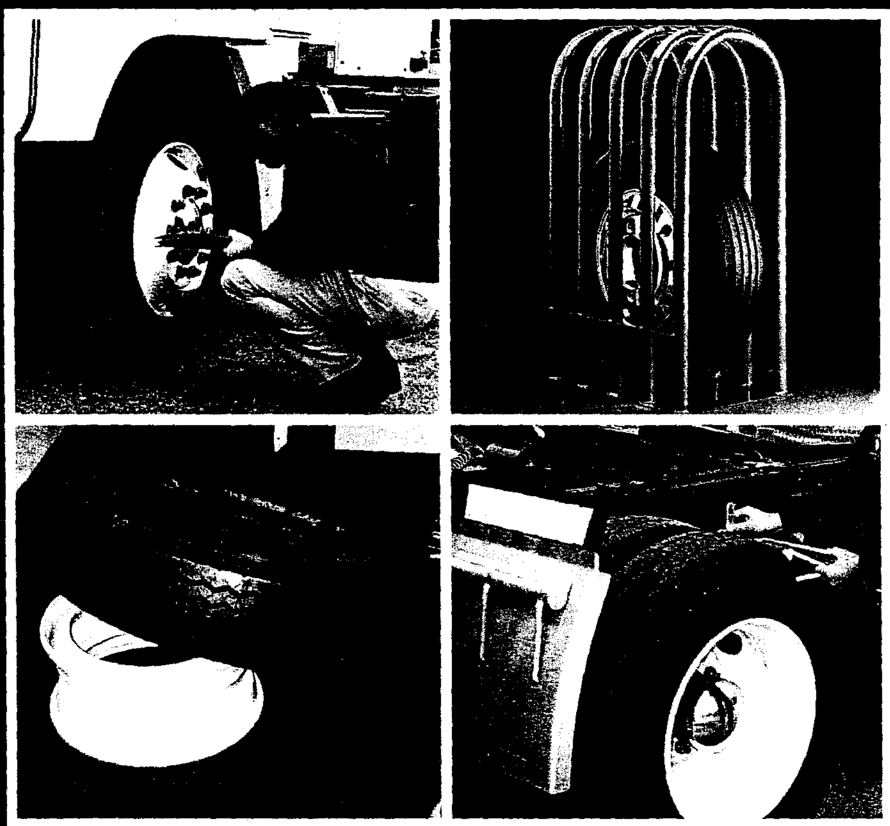
MICHELIN® TRUCK TIRE SERVICE MANUAL



1ST EDITION

INTRODUCTION

Read this manual carefully - it is important for the SAFE operation and servicing of your tires. WARNING

The purpose of this manual is to provide you the Michelin Truck Tire customer with some useful information to help you obtain maximum performance and the lowest cost per mile. Your Michelin radial tires are a significant investment and should be protected like any other investment. This manual will show you how to do this by increasing your knowledge of tires regarding their selection, vehicle characteristics that affect performance, maintenance and extending tire life through repair and retreading. For complete tire specifications, refer to application data books. or contact your local Michelin Representative.

For additional information consult the following manuals:

- Michelin Data Book (Passenger Tire and Light Truck Tire) MDL40648
- Michelin Commercial Light Truck Tire and Truck Tire Data Book MWL40731
- Michelin Industrial and Special Application Tire Data Book MWL40733
- Michelin Truck Tire Retreading Manual MWT40164
- Michelin Radial Tire Repair Manual MWT40163
- Truck Tire Limited Warranty and Driver's Manual MWE40021
- Passenger and Light Truck Owner's Manual Limited Warranty MDW40616

MICHELIN'S MAJOR ACHIEVEMENTS

For over a century now, Michelin has been building a worldwide reputation for technological breakthrough after breakthrough. The historical highlights presented here are some that have made the company what it is today - and the modern tire what it is today.

1889 Brothers Edouard and Andre Michelin founded the company as a small rubber factory in Clermont-Ferrand, France.

1891 Michelin introduces the first pneumatic (air-filled) tire, which is easier to mount and repair.

1895 The first pneumatic car tire (from Michelin) helped make the automobile more practical.

1906 Michelin develops the first removable rim and first spare tire, which made repairs simpler.

1908 The first dual truck tires increase a vehicle's carrying capacity, another Michelin innovation.

1908-1931 Michelin produces tires in the United States at a Milltown, NJ plant which was closed in response to the Great Depression.

1923 Michelin invents the first low-pressure passenger car tire to enhance ride comfort and traction.

1929 Michelin next turns to the rails, developing the first rubber tire for railroad cars, adding comfort and reducing noise.

1938 Michelin replaces the usual textile fabric of a tire with steel wire, the "Metallic," which was the forerunner of the steel-belted radial.

1946 A revolution begins. Michelin patents the first steel-belted radial, giving drivers distinct advantages over bias-ply tires: longer mileage. better ride comfort fewer flats, improved traction and greater fuel economy.

1950 Michelin Tire Corporation, incorporated in New York City, begins selling tires in North America.

1951 Michelin introduces the first radial ply truck tire.

1957 Michelin develops the radial tire for earthmovers.

1968 The Michelin XWW becomes the first original equipment radial to be fitted on American cars as Michelin radializes the U.S. market.

1970 Michelin opens its first North American manufacturing plant in Canada.

1975 Michelin opens its first manufacturing plants in the United States.

1979 Michelin introduces the first low-profile truck tire, which improves mileage, fuel economy and handling.

1981 Michelin patents the first radial for jet airplanes to provide significant weight savings.

1987 The first radial for motorcycles is launched by Michelin.

1991 New fuel savings technology is announced for passenger and truck tires.

1992 First full line of fuel efficient "Advanced Technology" truck tires introduced for long haul service.

1993 Michelin introduced the "Green" tire for automobiles with its XSE technology.

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Section One

TIRE SELECTION

MICHELIN

WHY RADIAL?

