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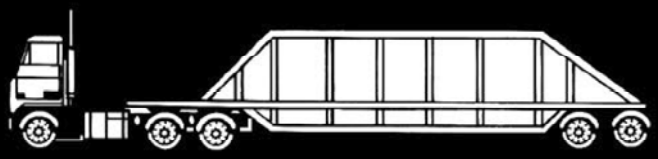
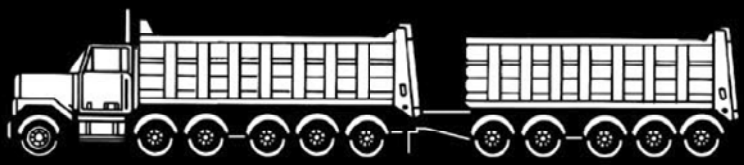
AXLE APPLICATION GUIDELINES

MINING

TP-9441MN7





REVISED 1-05

Mining Vocation – Axle Guidelines

TP-9441-MN7

Mining Vocational Definition:

Combination vehicles (usually Tractor/Trailer combinations or Trucks with Full Trailers) used in the movement of rock, ore, gravel and minerals in and around mines, between mines and delivery site. Vehicles are typically high powered, specially designed for high loading. Tractor/Trailer Construction vehicles are also included in this vocation.

Two duty cycles have been redefined compared to previous versions of the guideline. Please refer to Page 3.

Mining Vehicles Include:

- Bottom Dump Trailer Combination
- Semi-End Dump
- Transfer dump
- Hopper Trailer Combinations
- Michigan Special Gravel Trains

(For Straight Truck configuration vehicles see CONSTRUCTION Application Guideline, TP-9441-CS).

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Mining Vocation – Axle Guidelines

Intended Use of This Guideline

This document addresses the approvable GAW, Axle Input Torque and GVW/GCW Ratings for Meritor Axles used in the Mining vocation (U.S. and Canada only).

Conditions for Approval

Axles are approved for use in the vocation covered by this document, when the axles meet all the criteria for:

- AXLE STRUCTURE
- CREEP LOADS
- AXLE INPUT TORQUE
- GROSS VEHICLE WEIGHT (GVW) or GROSS COMBINATION WEIGHT (GCW)

as described in this publication. IMPORTANT NOTES are considered to be part of the axle approval.

For any questions concerning this document (interpretation and calculations) or for loadings, configurations or duty cycles outside the parameters of this guideline, contact ArvinMeritor CVS Axle Customer Support by telephone, by FAX or in writing to the address shown below, using the Meritor Axle Components Application form RA4901-B-040H.

ArvinMeritor, Inc.
Attn: CVS Axle Customer Support
2135 W. MAPLE RD TROY, MI 48084
PHONE: 800-535-5560
FAX: 258-435-5580

Warranty

For complete details (*and specific coverage)* refer to Meritor's Warranty Publication (SP-95155). As previously stated in several Product Information Letters, all RT-185/380 family axles must have an axle application approved by ArvinMeritor CVS Axle Applications Engineering to be eligible for Warranty.

Contact ArvinMeritor on questions concerning warranty coverage and application approvals for product used outside of these published guidelines.

Note: Axle applications for tire sizes, tracks, mounting centers, other front axle KPIs, other Meritor axle models, engine/transmission torques beyond those listed, or GVW/GCW other than shown within this **AXLE GUIDELINE** may still be approvable. Contact ArvinMeritor CVS Axle Applications Engineering for possible approval.

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Mining Vocation – Axle Guidelines

What Is the Mining Vocation?

- Movement of rock, ore, gravel, and minerals between mining sites, processing and delivery sites. Tractor/Trailer Construction vehicles are also included in this vocation.
- Duty Cycle I: Operation on road surfaces made of concrete, asphalt, maintained gravel, crushed rock, hard packed dirt or other similar surfaces 8% max grades for 95% of the distance. Off-road (12% max grade, job site) for 5% of the distance. Does NOT apply to coal mining operations in Kentucky, West Virginia, Virginia or Tennessee.
- Duty Cycle II: Operation on road surfaces made of concrete, asphalt, maintained gravel, crushed rock, hard packed dirt or other similar surfaces 8% max grade for 95% of the distance. Off road (20% max grade, job site) for 5 % of the distance. Applies to coal mining operations in Kentucky, West Virginia, Virginia or Tennessee and other severe mining sites.
- High Horse Power Engines typically used in this vocation.
- A distance of 3 to 30 miles between starting and stopping (typical).
- Vehicles may use a single retardation device (engine, exhaust, transmission, chassis or axle mounted).
- Vehicles operating on downgrades for more than 40 percent of the loaded distance may require de-rating. For these situations, specific distance at grade information may be needed for evaluation. Consult ArvinMeritor CVS Axle Applications Engineering for further details.

Notes:

Increases in grades and/or number of stops/starts have a notable influence on the service life of the driving axles.

Vehicles using multiple retardation devices are **not** covered by this guideline.

Types of Vehicles Approved by this Guideline

- Combination Vehicles:
  6 x 4, 8 x 4, 10 x 4 tractors and trucks with full trailers. (Michigan Specials are included in this guideline.)
- For Straight trucks, refer to **Construction** guideline TP-9441-CS

Duty Cycles

Duty Cycle	I	II
Location	USA & CANADA except KY, WV, VA and TN	KY, WV, VA,TN & Other Severe Mining Sites
On-Highway		
Route Distance (%)	95	95
Max Grade (%)	8	8
Off-Highway		
Route Distance (%)	5	5
Max Grade (%)	12	20
Vehicle Loading		
Start Route (% GCW)	100	100
Return Route (% GCW)	40	40
Distance Between Stops/Starts	3 to 30 miles (1.9 to 18.6 kms)	3 to 30 miles (1.9 to 18.6 kms)

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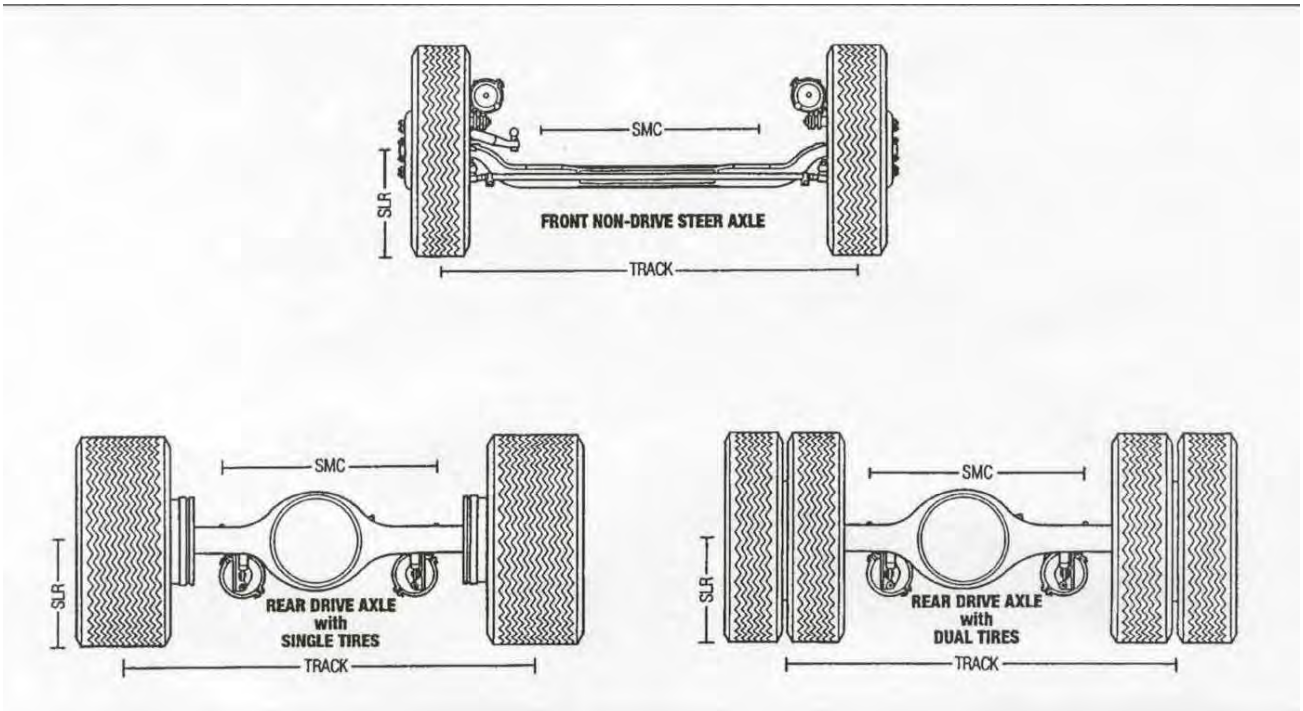
Mining Vocation – Axle Guidelines

Front Non-Drive Steer and Rear Drive Axle Structural Guides



The following items determine the structural requirements of the axle:

- The load capacities (Gross Axle Weight Rating) are compared against the TRACK using the following:
    1. The maximum value of the Static Load Radius (SLR) of the Tires. (Front and Rear Axles)
    2. Suspension Mounting Centers (SMC). (Front and Rear Axles)
    3. The standard front axle King Pin Intersection (KPI) dimensions. (Front Axles Only)
    4. Axle Housing Wall Thickness (Rear Axles Only)
- If single tires are used, the TRACK is measured (at the ground) from the center of one tire to the center of the opposite tire.
- If dual tires are used, the TRACK is measured from the center of the dual tires to the same point on the opposite side.
- The Gross Axle Weight Rating, as a function of SLR, and the axle SMC must meet the specifications of the graphs.

