SECTION C:
CONTROLS COMPONENT INSTALLATION

ALLISON 6TH GENERATION CONTROLS

APPLICABLE MODELS: 1000/2000 Product Family
2900 Product Family
3000 Product Family
4000 Product Family

Contents:

SECTION C: CONTROLS COMPONENT INSTALLATION

1.0 INTRODUCTION

This section defines the proper installed location and environment of the major transmission controls components. Some of these components are model-dependent and may not be applicable to your transmission assembly. For general descriptions of the components, refer to *Section A-1: Controls System Familiarization* of this manual.

2.0 REFERENCED DOCUMENTS

Unless otherwise noted, all documents referenced in this document may be found in the Allison HUB website at https://hub.allisontransmission.com/login. To locate the referenced documents look for Tech Data under the Engineering heading on the Allison HUB home page. In this document, these references are identified by italic font. Contact your Allison Transmission representative if you do not have access to the Allison HUB. A list of all items referenced in this document can be found at the end of this document.

3.0 GENERAL GUIDELINES

3.1 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.

3.2 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 Allison Transmission, 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 such a label. Refer to *Section F: Controls Support Equipment* of this manual for information on ordering Allison literature.

3.3 PAINTING ON THE VEHICLE

3.3.1 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.

3.3.2 PAINTING OF TRANSMISSION CONTROL COMPONENTS

While it may be desirable to paint chassis-mounted components in order to enhance overall vehicle appearance 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.

3.4 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 chassis-mounted TCM, Allison shift selectors, and their connectors are sealed. However, these components are not considered immersible and are not able to withstand high pressure washes or steam cleaning. Locate these components where they will not be subject to immersion, high pressure washes or steam cleaning.

The electrical components and connectors used with Allison Transmissions products do not contain Ultraviolet (UV) Radiation protective additives or coatings. The vehicle builder is responsible for providing protection from prolonged exposure to direct or indirect sources of UV.

Installations of the Allison controls components must meet the environmental requirements in *Allison 6th Generation Controls System Data*. In addition, mount the Allison controls components away from direct exposure to road hazards and weather.

In order to meet the temperature limits listed in *Allison 6th Generation Controls System Data*, 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.

3.5 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 components 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 - 2900 (Shift-by-Wire) and 3000/4000 Product Families
- 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.

3.6 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 paragraph 4.0 of this document
- Designing the transmission wiring harness to meet all requirements in *Technical Document 173 (TD-173), Wiring Harnesses for Transmissions with Allison 4th, 5th, & 6th Generation Controls*.
- Routing and installing the transmission wiring harness according to paragraph 7.0 in this document.
- Providing suppression for electrical components used with the transmission control system which are supplied and installed by the vehicle builder. 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.

3.7 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.

4.0 TRANSMISSION CONTROL MODULE (TCM)

This document discusses the chassis-mounted TCM used on the 1000/2000, 2900, 3000 and 4000 Product Family transmissions. Refer to the *Control Module (TCM) Installation Drawing, AS07-612*.

4.1 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.

4.2 TCM MOUNTING

4.2.1 LOCATION

- The preferred mounting location for the chassis-mounted TCM is the vehicle cab.
- Do not mount the TCM on a structure that moves relative to the chassis (e.g. air-ride seat structure). This can have an adverse effect on inclinometer calculations.
- Do not mount the chassis-mounted TCM on the transmission. The environmental conditions on the transmission are too severe for the chassis-mounted 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
  - Steam Cleaning
  - Direct road spray/debris
  - The environmental concerns discussed in paragraph 3.4 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.

- **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 *AS07-612* for minimum clearance requirements.

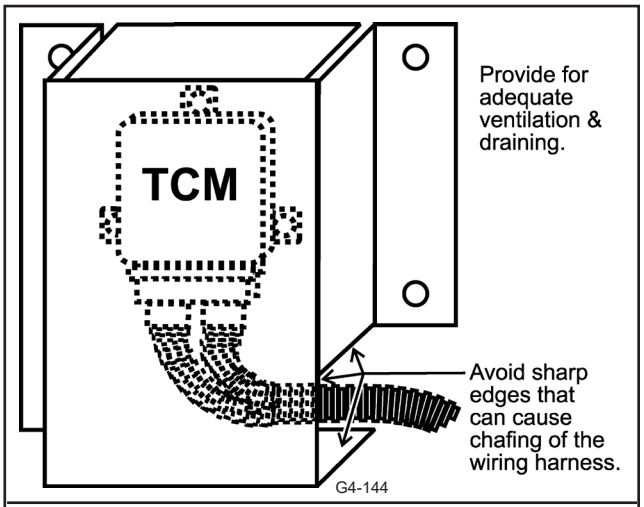


Figure C-1: Typical Splash Shield

4.2.2 ATTACHMENT

- Use the three mounting pads with thru-holes to attach the TCM to a flat, rigid surface. Refer to the *TCM Installation Drawing, AS07-612*, 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, over the life of the vehicle. Allison Transmission recommends lock washers 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.

