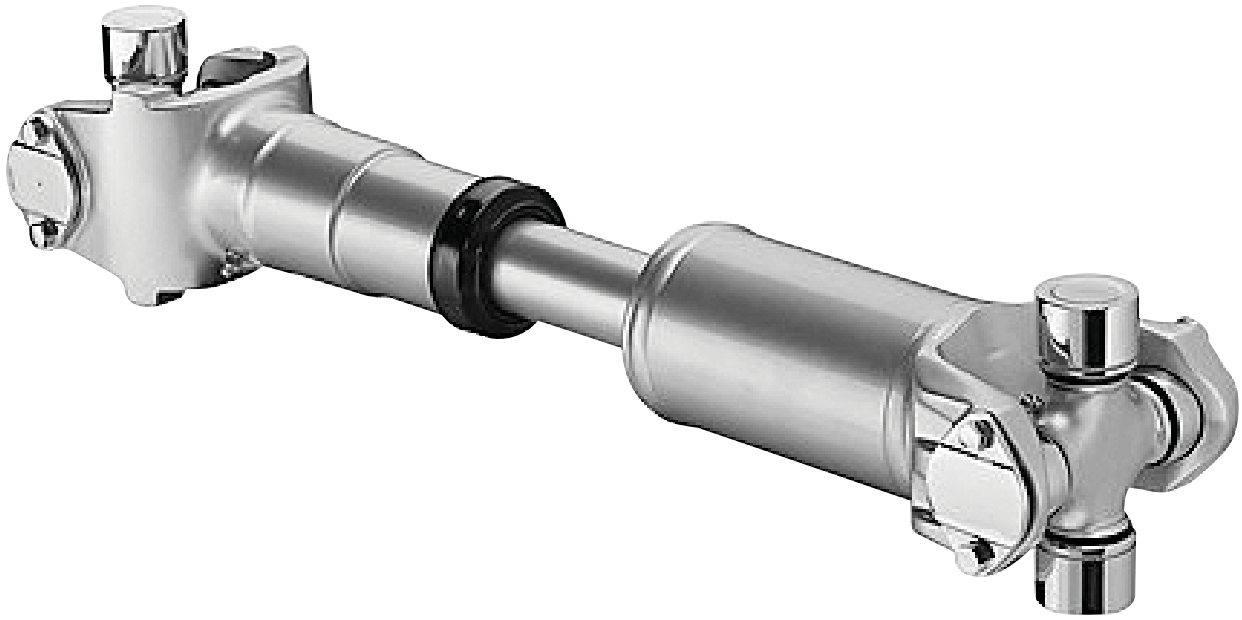
MERITOR

TP-12126

Driveline Application Guidelines

Revised 06-13



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Purpose of These Guidelines

The guidelines contained in this document describe the correct method required to size Meritor drivelines operated in the United States and Canada. These guidelines are not intended to be used for any other purposes or in any other territories.

For any questions concerning guidelines contained in this document, such as interpretation and calculations; or for loadings or configurations outside the parameters of these guidelines, please contact Meritor's OnTrac Customer Service Center at 866-668-7221.

Changes to Guidelines

These guidelines are subject to change at any time, without prior notice, at the discretion of Meritor. To ensure you have the most current guidelines, please contact Meritor's OnTrac Customer Service Center at 866-668-7221 or visit the Literature on Demand section of meritor.com to access publication TP-12126, Driveline Application Guidelines.

Warranty

Meritor drivelines that are included in the guideline and operated within the vocational limitations provided in this document are covered by Meritor's warranty. For complete details and specific coverage, refer to publication SP-95155, Commercial Vehicle Systems Warranty. To access this publication, visit the Literature on Demand section of meritor.com.

Contact Meritor for questions concerning warranty coverage and application approvals for Meritor drivelines operated outside of the parameters provided in these guidelines.

Operating variances in torque, horsepower, speed, environment, angles and the number of stops and starts have a notable influence on the service life of a driveline.

Comparing Meritor's RPL Series Permalube™ and Xtended Lube MXL™ Series Drivelines

Meritor offers two types of drivelines: the RPL Series Permalube™ and the Xtended Lube MXL™ Series.

- RPL Series Permalube™ drivelines are permanently-lubricated for the life of the driveline.
- Xtended Lube MXL™ Series drivelines are greaseable and require lubrication at specific intervals. Refer to Maintenance Manual 1, Preventive Maintenance and Lubrication, for complete information, or visit the Literature on Demand section of meritor.com to access this publication.

Notes

1. For review and approval of brakes, axles, Meritor WABCO products, suspensions, Telma® retarders, trailer axles, transfer cases, wheel ends and other components, contact Meritor's OnTrac Customer Service Center at 866-668-7221.
2. Where a chassis is being sold as an incomplete vehicle, it is the responsibility of the OEM and/or the dealer to accurately convey all approved driveline selection information to the body builder. Also, it is the responsibility of the final vehicle builder to ensure the assigned tagged values for gross axle weight rating (GAWR) and gross vehicle weight (GVW)/gross combination weight (GCW) do not exceed those limits approved by Meritor. This includes auxiliary axles and Federal Motor Vehicle Safety Standards (FMVSS) brake standards.
3. The following situations are not covered under Meritor's warranty: vehicles operating outside of an approved Meritor application, such as a different vocation, drivetrain configuration, load distribution changes, and testing of any kind; and driveline failures that result from operator abuse, misuse or overload. Refer to publication SP-95155, Commercial Vehicle Warranty, for complete information on Meritor's warranty coverage.
4. Any use of Meritor driveline components in vehicles equipped with an automatic transmission retarder must be submitted to Meritor for approval.