NOTE: Axle applications for tire sizes, tracks, mounting centers, other front axle KPIs and other Meritor axle models not shown within this **AXLE GUIDELINE** may still be approvable. Contact ArvinMeritor CVS Axle Applications Engineering for possible approval.

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Mining Vocation – Axle Guidelines

Typical Meritor Axle Models

NON-DRIVE FRONT STEER AXLES				
	GAWR			
MODEL *	LBS.	KGS.	KPI (Inch)	DROP (Inch)
FF-941	12,000	5,448	69.00	3.50
FF-943	12,000	5,448	69.00	5.00
FF-961	12,000	5,448	69.00	3.50
FF-966	12,000	5,448	69.00	Double Drop 3.5/2.0
MFS-12-143	12,000	5,448	71.50	3.74
MFS-12-144	12,000	5,448	71.50	5.00
FF-942	13,200	5,993	69.00	3.50
FF-944	13,200	5,993	69.00	5.00
FF-967	13,200	5,993	69.00	Double Drop 3.5/2.0
MFS-13-143	13,200	5,993	71.50	3.74
MFS-13-144	13,200	5,993	71.50	5.00
FG-941	14,600	6,628	69.00	3.50
FG-943	14,600	6,628	69.00	5.00
MFS-14-143	14,700	6,668	71.50	3.74
MFS-14-144	14,700	6,668	71.50	5.00
FL-941	16,000	7,264	68.50	3.50
MFS-16-122	16,000	7,264	69.00	3.50
MFS-16-143	16,000	7,264	71.50	3.74
FL-941	18,000	8,172	68.50	3.50
MFS-18-133	18,000	8,172	71.00	3.74
FL-941	20,000	9,080	68.50	3.50
FL-943	20,000	9,080	68.83	5.00
MFS-20-133	20,000	9,080	71.00	3.74

TANDEM REAR DRIVE AXLES					
	GAWR		WALL		
MODEL *	LBS.	KGS.	THICKNESS	FEATURE	NOTES
RT-40-145/P/A	40,000	18,160	9.5 or 11.0 mm	"R" Wheel End	
RT-40-160/P/A	40,000	18,160	11.0 mm	"R" Wheel End	
RT-44-145/P	44,000	19,976	12.7 mm	"R" Wheel End	
RT-46-160/P/A	46,000	20,884	12.7 mm	"R" Wheel End	RT-46-160 is not approvable for use in Canada for this vocation. The RT46164 is required.
RT-46-164/P/A	46,000	20,884	16.0 mm	"R" Wheel End	
RT-50-160/P/A	50,000	22,700	16.0 mm	"R" Wheel End	

Applications for vehicles using the RT-185/380 axle families listed below must be submitted to ArvinMeritor for approval. For vehicles built without an application approval on file, the warranty will be null and void.

	GAWR		WALL		
MODEL *	LBS.	KGS.	THICKNESS	FEATURE	NOTES
RT-52-185	52,000	23,608	14.3 mm	"R" Wheel End	
RT-52-380					Hel/Hyp Double Reduction
RT-58-185	58,000	26,332	14.3 mm	"U" Wheel End	
RT-58-380					Hel/Hyp Double Reduction
RT-70-380	70,000	31,780	17.0 mm	"W" Wheel End	Hel/Hyp Double Reduction

DRIVE AXLE OPTIONS: A = Aluminum Carrier (Available only in rear of RT-160/RT-164 family)
P = Pump (Forward Carrier)

Refer to ArvinMeritor Publication TP-7824 for additional dimensional information.
* Refer to ArvinMeritor Publication SP-20200 for current model nomenclature
The above GAWR values are the maximum allowed for the axle and could be reduced due to the specific track, tire size, KPI, housing wall

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Mining Vocation – Axle Guidelines

Chart A

Front Non-Drive Steer Axle Structural Rating

Max. SLR = 21.1 Inch (535.9 mm) KPI = 69.00 Inch (1752.6 mm)

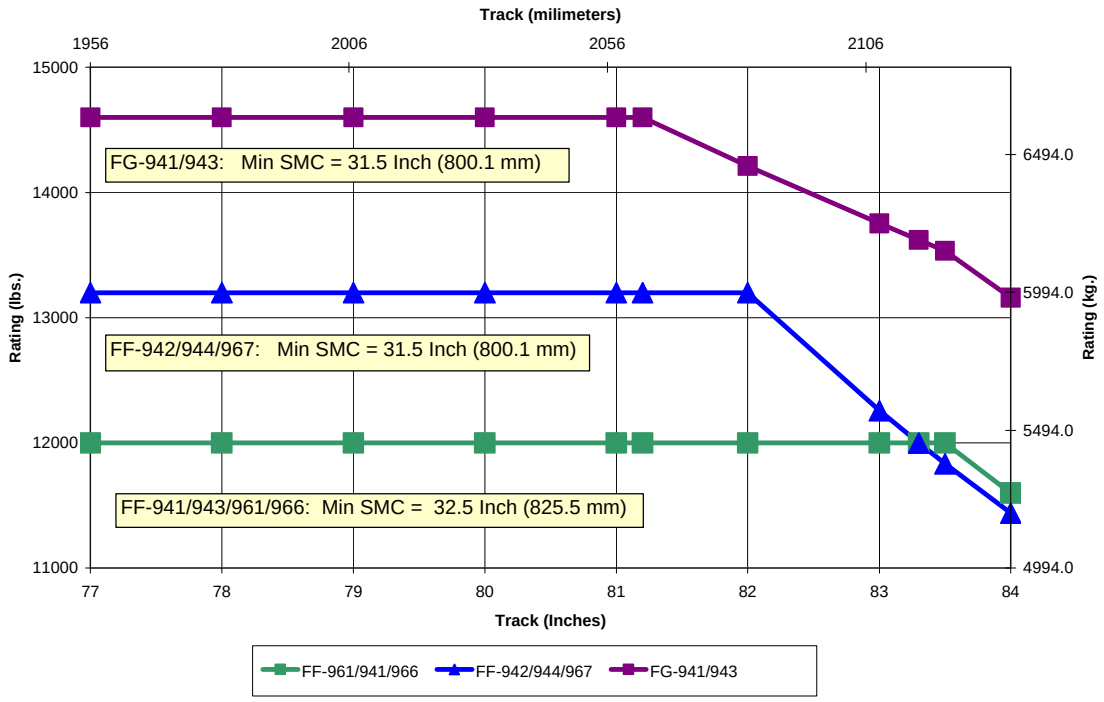
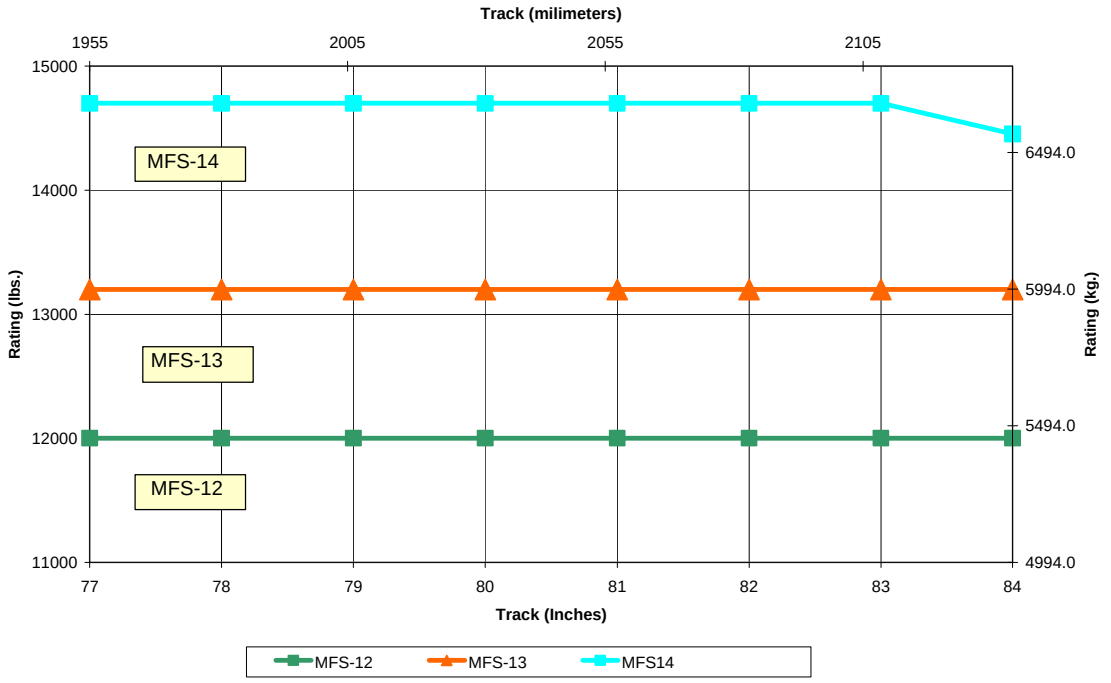


Chart B

Front Non-Drive Steer Axle Structural Rating

Max SLR = 21.1 Inch (535.9 mm) Min SMC = 31.5 Inch (800.1 mm) KPI = 71.50 Inch (1752.6 mm)



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Mining Vocation – Axle Guidelines

