# TRANSMISSION MOUNTING DESIGN — TRANSMISSION OVERHUNG —

**ALLISON ON-HIGHWAY TRANSMISSIONS**

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

## Contents:

# TRANSMISSION MOUNTING – TRANSMISSION OVERHUNG

## 1.0 INTRODUCTION

The purpose of this document is to summarize design considerations for mounting arrangements where the transmission is overhung, or cantilevered, from the rear of the engine.

**NOTE: For mounting requirements that apply to all mounting arrangements, including this one, refer to *Transmission Mounting – General Requirements*.**

## 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

The terms rear support and rear mount are both used in this document. They have distinct meanings as described below:

- **Rear Support** - Attachment from the rear of the transmission to the vehicle frame that is designed to relieve the bending moment at the interface of the engine flywheel housing to the converter housing. The rear support does not actually carry any of the powerpack's weight. The engine mounts carry all of the powerpack weight. A rear support may be used when the transmission is overhung from the engine flywheel housing.

- **Rear Mount** - Attachment from the rear of the powerpack to the vehicle frame that is designed to carry a significant portion of the powerpack weight. In some installations a mount at the rear of the transmission is used in conjunction with two side mounting pads on the engine block.

## 4.0 OVERHUNG TRANSMISSION MOUNT

When the transmission is overhung from the rear of the engine, all powerpack mounts are attached to the engine and the engine flywheel housing. The vertical support for the transmission is provided by the engine mounting pads. Figure 1 illustrates a typical power package mounting using engine flywheel housing pads and front trunnion mount, with the transmission overhung from the rear of the engine.

In an overhung mounting arrangement, the transmission weight is carried by the bolts that attach the transmission

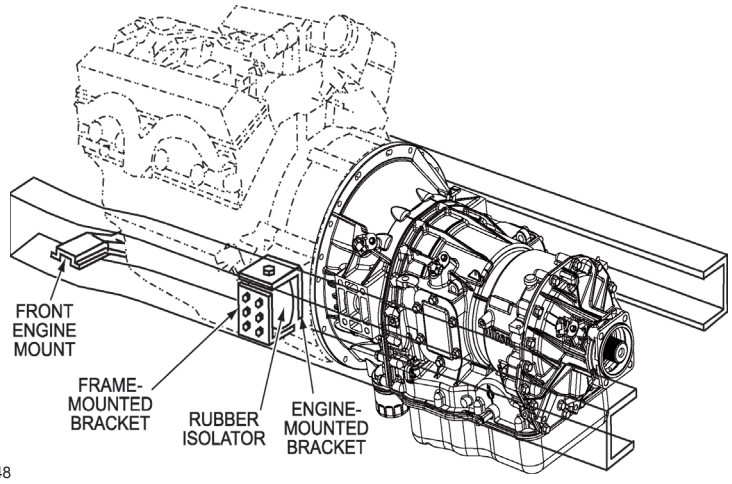



***Figure 1: Overhung Transmission Mounting Configuration – 1000/2000 Product Family Model Shown with SAE No. 3 Converter Housing***

to the flywheel housing. The number and location of the bolts required at the transmission to flywheel housing interface are specified on the following Installation Drawings:

- *AS64-422 for 1000/2000/2900 Product Family SAE No. 2 Housing*
- *AS64-423 for 1000/2000/2900 Product Family SAE No. 3 Housing*
- *AS66-420 for 3000 Product Family*
- *AS67-420 for 4000 Product Family*

## 4.1 BENDING MOMENT CONSIDERATIONS

When the transmission is overhung from the rear of the engine, it is important to insure that the bending moments for both the engine flywheel housing and the transmission converter housing do not exceed their respective permissible limits. The maximum bending moment is located at the flywheel housing side pads. Therefore, the bending moments are similar at the engine block to flywheel housing split line and at the flywheel housing to converter housing split line. If side mounting pads on the engine block are used instead of the side pads on the flywheel housing, the bending moment at the engine block to flywheel housing split line may be significantly greater than that calculated at the flywheel housing to converter housing split line.