As the diagrams demonstrate, the radial "X" concept, compared to the bias-ply construction, improves the tire's highway performance. Under the same pressure and load conditions, the "X" offers more fuel and cost-efficiency, better road handling and increased comfort:

Fuel Efficiency: The steel braced tread and radial casing result in less rolling resistance and less heat buildup from internal friction when the tire is in motion. This combination translates into lower fuel bills and extended casing life.

Lower Cost-Per-Mile: The radial construction of the "X" tire reduces friction and heat buildup inside the tire, retarding casing deterioration. This, combined with the radials proven tread life advantages, provides the lower overall cost/mile.

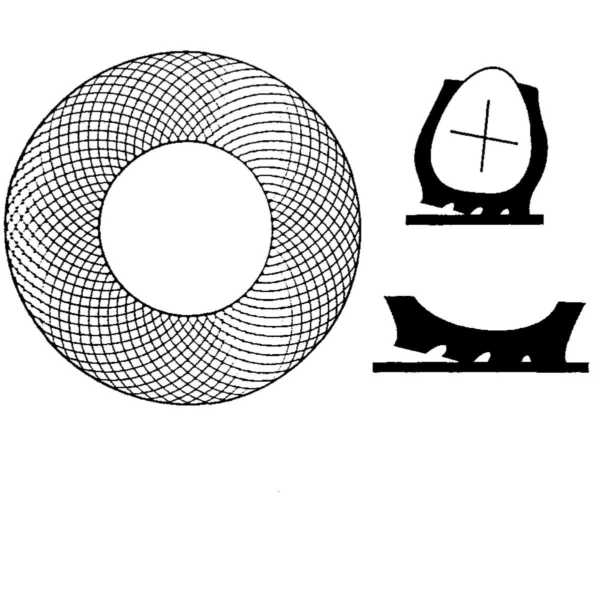
In addition, the retreadability of the "X" truck tire is a significant cost saver.

Road Handling: A radial tire has a better grip on the road; its footprint is larger; its sidewalls and its tread work independently, and its contact area on the ground is not distorted. Better road handling means greater dependability and performance.

Comfort: By its construction, a radial tire deflects more than a bias-ply tire. That flexibility helps to cushion shocks and gives a smoother ride.

Reduced Down Time: The steel belts help protect against punctures.

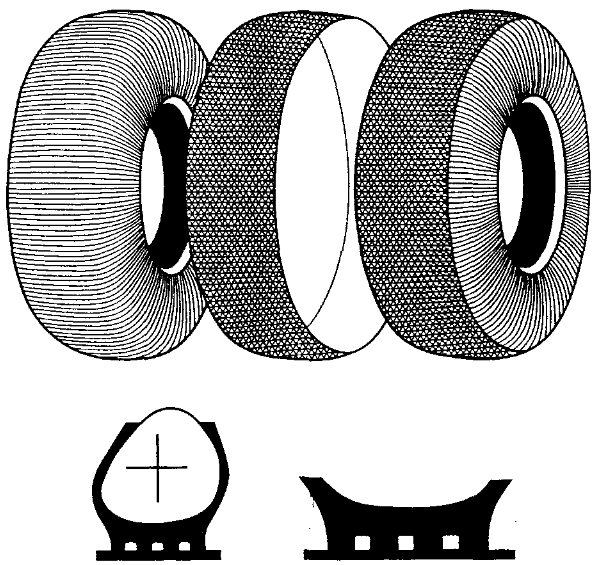
THE CROSS-PLY TIRE



Cross-ply or conventional tires have a number of plies which are laid diagonally, criss-crossing one another. As the tire revolves and deflects, these crossed plies interact and generate heat - a process which prematurely ages the components and shortens the life of the tire.

The number of cross-plies in a conventional tire tends to stiffen its walls, preventing sufficient flex under heavy load. This causes lateral tread movement which impairs road grip and causes tread abrasion.

THE MICHELIN "X" RADIAL



1. The cords in the casing of the "X" are laid radially, a design feature that makes the tire's walls extremely flexible. These supple walls "give" under load, absorbing unevenness in the road surface. The "X", therefore, introduced a new era in driving comfort.
2. Another "X" innovation is the belt around the casing that braces and stabilizes the tread, improving contact between vehicle and road and reducing unwanted movement in the tread-road contact area.
3. In other words, the two major features of the "X" - its radial wall and tread bracing belts - perform their functions quasi-independently.

WHY MICHELIN?
EXPERIENCE, QUALITY, INTEGRITY
NO COMPROMISE

EXPERIENCE

Michelin. It's a name known around the world for high quality tires and technological innovation.

Michelin has been earning that reputation for more than a century now, making radial tires for almost every vehicle on the road - and in the air: from bicycles and motorcycles to passenger and performance cars to heavy trucks and earthmovers to aircraft.

Michelin tires are designed, produced and marketed by a worldwide work force of 125,000 employees, with 68 manufacturing plants. In North America, Michelin operates 20 plants and employs 26,000 people.

QUALITY

Before, during and after the manufacturing process, Michelin tires are tested to ensure quality control. New methods of testing are always being developed, to keep producing a better product.

Engineers in physics, chemistry, electronics and other fields use a wide range of materials and techniques. Electron microscopy, x-rays, holography, transmission and absorption spectography, high-speed photography and various other investigative techniques are used to study the tire and the tire-and-wheel-assembly interaction with the rest of the vehicle.

Quality control goes beyond the laboratory to the production line itself. At each stage of the manufacturing process, from raw materials to finished product. production standards and requirements are constantly verified.

Michelin's North American facilities have grown considerably since the first plants opened in the early 1970's. Today all plants incorporate Michelin's latest technological developments and highly automated production processes.

Testing plays an important role in assuring Michelin quality. That's why Michelin operates the Laurens Proving Ground in South Carolina. Opened in 1976. the facility today includes a wide range of testing capabilities for all categories of tires.

In addition, Michelin tires are fitted every day on various vehicles and machines and tested repeatedly on tracks, roads, highways and job sites around the world.