Chart C

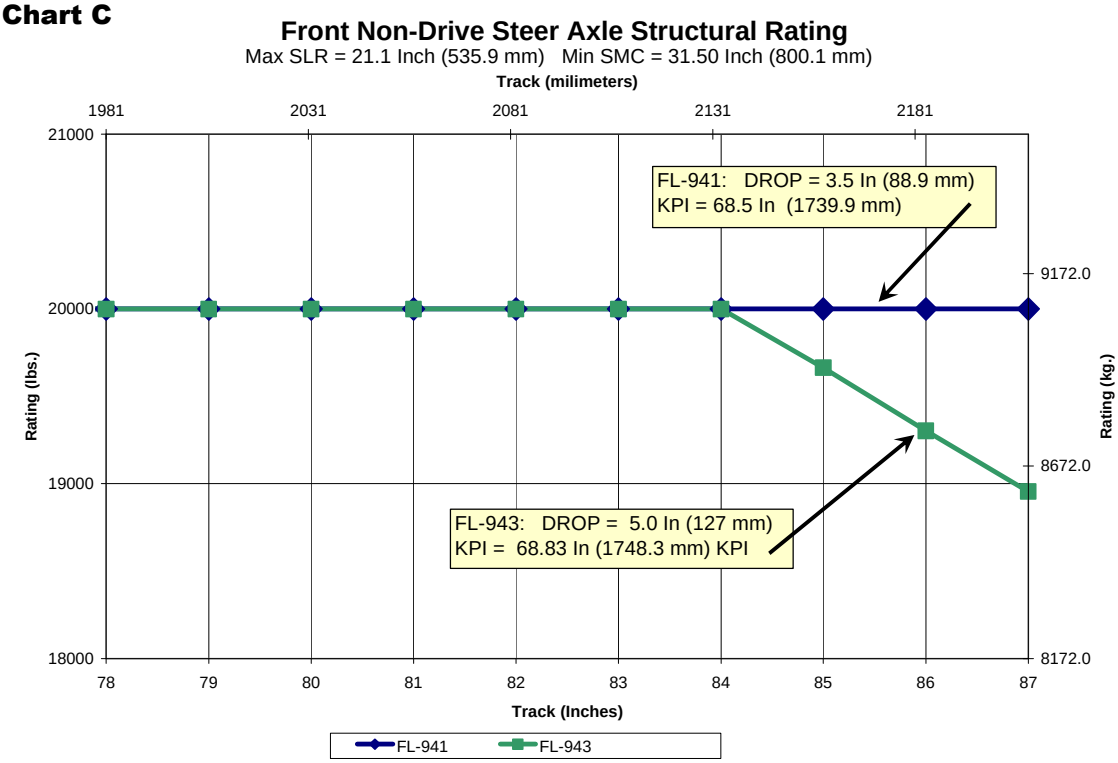
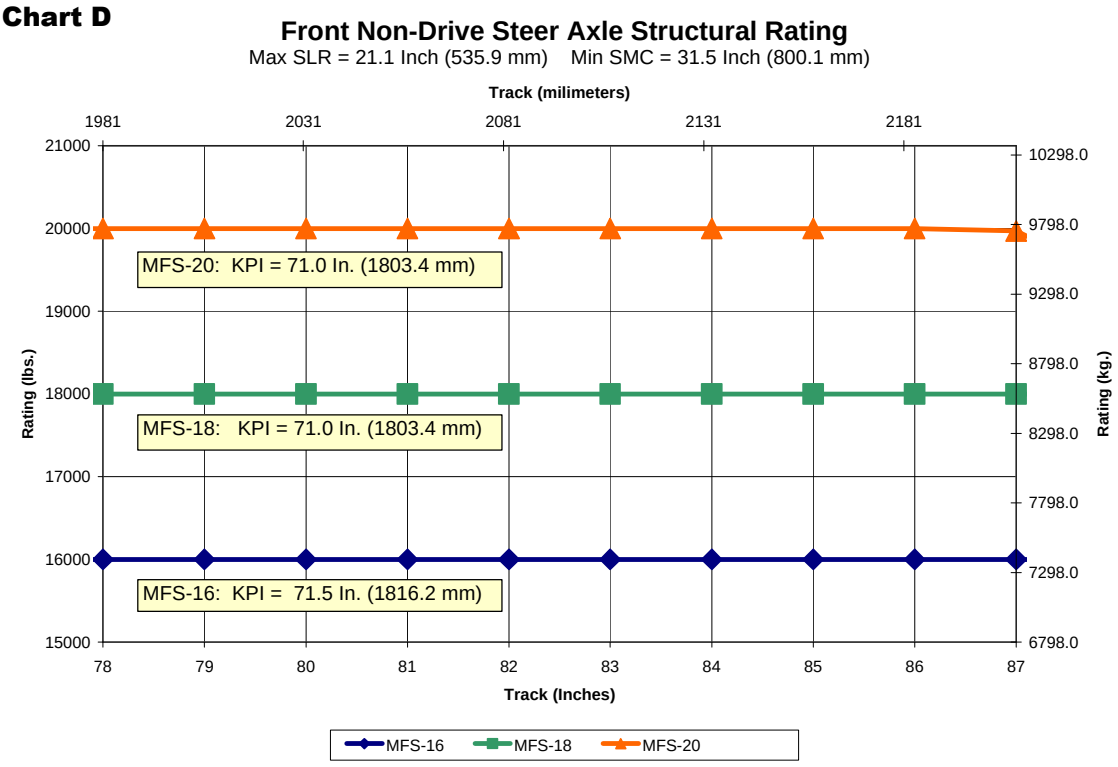


Chart D



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Mining Vocation – Axle Guidelines

Chart E

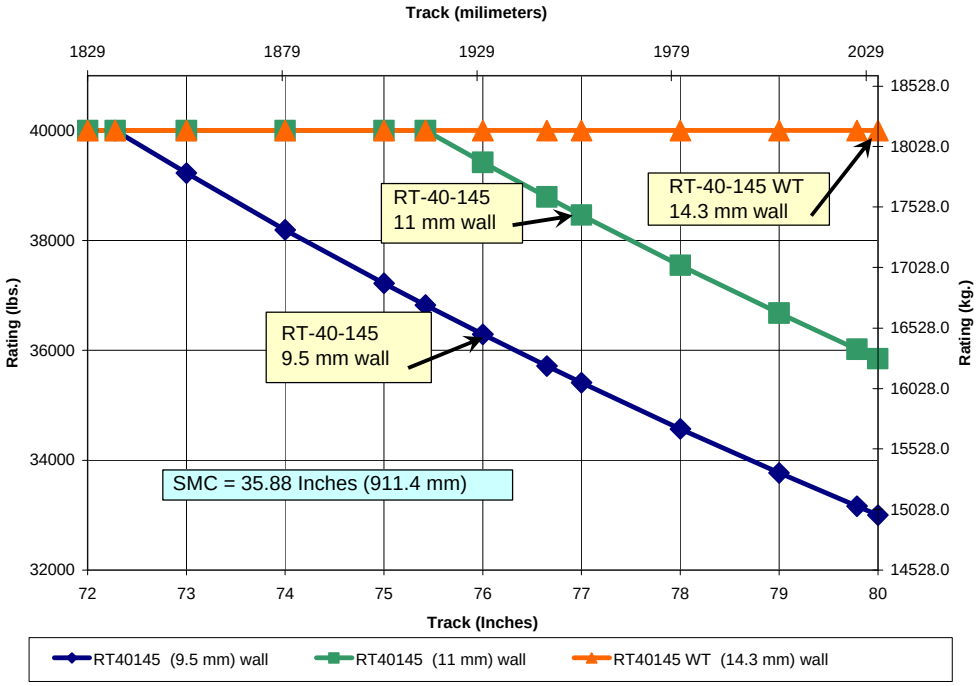
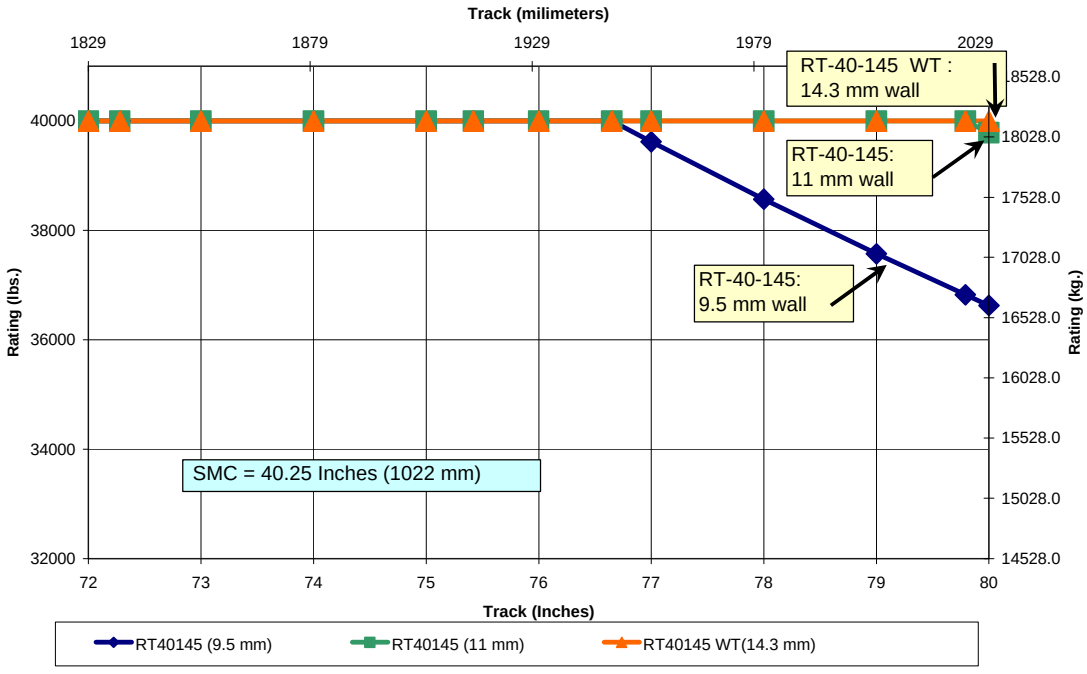


