

xEV MD 4SPD AUTOMATED MANUAL TRANSMISSION TRIG2150 EN-US

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Important Information	1	Section 8: Harness Routing and Clipping	
System Integrator Design Package	2	Requirements	22
Acronyms Associated with xEV	2	Predetermined Clipping Points	22
Section 1: Introduction and General Information	3		
System Features and Familiarization	3		
Transmission Components Temperature			
Requirements	3		
Transmission Assembly	4		
Component and Touch-point Identification	5		
Section 2: Component Weight and			
Center of Gravity	6		
Section 3: Vehicle Space Claim	7		
Cab Floor Access Plate	7		
Transmission Dimensions	8		
Driver Interface Device Space Claim	9		
Transmission Operating Angle	9		
Input Shaft Spline Data	9		
Motor Shaft Alignment	9		
Oil Seal	9		
Section 4: System and Feature Integration	11		
Eaton Vehicle System Integration (VSI) Group ...	11		
Required Feature Integration:	11		
Optional Feature Integration:	13		
Section 5: Lubrication Requirements	15		
Section 6: Cooler Requirements	16		
Section 7: Electrical System Requirements	17		
Power Requirements	17		
Electrical Current Requirements	17		
Operating Conditions over Temperature			
for 12-Volt Systems	17		
Mating Connector and Terminal Requirements ...	17		
Network Communication Requirements	18		
Vehicle Service Requirements for Electronics ...	18		
System Integrator Interface Connections	18		
38-Way Vehicle Connector	19		
Driver Interface Device (DID)	20		
Control Area Network (CAN) Communications ...	20		
Wiring Recommendations	21		

Important Information

This symbol is used throughout this manual to call attention to procedures where carelessness or failure to follow specific instructions may result in personal injury and/or component damage.

Departure from the instructions, choice of tools, materials and recommended parts mentioned in this publication may jeopardize the personal safety of the service technician or vehicle operator.



Warning: Failure to follow indicated procedures creates a high risk of personal injury to the servicing technician.

Caution: Failure to follow indicated procedures may cause component damage or malfunction.

Important: Highly recommended procedures for proper service of this unit.

Note: Additional service information not covered in the service procedures.

Tip: Helpful removal and installation procedures to aid in the service of this unit.

This Eaton publication has been assembled to assist the System Integrator with proper design integration, handling and assembly of the Eaton xEV transmission. For additional information such as transmission operation, troubleshooting and warranty information, please see the Other Useful Publications section in this manual.

The xEV system is designed to operate correctly and safely when the requirements in this installation guide are met, in particular, unintended or incorrect system operation could occur if requirements marked as a safety requirement are not complied with.

Transmissions installed at System Integrator facilities shall meet all requirements as identified in the Eaton Transmission Applications Guidelines and be approved by Eaton Application Engineering. Contact your OEM Application Engineering department or Eaton Application Engineering for the proper Application Approval Form. All applications shall be submitted for approval.

Eaton xEV transmissions are only compatible with EV components (i.e. motor, inverter, supervisory control module) as certified by Eaton Corporation. For specific motor/inverter information, please contact the motor/inverter manufacturer.

Failure to adhere to Eaton installation requirements or any handling and installation requirements may affect transmission performance and/or warranty coverage.

Any reference to brand names in this publication is made as an example of the types of tools and materials recommended for use and should not be considered an endorsement. Equivalents may be used.

Every effort has been made to ensure the accuracy of the information contained in this manual. However, Eaton Corporation makes no warranty, either expressed or implied, based on the information provided. Eaton reserves the right to discontinue or modify its models and/or procedures and to change specifications at any time without notice.

The System Integrator shall be responsible for producing parts that meet the requirements of this document.

System Integrator Design Package

The System Integrator shall submit a design package to Eaton Corporation OEM customer support engineering for approval prior to any build.

A design package consists of the following information:

- Detailed drawing of chassis battery power and ground scheme.
- Construction detail of individual wiring low voltage harnesses including harness routing location and clipping points.
- Wiring schematic: High-level schematic of how this transmission interfaces with the vehicle.
- Vehicle communication architecture with components.

Acronyms Associated with xEV

- ATC or ASR: Automatic Traction Control
- EV System: All components used in powertrain configuration (i.e. SCM, motor, inverter, etc.)
- SCM: Supervisory Control Module
- TCM: Transmission Control Module
- System Integrator: This refers to the party responsible for verifying the integration of the components in the system. This could be identified as the vehicle OEM or other partner.

Section 1: Introduction and General Information

System Features and Familiarization

Integration Features:

- 12 or 24 volt vehicle electrical system capable.
- Compatible with ABS and ATC or ASR.
- Product-specific J1939 messaging.
- No requirements for external lubrication or cooling systems.
- SAE J1134 Nodal Mount

System Performance Features:

- Intelligent start gear selection automatically selects appropriate gear based on percent grade, vehicle weight and motor torque.
- Intelligent gear selection for acceleration management.
- Recuperative braking maintains high gear during braking event to recover electric energy

Mechanical Performance Features:

- Cooler-less operation.
- Aluminum transmission housing for reduced weight.

Diagnostic Features:

- Supported by Eaton ServiceRanger PC-based service tool.

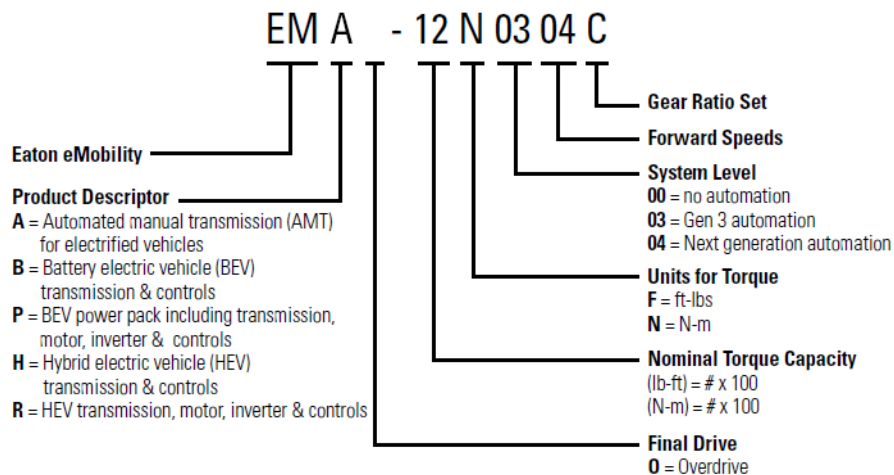
Transmission Components Temperature Requirements

The temperature limit for all electrical system components is 250 °F (121 °C). If sufficient air gap between the heat source and the following transmission components cannot be achieved, the System Integrator must provide proper methods of heat shielding to ensure this limit is not exceeded. The components and systems to be protected would include, but not limited to, the Shift Motors, Sensors, Wire Harness, Transmission Controller.

