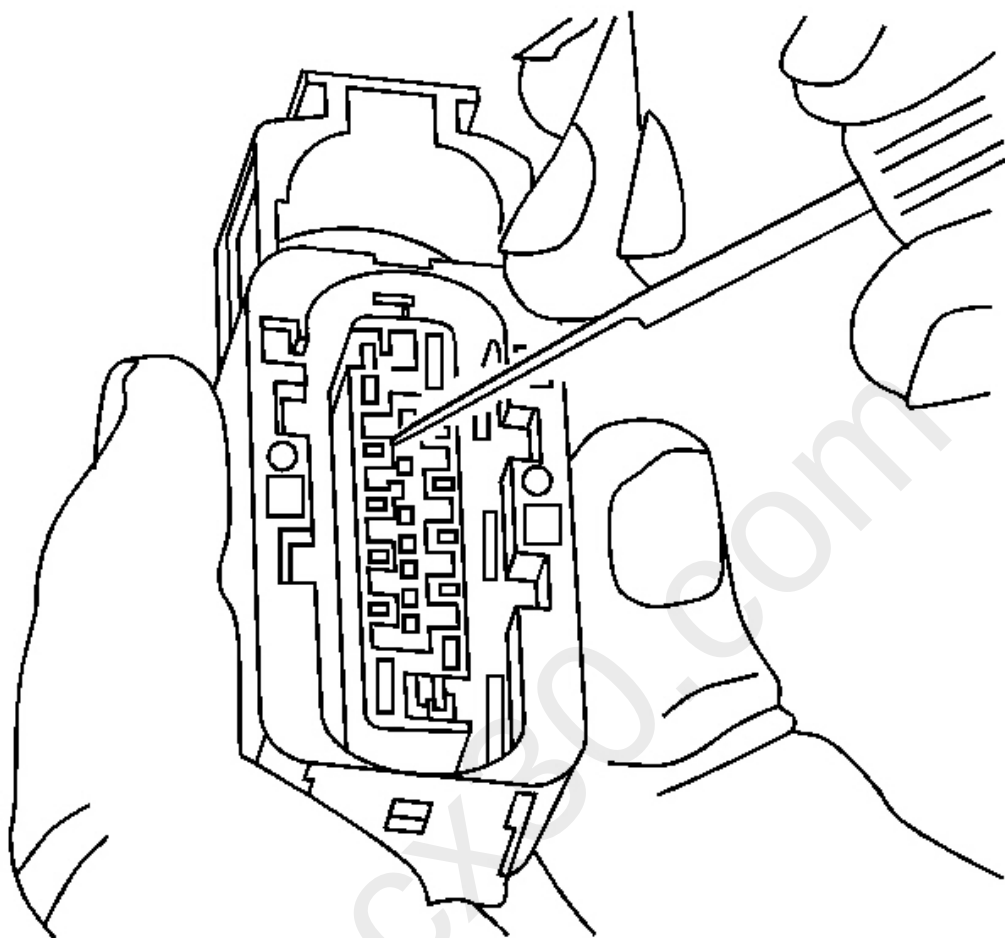


Fig. 94: Pulling Wire Out Of Back Of Connector
Courtesy of GENERAL MOTORS CORP.

10. While holding the removal tool in place, gently pull the wire out of the back of the connector. Always remember never use force when pulling a terminal out of a connector.

Repair Procedure

Use the appropriate terminal and follow the instructions in the **J-38125** .

Location of the terminal in the repair tray and the proper crimp tool can be found in the appropriate connector end view.

DELPHI CONNECTORS (STEERING GEAR)

Removal Procedure

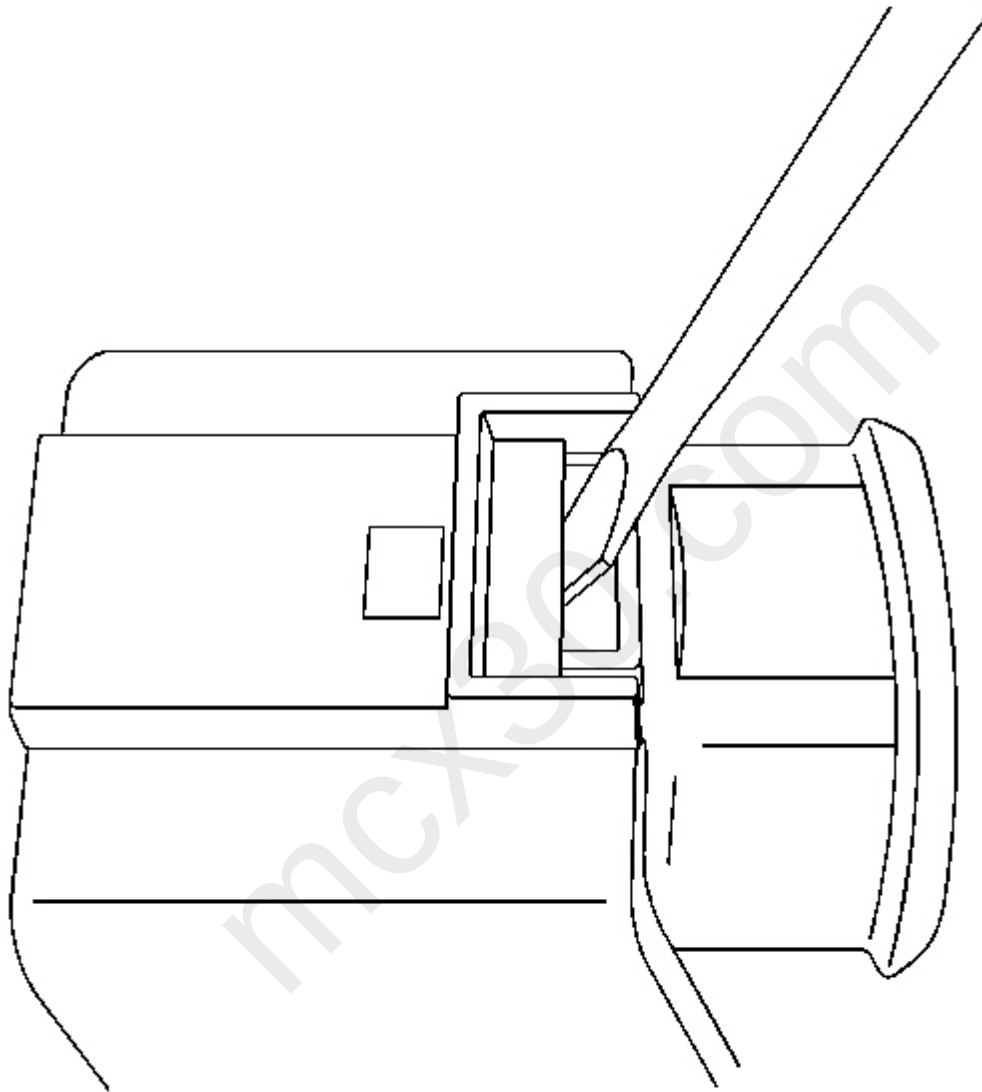


Fig. 95: Releasing Locking Tab On Connector
Courtesy of GENERAL MOTORS CORP.

1. Use a small flat-bladed tool to release the locking tab on the connector.

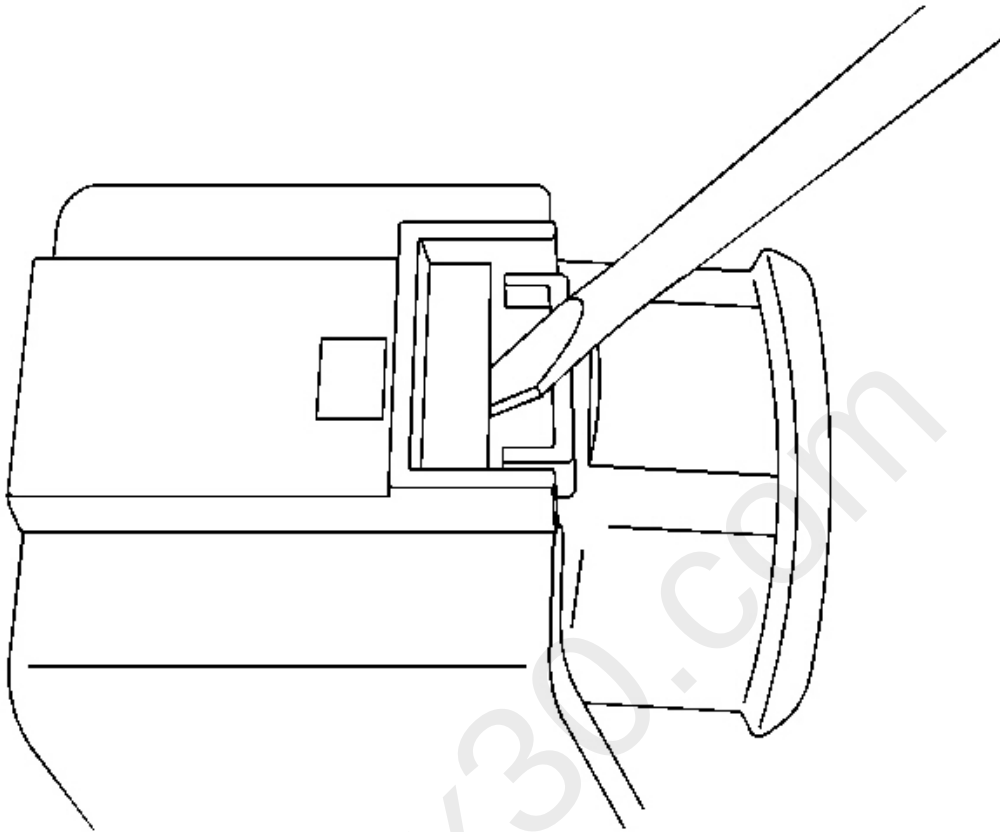


Fig. 96: Releasing Connector
Courtesy of GENERAL MOTORS CORP.

2. Push down the locking tab to release the connector. The small flat-bladed tool may need to be pushed down and angled back slightly to depress the locking tab. Pull on the connector body while releasing the locking tab to disconnect the connector.

FCI CONNECTORS (LEVER LOCK)

Special Tools

J-38125 Terminal Repair Kit

Removal Procedure

Follow the steps below in order to remove terminals from the connector.

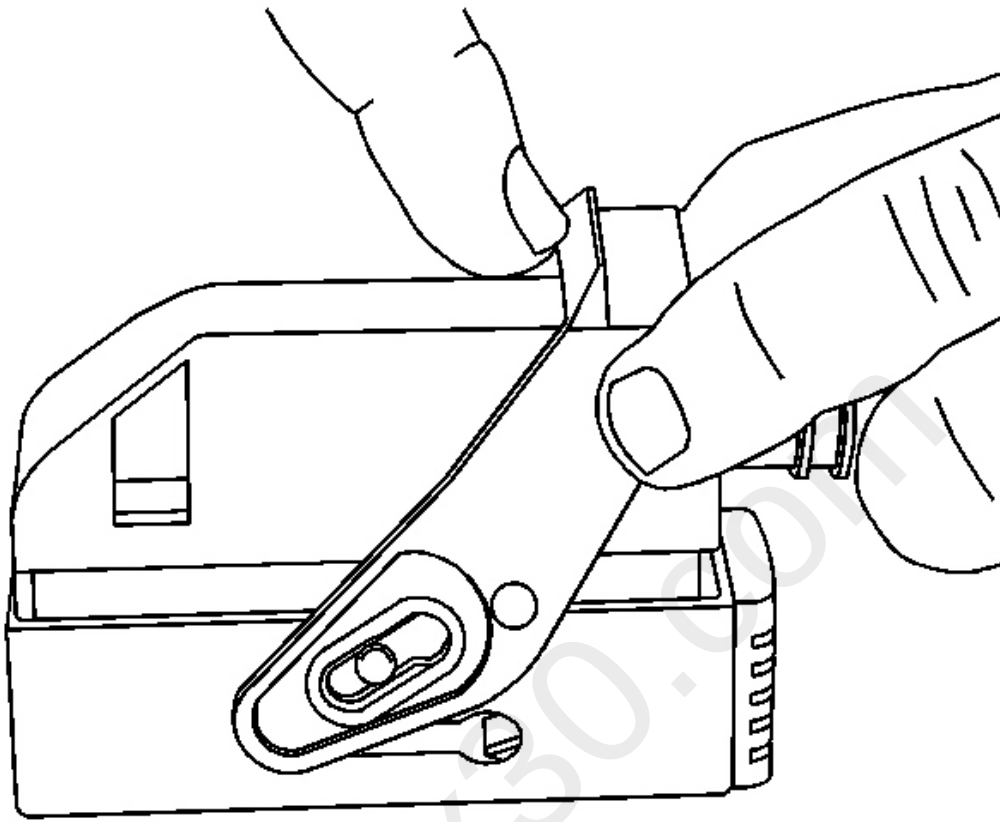


Fig. 97: Identifying Release Tab
Courtesy of GENERAL MOTORS CORP.

1. Slide the lever lock forward while pressing down on the lever lock release tab.
2. The release tab is located on the top of the wiredress cover.

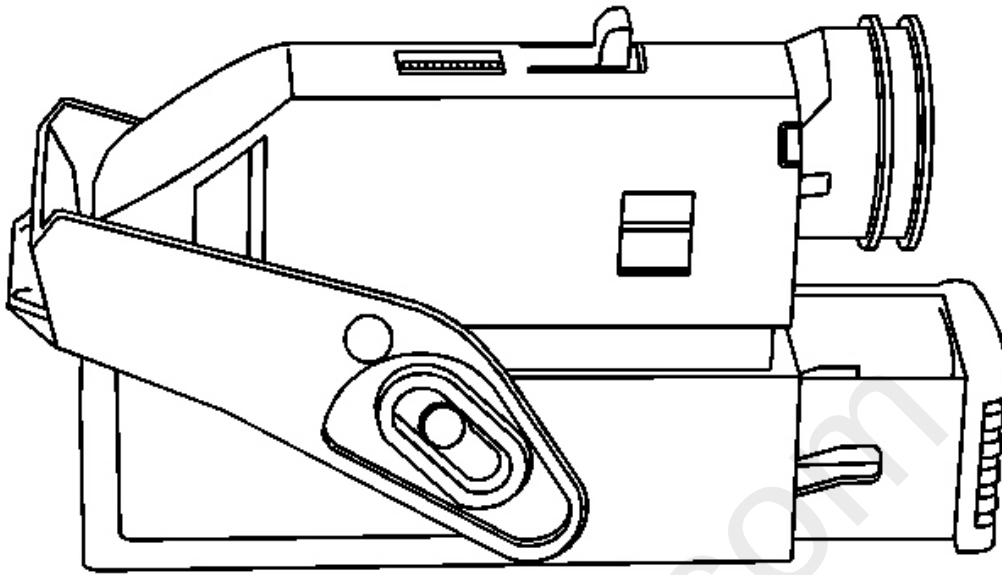


Fig. 98: View Of Connector In Released Position
Courtesy of GENERAL MOTORS CORP.

3. View of connector in released position.
4. Disconnect the connector from the component.
5. Locate the dress cover locking tabs at the corners of the dress cover. Use a small flat-blade tool to release the locking tabs and remove the dress cover.

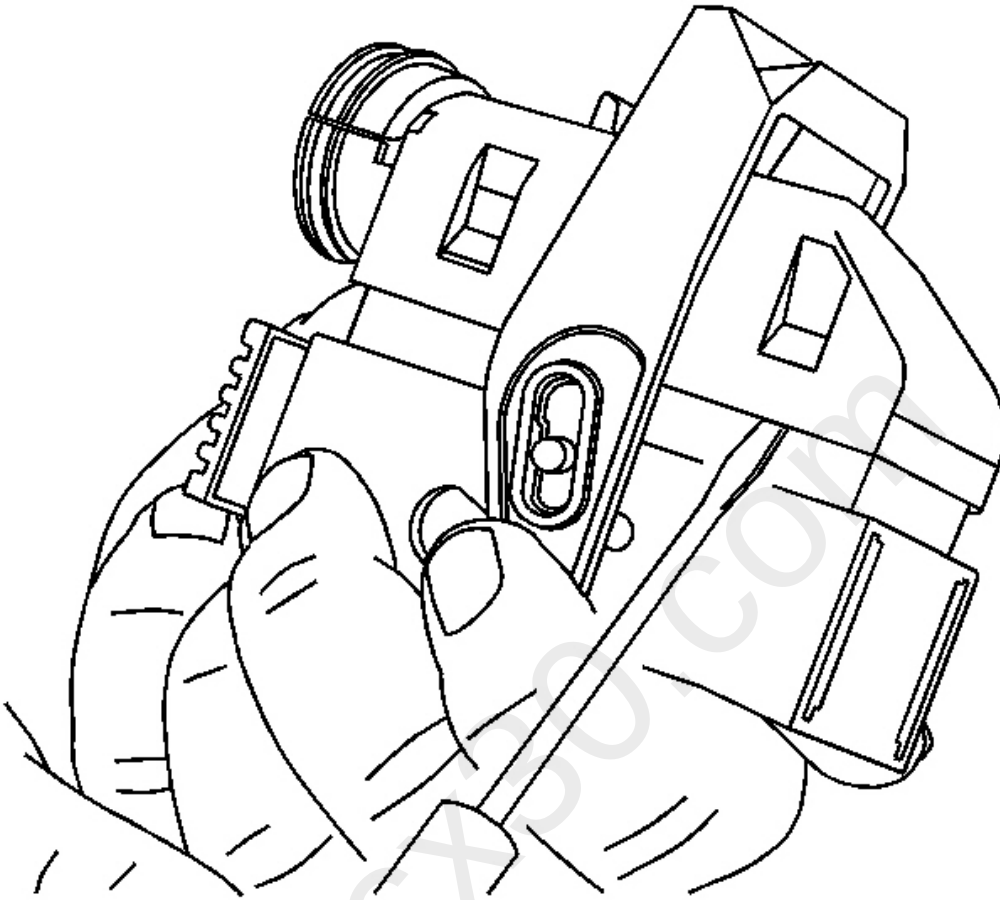


Fig. 99: View Of Sliding Terminal Position Assurance (TPA) Up One Notch
Courtesy of GENERAL MOTORS CORP.

6. Use a small flat-blade tool to slide the terminal position assurance (TPA) up one notch on both ends of the connector. The TPA is located underneath the wire dress cover.

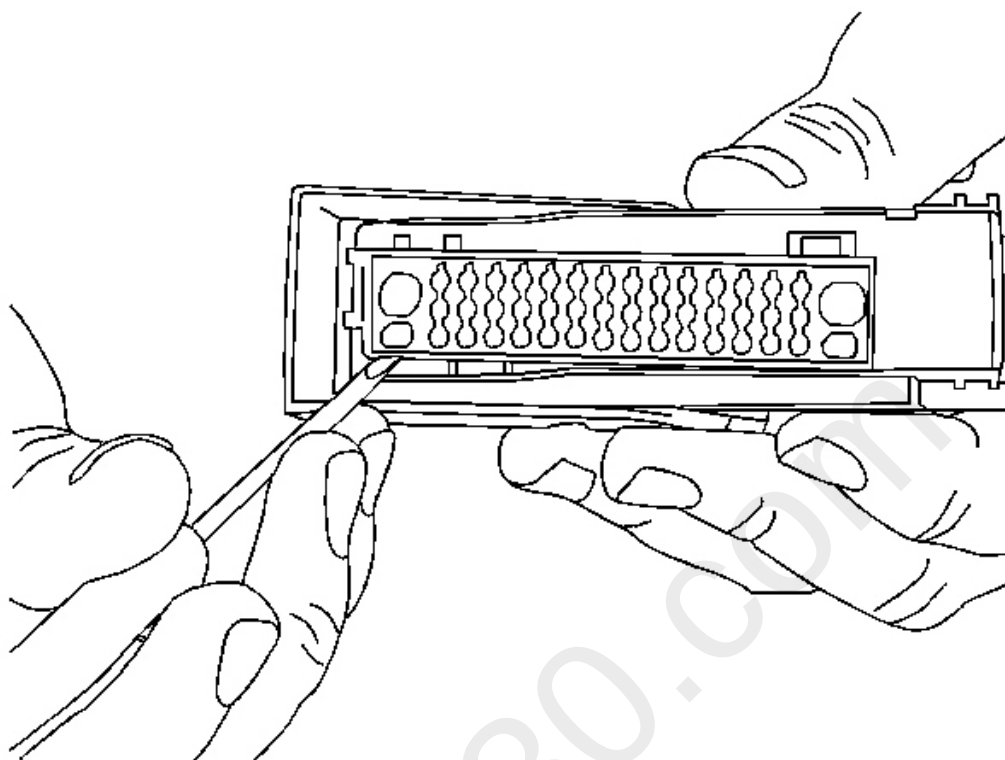


Fig. 100: View Of Releasing Terminals
Courtesy of GENERAL MOTORS CORP.

For the larger terminals insert the J 38125-556 tool to release the terminals by inserting the tool into the terminal release cavity. For the smaller terminals insert the J 38125-560 tool to release the terminals by inserting the tool into the terminal release cavity. See the release tool cross reference in the Reference Guide of the **J-38125** to ensure that the correct release tool is used.

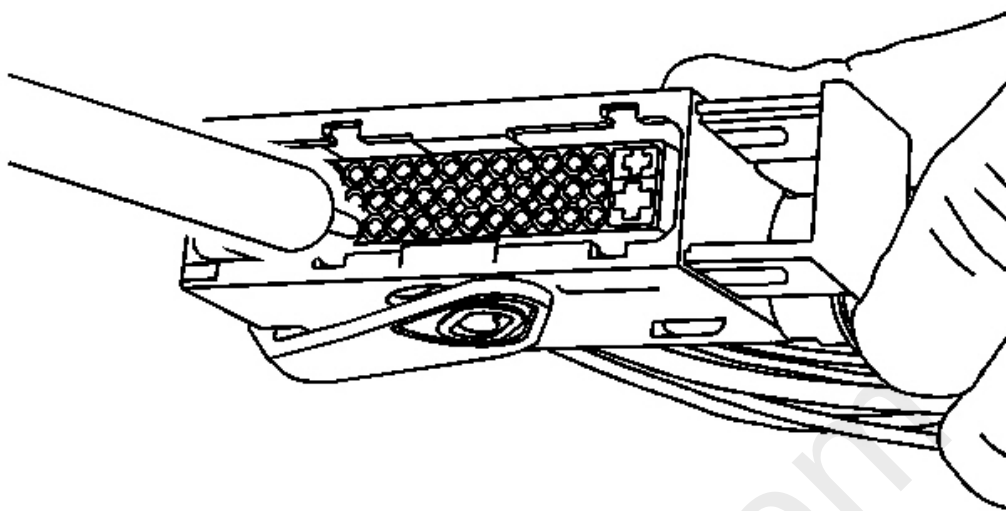


Fig. 101: Holding Removal Tool In Place
Courtesy of GENERAL MOTORS CORP.

7. While holding the removal tool in place, gently pull the wire out of the back of the connector. Always remember never use force when pulling a terminal out of a connector.

Repair Procedure

Use the appropriate terminal and follow the instructions in the **J-38125** .

Location of the terminal in the repair tray and the proper crimp tool can be found in the appropriate connector end view.

FCI CONNECTORS (SIR)

Removal Procedure

NOTE: **The orange CPA must be released first to disconnect or to connect the connector.**

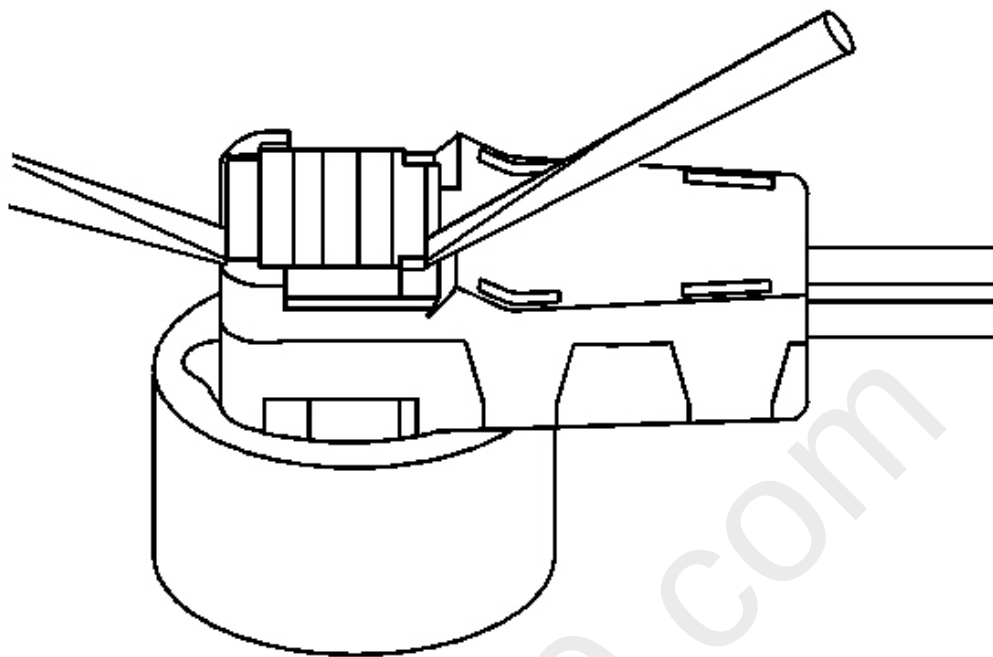


Fig. 102: Lifting Orange CPA

Courtesy of GENERAL MOTORS CORP.

1. Lift the orange CPA vertically (avoid lifting on an angle to the connector) approximately 4 mm to release the connector. Use a small flat-bladed tool to help release the orange CPA. The orange CPA can also be released manually without any tools.

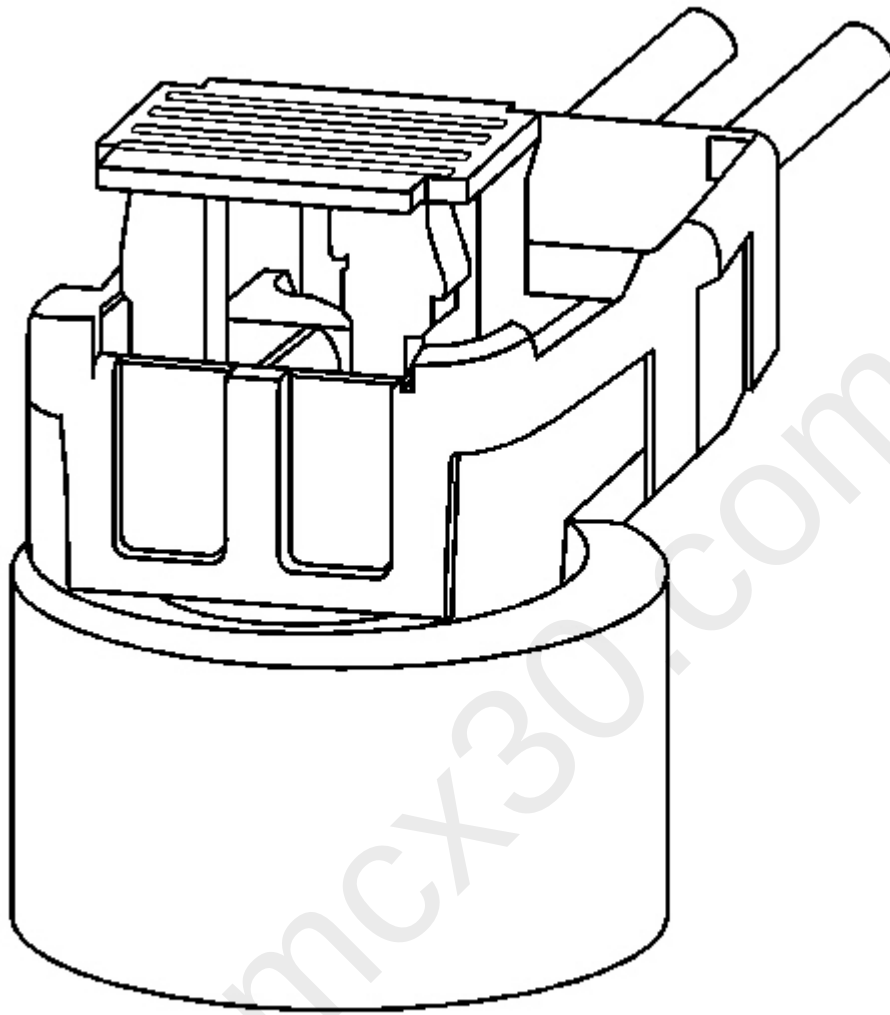


Fig. 103: Disconnecting Connector
Courtesy of GENERAL MOTORS CORP.