Chart F



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Mining Vocation – Axle Guidelines

Chart G

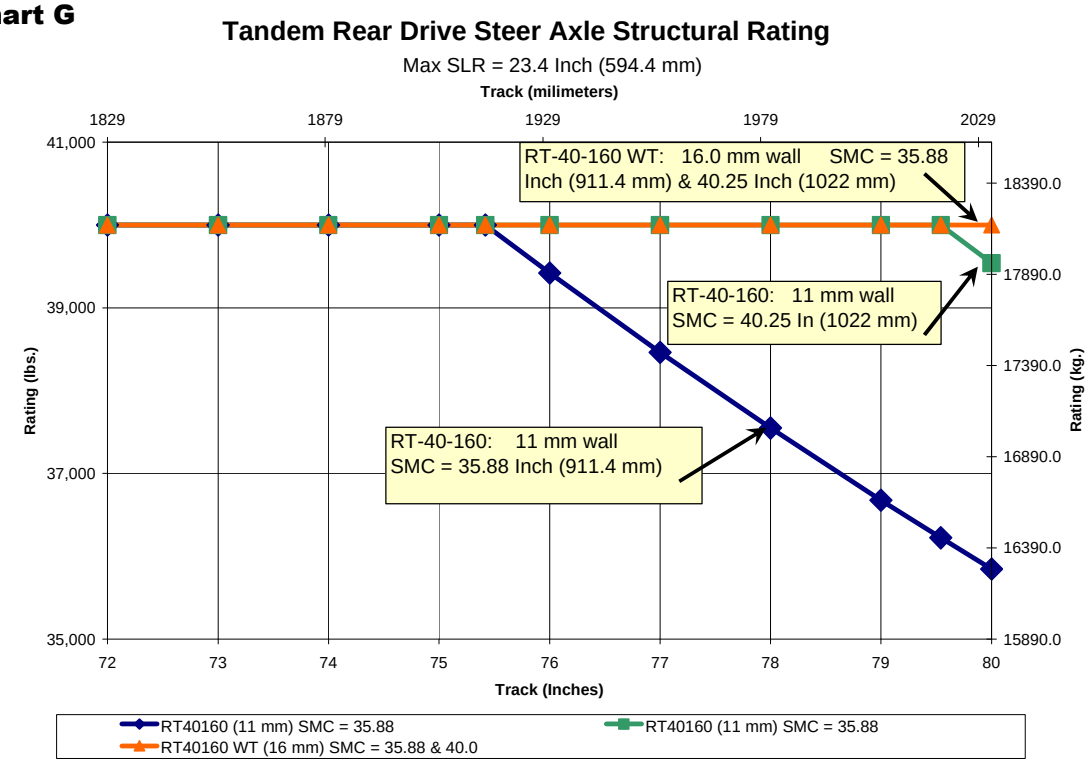
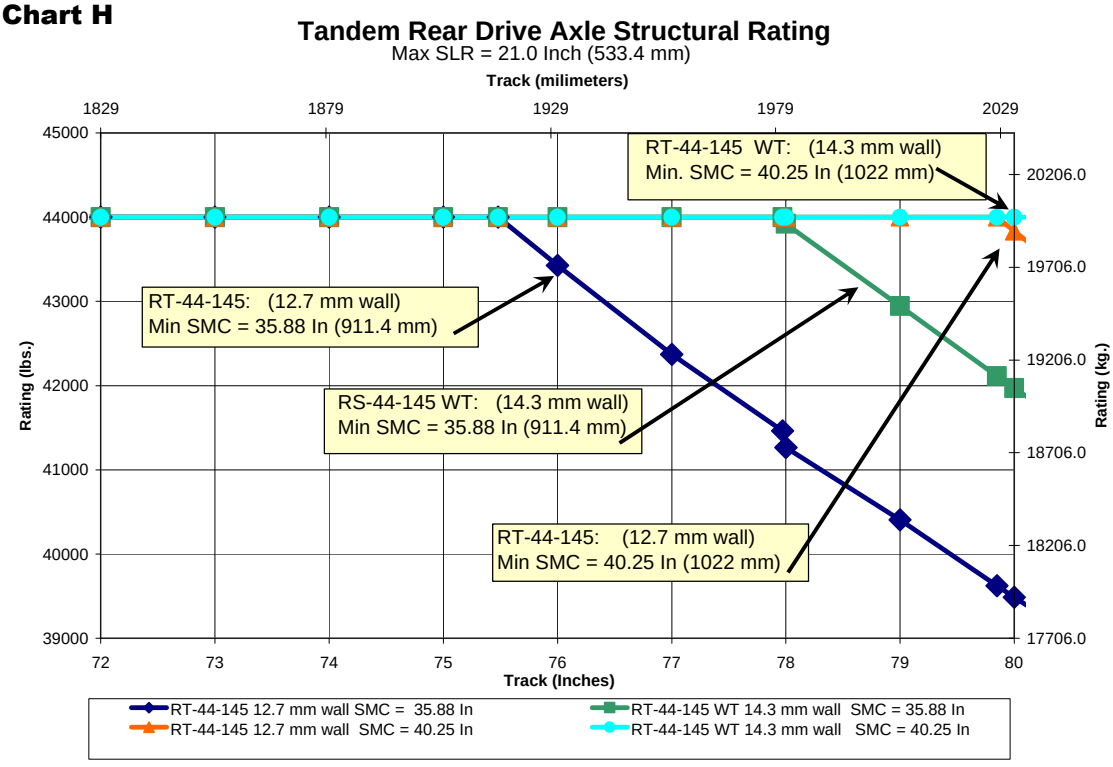


Chart H



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Mining Vocation – Axle Guidelines

Chart I

Tandem Rear Drive Axle Structrual Rating

Max SLR = 23.4 In (594.4 mm) Min SMC = 35.88 In (911.4 mm)

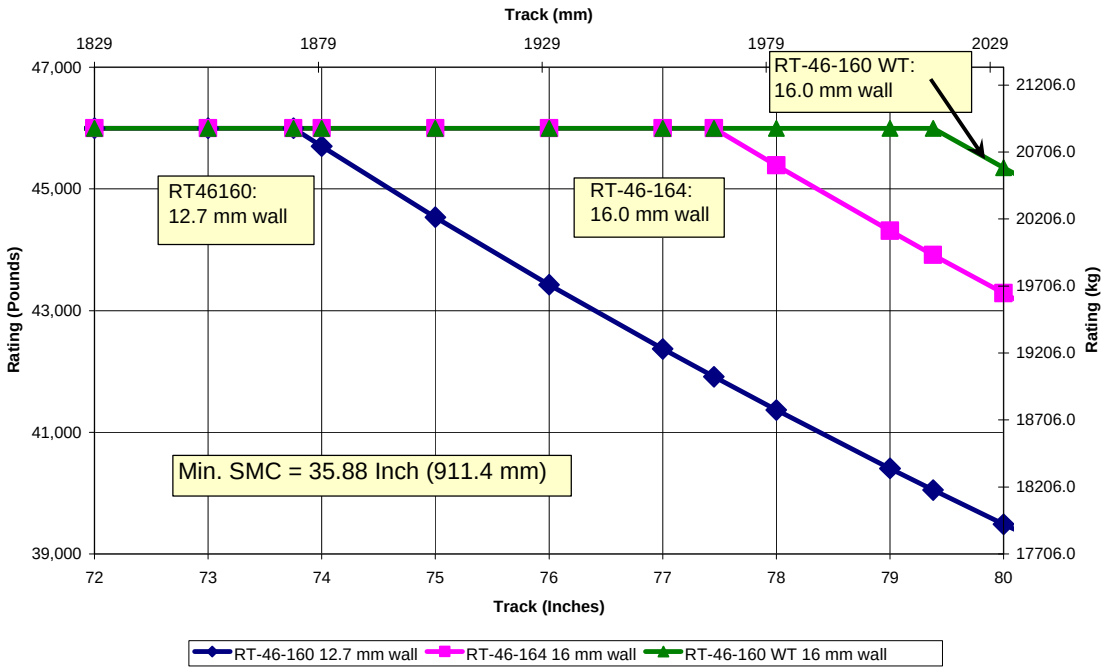
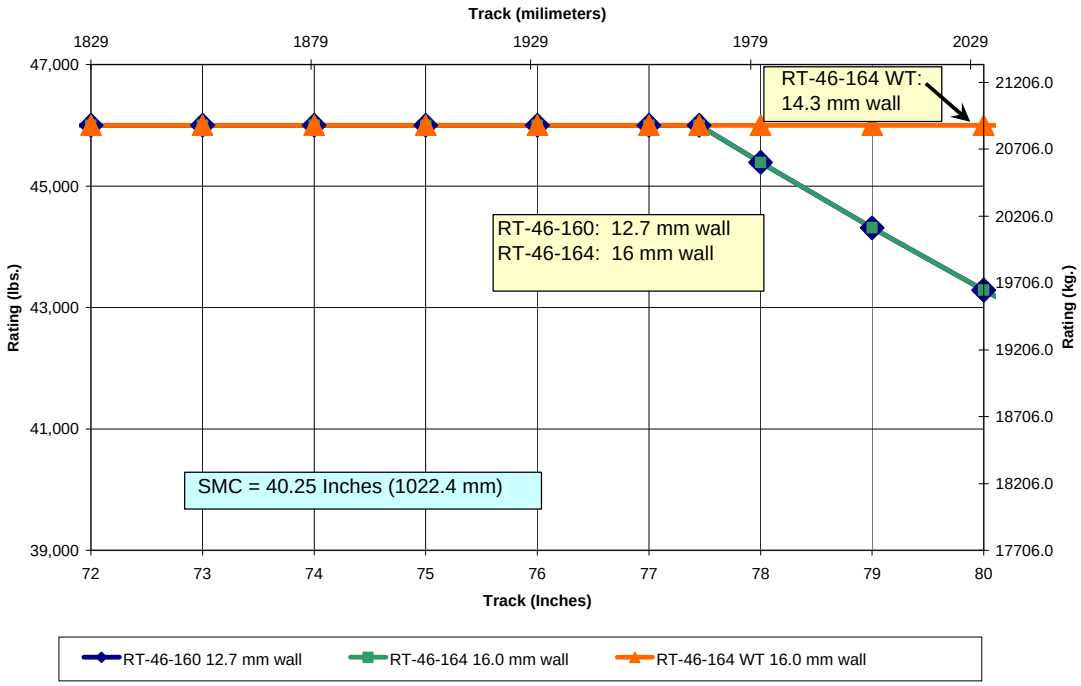