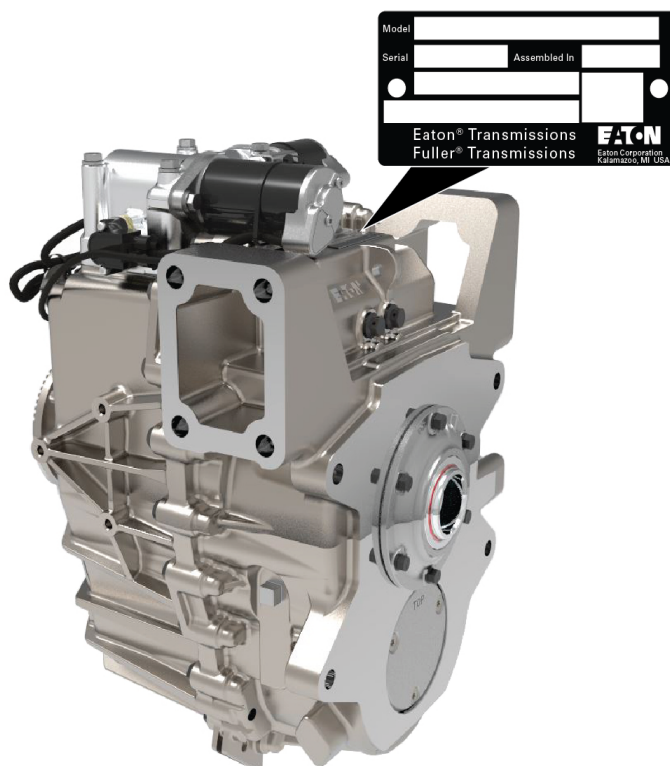
Transmission Assembly

The Eaton xEV Medium-Duty Automated Transmission is an automated 4 speed single countershaft transmission. xEV is electrically shifted with high efficiency gearing, light-weight aluminum enclosures, simple install nodal mounts, and features Eaton GearLogic™ software.

Following is a nomenclature tree that describes the multiple configurations of the transmission model numbers:

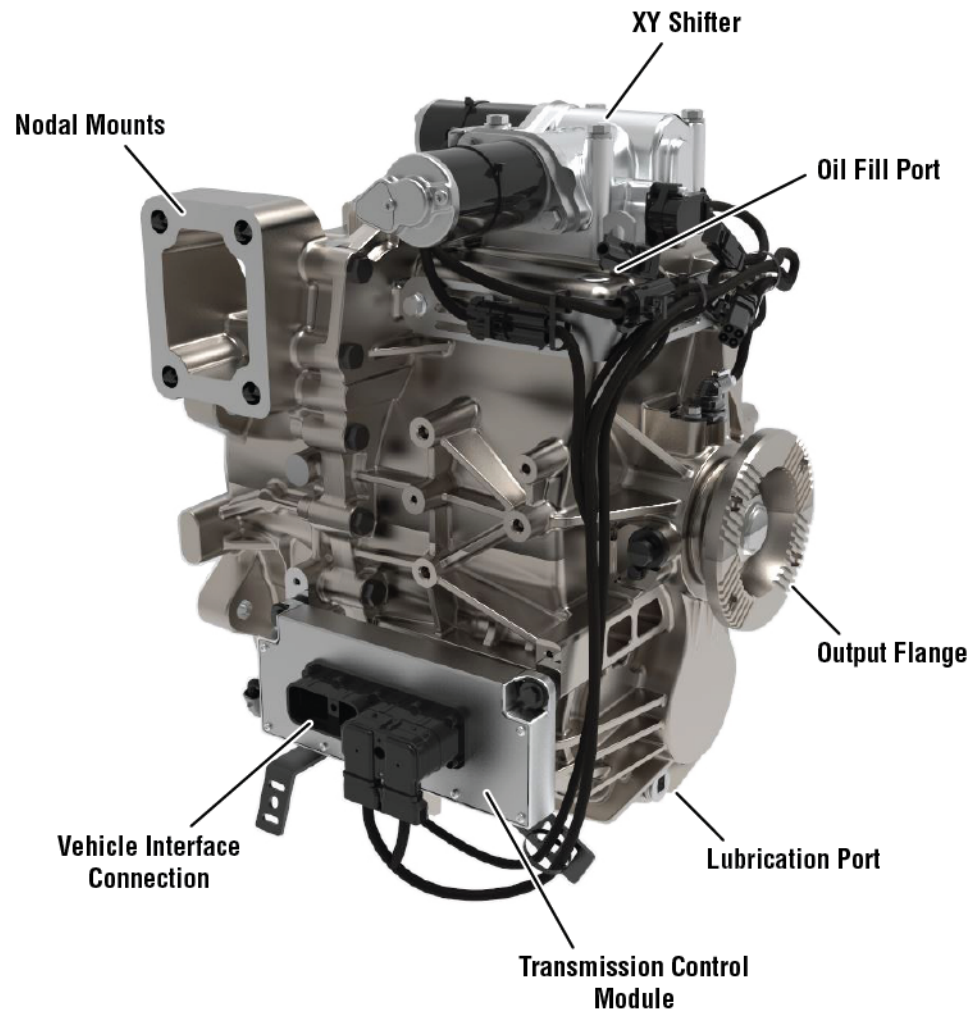


All xEV transmissions are supplied with component identification tags which define the transmission model number, assembly number and serial number. Identification tags are located on the top of the transmission between the nodal mounts on the input shaft side of the transmission. Do not remove identification tag.



Component and Touch-point Identification

Transmission Assembly



Section 2: Component Weight and Center of Gravity

Dry Weight: 241 lb. (109 kg)