5.0 SHIFT SELECTOR SYSTEM – 1000/2000 PRODUCT FAMILIES AND 2900 (SHIFT-BY-CABLE) PRODUCT FAMILIES

The shift selector system for 1000/2000 and 2900 Product Family transmissions is supplied and installed by the vehicle builder. 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): Requirements for Shift Selector and Cable System* and to *Installation Drawing AS64-410, 1000/2000 Shift Selector Design Requirements* or *Installation Drawing AS64-910, 2900 Shift Selector Design Requirements*. *TD-177* also describes various shift selector configurations.

CAUTION: The vehicle builder 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.

The addition of supplementary features to the shift selector system may be used to enhance operator control over transmission operation:

- Tap Up / Tap Down
- 3-Position Hold Switch
- *Input Function AR: OverDrive Disable*

These might NOT be standard features of the shift selector system design and therefore could require separate and additional design and installation effort. Refer to paragraph 5.7 for details.

5.1 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.

5.2 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.

5.3 TRANSMISSION SHIFT LEVER INSTALLATION

Failure to properly install or adjust the shift lever on the transmission may result in the generation of diagnostic codes. Mis-adjustment may also affect reverse warning or neutral start signal functionality. Refer to the *Installation Drawing AS64-410, 1000/2000 Shift Selector Design Requirements* or *Installation Drawing AS64-910, 2900 Shift Selector Design Requirements*.

The procedure for installing the shift lever onto the transmission selector shaft is in Appendix A.

5.4 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 where possible. If bends are required, make them as large as practical, particularly when direction changes in the cable routing are necessary.
- Minimum bend radius is normally considered to be 127 mm (5.0 in). Consult the 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.

5.5 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.

Follow the procedure in Appendix A to attach and adjust the shift selector cable at shift lever on the transmission.

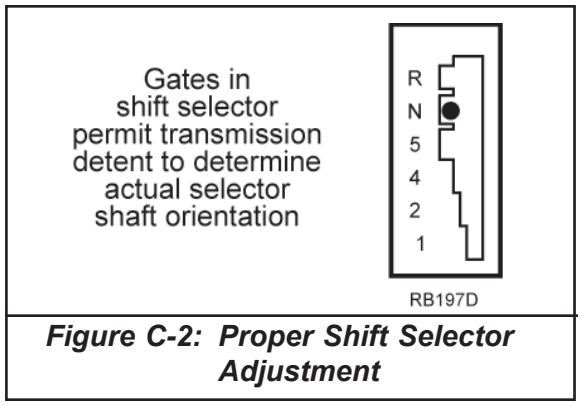


Figure C-2: Proper Shift Selector Adjustment

5.6 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 and 2900 (Shift-by-Cable) 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.

5.7 SUPPLEMENTARY FEATURES FOR RANGE DISABLES AND HOLDS

The control system features discussed in this section may be installed to provide the operator with enhanced control over transmission operation. Each of these features provides a means to modify range selection from that which is indicated by the position of the primary shift selector. For additional information regarding the availability and effect of using these features, refer to the discussion regarding shift selectors in *Section A-1: Controls System Familiarization* of this manual.

5.7.1 TAP UP / TAP DOWN

Relying on SAE J1939 vehicle communications, this provision may be used as an input signal to alert the TCM of an operator request to raise or lower the selected forward gear range, one range at a time. A typical input device might be an UP/DOWN momentary rocker switch on the steering wheel, bump positions on the shift selector, or momentary pushbuttons. Use of this feature requires installation of a display for Requested Range, which must be supplied and installed by the vehicle builder. For details regarding the installation and use of J1939 communications within a vehicle, refer to *Datalink Communications*.

5.7.2 3-POSITION HOLD SWITCH

Used with six-speed transmission models only, this non-momentary switch permits the operator to select 6, 5, or 4 as the highest available range during transmission operation. The feature may be used with any 1000/2000 six-speed transmission. The switch is supplied and installed by the vehicle builder. For installation requirements, refer to *Installation Drawing AS07-621*.

5.7.3 OVERDRIVE DISABLE SWITCH

This feature is also known as *Input Function AR: OverDrive Disable*. When used with five-speed transmission models, closing the switch to enable this input function sets 4th as the highest available range during transmission operation.

The function operates similarly with six-speed transmission models, except the selected range of the enabled function may be set to either 5th or 4th as the highest available range during transmission operation. When set to 4th, this function effectively becomes **Double OverDrive Disable**.