Use the Bending Moment Calculation Worksheet in Appendix I to determine the bending moment at the rear face of the engine flywheel housing for your application. If the specific transmission used in the installation has optional features, such as a converter housing with PTO provision, a retarder, or a direct-mounted cooler, those features must be included in the transmission's Center of Gravity (C.G.). The bending moment must also include all hardware and auxiliary equipment that is attached to the transmission, such as the transmission output yoke or flange, PTOs and pumps, the park brake, the retarder accumulator or a non-Allison transfer-case. As shown on the Worksheet, the bending moment should include 50% of the weight of the first driveshaft, applied at the yoke's bearing cross or the flange face. For data on components avalable from Allison Transmission, refer to *Transmission Data* for transmission models in the *1000/2000*, *2900*, *3000*, or *4000* Product Families.

The powerpack mounting must be modified if the calculated bending moment, M, exceeds one of the following:

- the transmission static bending moment limit. Refer to the applicable *Transmission Data* document for limits.
- the engine manufacturer’s flywheel housing bending moment limit.

If the more restrictive of these two bending moment limit is exceeded by 15% or less, the addition of a transmission rear support may be considered. Refer to paragraph 4.2, Rear Support Design Considerations.

This situation is reflected in the sample calculation which is attached as Appendix II.

If the transmission static bending moment exceeds its limit by more than 15%, an alternative mounting arrangement must be used. The following options may be considered:

- Use the transmission converter housing side pads, if available, instead of the flywheel housing mounting pads for the powerpack rear mounts. Refer to *Mounting Using Transmission Side Pads*.
- Use a cradle mount between the engine flywheel mounting pads and the transmission converter side pads, if available. Refer to Cradle Mounting of the Engine and Transmission in *Mounting Using Transmission Side Pads*.
- For the 4000 seven-speed models, the cradle mount may be attached to the flywheel housing mounting pads and the side pads on the seven-speed adapter housing. Refer to Cradle Mounting of the Engine and Transmission in the *Mounting Using Transmission Side Pads* document.

• If a non-Allison transfer-case is attached to the rear of the transmission, a cradle mount may be attached to the mounting pads on the transfer-case. The cradle mount isolation point must be located to establish zero bending moment at the flywheel housing to converter housing split line. The cradle mounting calculations discussed in *Technical Document 179 (TD-179), Mounting Calculations for 4000 Product Family Transmissions*, may be easily applied to the other product families.

If the transmission limit is exceeded but by less than 15%, and the engine limit is exceeded by more than 15%, consult the engine manufacturer. The engine manufacturer may have concerns about the dynamic loading at the flywheel housing. The rear support discussed in this section only shifts the dynamic load range; it does not reduce the dynamic loads at the flywheel housing.

## 4.2 REAR SUPPORT DESIGN CONSIDERATIONS

If a transmission rear support is used to reduce bending moments at the transmission to engine flywheel housing interface, several items should be noted:

• Design the rear support such that the upward vertical static spring force results in a zero bending moment at the flywheel housing to converter housing split line (Figure 2):
  $R_S$ = M / $L_S$ (N or lb) where
  $R_S$ is the spring force
  M is the total calculated moment
  $L_S$ is the distance from rear face of the flywheel housing to the center of the isolator at the transmission rear support.
  A positive (+) $R_S$ value indicates upward support needed.
  A negative (-) $R_S$ value indicates downward support needed.

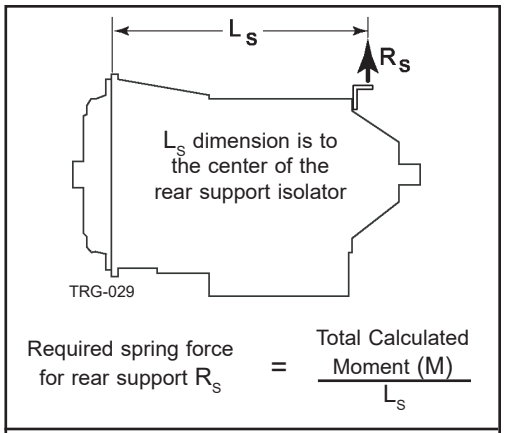



***Figure 2: Rear Support Preload Calculation***

• The rear support must provide support in only the vertical direction. It is strongly recommended that the preload on the spring is sufficient to yield zero bending moment at the flywheel housing to converter housing split line. Typically, a defection of at least 25 mm (1.0 inch) is required.