INTEGRITY

Because the tire is the vital contact between the driver and the road, Michelin is dedicated to providing customers with tires built for outstanding performance and dependability at low cost-per-mile.

At Michelin, there is only one boss — the customer. It is the customer who judges the product and ultimately decides whether the company succeeds or fails. So Michelin puts its considerable technological strength into a full line of radial tires to meet customer needs.

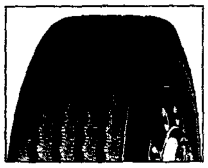
WHICH MICHELIN TIRE?

The choice of tire type depends upon the application of the tire and wheel position. No matter what your application may be, Michelin has a tire specifically designed for it. These applications include the following:

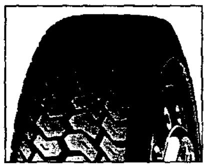
TRUCK TIRE APPLICATIONS

Long Haul (A)

The Long Haul application is composed of businesses operating primarily in common carrier and lease rental vocations.

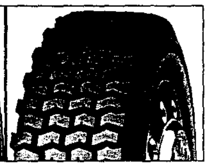

XZA-1+

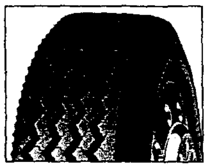

PILOT® XZA®

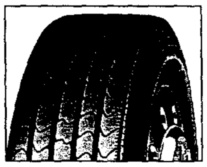

XDA+

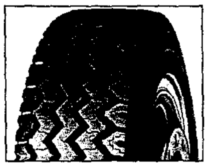

XD-1


XDHT


XM+S4


XTA


XT-1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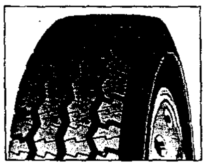
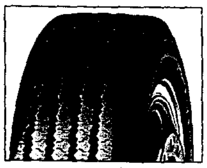
Urban (U)

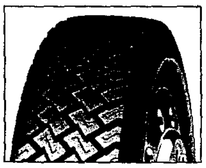
Urban applications are very short mileage with a high percentage of stop and go. Primarily users are in retail/wholesale delivery and bus fleets.

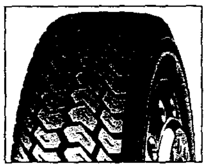

XZU4


XZU2


XZU


PILOT® XA®

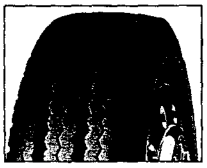

PILOT® XDU


XDA®

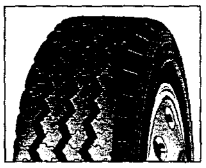
Regional (E)

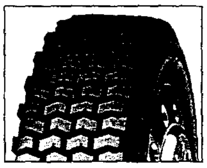
The Regional application is made up of businesses such as public utilities, government - federal, state, and local, food distribution/process, manufacturing/process, petroleum, and schools.


XZA®


XZA®


PILOT® XZA®

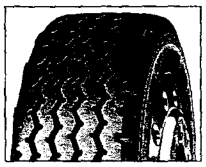

XZA® (SMTK)

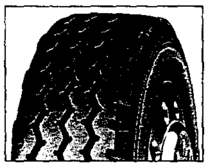

XM+S4


XZT (SMTK)

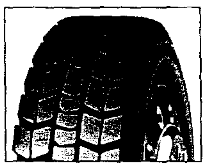
On/Off Road (Y)

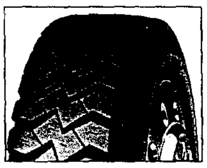
On/Off Road tires are designed to provide the durability and performance necessary in highly aggressive operating conditions. Vocations such as construction, mining and refuse use these highly specialized tires.

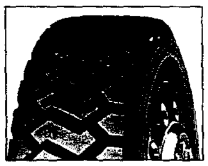

PILOT® XZY®

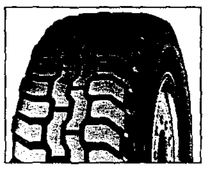

XZY®

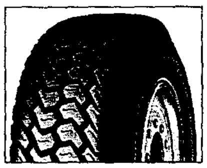

XZY-1

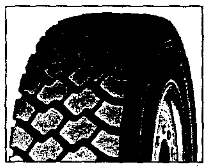

XDY-1


XDY


XDL


XY-1


WIDE BASE XZY®

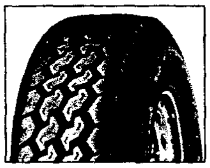

XZH*

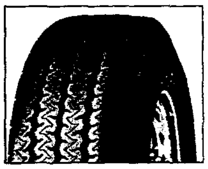
* Available 4th Quarter 1994.

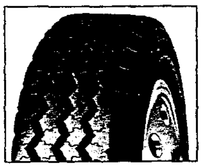
COMMERCIAL LIGHT TRUCK TIRE APPLICATIONS

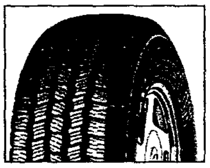
- Highway Tires, All-Wheel-Position
- All-Season, All-Terrain Tires
- All-Terrain Drive Axle Traction Tires
- Highway Mud & Snow Tires

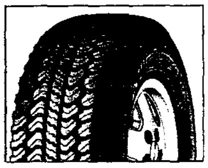

XPS RIB®

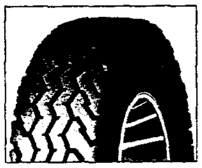

XPS TRACTION®


XCA


XZA®


LTX® M/S


LTX® A/T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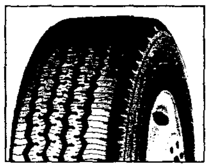
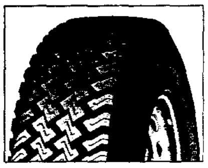

LTX® A/S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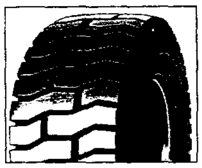
INDUSTRIAL TIRE APPLICATIONS