2. Grab the connector on both sides and lift the connector vertically to disconnect the connector.

Installation Procedure

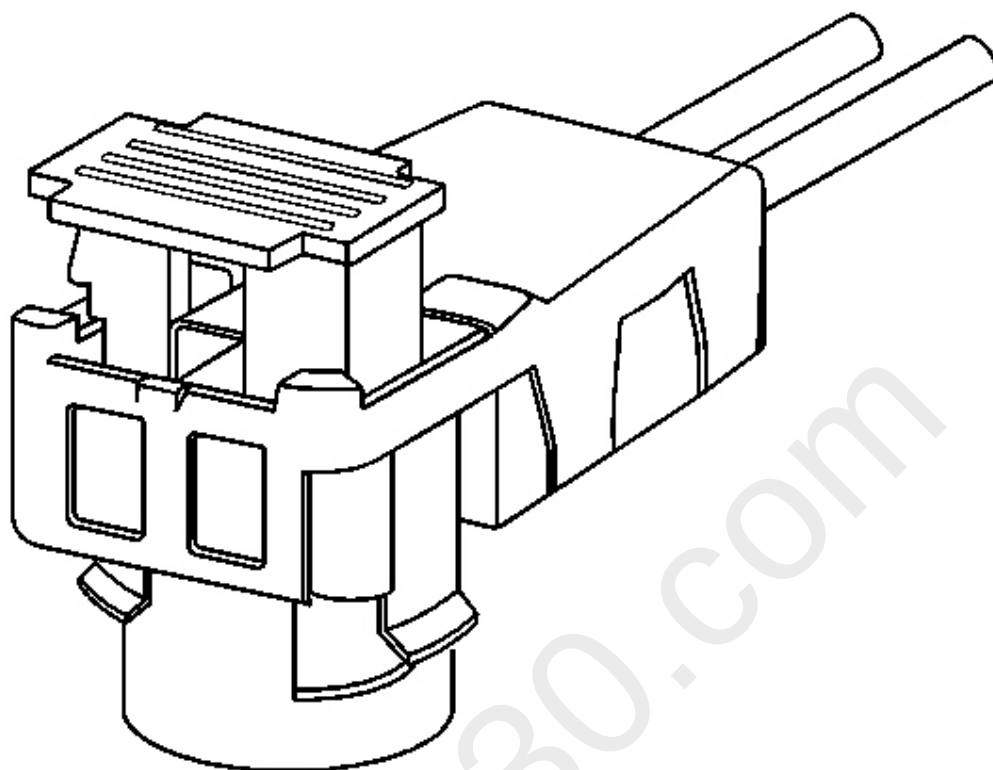


Fig. 104: Lifting Orange CPA
Courtesy of GENERAL MOTORS CORP.

1. Lift the orange CPA vertically approximately 4 mm before installing the connector. Use a small flat-bladed tool to help release the orange CPA. The orange CPA can also be released manually without any tools.

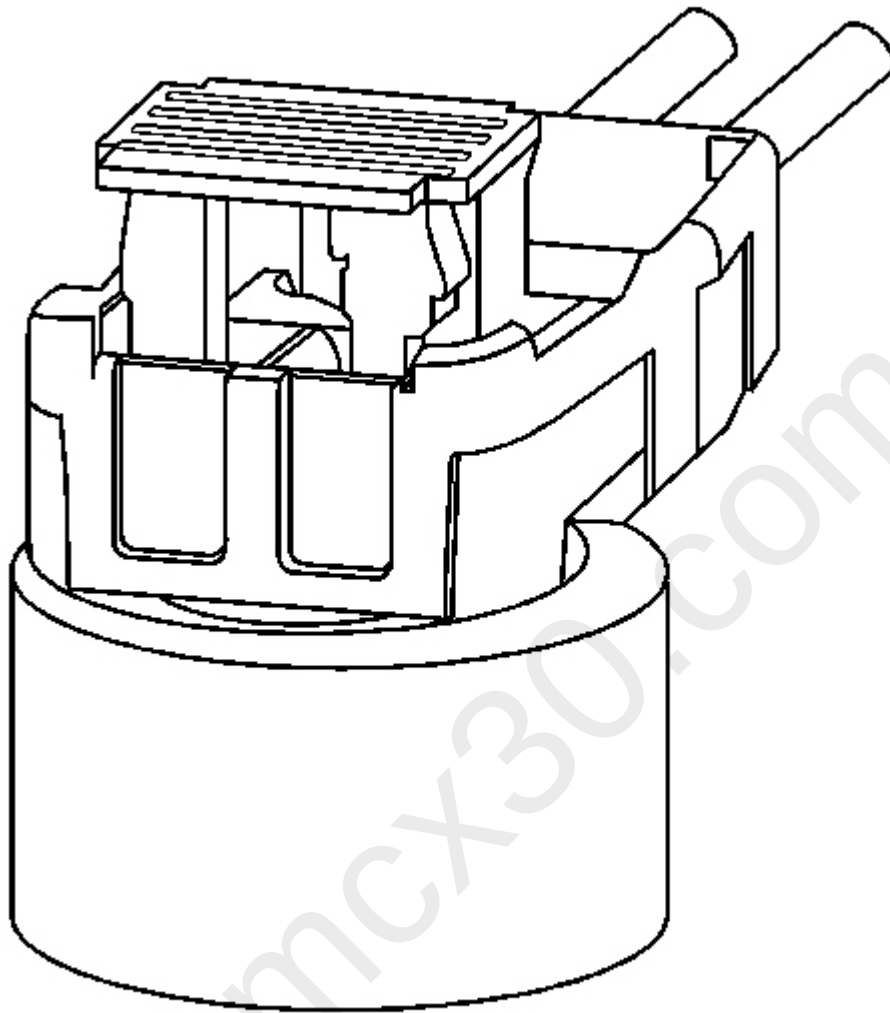


Fig. 105: Disconnecting Connector
Courtesy of GENERAL MOTORS CORP.

2. Line up the connector key tabs with the initiator key slots. Grab the connector on both sides and push the connector down into the initiator connector sub assembly until fully seated.

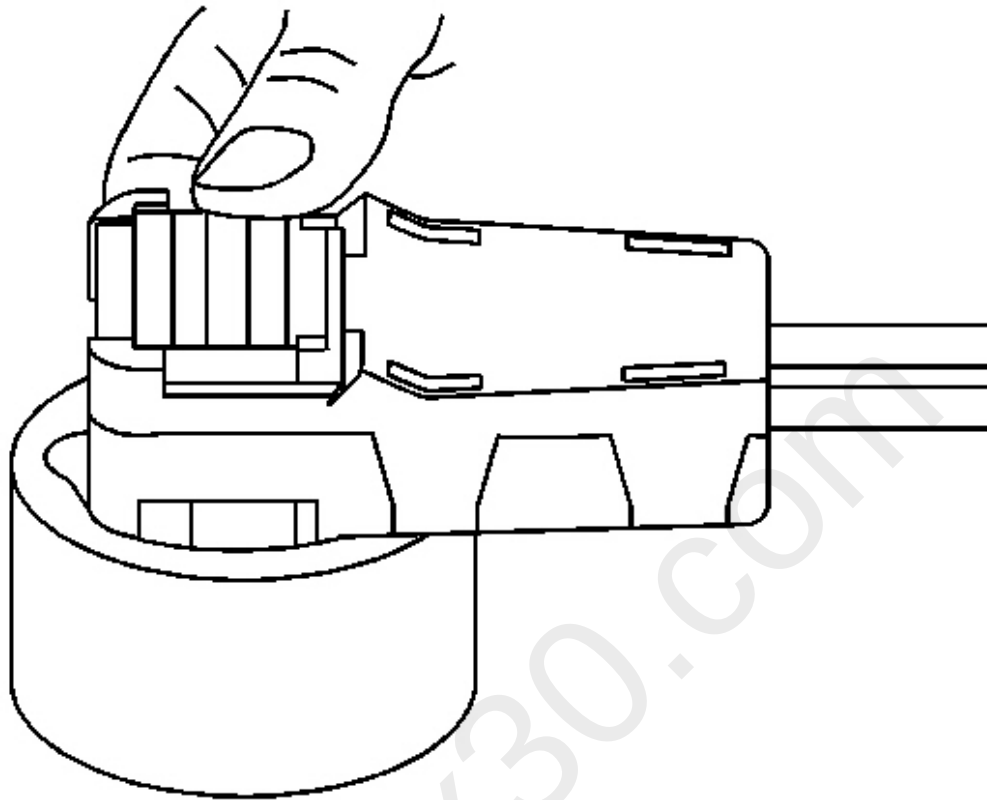


Fig. 106: Pushing Down Orange CPA
Courtesy of GENERAL MOTORS CORP.

3. After the connector is fully seated, push down the orange CPA with your thumb. Push down until the orange CPA is touching the yellow cover on the connector.

FEP CONNECTORS (STEERING GEAR)

Removal Procedure

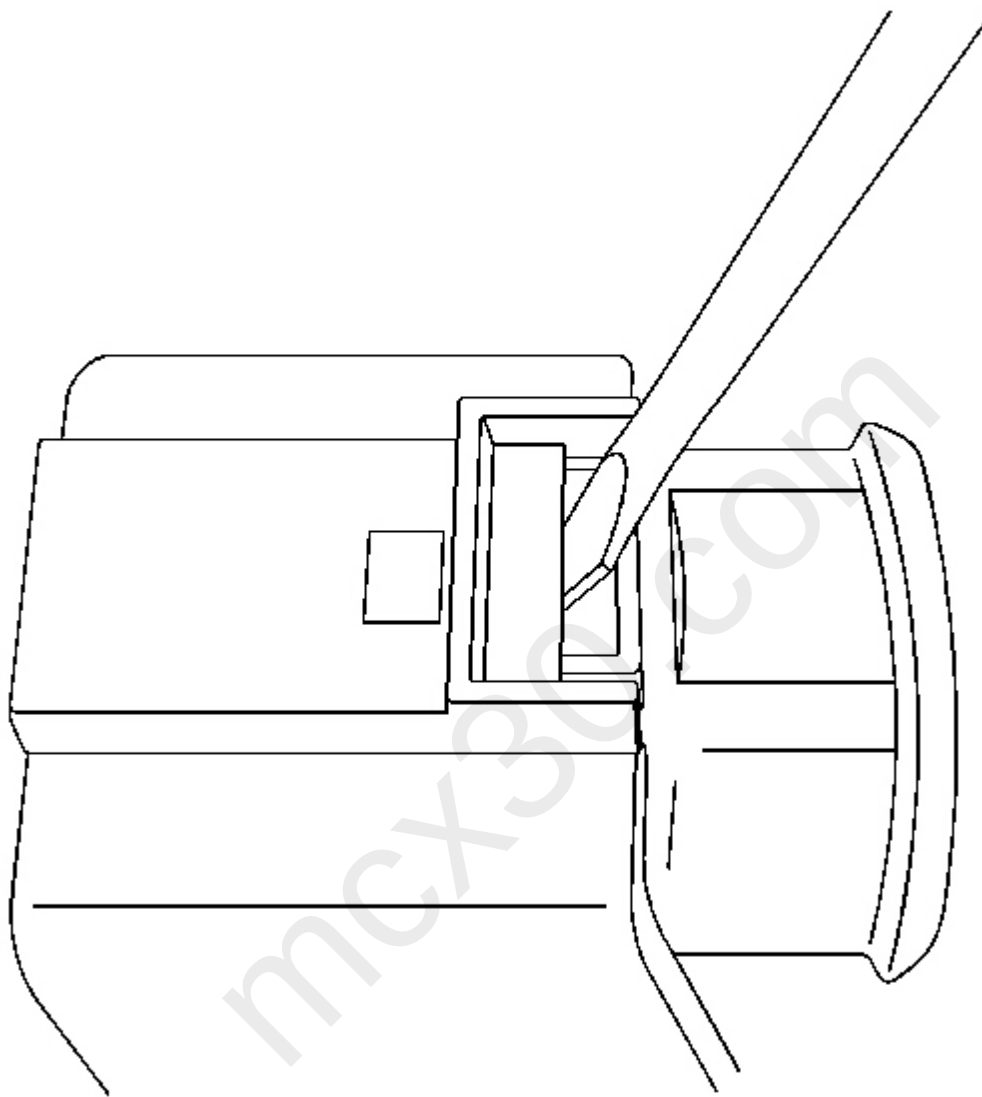


Fig. 107: Releasing Locking Tab On Connector
Courtesy of GENERAL MOTORS CORP.

1. Use a small flat-bladed tool to release the locking tab on the connector.

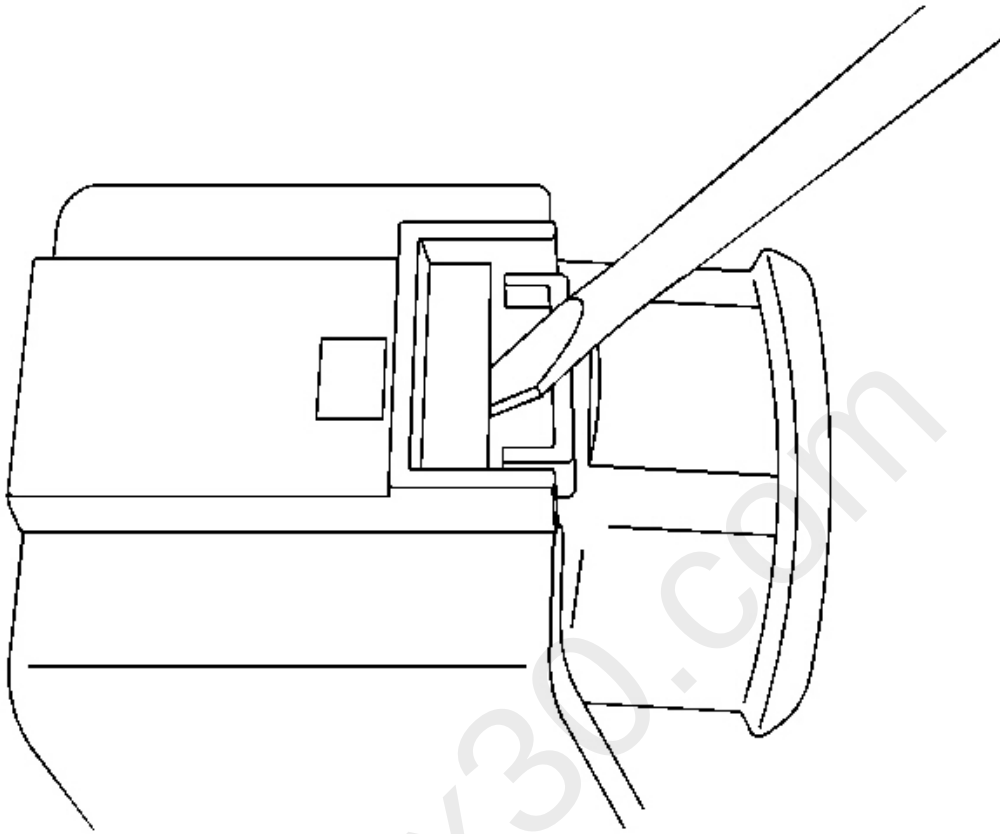


Fig. 108: Releasing Connector
Courtesy of GENERAL MOTORS CORP.

2. Push down the locking tab to release the connector. The small flat-bladed tool may need to be pushed down and angled back slightly to depress the locking tab. Pull on the connector body while releasing the locking tab to disconnect the connector.

JST CONNECTORS

Special Tools

J-38125 Terminal Repair Kit

Removal Procedure

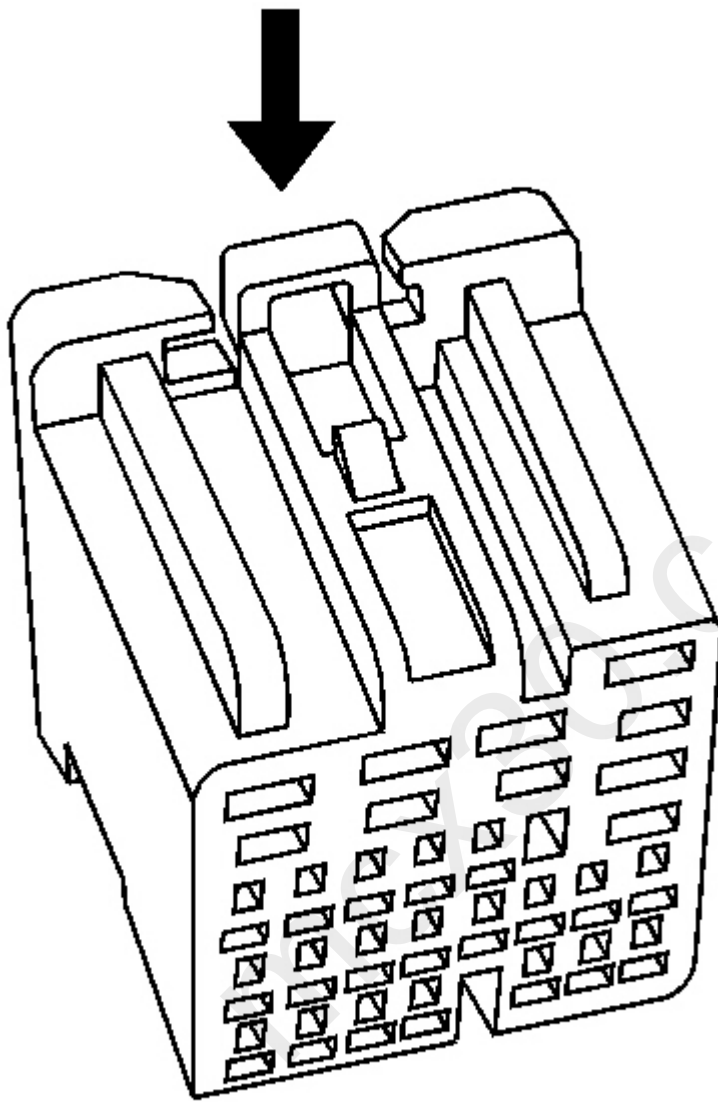


Fig. 109: Locating Connector Lock
Courtesy of GENERAL MOTORS CORP.

1. While depressing the lock, remove the connector from the component.

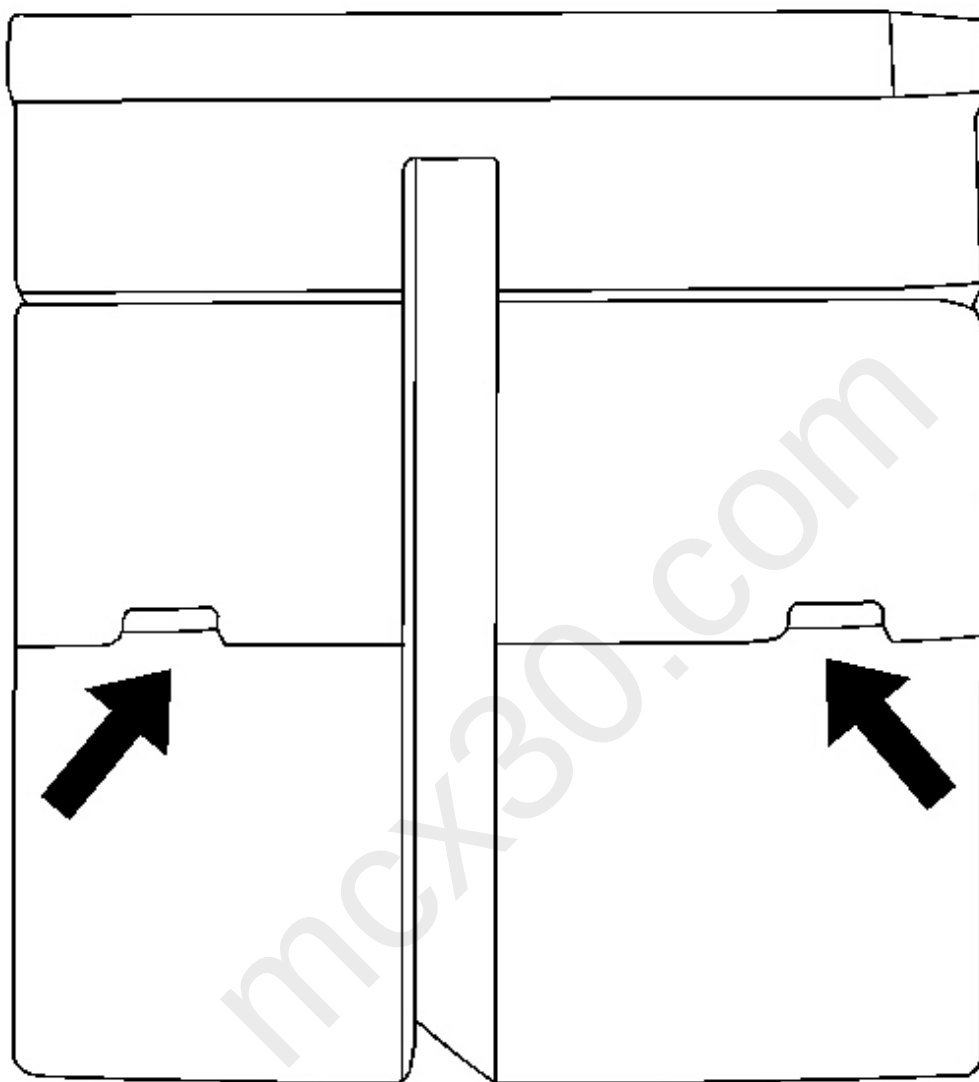


Fig. 110: Identifying TPA On Both Sides Of Connector
Courtesy of GENERAL MOTORS CORP.

2. Locate the two indents of the terminal position assurance (TPA) located on the bottom of the connector body.

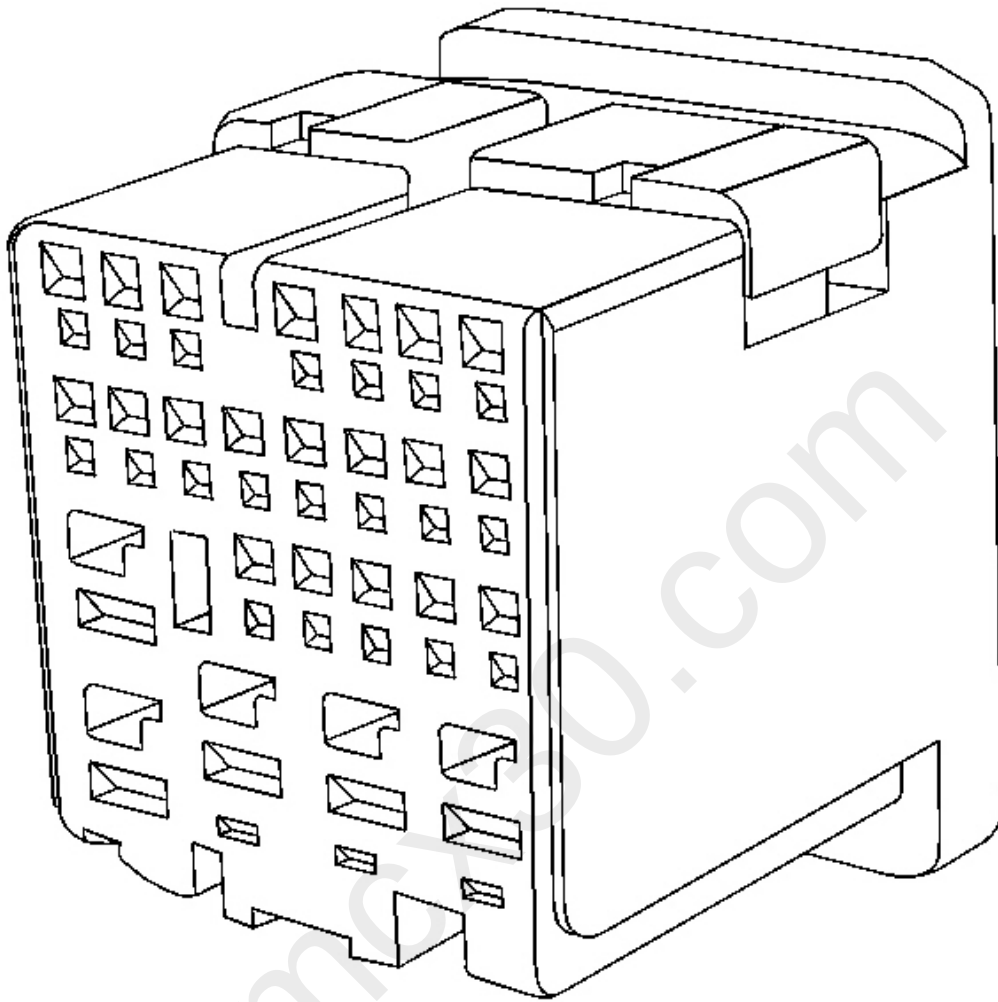


Fig. 111: Raising TPA On Both Sides Of Connector
Courtesy of GENERAL MOTORS CORP.

NOTE: The TPA cannot be removed from the connector while there are terminals present in the connector body.

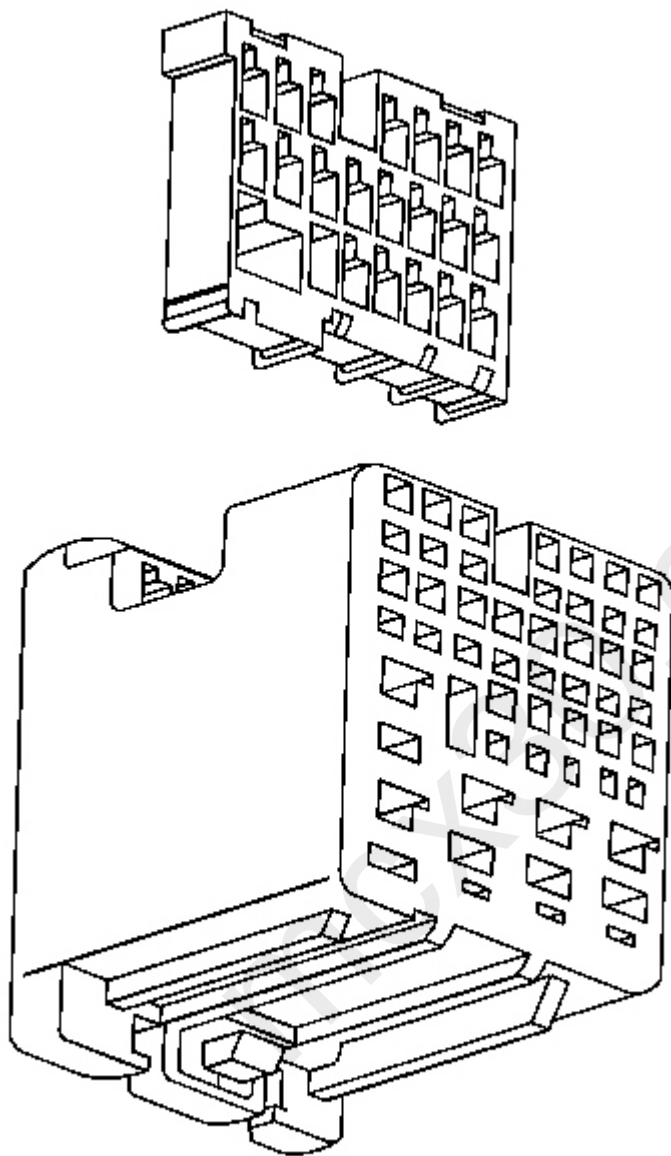


Fig. 112: View Of TPA Removed From Connector Body
Courtesy of GENERAL MOTORS CORP.

3. Use a small flat-blade tool to very carefully raise the TPA on both sides of the connector.
4. View of the TPA when removed from the connector body.

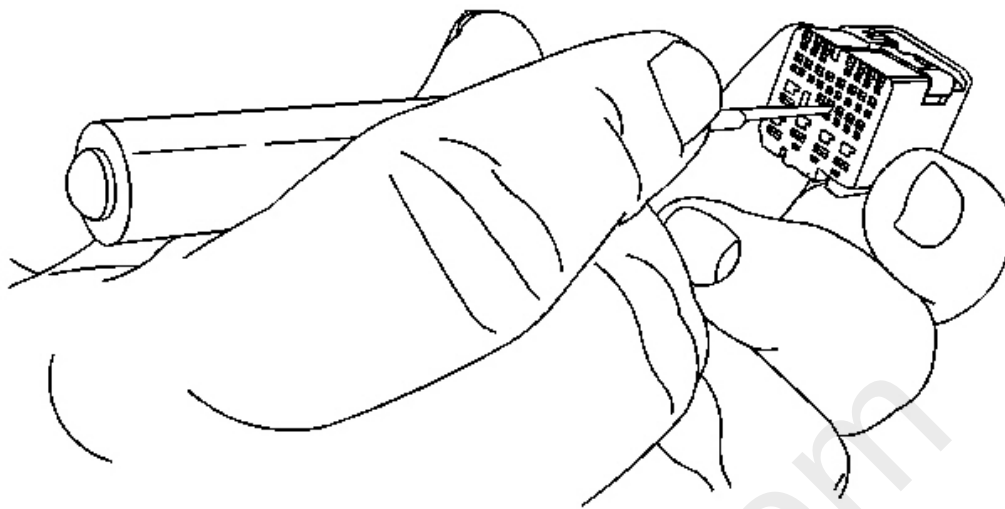


Fig. 113: Pulling Wire Out Of Back Of Connector
Courtesy of GENERAL MOTORS CORP.