• The following spring rates are recommended for transmission rear supports:
  - 1000/2000 Product Family 43.8 - 52.5 kN/m (250 - 300 lb/in)
  - 2900 Product Family 43.8 - 52.5 kN/m (250 - 300 lb/in)
  - 3000 Product Family 50 - 70 kN/m (300 - 400 lb/in)
  - 4000 Product Family 105 - 140 kN/m (600 - 800 lb/in)

• For the 1000/2000 Product Families, attach the rear support to the transmission rear cover using the rear cover to main case bolts (Figure 3), or to the park brake mounting pads on the rear cover (Figure 4). Refer to the *Rear Support Provisions Installation Drawing, AS64-430* and the *Park Brake Installation Drawing, AS64-450*.

• For the 2900 Product Families, attach the rear support to the transmission rear cover using the rear cover to main case bolts (Figure 3), or to the park brake mounting pads on the rear cover (Figure 4). Refer to the *Rear Support Provisions Installation Drawing, AS64-930* and the *Park Brake Installation Drawing, AS64-950*.

• For the 3000/4000 Product Families, attach the rear support to the transmission rear cover or retarder housing using the optional rear support bracket available from Allison. Refer to the appropriate *AS66-430, Rear Support Installation Drawing (3000 Product Family)* or *AS67-430* (4000 Product Family).

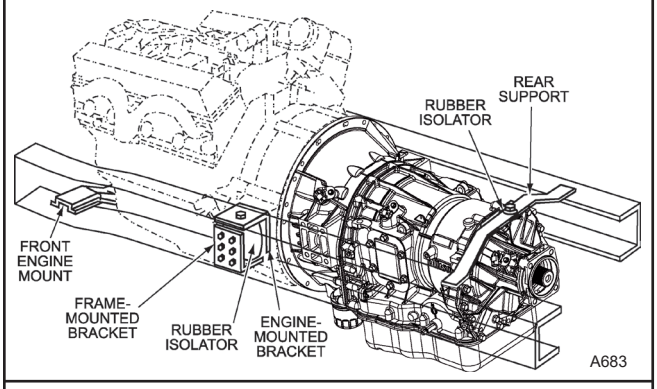



***Figure 3: Using Main Case-to-Rear Cover Splitline Bolts for Attaching Rear Support – 1000/2000 Models***

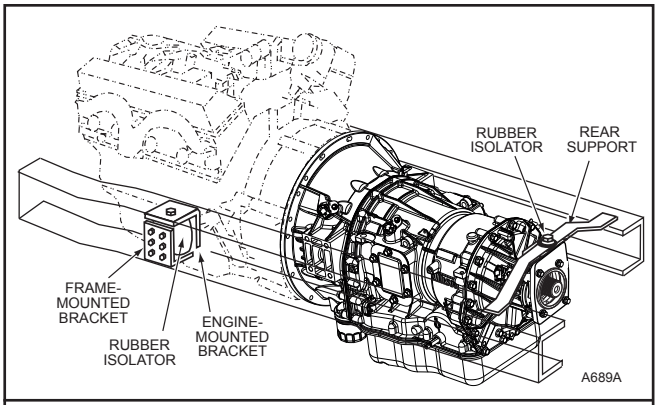
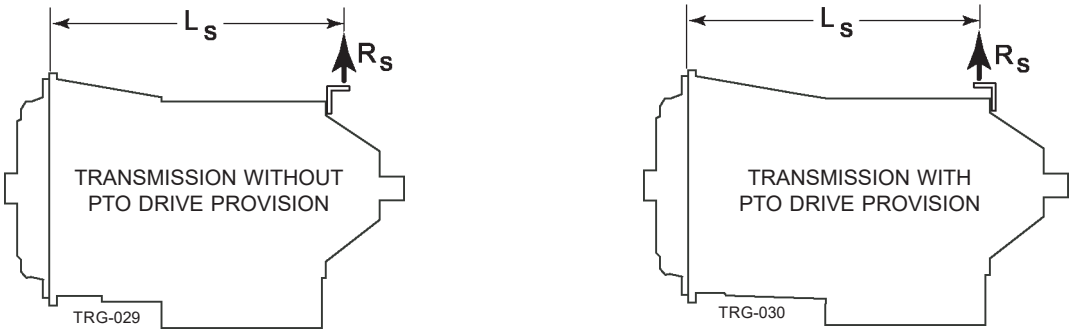



***Figure 4: Using Park Brake Mounting Pads for Attaching Rear Support – 1000/2000 Models***

- The Allison brackets for the 3000/4000 Product Families were designed to be reversible. One advantage of this design is that the same cross-member location can be used to support the rear of both PTO and non-PTO transmission models – accomplished by orienting the bracket toward the engine for PTO models or away from the engine for non-PTO models as illustrated in Figure 5.