- Drive & Steer
- Fork Lift/Utility Vehicles
- Indoor Outdoor Applications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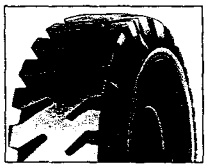
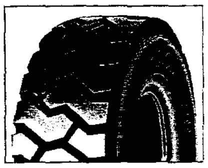
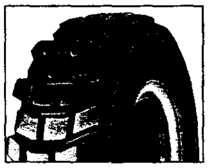

XZM


XZM LOW PROFILE

SPECIAL TIRE APPLICATIONS

- Military
- High Flotation
- On and Off Road Applications


XL


XS


XZL


XML

Due to constant innovation and development, the types and sizes of Michelin tires are always changing. In addition to the Michelin Truck Tire Service Manual, also check the current Product Line Brochure, price lists, and application data books for what is now available to suit your particular needs.

TUBELESS OR TUBE-TYPE?

As shown below, there are considerable advantages to using tubeless instead of tube-type tires. Whether you choose tube-type or tubeless, Michelin has the tire to meet your needs.

MICHELIN "X" RADIAL TUBELESS TRUCK TIRES

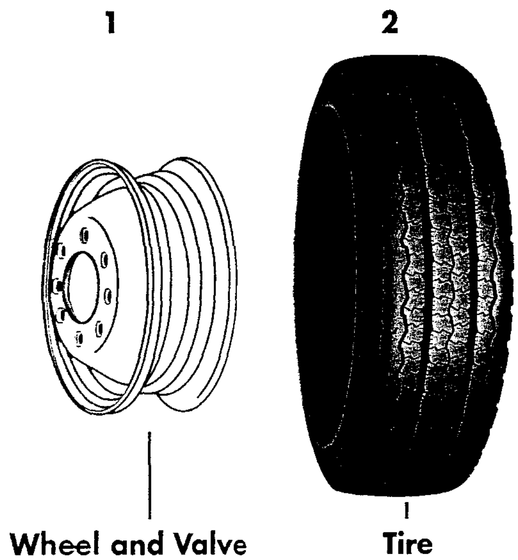
Tubeless - Simplified mounting requires three components.

- No tube and flap
- Less downtime due to flats
  Fewer road delays
- Fewer components
  Mismatching of flanges and lock rings is eliminated
  - No cracked rings or components
  - No bent or distorted parts
- Slower rate of pressure loss from punctures
- Cooler running
- Lower profile

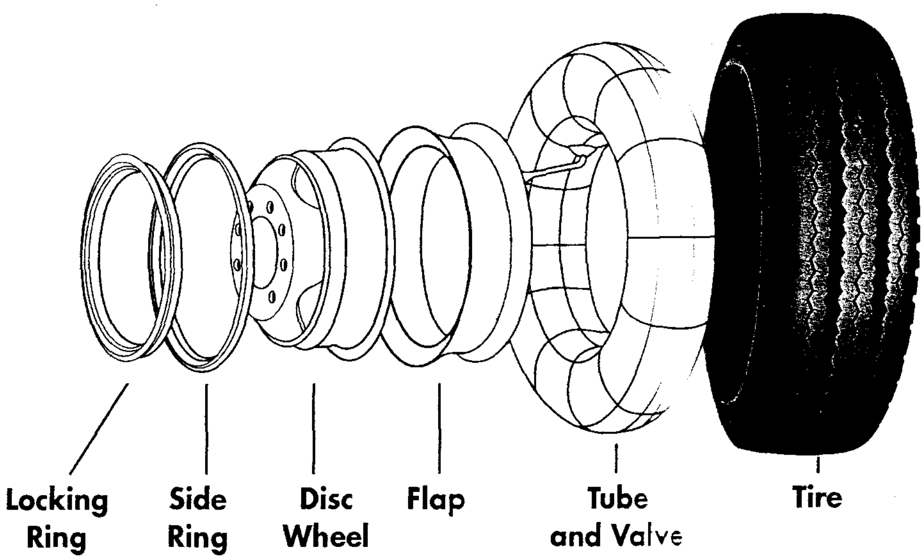
ADDS UP TO:

- Increased mileage - Longer carcass life
- Fuel savings
- Extra payload
- Reduction in labor and inventory costs
- Greater stability
- Improved road handling
- Lower overall end cost as compared to tube-type tires

TUBELESS (Three Components)



TUBE-TYPE (Seven Components)



DETERMINING MICHELIN TIRE SIZE

DEFINITIONS

1. **Tire Size:** Michelin radial truck tire sizes are designated by the nominal section width in inches or millimeters and the rim diameter with an "X" following the rim diameter. (e.g., 10.00R20X). The "R" indicates a radial tire. Some sizes are also designated with ISO* markings for their load and speed rating. (e.g. 144/141K) See pages 9, 50 and 51.

2. **Aspect Ratio:** A nominal number which represents the section height divided by the section width and expressed as a percentage.
   Example: Tire Size 275/80R22.5
   Aspect Ratio = 80

3. **Tube Code:** The proper Michelin tube to be used with Michelin tube-type tires is designated by the nominal rim diameter followed by a code. Example: Tube for 10.00R20X is 20N.

   Michelin tubes are made of butyl rubber and marked with the trade name "AIRSTOP". Because of the extreme flexibility of the Michelin "X" tire, it is recommended to use an "AIRSTOP" tube. These tubes are made with an overlap splice which is stronger than the butt splice used in many other tubes.

4. **Rims:** The approved rims are designated for each size tire. Michelin tires should only be mounted on the rims shown. The rim shown first is the preferred rim. Be sure to check rim manufacturers' specifications.