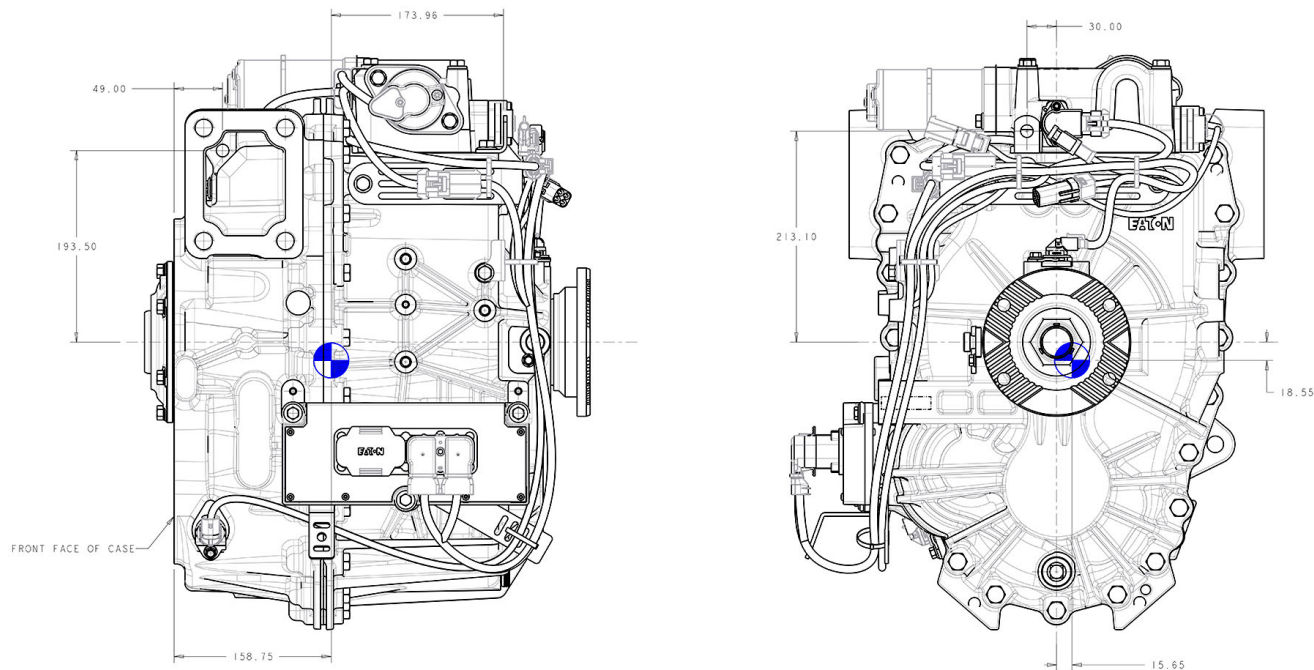


Table 1:

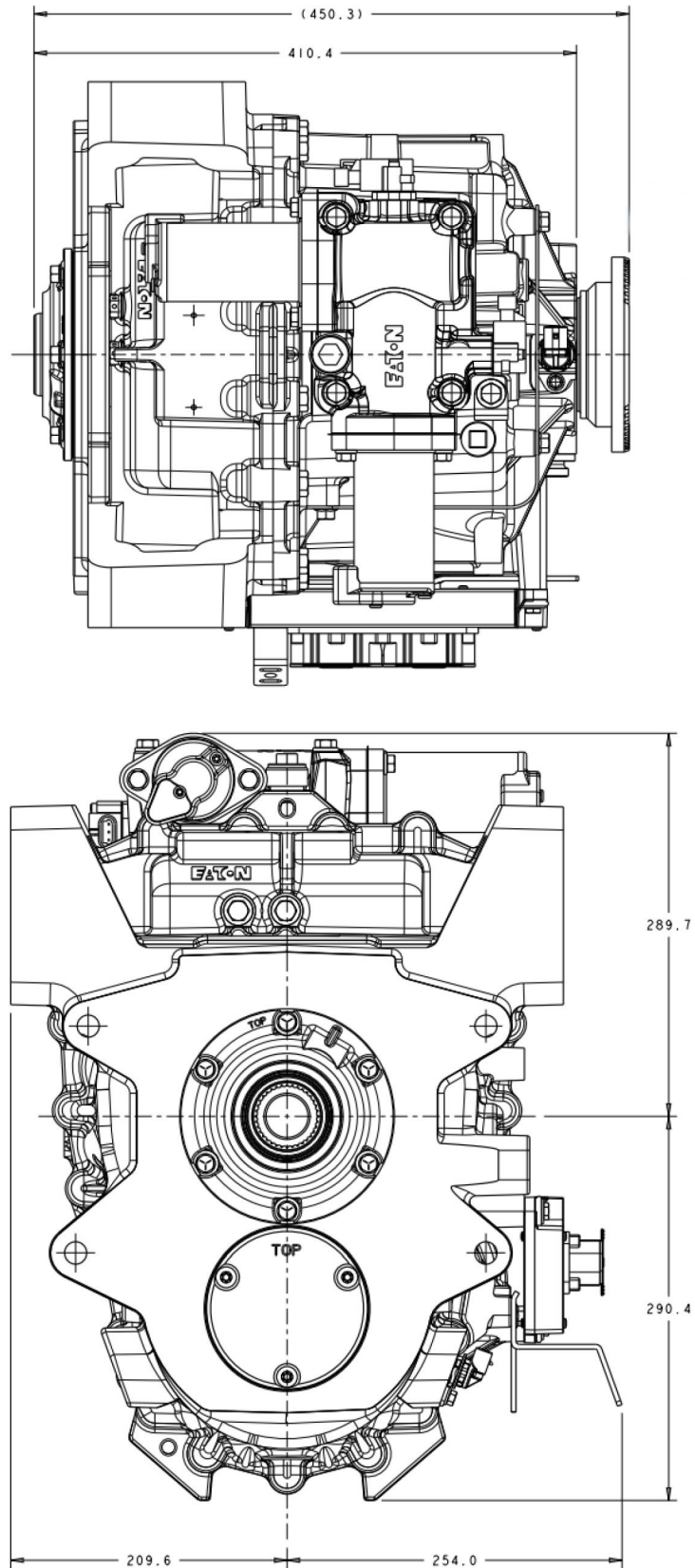
Gear Ratio	1st	2nd	3rd	4th	Reverse	Overall
	4.83	2.82	1.65	1.00	4.83*	4.83

Section 3: Vehicle Space Claim

Cab Floor Access Plate

A cab floor access plate is recommended for service access to the transmission top. A minimum access plate size of 15-inches x 12-inches is sufficient to allow service of the transmission control module or electronic shifter.

Transmission Dimensions



Driver Interface Device Space Claim

The Eaton xEV driver interface device, or shift controller, does not have an established space claim for the vehicle. The System Integrator is responsible for furnishing an appropriate driver interface device and corresponding space claim(s).

Transmission Operating Angle

Eaton's EV MD transmission requires that the maximum operating angle be within +12.0° (input end up) to -6.0° (input end down) to insure proper lubrication.

Input Shaft Spline Data

No. of Splines	36
Major Diameter	48.01
Minor Diameter	44.77

External Involute Full Fillet Root Side Fit conforms to TESS-EX2003736-1, which is available upon request.

