SECTION C: CONTROLS COMPONENT INSTALLATION

ALLISON 4TH GENERATION CONTROLS

Items discussed in the CONTROLS COMPONENT INSTALLATION section are:

SECTION C: CONTROLS COMPONENT INSTALLATION

1.0 INTRODUCTION

This section defines the proper installed location and environment of the major transmission controls components. Individual items discussed in this section are:

- Transmission Control Module (TCM)
- Shift Selectors
- Wiring Harnesses
- Speed Sensors
- Retarder Controls
- Vehicle Interface Module (VIM)

Some of these components are model-dependent and may not be applicable to your transmission assembly. For general descriptions of the above components, refer to *Section A: Controls Familiarization* in this manual.

Unless otherwise noted, all documents referred to in this section may be found on the Extranet at the Allison Transmission website, *www.allisontransmission.com*. To locate the documents, which are identified by *italic* font, look for Tech Data under the Engineering heading on the Extranet home page. Contact your Allison Transmission representative if you do not have access to the Allison Transmission Extranet.

2.0 GENERAL GUIDELINES

2.1 BEFORE STARTING THE ENGINE...

NOTE: All of the following must be properly installed and interfaced with the TCM before initial start-up of the engine:

- **main electrical connector to transmission**
- **speed sensors**
- **shift selector**
- **retarder, if applicable**
- **retarder modulation request (RMR) controls, if applicable**
- **transfer case, if applicable**
- **throttle position sensor (TPS), if applicable**
- **engine brake**

If the engine is started before all transmission-related components and connectors are properly installed, the Autodetect feature of the TCM may not determine the proper powertrain configuration. As a result, transmission system diagnostic codes may be recorded or Autodetect may require resetting to operate properly.

2.2 WELDING ON THE VEHICLE

Take the following steps whenever welding on the vehicle:

- Always disconnect the harnesses from the TCM.
- Always disconnect the TCM power and ground circuits from the battery.
- Do not connect welding cables to controls components.
- Do not weld on controls components.
- Always protect controls components from sparks and heat.

A label, which describes the appropriate steps to take when welding, is available from SGI, Inc, and should be installed in a conspicuous location on all vehicles. Vehicles used in vocations which typically involve modifications or frequent repairs requiring on-vehicle welding must display the label. Refer to *Section F: Controls Support Equipment* in this manual for SGI contact information.

2.3 PAINTING ON THE VEHICLE

2.3.1 ELECTROSTATIC PAINTING

If the vehicle chassis or body is painted using an electrostatic painting process, electrical voltage must not be discharged through the TCM. To prevent this possibility, Allison recommends installing the TCM after the electrostatic paint process is complete. If the TCM is installed prior to electrostatic painting, the vehicle builder must insure the following:

- that the TCM is not painted
- that the elements being painted are properly and continuously grounded to earth during the entire painting process

Allison Transmission is not responsible for TCM damage which results from improper grounding during electrostatic painting of the vehicle.

During electrostatic painting, the paint droplets receive an electrostatic charge which attracts them to earth-grounded surfaces. Voltages at the spray gun can exceed several thousand volts. The charge which builds up on an improperly grounded chassis or body can be discharged through the TCM, resulting in damage to the TCM.

2.3.2 PAINTING OF TRANSMISSION CONTROL COMPONENTS

While it may be desirable to paint chassis-mounted components in order to enhance overall vehicle appearance and/or provide corrosion protection, the transmission control components must not be painted due to:

- paint residue can compromise the integrity of connectors and connector seals.
- paint can reduce thermal conductivity from inside the TCM to ambient air.
- paint can cover labels or other identification, hindering the process to service these components.

2.4 ENVIRONMENT

Allison Transmission designed the Allison controls components to operate in normal vehicle cab and chassis environments. The Allison controls components will withstand moisture, direct light and heat, and shock loads. The TCM, Allison shift selectors, and their connectors are sealed, but are not considered immersible.

Installations of the Allison controls components must meet the environmental requirements in the *Allison 4th Generation Controls Specifications*. In addition, mount the Allison controls components away from direct exposure to road hazards and weather.

In order to meet the temperature limits in the *Controls Specifications*, allow for free air movement around each component. The air movement will dissipate heat away from the components. Exceeding the temperature limits will reduce the life of the components.

2.5 SERVICE REQUIREMENTS

Access to service the control components is necessary throughout the life of the vehicle. Service access must be considered when designing the installation of the transmission and controls components and should include the effort required to remove covers, body parts, or chassis members to gain access to the component(s) being serviced.

The Allison Service Department has established required maximum times for removal and replacement (R&R) for Allison transmissions, controls, and related components. For additional information regarding these requirements, refer to *Technical Document 176 (TD-176), Service Requirements — Removal and Replacement Times for Allison Transmissions.*

Clearance and access must be provided to remove the wiring harness connectors from the following controls components:

- TCM
- Shift selectors - 3000/4000 Product Families only
- Transmission main connector
- Speed sensors
- Retarder controls - 3000/4000 Product Families only
- Retarder valve body connector - 3000/4000 Product Families only
- Throttle Position Sensor
- Vehicle Interface Module

Refer to the appropriate controls installation drawing or transmission installation drawing for minimum clearances. Provide sufficient slack in the harness at the connectors in order to minimize stress on the harness and connectors.

2.6 ELECTROMAGNETIC COMPATIBILITY

The transmission control system has been designed and tested to meet strict standards for electromagnetic compatibility in the vehicle environment.

Minimize the potential for electromagnetic interference by

- locating and mounting the TCM as described in Section 3.0 of this document
- designing the transmission wiring harness to meet all requirements in *Technical Document 173 (TD-173), Wiring Harnesses for Transmissions Equipped with Allison 4th Generation Controls.*
- routing and installing the transmission wiring harness according to Section 6.0 in this document.
- providing suppression for customer-supplied electrical components used with the transmission control system. Refer to *Section D: Vehicle Electrical System Interface* of this manual.

The OEM or body builder must verify that the vehicle wiring does not adversely affect the transmission control system. The OEM or Body Builder may contact Allison Transmission Application Engineering for help in this evaluation. In addition, the OEM or body builder must verify that the transmission control system does not adversely affect other vehicle systems.

2.7 DOCUMENTATION

All vehicle wiring, especially wiring that interfaces with the transmission control system, must be completely documented in vehicle schematics. Include relays and interface connections in the documentation. A decal should be placed on the vehicle showing the location of all interface relays, Allison components, and interface connections.

Failure to provide adequate documentation will result in increased downtime. Service personnel could spend excess time tracing undocumented wiring systems and locating undocumented vehicle interface components.

3.0 TRANSMISSION CONTROL MODULE (TCM)

Refer to the Transmission Control Module (TCM) installation drawing, AS07-412.