5. Use the J 38125-12A tool to release the terminals by inserting the tool into the left side of the terminal release cavity as shown in the graphic. Use the tool to move the terminal release to the right with a gentle prying motion. See the release tool cross reference in the Reference Guide of the **J-38125** to ensure that the correct release tool is used.
6. While holding the removal tool in place, gently pull the wire out of the back of the connector. Always remember never use force when pulling a terminal out of a connector.

Repair Procedure

Use the appropriate terminal and follow the instructions in the **J-38125** .

Location of the terminal in the repair tray and the proper crimp tool can be found in the appropriate connector end view.

KOSTAL CONNECTORS (GLOW PLUG CONTROL MODULE)

Special Tools

J-38125 Terminal Repair Kit

Removal Procedure

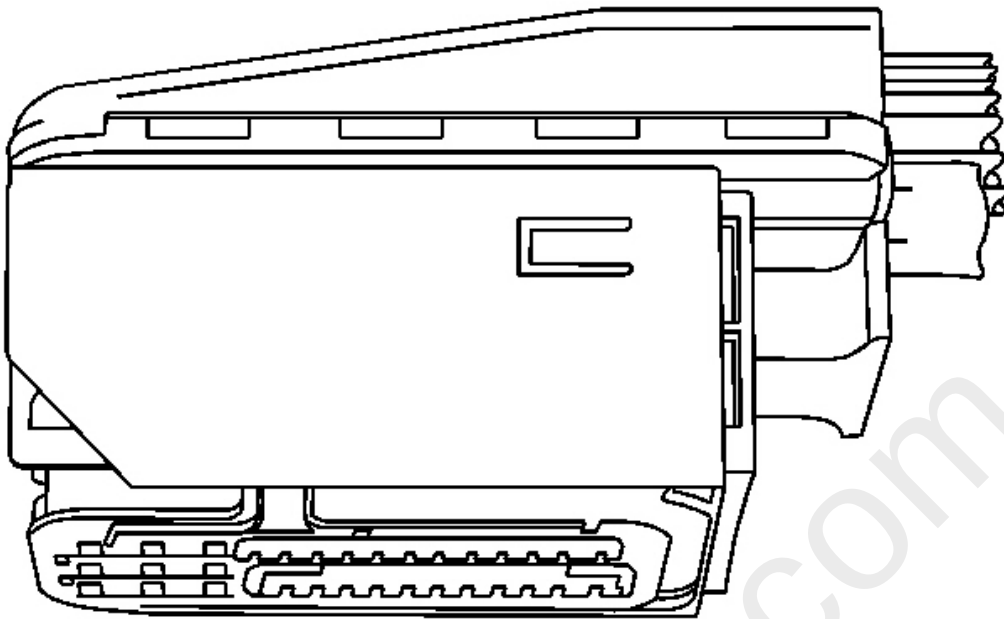


Fig. 114: View Of Typical Kostal Connector
Courtesy of GENERAL MOTORS CORP.

View of typical connector.

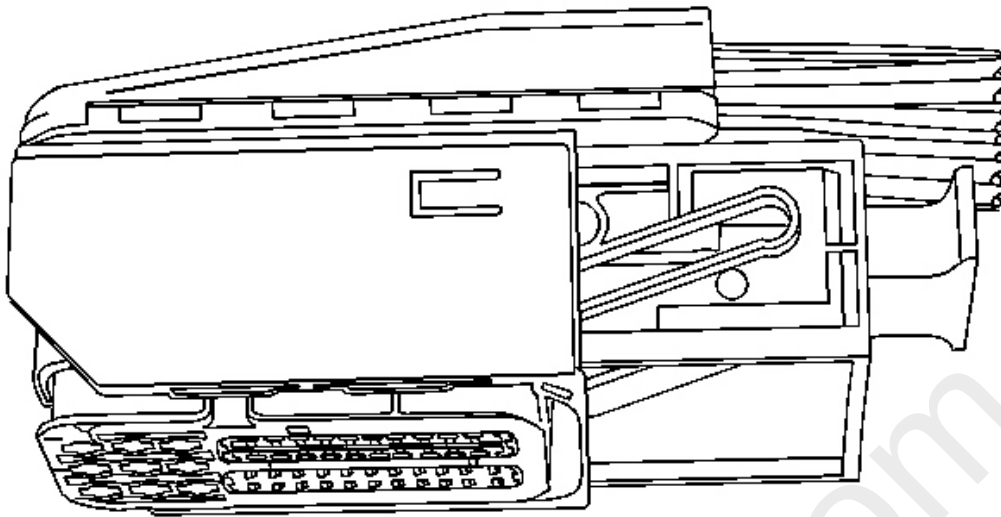


Fig. 115: View Of Connector In Released Position
Courtesy of GENERAL MOTORS CORP.

View of connector in released position.

1. Locate the assist lever at the back of the connector. Move the assist lever to the rear position.
2. Disconnect the connector from the component.

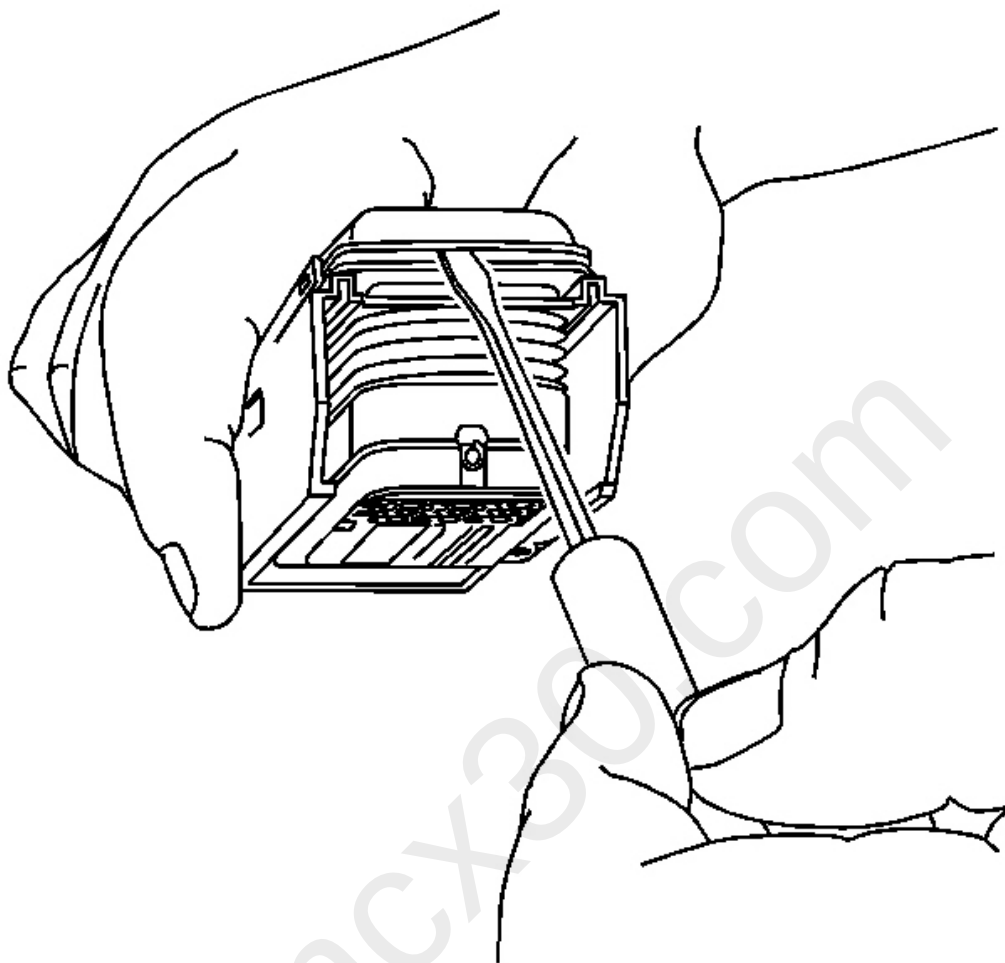


Fig. 116: Removing Dress Cover
Courtesy of GENERAL MOTORS CORP.

3. Use a small flat-blade tool to remove the dress cover.

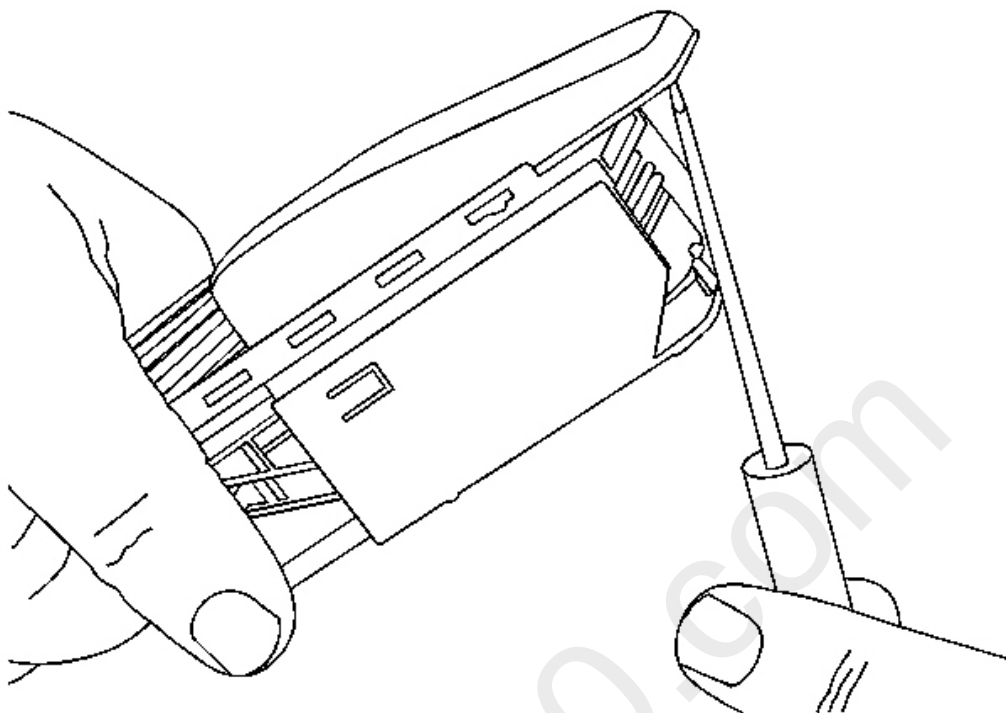


Fig. 117: Sliding Dress Cover Forward & Off Of Connector
Courtesy of GENERAL MOTORS CORP.

4. Slide the dress cover forward and off of the connector.

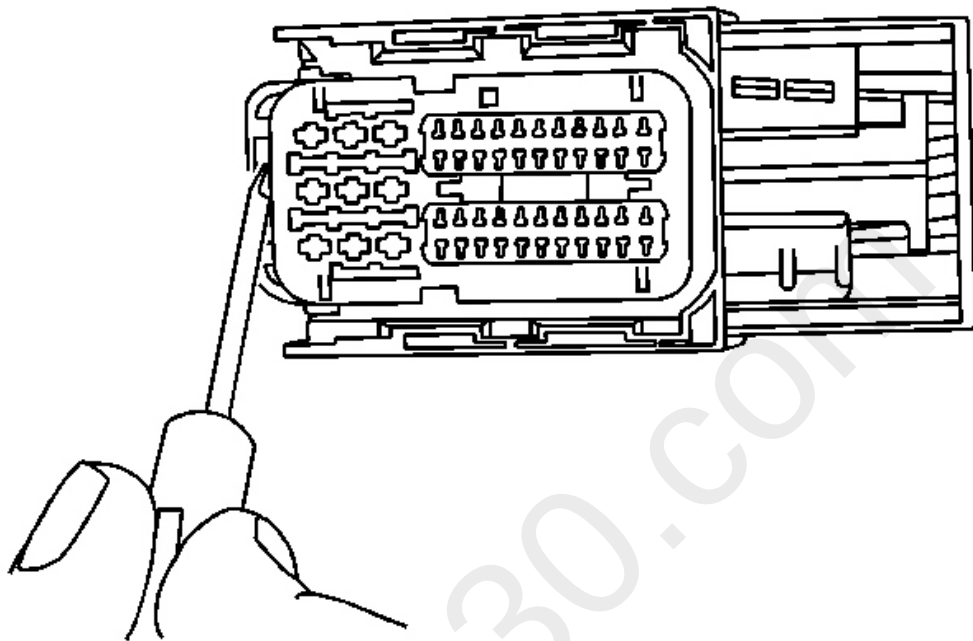


Fig. 118: Locating TPA In Front & Rear Of Connector
Courtesy of GENERAL MOTORS CORP.

5. The terminal positive assurance (TPA) is located in the front and rear of the connector.

NOTE: **The front TPA cannot be removed from the connector. Only move it to the preset position.**

6. Use a small flat-blade tool to move the front TPA to the preset position, outboard approximately 0.125 in. (3 mm).

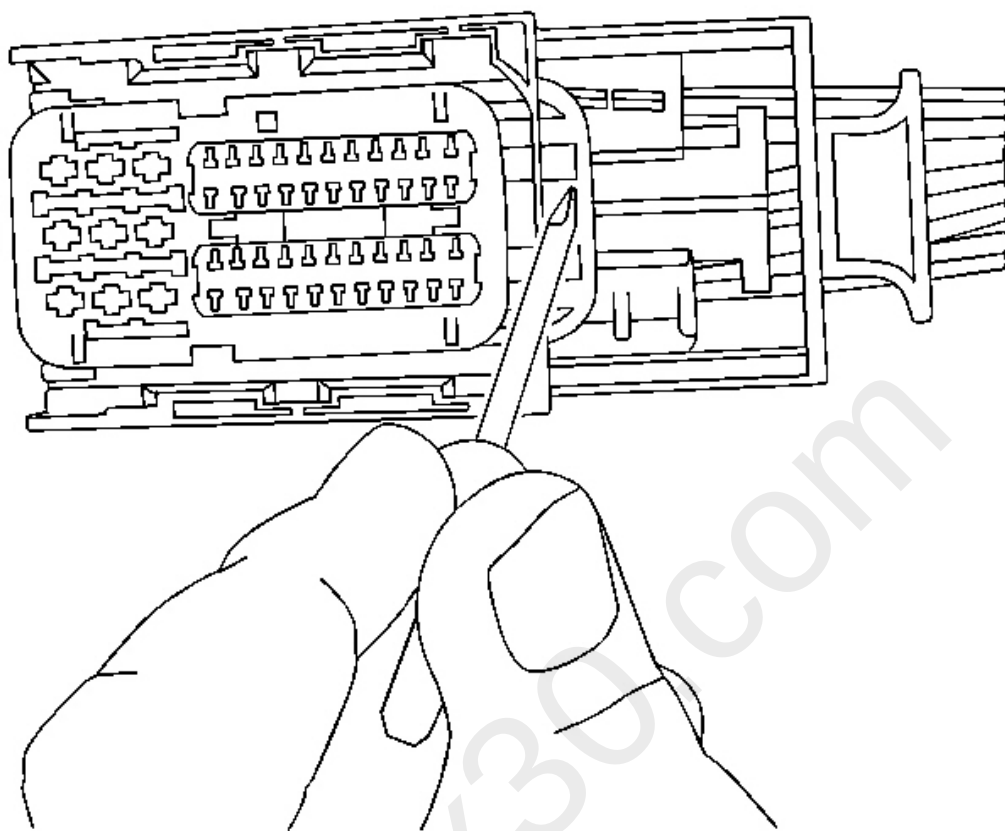


Fig. 119: Removing Rear TPA
Courtesy of GENERAL MOTORS CORP.

7. Use a small flat-blade tool to completely remove the rear TPA from the connector.

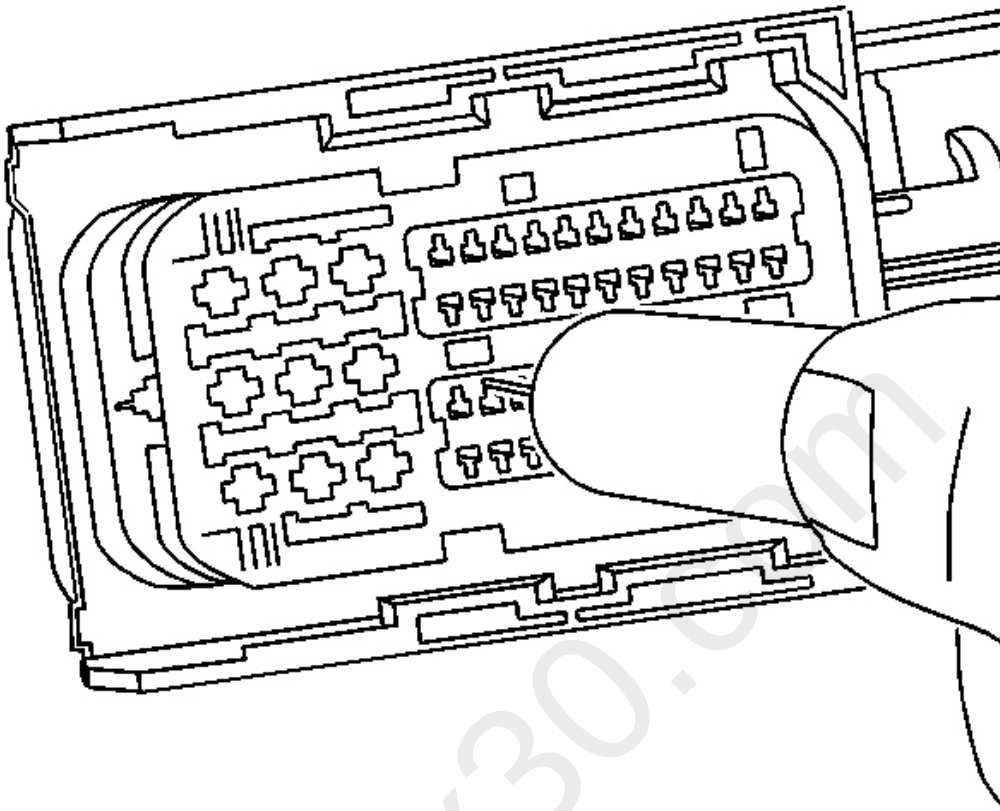


Fig. 120: Releasing Terminals
Courtesy of GENERAL MOTORS CORP.

8. Use the J 38125-24 or the J 38125-560 tool to release the terminals by inserting the tool into the terminal release cavity. See the release tool cross reference in the Reference Guide of the **J-38125** to ensure that the correct release tool is used.
9. While holding the removal tool in place, gently pull the wire out of the back of the connector. Always remember never use force when pulling a terminal out of a connector.

Repair Procedure

Use the appropriate terminal and follow the instructions in the **J-38125** .

Location of the terminal in the repair tray and the proper crimp tool can be found in the appropriate connector end view.

KOSTAL CONNECTORS (TRANSMISSION)

Special Tools

J-38125 Terminal Repair Kit

Removal Procedure

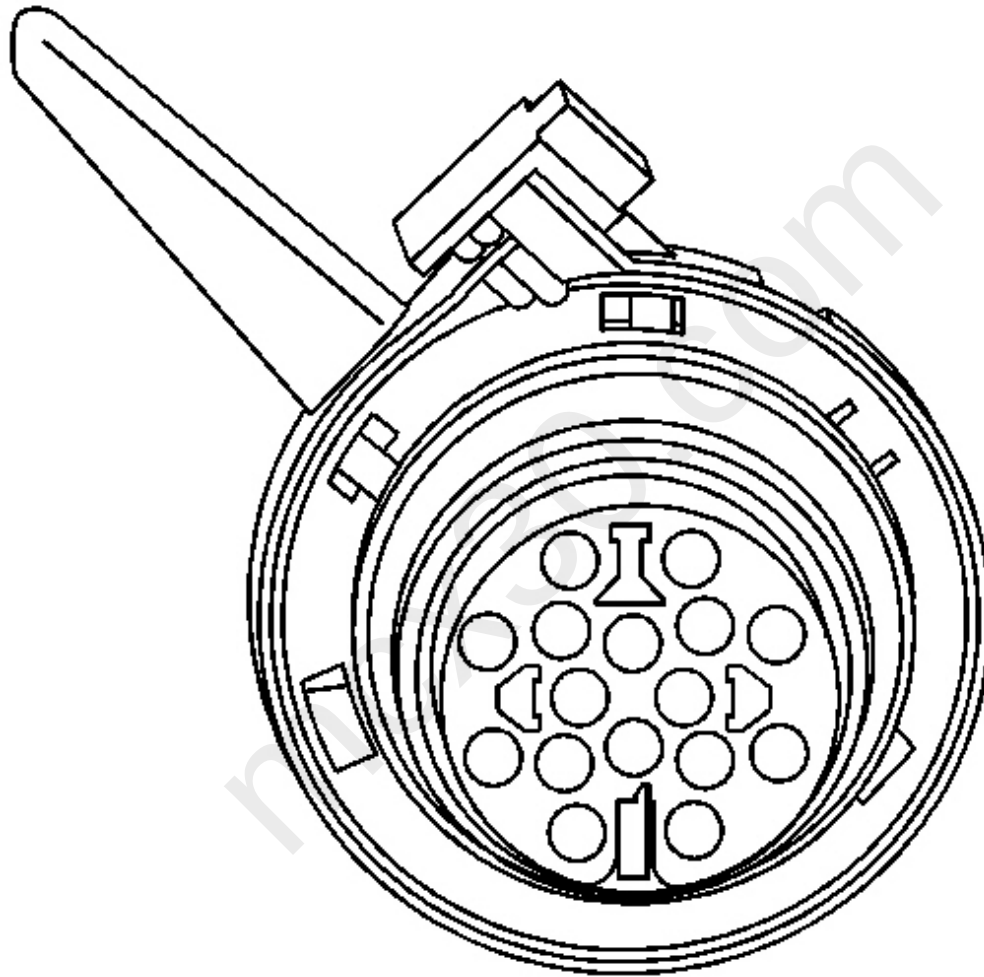


Fig. 121: View Of Connector & Lock
Courtesy of GENERAL MOTORS CORP.

1. While depressing the lock, twist and remove the connector from the component.

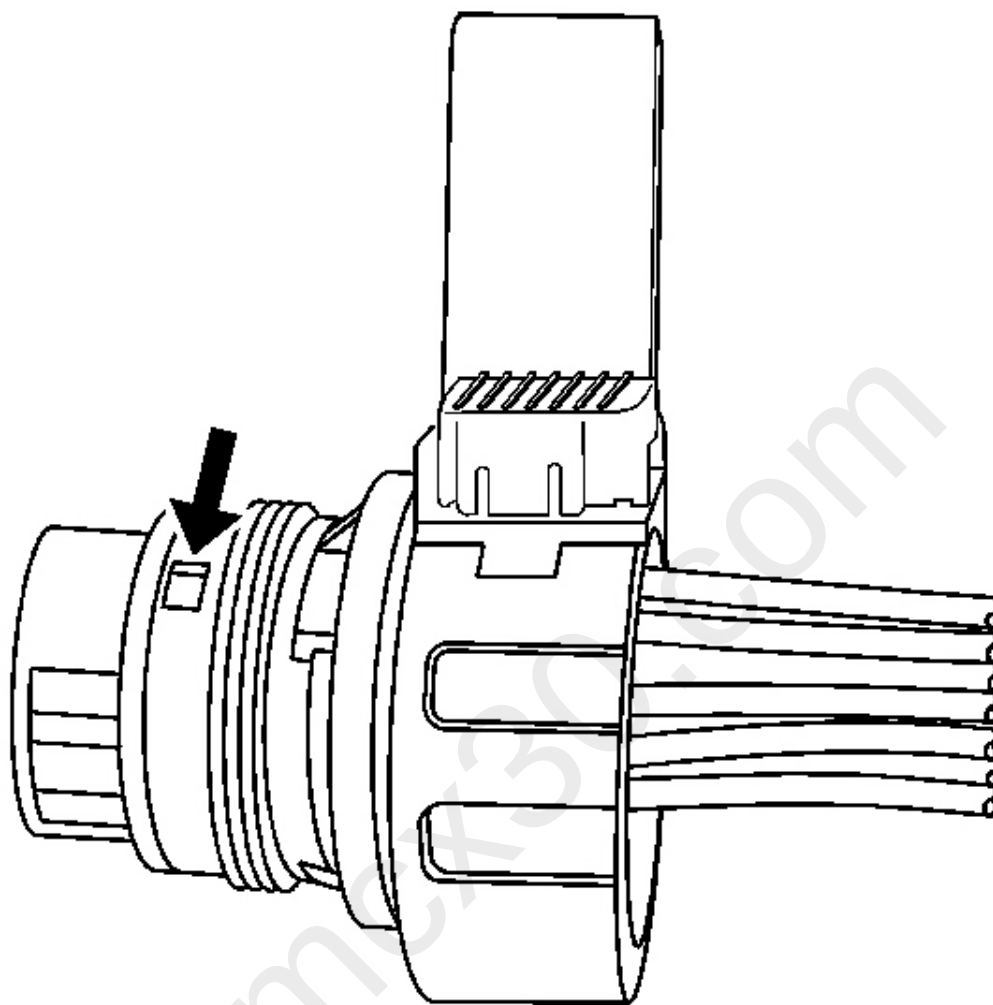


Fig. 122: View Of Terminal Position Assurance (TPA)
Courtesy of GENERAL MOTORS CORP.

2. Locate the terminal position assurance (TPA).

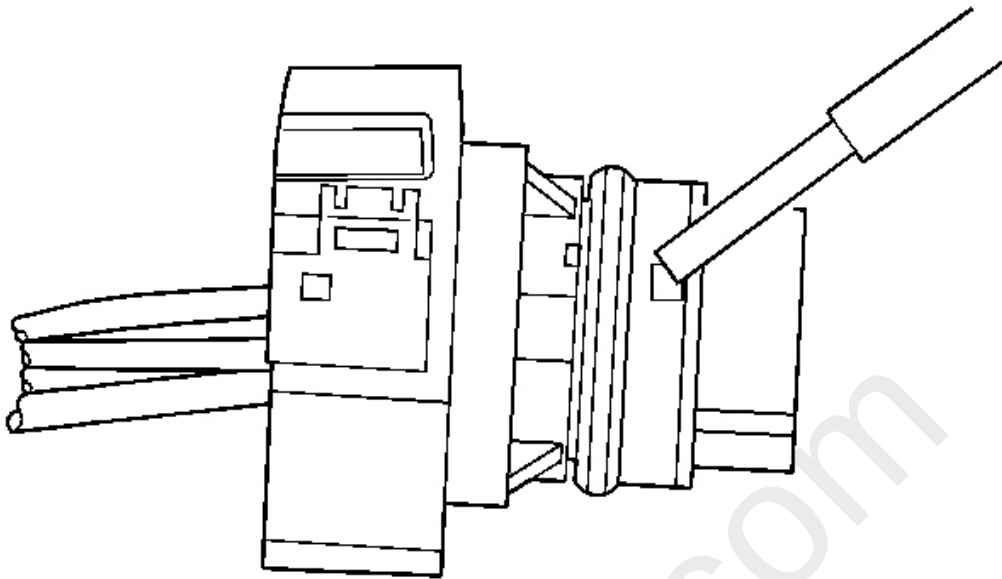


Fig. 123: View Of TPA & Flat-Bladed Tool
Courtesy of GENERAL MOTORS CORP.