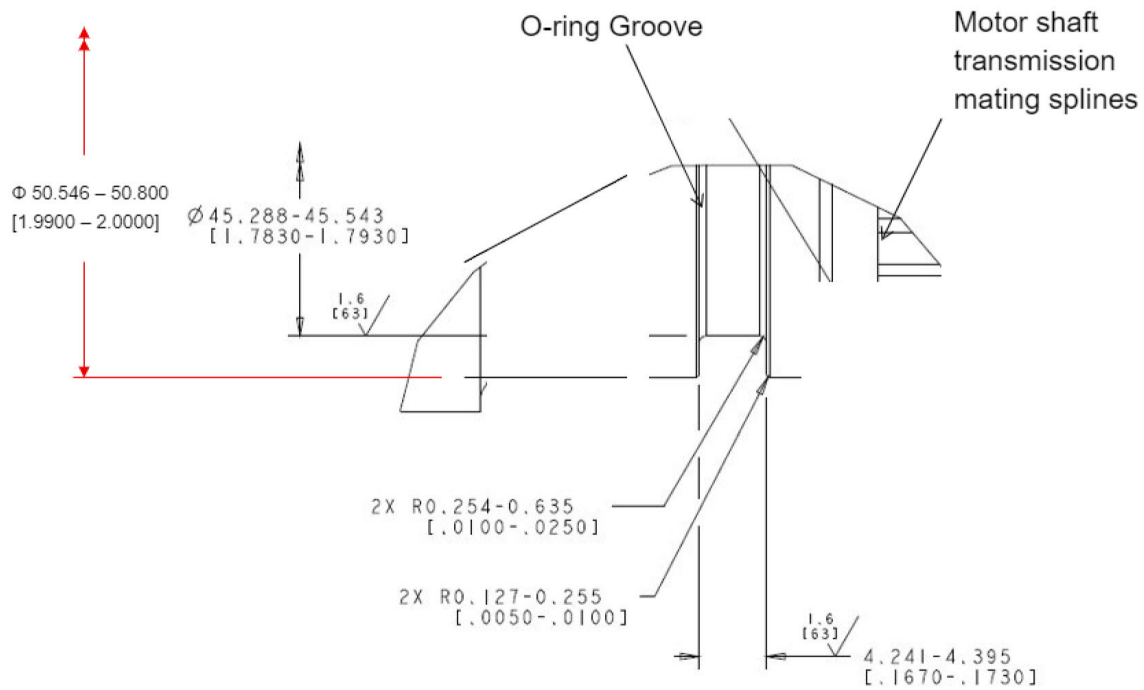
Motor Shaft Alignment

The transmission shaft alignment feature is the outside diameter of the front bearing cover. The front bearing cover outside diameter print dimension is Ø 162.700 - 162.750. The counter bore print dimension is 6.50 +/- 0.50

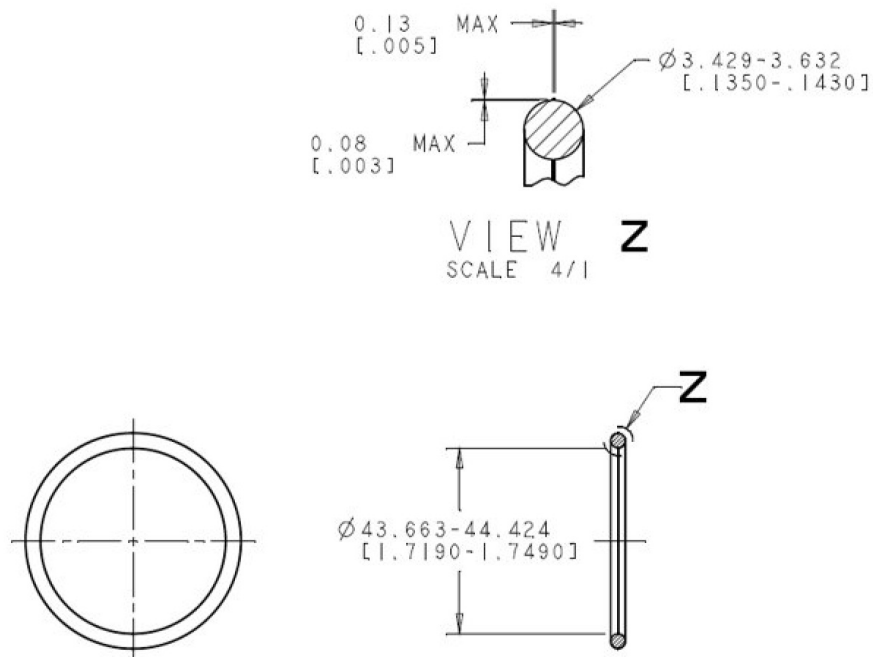
Oil Seal

The System Integrator is responsible for an O-ring on the motor output shaft. This design must be included on the motor output shaft/adaptor design. Eaton recommends the center of the O-ring groove be located 61.698 mm from the end of the motor shaft. There is flexibility in the exact O-ring groove location. However, Eaton requests review of final design to verify variants meet these requirements.

Below is Eaton's recommendations for O-ring design.



O-ring size shall conform to the following specifications:



Section 4: System and Feature Integration

Eaton Vehicle System Integration (VSI) Group

Integration requirements for the features identified in this section are maintained by the Eaton eMobility VSI group in what is known as a Truck System Integration (TSI) documents. The TSI documents can vary by System Integrator, vehicle model year and transmission model. The TSI documents are also used to document interfaces with System Integrator proprietary messages. Integration of new features or integration of existing Eaton products to new vehicle platforms should be discussed with the Eaton eMobility VSI group to identify the relevant requirements or to generate new requirements.

The list below identifies the system features for which all integration requirements are maintained as TSI documents. A brief description or high-level requirement of each feature is provided, and each feature is identified as "required" or "optional".

Required: The System Integrator design shall meet all system integration requirements in order for the xEV system to operate correctly and safely and to avoid unintended or incorrect system operation..

Optional: The OEM has the option to integrate each feature as desired.

Required Feature Integration:

EV System Components

Eaton xEV transmissions are only compatible with components certified by Eaton. The EV system modules shall contain the proper configuration settings for xEV transmission operation.

For a list of Eaton recommended settings, contact Eaton OEM engineering representative.

For specific EV system component information, please contact component manufacturer.

Compatibility and Operation with J1939 Communication

Eaton xEV transmissions utilize SAE J1939 communications protocols on multiple CAN networks as the primary means of communication to other vehicle components. xEV transmissions can support 250 Kbps or 500 Kbps networks and implement automatic baud rate detection if necessary. Other vehicle network types and protocols (i.e. J1587, LIN or FlexRay) are not supported.

Drive Interface Device

Eaton xEV TCM can communicate with a driver interface device on J1939, analog or PNL shift input devices. Contact Eaton OEM engineering representative for shift input device design and interface requirements. Please see "Section 7: Electrical System Requirements" for details on DID electrical and communication interfaces to the transmission system.