3.1 ELECTRICAL ISOLATION

CAUTION: Electrically isolate the TCM from the vehicle chassis. In order to prevent grounding of the TCM case to the chassis, provide a minimum of 6.4 mm (0.25 inch) clearance between the TCM housing and un-isolated conductive material near the TCM.

The vehicle chassis is often used as the ground structure for various vehicle systems. Failure to electrically isolate the transmission TCM from the vehicle chassis increases the risk that parasitic currents may travel through the transmission TCM and degrade the transmission system performance. In severe cases, transmission TCM component damage may result.

Much of the external structure of the TCM, including the mounting provisions, is constructed of nonconducting material. However, the central section of the TCM, which contains numerous protruding cooling fins, is made of conductive material. The conductive portion of the TCM must not contact any items which could provide a ground path to the chassis.

3.2 ELECTROMAGNETIC COMPATIBILITY

CAUTION: Do not locate the TCM where it is subjected to sources of electrical interference. Do not mount the TCM within 150 mm (6.0 inches) of any inductive control devices or inductive loads. Such devices include motors, fuel injectors, ignition coils, fluorescent ballasts, inverters, switches and relays. Noise emitted from devices of this type can cause TCM performance degradation.

If it is not possible to follow the above recommendations, the OEM or Body Builder must evaluate the installation. The OEM or body builder must verify that the vehicle wiring does not adversely affect the transmission control system. The OEM or Body Builder may contact Allison Transmission Application Engineering for help in this evaluation.

3.3 TCM MOUNTING

3.3.1 LOCATION

- The preferred mounting location for the TCM is the vehicle cab.
- Do not mount the TCM on the transmission. The environmental conditions on the transmission are too severe for the TCM.
- Although in-cab mounting is the much-preferred location, mounting on the chassis or in the engine compartment may be adequate. The TCM must be protected from the following:
  - high pressure wash
  - direct road spray/debris
  - the environmental concerns discussed in section 2.3 in this document
  - damage during normal vehicle service procedures

  One method of providing this required protection is to install a splash shield around the TCM as illustrated in Figure C-1.

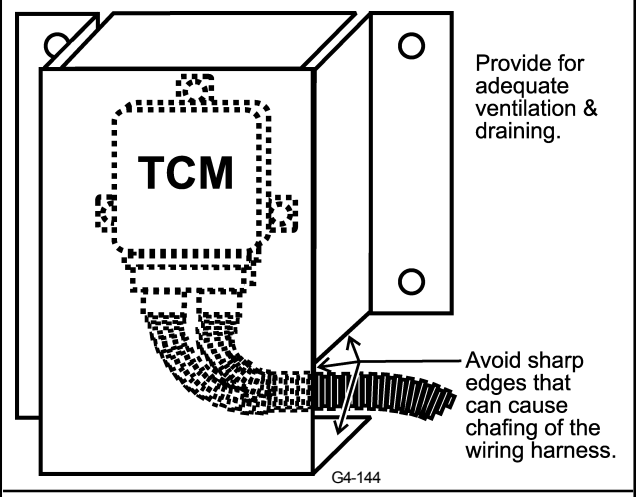


Figure C-1: Typical Splash Shield

- **Chassis mounting of the TCM must be reviewed for acceptability by Allison Engineering.**
- Shield the TCM from heat if it is located closer than 300 mm (12 in.) to the exhaust. The shield must not trap dirt and debris and must permit air flow around the TCM.
- Allow sufficient clearance to install and remove the harness connector. Refer to AS07-412 for minimum clearance requirements.

3.3.2 ATTACHMENT

- Use the three mounting pads with thru-holes to attach the TCM to a flat, rigid surface. The three mounting holes are located on the non-conducting portion of the TCM case. Refer to the TCM installation drawing, AS07-412, for the location and size of the mounting holes.
- Attach the TCM to a rigid surface that meets the flatness requirements shown on the TCM installation drawing. The flatness of the mounting surface is important in order to prevent damage to the TCM case during installation.
- Maintain the clamping torque on all three TCM mounting pads, as specified on AS07-412, over the life of the vehicle. Allison Transmission recommends lockwashers or prevailing torque nuts to meet this requirement. Use of such fasteners will also avoid excessive torque on the mounting bolts and avoid excessive clamping force on the TCM mounting pads. Failure to maintain the proper clamp on any of the three TCM feet could result in vibration or other problems which may result in degradation of TCM performance.
- The TCM must be oriented with the connector pointing horizontal or downward, between 3 o'clock and 9 o'clock. This orientation directs any moisture on or in the harness away from the connector. Figure C-1 illustrates an acceptable TCM mounting orientation.

4.0 SHIFT SELECTOR SYSTEM – 1000/2000 PRODUCT FAMILIES

For the 1000/2000 Product Families the shift selector system is customer-furnished. Refer to *Section F: Controls Support Equipment* of this manual for suppliers of shift selectors and shift system components. For detailed design requirements, refer to *Technical Document 177 (TD-177): Specifications for Shift Selector and Cable System* and to installation drawing AS64-410, Shift Selector Design Requirements. *TD-177* also describes various shift selector configurations.

CAUTION: The vehicle manufacturer is responsible for selecting and installing the correct shift selector hardware to match the configuration of the transmission and the installation. For example:

- **Use a selector with a Park (P) position only with a transmission that includes a park pawl.**
- **Use a selector with a Park Brake (PB) position only in an installation that automatically applies the park brake when the PB position is selected.**
- **Use a selector without a P or PB position in an installation that does not have a transmission park pawl or an automatically applied park brake**

The final vehicle assembly inspection procedure MUST include a check to verify that the correct combination of shift selector/transmission assembly has been installed and that the park mechanism, if present, operates properly.

WARNING: If a selector with a Park Brake (PB) position is used, the vehicle's Park Brake must be automatically applied whenever the selector is shifted to the PB position.

4.1 SHIFT SELECTOR INSTALLATION

The shift selector installation must provide rigidity, strength, and isolation from noise and vibration. Consult the shift selector manufacturer for specific installation requirements.

4.2 TRANSMISSION DETENTS

Positive detents are provided in the transmission to center and hold the selector shaft in each selected position. The shift selector linkage friction must not override the transmission's internal detents. The shift selector system must permit the operator to detect when the transmission is in a detent position.

4.3 TRANSMISSION SHIFT LEVER INSTALLATION

Failure to properly install or adjust the shift lever on the transmission may result in the generation of diagnostic codes. Misadjustment may also affect reverse warning or neutral start signal functionality. Refer to the Shift Selector Design Requirements installation drawing, AS64-410. Follow the procedure below when installing the shift lever onto the transmission selector shaft.

1. Verify that the proper side of the shift lever is facing toward the transmission. Verify that the lever is in the proper angular orientation to the selector shaft.