This function is available as a standard feature of all 1000/2000 input/output (I/O) function packages and is therefore available for use with all transmission applications. For installation and interface requirements, refer to the wiring schematic for *Input Function AR*.

The selection of 4th or 5th must be specified when the TCM calibration is defined. The selection cannot be changed unless the TCM is re-calibrated.

When used with the 2900 Product Family this function will command 6th range.

6.0 SHIFT SELECTORS – 2900 (SHIFT-BY-WIRE) PRODUCT FAMILIES AND 3000 AND 4000 PRODUCT FAMILIES

Allison Transmission offers several different types of shift selectors for the transmissions in the 2900 Product Families and 3000 and 4000 Product Families. Available shift selectors include:

- Lever selector
- Keypad pushbutton selector
- Strip pushbutton selector (Not available with the 2900 Product Families)

For descriptions of the Allison shift selectors, refer to *Section A-1: Controls System Familiarization* of this manual. Electrical requirements for the shift controls can be found in *Allison 6th Generation Controls System Data*.

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

Refer to paragraph 3.4 and to *Allison 6th Generation Controls System Data* 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 pushbutton, strip pushbutton and bump lever shift selectors can communicate with the TCM over the SAE J1939 datalink at 250 kbps or at 500 kpbs. The Allison selectors detect and adapt to the network baud rate.

The selector designs include 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.

The CAN2 interface may be used for the shift selector communication as a means to reduce bus loading on CAN1. This provision is applicable to both single-selector installations and dual-selector installation using the Allison pushbutton and lever selectors, and non-Allison selectors. For dual-selector installations, both selectors must be on the same CAN network, either CAN1 or CAN2.

6.1 BUMP LEVER SHIFT SELECTOR

The bump 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, AS07-617*, 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* of this manual for P.D.C. contact information.

The lever selector installation must meet the following requirements:

- Attach the lever selector 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 *AS07-617*. 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 easily read 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 *AS07-617*. 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 *AS07-617* for minimum clearance requirements.

6.2 KEYPAD PUSHBUTTON SELECTORS

Allison offers several configurations of the keypad pushbutton selector. The configurations are different sizes in order to accommodate various space-claim requirements. The dimensions for the available configurations are shown on *Shift Selector Installation Drawing, AS07-617*. Some configurations of the keypad selector include a gauge-type mounting provision. *AS07-617* 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 easily read 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 *AS07-617*. 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 *AS07-617* for minimum clearance requirements.

6.3 STRIP PUSHBUTTON SELECTOR

Allison offers strip pushbutton selectors with the buttons arranged both horizontally and vertically to accommodate various space-claim requirements. The strip pushbutton selector design incorporates a gauge-type mounting feature. Refer to *AS07-517* 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 pushbutton selector:

- Locate the selector so that the operator has an uninhibited view and can easily read the selector pushbuttons. Recommended orientation is that the face of the selector be within 30º of perpendicular to the operator's line of sight.
- Allow sufficient clearance to install and remove the harness connector. Refer to *AS07-517* for minimum clearance requirements.

The strip pushbutton selectors do not include a display, which is necessary to alert the operator of conditions being monitored by the optional Prognostics feature of the transmission controls. If the installation requires a display for this or another user-specified purpose, the vehicle manufacturer must supply and install a separate display. For further information, refer to Remote Displays in *Section A-1: Controls System Familiarization* of this manual. For source information, refer to *Section F: Support Equipment* of this manual. Strip pushbutton selectors are not compatible with the 2900 Product Families.

6.4 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 at the selector 2 connector is required to identify selector 2. The location of the jumper wire depends upon the type of selector; refer to the *System Schematic Installation Drawing*.
- The controls will recognize operator input from only one selector at a time, as determined by a dash-mounted electrical switch. Therefore, one of the following Shift Selector Transition Inputs must be integrated into the installation:
  - *Input D, Shift Selector Transition*
  - *Input AL, Shift Selector Transition and Secondary Shift Schedule*
  - *Input BZ, Shift Selector Transition and Oil Field Pumping*

Selector 1 May Be Any of the Following:

- **Allison lever selector (J1939-based)**
- **Allison keypad pushbutton selector (J1939-based)**
- **Allison 3-button strip pushbutton selector (J1939-based)**
- **Non-Allison, J1939-based selector**
- **Non-Allison selector using TCM analog selector outputs SS1, SS2, SS4, SSP**

Selector 2 May Be Any of the Following:

- **Allison lever selector (J1939-based)**
- **Allison keypad (non-strip) pushbutton selector (J1939-based)**
- **Non-Allison, J1939-based selector**

NOTE: Allison 6-button strip pushbutton selectors cannot be used for multi-station controls installations.