WARNING: This is a safety requirement. In order to not confuse a vehicle driver or conflict with the gear display during a mode transition, for driver interface devices equipped with illuminated mode indicators, the interface shall flash the requested mode indicator (and hold previous mode solid) if the mode feedback from the J1939 ETC7 message does not match the requested mode. Failure to communicate a mode change and agree with a vehicle driver display on driver interface devices equipped with illuminated mode indicators has the potential to cause unintended vehicle direction and unintended vehicle motion, which may result in serious injury or death.



WARNING: This is a safety requirement. To prevent miss-informing the vehicle driver, for driver interface devices equipped with illuminated mode indicators, the driver interface device shall show an error state or warning light within 500ms if the vehicle stops receiving valid J1939 ETC7 messages from the TCM. Failure to notify the driver of lost communication with the transmission has the potential to cause unintended vehicle direction and unintended vehicle motion, which may result in serious injury or death.

A typical driver interface device (DID) allows driver selection of "RNDML" (reverse, neutral, drive, manual, and low modes). All driver inputs are treated as requests and honored as dictated by vehicle operating conditions to ensure safe operation. Confirmation of the Transmission Requested Gear Feedback signal is found in the J1939 ETC7 message.

- Driver Interface Device Modes:
 - Reverse Mode: *Reverse is achieved by rotating the vehicle motor in the opposite direction (compared to Drive Mode) to provide reverse motion. The TCM selects the first gear ratio when Reverse is selected on the DID.
 - Neutral Mode: Initiates a sequence that puts the transmission in gearbox Neutral where no torque is transferred through the transmission.
 - Drive (Forward) Mode: Will initiate a sequence of events that places the transmission in gearbox into Drive, the standard mode of transmission operation. The TCM will automatically select, engage, and shift to the forward gear appropriate to the road/motor speed conditions and vehicle configuration.
 - Manual (Forward) Mode: Initiates a sequence that puts the transmission in gearbox Manual. The transmission engages a forward gear but inhibits the automatic shifting. Shifts in Manual mode are accomplished by sending the appropriate UP or DOWN shift request. Shifts are allowed if the conditions satisfy vehicle limit criteria.
 - Low (Forward) Mode: Initiates a sequence that puts the transmission in gearbox Low. The transmission engages a forward gear then executes a downshifting sequence with higher downshift points.

Note: Manual gear shift requests are allowed when the transmission is in Manual, Drive, or Reverse mode. The driver initiates a gear shift by requesting a gear Upshift or Downshift. The manually requested shift is allowed if vehicle conditions satisfy the shift criteria for the current gearbox mode.

Gear Display



WARNING: This is a safety requirement. To inform the vehicle driver of the transmission state, the vehicle driver display system shall provide a minimum of 2 digits to show transmission mode and status information conveyed via the Transmission Current Range (J1939 ETC2 message) signal. Failure to notify the driver and provide feedback information on the state of the transmission has the potential to cause unintended vehicle direction, unintended vehicle motion or other hazards associated with an uninformed driver, which may result in serious injury or death.



WARNING: This is a safety requirement. To prevent miss-informing the vehicle driver, the vehicle driver display system shall show an error state or warning light within 500ms if the vehicle stops receiving valid ETC2 messages from the TCM. Failure to notify the driver of lost communication with the transmission has the potential to cause unintended vehicle direction, unintended vehicle motion or other hazards associated with a misled driver, which may result in serious injury or death.

A gear display is required for proper transmission operation. The System Integrator is responsible for supplying the gear display and wiring per governmental safety standards, such as the Federal Motor Vehicle Safety Standard (FMVSS).

The gear display offers real-time information pertaining to current engaged gear, engagement status during gear shifting, transmission synchronization during shifting and transmission fault status. The gear display interfaces with the transmission with the J1939 ETC2 message. Two characters messages can also be displayed through the gear display as a means to communicate transmission information to the driver (i.e. "OS" for Over speed). Messaging content can vary by System Integrator, please contact Eaton eMobility VSI for specific details.

Alert Tone



WARNING: This is a safety requirement. This is a safety requirement. To complement the visible warnings of the driver display system, the vehicle system shall have an audible Warning capability to communicate warning status to the driver including those communicated from the TCM. Failure to additionally notify the driver by audible means increases the likelihood a hazardous condition, if encountered, could go unnoticed by the driver, which may result in serious injury or death.



Required tone information shall be conveyed from the xEV transmissions via the control character of the Transmission Current Range signal in the SAE J1939 ETC2 message. It is the System Integrator's responsibility to choose tone attributes (i.e. type, duration, frequency) for a given set of conditions. System Integrator's also have the ability to add audible notifications in addition to those explicitly sent from the transmission by triggering off other sources such as the Message Display, Gear Display and Driver Interface Device.

Service Lamps

Red and Amber transmission indicator lamps are required on the dash. The lamps shall respond to transmission broadcast J1939 DM1 messages. An Amber Lamp signal from the transmission would indicate the need for service while a Red Lamp signal would indicate the immediate need to cease driving and/or that vehicle motion is prohibited

Accelerator Pedal



WARNING: This is a safety requirement. The accelerator pedal system is the primary driver input for vehicle acceleration, the accelerator pedal shall confirm pedal movement before the vehicle system transmits non-zero Accelerator Pedal Position (SPN91) to the transmission. Failure to provide an input that does not accurately represent the vehicle driver's intent has the potential to cause the transmission to engage the driveline resulting in unintended vehicle motion, which may result in serious injury or death.

Optional Feature Integration:

Using Rear Supports

The System Integrator is responsible for determining if rear supports are needed. If rear supports are desired, the System Integrator is responsible for rear mount design.

Calibration File

To achieve designed performance levels and activation of some features, the Eaton xEV transmissions require calibration files to be installed onto the TCM in addition to the application software. For production vehicles the calibration files are installed at the System Integrator Vehicle Equipment Programming Station (see VEPS section for more information), in-service vehicles can have the calibration files changed with the ServiceRanger service tool.

Calibration files contain parameters developed by Eaton calibration engineers that are vehicle configuration specific and are certified under an Eaton part number. Calibration files may contain, but are not limited to, shift point maps, motor tuning parameters and System Integrator specific tuning of features. See VEPS in Section 11 for more information.

Configuration Parameters

In addition to the calibration file previously described, the xEV transmission also has optional configuration parameters which can be controlled independent of the calibration files, although the calibration files have the ability to change the default configuration parameters. Configuration parameters are features, functions, and options that can be selected, enabled, disabled, or modified with discrete values by authorized internal or external parties. For production vehicles the default configuration parameters can be changed by the System Integrator Vehicle Equipment Programming Station (see VEPS section), in-service vehicles can have the configuration parameters changed with the ServiceRanger service tool provided the user has the correct permission level for a particular parameter.

Anti-lock Braking System (ABS)



WARNING: This is a safety requirement. The vehicle system shall provide accurate entry and exit information of ABS (skid) events to the transmission via a J1939 EBC1 Message signal. Failure to notify the transmission of skid events creates potential for reduction in lateral control of the vehicle due to loss of power steering (engine stalling) or abrupt driveline retardation, which may result in serious injury or death.