5. Any use of Meritor driveline components in vehicles equipped with hybrid propulsion systems must be submitted to Meritor for approval.
6. Any use of Meritor driveline components in vehicles with an all-wheel drive configuration must be submitted to Meritor for approval.
7. For calculated application values outside the standard and approved limits specified in these guidelines, contact your Meritor DriveForce™ representative or Meritor's OnTrac Customer Service Center at 866-668-7221. The correct selection of a driveline product depends on correctly identifying the vocation.
8. **For Linehaul vocations, the Linehaul sizing charts must be used. The non-Linehaul sizing charts are not appropriate for the selection of driveline sizes in the Linehaul vocation.**
9. **For non-Linehaul vocations, the non-Linehaul sizing charts must be used.**
10. The approval limits in this application guideline apply to driveline systems that follow Meritor's recommendations. For maintenance and service information, please refer to Maintenance Manual MM-96147, Drivelines and Maintenance Manual 1, Preventive Maintenance and Lubrication, visit Literature on Demand at meritor.com to access these publications.

Introduction

The main shaft drivelines shown in the Terminology section are sized based on a combination of two calculation methods:

- Driveline Index (DI) calculation method
- Driveline Torque (DT) calculation method

Several factors such as vocation, weight, horsepower, torque, tire size and axle ratio have great influence on the minimum required driveline sizing.

NOTE: When calculation methods lead to values exceeding the acceptable limits set by this guideline, Meritor advises submitting an application request or contacting Meritor's OnTrac Customer Service Center at 866-OnTrac1 (668-7221) for driveline application approval.

NOTE: Although the driveline selection must meet the sizing based on the two calculation methods mentioned above, use the following guidelines for correct driveline application approval.

1. **Torsional and inertial accelerations**
   Recommended limits for torsional and inertial accelerations resulting from non-constant velocity motion of universal joints operating at angle are as follows:

Application	Torsional Acceleration (rad/sec^2)	Inertial Acceleration (rad/sec^2)
Medium Truck and On-Highway Linehaul	300	800
Vocational and Off-Highway	500	1000

Table 1

These values represent levels where some driveline vibrations become noticeable to some of the vehicle occupants. The degree of vibration will vary based on vehicle configuration and joint angles. Inertial acceleration is proportional to joint angle. Torsional acceleration is proportional to the angle difference between the joints.

2. **Automated manual transmissions**
   All applications that include an automated manual transmissions with an engine torque rating of 1,000 lb-ft. or greater must specify only the following main drivelines:

   Meritor RPL25, RPL25SD or 18MXL Full Round or Easy Service™ Drivelines

3. **Angles**
   Driveline sizing is formulated with dependence on vehicle gradeability and is based on acceptable life and product reliability. This methodology is based on ideal joint operating angles. **The maximum allowable joint angle is 6 degrees. With two jointed drivelines, the difference in angles between both joints must not exceed 1.5 degrees.** Minor adjustments of the vehicle ride height can severely alter the U-joint operating angles and result in reduced U-joint life or reduced performance.

4. **Tridem drive axles**
   All tridem drive axle applications require an 18MXL first inter-axle driveline if a 17, 176 or 18 series main driveline has been specified; or if a 92N main driveline has been specified, and angularity and suspension travel are acceptable. Meritor must also review and approve all tridem applications.

5. **Multiple Reduction Axle**
   Where a chassis is equipped with a two-speed, double reduction or planetary wheel-end axle, use the greatest numerical value obtained as a result of the multiplied axle ratio for driveline size calculations.
6. **Inter-axle driveline sizing**
   Please use Table 2 to determine inter-axle driveline size.

	Inter-axle Driveline Size		
		Tridem Axle	
Main Shaft	Tandem Axle	First Shaft	Second Shaft
18MXL, 176MXL, 17MXL	17MXL	18MXL	17MXL
RPL20, RPL25, RPL25SD	RPL20	18MXL	17MXL, 18MXL, RPL20
92N	17MXL, RPL20, 92N	92N	92N

Table 2

Definitions

Linehaul

- Linehaul is defined as the long distance hauling of food, goods and finished materials. Not included are raw ferrous materials, minerals (except oil), logs or log chips.
- Annual mileage greater than 60,000 miles.
- Start/Stop cycle greater than 30 miles.

Non-Linehaul

- A vehicle that does not meet all the conditions outlined in the Linehaul definition.

Inter-axle Shaft Driveline

- A driveline that connects one axle directly to another.

Main Shaft Driveline

- A driveline that connects the transmission to the drive axle or from the transmission to the transfer case and/or from the transfer case to the drive axle.

Methodology

For Linehaul and Non-Linehaul Applications

Use the steps described below to determine the minimum required driveline size.

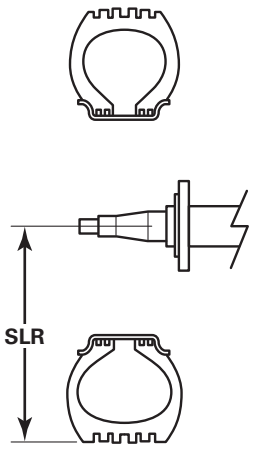
1. Determine the vocation.
2. Use the DI calculation method to determine a minimum driveline size.
3. Use the DT calculation method to determine a minimum driveline size.
4. If the two methods identify different size drivelines, select the driveline with the higher rating identified by the DI and DT calculation methods.