NOTE: For installations with two J1939-based selectors, both selectors must be installed on the same CAN interface, either CAN1 or CAN2.

NOTE: Selection of secondary shift selector may impact Functional Safety implementation capability of vehicle, regardless of primary shift selector selection.

Figure C-3: Acceptable Combinations of Shift Selectors in Two-Selector Installations

- Selector 2 must be a J1939-based shift selector. Allison lever and keypad selectors are acceptable for use as Selector 2. Non-Allison selectors that communicate over J1939 are also acceptable for use as Selector 2. Refer to Figure C-3 and the *System Schematic Installation Drawing*.
- If both selectors are J1939-based, then both selectors may be installed on either CAN1 or on CAN2. J1939-based selectors include the Allison lever, keypad and strip pushbutton selectors, and non-Allison, 1939-based, selectors.
- Both selectors must be on the same CAN network, either CAN1 or CAN2.
- Multi-Station Controls is currently **not** available for the 2900 Product Families.

6.5 CONTROLLING MULTIPLE TRANSMISSIONS WITH A SINGLE SELECTOR.

A single shift selector may be used to control multiple transmissions in installations where multiple selectors are not an option. For detailed installation requirements, contact your Allison Representative and request *Engineering Memorandum (EM) 78, Using a Single Shift Selector to Control Multiple Transmissions – 3000 and 4000 Product Families*.

7.0 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, 5th & 6th Generation Controls*.

7.1 ELECTROMAGNETIC COMPATIBILITY

CAUTION: The vehicle wiring system and operating environment 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. 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 and/or strong magnetic fields

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.

7.2 HARNESS INSTALLATION

7.2.1 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 or 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.

Route harnesses to connectors in such a way that liquids and moisture are not routed into the back of the connectors. For harnesses routed to connectors from above or horizontally, include drip-loops close to the connectors. This is particularly important when the connectors are mounted horizontally or nearly horizontally (see 7.3, Connectors).

7.2.2 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: Each transmission housing includes several bosses or other provisions which are recommended for attaching brackets or clips to secure harnesses. See the illustrations in Appendix B for 1000 / 2000 transmission models. Additional information for these transmission models is illustrated on *Installation Drawing AS64-431*.

Refer to Installation Drawings *AS64-931 (2900 Product Family models)*, *AS66-431 (3000 Product Family models)* and to *AS67-431 (4000 Product Family models)* for similar information relating to these product families.

7.2.3 TEMPERATURE

The surface temperature of the wiring harness and connectors must not exceed the limit shown in *Allison 6th Generation Controls System Data*. 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.

7.3 CONNECTORS

The harness installation must meet the following connector requirements:

- Mount connectors with the wire 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 wire seal end of the connector.
- If the connector includes wire combs, do not pull the wire at the connector such that the wire is in

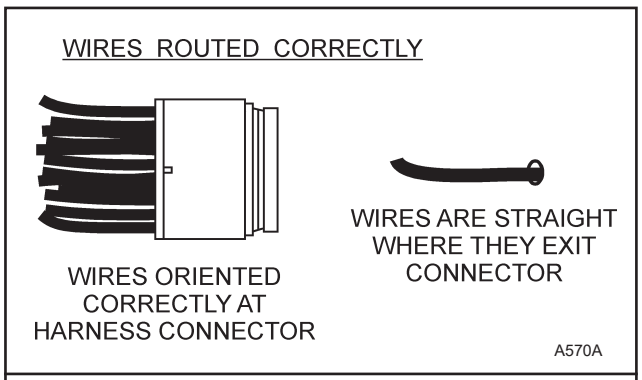


Figure C-4: Proper Wiring Harness Installation Practices

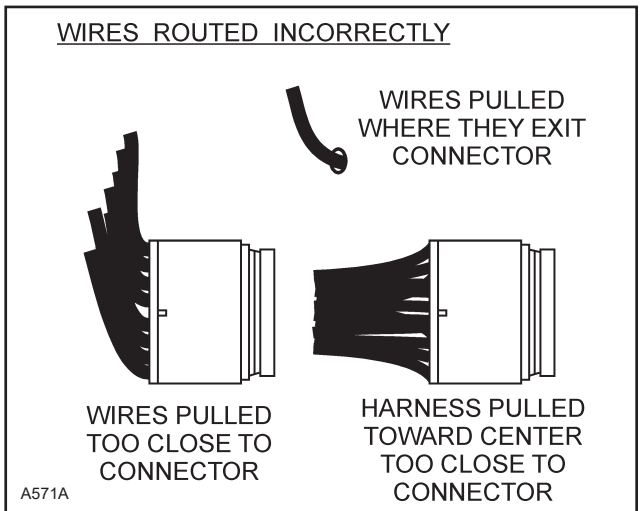


Figure C-5: Improper Wiring Harness Installation Practices

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-4 and C-5.