5. **Flap Code:** When a flap is required, the proper size to use with Michelin tires on each particular rim is designated by a code, the last two digits of which is the rim diameter. Unless otherwise specified, the flap for the preferred rim is normally supplied with the tire. (e.g. 200-20LB)

6. **Overall Width:** The maximum width (cross section) of the unloaded tires including protruding side ribs and decorations. (See Figure 1)

7. **Overall Diameter:** The diameter of the unloaded new tire (measured from opposite outer tread surfaces). (See Figure 1)

8. **Free Radius:** One-half the overall diameter of the unloaded new tire.

9. **Nominal Wheel Diameter:** Diameter of rim seat supporting the tire bead given in nearest whole numbers, e.g. 22.5".

10. **Section Height:** The distance from rim seat to outer tread surface of unloaded tire.

11. **Loaded Radius:** The distance from the wheel axle centerline to the supporting surface under a tire properly inflated for its load according to the load and inflation tables. (See Introduction for listing of application specified data books.)

12. **Tire Deflection:** Free radius minus the loaded radius.

13. **Revolutions Per Mile:** The measured number of revolutions for a tire traveling one mile. This can vary with speed, load, and inflation. Rolling circumference can be calculated from the revolutions per mile as follows:

$$\frac{63{,}360}{\text{Revs per Mile}} = \text{Rolling circumference in inches}$$

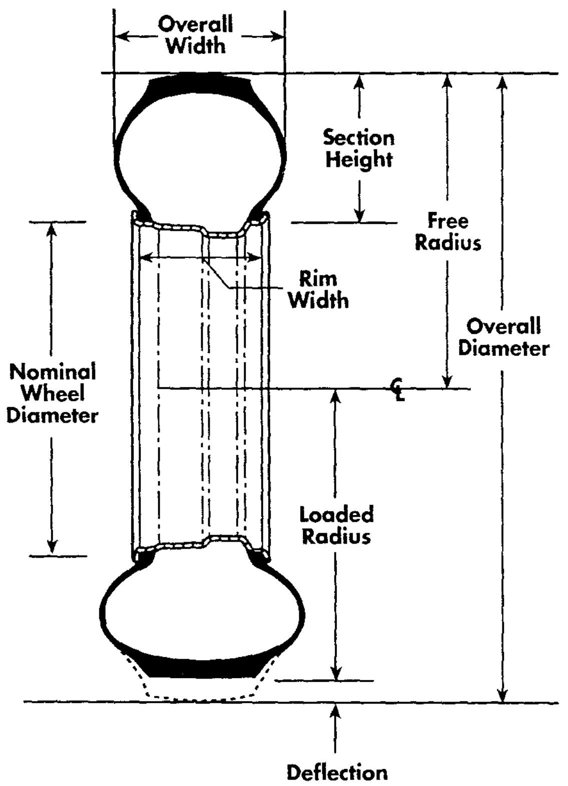


FIGURE 1

* ISO - International Standardization Organization

All the information required to determine the proper tire size is contained in the application specified data books. (See Introduction for listing.) A sample is shown below.

To select the proper tire size for a vehicle, it is necessary to know the maximum axle loads that the tires will carry and the maximum continuous speed at which they will operate. The maximum load that a tire can carry is different if it is mounted in dual configuration rather than single. The allowable axle loads and the required inflation pressures to carry these loads are shown in the charts for both single and dual mountings. The maximum allowable speed is also indicated.

TIRE SPECIFICATIONS FOR WHEEL DIAMETER: 22.5

Size	Tread	Load Range	Loaded Radius in.	Loaded Radius mm	Overall Diameter in.	Overall Diameter mm	Overall Width in.	Overall Width mm	Approved Rims width	Approved Rims cont.	Min. Dual Spacing in.	Min. Dual Spacing mm	App. Flaps	App. Tubes	Revs Per Mile	Tread Depth 32nds
275/80R22.5	[illegible]	G	18.7	475	40.1	1019	10.9	277	8.25		12.3	312		TBLS	516	18
									7.50							

Size	INFLATION PRESSURE (psi and kPa) LOADS PER AXLE (lbs. and kg.) AT DIFFERENT PRESSURES 2 TIRES: Single (S) 4 Tires: Dual (D)										Max. Speed
275/80R22.5	psi		70	75	80	85	90	95	100		mph
	lbs.	S	9120	9650	10180	10730	11250	11840	12350		65
		D	16450	17400	18350	19330	20280	21340	22700		
	kPa		480	520	550	590	620	660	690		kph
	kg.	S	4137	4377	4618	4867	5103	5371	5602		105
		D	7462	7893	8324	8768	9199	9680	10297		

Note: Rim listed [illegible] s the measuring rim.

LOADS PER AXLE AND INFLATION PRESSURES

The carrying capacity of each tire size is tabulated for various inflation pressures by axle load for single applications (2 tires) and dual applications (4 tires). Due to the effects of bouncing and crowned roads, the four tires in dual may not equally share the axle load. Therefore, to protect the tire carrying the largest share of the load, the capacity for duals is not twice the capacity for a single formation but is usually between 5 and 13% less depending on tire size.

All trucks should be weighed, fully loaded, on a scale. Each axle, front and rear, must be weighed separately. Actual gross axle weights should be compared with the load inflation tables to determine the inflation pressure required. The load carried by each individual front axle tire should be noted.

If the maximum load-carrying capacity of the tire is below the actual scale weight, greater carrying capacity tires should be used. This means either a tire with a higher load range or ply rating, or a larger tire size.

MAXIMUM SPEED RESTRICTIONS

Truck tires should normally be inflated according to the specification tables. The carrying capacities and inflation pressures specified in these tables are determined with the tire's rated maximum speed in consideration (see specifications tables for each tire's rated speed).

The carrying capacity can be increased by reducing the maximum speed at which the tire will operate and adjusting inflation pressures according to the information contained in the following chart. To use the chart, multiply the load and pressure values taken from the specifications section by the appropriate load and pressure coefficients given in the chart. Note that the coefficients to be applied are dependent on the tire's rated maximum speed and on the speed at which the tire will be used. Give special attention to rim/wheel or vehicle axle ratings that may be exceeded by the increased load and pressure.