2. Align the slot in the shift lever with the flats on the selector shaft.

3. Push the shift lever onto the shaft far enough to install the retaining nut.

CAUTION: DO NOT drive the lever onto the selector shaft.

4. Use the lever to rotate the selector shaft clockwise until the stop inside the transmission prevents any further shaft rotation. Manually tighten the nut to the torque shown on the Shift Selector Design Requirements installation drawing.

CAUTION: DO NOT use an impact wrench to tighten the nut, as this may damage components in the transmission.

5. Verify that the lever is seated tightly against the shoulder of the selector shaft.

6. Orient the selector shaft in the Neutral position, which is the proper position when making cable adjustments (Section 4.5). The transmission main case includes a cast feature which identifies the orientation of the selector shaft in this position.

4.4 SHIFT CABLE INSTALLATION

Follow all installation requirements of the manufacturers of the shift selector, cable, and associated hardware. Follow all special requirements to verify proper selection of gear range positions.

For maximum efficiency, follow the guidelines below when routing the shift cable:

- Make cable routing as short and direct as possible.
- Avoid bends should where possible. If bends are required, make them as large as practical, particularly when direction changes in the cable routing are necessary.
- Minimum bend radii are normally considered to be 127 mm (5.0 in). Consult cable manufacturer to confirm requirements for the components used in your installation.

In order to prevent movement during vehicle operation, secure the shift cable as described below:

- Secure cable to adjacent structures.
- Use an adequate number of cable tie-down points to minimize cable motion.
- Do not tie cable to flexible or movable items such as wire bundles or hoses.
- Always secure cables along straight sections of the cable.
- Secure cable tangentially to bends.

Protect the cable from damage.

- Avoid potentially abrading surfaces such as screws, bolt heads, slits of nylon conduit, or sheet metal edges.
- Use rubber edge guards, grommets, or portions of conduit to protect cables that pass through holes in sheet metal.
- At the transmission end of the cable, keep the shift cable rod free of paint, undercoating, or other adhering substances.
- Use a protective cover on the exposed end of the cable during the application of paint or undercoating to the vehicle.

4.5 SHIFT SELECTOR AND CABLE ADJUSTMENT

The shift cable must be adjusted after the shift selector has been installed in its permanent mounting location, the shift cable routing is finalized, and the cable has been secured.

NOTE: All changes to the shift cable routing, including changes to the shift selector location, will affect the adjustment of the shift cable. Therefore, the shift cable must be readjusted if its routing is modified by a body builder or during transmission or vehicle service.

When properly adjusted, the handle of a lever shifter should be centered in each gate position when the transmission selector shaft is held in place by the internal transmission detent. See Figure C-2.

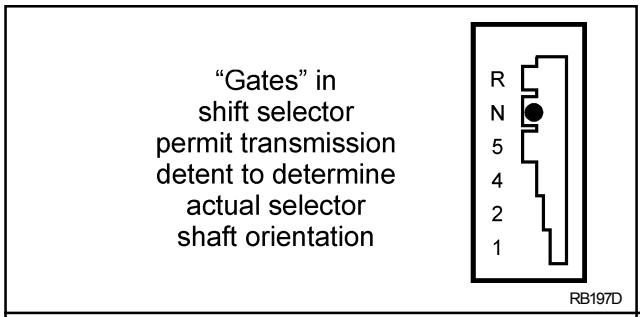


Figure C-2: Proper Shift Selector Adjustment

Follow procedure below to attach and adjust the shift selector cable at shift lever on the transmission.

1. With the engine off, set the park brake and block the wheels to prevent vehicle movement.

2. Place both the shift selector and the transmission selector shaft in the Neutral position.

3. Attach the cable to the shift selector at the operator's station.

4. At the transmission end of the cable, push the cable to move the shift handle against the end of the shift selector Neutral gate. Note the position of the pivot at the end of the cable with respect to the hole in the shift lever. Refer to Figure C-3.

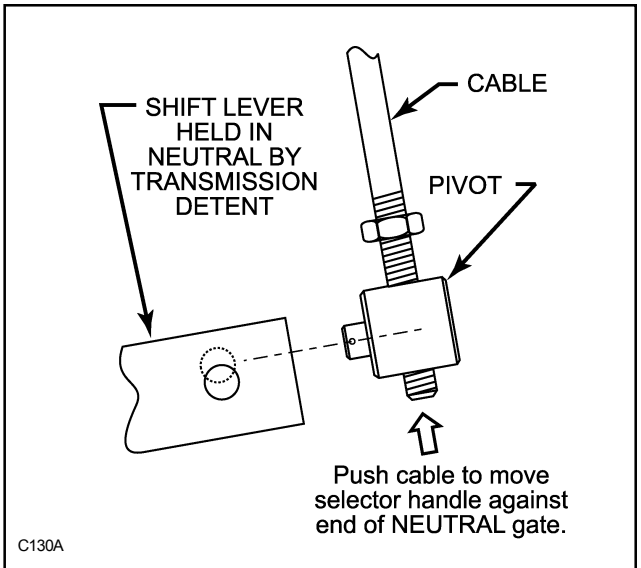


Figure C-3: Proper Shift Selector Cable Adjustment

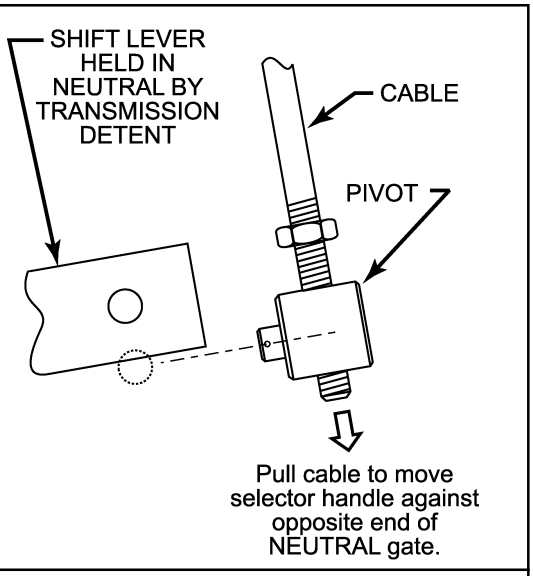


Figure C-4: Proper Shift Selector Cable Adjustment

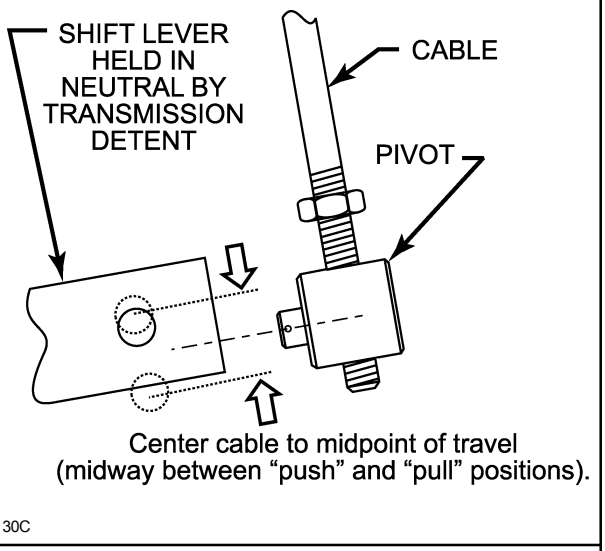


Figure C-5: Proper Shift Selector Cable Adjustment

5. Pull the cable to move the shift handle against the opposite end of the shift selector Neutral gate. Note the position of the pivot at the end of the cable with respect to the hole in the shift lever. Refer to Figure C-4.