- 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.
- Do not use dielectric grease or similar compounds in the connector interface area. Use of lubricants typically results in the accumulation of dirt and debris on the contacts.
- Do not spray the connectors with cleaning agents. Cleaning agents may degrade some plastic connector parts.
- 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 wires at the connector such that the seals are stretched or opened. See Figure C-4 for proper wiring harness installation practice. Figure C-5 illustrates installation practices to avoid.
- Locate the diagnostic tool connector in an area of the driver's compartment where a technician can easily access the connector.

8.0 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 model 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, 2900, and 4000 Product Families, the turbine speed sensor is external and requires connection to the wiring harness.

NOTE: The angular orientation of the transmission speed sensors must be properly located and aligned with internal transmission components in order to obtain accurate speed readings. The speed sensors are correctly positioned when shipped from the Allison factory. DO NOT remove and reinstall the sensors in a different angular orientation with respect to the transmission. Likewise, DO NOT remove and reinstall the speed sensor clamp bolts to attach brackets, p-clamps, or other items.

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 the wiring harness to use the signals directly from the speed sensors.

9.0 RETARDER CONTROLS – 3000 & 4000 PRODUCT FAMILIES

Operator control of the retarder can be accomplished by one of the methods listed below. The desired method must be specified when the TCM calibration is defined.

- **Both Analog and SAE 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 paragraph 9.1.
- **SAE J1939 Only**: Retardation is requested or limited based on messages from an SAE J1939-based vehicle controller. See paragraph 9.2.
- **Analog Only**: 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. See paragraph 9.3.

9.1 BOTH ANALOG AND SAE 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 paragraph 9.4.

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 ERC1 *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*.

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

9.2 SAE 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 ERC1 *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*.

9.3 ANALOG ONLY

When this retarder calibration option is selected, the 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 paragraph 9.4.

A master control is required, permitting the operator to enable or disable the retarder system.

9.4 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 AS07-504, Retarder Control Hardware*
- *Retarder Option*

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.

10.0 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 AS07-552* for space claim requirements.

11.0 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 AS07-551*. Contact the Allison Parts Distribution Center (PDC) for TPS availability.

APPENDIX A: INSTALLATION INSTRUCTIONS SHIFT LEVER AND CABLE ADJUSTMENT 1000/2000 PRODUCT FAMILIES AND 2900 (SHIFT-BY-CABLE) PRODUCT FAMILIES

TRANSMISSION SHIFT LEVER INSTALLATION

Failure to properly install or adjust the shift lever on the transmission may result in the generation of diagnostic codes. Mis-adjustment may also affect reverse warning or neutral start signal functionality. Refer to the *1000/2000 Shift Selector Design Requirements Installation Drawing, AS64-410* or *2900 Shift Selector Design Requirements Installation Drawing, AS64-910*. 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 *AS64-410, 1000/2000 Shift Selector Design Requirements* or *AS64-910, 2900 Shift Selector Design Requirements*.

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

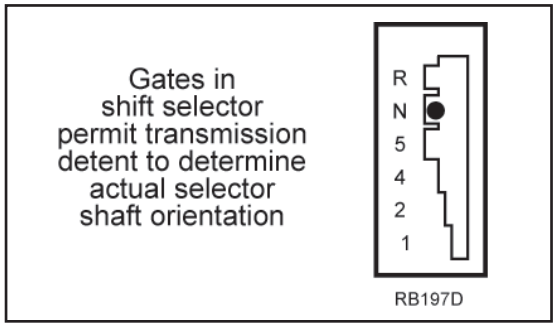
5. Verify that the lever is seated tightly against the shoulder of the selector shaft.
6. Orient the selector shaft in the Neutral position, which is the proper position when making cable adjustments. See procedure below. The transmission main case includes a cast feature which identifies the orientation of the selector shaft in this position.