The following coefficients may be used by the vehicle manufacturer in determining the maximum gross axle weight rating, bearing in mind rim or wheel and other component limitations. For existing vehicles or for speeds less than 20 mph (32 kph), please consult Michelin Tire Corporation.

These limits apply only to Light Truck and Truck tires, but do not include Special Application tires, tires for high cube vans and low bed trailers.

STATIC AND LOW SPEED LOAD AND PRESSURE COEFFICIENTS

WARNING **Do not exceed loads or air pressure limits of the wheel or rim without permission of the component manufacturer.**

Speed (mph)	Speed (kph)	Tires with Max. Speed of 65 mph (105 kph)		Tires with Max Speed of 55 mph (90 kph)		Tires with Max. Speed of 40 mph (65 kph)	
		Load	Pressure	Load	Pressure	Load	Pressure
75	120	.91	1				
70	113	.96	1				
65	105	.99	1				
60	97	1	1	.94	1		
55	89	1.03	1	.99	1		
50	80	1.04	1.02	1.02	1		
45	72	1.06	1.03	1.05	1.02		
40	65	1.08	1.04	1.08	1.04	1	1
35	56	1.11	1.06	1.11	1.07	1.05	1.03
30	48	1.13	1.08	1.13	1.08	1.11	1.07
25	40	1.15	1.10	1.15	1.10	1.15	1.10
20	32	1.23	1.12	1.23	1.12	1.23	1.12
15	24	1.39	1.18	1.39	1.18	1.39	1.18
10	16	1.60	1.24	1.60	1.24	1.60	1.24
5	8	1.90	1.33	1.90	1.33	1.90	1.33
0	0	2.50	1.40	2.50	1.40	2.50	1.40

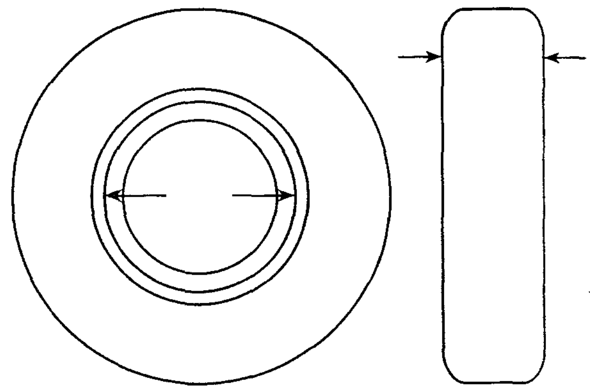
RIMS, TUBES AND FLAPS

The correct rims, tubes and flaps for each tire size are indicated in the specifications tables. For complete tire specifications, refer to application specified data books. (See Introduction for listing.)

MICHELIN TRUCK TIRE SIZE MARKINGS

Most truck tire sizes are indicated by the section width in inches, followed by R for radial, followed by the rim or wheel diameter in inches:

TUBE -TYPE	**TUBELESS**
10.00R20	11R22.5
10.00 = nominal section in inches	11 = nominal section in inches

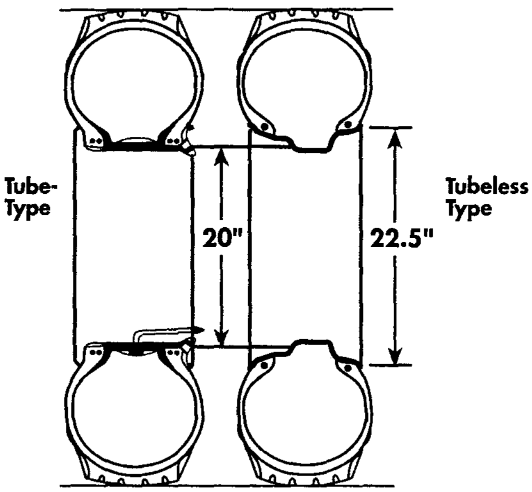


R= radial	R= radial
20 = rim or wheel diameter in inches	22.5 = rim or wheel diameter in inches

Note: A "rule-of-thumb" formula for finding equivalent tubeless sizes from tube-type. Take nominal section width and remove all figures after the decimal point. Add 1 to nominal section and add 2.5 to rim diameter.

Example:	**TUBE -TYPE**		**TUBELESS**
	8.25R20	=	9R22.5
Nom. Cross Section	8.25		9
Remove	.25		
Add	1 to 8	=	9
Rim Diameter	20		
Add 2.5 to Rim Diam.	20 + 2.5	=	22.5

Thus we have 9R22.5 Tubeless.



EQUIVALENT SIZES

TUBE -TYPE	TUBELESS TYPE
8.25R15	9R17.5
8.25R20	9R22.5
9.00R20	10R22.5
10.00R20	11R22.5
11.00R20	12R22.5
10.00R22	11R24.5
11.00R22	12R24.5

MICHELIN "X" LOW-PROFILE PILOT TRUCK TIRES

The Pilot tire is marked in accordance with the ISO (International Standardization Organization) system and contains load indices which indicate the load capacity of the tire in single and in dual usage.

Example: 275/80R24.5 Pilot 144/141K

275 = nominal cross section in mm (metric)
80 = aspect ratio
R = radial
24.5 = rim or wheel diameter in inches
144 = load index in single mounting
141 = load index in dual mounting
K = speed code indicating maximum speed of the tire

Michelin introduced the Pilot "X" low-profile radial truck tire for long haul in 1979 to meet the needs of America's trucks and trailers. The Michelin Pilot "X" low-profile radial truck tire has established new standards for America's tires for the 90's.

Compared to standard radial tires, the Pilot "X" can offer:

- Longer original tread mileage
- Greater casing life
- Lower weight for increased payloads
- Lower height for greater clearance on trailers and/or greater cargo space with a newly designed trailer
- Excellent traction, handling and stability.