6. Center the position of the cable at the midpoint of travel determined by steps 3 and 4. See Figure C-5.

7. Holding the cable at the position determined in step 5, rotate the pivot on the threaded section of the cable end until it is aligned with the hole in the shift lever. See Figure C-6.

8. Verify that the attachment pin of the pivot does not bind in the shift lever hole and that the detent in the transmission is positively engaged. This condition is sometimes called "free-pin-fit", referring to lack of friction at the cable / shift lever interface once the transmission detent is engaged. Repeat steps 4 through 6 as necessary to create this condition.

9. Attach the pivot to the shift lever and secure with the lock pin. If a jam nut is provided with the cable hardware, torque the jam nut to lock the pivot to the cable end as noted in Figure C-6. If the cable manufacturer does not provide a jam nut with the cable assembly, do not add one during the installation process.

CAUTION: Once the jam nut is tightened, the pivot pin should slide freely into the hole in the lever. Do not twist the cable to insert it into the lever. Loosen the jam nut, reorient the pivot to insert freely into the lever, then tighten the jam nut again.

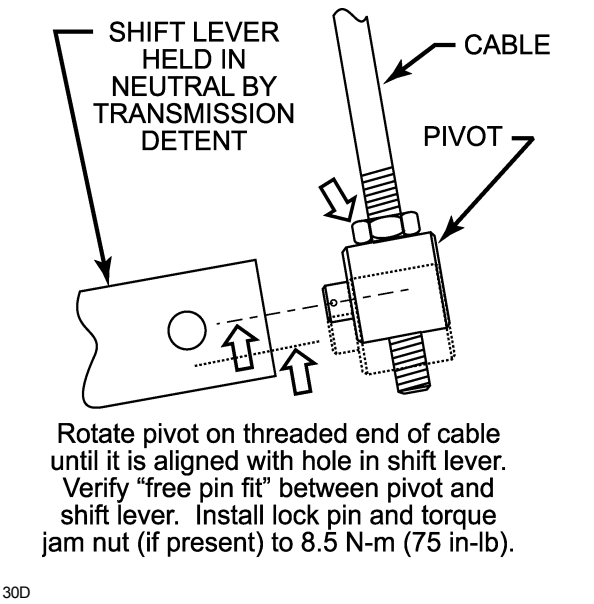


Figure C-6: Proper Shift Selector Cable Adjustment

10. Once this attachment is made, move the selector through all the range positions at the operator's station. Verify that free-pin-fit exists in each range position, and that the position of the shift lever is determined by the internal transmission detent — not by tension or compression on the shift cable. Special attention should be devoted to the free-pin-fit in the Neutral position, in the lowest forward range (1), and, if available, in the Park or Park Brake position.

4.6 MULTI-STATION CONTROLS

Vehicles with multi-station controls have two or more operator locations. For example, a fuel delivery vehicle with one selector at the driver's seat and another selector at the pumping location. Such an arrangement requires the ability to select a gear range at one shift selector and have the shift selector at the other location move to the same range selection. Both selectors must always be properly adjusted to avoid damage to the transmission. For cable or linkage systems, it is essentially impossible to keep both selectors properly adjusted. Therefore,

CAUTION: Allison Transmission does not allow cable or linkage systems on multi-station applications with the 1000/2000 Product Families.

Electric, pneumatic, or hydraulic control systems may be used for transmission installations which are interfaced with multi-station shift control systems. Such systems are the responsibility of the vehicle manufacturer and must be reviewed by an Allison representative for transmission operational concerns. As a result of the review, validation testing may be recommended.

5.0 SHIFT SELECTORS – 3000 AND 4000 PRODUCT FAMILIES

Allison Transmission offers several different types of shift selectors for the transmissions in the 3000 and 4000 Product Families. Available shift selectors include:

- Lever selector
- Keypad push-button selector
- Strip push-button selector

For descriptions of the Allison shift selectors, refer to *Section A: Controls Familiarization* of this manual. Electrical requirements for the shift controls can be found in *Controls Specifications – Allison 4th Generation Controls*.

The shift selector provides the communication link between operator and transmission. Therefore, the shift selector must be readily accessible to the operator.

Refer to section 2.3 and to the *Controls Specifications – Allison 4th Generation Controls* for environmental requirements for the shift selector. In some installations, an Allison shift selector will be exposed to the elements. For example, installation in a chassis to be stored outside prior to completion of the vehicle build. In these cases, the following precautions must be met:

- Cover the shift selector.
- Cover the shift selector's harness and connector if they are exposed.
- The cover must be closed.
- The cover must include a desiccant to absorb moisture.
- The cover must be designed and installed to allow condensation or other moisture to drain out.

NOTE: The Allison keypad and lever shift selectors communicate with the TCM via the SAE J1939 datalink. The design includes a provision to communicate direction change requests to the TCM, even in the event of a datalink communication failure. This provision requires the installation of a separate, dedicated, direction signal wire, wire 134. Failure to install and connect wire 134 will result in the generation of a diagnostic code.

5.1 LEVER SHIFT SELECTOR

The lever shift selector may be mounted in the dash, below the dash or in a pedestal. The side of the lever selector case has three pads with thru-holes for use in mounting. Refer to the Shift Selector Installation Drawing, AS07-417, for definition of hole size and location. Threaded clip nuts may be installed on the three pads with the thru-holes to create threaded mounting provisions. Threaded clip nuts designed for the lever selector mounting holes are available from the Allison Parts Distribution Center (P.D.C.). Refer to *Section F: Controls Support Equipment* for P.D.C. contact information.