NOTE: **The TPA cannot be removed from the connector while there are terminals present in the connector body.**

3. Use a small flat-blade tool to push the TPA until it bottoms out.

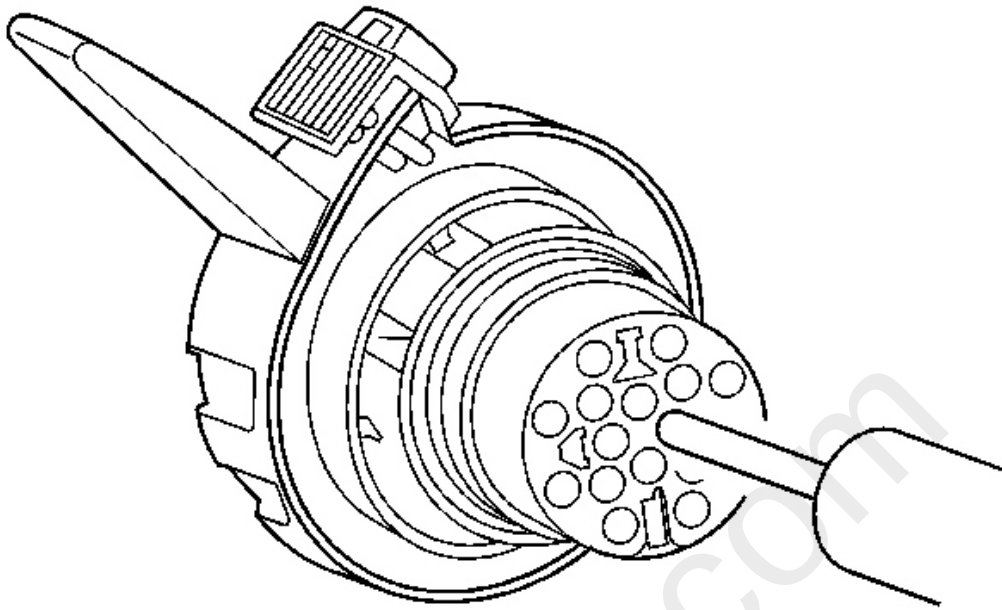


Fig. 124: Releasing Terminals
Courtesy of GENERAL MOTORS CORP.

4. Use the J 38125-28 tool to release the terminals by inserting the tool into the terminal cavity as shown in the graphic. See the release tool cross reference in the Reference Guide of the **J-38125** to ensure that the correct release tool is used.
5. While holding the removal tool in place, gently pull the wire out of the back of the connector. Always remember never use force when pulling a terminal out of a connector.

Repair Procedure

Use the appropriate terminal and follow the instructions in the **J-38125** .

Location of the terminal in the repair tray and the proper crimp tool can be found in the appropriate connector end view.

Terminal Replacement Procedure

After the terminal is crimped to the wire, perform the following procedure in order to replace the terminal.

1. Slide the new terminal into the correct cavity at the back of the connector.
2. Push the terminal into the connector until it locks into place. The new terminal should be even with the other terminals. Ensure that the terminal is locked in place by gently pulling on the wire.

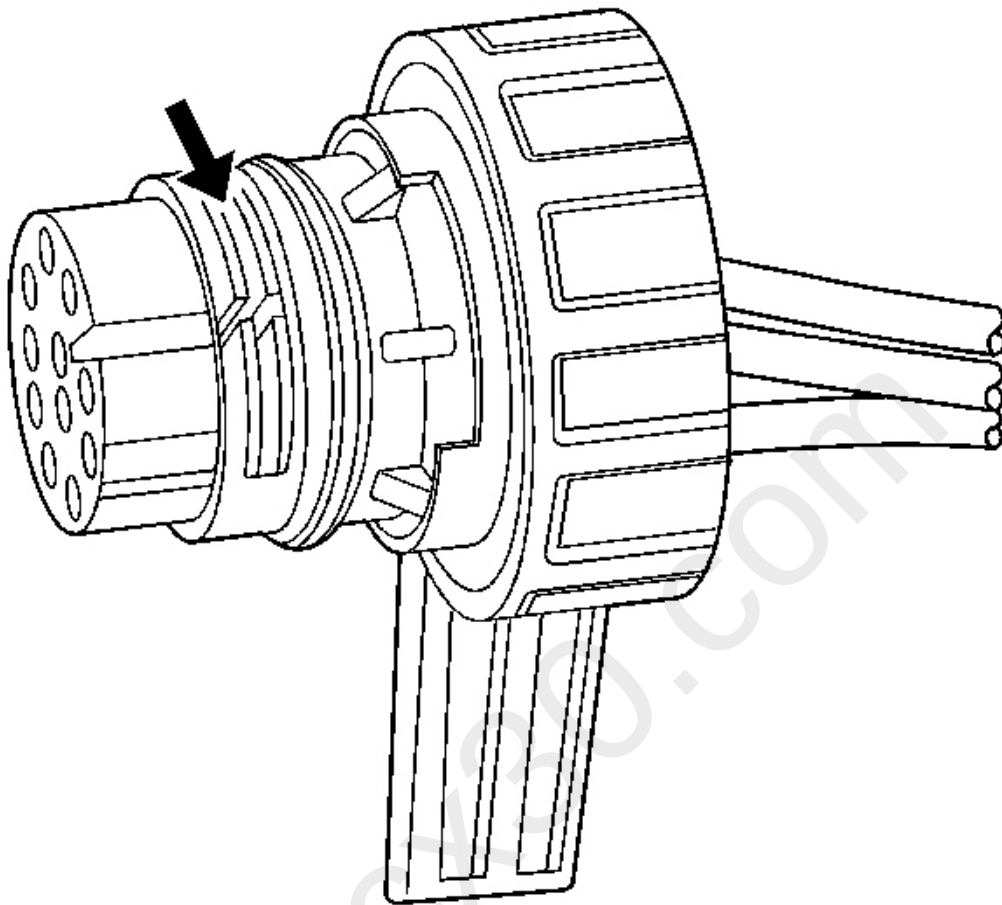


Fig. 125: Locating Terminal Position Assurance (TPA)
Courtesy of GENERAL MOTORS CORP.

3. Locate the terminal position assurance (TPA).

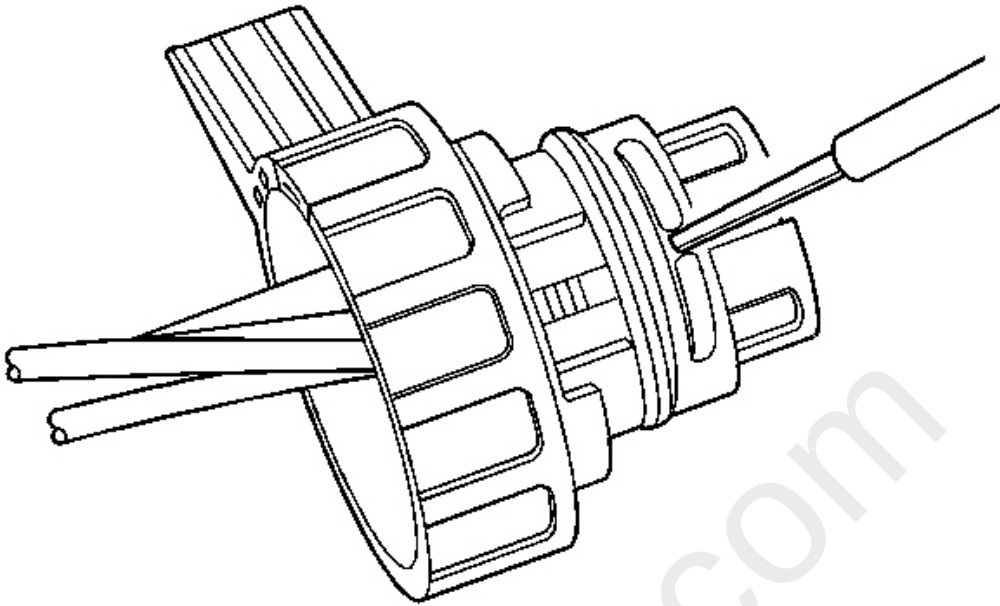


Fig. 126: View Of TPA & Flat-Bladed Tool
Courtesy of GENERAL MOTORS CORP.

4. Use a small flat-blade tool to push the TPA until it bottoms out.

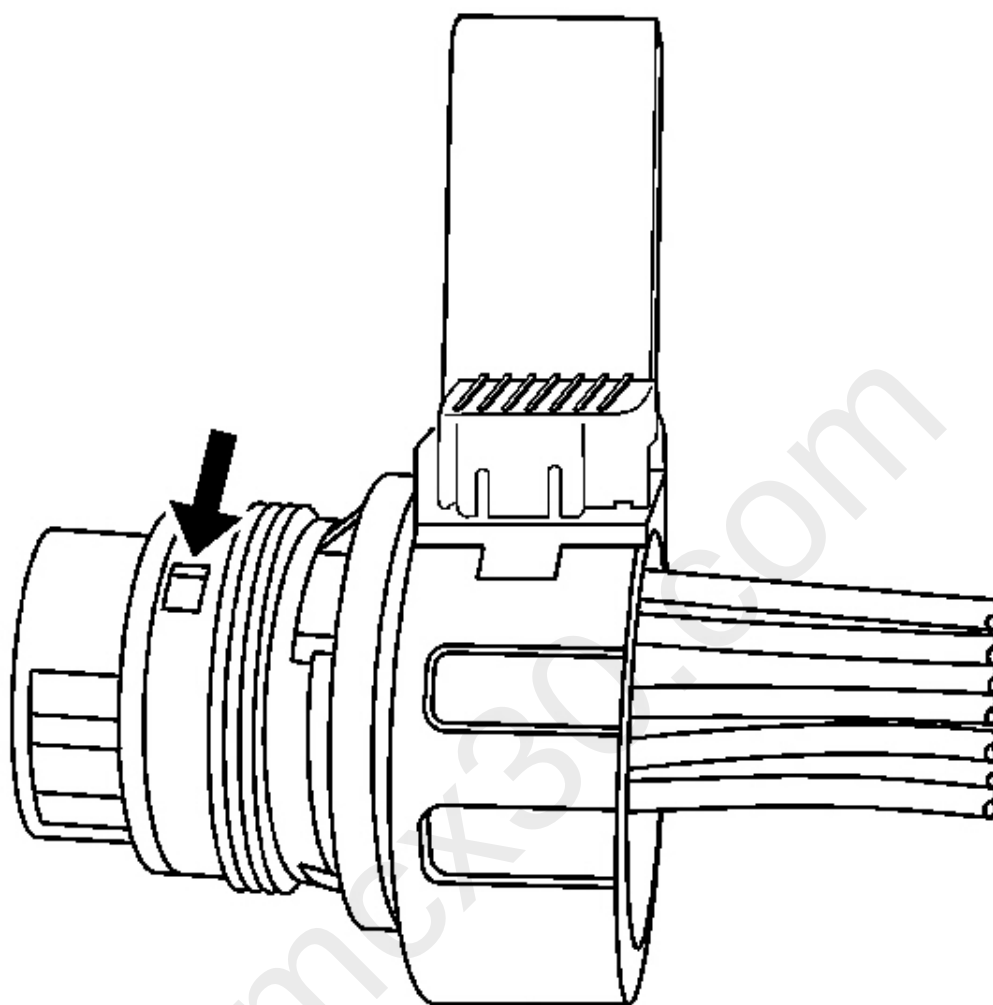


Fig. 127: View Of Terminal Position Assurance (TPA)
Courtesy of GENERAL MOTORS CORP.

5. Ensure the TPA is fully seated. The TPA should be centered and flush with the connector body when viewed.

MOLEX CONNECTORS

Special Tools

J-38125 Terminal Repair Kit

Terminal Removal Procedure

1. Locate the connector position assurance (CPA) on the top of the wire dress cover. Slide the CPA forward.

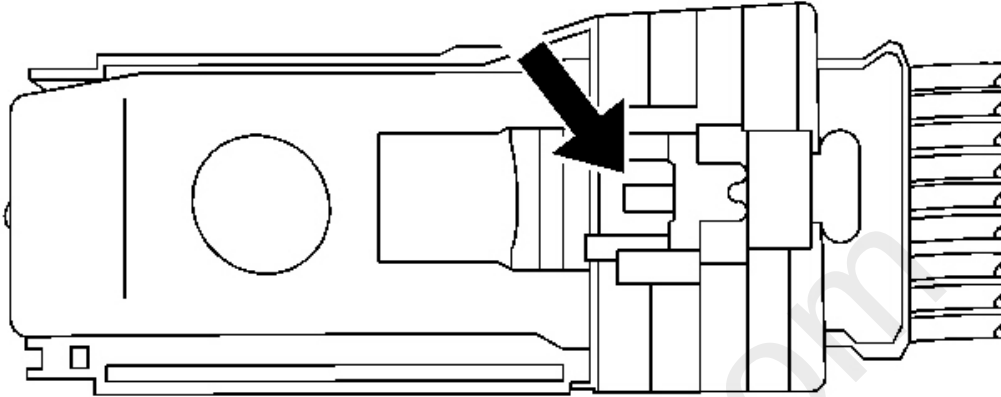


Fig. 128: Identifying Lever Lock Release Tab
Courtesy of GENERAL MOTORS CORP.

2. Slide the lever lock forward while pressing down on the lever lock release tab.

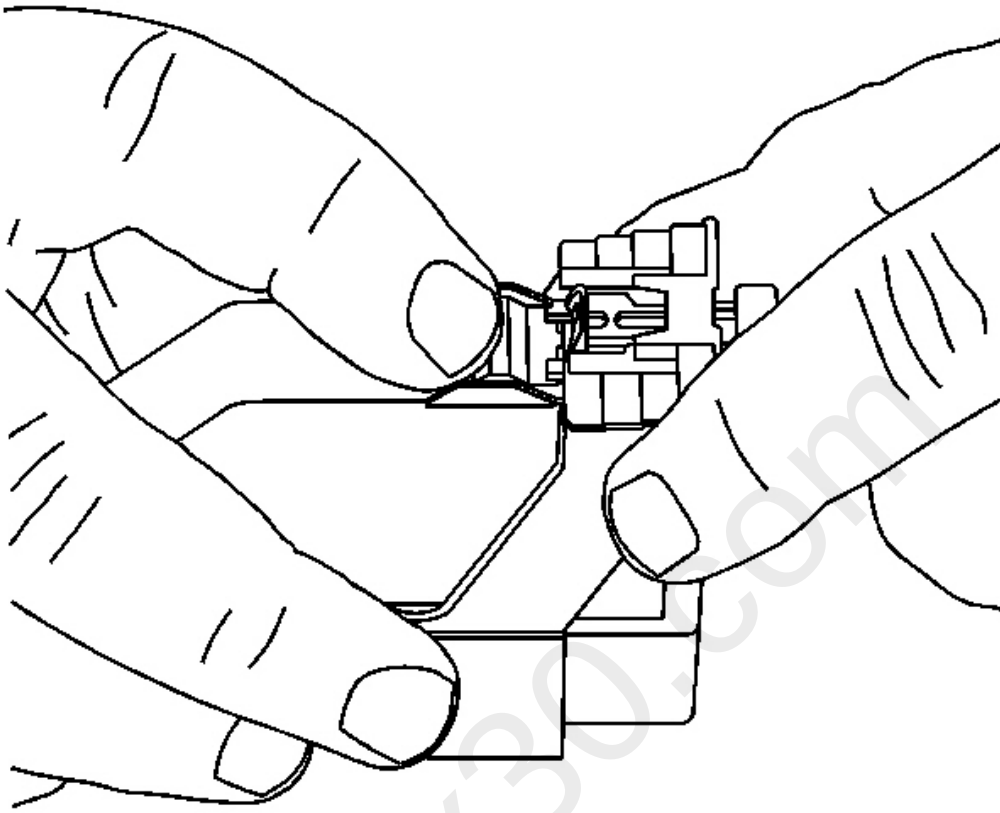


Fig. 129: View Of Lever In Full Forward Position
Courtesy of GENERAL MOTORS CORP.

3. The lever should be in the full forward position.

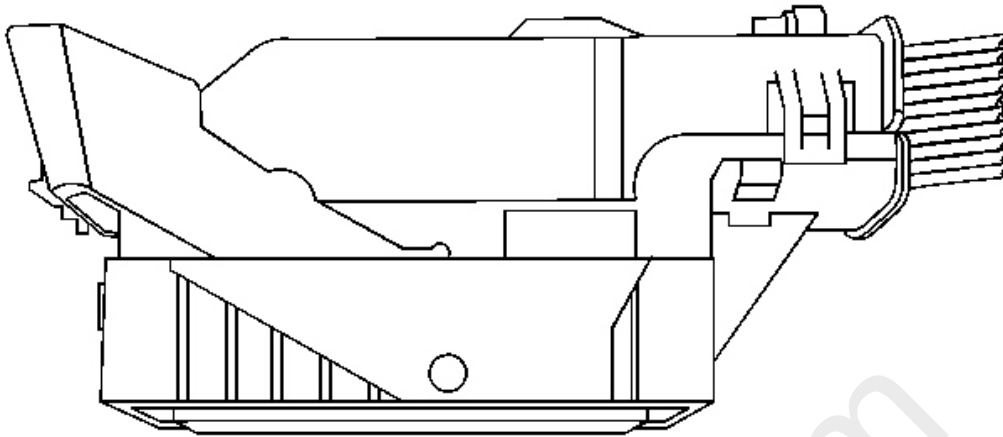


Fig. 130: View Of CPA Connector
Courtesy of GENERAL MOTORS CORP.

4. Disconnect the connector from the component.

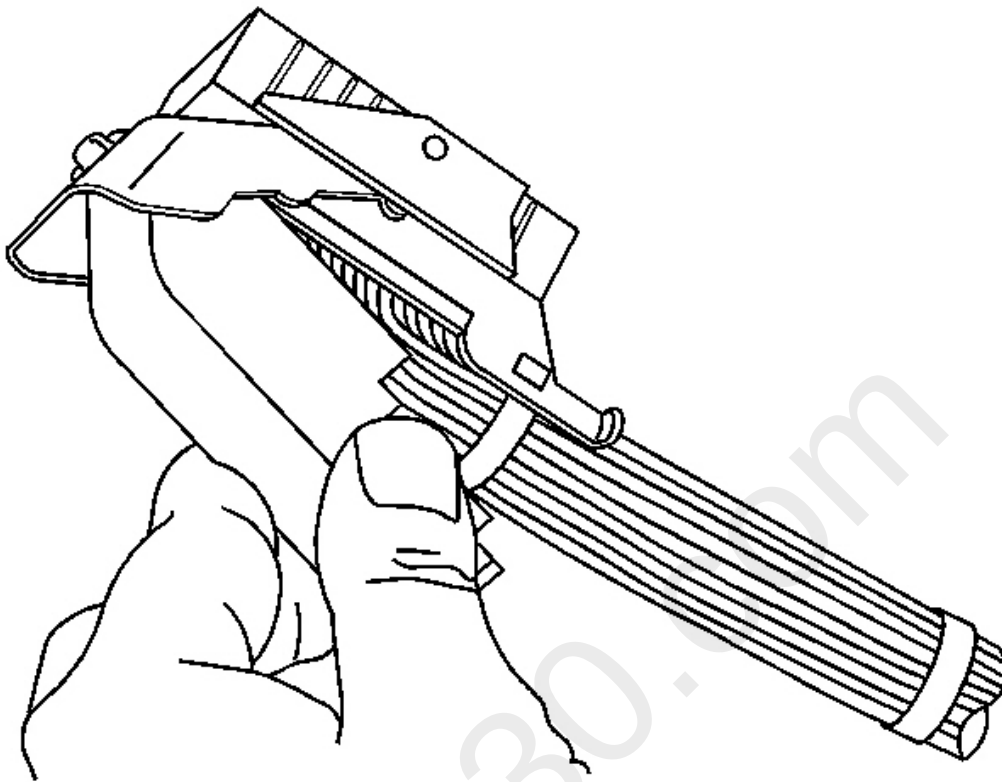


Fig. 131: Removing Dress Cover
Courtesy of GENERAL MOTORS CORP.

5. Remove the dress cover by using a flat bladed tool to release the dress cover locking tabs and lift up on the dress cover.
6. Cut the tie wrap that holds the wires to the connector body.

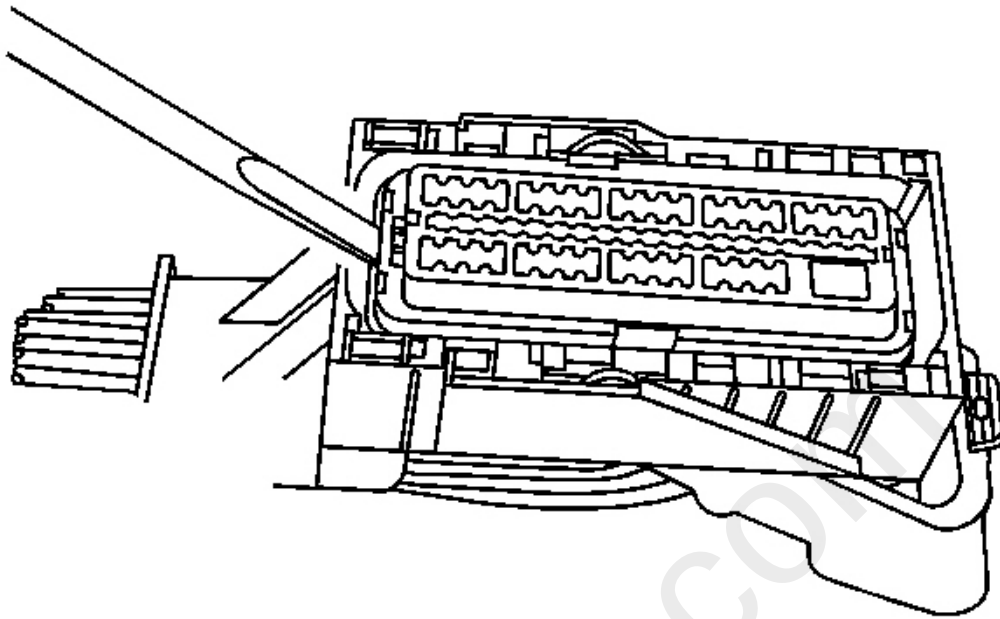


Fig. 132: Prying One Side Of Nose Piece
Courtesy of GENERAL MOTORS CORP.

7. Use a small flat-blade tool to pry one side of the nose piece up to the pre-stage position. When the nose piece is in the pre-staged position, the nose piece will be raised above the connector body the length of the step in the nose piece.

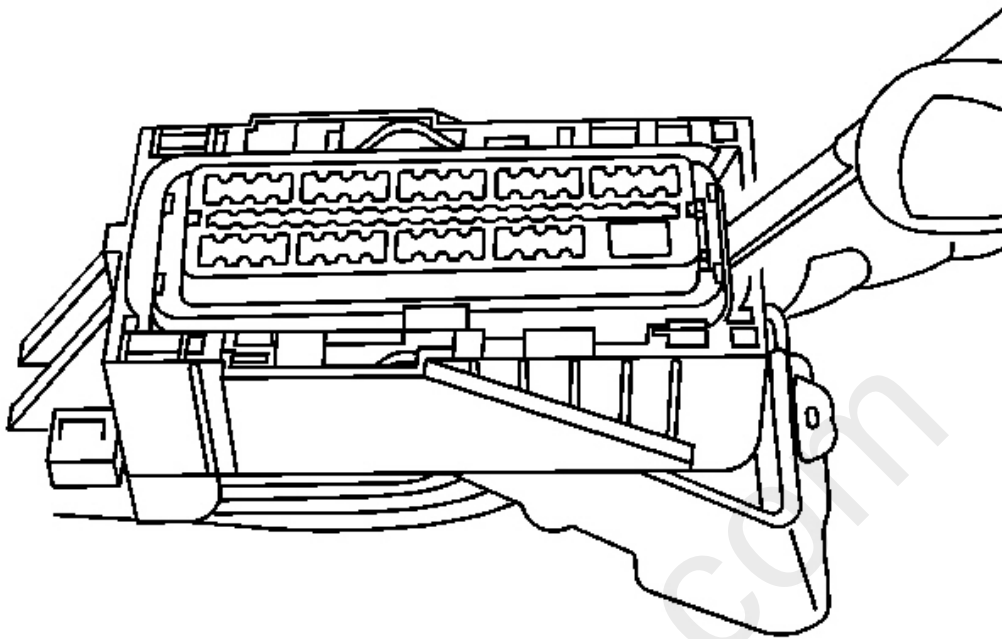


Fig. 133: Prying Side Of Nose Piece
Courtesy of GENERAL MOTORS CORP.

8. Use a small flat-blade tool to pry the other side of the piece to the pre-stage position. If the nose piece is higher than the first step in the nose piece, gently push down on the nose piece until it meets with resistance from the connector body, you should feel the nose piece click into position.

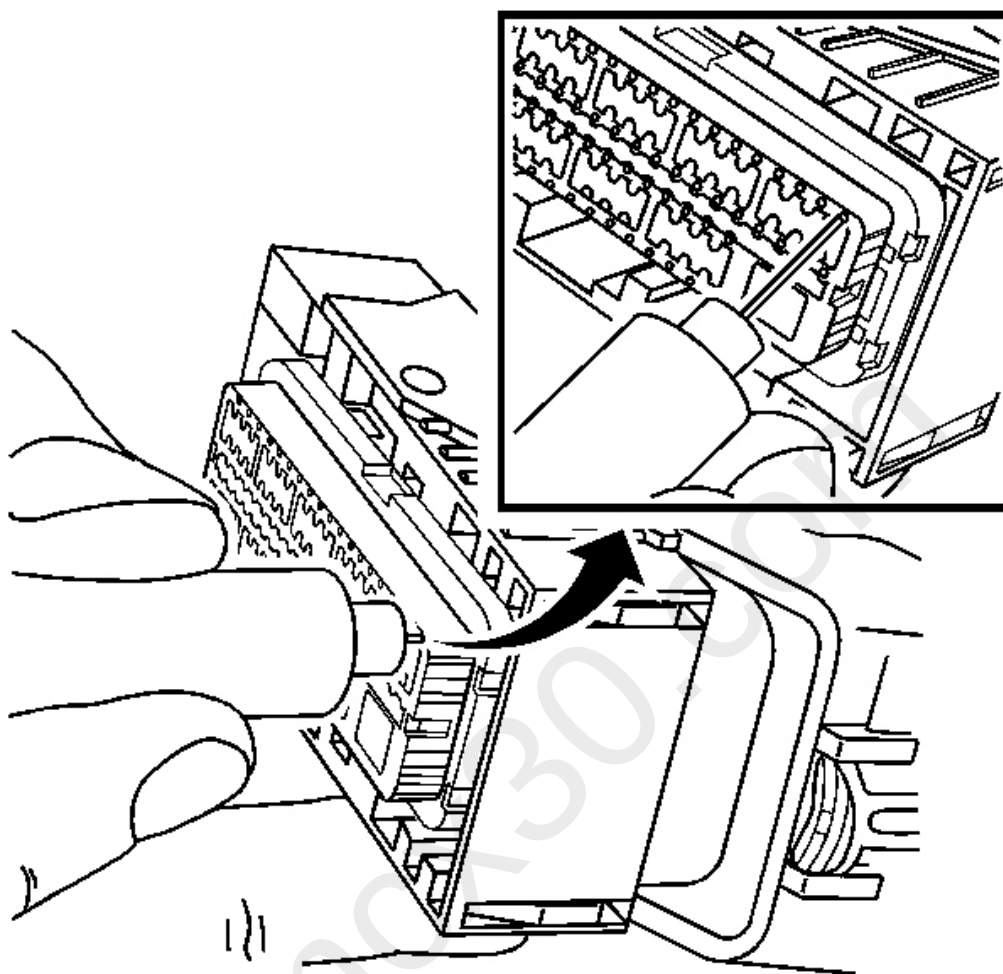


Fig. 134: Inserting J 38125-213 Into Small Terminal Release Hole
Courtesy of GENERAL MOTORS CORP.

9. Insert the J 38125-213 into the small terminal release hole on the nose piece and gently pull on the back of the wire.
10. See the release tool cross reference in the Reference Guide of the **J-38125** Terminal Repair Kit to ensure that the correct release tool is used.

Terminal Repair Procedure

Refer to the terminal crimping procedure in the Reference Guide of the **J-38125** Terminal Repair Kit.

Terminal Replacement Procedure

After the terminal is crimped to the wire, perform the following procedure in order to replace the terminal.

1. Slide the new terminal into the correct cavity at the back of the connector.
2. Push the terminal into the connector until it locks into place. The new terminal should be even with the other terminals. Ensure that the terminal is locked in place by gently pulling on the wire.
3. To assemble the connector, reverse the connector disassembly procedure.