- Isolate the rear support from the frame with isolation pads, biscuits, or bushings. This isolation will reduce shock loads and reduce the transmittal of vibration and noise between the powerpack and the frame.




Dimension "$L_S$" to rear support mounting bracket is identical for:
- transmissions with PTO drive provision (bracket facing toward front), and
- transmissions without PTO drive provision (with bracket facing toward rear)

***Figure 5: Bracket Orientation to Maintain Support Location – 3000/4000 Product Families***

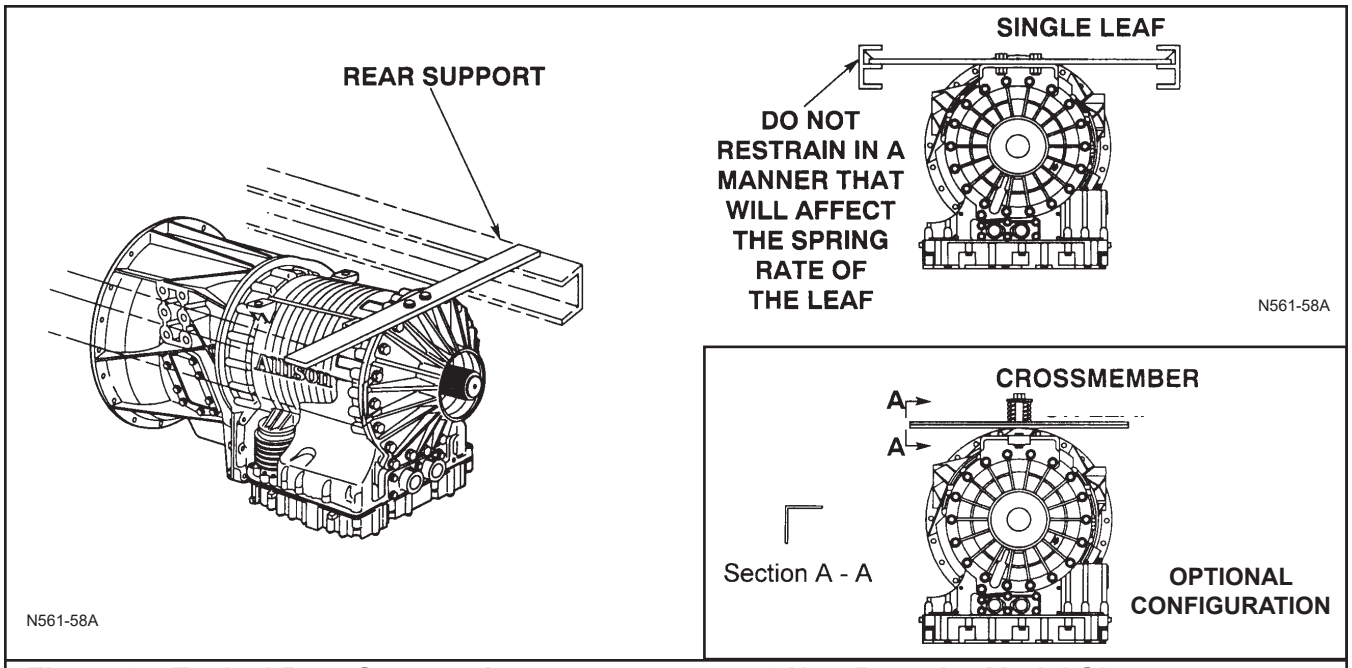



***Figure 6: Typical Rear Support Arrangements – 4000 Non-Retarder Model Shown***

- A rear support must be sufficiently flexible to permit frame flexing and powerpack roll without imparting a rotational load on the transmission. This is normally accomplished with a leaf spring or spring-loaded cross-member reacting to the vehicle frame as shown in Figures 6 and 7.