Cruise Control and Advanced Cruise Control Systems

Eaton xEV transmissions do not currently support cruise control and advanced control systems.

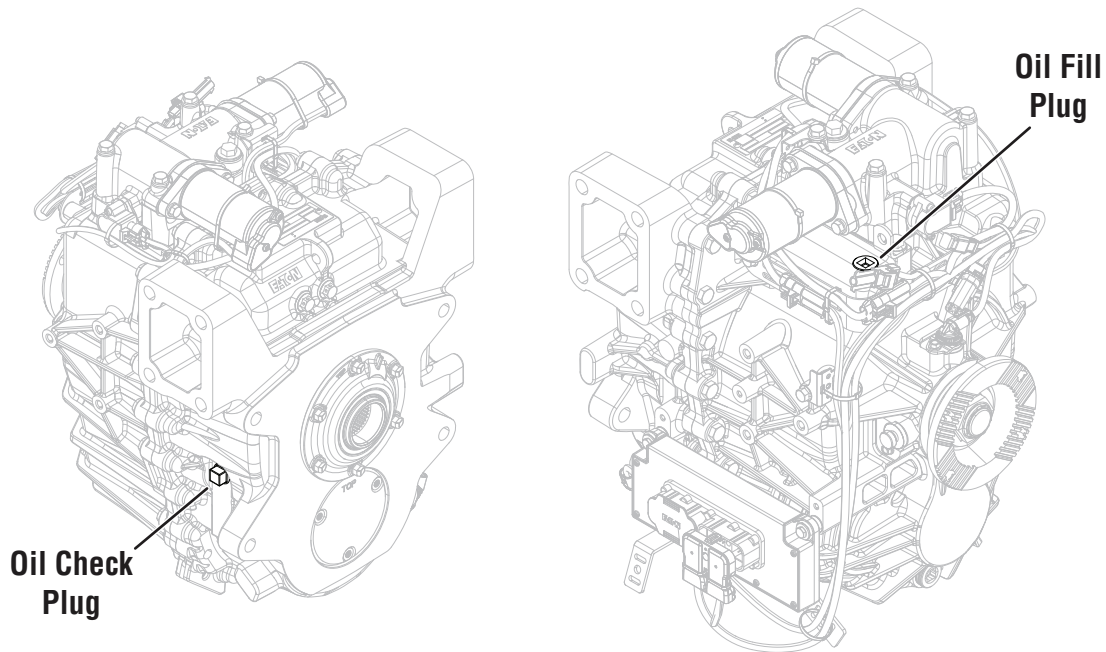
Stability and Traction Control Systems

Eaton xEV transmissions do not currently support ASR and ATC systems.

Section 5: Lubrication Requirements

Eaton xEV transmissions are designed so the internal parts operate in a bath of lubricant circulated by the motion of the gears and shafts. Thus, all parts will be amply lubricated if these procedures are closely followed:

A list of approved lubricants and suppliers can be found in the *Approved Lubricant Supplier Manual*, TCMT0020. Not using the required lubricant will result in degraded performance and shortened life of the product.



- Lubrication capacity: 7.3 liters
- Additives and / or friction modifiers are not approved. Additives of any kind will result in unpredictable consequences. No liability of any kind will be accepted by Eaton for any damage resulting from the use of such additives.
- Failure to use the required lubricant will affect the transmission performance and the warranty coverage.
- All approved lubricants are required to display the PS-386 approved logo.

EATON®

Eaton Approved Lubricant

PS-386 Synthetic Transmission Fluid

Section 6: Cooler Requirements

The xEV transmission is designed to operate without a cooler.

Section 7: Electrical System Requirements

NOTICE: “Power” refers to both power positive and power negative supply. This is typically battery plus and battery negative. “Switched ignition” refers to power that is enabled with ignition key operation.

Power Requirements

- The vehicle shall have a negative ground power system.
- The vehicle primary power system shall be either of the following types: 12 or 24 volt.
- If a disconnect switch is used for the supervisory control, it shall be configured such that it also removes power to the TCM.
- The System Integrator shall provide power wiring to the TCM such that the differential voltage (TCM negative subtracted from TCM positive) under all operating conditions exceeds:
 - 9 volts DC at a load of 30 amps as configured for a 12 volt base system.
 - 18 volts DC at a load of 30 amps as configured for a 24 volt base system.
- The System Integrator shall supply power to the TCM that does not exceed a steady state voltage of 32 volts DC.
- The System Integrator shall provide switched ignition power to the TCM such that it provides 10 amps at 12 volts DC.
- Power and switched ignition to the TCM shall not be switched off during the start process.

NOTICE: Removal of ignition power quickly followed by the removal of constant power may not provide the TCM adequate time to power down and could result in loss of information.

Electrical Current Requirements - Operating Conditions over Temperature for 12-Volt Systems

- The Main Power 30 amp fuse connection for the TCM is required to be identified at the termination.
- The Switched Ignition 10 amp fuse connection for the TCM shall be identified at the termination.
- Operating current characteristics for the TCM:
 - Active Shifting Current = 30 amps
 - Maintaining current gear = 6 to 15 amps
 - Power down sequence = 6 to 15 amps

Mating Connector and Terminal Requirements

- Connectors shall be designed for use in the heavy-duty industry, conforming to SAE-J2030 and SAE-J1455.
- Terminal position assurance (TPA) and connector position assurance (CPA) devices shall be used on connector systems that support those devices.
- When interfacing to Eaton components, use connector systems specified within Eaton documentation or an Eaton approved equivalent.
- Mating halves of terminal systems shall use plating materials that are compatible with each other.
- Terminal plating shall be gold for all TCM interfaces.
 - Recommended minimum plating thickness of 0.75 microns of gold over 1.2 micron of nickel.

- Required wire size: The cable for the Deutsch connector (DRC26-38-S01) should be
 - 18 GXL max / 18 TXL min. for Communication and control wires.
 - 12 GXL or 14 SXL for Power Supply wires.
 - 12 GXL or 14 SXL for V-Ignition wires.

NOTICE: Specified cable sizes ensure proper connector sealing and current carrying capacity.

NOTICE: Cable cross-sectional area and insulation are specified to ensure proper connector cable sealing and current carrying capacity.

Network Communication Requirements

The use of either shielded or unshielded twisted pair shall be a System Integrator decision based upon EMC validation testing.