SUMITOMO CONNECTORS

Special Tools

J-38125 Terminal Repair Kit

Terminal Removal Procedure

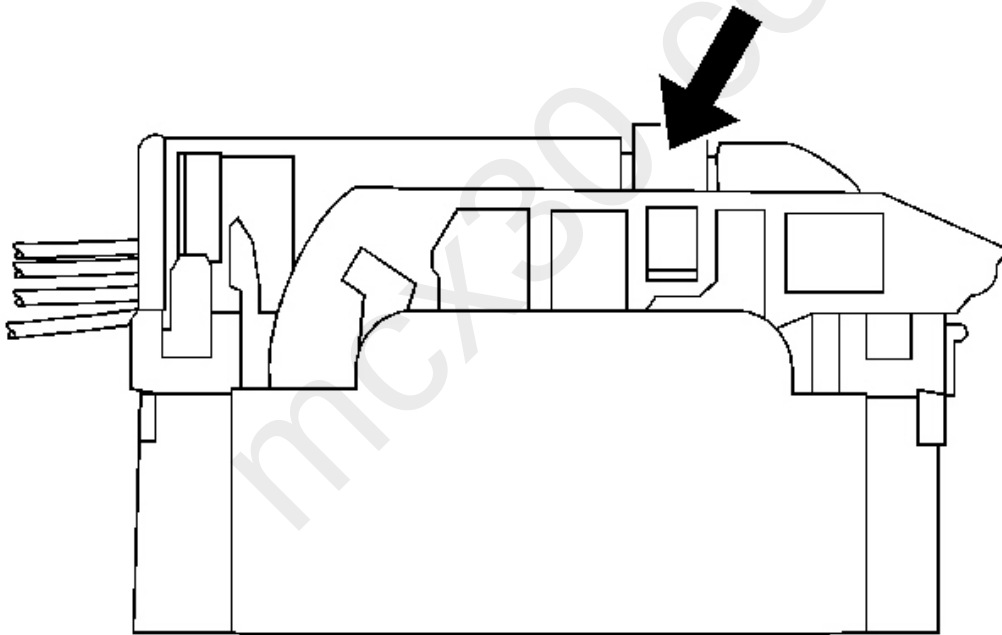


Fig. 135: Identifying Lever Lock
Courtesy of GENERAL MOTORS CORP.

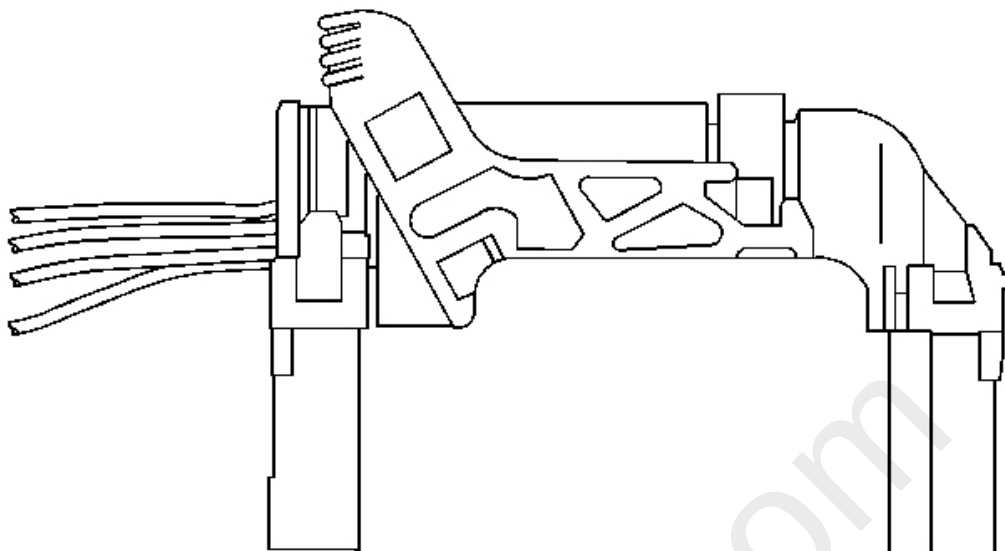


Fig. 136: View Of Lever Lock In Forward Position
Courtesy of GENERAL MOTORS CORP.

1. Slide the lever lock forward while pressing down on the lever lock release tab.
2. Disconnect the connector from the component.

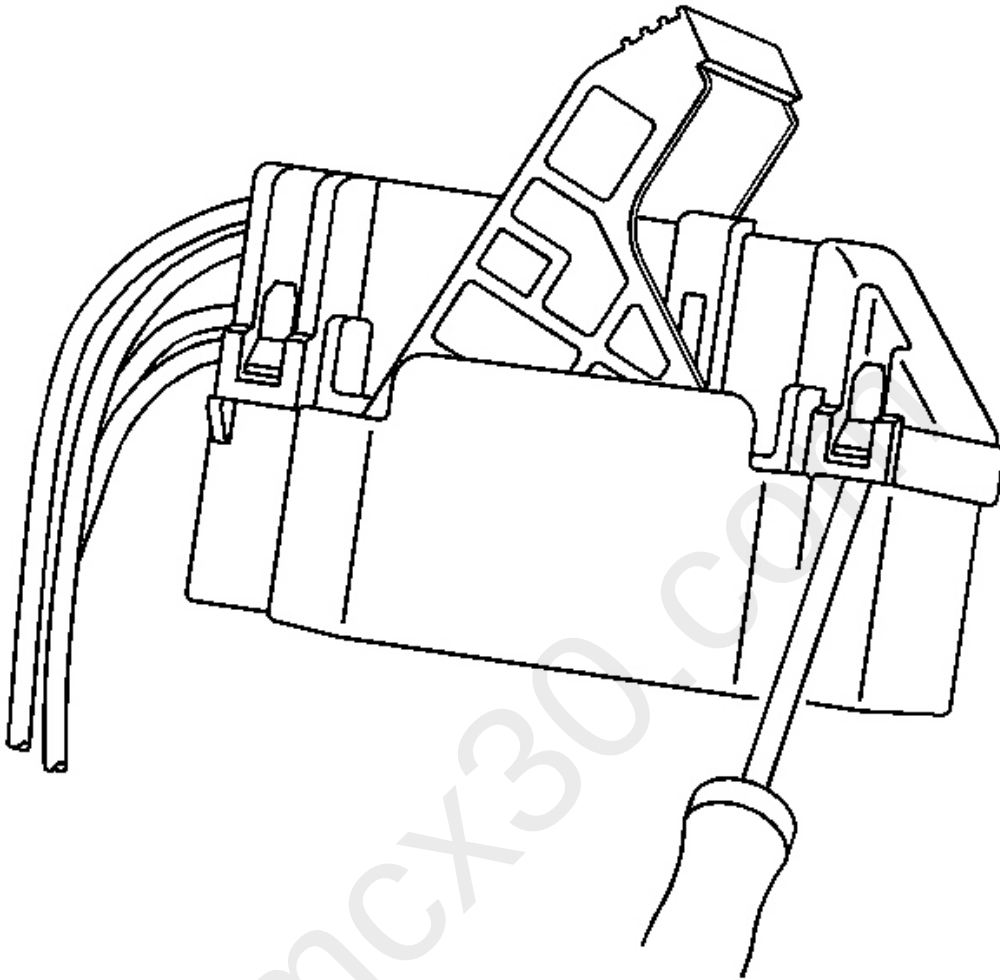


Fig. 137: Releasing Connector Locking Tabs
Courtesy of GENERAL MOTORS CORP.

3. Remove the dress cover by using a flat-blade tool to release the connector locking tabs and pulling off the dress cover.

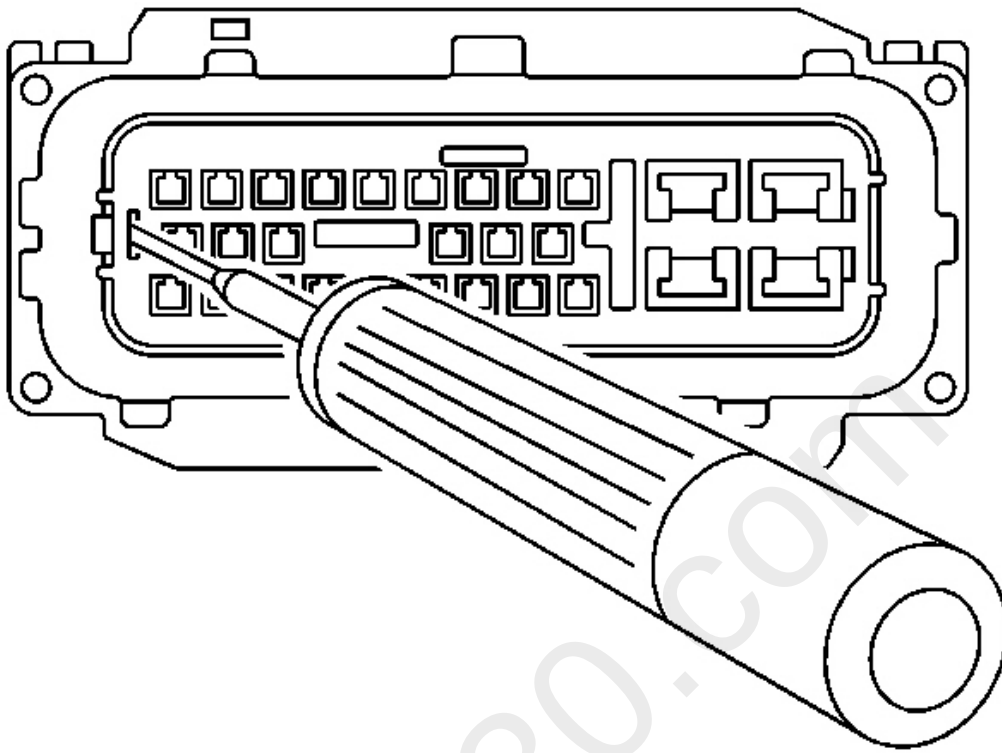


Fig. 138: Inserting J-38125-12A (12094429) Into Single Retainer Slot
Courtesy of GENERAL MOTORS CORP.

4. Relieve the tension on the nose piece retainers by inserting J 38125-12A into the single retainer slot on the end of the nose piece and gently prying out the locking tab. Repeat the process for both of the nose piece locking tabs on the opposite side of the nose piece.

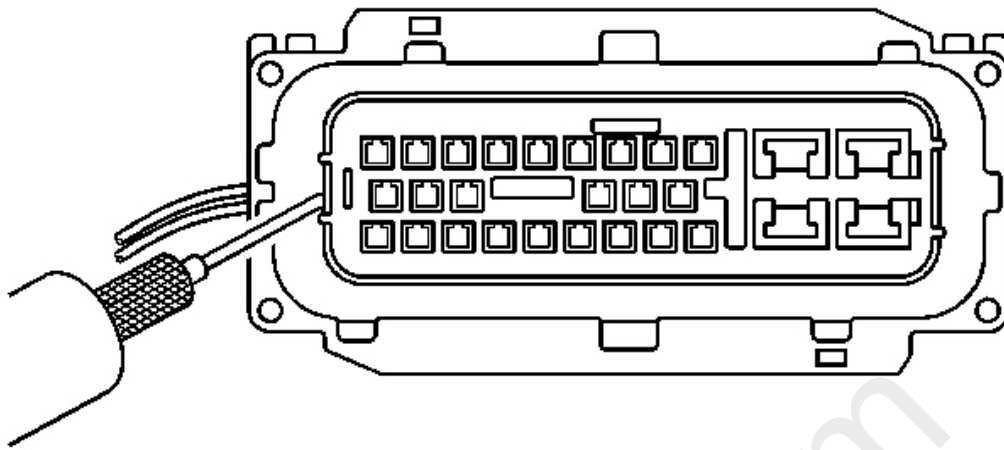


Fig. 139: Pulling Up One End Of Nose Piece (1st Side)
Courtesy of GENERAL MOTORS CORP.

5. Once the nose piece retainers are relaxed, use the J 38125-552 to pull up the nose piece by hooking the tool under the nose piece and pulling up. The nose piece should raise slightly.

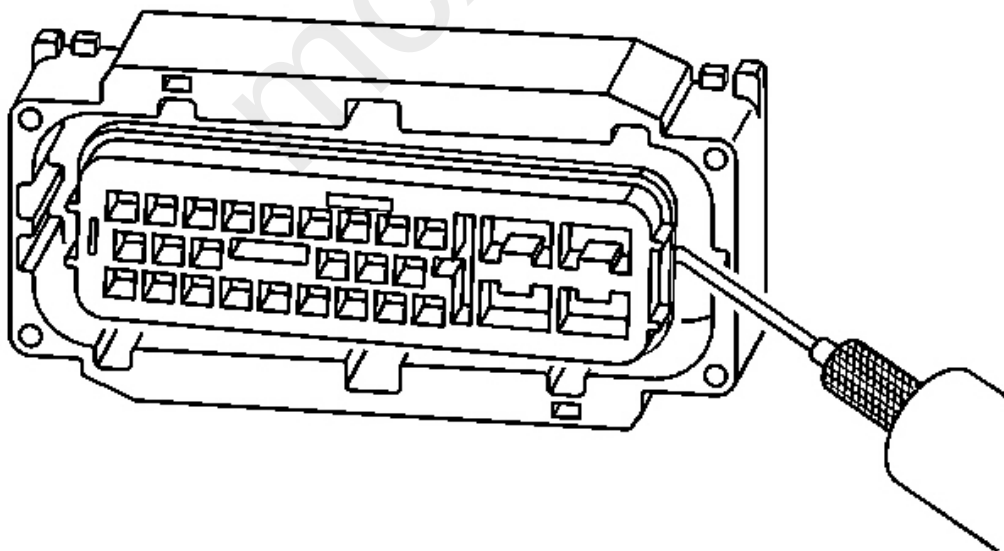


Fig. 140: Pulling Up One End Of Nose Piece (2nd Side)

Courtesy of GENERAL MOTORS CORP.

6. On the opposite side of the nose piece, use the J 38125-552 to pull up the nose piece by hooking the tool under the nose piece and pulling up. The nose piece should release completely. If the nose piece does not come off, repeat the procedure on the opposite side.

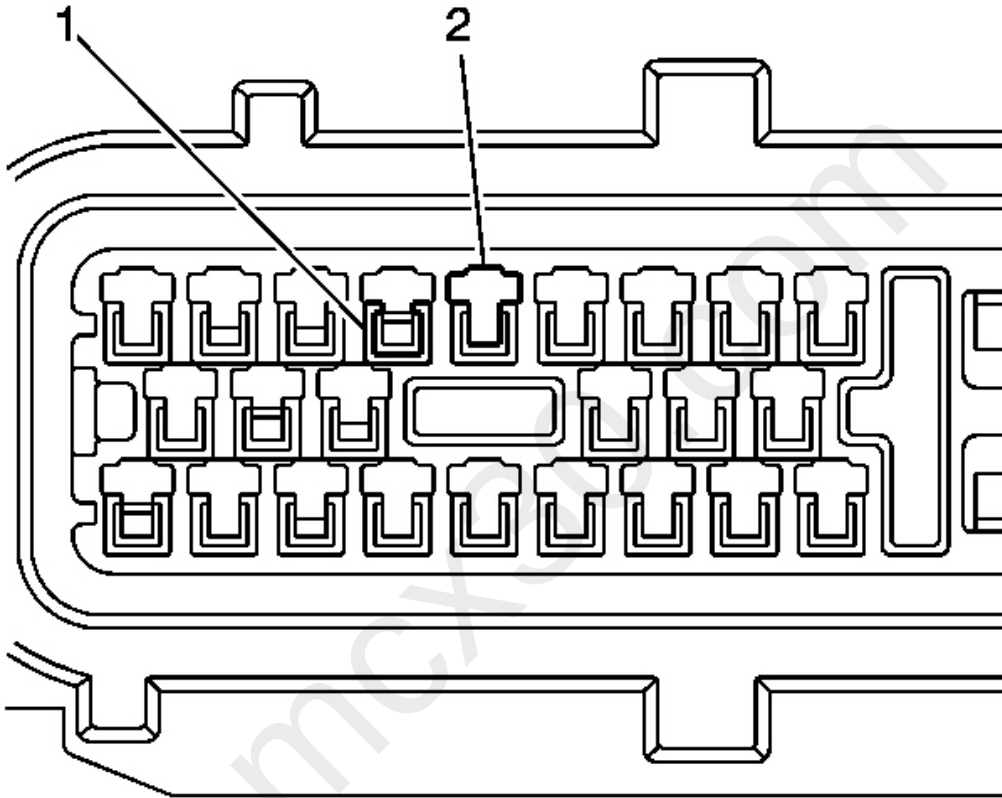


Fig. 141: View Of Terminal & Entry Canal

Courtesy of GENERAL MOTORS CORP.

7. The illustration above identifies the entry canal where the terminal release tool will be inserted, and the terminal cavity.
 - Terminal (1)
 - Entry Canal (2)

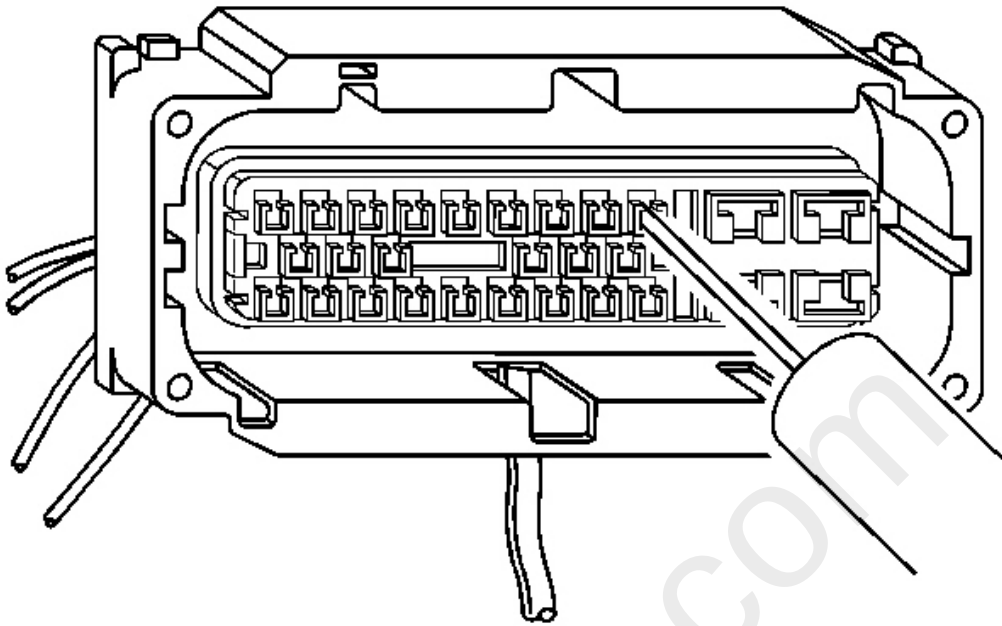


Fig. 142: Inserting J-38125-553 (15315247) Tool Into Entry Canal
Courtesy of GENERAL MOTORS CORP.

8. Insert the J 38125-553 tool into the entry canal and pry up on the terminal retainer. The terminal retainer is a small plastic piece on the top of the terminal. The terminal retainer must be held up while the terminal is pulled out of the connector.

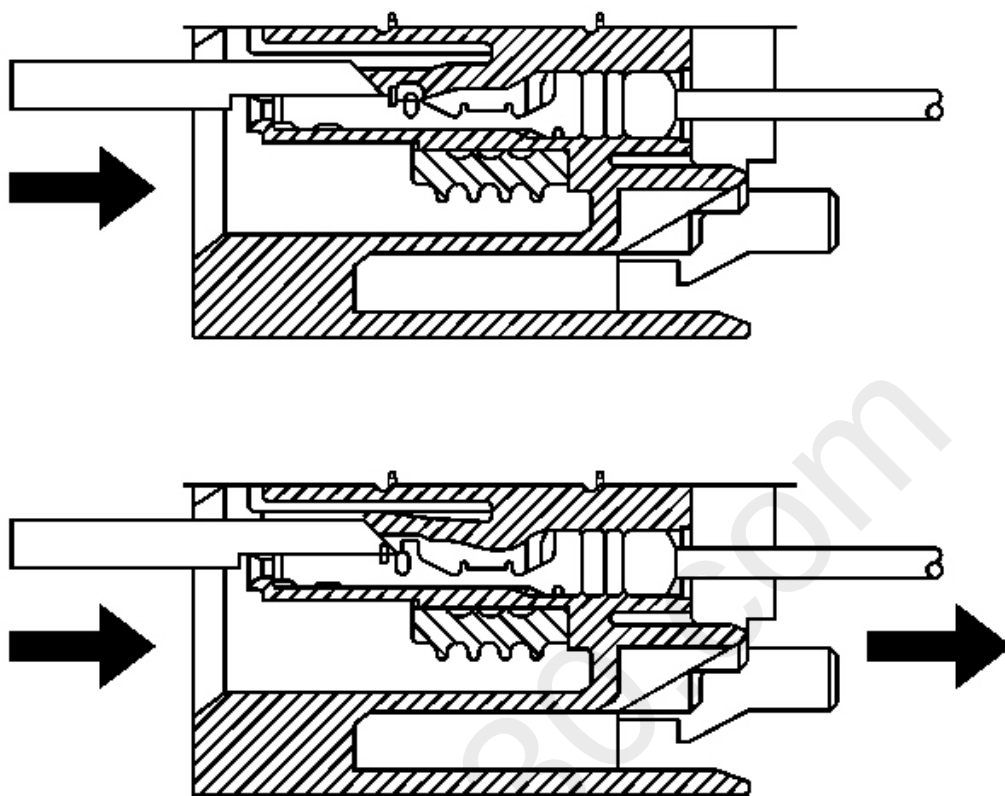


Fig. 143: Cutaway View Of Connector
Courtesy of GENERAL MOTORS CORP.

9. The illustration shows a cutaway view of the connector to aid the technician in releasing the terminal retainer.
10. See the release tool cross reference in the Reference Guide of the **J-38125** Terminal Repair Kit to ensure that the correct release tool is used.

Terminal Repair Procedure

Refer to the terminal crimping procedure in the Reference Guide of the **J-38125** Terminal Repair Kit.

Terminal Replacement Procedure

After the terminal is crimped to the wire, perform the following procedure in order to replace the terminal.

1. Slide the new terminal into the correct cavity at the back of the connector.
2. Push the terminal into the connector until it locks into place. The new terminal should be even with the

other terminals. Ensure that the terminal is locked in place by gently pulling on the wire.

3. To assemble the connector, reverse the connector disassembly procedure.

TYCO/AMP CONNECTORS (CM 42-WAY)

Special Tools

J-38125 Terminal Repair Kit

Removal Procedure

1. Locate the connector position assurance (CPA) on the connector body and pull the CPA out. The CPA is on the wire harness side of connector.
2. Disconnect the connector from the component.

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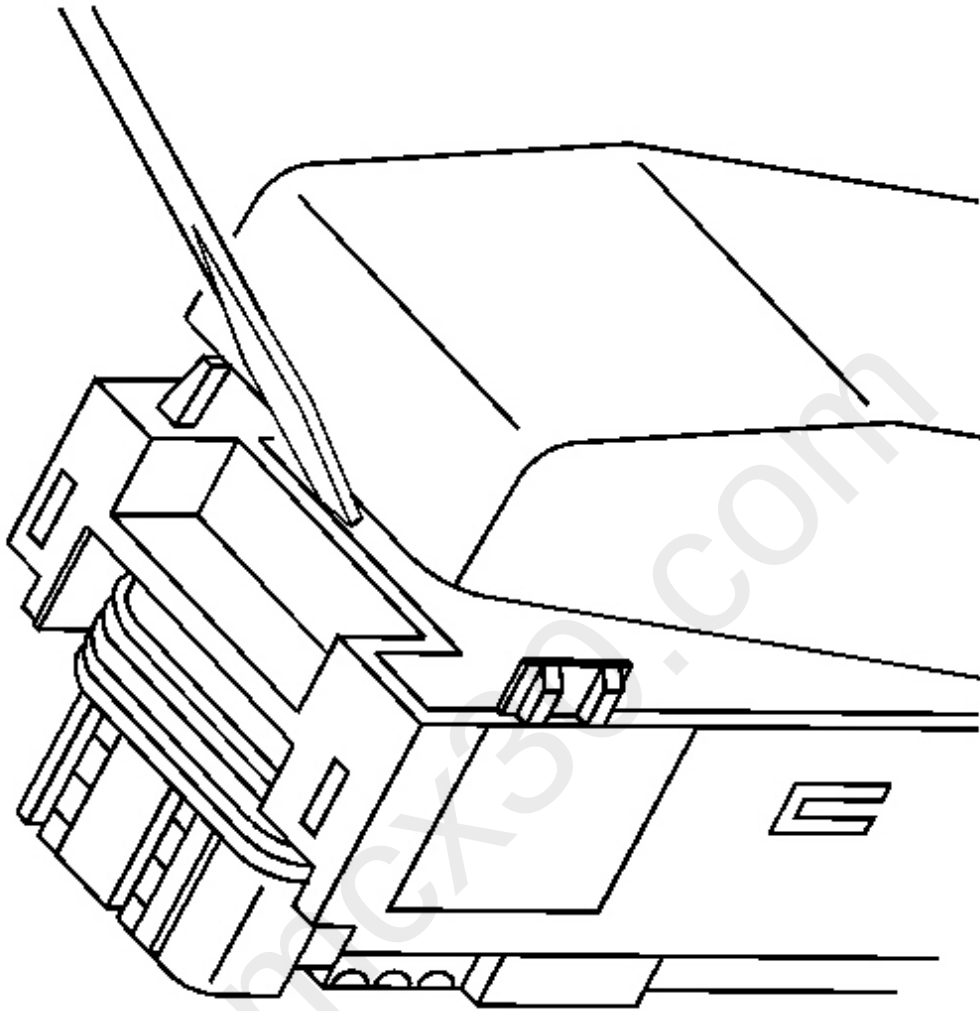


Fig. 144: Prying Off Dress Cover
Courtesy of GENERAL MOTORS CORP.

3. Use a small flat-bladed tool to gently pry off the dress cover by inserting the tool under the cover opposite the harness side and prying up.
4. Remove the cover.

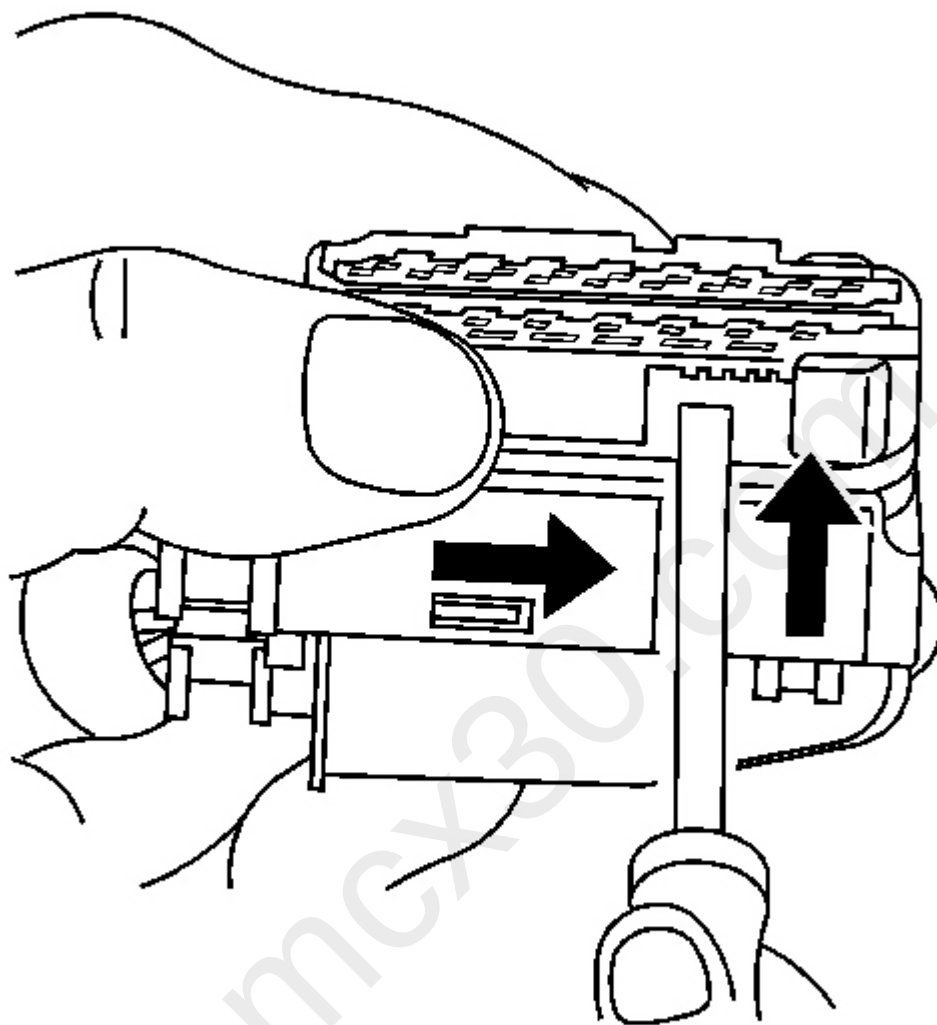


Fig. 145: View Of Terminal Position Assurance (TPA)
Courtesy of GENERAL MOTORS CORP.