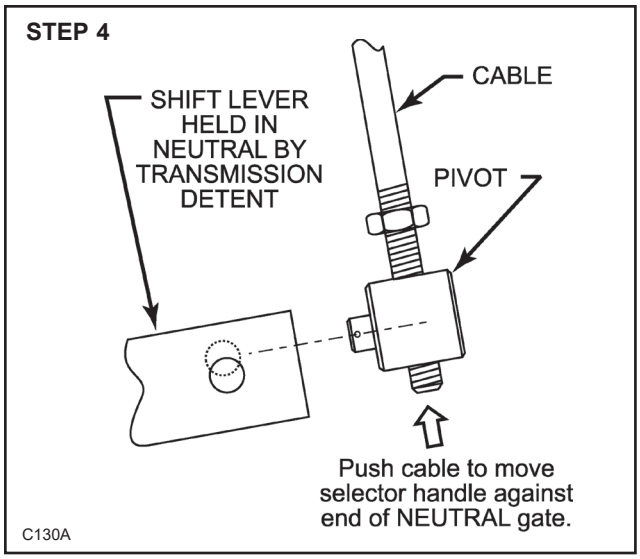
SHIFT SELECTOR AND CABLE ADJUSTMENT

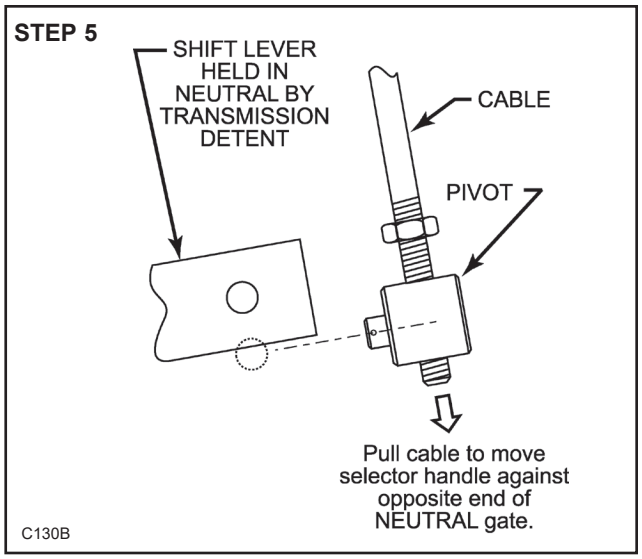
The shift cable must be adjusted after the shift selector has been installed in its permanent mounting location, the shift cable routing is finalized, and the cable has been secured.

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.







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.

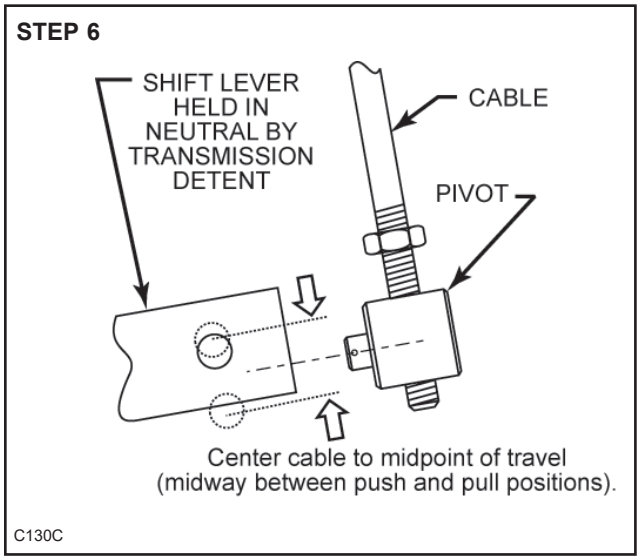
3. Attach the cable to the shift selector at the operator's station.

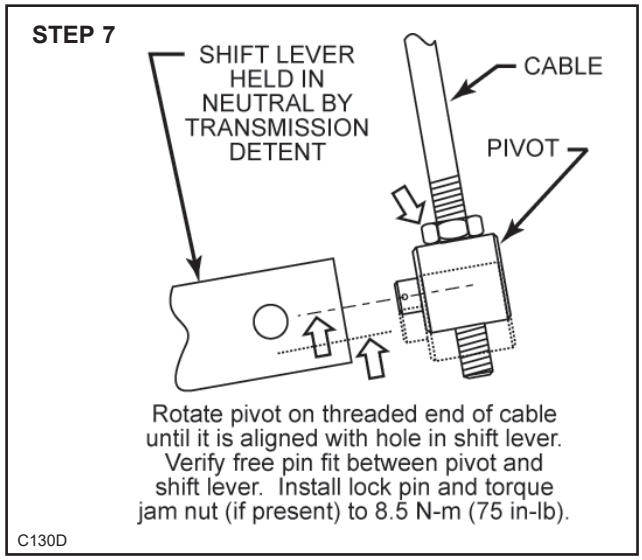
4. At the transmission end of the cable, push the cable to move the shift handle against the end of the shift selector Neutral gate. Note the position of the pivot at the end of the cable with respect to the hole in the shift lever.

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.