Chart J

Tandem Rear Drive Axle Structural Rating

Max SLR = 21.1 Inch (535.9 mm) SMC = 40.00 Inch (1026 mm)



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Mining Vocation – Axle Guidelines

Chart K

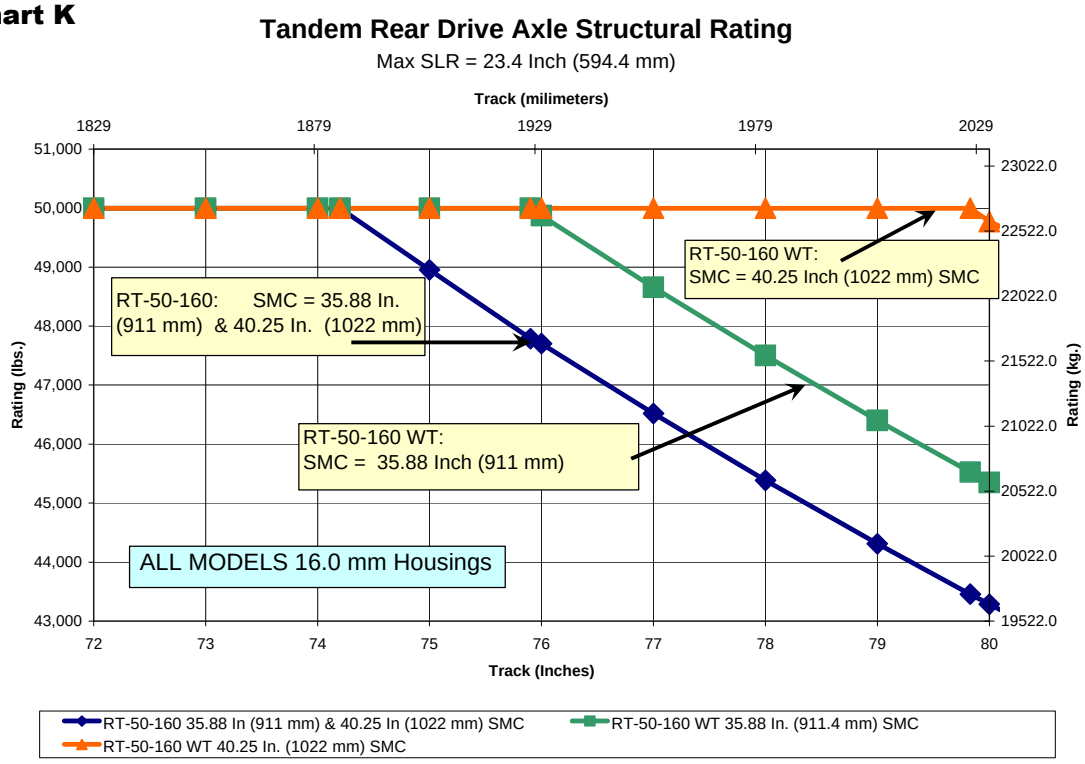
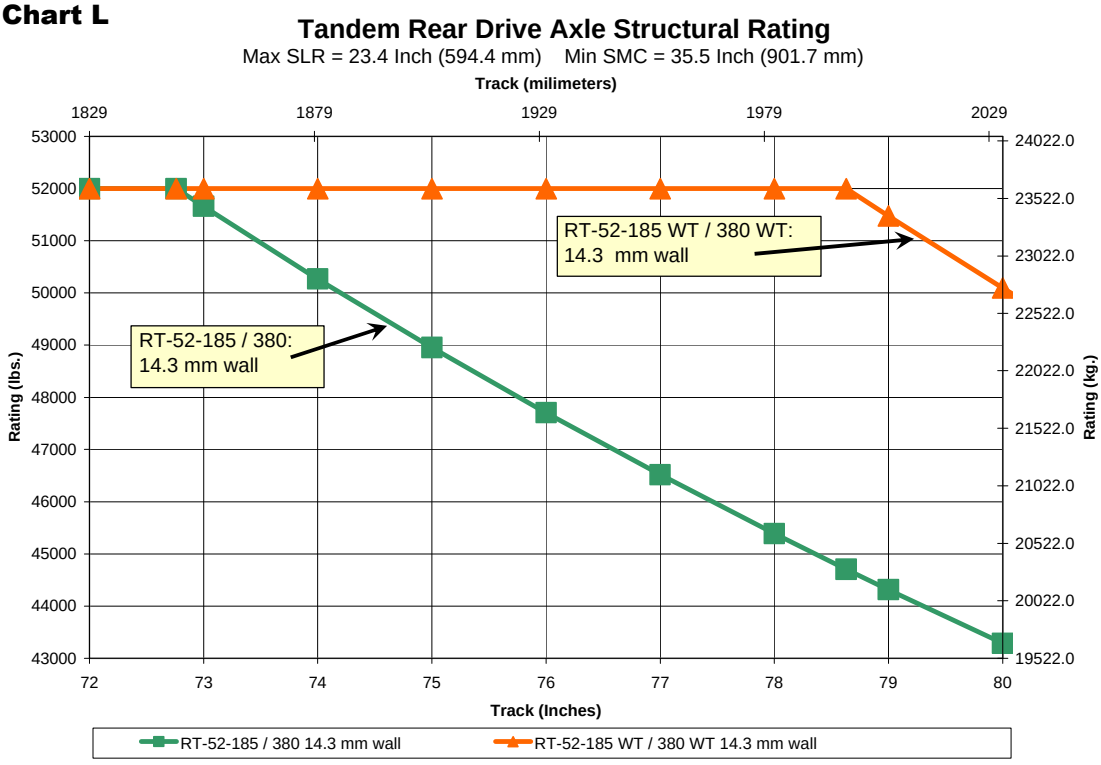


Chart L



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Mining Vocation – Axle Guidelines

Chart M

Tandem Rear Drive Axle Structural Ratings

Max SLR = 23.4 In (594.4 mm)