Driveline Index (DI) Method Calculation

The Driveline Index (DI) method consists of calculating a DI value and using it in the following graphs to determine the minimum driveline size. The DI value is obtained according to the following formula:

$$DI = \frac{R_a \times 1{,}000{,}000}{GCW \times SLR}$$

- R_a = Axle Ratio
- *GCW* = Gross Combined Weight of Vehicle [lb]
- *SLR* = Drive Tire Static Loaded Radius [in]



Tire section cut

Driveline Sizing Selection

Once you have determined the vocation and the DI value, use the appropriate graphs to determine the minimum driveline size as follows:

• Linehaul Vocation Driveline Sizing

To determine the recommended driveline size, the following values are needed:

1. DI value
2. Engine horsepower (HP)

Use graphs 1 and 2 entitled "Linehaul Main Shaft Sizing". Find the engine horsepower along the vertical axis of the chart. Find the Driveline Index (DI) value along the horizontal axis. The point on the chart representing the intersection of these values indicates the recommended driveline size. **The point must lie to the right of the curve representing the respective driveline.**

• Non-Linehaul Vocations Driveline Sizing

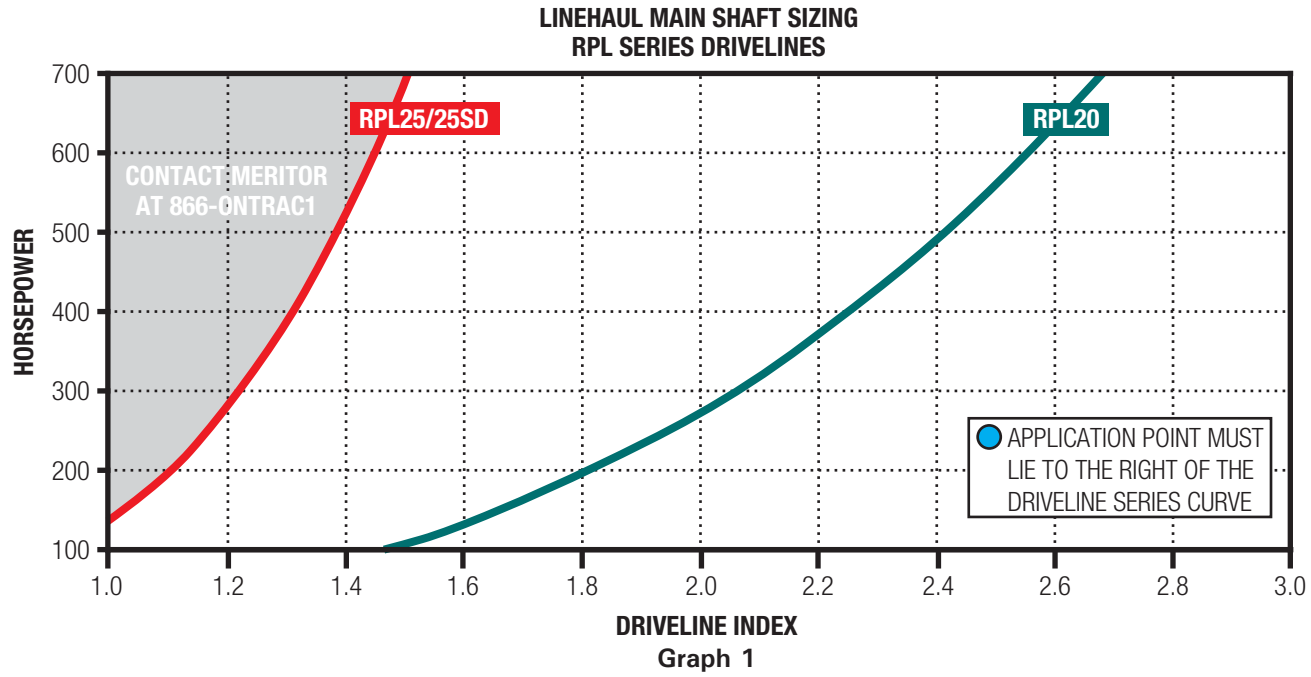
To determine the recommended driveline size, the following values are needed:

1. DI value
2. Engine torque (lb-ft)

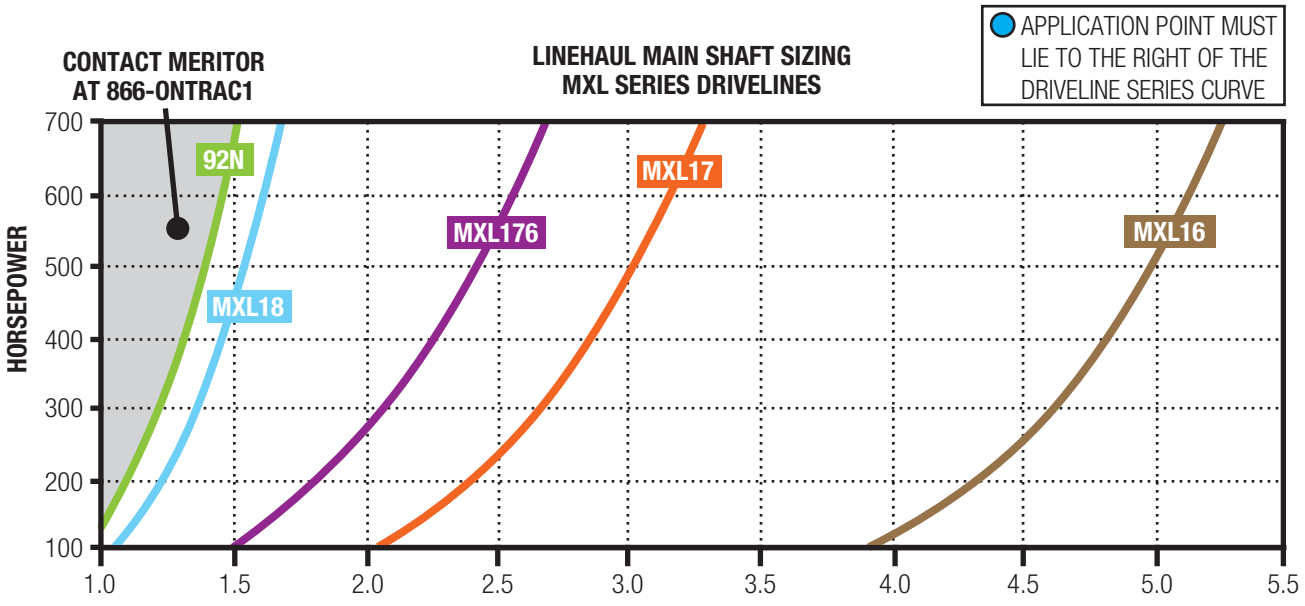
Use graphs 3 and 4 entitled "Non-Linehaul Driveline Sizing". Find the engine torque rating along the vertical axis of the chart. If engine has dual torque rating, use the greater torque rating. Find the Driveline Index (DI) along the horizontal axis. The point on the chart representing the intersection of these values indicates the recommended driveline size. **The point must lie to the right and below the driveline series lines.**