6. Center the position of the cable at the midpoint of travel determined by steps 4 and 5.

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





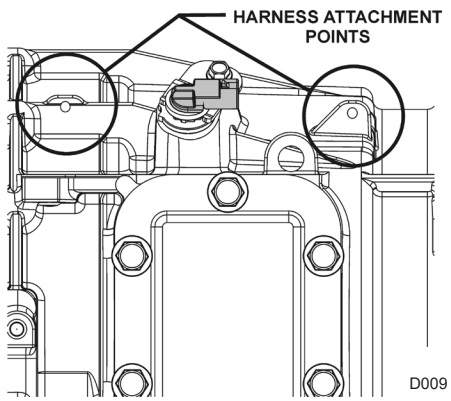
8. Verify that the attachment pin of the pivot does not bind in the shift lever hole and that the detent in the transmission is positively engaged. This condition is sometimes called free-pin-fit, referring to lack of friction at the cable / shift lever interface once the transmission detent is engaged. 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 the illustration for Step 7. If the cable manufacturer does not provide a jam nut with the cable assembly, do not add one during the installation process.

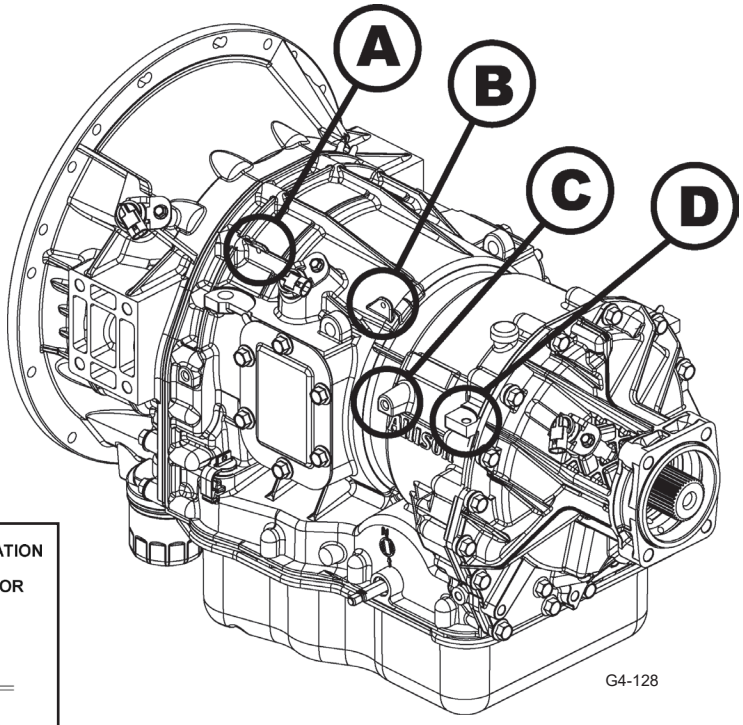
CAUTION: Once the jam nut is tightened, the pivot pin should slide freely into the hole in the lever. Do not twist the cable to insert it into the lever. Loosen the jam nut, reorient the pivot to insert freely into the lever, then tighten the jam nut again.

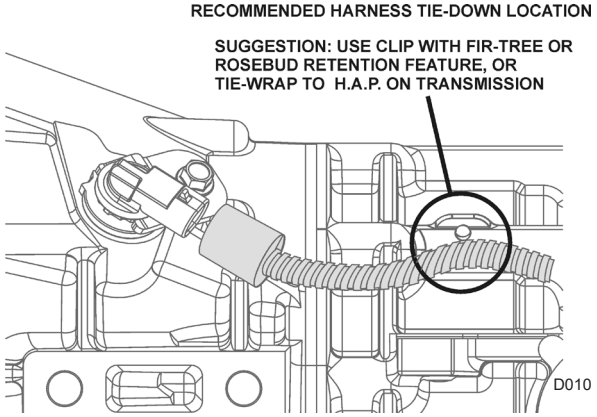
10. Once this attachment is made, move the selector through all the range positions at the operator's station. Verify that free-pin-fit exists in each range position, and that the position of the shift lever is determined by the internal transmission detent — not by tension or compression on the shift 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.