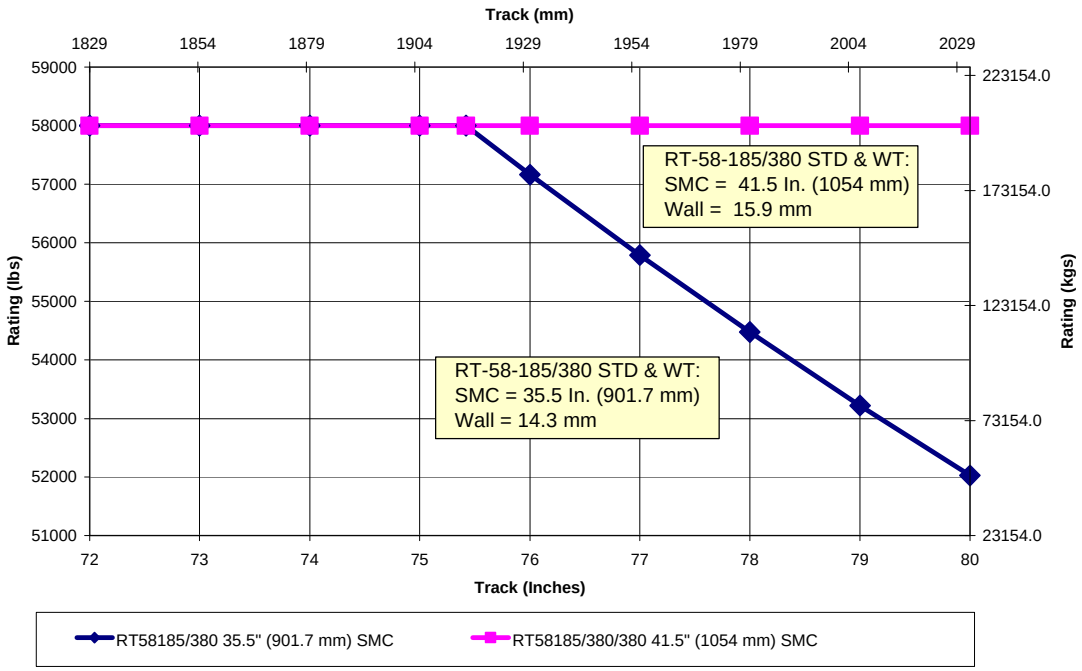
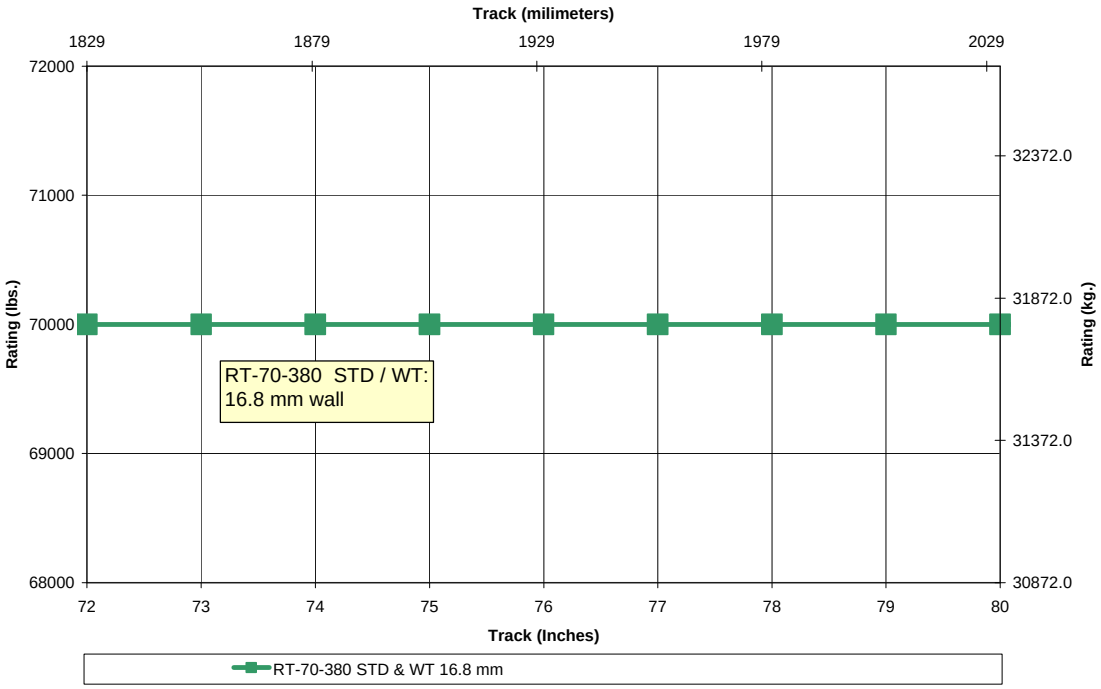


Chart N

Tandem Rear Drive Axle Structural Rating

Max SLR = 23.4 Inch (594.4 mm) SMC = 35.5 Inch (901.7 mm) and 41.5 In (1054 mm)



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Mining Vocation – Axle Guidelines

Creep Rating Definition

CREEP RATINGS - Low speed, off-highway (work site) axle loads which exceed standard gross axle weight ratings (GAWR).

Creep ratings shown below are approved only for vehicles which conform to the listed parameters:

* Tandem Rear Drive Axles Only
* Maximum operating speed of 5 MPH
* Minimum spring mount centers for drive axles per chart
* Maximum tire SLR per chart.

Operators using vehicle equipped with liftable tag or pusher axle(s) must consider creep ratings when any liftable axle is unloaded.

Liftable tag or pusher axle(s) should only be raised (or unloaded) to improve vehicle maneuverability in off-road use or when vehicle is unloaded.

Axle Creep ratings cannot be exceeded.

STANDARD AND WIDE TRACK AXLES

Track Width: 72.00 Inches (1829 mm) to 80.0 Inches (2032 mm)

Axle Model	Creep GAWR Lbs (kg)	Min. SMC Inches (mm)	Max. SLR Inches (mm)
RT-40-145	55,000 lbs (24,970 kg)	35.88 In (911.4 mm)	20.5 In (502.7 mm)
RT-40-160	See following graphs		23.4 In (594.4 mm)
RT-44-145	55,000 lbs (24,970 kg)	35.88 In (911.4 mm)	20.5 In (502.7 mm)
RT-46-160	See following graphs	35.88 In (911.4 mm)	23.4 In (594.4 mm)
RT-46-164	See following graphs	35.88 In (911.4 mm)	23.4 In (594.4 mm)
RT-50-160	See following graphs		
RT-52-185	See following graphs	35.50 In (901.7 mm)	23.4 In (594.4 mm)
RT-52-380	See following graphs		
RT-58-185	70,000 lbs (31,780 kg)	35.50 In (901.7 mm)	23.4 In (594.4 mm)
RT-58-380	See following graphs		
RT-70-380	75,000 lbs (34,050 kg)	35.50 In (901.7 mm)	23.4 In (594.4 mm)

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Mining Vocation – Axle Guidelines

Chart O

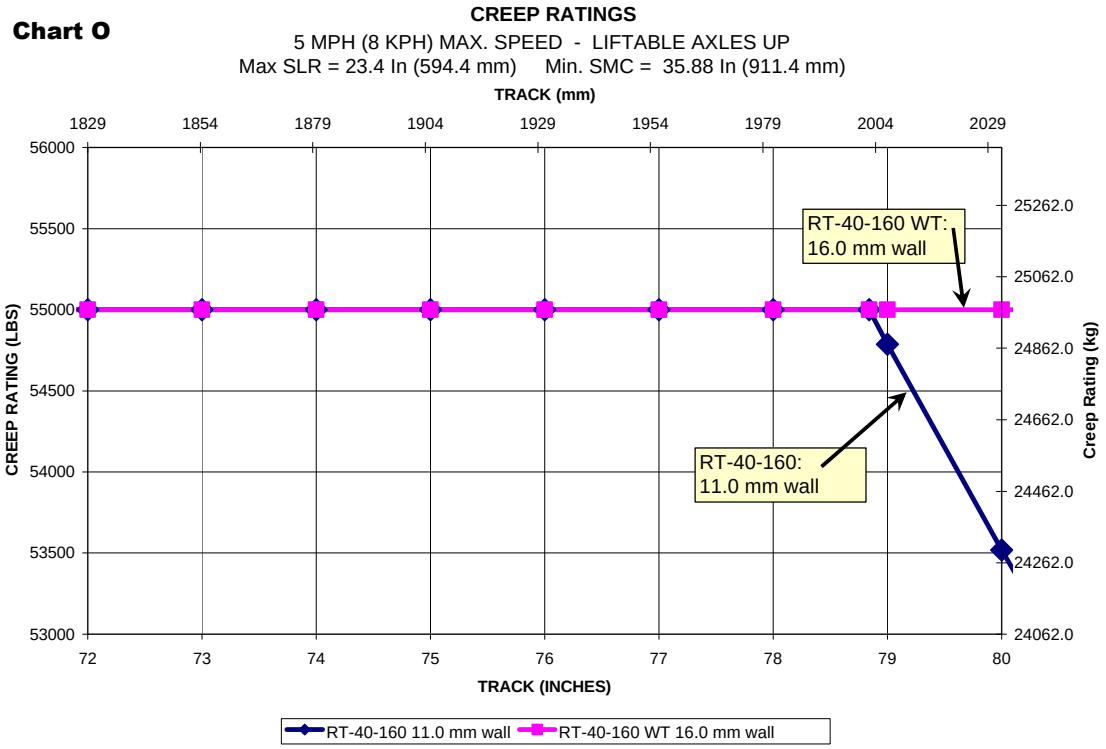
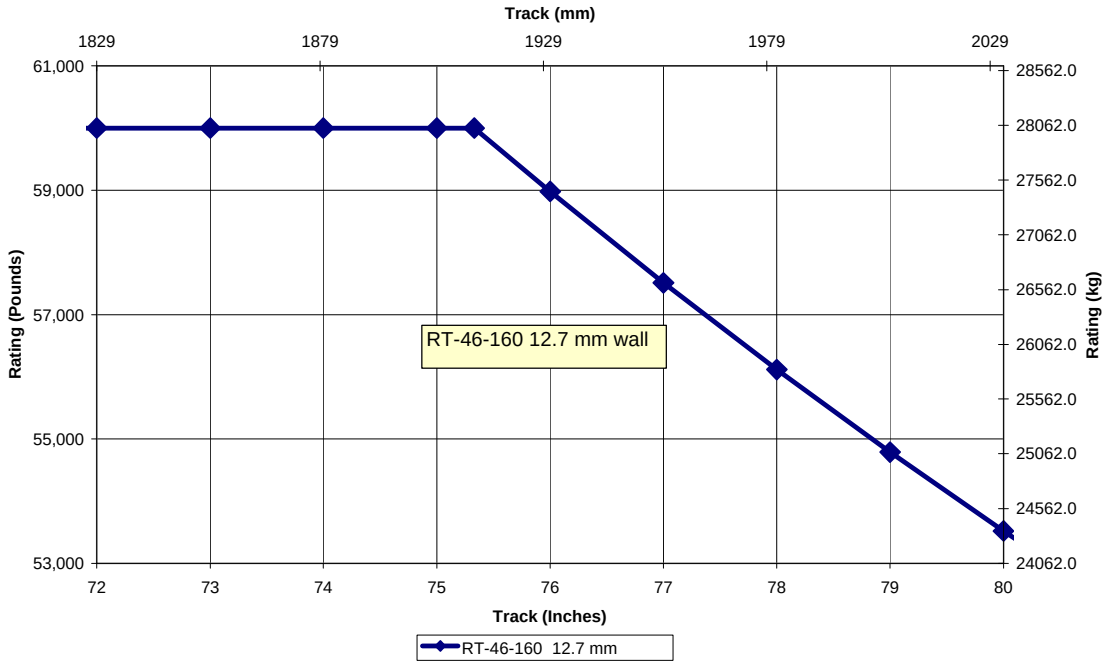