DI Linehaul Vocation Graphs

The following graphs represent the curves shown for the Linehaul Main Shaft Sizing:



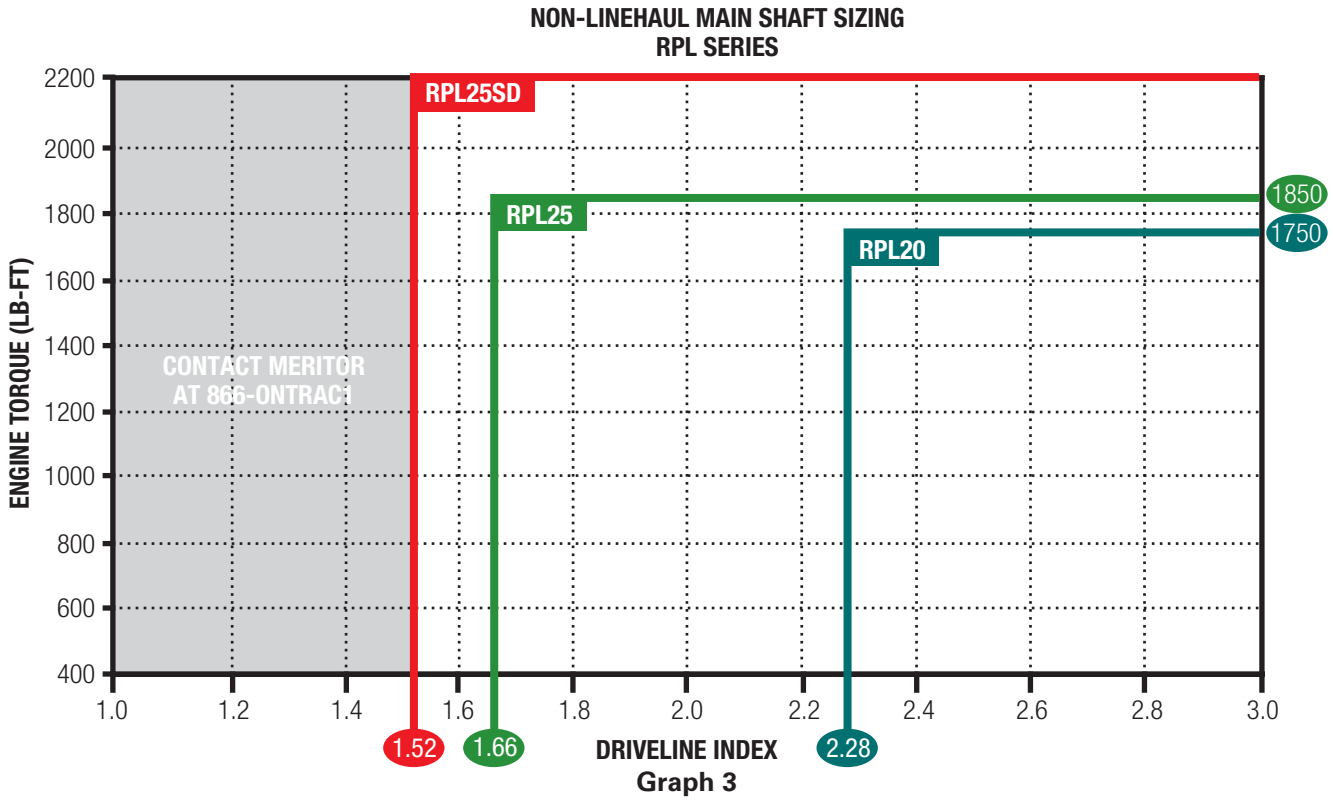
Graph 1



Graph 2

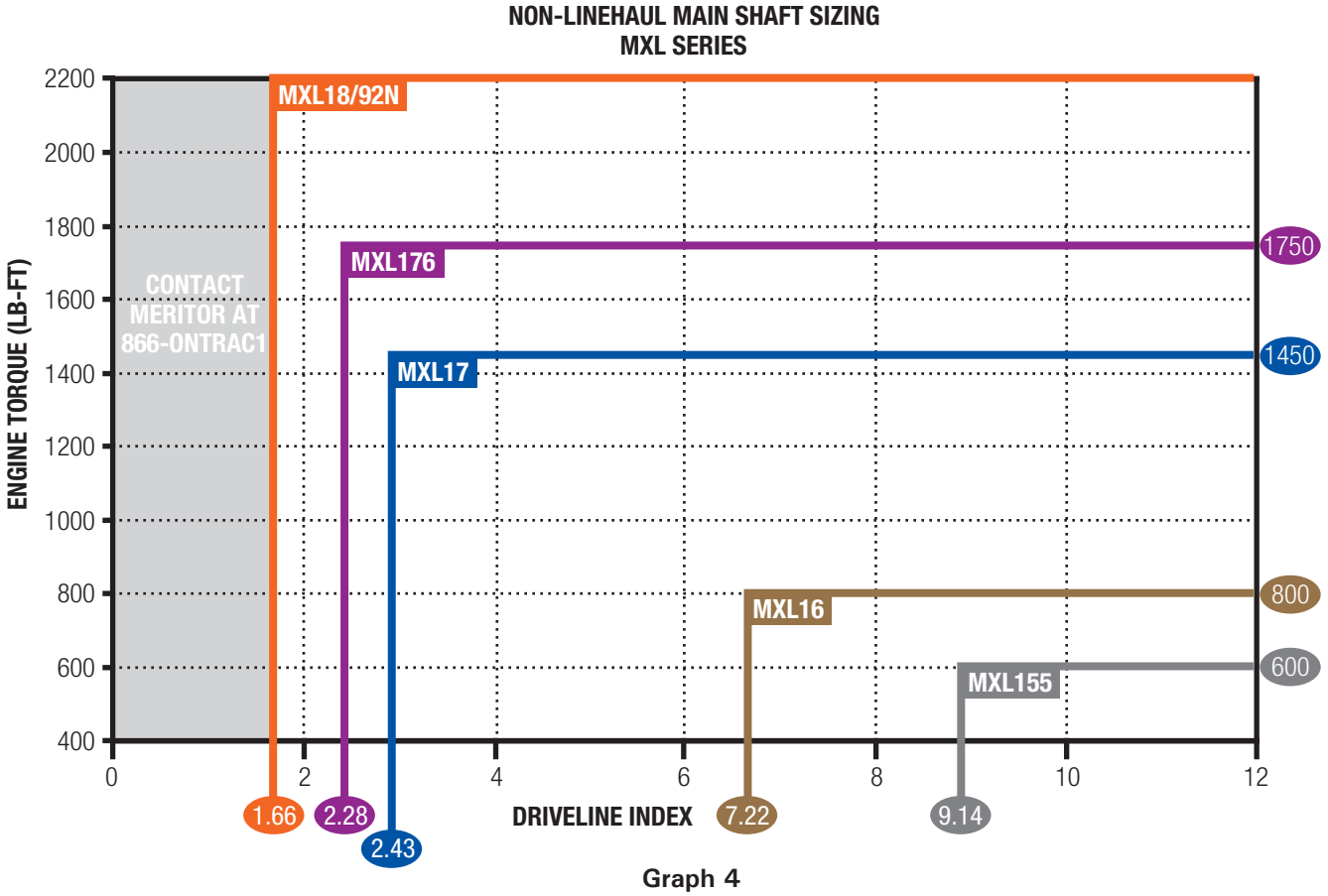
DI Non-Linehaul Vocation RPL Driveline Graph

The following graph represents the curves shown for non-Linehaul main shaft sizing:



Graph 3

DI Non-Linehaul Vocation MXL Graph



Graph 4

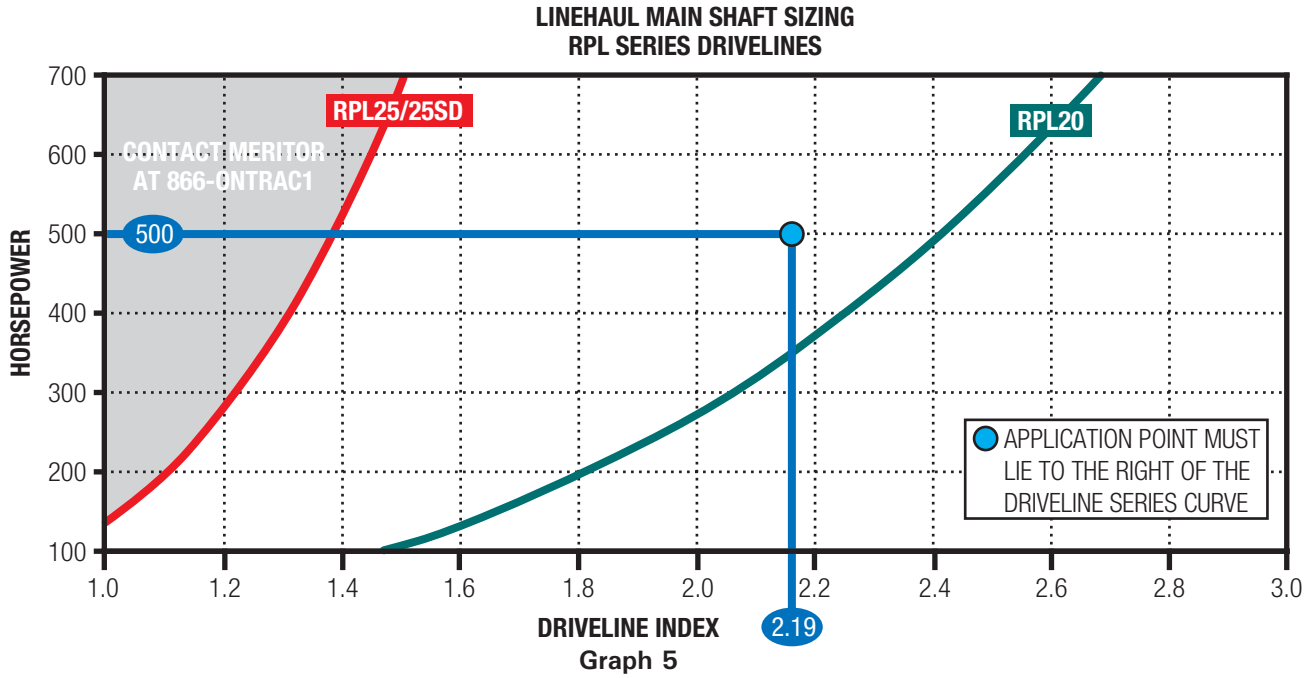
Example of a DI Calculation

Calculate DI value using a rear axle ratio of 3.42 with an expected GCW of 80,000 lb and a rear tire SLR of 19.5" for a Linehaul vehicle using a 500 hp engine.