The lever selector installation must meet the following requirements:

- Attach the lever shifter securely to a metal bracket or pedestal. The mounting must withstand the forces that an operator may apply to the handle of the lever selector.
- If the three mounting holes in the selector case are used, the metal mounting surface must meet the flatness requirement shown on AS07-417. The flatness requirement prevents damage to the selector case when the mounting fasteners are tightened during installation.
- Locate the selector so that the operator's view of the selector face is uninhibited. The operator must be able to see the display, which is on the face of the lever selector. Allison recommends that the face of the selector be within 30º of perpendicular to the operator's line of sight.
- Mount the lever shift selector with the face at an angle as specified on AS07-417. This will minimized the accumulation of liquid and dirt on the face of the selector.
- Allow sufficient clearance to install and remove the harness connector. Refer to AS07-417 for minimum clearance requirements.

5.2 KEYPAD PUSH-BUTTON SELECTOR

Allison offers several configurations of the keypad push-button selector. The configurations are different sizes in order to accommodate various space-claim requirements. The dimensions for the available configurations are shown on installation drawing AS07-417. Some configurations of the keypad selector include a gauge-type mounting provision. AS07-417 defines the mounting provisions for each configuration.

The keypad selector installation must meet the requirements listed below:

- Locate the selector so that the operator's view of the selector face is uninhibited. The operator must be able to see the display, which is on the face of the keypad selector. Allison recommends that the face of the selector be within 30º of perpendicular to the operator's line of sight.
- Mount the keypad shift selector with the face at an angle as specified on AS07-417. This will minimized the accumulation of liquid and dirt on the face of the selector.
- Allow sufficient clearance to install and remove the harness connector. Refer to AS07-417 for minimum clearance requirements.

5.3 STRIP PUSH-BUTTON SELECTOR

Allison offers strip push-button selectors with the buttons arranged both horizontally and vertically to accommodate various space-claim requirements. A gauge-type mounting provision is included with each strip push-button selector. Refer to AS07-417 for dimensions and mounting provisions.

The typical strip selector installation is in the dash with the selector face nearly vertical. Follow the guidelines below when mounting the strip push-button selector:

- Locate the selector so that the operator has an uninhibited view of the selector push-buttons. Allison recommends that the face of the selector be within 30º of perpendicular to the operator's line of sight.
- If dimming is required, the installer must provide external lighting.
- Allison limits how the strip push-button selector is used in two-selector installations. Refer to section 5.4, below.

- Allow sufficient clearance to install and remove the harness connector. Refer to AS07-417 for minimum clearance requirements.

The strip push-button selectors do not include a display. If an installation requires a display, the vehicle manufacturer must provide the display. For further information, refer to Remote Displays in *Section A: Controls Familiarization* of this manual.

5.4 MULTI-STATION CONTROLS

The 3000 and 4000 Product Families' transmission controls and calibrations are capable of operating in vehicles with selectors at two operator stations. Listed below are the requirements for installations with two shift selectors. Refer to the System Schematic Installation Drawings for interface details.

- Either Selector 1 or Selector 2 can be used for driving the vehicle or for the auxiliary operation.
- The TCM must distinguish between the selectors in order to associate the correct shift calibration with the appropriate selector. The installation of a jumper wire from pin 5 to pin 6 at the selector connector is required to identify selector 2. Refer to the System Schematic Installation Drawing.
- Selector 2 must be a J1939-based shift selector. The Allison lever and keypad selectors, which communicate with the TCM over the SAE J1939 datalink and selector direction signal wire 134, are acceptable for use as Selector 2. Refer to the System Schematic Installation Drawing.
- The Allison strip shift selector is not J1939-based, and therefore may not be used as Selector 2. All other combinations are compatible, as shown in Figure C-7.

IF SELECTOR 2 IS:	SELECTOR 1 MAY BE:
Allison lever selector	Allison lever selector Allison keypad pushbutton selector Allison strip pushbutton selector OEM-supplied, J1939-based selector
Allison keypad pushbutton selector	Allison lever selector Allison keypad pushbutton selector Allison strip pushbutton selector OEM-supplied, J1939-based selector
OEM-supplied, J1939-based selector	Allison lever selector Allison keypad pushbutton selector Allison strip pushbutton selector OEM-supplied, J1939-based selector

Figure C-7: Acceptable Combinations of Shift Selectors in Two-Selector Installations

The controls will recognize operator input from only one selector at a time — as determined by a dash-mounted electrical switch. For additional information, refer to "Shift Selector Transition" in *Section E: Input and Output Functions* of this manual.

6.0 WIRING HARNESSES

The vehicle manufacturer is responsible for installing and routing the transmission harness such that the harness provides uninterrupted communication between the following systems:

- the transmission
- the TCM
- the shift selector
- all other transmission controls components in the vehicle
- all vehicle systems that interface with the transmission controls

Interrupted communication in the transmission control system can cause the following problems:

- transmission malfunction
- intermittent diagnostic codes that are difficult to diagnose

In order to maintain uninterrupted communication, the transmission harness installation and routing must meet the following conditions throughout the life of the vehicle:

- the wiring system must meet Allison's electromagnetic compatibility requirements
- the wires in the harness must remain intact and must not incur any damage
- all of the connectors and all other connections must remain secure and intact

For Allison Transmission's harness design requirements, refer to *Technical Document 173 (TD-173), Wiring Harnesses for Transmissions with Allison 4th Generation Controls*.

6.1 ELECTROMAGNETIC COMPATIBILITY

CAUTION: The vehicle wiring system MUST NOT interfere with proper operation of the transmission system.

Induced electrical noise which is coupled into the transmission control system can cause transmission operational anomalies. In vehicles, the following conditions can generate induced electrical noise:

- wires transmitting high frequency signals
- wires transmitting high voltage signals
- wires with inductive voltage transients
- high power wires capable of producing capacitive coupling

Examples of vehicle wiring with the above types of signals include:

- fluorescent lighting wires
- solenoid drive wires
- relay drive wires
- ignition wires
- fuel injector wires
- starter motor wires

The installer can minimize the potential for electromagnetic interference with the transmission control system. When installing the types of wiring listed above, follow these recommendations:

- Separate the wiring from the transmission wiring harness.
- Avoid running the wiring parallel to and within 150 mm (6 inches) of the transmission wiring for more than 900 mm (3 feet).
- Keep the wiring separate from the following low current analog transmission wires:
  - transmission speed sensor wires
  - oil level sensor wires
  - temperature sensor wires
  - retarder modulation request (RMR) wires
  - throttle position signal (TPS) wires
- Minimize wire lengths between system components. Make wires as short as possible without pulling the wires tight. Long interface wires are potential antennas capable of receiving electromagnetic interference (EMI).

If it is not possible to follow the above recommendations, the OEM or Body Builder must evaluate the installation. The OEM or body builder must verify that the vehicle wiring does not adversely affect the transmission control system. The OEM or Body Builder may contact Allison Transmission Application Engineering for help in this evaluation. In addition, the OEM or body builder must verify that the transmission control system does not adversely affect other vehicle systems.