5. Using a small flat-bladed tool, push on the side of the nose piece retainer while pushing the nose piece forward with your thumb. This will release the terminal position assurance (TPA).

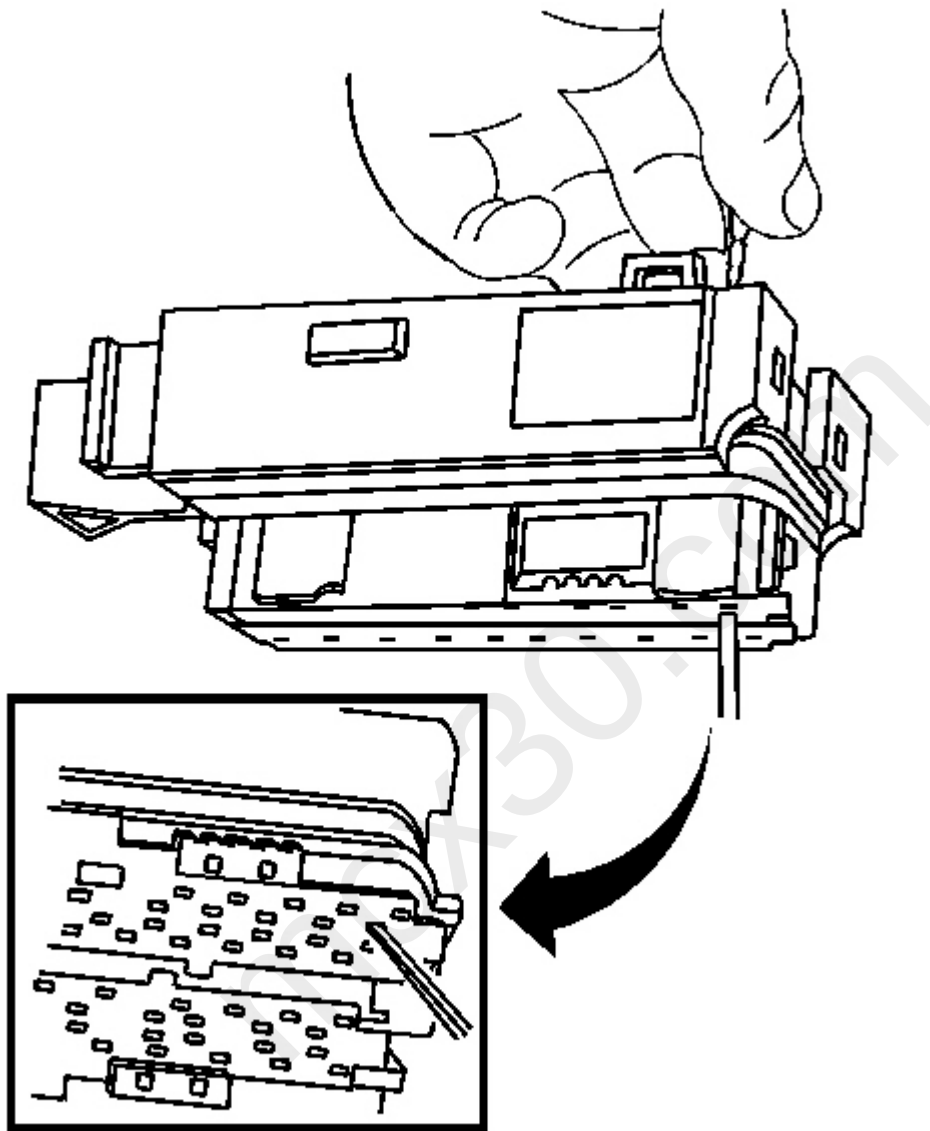


Fig. 146: Inserting J 38125-12A Into Terminal Release Cavity
Courtesy of GENERAL MOTORS CORP.

6. Insert the J 38125-12A into the corresponding terminal release cavity. The release cavities are the 2 center rows of cavities on one half of the connector.

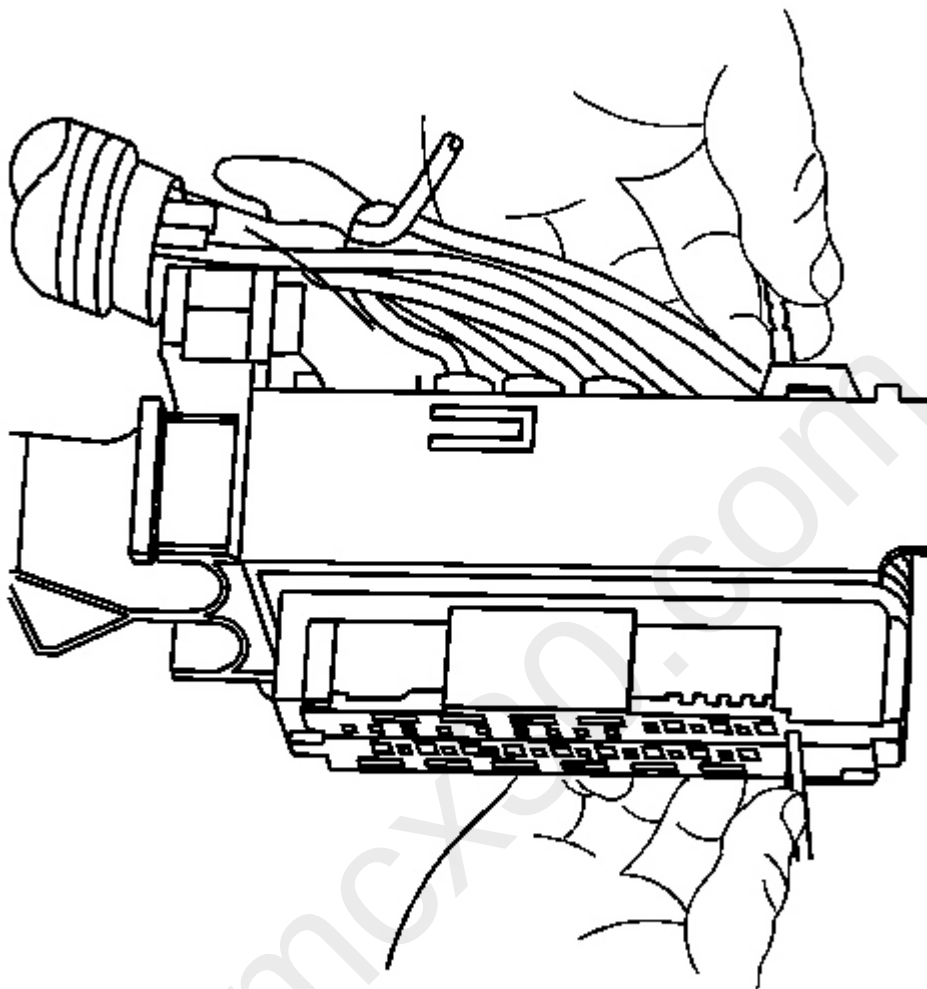


Fig. 147: Pulling Wire Out Of Back Of Connector
Courtesy of GENERAL MOTORS CORP.

7. Pressing the J 38125-12A tool in the release cavity of the terminal you are removing, gently pull the wire out of the back of the connector. Always remember never use force when pulling a terminal out of a connector. See the release tool cross reference in the Reference Guide of the **J-38125** to ensure that the correct release tool is used.

Terminal Repair Procedure

Use the appropriate terminal and crimper in the **J-38125** in order to replace the terminal.

TYCO/AMP CONNECTORS (SENSOR)

Special Tools

J-38125 Terminal Repair Kit

Terminal Removal Procedure

1. Disconnect the connector from the component.

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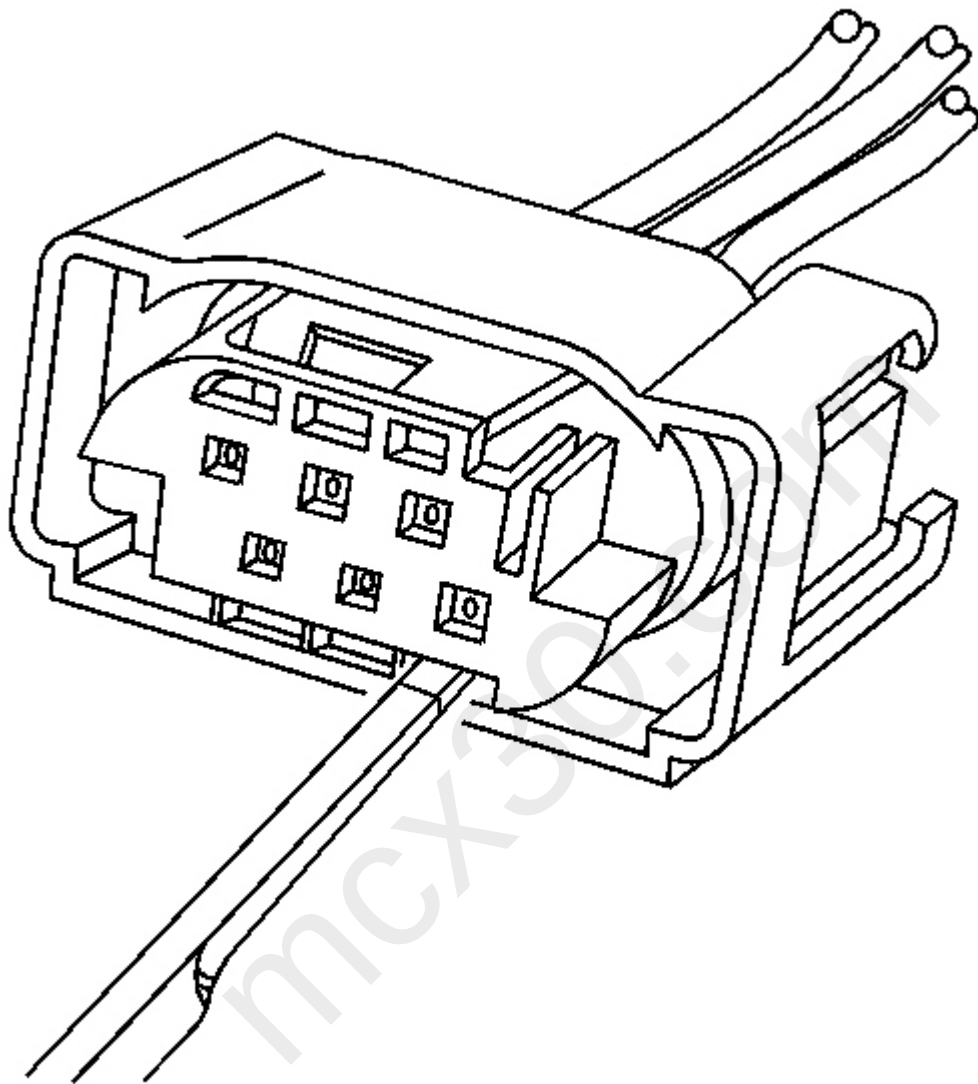


Fig. 148: Inserting Special Tool Into Lower Right Face Cavity
Courtesy of GENERAL MOTORS CORP.

2. Insert the J 38125-11A tool into the cavity on the lower right hand face of the connector until the terminal release tang access panel slides over.

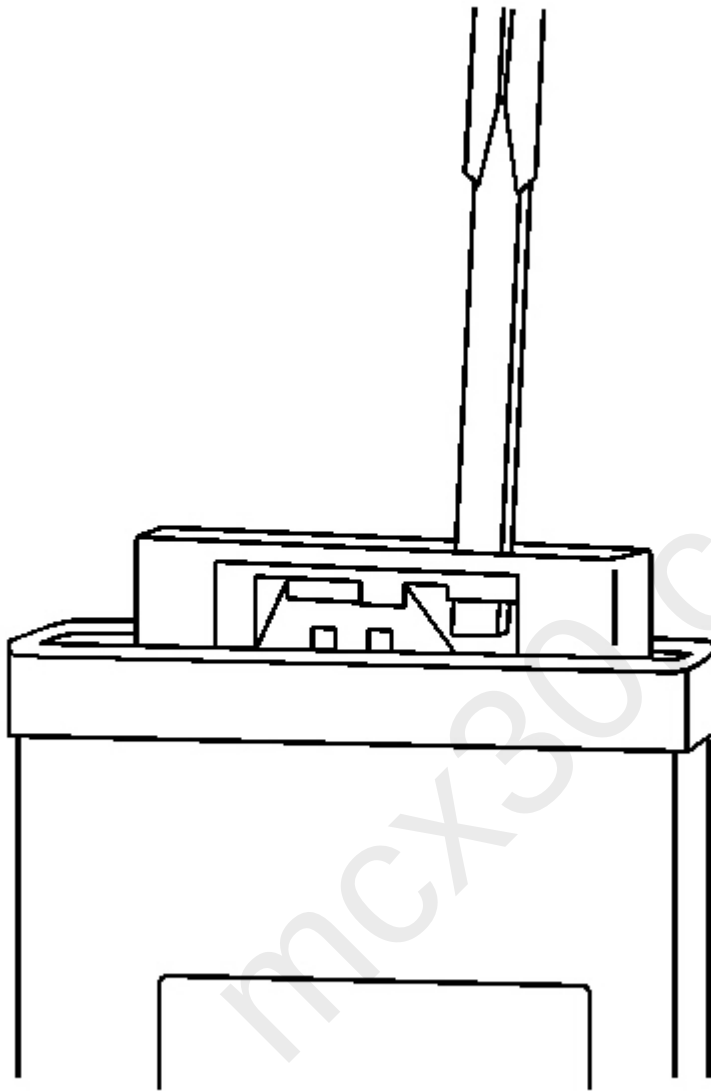


Fig. 149: Pushing Wire Side Of Terminal Toward Connector
Courtesy of GENERAL MOTORS CORP.

3. Ensure that the terminal release tang access panel is in the correct location to access the terminals.
4. Push the wire side of the terminal that is being removed toward the connector and hold it in position.

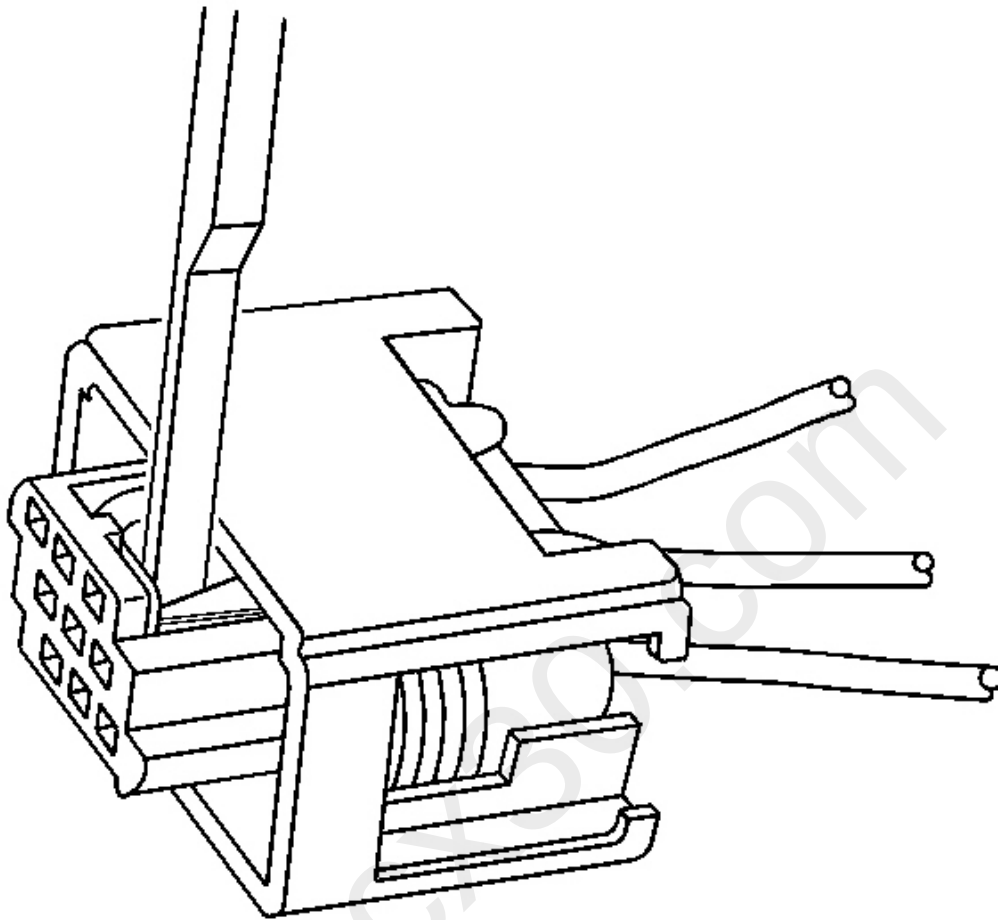


Fig. 150: Inserting Tool Into Terminal Release Tang Access Slot (Sensor)
Courtesy of GENERAL MOTORS CORP.

5. Insert the J 38125-11A into the terminal release tang access slot located behind the access panel of the connector and press down on the terminal while carefully pulling the terminal out of the connector. Always remember never use force when pulling a terminal out of a connector. If the terminal is difficult to remove, repeat the entire procedure.

Terminal Repair Procedure

Use the appropriate terminal and follow the instructions in the **J-38125** .

TYCO/AMP CONNECTORS (0.25 CAP)

Special Tools

Terminal Removal Procedure

1. Disconnect the connector from the component by pressing down on the connector position assurance (CPA).

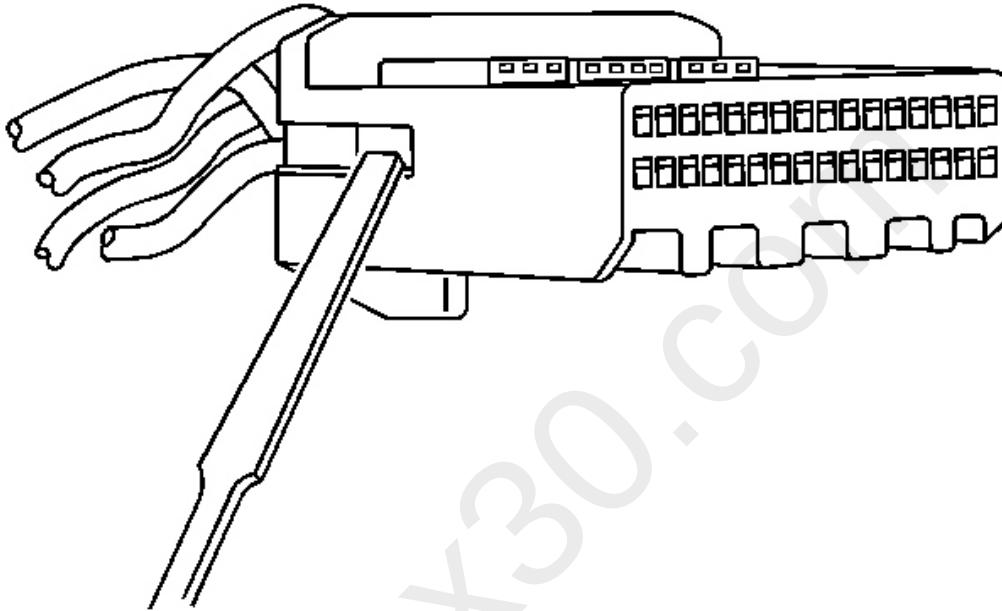


Fig. 151: Releasing TPA

Courtesy of GENERAL MOTORS CORP.

NOTE: The TPA on this connector cannot be removed unless the terminals are removed first. The TPA will come out of the connector body, but only slightly. When the TPA is slightly raised the terminals can be removed. Using excessive force to remove the TPA with the terminals still in the connector will damage the connector.

2. Use a small flat-bladed tool to release the terminal position assurance (TPA) by inserting the tool in the small recess on the side of the connector and pushing up until the TPA releases from the connector body. The TPA should raise just slightly. Do not try to remove the TPA.
3. Repeat the process for the other side of the connector.

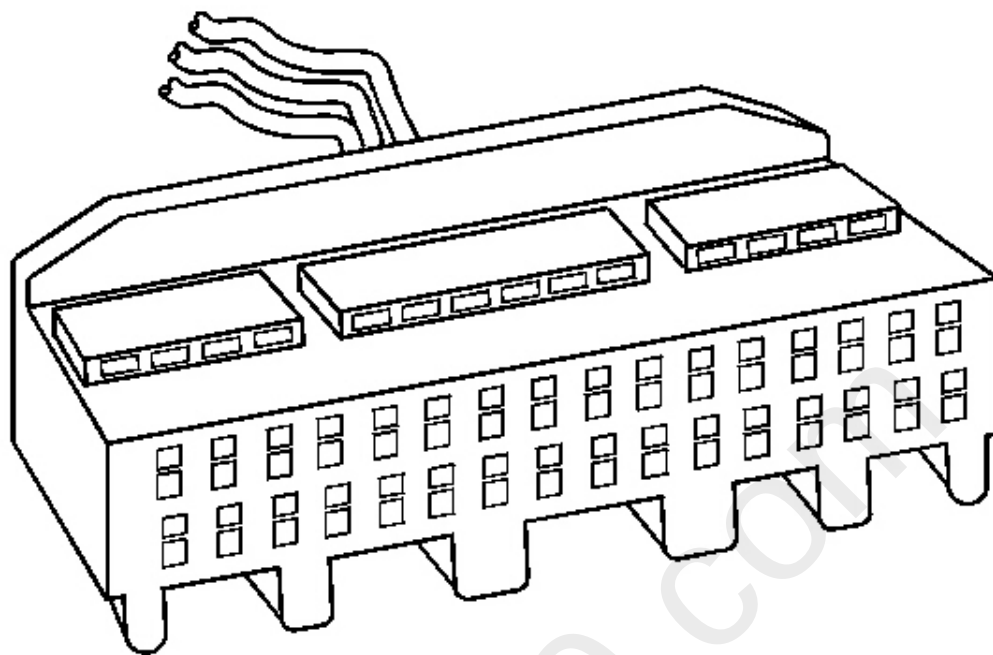


Fig. 152: View Of TPA

Courtesy of GENERAL MOTORS CORP.

4. Ensure that the TPA is in the proper position to remove the terminals.

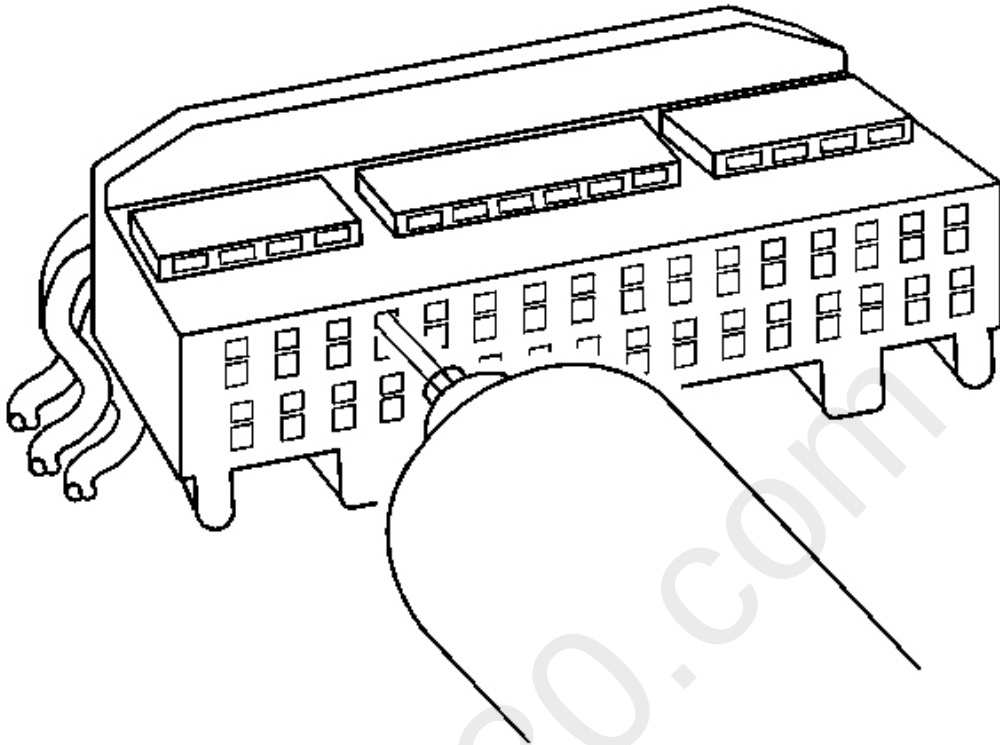


Fig. 153: Inserting Special Tool Into Release Cavity
Courtesy of GENERAL MOTORS CORP.

5. While pushing the terminal forward, insert the J 38125-24 in the release cavity above the terminal you are removing, gently pull the wire out of the back of the connector. Always remember never use force when pulling a terminal out of a connector. See the release tool cross reference in the Reference Guide of the **J-38125** to ensure that the correct release tool is used.

Terminal Repair Procedure

Use the appropriate terminal and follow the instructions in the **J-38125** in order to replace the terminal.

TYCO/AMP CONNECTORS (43-WAY)

Special Tools

J-38125 Terminal Repair Kit

Removal Procedure

Follow the steps below in order to remove terminals from the connector.

1. Locate the lever lock on the wire dress cover. Slide the lever lock away from the connector body.
2. Disconnect the connector from the component.
3. Locate the dress cover locking tabs on the dress cover of the connector. Using a small flat-blade tool release all of the locking tabs.
4. Once the locks are unlocked, lift the dress cover off.

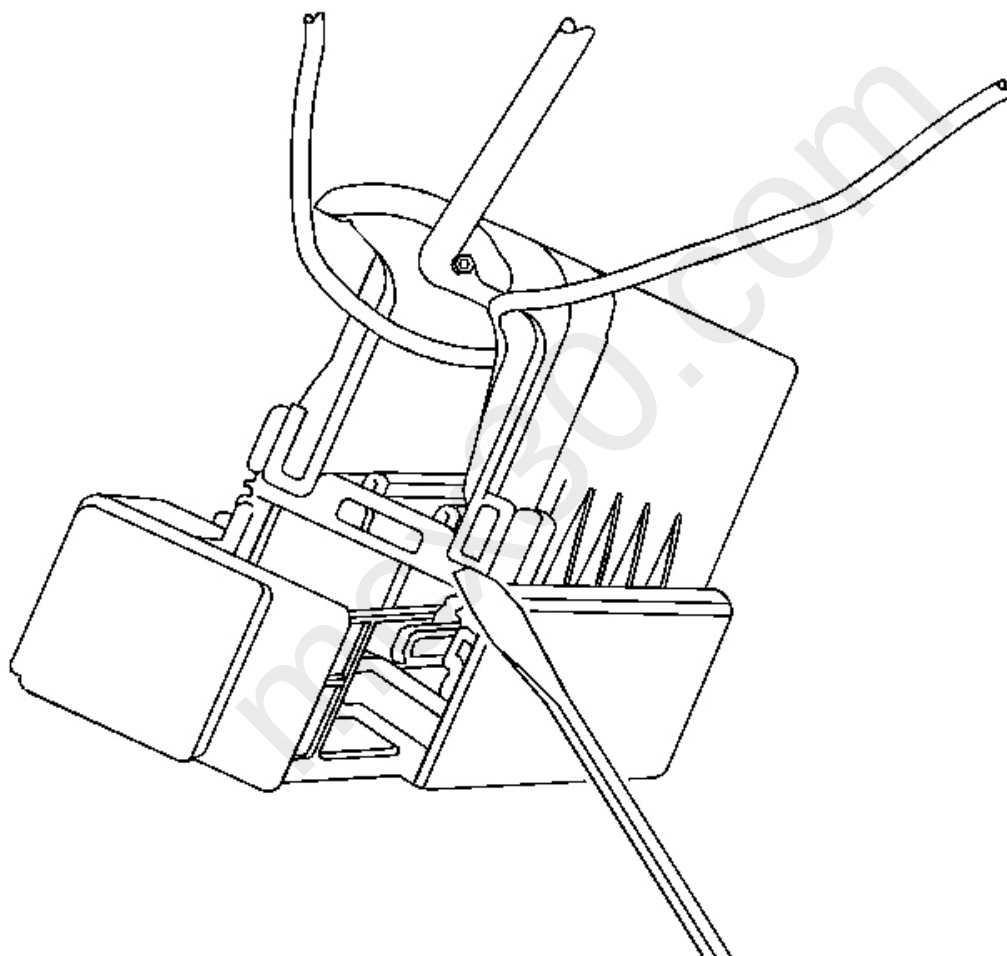


Fig. 154: Releasing TPA

Courtesy of GENERAL MOTORS CORP.