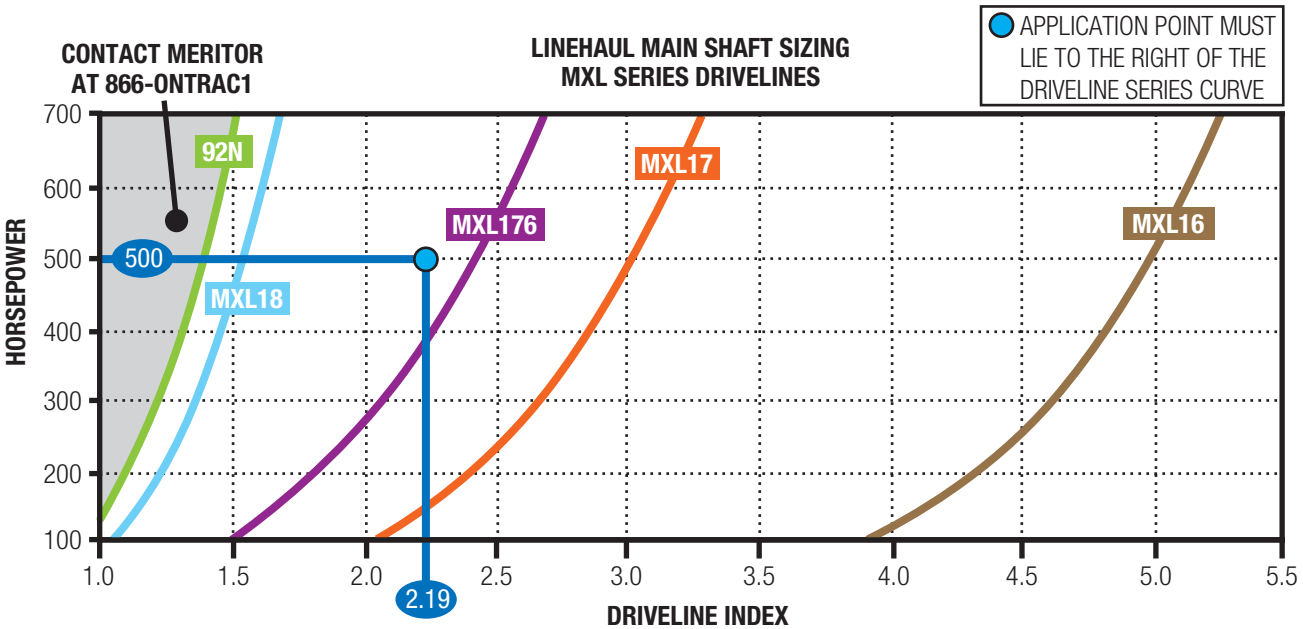
- R_a = 3.42
- *GCW* = 80,000 [lb]
- *SLR* = 19.5 [in]

$$DI = \frac{3.42 \times 1{,}000{,}000}{80{,}000 \times 19.5} = 2.19$$

Find the driveline size for a Linehaul vocation with a 500 hp engine. Trace a point on the intersection of DI = 2.19 and 500 hp engine on the graph as follows. According to the DI method, the minimum required size would for a RPL Permalube driveline would be an RPL 25 or an MXL 18 for a greaseable driveline, per graphs 5 and 6.



Graph 5



Graph 6

Driveline Torque (DT) Calculation

The maximum driveline torque (MDT) generated by the engine at the lower gear is obtained as follows:

$$MDT = T \times TLGR \times TE \times SR \times TCR \times C$$

MDT = Maximum Driveline Torque in Low Gear
T = Net Engine Torque or 95% of the Gross Engine Torque
TLGR = Transmission Low Gear Ratio (highest numerical gear ratio of Forward and Reverse gears)
TE = Transmission Efficiency (automatic = 0.8; manual = 0.85)
SR = Torque Converter Stall Ratio (if applicable; if not then SR=1)
TCR = Transfer Case Ratio (if applicable; if not then TCR=1)
C = Transfer Case Efficiency (if applicable use 0.95; if not then C=1)

The wheel slip torque (WST) generated by the engine in the lowest gear is obtained as follows:

$$WST = \frac{W \times SLR}{16.06 \times R_a}$$

WST = Wheel Slip Torque Applied to the Driveshaft
W = Gross Axle Weight Rating (lb)
SLR = Tire Static Loaded Radius (in)
R_a = Axle Ratio

The equations above calculate the maximum torque values the driveline is expected to experience under normal operating conditions. Misuse or abuse can result in greater torque values being transmitted through the driveline. Damage to components and driveline failures can result.

DT For Linehaul and Non-Linehaul Applications

Calculate MDT and WST with the formulas on the previous page. Compare the two values and establish the lesser of the two. Relate the lesser calculated torque to Meritor driveline ratings from the following driveline maximum torque and sizing values in Table 3. If your torque exceeds the Meritor rating for the driveline used in your application, switch to a size with a rating greater or equal to your calculation. However, the series selected cannot be more than one series below the series called for by the maximum driveline torque (MDT).