Some special applications such as use on unimproved roads may require rear supports to minimize the adverse effects of the terrain. Review your installation with Allison Engineering if severe operation is expected.

Design and sourcing of the rear support are the responsibility of the vehicle manufacturer.

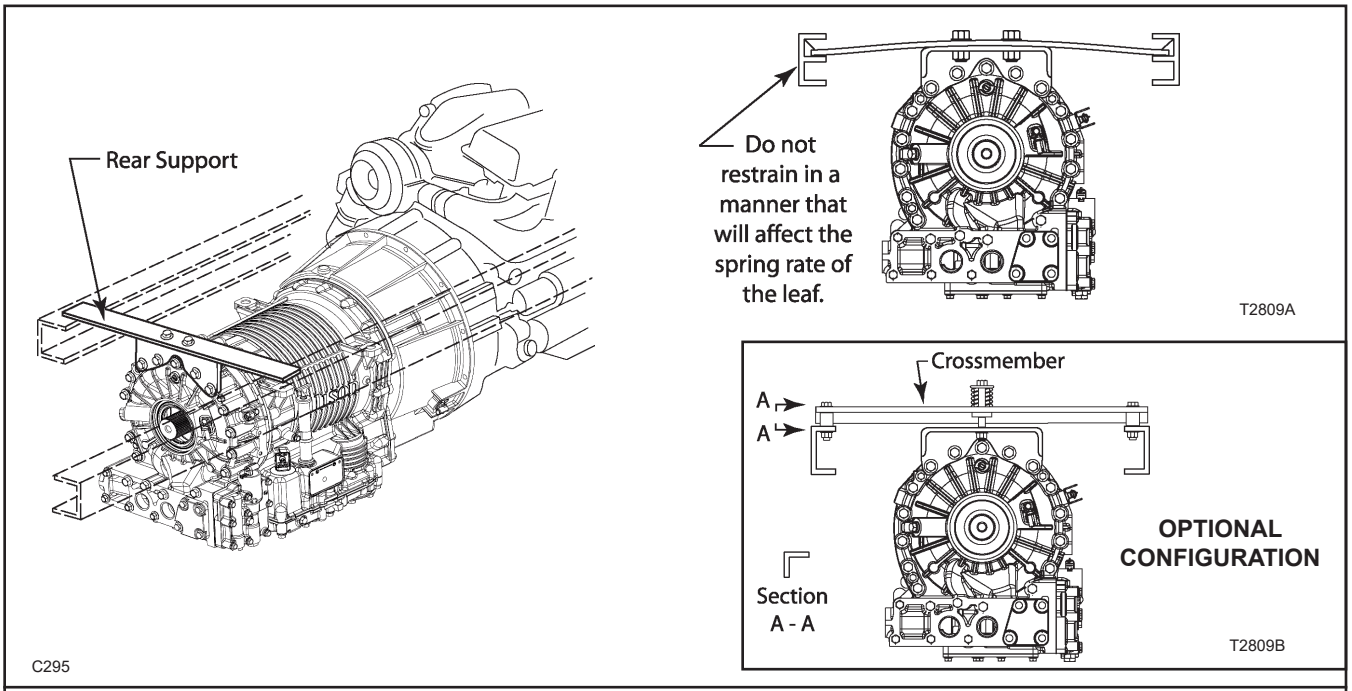



***Figure 7: Typical Rear Support Arrangements – 3000 Model with Retarder Shown***

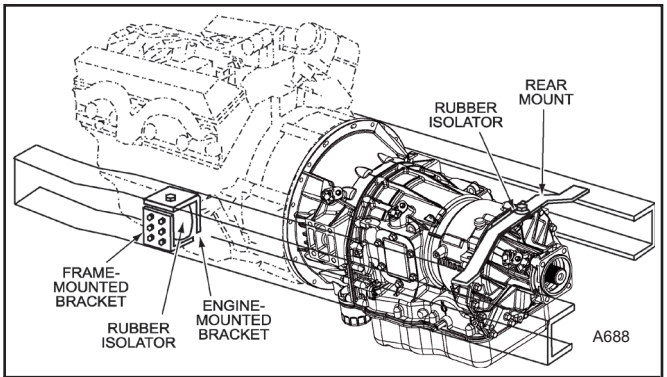



***Figure 8: Automotive Mount Using Main Case / Rear-Cover Splitline Bolts for Attaching Rear Mount Bracket – 1000/2000 Product Family***