Chart P



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Mining Vocation – Axle Guidelines

Chart Q

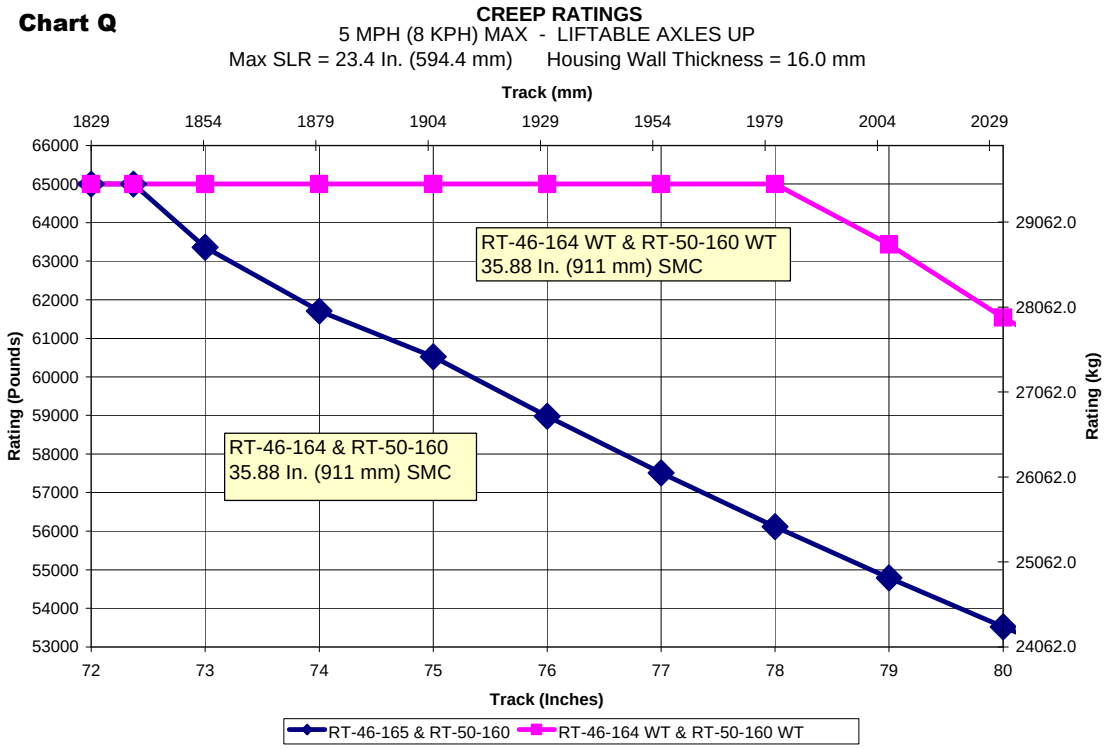
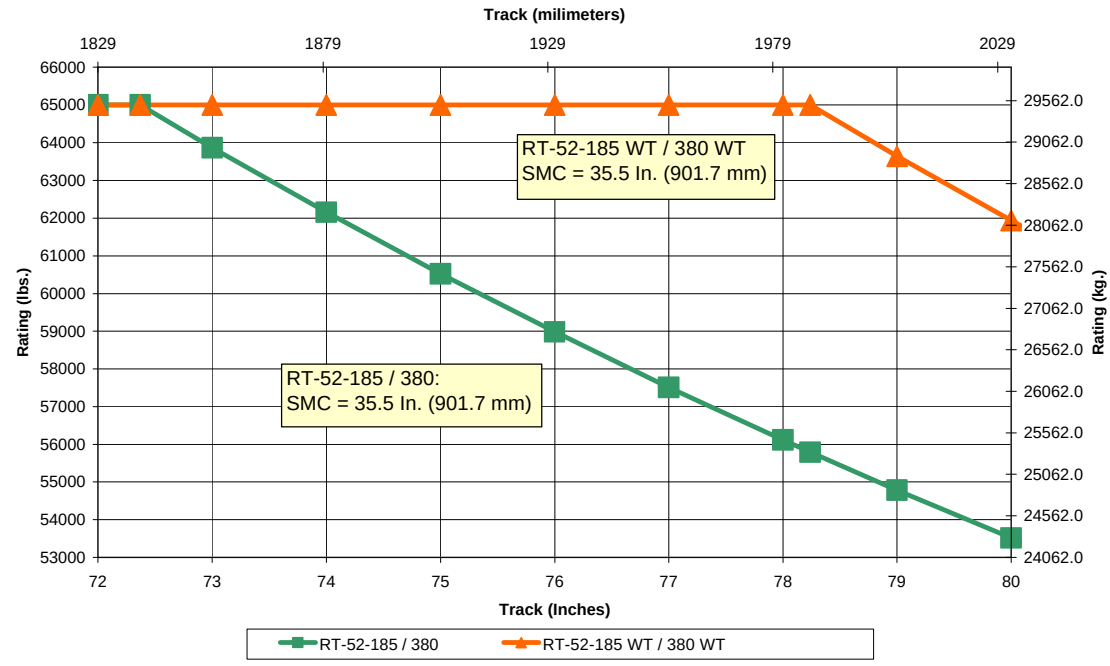


Chart R



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Mining Vocation – Axle Guidelines

Axle Torque Ratings

The following formula is used to determine **CALCULATED INPUT TORQUE TO AXLE**

Formula 1	CALCULATED INPUT TORQUE TO AXLE = T x N1 x N2		
Rear Drive Axle	where	T	= Maximum Gross Engine Torque (LB - FT)
		N1	= Lowest Transmission Forward Gear Ratio
		N2	= Torque Converter Stall Ratio
			= 2.5 or specific value for Automatic Transmission
			= 1.0 for Manual Transmission

The chart below is to be used to determine axle input torque limits approved for the identified Meritor axle models by available ratio.

Axle Torque Ratings For Mining Vocation

	MAXIMUM INPUT TORQUE TO AXLE - LB-FT (N-M)			
	Tandem Rear Drive			
Axle Models	**RT-145**	**RT-160 / 164**	**RT-185**	**RT-380**
Ratio				
3.07	XX	30,000 (40,674)	X	X
3.21	XX	30,000 (40,674)	X	X
3.42	23,000 (31,183)	30,000 (40,674)	X	X
3.58	22,100 (29,963)	30,000 (40,674)	X	X
3.73	22,100 (29,963)	30,000 (40,674)	30,000 (40,674)	X
3.90	22,100 (29,963)	X	X	X
3.91	X	30,000 (40,674)	X	X
4.10	X	30,000 (40,674)	30,000 (40,674)	X
4.11	22,100 (29,963)	X	X	X
4.30	X	30,000 (40,674)	30,000 (40,674)	X
4.33	21,800 (29,556)	X	X	X
4.56	X	30,000 (40,674)	30,000 (40,674)	X
4.63	20,400 (27,658)	X	X	X
4.88	18,000 (24,404)	X	X	X
4.89	X	30,000 (40,674)	30,000 (40,674)	X
5.13	X	X	X	X
5.29	16,600 (22,506)	X	X	X
5.38	X	26,200 (35,522)	30,000 (40,674)	X
5.52	X	X	X	30,000 (40,674)
5.63	X	23,000 (31,183)	X	X
5.86	12,200 (16,541)	X	X	X
6.07	X	X	X	30,000 (40,674)
6.14	11,800 (15,998)	20,400 (27,658)	24,000 (32,539)	X
6.37	X	X	X	27,200 (35,878)
6.43	10,800 (14,642)	17,800 (24,133)	X	X
6.75	X	X	X	26,200 (35,522)
6.83	10,200 (13,829)	17,800 (24,133)	20,400 (27,658)	X
7.17	9,400 (12,744)	16,000 (21,693)	18,400 (24,947)	X
7.24	X	X	X	21,200 (28,743)
7.83	X	X	X	20,400 (27,658)
9.14	X	X	X	16,000 (21,693)
10.12	X	X	X	13,400 (18,168)
10.62	X	X	X	12,200 (16,541)
Maximum Gross Engine Torque - LB-FT (N-M)				
	1650 (2237)	2050 (2788)	2050 (2788)	2050 (2788)

NOTES:
1) Axle torque ratings charted above are to be used only with guidelines for Mining Vocation.
2) XX = Contact ArvinMeritor CVS Axle Applications Engineering for possible approval.
3) Calculated Input Torque to Axle (per formula) must be less than Maximum Allowable Input Torque to Axle (per chart).
4) X = Ratio not available.