NOTE: Always use care when removing a terminal position assurance (TPA) in order to avoid damaging it.

5. Release the TPA by inserting a small flat-blade tool into the blue locking tabs on both ends of the connector. Gently slide the TPA up to the released position on both ends.

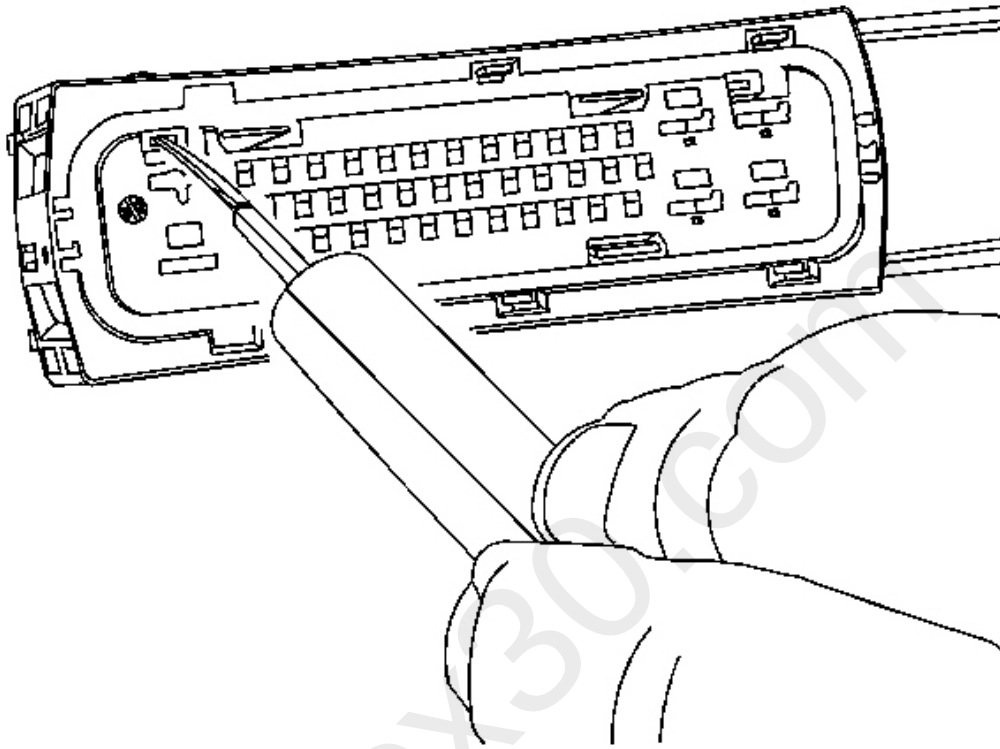


Fig. 155: Inserting Tool Into Terminal Release Cavity
Courtesy of GENERAL MOTORS CORP.

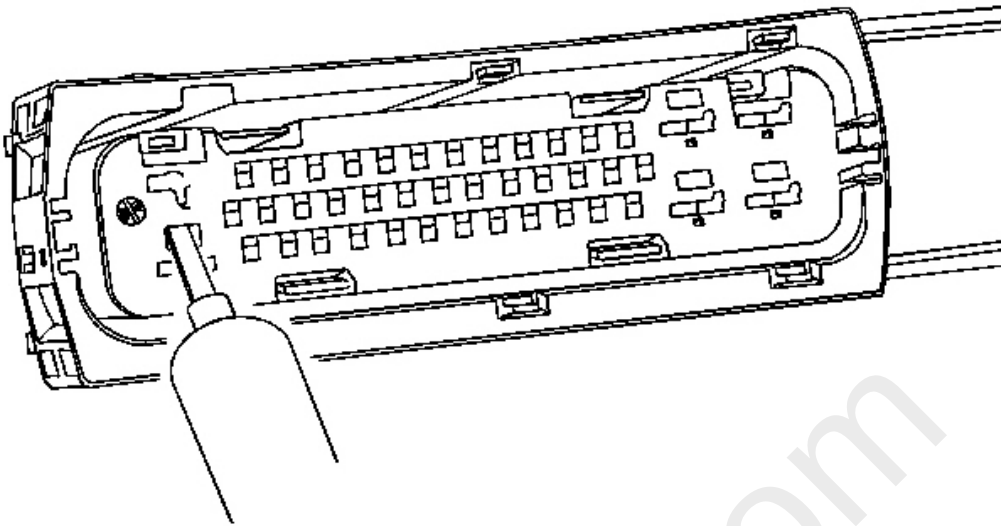


Fig. 156: View Of Release Tool Being Used For Larger Terminals
Courtesy of GENERAL MOTORS CORP.

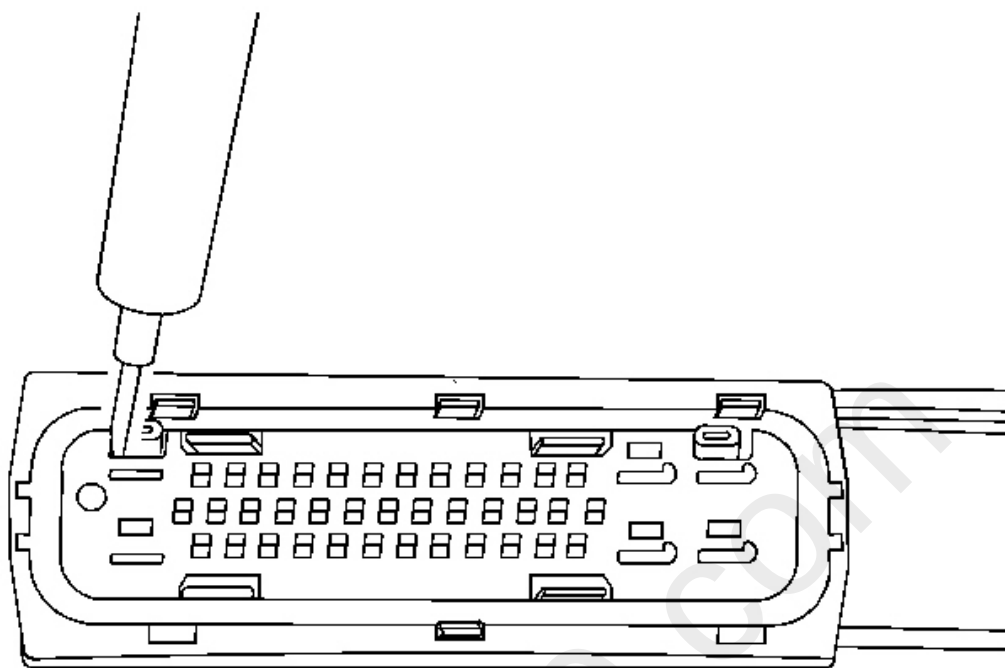


Fig. 157: View Of Release Tool Being Used For Larger Terminals
Courtesy of GENERAL MOTORS CORP.

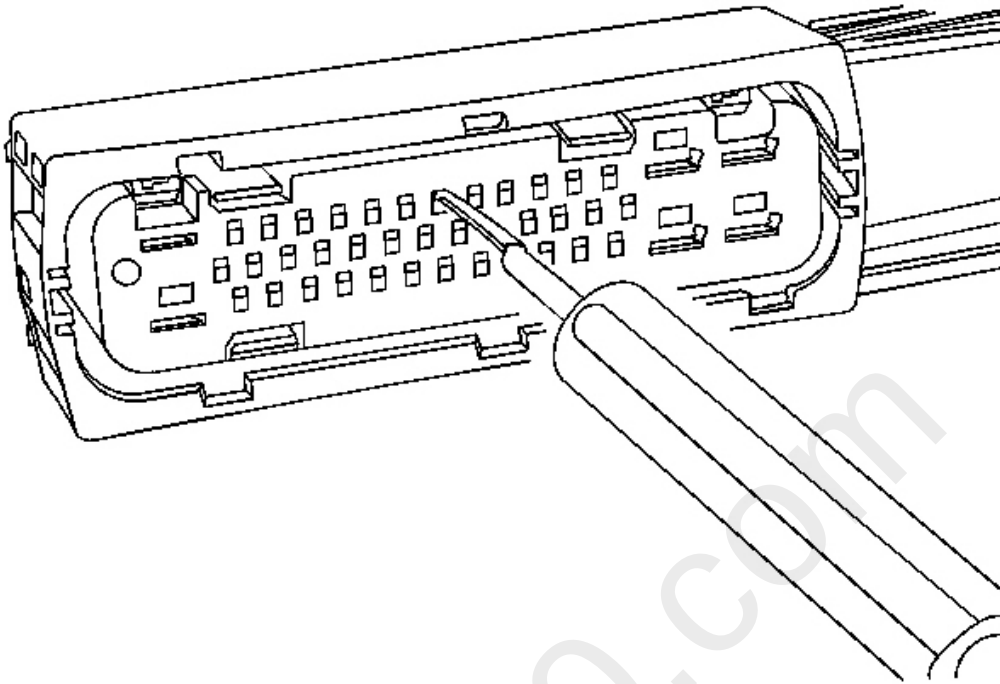


Fig. 158: View Of Release Tool Being Used For Smaller Terminals
Courtesy of GENERAL MOTORS CORP.

6. For the larger terminals insert the J 38125-13A tool to release the terminals by inserting the tool into the terminal release cavity. For the smaller terminals insert the J 38125-12A tool to release the terminals by inserting the tool into the terminal release cavity. See the release tool cross reference in the Reference Guide of the **J-38125** to ensure that the correct release tool is used.

View of the release tool being used for the larger terminals.

View of the release tool being used for the larger terminals.

View of the release tool being used for the smaller terminals.

7. While holding the removal tool in place, gently pull the wire out of the back of the connector. Always remember never use force when pulling a terminal out of a connector.

Repair Procedure

Use the appropriate terminal and follow the instructions in the **J-38125** .

Location of the terminal in the repair tray and the proper crimp tool can be found in the appropriate connector end view.

TYCO/AMP CONNECTORS (DOOR MODULE)

Special Tools

J-38125 Terminal Repair Kit

Removal Procedure

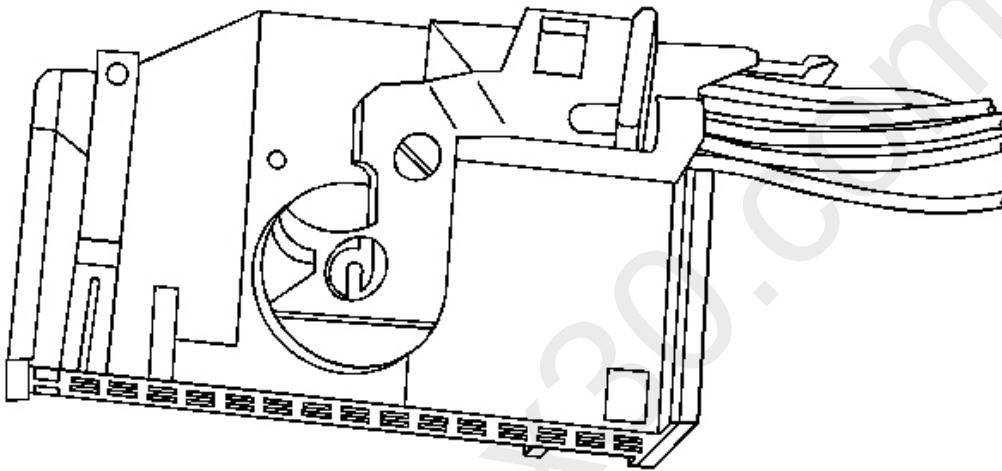


Fig. 159: Side View Of Tyco/AMP Connector
Courtesy of GENERAL MOTORS CORP.

Side view of connector.

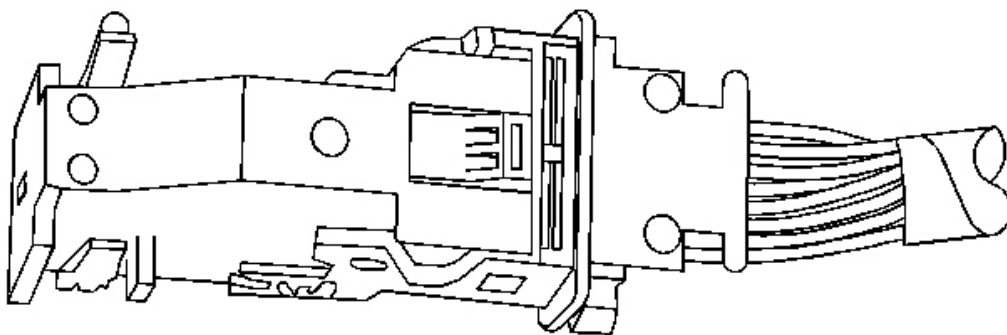


Fig. 160: Top View Of Tyco/AMP Connector
Courtesy of GENERAL MOTORS CORP.

View of top of connector.

1. Locate the assist lever and lock on the top of the connector.

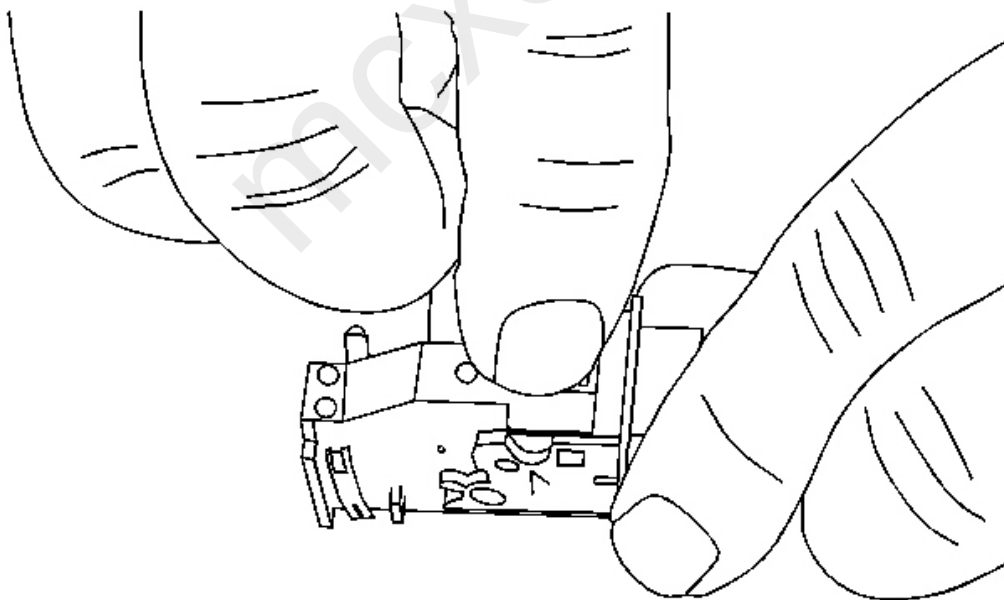


Fig. 161: Depressing Lock & Pulling Assist Lever

Courtesy of GENERAL MOTORS CORP.

2. While depressing the lock, pull the lever over and past the lock.

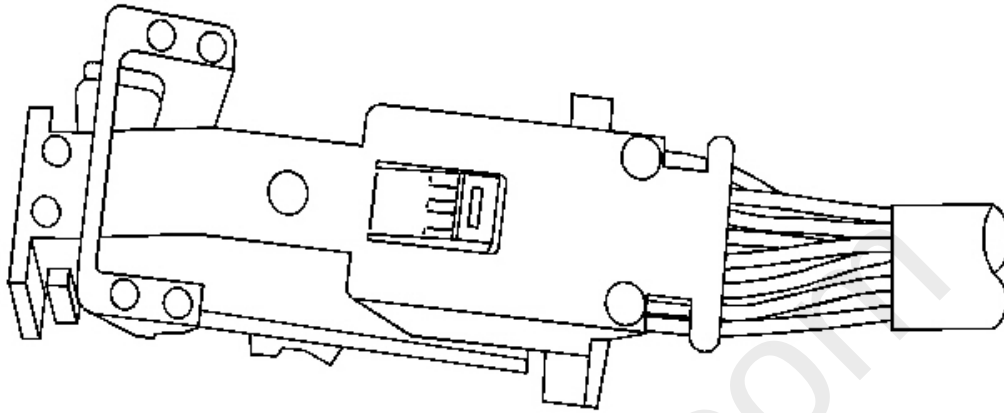


Fig. 162: View Of Component Connector
Courtesy of GENERAL MOTORS CORP.

3. Disconnect the connector from the component.

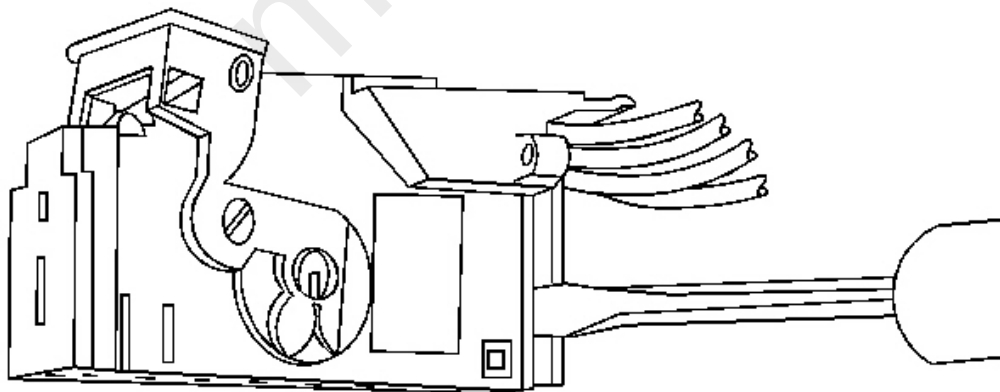


Fig. 163: Identifying Locking Tabs
Courtesy of GENERAL MOTORS CORP.

4. Locate the dress cover locking tabs at the rear of the connector. Use a small flat-blade tool to release the locking tabs. Repeat this procedure for the other locking tab.

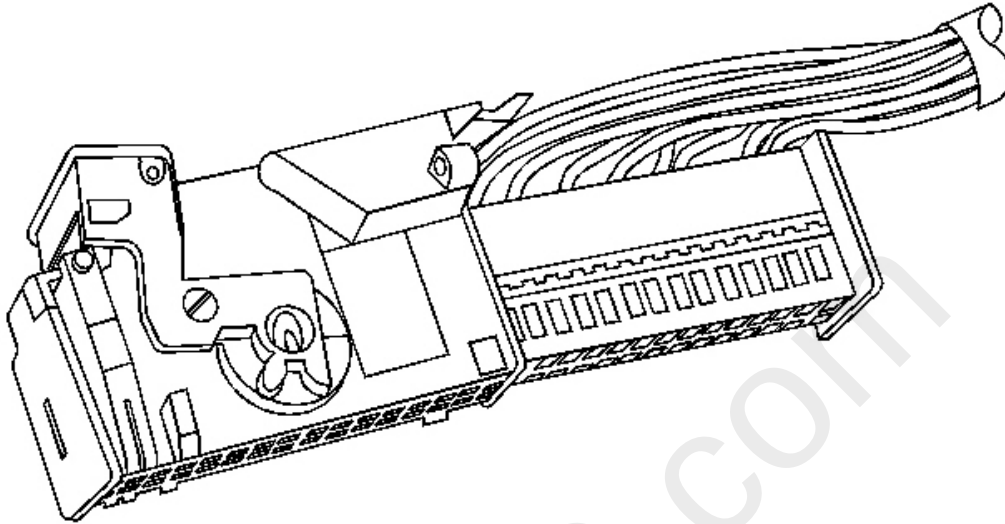


Fig. 164: Sliding Inner Connector Out Of Connector Housing
Courtesy of GENERAL MOTORS CORP.

5. Once the locking tabs are unlocked, slide the inner connector out of the rear of the connector housing.

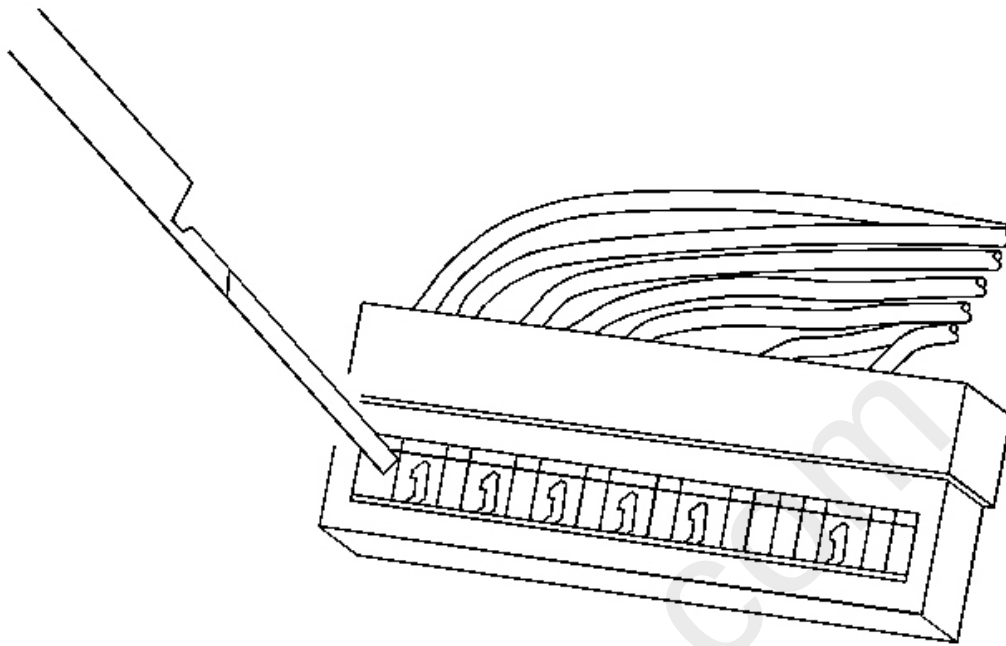


Fig. 165: Releasing Terminals
Courtesy of GENERAL MOTORS CORP.

6. Use the J 38125-12A tool to release the terminals by pressing on the tang. See the release tool cross reference in the Reference Guide of the **J-38125** to ensure that the correct release tool is used.
7. While holding the removal tool in place, gently pull the wire out of the back of the connector. Always remember never use force when pulling a terminal out of a connector.

Repair Procedure

Use the appropriate terminal and follow the instructions in the **J-38125** .

Location of the terminal in the repair tray and the proper crimp tool can be found in the appropriate connector end view.

YAZAKI CONNECTORS (2-WAY)

Special Tools

J-38125 Terminal Repair Kit

Terminal Removal Procedure

1. Disconnect the connector from the component.

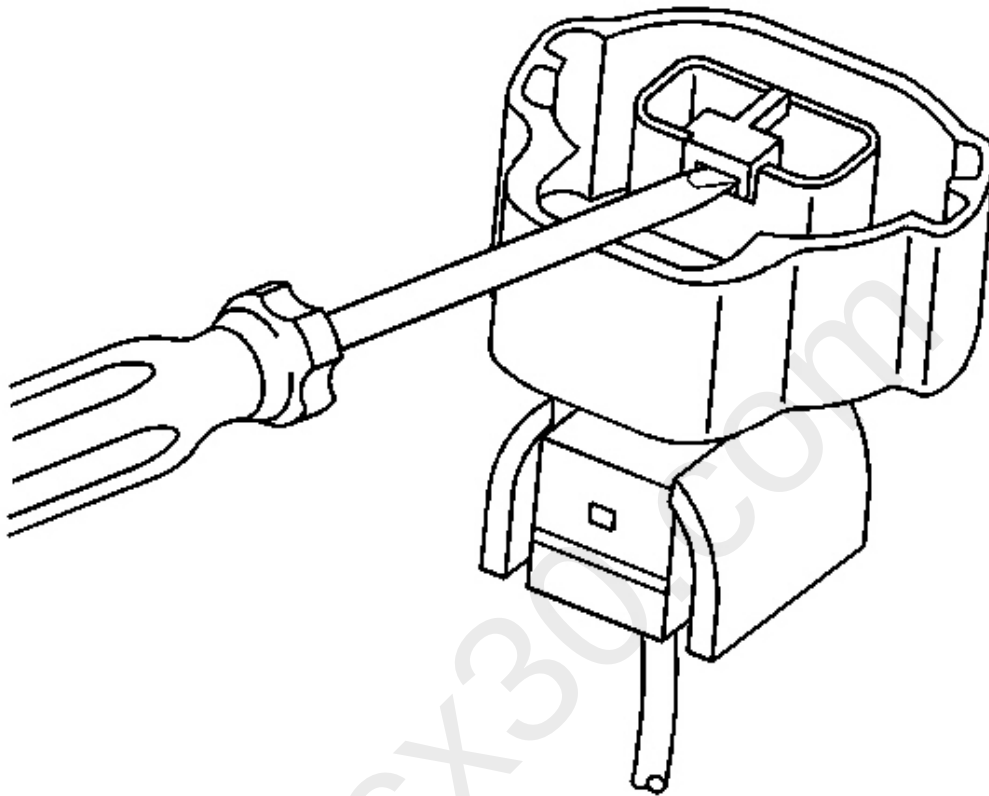


Fig. 166: Identifying Terminal Position Assurance (Yakazi)
Courtesy of GENERAL MOTORS CORP.

2. Insert a small flat-blade tool in the slot below the front loaded terminal position assurance (TPA) and pry up.
3. Remove the TPA by pulling it out of the connector.
4. Push the wire side of the terminal that is being removed toward the connector and hold it in position.

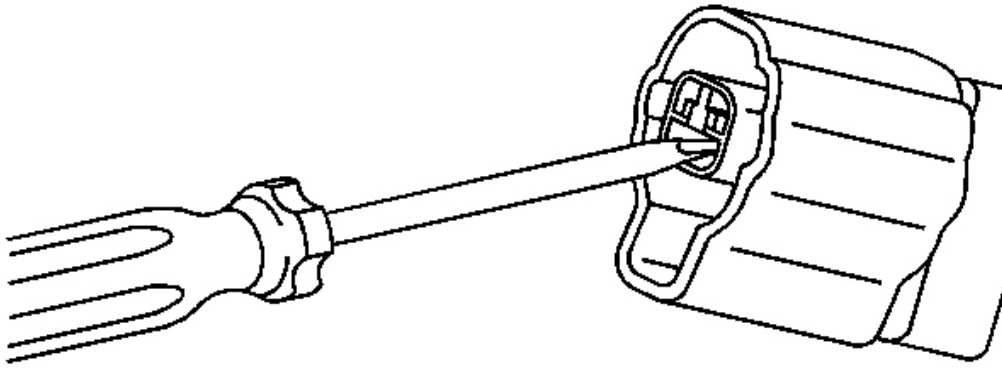


Fig. 167: Inserting Tool Into Terminal Cavity (Yakazi)
Courtesy of GENERAL MOTORS CORP.

5. Insert the J 38125-553 on a slight upward angle into the cavity below the terminal to be removed. Ensure that the pointed on the end of the tool is facing the bottom of the terminal and it stays in contact with the terminal until it stops on the plastic terminal retainer. See the release tool cross reference in the Reference Guide of the **J-38125** to ensure that the correct release tool is used.

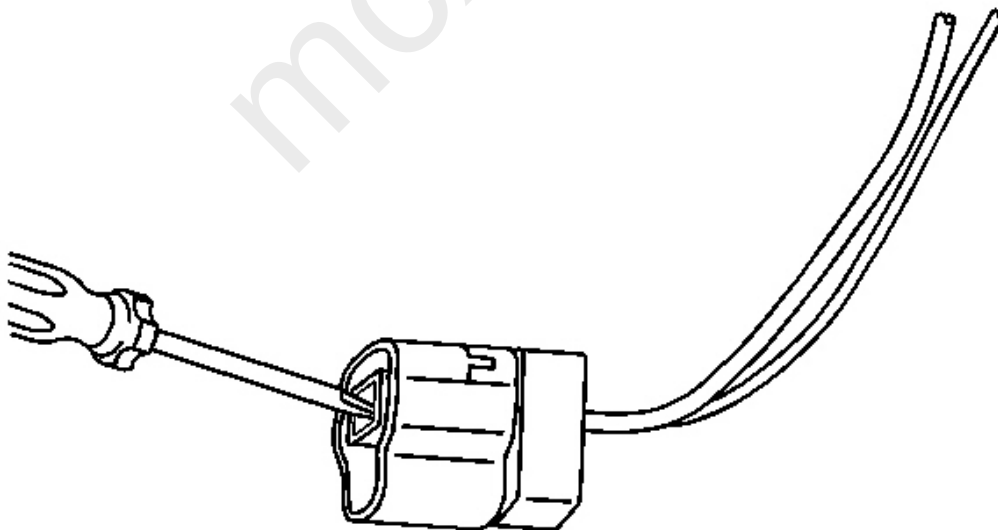


Fig. 168: Pulling Terminal Out Of Connector (Yakazi)
Courtesy of GENERAL MOTORS CORP.