- Eaton required controller area network (CAN) communication with the EV System.
- Eaton provides the System Integrator option of supporting CAN communications utilizing the SAE J1939 CAN physical layer with shielded twisted pair data cable (SAE J1939/11) or unshielded twisted pair data cable (SAE J1939/15).
 - For shielded, twisted-pair installations (STP), the data link cable, connectors, and termination shall meet the performance and assembly requirements of SAE J1939/11.
 - For unshielded, twisted-pair installations (UTP), the data link cable, connectors, and termination shall meet the performance and assembly requirements of SAE J1939/15.
- Twisted pair requirements:
 - 2 Cables = 10 Twists / 25.4 cm
 - 3 Cables = 8 Twists / 25.4 cm
 - (16 and 18 Gauge Cable Only)

Vehicle Service Requirements for Electronics

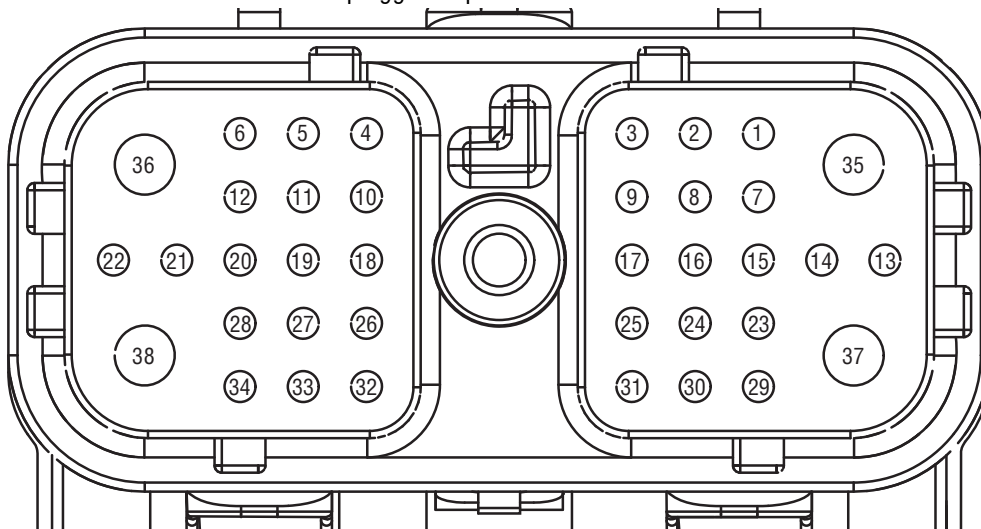
- Battery positive and negative circuits to the Eaton xEV TCM must be disconnected prior to any type of welding on the vehicle
- Battery negative must be disconnected prior to removal or installation of TCM harness connectors.
- Removal and/or replacement of a battery shall not disturb the terminating connectors of the TCM.

System Integrator Interface Connections

There will be one 38-way vehicle connector that mates the transmission control module with the vehicle CAN network. The vehicle connector is shipped with a cover that must be removed before harness is connected.

38-Way Vehicle Connector

NOTICE: All unused connector cavities shall be plugged to prevent water intrusion.



38-Way Pin	Description	Wire
1	Not Used	Plug
2	J1939 Low (-)	18 TXL
3	J1939 High (+)	18 TXL
4	Not Used	Plug
5	Not Used	Plug
6	Not Used	Plug
7	Not Used	Plug
8	Not Used	Plug
9	Not Used	Plug
10	Not Used	Plug
11	Not Used	Plug
12	Not Used	Plug
13	Not Used	Plug
14	Shift Control Input Common 2 (-)	18 TXL
15	Shift Control Input Auto Mode Signal (+)	18 TXL
16	Shift Control Input Manual Mode Signal (+)	18 TXL
17	Shift Control Input Common 1 (-)	18 TXL
18	Not Used	Plug
19	Not Used	Plug

38-Way	Description	Wire
20	Not Used	Plug
21	Not Used	Plug
22	Not Used	Plug
23	Service Light Supply	18 TXL
24	Not Used	Plug
25	Shift Control Protected Battery Negative (-)	18 TXL
26	Not Used	Plug
27	HIL Low (-)	18 TXL
28	HIL High (+)	18 TXL
29	Not Used	Plug
30	Not Used	Plug
31	Shift Control Protected Battery Positive (+)	18 TXL
32	Not Used	Plug
33	Not Used	Plug
34	Not Used	Plug
35	Ignition	12 GXL or 14SXL
36	Battery Negative (-)	12 GXL
37	Not Used	Plug
38	Battery Positive (+)	12 GXL

Driver Interface Device (DID)

The Vehicle System Integrator is responsible for making the appropriate electrical connections for the driver interface device to the TCM vehicle connector and supplying any required electrical connector for the driver interface device. The driver interface device network shall have no failure modes that would induce an electrical hardware failure in the TCM, or any other transmission component connected to the drive interface device. The TCM is designed to tolerate shorts to ground and high impedance failures in connected circuitry but cannot tolerate high voltages or current surges.

The driver interface device network shall not impose any service or maintenance requirements on the TCM.

Typical communication is through the J1939 communications network (primary) and a PWM input (secondary). The PWM is an optional feature.

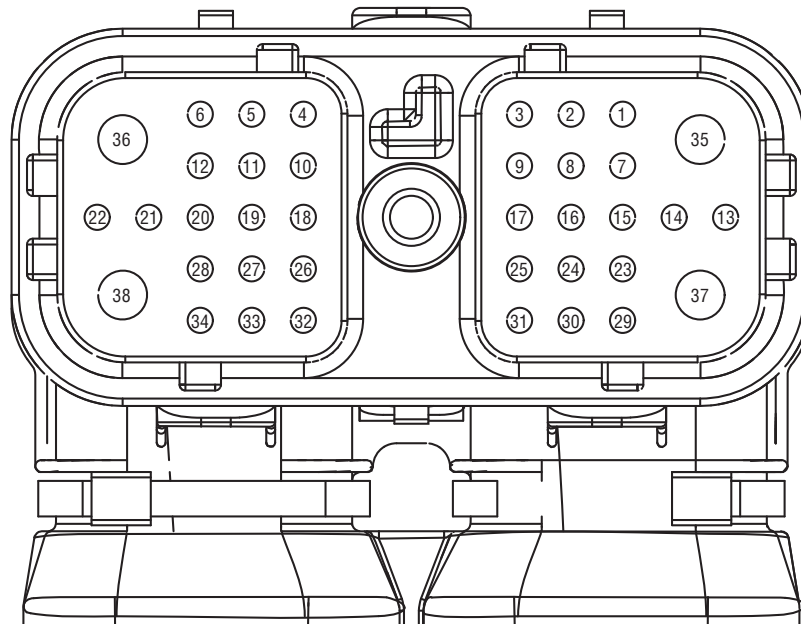
Also, the TCM can control the power up and shutdown of the driver interface device.