6.2 HARNESS INSTALLATION

6.2.1 ROUTING

CAUTION: Wires must not contact, or have potential to contact, sharp or abrading surfaces.

When installing harnesses, avoid the following hazards:
- sharp surfaces
- sharp edges
- screws
- bolt heads
- brackets
- cut edges of nylon conduit
- pinch points such as tilt cab hinges and electrical access covers

If the above hazards can not be avoided, use rubber edge guards, grommets, or portions of conduit to protect the harness where it passes near or through the hazard. Failure to protect wiring will result in chafed wires which may result in either short or open circuits.

Do not locate harnesses close to moving parts, including:
- belts
- fans
- pulleys
- PTO shafts
- transmission output shaft
- park brake mechanisms and linkage
- steering shafts
- moving seat mechanisms
- throttle pedal and linkage
- doors
- levers

Moving parts can pull connectors apart, resulting in intermittent electrical connections.

In addition, do not
- bend the harness sharply
- kink the harness
- pinch the harness
- cut the harness
- pull the harness too taut
- coil the harness

If a harness is too long, wrap the harness back on itself, then tie down the harness to minimize relative movement.

Locate the harness away from road hazards and corrosive materials. Where necessary, protect the harness with conduit, tubes or shielding.

6.2.2 HARNESS SUPPORT

Support each section of the transmission harness according the following requirements:
- Secure the harness every 200 to 400 mm (8 to 16 inches). Use closer attachment points for smaller diameter wire bundles.
- Secure the harness to the powerpack, the cab, and the vehicle frame or chassis rails.
- Do not attach the harness to hydraulic lines or water hoses.

- Use nylon cable ties, rubber-coated metal clamps, or plastic-coated metal clamps to secure the harness.
- Do not pull cable ties so tight that the convoluted tube or other harness covering is crushed or deformed.
- Size clamps to the outside diameter of the harness covering. Do not crush or deform the harness covering with the clamps.
- Provide strain relief at all connectors, including the transmission controls components and the speed sensors on the transmission.

There is relative motion between the powerpack, the chassis, and the cab. Observe the following practices when routing the transmission harness between the powerpack, the chassis, and the cab:

- Provide sufficient slack in the harness between fixed points. The slack must account for the relative movement without inducing tension at any of the connectors. Tension is considered to be any strain greater than the weight of the harness assembly itself. Fixed points are clips, clamps, connectors, tie-wraps and grommets.
- Secure the harness as close as possible to the connector of each transmission controls component.
- Attach the harness support that is closest to each transmission controls component to the same part of the vehicle as the controls component itself. This will prevent movement of the wires at the entrance to the controls component connector.

The transmission harness may rest on the transmission housing if the following conditions are met:

- the harness covering meets the requirements in TD-173
- the harness is not under tension
- the portion of the harness on the transmission experiences minimal movement relative to the transmission housing

NOTE: The transmission housings for models in the 1000 and 2000 Product Families include several bosses which are recommended for attaching brackets or clips to secure harnesses. See the illustrations in the Appendix. Refer to the Basic Transmission Installation drawings for specific locations and definition of these provisions.

Similar information is being added to installation drawings AS66-431 (3000 Product Family models) and to AS6-431 (4000 Product Family models) as it becomes available.

6.2.3 TEMPERATURE

The surface temperature of the wiring harness and connectors must not exceed the limit shown in *Allison 4th Generation Controls Specifications*. Allison Transmission recommends the following methods for meeting harness and connector temperature limits:

- Locate wiring harnesses away from radiant heat sources such as engine exhaust systems and manifolds, electronic device heat sinks, oil/water coolers.
- Protect wiring harnesses from high temperature sources. Acceptable protection includes heat shields, heat reflective tape, high temperature conduit (Tefzel or equivalent).
- Use thermal shielding if the harness is within 200 mm (8 in.) of an exhaust manifold
- Use thermal shielding if the harness is within 100 mm (4 in.) of the final section of a tail pipe

The vehicle manufacturer is responsible for validating that the surface temperatures of the harness and connectors do not exceed their respective temperature limits.

6.3 CONNECTORS

The harness installation must meet the following connector requirements:

- Mount connectors with the seal end pointing horizontal or downward, between 3:00 o'clock and 9:00 o'clock. This orientation prevents dirt and moisture from collecting on the seal end of the connector.
- Locate connectors where they will be protected from bombardment by stones and dirt.
- Locate connectors where they will be protected from road splash and from cleaning spray.
- Follow each connector manufacturer's instructions for mating the two halves of the connector system.
- If the connector is designed to accommodate a secondary lock, the lock provision must be used and properly engaged.
- Assemble all connectors in the transmission controls system to their mating half before the vehicle or chassis is exposed to an outside environment.
- Connect all components in the transmission controls system to the transmission wiring harness before transporting partially completed chassis or vehicles.
- Do not force connectors together. If connectors are difficult to mate, check connectors for misaligned, damaged or bent terminals. Correct the problem before mating the connectors.
- Do not pull the wires at the connector such that the seals are stretched or opened. See Figure C-8 for proper wiring harness installation practice. See Figure C-9 for an illustration of practices to avoid.
- If the connector includes wire combs, do not pull the wire at the connector such that the wire is in tension with the wire combs. Wire combs are the plastic pieces at the back of the connector that keep the wire bend from stretching the seals. Refer to Figures C-8 and C-9.
- Locate the diagnostic tool connector in an area of the driver's compartment where a technician can easily access the connector.