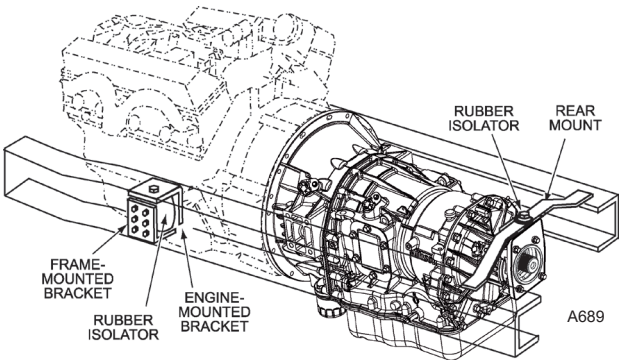



***Figure 9: Using Park Brake Mounting Pads for Attaching Rear Mount Bracket – 1000/2000 Product Family***

## 5.0 AUTOMOTIVE MOUNT

This three-point mounting arrangement has two engine side mounts and a mount at the rear of the transmission. The powerpack's rear mount bracket is attached to the rear of the transmission through a rubber isolator mount. The rear mount bracket may be attached to the main case to rear cover split line bolts (Figure 8). Refer to *AS64-430, Rear Support*.

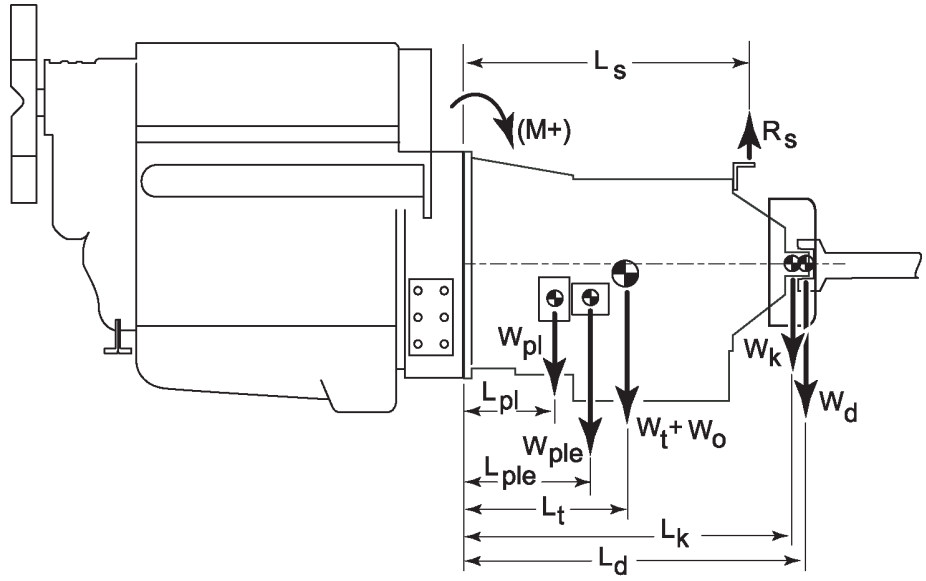
As an alternate arrangement for the 1000/2000 Product Family, the rear mount bracket may be also attached to the park brake mounting pads on the transmission rear cover as illustrated in Figure 9. See *Installation Drawing AS64-450, Park Brake*.

The following guidelines apply to the automotive mounting arrangement with Allison transmissions:

- The engine mounting pads must support most of the weight of the powerpack, thus minimizing the load on the rear of the transmission. One way this can be accomplished is by locating the engine side mounting pads close to the center of gravity for the complete engine-transmission package. The complete engine-transmission package includes all equipment attached to the engine and to the transmission, and 50% of the weight of the front propshaft.
- The bending moment must not exceed the limit for the engine flywheel housing. Contact Allison Engineering if assistance is required in analyzing this type of mounting configuration.
- The mounting design must provide transmission support in the vertical direction only.
- The preload force at the transmission rear mount must not result in a negative bending moment at the engine/transmission interface which exceeds the maximum bending moment limit for the engine.
- The rear mount must provide sufficient flexibility to permit frame flexing and power pack roll without imparting rotational stress on the transmission. This is frequently accomplished with a leaf spring or spring-loaded cross-member reacting to the vehicle frame as shown in Figures 8 and 9.
- Isolate the rear mount from the frame with isolation pads, biscuits, or bushings – to reduce shock loads and the transmission of vibration and noise between the powerpack and the frame.
- The design must accommodate all significant loads on the mounting pad and bolts. The friction coefficient used for these calculations should not exceed 0.1.