EQUIVALENT LOW-PROFILE SIZES

MICHELIN	T&RA
235/80R22.5	245/75R22.5
255/80R22.5	265/75R22.5
275/80R22.5	295/75R22.5
275/80R24.5	285/75R24.5

REGROOVING

Only Michelin "X" truck tires which are marked "REGROOVABLE" on the sidewall may be regrooved. After regrooving, you must have at least 3/32" of under tread covering the top ply. If steel is exposed the tire must be scrapped or retreaded.

It is the responsibility of the regroover to assure that all Federal Regulations are met.

TRUCK TYPE BY WEIGHT CLASS

CLASS 1 6,000 lbs. GVW and less	CLASS 2 6,001 to 10,000 lbs. GVW	CLASS 3 10,001 to 14,000 lbs. GVW	CLASS 4 14,001 to 16,000 lbs. GVW	CLASS 5 16,001 to 19,500 lbs. GVW
MILK/BREAD	MILK/BREAD	MILK/BREAD	CONVENTIONAL VAN	RACK
UTILITY VAN	UTILITY VAN	COMPACT VAN	LARGE WALK-IN	LARGE WALK-IN
PICK-UP	PICK-UP	WALK-IN		BUCKET
COMPACT VAN	COMPACT VAN			TREE SPECIALIST
WALK-IN	WALK-IN			BOTTLED GAS
MULTI-PURPOSE	MULTI-PURPOSE			
CREW COMPARTMENT PICK-UP	CREW COMPARTMENT PICK-UP			
PANEL	MINI			

TRUCK TYPE BY WEIGHT CLASS

CLASS 6 19,501 to 26,000 lbs. GVW	CLASS 7 26,001 to 33,000 lbs. GVW	CLASS 8 33,001 lbs. and over	TRAILER Weight: Not specified	NOTES
TOW	HOME FUEL	FUEL	VAN	**GVW** = Gross Vehicle Weight. The total weight of the loaded vehicle includes chassis, body and payload. **GCW** = Gross Combination Weight. Total weight of loaded tractor-trailer combination includes tractor-trailer and payloads. Apparently identical vehicles appear in different vehicle weight classes. This is because of a difference in the components installed in each vehicle such as engines, transmissions, rear axles and even tires that are not readily discernible in the external appearance of those particular vehicles.
FURNITURE	TRASH	DUMP	DOUBLES	
STAKE	FIRE ENGINE	CEMENT	LIQUID TANK	
COE VAN	SIGHTSEEING	REEFER	DRY BULK	
SCHOOL	TRANSIT	TANDEM AXLE VAN	LOGGER	
SINGLE AXLE VAN		INTERCITY	PLATFORM	
BOTTLER	GCW TO 65,000	GVC TO 80,000	DROP FRAME	
LOW PROFILE COE	MEDIUM CONVENTIONAL	LOW PROFILE TANDEM COE	DUMP	
	HIGH PROFILE COE	HEAVY CONVENTIONAL	REEFER	
		HEAVY TANDEM CONVENTIONAL	DEEP DROP	
		COE SLEEPER	AUTO TRANSPORTER	

Section Two

MOUNTING THE TIRE

MICHELIN®

WARNINGS!

WARNING Tire and rim servicing can be dangerous and must be done only by trained personnel using proper tools and procedures. Failure to read and comply with all procedures may result in serious injury or death to you or others.

WARNING Re-inflation of any type of tire/rim assembly that has been operated in a run-flat or underinflated condition (80% or less of recommended pressure), can result in serious injury or death. The tire may be damaged on the inside and can explode while you are adding air. The rim parts may be worn, damaged or dislodged and can explosively separate.

WARNING Use of starting fluid, ether, gasoline of any other flammable material to lubricate, seal or seat the beads of a tubeless tire can cause the tire to explode or can cause the explosive separation of the tire/rim assembly resulting in serious injury or death. The use of any flammable material during tire servicing is absolutely prohibited.

WARNING Any inflated tire mounted on a rim contains explosive energy. The use of damaged, mismatched or improperly assembled tire/rim parts can cause the assembly to burst apart with explosive force. If you are struck by an exploding tire, rim part or the air blast, you can be seriously injured or killed.

WARNING Re-assembly and inflation of mismatched parts can result in serious injury or death. Just because parts come in together does not mean that they belong together. Check for proper matching of all rim parts before putting any parts together.

WARNING Mismatching tire and rim diameters is dangerous. A mismatched tire and rim assembly may explode and can result in serious injury or death. This warning applies to any combination of mismatched components, such as 14" and 14.5" or 16" and 16.5" tires and rim combinations. Never assemble a tire and rim unless you have positively identified and correctly matched the parts.

MOUNTING THE TIRE

FITTING TIRES — NOT ORIGINAL EQUIPMENT SIZES

When fitting tires of sizes different than those specified by the vehicle manufacturer, the following points must be considered:

1. **GEAR RATIO:**

   The effect of tire size change on gear ratio should be considered in individual operations:

   - A decrease in tire radius will increase startability (tractive force) and decrease geared and indicated top speed.
   - An increase in tire radius will reduce tractive force and increase top geared speed.

2. **WHEEL DIAMETER:**

   If a smaller wheel diameter is chosen, make sure that brake clearances are checked before making a recommendation.

3. **RIM WIDTH:**

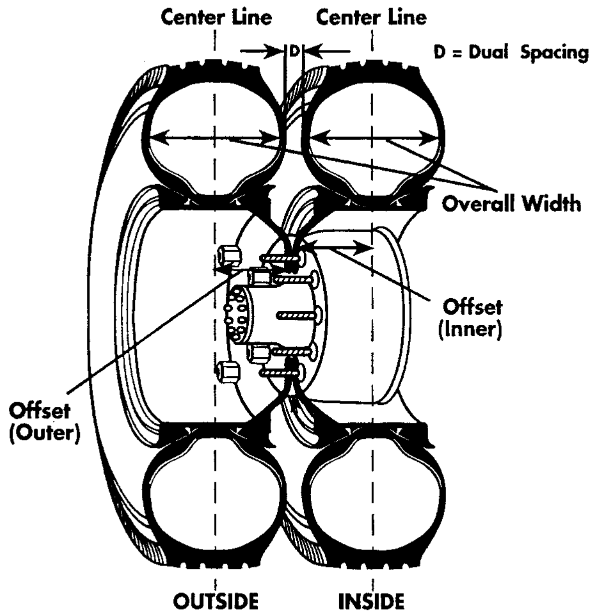
   An increase in the tire section may require a wider rim with a greater offset.