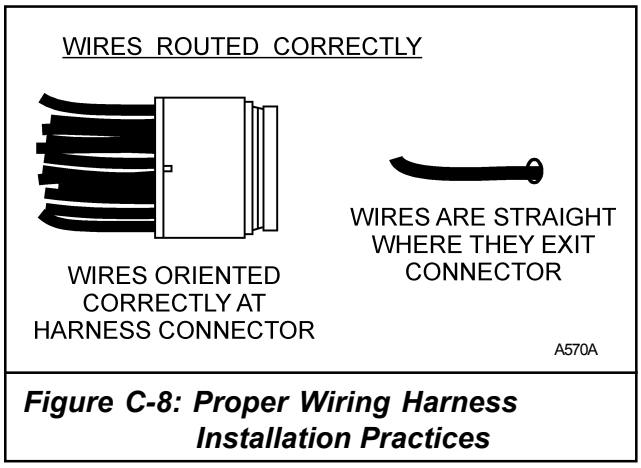


Figure C-8: Proper Wiring Harness Installation Practices

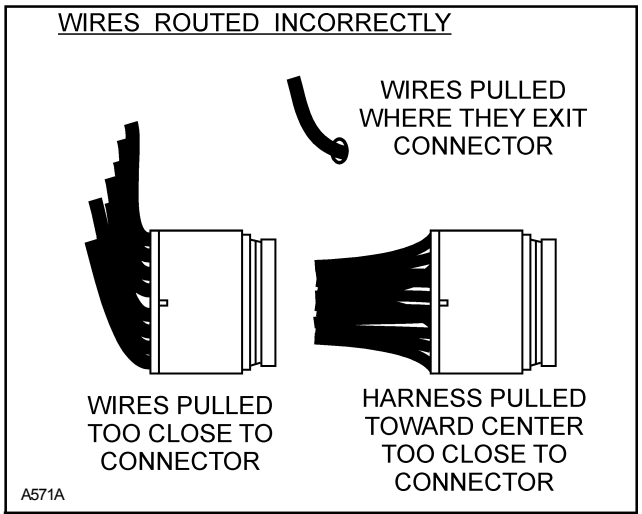


Figure C-9: Improper Wiring Harness Installation Practices

7.0 SPEED SENSORS

Three speed sensors are integral to the transmission assembly. The speed sensors provide the transmission input speed, converter turbine speed, and transmission output speed signals to the TCM. For the specific location of the speed sensors, refer to the basic transmission installation drawing for your transmission model.

The transmission input speed sensor is located on the converter housing. The transmission output speed sensor is located on the output housing. Both speed sensors require connection to the wiring harness.

The mounting provision for the turbine speed sensor differs between the transmission Product Families:

- For transmission models in the 3000 Product Family, the turbine speed sensor is internal to the transmission and does not require an external connection.
- For transmission models in the 1000, 2000 and 4000 Product Families, the turbine speed sensor is external and requires connection to the wiring harness.

NOTE FOR 1000 AND 2000 MODELS: The angular orientation of the transmission speed sensors must align properly with internal transmission components in order to obtain accurate speed readings. The speed sensors are correctly aligned when shipped from the Allison factory. DO NOT remove and reinstall the sensors in a different angular orientation with respect to the transmission.

CAUTION: The output signals of the speed sensors are for use only by the transmission controls system. DO NOT splice into the speed sensor leads or wiring harness to use the signals directly from the speed sensors.

8.0 RETARDER CONTROLS – 3000 & 4000 PRODUCT FAMILIES

Operator control of the retarder can be accomplished by either of the following two methods. The TCM must be calibrated to the proper method to insure desired retarder operation:

- **Both Analog and J1939**: Input is based on a Retarder Enable switch for activation, plus one or more Allison Retarder Modulation Request (RMR) components to select the desired level of retardation. In addition, retardation is requested or limited based on messages from an SAE J1939-based vehicle controller, See Section 8.1.
- **J1939 Only**: Retardation is requested or limited based on messages from an SAE J1939-based vehicle controller. See Section 8.2.

8.1 BOTH ANALOG AND J1939

When this retarder calibration option is selected, the primary request for retardation level is based on an analog input signal from an Allison Retarder Modulation Request (RMR) device to the TCM. Several types of RMR devices are available for this purpose, either individually or in specific combinations. See Section 8.3.

When the retarder system is enabled, the retarder may also be enabled by an SAE J1939-based vehicle controller in the form of a single ERC-1 *Retarder Selection, Non-Engine* parameter, or by one or more TSC1 torque control messages. Retarder operation may also be limited by TSC1 torque limit messages sent by certain devices on the vehicle network, such as ABS. For details regarding the installation and use of J1939 communications within a vehicle, refer to *Datalink Communications* tech data (see Section 1.0 for access instructions).

A master control is required, permitting the operator to enable or disable the retarder system regardless of the source of the controlling requests.

8.2 J1939 ONLY

This calibration option should be selected only when there will be no analog inputs from Allison Retarder Modulation Request (RMR) devices. Input is based on messages from an SAE J1939-based vehicle controller in the form of a single ERC-1*Retarder Selection, Non-Engine* parameter, or by one or more TSC1 torque control messages. Retarder operation may also be limited by TSC1

torque limit messages sent by certain devices on the vehicle network, such as ABS. A master control, which permits the operator to enable or disable the retarder system, is required.

For details regarding the installation and use of J1939 communications within a vehicle, refer to *Datalink Communications* tech data (see Section 1.0 for access instructions).

8.3 RETARDER MODULATION REQUEST (RMR) DEVICES

The retarder controls mount inside the cab. Locate the controls within easy reach of the operator. Allow sufficient clearance to install and remove the harness connector. Refer to the following documents for more detailed information on retarder controls:

- *Technical Document 175 (TD-175), Guidelines For Selecting Retarder Controls*
- Installation Drawing AS07-404, Retarder Control Hardware
- the *Retarder Provision Section* of the appropriate transmission *Installation Manual*

Specific installation considerations for the various types are:

- Retarder Enable/Disable Switch – This switch permits the operator to enable or disable the retarder system. Allison requires that the enable/disable switch be located where the operator can easily access the switch while driving the vehicle. The enable/disable switch is required in all retarder installations.
- Foot Pedal – Mounts to the cab floor. Locate the pigtail connector in an environmentally protected place.
- Hand Lever – Mounts to a bracket attached to the steering column or in the dash. Right hand location is most common. Position the hand lever control so that the lever movement is in or near the horizontal plane. This prevents inadvertent lever movement due to shock loads to the chassis from potholes, curbs, and sudden stops. Inadvertent lever movement could change the requested retarder capacity without the operator's knowledge.
- Pressure Switches – Equipped with 1/8-NPTF fittings for attachment to air brake lines. Locate the switches in a protected environment. Do not expose the switches or their connectors to direct spray or road contamination.
- Resistance Module – Several of the retarder control components are mechanical devices. These mechanical controls require use of an electronic resistance module to convert the retarder actuation signal into a signal which is TCM-compatible. When used, install the resistance module in a protected environment such as the vehicle cab.

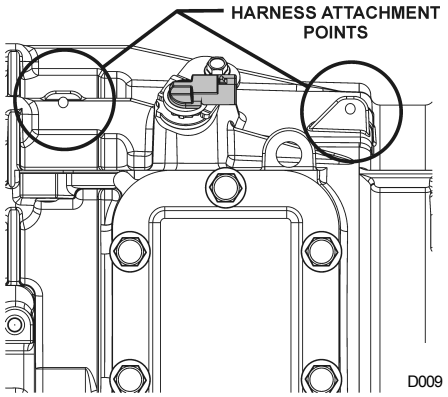
9.0 VEHICLE INTERFACE MODULE (VIM)

Mounting requirements for the VIM are the same as described for the TCM. Provide sufficient space to allow access to the connectors, relays and fuses for installation and service. Refer to installation drawing AS07-452 for space claim requirements.