Maximum Driveline Torque and Sizing Values

Driveline Series	Swing Diameter		Tube Size: Outside Diameter	Tube Size: Wall Thickness	Maximum-Rated Torque	
	in.	mm	in.	in.	lb-ft	Nm
155N	6.0	152.4	4.000	0.083	3,800	5,152
16MXL	7.0	177.8	4.000	0.109	6,000	8,135
17MXL	7.8	198.1	4.095	0.180	10,000	13,558
176MXL	8.4	213.4	4.095	0.180	12,000	16,269
18MXL	9.1	231.1	4.590	0.180	16,500	22,370
92N	8.62	218.9	4.590	0.180	17,200	23,719
RPL20	7.8	198.1	4.095	0.180	12,000	16,269
RPL25	9.1	231.1	4.590	0.180	17,200	23,319
RPL25SD	9.1	231.1	4.690	0.230	18,500	25,082

Table 3

The maximum-rated torque is the short-duration input torque capacity of the driveline assembly. Input torque greater than the maximum-rated torque can permanently damage driveline components. The maximum input torque to the driveline for any vehicle application depends on various parameters, such as gross engine torque, transmission ratio, axle ratio and GVW.

Example of a DT Calculation

Determine the driveline size for an application using a 40,000 lb rated tandem with a rear axle ratio of 2.47, an expected GCW of 80,000 lb and using tires with a 19.5" SLR. The application is using a manual automated transmission with a 10.9 low gear ratio and an 1850 lb-ft net output torque engine. The customer requests premium and standard driveline approvals.

The maximum driveline torque generated by the engine at the lower gear is obtained as follows:

$$MDT = 1850 \times 0.95 \times 10.9 \times 0.85 \times 1 \times 1 \times 1$$

MDT = 16,283 lb-ft

The wheel slip torque generated by the application is obtained as follows:

$$WST = \frac{40{,}000 \times 19.5}{16.06 \times 2.47}$$

WST = 19,668 lb-ft

Determine the lesser of the calculated values:

16,283 lb-ft <19,668 lb-ft

Lesser of the calculated torque values: 16,283 lb-ft

Relate the 16,283 lb-ft to Meritor's driveline torque rating:

Driveline Series	Swing Diameter		Tube Size: Outside Diameter	Tube Size: Wall Thickness	Maximum-Rated Torque	
	in.	mm	in.	in.	lb-ft	Nm
155N	6.0	152.4	4.000	0.083	3,800	5,152
16MXL	7.0	177.8	4.000	0.109	6,000	8,135
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RPL25SD	9.1	231.1	4.690	0.230	18,500	25,082