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Mining Vocation – Axle Guidelines

GVW/GCW Ratings

This chart lists maximum approved GVW/GCW for Meritor axle models (by ratio) for the two duty cycles outlined in this **AXLE GUIDELINE**.

MAX GVW/GCW'S LBS (KGS) BY AXLE BY RATIO

DUTY I

8% MAX GRADES ON-ROAD FOR 95% OF ROUTE
12% MAX GRADES OFF-ROAD FOR 5% OF ROUTE
100% LOAD GOING, EMPTY RETURN

Axle Models	RT-145 MAX SLR = 21.0"	RT-160/164 MAX SLR = 21.0"	RT-185 MAX SLR = 21.0"	RT-380 MAX SLR = 23.4"
Hypoid Ratios				
3.07	80,000 (36,320)	145,000 (65,830)	X	X
3.21	80,000 (36,320)	145,000 (65,830)	X	X
3.42	80,000 (36,320)	145,000 (65,830)	X	X
3.58	80,000 (36,320)	145,000 (65,830)	X	X
3.73	80,000 (36,320)	145,000 (65,830)	170,000 (77,180)	X
3.91	80,000 (36,320)	145,000 (65,830)	X	X
4.11	80,000 (36,320)	145,000 (65,830)	170,000 (77,180)	X
4.30	X	145,000 (65,830)	170,000 (77,180)	X
4.33	80,000 (36,320)	X	X	X
4.56	x	145,000 (65,830)	170,000 (77,180)	X
4.63	80,000 (36,320)	X	X	X
4.88	80,000 (36,320)	X	X	X
4.89	X	130,000 (59,020)	155,000 (70,370)	XX
5.29	80,000 (36,320)	X	X	X
5.38	X	130,000 (59,020)	155,000 (70,370)	X
5.52	X	X	X	185,000 (83,990)
5.63	X	130,000 (59,020)	X	X
5.86	70,000 (31,780)	X	X	X
6.07	X	X	X	185,000 (83,990)
6.14	70,000 (31,780)	130,000 (59,020)	155,000 (70,370)	X
6.37	X	X	X	185,000 (83,990)
6.43	70,000 (31,780)	130,000 (59,020)	X	X
6.75	X	X	X	170,000 (77,180)
6.83	70,000 (31,780)	130,000 (59,020)	155,000 (70,370)	X
7.17	70,000 (31,780)	130,000 (59,020)	155,000 (70,370)	X
7.24	X	X	X	170,000 (77,180)
7.83	X	X	X	170,000 (77,180)
9.14	X	X	X	170,000 (77,180)
10.12	X	X	X	XX
10.62	X	X	X	XX

Notes:
1) X = Ratio not available.
2) XX = Contact ArvinMertor CVS Axle Applications Engineering for possible approval.
2) GCW limits beyond those shown within this **AXLE GUIDELINE** may be approvable. Contact ArvinMeritor CVS Axle Applications Engineering for possible approval.

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Mining Vocation – Axle Guidelines

GVW/GCW Ratings

This chart lists maximum approved GVW/GCW for Meritor axle models (by ratio) for the two duty cycles outlined in this **AXLE GUIDELINE**.

MAX GVW/GCW'S (LBS) BY AXLE BY RATIO

DUTY II

8% MAX GRADES ON-ROAD FOR 95% OF ROUTE
20% MAX GRADES OFF-ROAD FOR 5% OF ROUTE
100% LOAD GOING, EMPTY RETURN

Axle Models	RT-16X MAX SLR = 21.0"	RT-185 MAX SLR = 21.0"	RT-380 MAX SLR = 23.4"
Hypoid Ratios			
3.07	110,000 (49,940)	X	X
3.21	110,000 (49,940)	X	X
3.42	110,000 (49,940)	X	X
3.58	110,000 (49,940)	X	X
3.73	110,000 (49,940)	135,000 (61,290)	X
3.91	110,000 (49,940)	X	X
4.11	110,000 (49,940)	135,000 (61,290)	X
4.30	110,000 (49,940)	135,000 (61,290)	X
4.33	X	X	X
4.56	110,000 (49,940)	135,000 (61,290)	X
4.63	X	X	X
4.88	X	X	X
4.89	100,000 (45,500)	120,000 (54,480)	X
5.29	X	X	X
5.38	100,000 (45,500)	120,000 (54,480)	X
5.52	X	X	145,000 (65,830)
5.63	100,000 (45,500)	X	X
5.86	X	X	X
6.07	X	X	145,000 (65,830)
6.14	100,000 (45,500)	120,000 (54,480)	X
6.37	X	X	145,000 (65,830)
6.43	100,000 (45,500)	X	X
6.75	X	X	145,000 (65,830)
6.83	100,000 (45,500)	120,000 (54,480)	X
7.17	100,000 (45,500)	120,000 (54,480)	X
7.24	X	X	135,000 (61,290)
7.83	X	X	135,000 (61,290)
9.14	X	X	135,000 (61,290)
10.12	X	X	100,000 (45,500)
10.62	X	X	90,000 (40,860)

Notes:
1) X = Ratio not available.
2) XX = Contact ArvinMertor CVS Axle Applications Engineering for possible approval.
2) GCW limits beyond those shown within this **AXLE GUIDELINE** may be approvable. Contact ArvinMeritor CVS Axle Applications Engineering for possible approval.

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Mining Vocation – Axle Guidelines

Important Notes

1. The following optional features are approved by this **AXLE GUIDELINE.** All options may not be available on all axle models.
    a. **Driver-Controlled Differential Lock (DCDL)**
    b. **Oil Pump**
    c. **Advanced Lube**

2. For approval of **Transmissions, Clutch, Driveline, Telma Retarders, Brakes, Wheel Ends, Wabco ABS, Trailer Axles**, **Front Drive Steer Axles, Transfer Cases** and other components, contact the appropriate ArvinMeritor engineering function: Phone # 800-535-5560.

3. For details on ArvinMeritor's **Advanced Lubrication Program**, refer to ArvinMeritor Technical Publication TP-9303 or Maintenance Manual # MM-01.

4. For certain suspension models, ArvinMeritor requires the use of an increased housing wall thickness. See Meritor Product Information Letter # 134 or Contact ArvinMeritor CVS Axle Applications Engineering for clarification.

5. ArvinMeritor's Axle Application Approval, with respect to the **Suspension** selected, is limited to the location or the suspension attaching positions relative to those parameters (track, tire, mounting centers, etc.) specified. Attachment to the axle housing assembly and durability of the axle housing as a result of the suspension loadings on the housing, is the responsibility of the OEM. ArvinMeritor assumes responsibility of the bracket integrity and attachment only if
    a. The brackets are attached by ArvinMeritor or,
    b. ArvinMeritor has established a prior agreement with the OEM.

6. It is the responsibility of the OEM and/or the dealer to accurately convey all approved axle loading information to the **Body Builder** if the chassis is sold as incomplete. Also, it is the responsibility of the final vehicle builder to ensure the assigned tagged values for GAWR and GVW/GCW do not exceed those limits approvable by this vocational guideline.

7. The **OEM has the responsibility** to determine Steering Axle Specifics (Maximum Turn Angle, Tie Rod Arm selection, Steering Arm Selection, Geometry Limits, etc.). ArvinMeritor CVS Axle Applications Engineering can assist the OEM with these parameter selections.

8. Vehicle testing of any nature voids the warranty on Meritor axles. ArvinMeritor does not approve of automatic transmission stall testing and does not warrant components against these procedures. See Product Information Letter # 368.

9. **Driver-Controlled Differential Lock option**, when available, is highly recommended for all mining operations where vehicles operate in off-road areas.

10. The use of **NoSPIN** "differentials" in any single or tandem rear drive axle will result in the exclusion of axle shafts from warranty considerations. Certain other carrier components will also be excluded from warranty considerations if their failure is deemed the result of a NoSPIN failure or malfunction. Depending on axle loading, the NoSPIN can cause all differential torque to be directed to one axle shaft, causing overload (and potential failure.) NoSPIN is a product of Tractech Inc.

11. Vehicles equipped with multiple **Retardation Devices** of any type (engine brake, exhaust brake, hydraulic transmission, chassis mounted or axle mounted electromagnetic) must be

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approved by ArvinMeritor as well as the manufacturers of the selected retardation devices. Contact ArvinMeritor CVS Axle Applications Engineering for possible approval.

12. The **vehicle manufacturer is responsible** for providing a design that permits the "Caster Steer Non-Drive Axle" to be either (1) lifted or (2) locked in the straight ahead position, when operating the vehicle in a reverse direction.

13. Drive axles configured with single tires may require special consideration. Aggressive High Mobility Single Tires of on/off road and agricultural tread designs are capable of transmitting higher than normal wheel torque into the ground surface. This can result in axle components being stressed beyond allowable limits. If single tires are utilized with other than strict On-Highway tread designs, ArvinMeritor CVS Axle Applications Engineering should be consulted for special consideration of the application.

14. For **Straight Truck Vehicle Configuration** used in mining, please refer to the Construction Vocational Axle Guideline, TP-9441-CS.

15. **Vehicles operating on downgrades** for more than 40 percent of the loaded distance may require de-rating of allowable GVW or GCW loads. For these situations, specific distance at grade information may be needed for evaluation. Consult ArvinMeritor CVS Axle Applications Engineering for further details.

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Printed in the USA

TP-9441MN7
Revised 1-05
(16579/Meritor)

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