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

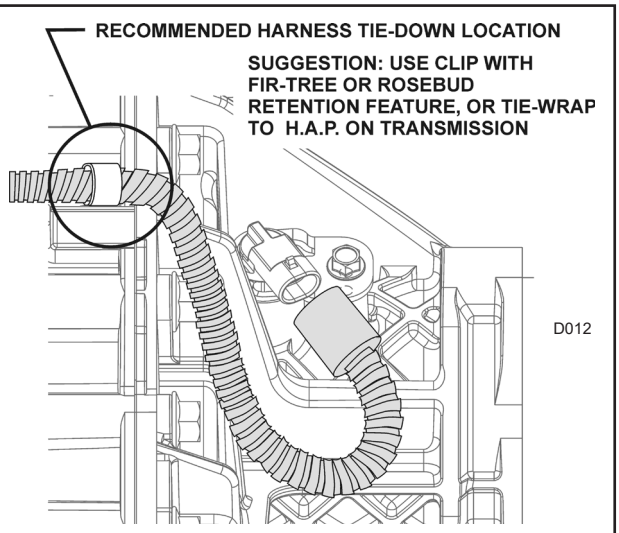


Close-Up: Locations A and B

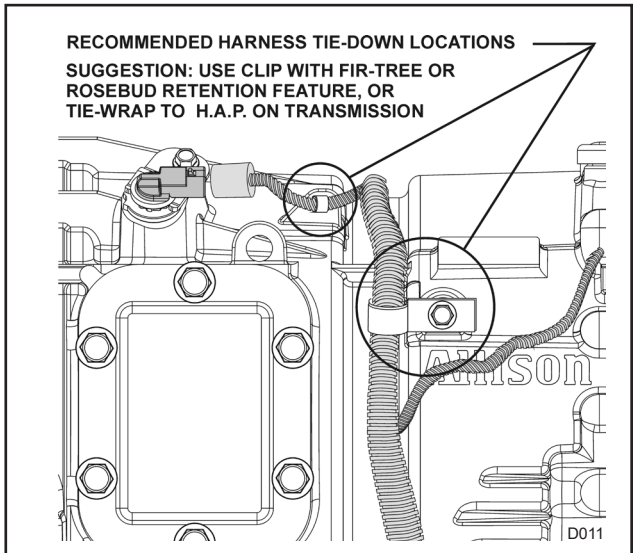




Close-Up: Harness Attachment at Location A



Close-Up: Harness Attachment at Location D



Close-Up: Harness Attachment at Locations B and C

LIST OF REFERENCED DOCUMENTS

Allison 6th Generation Controls Manual

- *Section A-1: Controls System Familiarization*
- *Section D: Vehicle Electrical System Interface*
- *Section F: Controls Support Equipment*

- *Allison 6th Generation Controls System Data*
- *Datalink Communications* for 6th Gen Controls
- *Input & Output Functions* for 6th Gen Controls
  - *Input D: Shift Selector Transition*
  - *Input AL, Shift Selector Transition and Secondary Shift Schedule*
  - *Input AR: OverDrive Disable*
  - *Input BZ, Shift Selector Transition and Oil Field Pumping*
- *Retarder Option*

Allison 6th Generation Controls Installation Drawings

- *AS07-504, Retarder Control Hardware*
- *AS07-612, Transmission Control Module (TCM)*
- *AS07-617, Allison Selectors for the 2900 and 3000/4000 Product Families*
- *AS07-621, System Schematic for 1000/2000 Product Family*
- *AS07-628, System Schematic for 2900 Product Family (Shift-by-Cable)*
- *AS07-629, System Schematic for 2900 Product Family (Shift-by-Wire)*
- *AS07-622, System Schematic for 3000/4000 Product Families, Except 7-Speed Models*
- *AS07-624, System Schematic for 4000 Product Family 7-Speed Models*
- *AS07-551, Throttle Position Sensor (TPS)*
- *AS07-552, Vehicle Interface Module (VIM)*

1000/2000 Product Family Installation Drawings

- *AS64-410, Shift Selector Design Requirements, 1000/2000 Product Family*
- *AS64-431, Connector and Harness Attachment Information, 1000/2000 Product Family*

2900 Product Family Installation Drawings

- *AS64-910, Shift Selector Design Requirements, 2900 Product Family*
- *AS64-931, Connector and Harness Attachment Information, 2900 Product Family*

3000 Product Family Installation Drawings

- *AS66-431, Connector and Harness Attachment Information, 3000 Product Family*

4000 Product Family Installation Drawings

- *AS67-431, Connector and Harness Attachment Information, 4000 Product Family*

Technical Documents (TD's)

- *TD-173, Wiring Harnesses for Allison Transmissions with Allison 4th, 5th & 6th Generation Controls*
- *TD-175, Guidelines for Selecting Retarder Controls*
- *TD-176, Service Requirements — Removal and Replacement Times for Allison Transmissions*
- *TD-177: Requirements for Shift Selector and Cable System*
- *TD-178, Throttle Position Sensor (TPS) for Use with Allison Transmissions*

Engineering Memorandums (EM's)

- *EM-78, Using a Single Shift Selector to Control Multiple Transmissions – 3000 and 4000 Product Families*

REVISION HISTORY

May 23, 2022

- Added 2900 Product Family

July 23, 2020

- Created new *Section C: Controls Component Installation* for Allison 6th Generation Controls.