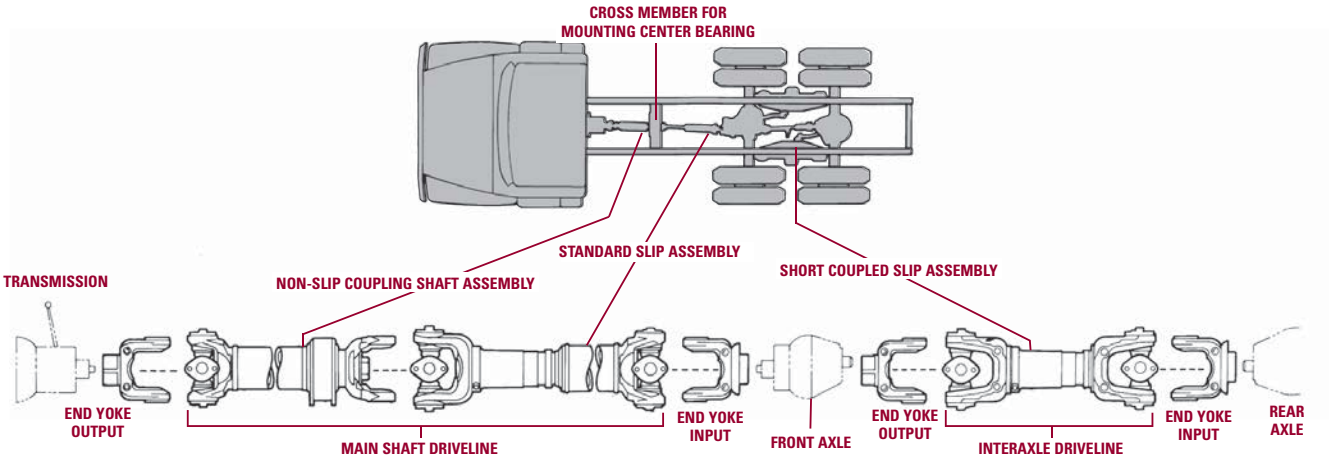
18MXL Approved

RPL25 Approved

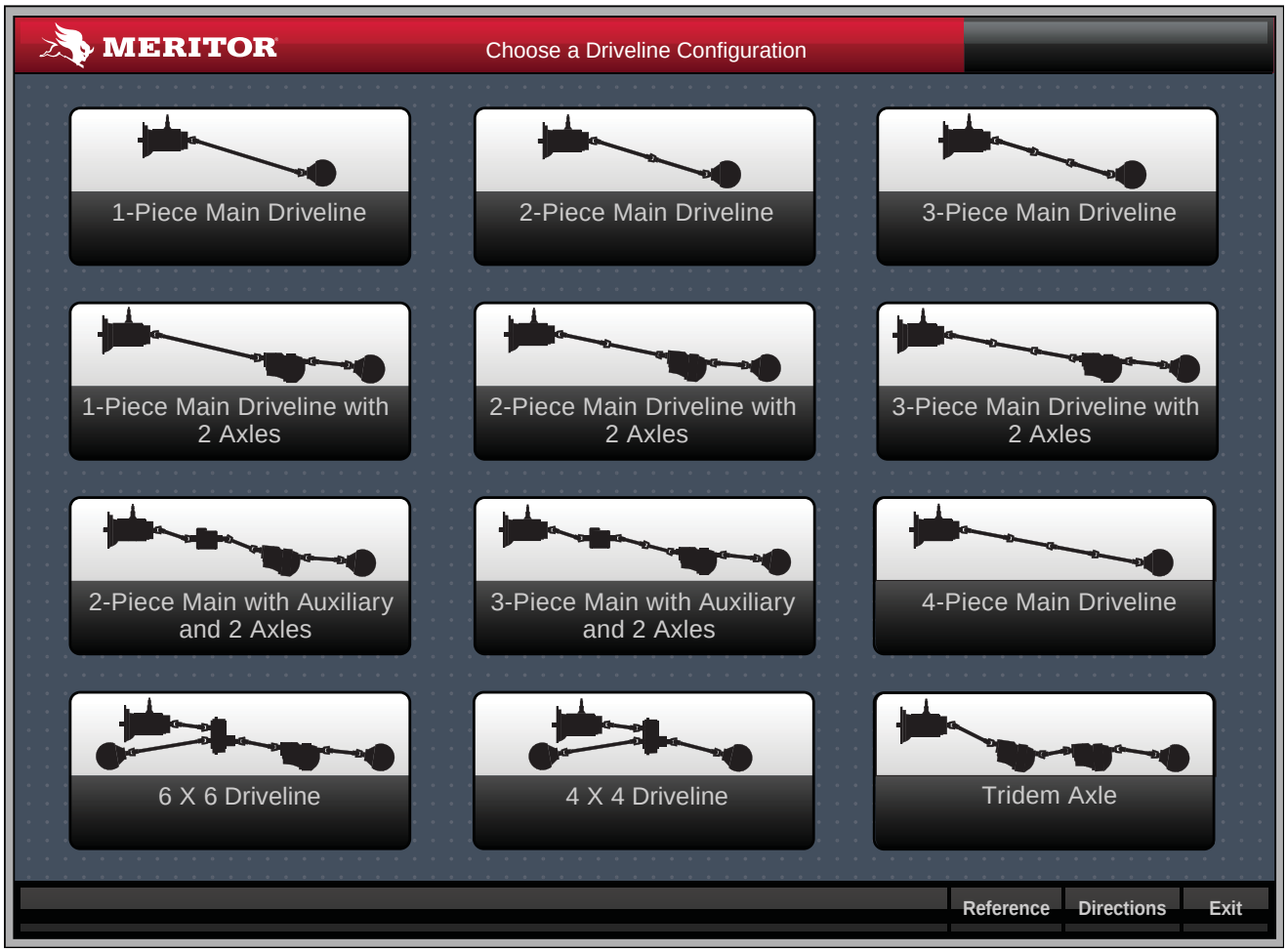
16,283

Table 4

Driveline Components



Meritor offers an online Driveline Angle Analysis that is recommended to be used as a verification tool for all truck configurations. Visit meritor.com to access the program.



End Yoke Designs

Wing-style Permalube™

They are identified with wing-style bushings that are retained.

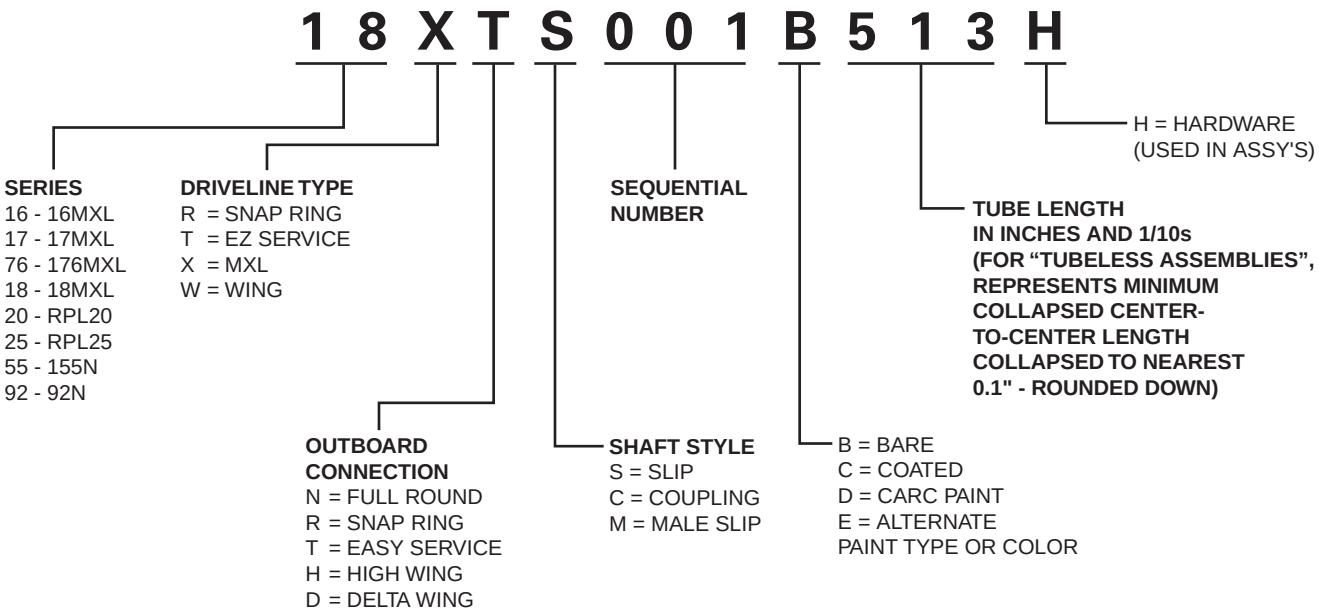
Full Round

They are identified by a full-round yoke connection surrounding the cup that requires correct alignment when assembling.

Easy Service™

Also called half-round, they are identified by two semi-round straps and four bolts for easy assembly and removal.

Meritor Driveline Assembly Number



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Printed in USA

Revised 06-13
TP-12126 (16579)

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