If using PWM feature:

The driver interface device PWM signal is a nominal 100 Hz pulse width modulated 0-5 volt DC signal intended as a non-primary signal to communicate TC1 information. The maximum low state voltage shall be less than 0.250vdc and the minimum high state voltage shall be 4.750vdc. Under normal operation this signal will provide a mode confirmation signal according to the gear requested. The PWM signal shall be simultaneous (within 50 ms) to the J1939 TC1 message and is intended to be used as a comparative signal. The signal shall be pulse width modulated in such a way as to provide the following duty cycles for given gear requests.

Control Area Network (CAN) Communications

- The CAN data link shall be utilized for network communications between the TCM and other components on the vehicle, such as the supervisor control module (SCM). This network is also known as the public J1939 data link.
- The CAN data link shall conform to SAE J1939/11 or SAE J1939/15.



From	To	Description
V-1	System Integrator	J1939 Shield (CAN)
V-2	System Integrator	J1939 Low (CAN)
V-3	System Integrator	J1939 High (CAN)

Wiring Recommendations

Electrical Contact Lubrication Recommendations

Eaton recommends the use of NyoGel® 760G on all electrical contacts that are not gold plated. The preferred method of application is to use a metered dispensing mechanism that places the material on the socket of the connector. It is also preferred that the material be placed immediately prior to connector mating to reduce the probability of contamination.

The NyoGel® 760G material shall not be applied to the transmission ECU 38-Way (Vehicle Interface) connector jackscrew. No anti-seize, lubricating, or foreign compound shall be applied to the connector jackscrew threads. The use of such compounds may affect jackscrew torque and prevent proper sealing of the connector.

Harness Design Recommendations

- Splices shall be ultrasonically welded and encapsulated and sealed to meet SAE-J1455.
- Convolved conduit shall have a service temperature of at least 257° F (125° C) and be made of a material that mitigates chafing of the wire insulation.
- Braided loom shall have a service temperature of at least 280° F (138° C). Coverage: A minimum of 10 picks per inch / maximum of 12 picks per inch.

Electrical Juncture Recommendations

- Do not use more than 3 ring terminals per mounting stud. Terminals such as ring, bullet, spade, etc., shall be sized for the correct current capacity of the circuit as stated by the manufacturer. Terminals shall be plated and non-insulated. Mated terminal plating shall be selected such that it prevents galvanic corrosion between contacting surfaces. Sleeves shall be insulated with a double wall shrink tubing. Sealing dielectric grease over the top of the ring is recommended.
- Do not use lock washers or star washers for contact surfaces.
- Terminal crimps and crimp tooling shall meet or exceed terminal manufacturer's specifications.

Section 8: Harness Routing and Clipping Requirements

- Harness and in-line connectors shall be anchored to prevent free movement. An anchor point shall be no further than 6 in [15.24 cm] (recommended 3 in [7.62 cm]) from a connector. The length of an unanchored section of harness should be no more than 12 in [30.48 cm].
- Eaton has provided multiple threaded bosses to which vehicle components can be clipped. The System Integrator shall not mount additional components to TCM, transmission brackets, mounting studs or lifting eyes under any circumstances without Eaton approval. This includes screws used to fasten any housing bearing covers. Removal of these will compromise transmission system operation and overall system reliability.
- Tie wrap application and tightness shall conform to Section 14.1.1 of IPC/WHMA-A-620 "requirements and acceptance for cable and wire harness assemblies", January 2002 revision or later. Tie wrap application shall meet the "target and defect" of a Class 3 product per IPC/WHMA-A-620. Use tie wraps on harness covering only, not individual wires. Do not anchor harness with tie wraps in contact with wire insulation. Tie wraps shall not pull on the harness such that connector cable seals are distorted. Cable anchors shall be installed in a manner that prevents cables from exerting excess strain on the connector body.
- The bend radius of a harness bundle shall be greater than six times the diameter of the harness bundle.
- The bend radius of an individual cable shall be greater than 2.5 times the diameter of the individual cable. Exceptions require Engineering approval.
- Harness installation shall utilize fixed clip points, for example, Fir trees, J-clips and P-clips.
- Harness routing shall not interfere with user accessible points such as oil fill and oil drain locations, lifting eyes, sensor locations, or applicable manufacturing fixture locations.

NOTICE: Ribs and gussets are not designed as attachment locations unless specifically supplied by Eaton with that intended purpose. Rib and gusset attachment devices, such as "hammer clips" are not approved for use on Eaton transmissions.

Predetermined Clipping Points

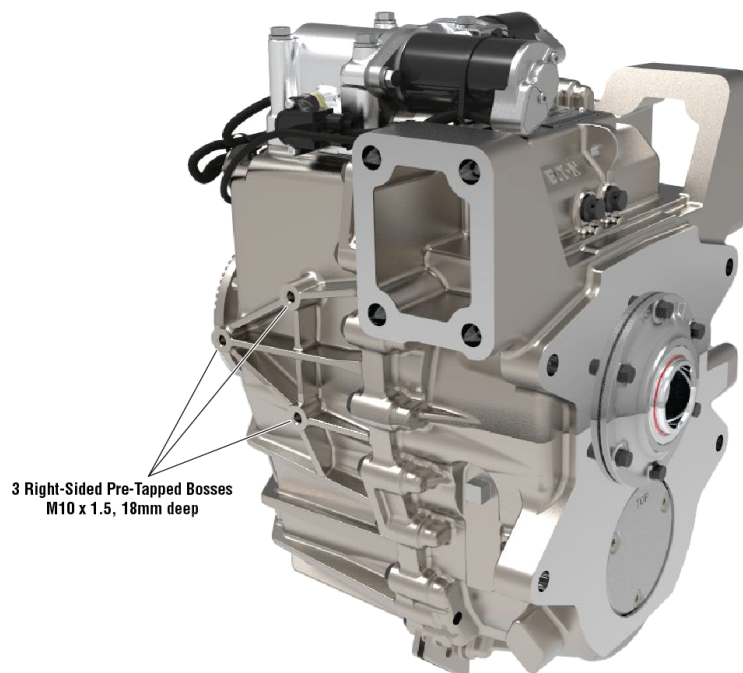
NOTICE: The System Integrator design shall not allow for removal of any transmission screws from any gasketed joint for any reason within the System Integrator assembly plant. Removal of any screws from a gasketed joint introduces a high risk of creating a lubrication leak, reduced structural integrity, and can compromise transmission system operation and overall system reliability. This includes screws used to fasten the shift controller, transmission control module (TCM), and rear case to main case fasteners.

NOTICE: Eaton has provided multiple provisions for clipping of System Integrator harnesses, hoses, cables, etc.

Approved System Integrator clipping points for periphery equipment are:

- 3 studs on right side of transmission: M10 X 1.5, 18-mm long
- 3 studs on left side of transmission: M10 X 1.5, 18-mm long

RIGHT VIEW



LEFT VIEW