Design and sourcing of the rear mount are the responsibility of the vehicle manufacturer.

# APPENDIX I: BENDING MOMENT CALCULATION WORKSHEET




| | Weight kg (lb) | | Distance to CG mm (in) | Moment kg-mm (lb-in) |
|---|---|---|---|---|
| Transmission assembly dry weight (include optional transmission features & hardware) | (Wt) _____ | x | (Lt) _____ = | _____ |
| Transmission oil fill weight (assume same CG as dry transmission) | | | | |
| ___ liters x 0.82 kg/l = weight in kg. | (Wo) _____ | x | (Lt) _____ = | _____ |
| or ___ quarts x 1.7 lb/qt. = weight in lb. | (Wo) _____ | x | (Lt) _____ = | _____ |
| Output yoke or flange | (Wk) _____ | x | (Lk) _____= | _____ |
| Transmission-mounted park brake (if not included in base transmission weight) | (Wk) _____ | x | (Lk) _____= | _____ |
| 50% of front driveshaft (at flange face or output yoke bearing cross) | (Wd) _____ | x | (Ld) _____ | = _____ |
| Left-side power take-off (PTO) unit | (Wpl) _____ | x | (Lpl) _____= | _____ |
| Accessory mounted to left-side PTO | (Wple) _____ | x | (Lple) _____= | _____ |
| Right-side power take-off unit (not shown) | (Wpr) _____ | x | (Lpr) _____= | _____ |
| Accessory mounted to right-side PTO | (Wpre) _____ | x | (Lpre) _____= | _____ |
| Other transmission mounted equipment (specify _____) | _____ | x | _____ = | _____ |
| Other transmission mounted equipment (specify _____) | _____ | x | _____ = | _____ |
| | *Add all moment values:* | | **TOTAL** = | _____ |

**Bending Moment, M, in Nm = (9.80665) x (TOTAL)/(1000) = _____**

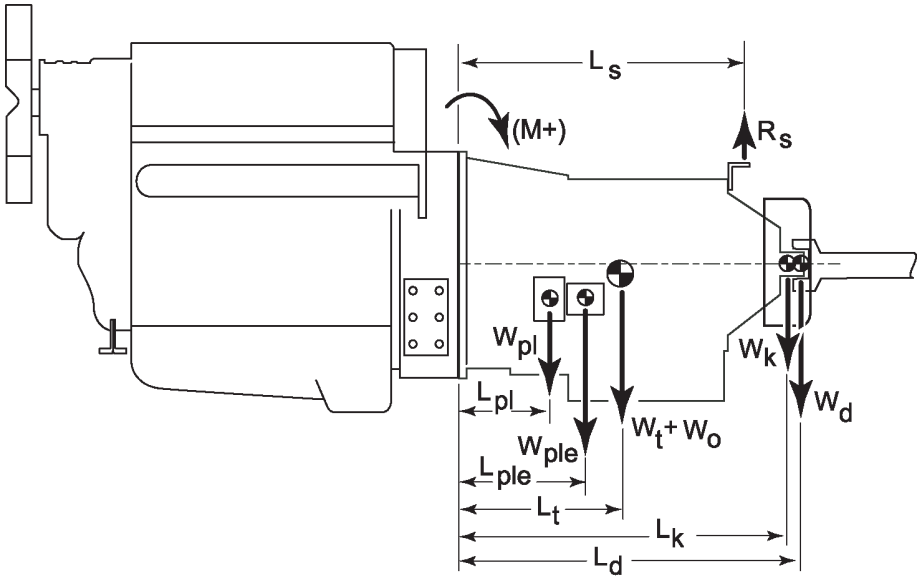
**Bending Moment, M, in lb-ft = TOTAL/12 = _____**

**NOTE: Include the weight and Center of Gravity (C.G.) for all equipment and hardware mounted to the transmission.**

Refer to *Transmission Data* for the following data for your transmission model and configuration:

- Transmission dry weight
- Transmission center of gravity
- Transmission oil fill volume
- Transmission static bending moment limit

# APPENDIX II: SAMPLE BENDING MOMENT CALCULATION




| | Weight kg (lb) | | Distance to CG mm (in) | | Moment kg-mm (lb-in) |
|---|---|---|---|---|---|
| Transmission assembly dry weight (243+18+36) (3000RDS with side/side PTO and retarder, remote cooler provision) | 297 kg | x | 391.2 mm | = | 116186 kg-mm |
| Transmission oil fill weight (assume same CG as dry transmission) 28.1 liters x 0.82 kg/l = weight in kg. | 23 kg | x | 391.2 mm | = | 9014 kg-mm |
| Output yoke or flange | 5.4 kg | x | 845 mm (est.) | = | 4563 kg-mm |
| 50% of front driveshaft | 12 kg | x | 899 mm | = | 10788 kg-mm |
| Left-side power take-off (PTO) unit | 15 kg | x | 188 mm | = | 2820 kg-mm |
| Accessory mounted to left-side PTO | 22 kg | x | 355 mm | = | 7810 kg-mm |
| Right-side power take-off unit (not shown) | none | x | n/a | = | 0 kg-mm |
| Accessory mounted to right-side PTO | n/a | x | n/a | = | 0 kg-mm |
| Other transmission mounted equipment | none | x | n/a | = | 0 kg-mm |
| | | | *Add all moment values:* **TOTAL** | = | 151181 kg-mm |

**Bending Moment, M, in Nm = (9.80665) x (TOTAL)/(1000)** = 1483 N-m (1067 lb-ft)

Transmission Bending Moment Limit (from *Transmission Data*) = 1708 N-m (1260 lb-ft)
Engine Flywheel Housing Limit (provided by engine manufacturer) = 1356 N-m (1000 lb-ft)

**The total calculated bending moment is less than the transmission limit, but exceeds the engine flywheel housing by approximately 7%. Therefore, a rear support may be considered to meet the engine manufacturer's requirement.**

**NOTE: Include the weight and Center of Gravity (C.G.) for all equipment and hardware mounted to the transmission.**

Refer to *Transmission Data* for the following data for your transmission model and configuration:
- Transmission dry weight
- Transmission center of gravity
- Transmission oil fill volume
- Transmission static bending moment limit

# LIST OF REFERENCED DOCUMENTS

- *Transmission Mounting – General Requirements*

- *Mounting Using Transmission Side Pads*

- *Transmission Data* for:
  - *1000/2000 Product Family*
  - *2900 Product Family*
  - *3000 Product Family*
  - *4000 Product Family*

***1000/2000 Product Family Installation Drawings***
- *AS64-422, Adaptation Requirements, SAE No. 2 Housing*
- *AS64-423, Adaptation Requirements, SAE No. 3 Housing*
- *AS64-430, Rear Support*
- *AS64-450, Park Brake*

***2900 Product Family Installation Drawings***
- *AS64-422, Adaptation Requirements, SAE No. 2 Housing*
- *AS64-423, Adaptation Requirements, SAE No. 3 Housing*
- *AS64-930, Rear Support*
- *AS64-950, Park Brake*

***3000 Product Family Installation Drawings***
- *AS66-420, Adaptation – General*
- *AS66-430, Rear Support*

***4000 Product Family Installation Drawings***
- *AS67-420, Adaptation – General*
- *AS67-430, Rear Support*

**Technical Documents**

- *TD-179, Mounting Calculations for 4000 Product Family Transmissions*

# REVISION HISTORY

**April 11, 2022**
- Added the 2900 Product Family

**February 6, 2014**
- In 4.2, Rear Support Design, removed "The rear support spring should not unload with a 5*g* rebound acceleration." Clarified the spring pre-load requirement.
- In 5.0, Automotive Mount, removed "A minimum deflection of 25 mm (1.0 inch) should be possible in both jounce and rebound." Removed the recommended spring rates, which do not apply to this mounting arrangement.
- Corrected misleading paragraph and figure numbers and references.

**July 17, 2008**
- Prepared document for Extranet publication

**June 19, 2008**
- Created new document, *Transmission Mounting Design – Transmission Overhung*
- Deleted guidelines for attaching rear support to pads on the lower portion of 1000/2000 rear cover.