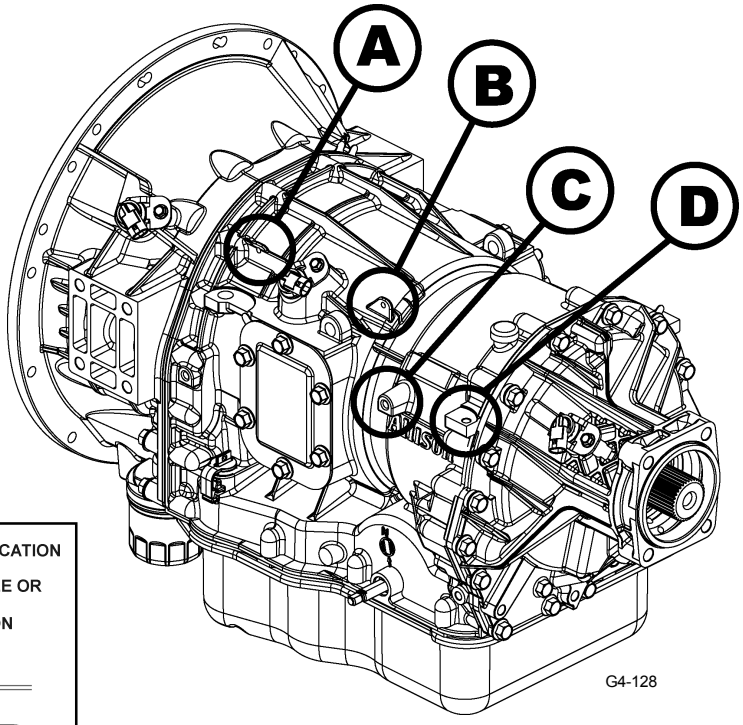
10.0 THROTTLE POSITION SENSOR (TPS)

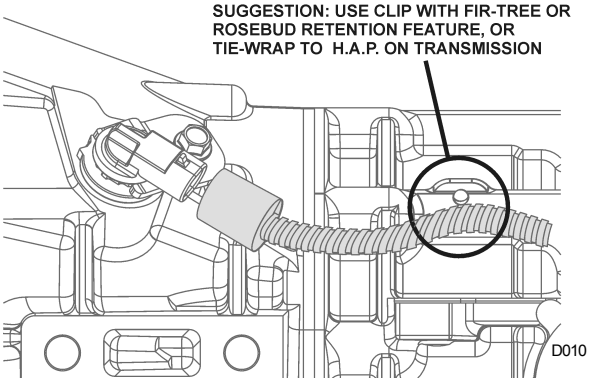
For engines without electronic controls, Allison provides a resistive-type throttle position sensor. For installation requirements, refer to *Technical Document 178 (TD-178), Throttle Position Sensor for Allison Transmissions*, and installation drawing AS07-451. Contact the Allison Parts Distribution Center (PDC) for TPS availability.

APPENDIX
RECOMMENDED ATTACHMENT POINTS FOR WIRING HARNESS
1000/2000 PRODUCT FAMILY



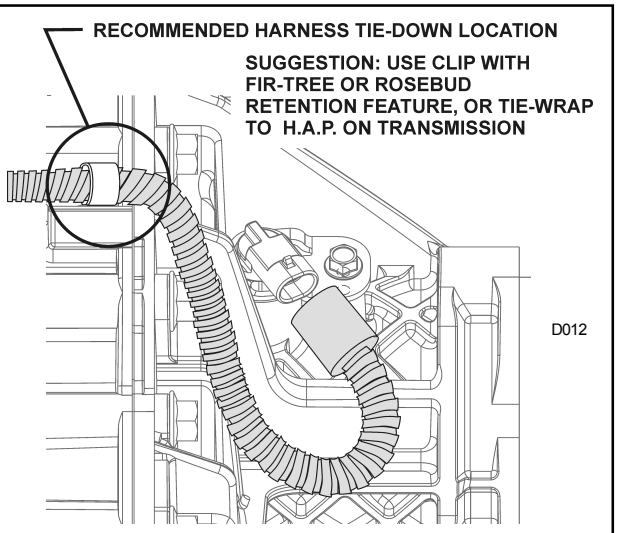
Close-Up: Locations A and B



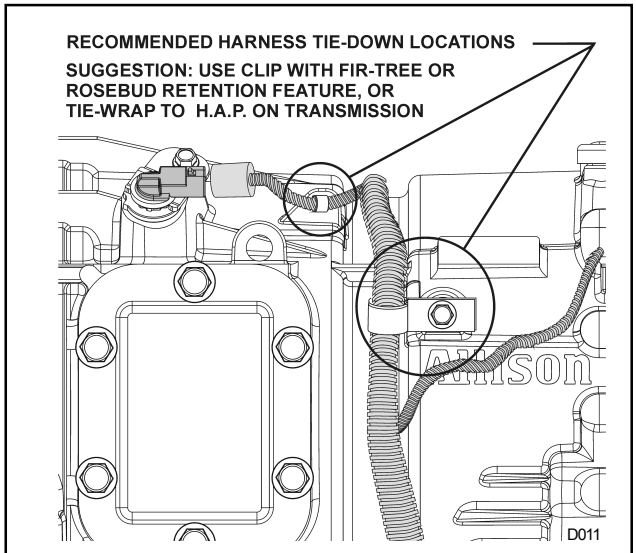


Close-Up: Harness Attachment at Location A

NOTE: Provisions relating to tie-down of harness at the main harness connector are not yet determined.



Close-Up: Harness Attachment at Location D



Close-Up: Harness Attachment at Locations B and C

REVISION HISTORY

November 28, 2005
- Updated Figure C-7 and associated text.
- In the NOTE in paragraph 6.2.2, added references to drawings AS66-431 and AS67-431.

August 11, 2005
- In section 2.2, changed source for the welding decal from PDC to SGI.
- Revised electrostatic painting precautions in section 2.3.1.
- In section 5.0, added reference to *Controls Specifications* for shift selector electrical requirements.
- In section 8.3, clarified requirement to install retarder enable/disable switch where the operator can easily reach the switch while driving the vehicle.

March 10, 2005
- Add "Before Starting the Engine", Section 2.1. In Section 4.3, step 6 was step 1. Add J1939 information to sections 8.0 through 8.2.

February 21, 2005
- Revise procedure for tightening nut on 1000/2000 selector shaft, paragraph 4.3.
- Rephrase portions of Section 4.4 for clarity
- Correct error in Figure C-8: SAE J-1939 was J-1959.

October 13, 2004
- Added section 2.2. TCM splash shield (section 3.3) no longer required. Revised section 5.4 for clarification. Added secondary lock requirement (section 6.3).

July 30, 2004
- Created new *Section C: Controls Component Installation* for Allison 4th Generation Controls.