6. Gently pry the plastic terminal retainer down and carefully pull the terminal out of the connector. Always remember never use force when pulling a terminal out of a connector. If the terminal is difficult to remove, repeat the entire procedure.

Terminal Repair Procedure

Use the appropriate terminal and follow the instructions in the **J-38125** .

YAZAKI CONNECTORS (16-WAY)

Special Tools

J-38125 Terminal Repair Kit

Removal Procedure

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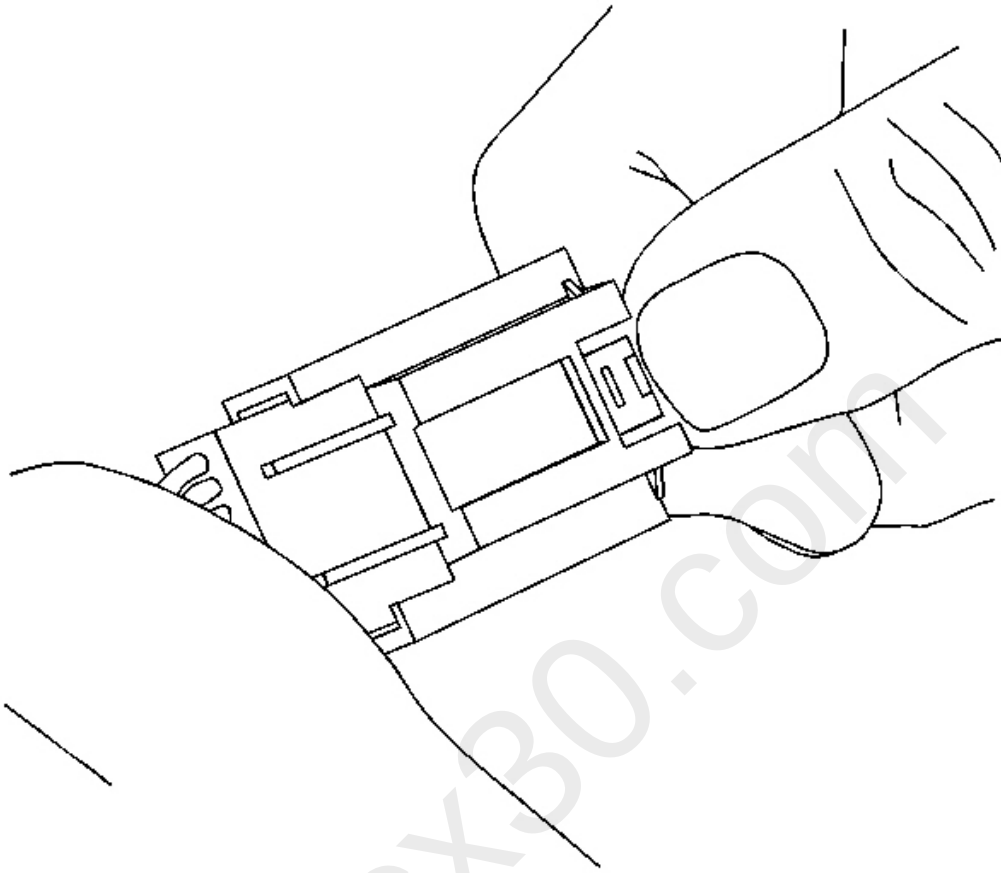


Fig. 169: Pulling Connector Halves Apart
Courtesy of GENERAL MOTORS CORP.

1. While depressing the lock, pull the two connector halves apart.

NOTE: **The TPA is fragile and may break if not done carefully.**

2. Use a small flat-blade tool to very carefully push the terminal position assurance (TPA) towards the face of the connector on both sides of the connector.

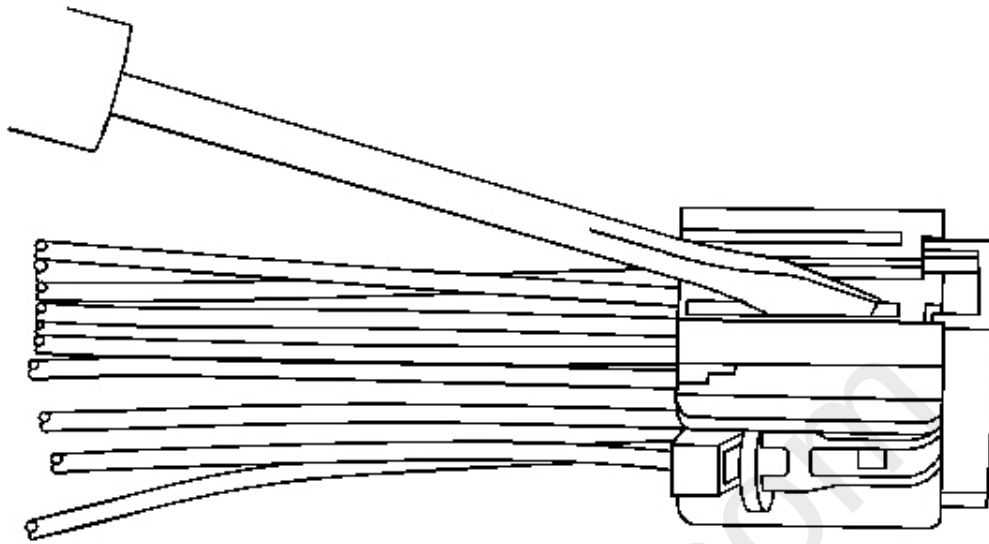


Fig. 170: View Of Male Connector Half & Female Terminals
Courtesy of GENERAL MOTORS CORP.

3. View of the male half of the connector with female terminals.

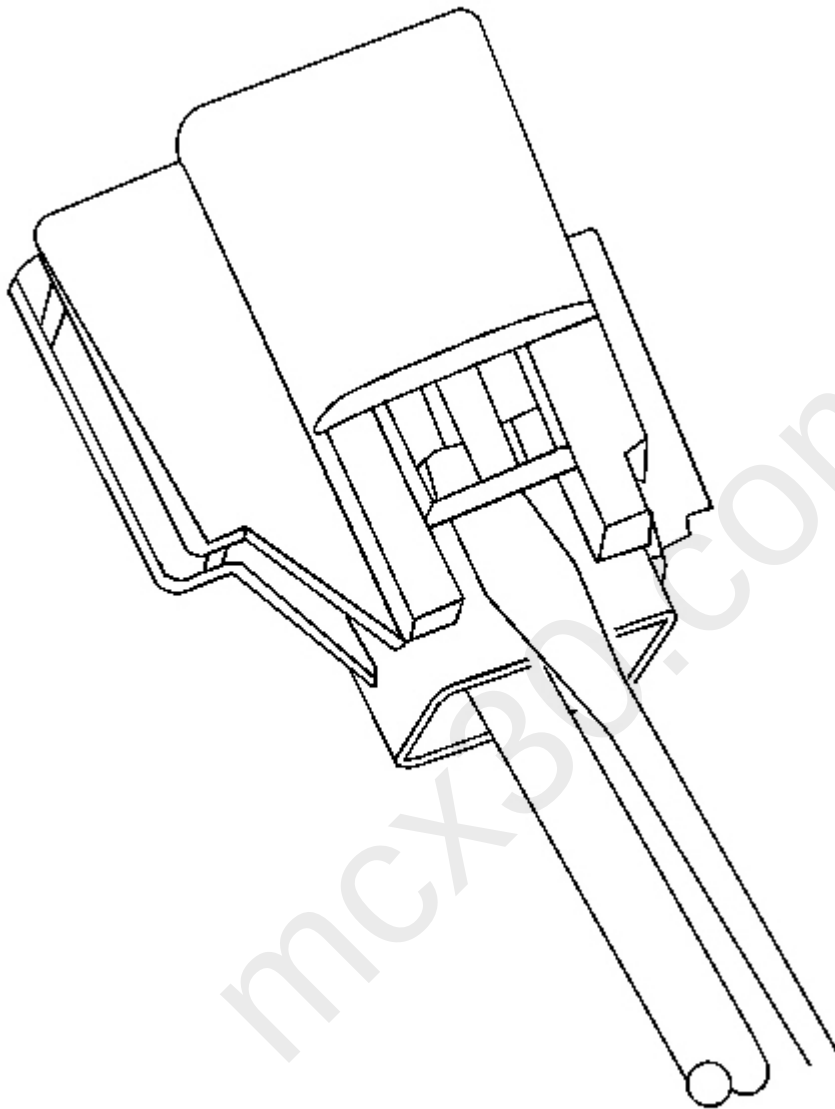


Fig. 171: View Of Female Half Of Connector With Male Terminals
Courtesy of GENERAL MOTORS CORP.

4. View of the female half of the connector with male terminals.
5. Use the J 38125-215 tool to release the terminals by inserting the tool into the terminal release cavity. See the release tool cross reference in the Reference Guide of the **J-38125** to ensure that the correct release tool is used.

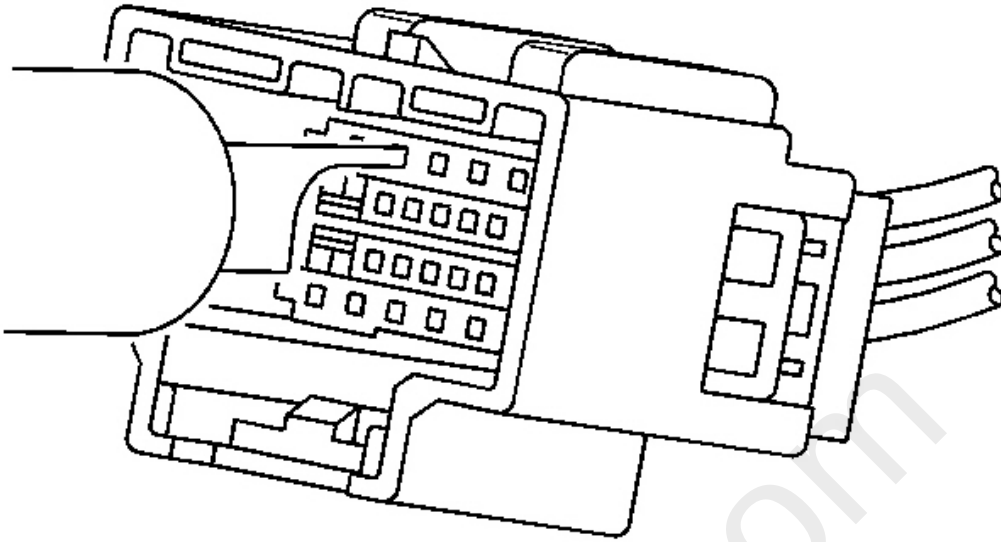


Fig. 172: Using Removal Tool On Female Half Of Connector
Courtesy of GENERAL MOTORS CORP.

6. View of the female half of the connector with male terminals.

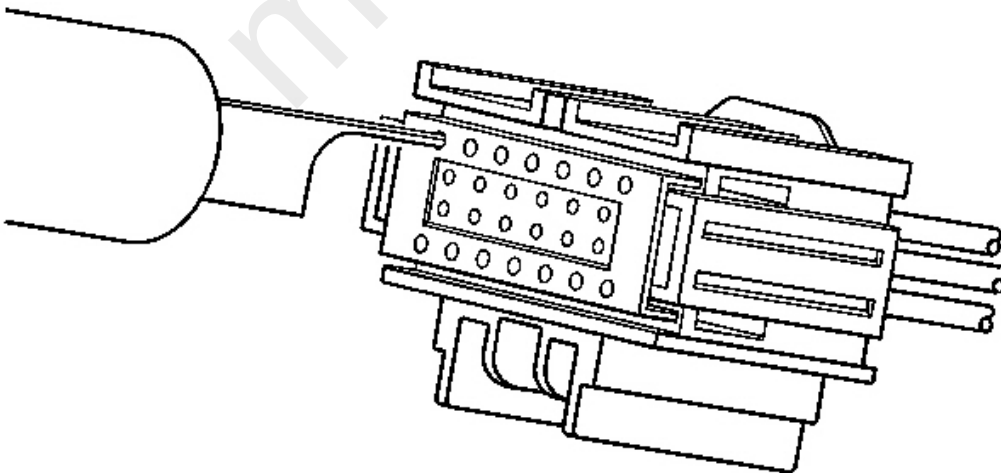


Fig. 173: Using Removal Tool On Male Half Of Connector
Courtesy of GENERAL MOTORS CORP.

7. View of the male half of the connector with female terminals.
8. While holding the removal tool in place, gently pull the wire out of the back of the connector. Always remember never use force when pulling a terminal out of a connector.

Repair Procedure

Use the appropriate terminal and follow the instructions in the **J-38125** .

Location of the terminal in the repair tray and the proper crimp tool can be found in the appropriate connector end view.

REPAIRING CONNECTOR TERMINALS

Special Tools

J-38125 Terminal Repair Kit

Use the following repair procedures in order to repair the following:

- Push to Seat terminals
- Pull to Seat terminals

Some terminals do not require all of the steps shown. Skip the steps that do not apply for your terminal repair. The **J-38125** contains further information.

1. Cut off the terminal between the core and the insulation crimp. Minimize any wire loss.

For cable seal terminals, remove the seal.

2. Apply the correct cable seal per gauge size of the wire, if used.

Slide the seal back along the wire in order to enable insulation removal.

3. Remove the insulation.
4. For sealed terminals only, align the seal with the end of the cable insulation.
5. Position the strip in the terminal.

For sealed terminals, position the strip and seal in the terminal.

6. Hand crimp the core wings.
7. Hand crimp the insulation wings.

For sealed terminals, hand crimp the insulation wings around the seal and the cable.

8. Solder all of the hand crimp terminals excepting Micro-Pack 100 .64 size. Soldering Micro-Pack 100 World terminals may damage the terminal.

TERMINAL WIRING REPAIR

Special Tools

- **EL-38125-10:** Splice Sleeve Crimp Tool
- **EL-38125-580:** Terminal Release Tool Kit
- **J-38125-5:** Ultra Torch
- **EL-35616:** Connector Test Adapter Kit

For equivalent regional tools, refer to Special Tools .

NOTE: **All repairs near the engine manifold, turbo engine and all exhaust pipes should follow the High Temperature Wiring Repair procedures.**

1. Find the appropriate connector end view within the connector end view section. The connector end view has the following information:
 - Diagnostic probe tool
 - Terminal release tool
 - Terminal/terminated lead part numbers
2. Determine if a terminal is damaged.

NOTE: **Not using the proper test kit probe may cause damage to the terminal(s) that are probed.**

- Locate the diagnostic probe tool from the connector end view. The connector end view describes the color and part number to help the technician find and use the correct tool.
 - Connect the probe tool to the Digital Multimeter.
 - Insert the probe tool into the cavity and follow the procedures from the Troubleshooting with a Digital Multimeter .
3. Disconnect the connector body to perform the repair.

NOTE: **Several procedures for specific connector bodies are called out in Wiring Repairs.**

Use the following repair procedures to repair the following terminals:

Delphi Connectors (Weather Pack) or Delphi Connectors (Push To Seat) or Delphi Connectors (Pull To Seat) or Delphi Connectors (Micro-Pack 100W) or Delphi Connectors (Micro .64) or Delphi Connectors (12-Way) or Delphi Connectors (Steering Gear)

- The TPA and CPA should be removed before releasing the terminal for the connector body.
- Look at the connector end view to locate the cavity of the damaged terminal and find the proper terminal release tool from the terminal release tool kit.

NOTE: Using the incorrect terminal release tool can damage the connector body.

- Insert the terminal release tool into the cavity.

NOTE: Some terminals have a lever that must be disengaged before the terminal can be released.

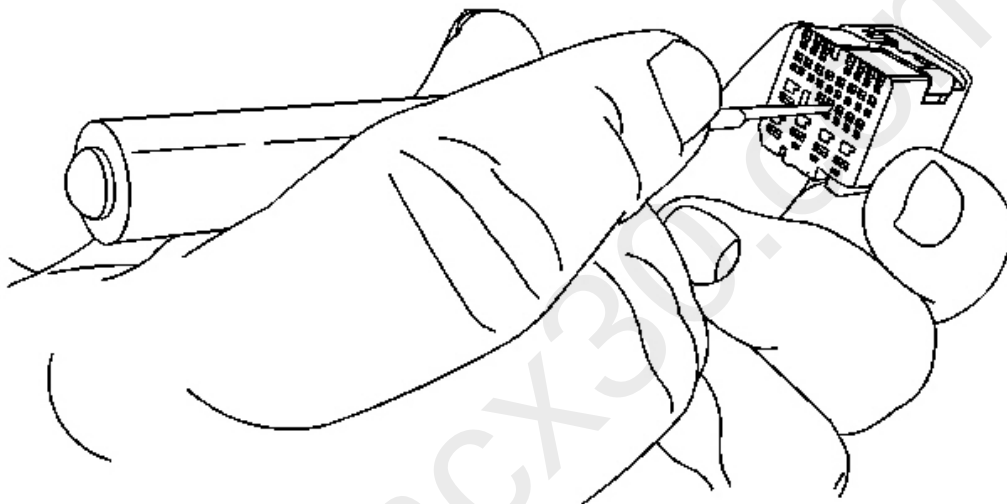


Fig. 174: Pulling Wire Out Of Back Of Connector
Courtesy of GENERAL MOTORS CORP.

Gently pull the wire out of the back of the connector.

TERMINATED LEAD REPAIR

Special Tools

- **EL-38125-10:** Splice Sleeve Crimp Tool
- **EL-38125-580:** Terminal Release Tool Kit
- **J-38125-5:** Ultra Torch
- **EL-35616:** Connector Test Adapter Kit

For equivalent regional tools, refer to **Special Tools** .

NOTE: **All repairs near the engine manifold, turbo engine and all exhaust pipes should follow the High Temperature Wiring Repairs procedures.**

Terminated leads are terminals that are crimped onto wires. The terminated lead can be used throughout the vehicle since it is designed for temperatures up to 150°C. The length of the wire is 450 mm.

The DuraSeal splice sleeve has the following 2 critical features:

- A special heat shrink tubing that environmentally seals the splice. The shrink tubing contains a sealing adhesive inside the shrink tubing.
- A cross hatched (knurled) core crimp that provides the necessary contact integrity for sensitive low energy circuits.

Part Number	Color	0.18-0.35	>0.35-1	>1-2.5	>2.5-5
19169142	Green (1)	X	-	-	-
12089189	Red (2)	-	X	-	-
12089190	Blue (3)	-	-	X	-
12089191	Yellow (4)	-	-	-	X

1. Use the connector end view to identify the correct terminated lead.
2. The terminated lead package should include a DuraSeal splice sleeve. If not, use the chart to identify the correct part.
3. Open the harness by removing any tape:

Use a sewing seam ripper, or a comparable tool, to cut open the harness, to avoid wire insulation damage.

4. Depending on how many terminals need repairs, cut the terminal and wire back at least 40 mm. Try to keep the harness wire length the same.

If more than one terminated lead is required, stagger the lengths by 40 mm. This helps reduce the bundle size of the wire harness.

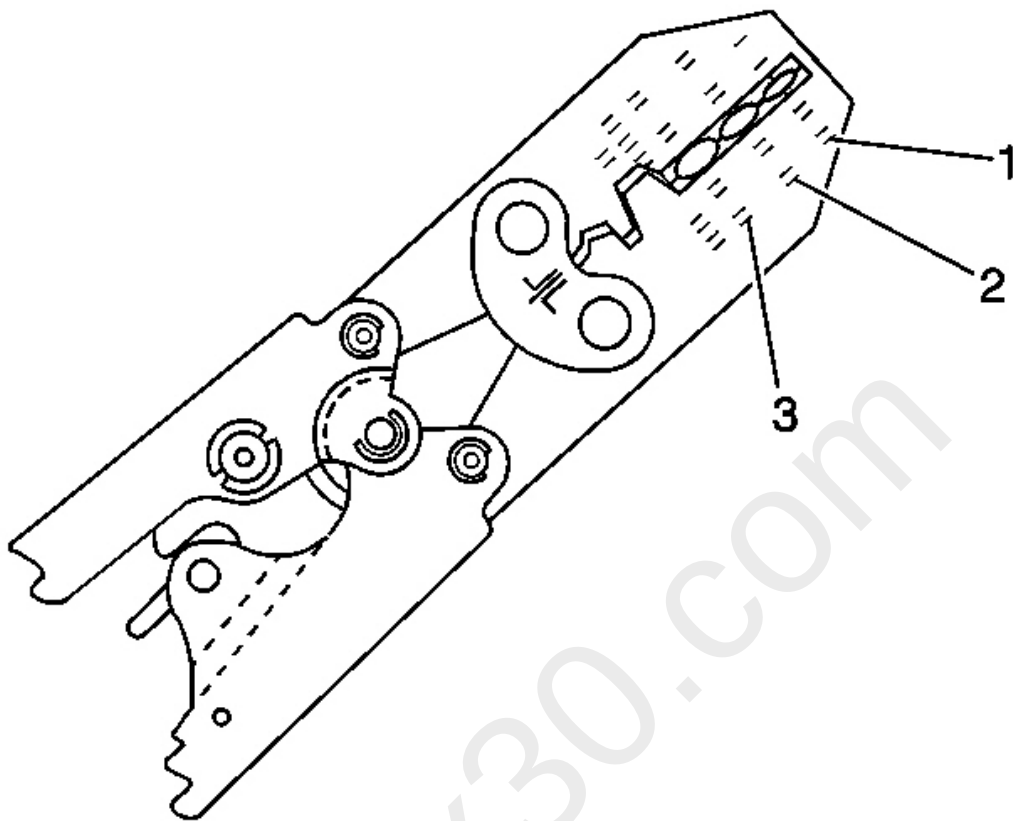


Fig. 175: Identifying Splice Crimp Tool Nests Terminal Identification
Courtesy of GENERAL MOTORS CORP.

5. Use the **EL-38125-10**: tool in order to position the DuraSeal splice sleeve in the proper color nest of the splice sleeve crimp tool. The crimp tool has four nests, one for each color.

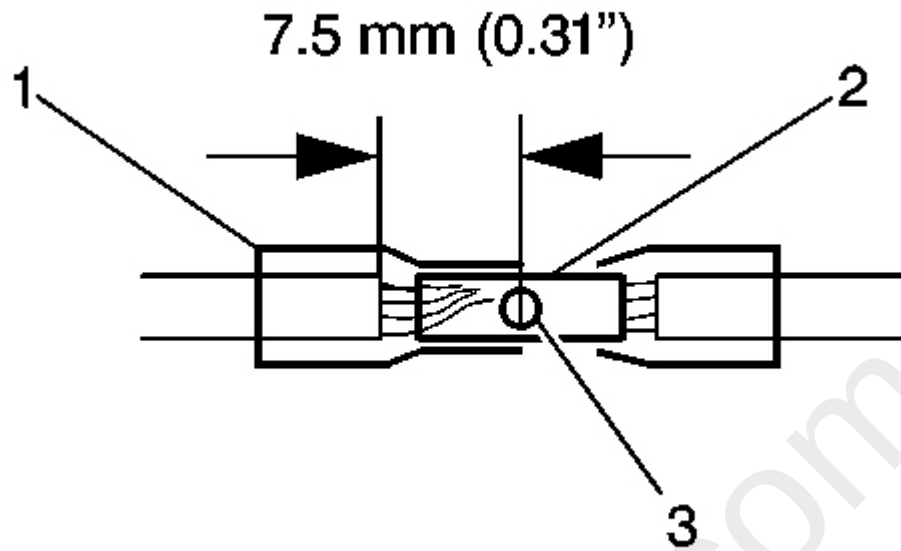


Fig. 176: Identifying Duraseal Splice Sleeve
 Courtesy of GENERAL MOTORS CORP.

6. Place the DuraSeal splice sleeve in the nest. Ensure that the crimp falls midway between the end of the barrel and the stop. The sleeve has a stop (3) in the middle of the barrel (2) in order to prevent the wire (1) from going further. Close the hand crimper handles slightly in order to firmly hold the DuraSeal splice sleeve in the proper nest.



Fig. 177: Identifying Crimped Duraseal Splice Sleeve
 Courtesy of GENERAL MOTORS CORP.

7. Insert the wire into the splice sleeve barrel until the wire hits the barrel stop.

8. Tightly close the handles of the crimp tool until the crimper handles open when released.

The crimper handles will not open until you apply the proper amount of pressure to the DuraSeal splice sleeve. Repeat steps 4 and 5 for the opposite end of the splice.



Fig. 178: Identifying Heated Splice Sleeve
Courtesy of GENERAL MOTORS CORP.

9. Using the **J-38125-5**: ultra torch, apply heat to the crimped area of the barrel.
10. Start in the middle and gradually move the heat barrel to the open ends of the tubing:
 - The tubing will shrink completely as the heat is moved along the insulation.
 - A small amount of sealant will come out of the end of the tubing when sufficient shrinkage is achieved.

IGNITION KEY CANNOT BE REMOVED FROM THE IGNITION LOCK CYLINDER

Step	Action	Yes	No
1	Did you review the Steering Wheel and Column Description and Operation and perform the necessary inspections?	Go to Step 2	Go to <u>Symptoms - Steering Wheel and Column</u>
2	Verify the ignition key cannot be removed from the ignition lock cylinder. Is the ignition key stuck in the lock cylinder?	Go to Step 3	System OK
3	Is the vehicle equipped with a manual transmission?	Go to Step 8	Go to Step 4
4	Turn the ignition key to the OFF position. Can the ignition key be turned to the OFF position and be removed?	Go to Step 8	Go to Step 5
5	Verify the adjustment of the shift control linkage. Refer to <u>Range Selector Lever Cable Adjustment</u> for RPO MH7 or MHC. Refer to <u>Range Selector Lever Cable Adjustment</u> for RPO MH2 or MH4. Can the ignition key be turned to the OFF position and be removed?	System OK	Go to Step 6

6	Inspect for a faulty ignition lock cylinder. Is the ignition lock cylinder damaged?	Go to Step 8	Go to Step 7
7	Inspect the ignition/start switch housing. Is the housing worn, damaged or loose?	Go to Step 9	Go to Step 10
8	Replace the ignition lock cylinder. Refer to <u>Ignition Lock Cylinder Replacement</u> . Did you complete the repair?	Go to Step 10	-
9	Replace the ignition/start switch housing. Refer to <u>Ignition and Start Switch Housing Replacement</u> . Did you complete the repair?	Go to Step 10	-
10	Operate the system to verify the repair. Did you correct the condition?	System OK	-

IGNITION KEY CANNOT TURN OR STICKS IN ANY POSITION

Step	Action	Yes	No
1	Did you review the Steering Wheel and Column System Description and perform the necessary inspections?	Go to Step 2	Go to <u>Steering Wheel and Column Description and Operation</u>
2	Verify that the ignition key sticks or cannot turn in any position. Is the key functioning correctly?	System OK	Go to Step 3
3	Inspect for an incorrect, worn, or damaged ignition key. Is the ignition key incorrect, worn, or damaged?	Go to Step 7	Go to Step 4
4	Inspect for a faulty ignition lock cylinder. Is the ignition lock cylinder damaged?	Go to Step 8	Go to Step 5
5	Inspect the ignition and start switch assembly for damage. Is the ignition and start switch assembly damaged?	Go to Step 9	Go to Step 6
6	Inspect the ignition and start switch housing for looseness. Is the ignition and start switch housing loose?	Go to Step 10	Go to Step 11
7	Replace the ignition key. Did you complete the repair?	Go to Step 11	-
8	Replace the ignition lock cylinder. Refer to <u>Ignition Lock Cylinder Replacement</u> . Did you complete the repair?	Go to Step 11	-
9	Replace the ignition and start switch. Refer to <u>Ignition and Start Switch Replacement</u> . Did you complete the repair?	Go to Step 11	-
	Tighten or replace the ignition and start switch		

10	housing. Refer to <u>Ignition and Start Switch Housing Replacement</u> Did you complete the repair?	Go to Step 11	-
11	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to Step 2

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