4. **OFFSET for dual wheels:**

   The minimum offset required is determined by the distance that must be left between the dual tires.

   OFFSET for front wheels:

   Wider rims may require a different offset to avoid interference with vehicle parts.



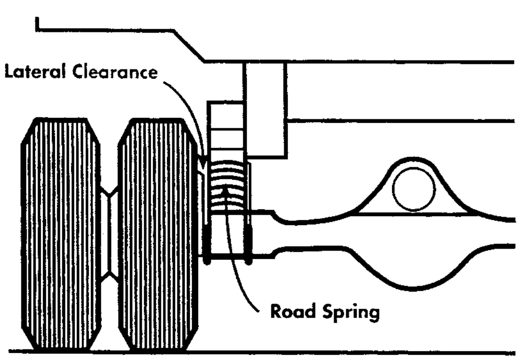
5. **TIRE CLEARANCES:**

All clearances around a tire should be checked:
- To the nearest fixed part of the vehicle, i.e., to parts which are not affected by spring deflection or steering mechanism.
- To the nearest part of the vehicle which can be moved, i.e., parts which are affected by spring deflection or steering mechanism.

Minimum clearances permissible:
- To a fixed part 15mm (⅝")
- To a moveable part 25mm (1")

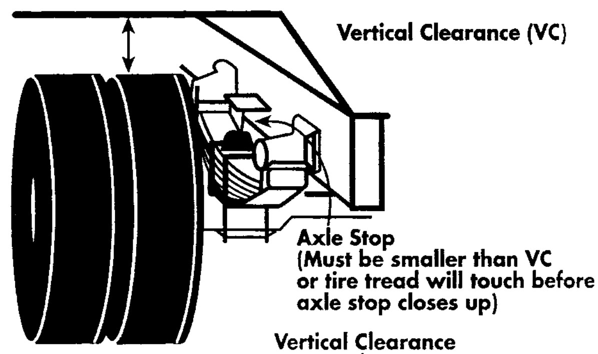
(a) Lateral Clearances

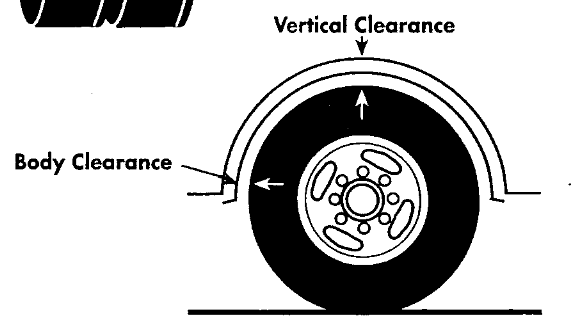
Lateral clearance is the smallest distance laterally between the tire and the nearest fixed point of the vehicle. **Lateral clearance will be reduced by an increase in the offset of the inner wheel** plus half any increase in the tire section.



(b) Vertical Clearances

A certain vertical clearance exists between the top of the tread and some part of the vehicle immediately above it, usually a fender. This will vary as the springs operate. The vertical movements of the whole axle, in relation to the whole chassis, are normally limited by an axle stop. When measuring vertical clearance, also measure the axle stop clearance; **the difference is the remaining vertical clearance.** When checking vertical clearance, consideration must be given to the degree of tread wear and an allowance of 1" must be made if the tread on the existing tire is between $\frac{2}{32}$" to $\frac{1}{32}$".



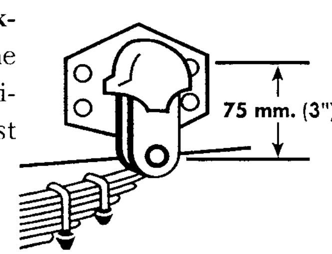


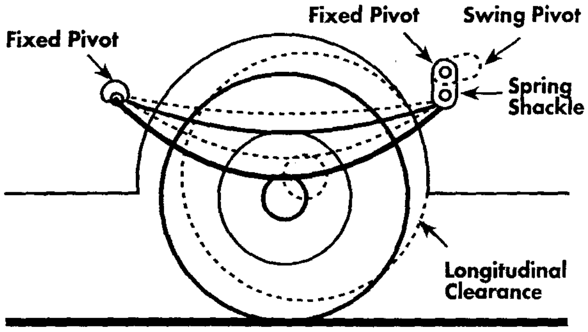
Vertical and body clearances are decreased by any increase in the free radius of the tire.

Check to be sure that the body clearance is not less than the vertical clearance. A fender bolt may be closer to the tire than the fender. This then is the smallest distance and should be recorded. (This may be corrected by reversing the bolt.)

(c) Longitudinal Clearances

The semi-elliptic spring method of suspension permits the axle to move back longitudinally as well as vertically when the spring deflects. As a guide, the maximum backward movement may be taken as **one third of the distance between the shackle pin centers**. The remaining longitudinal clearance must be noted.

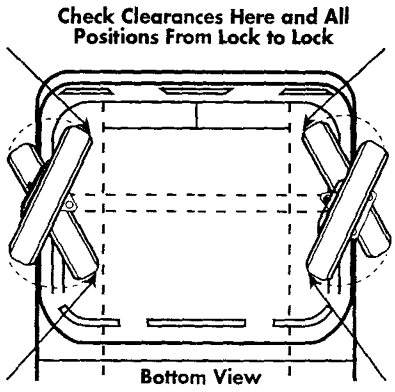




(d) Front Wheel Clearances

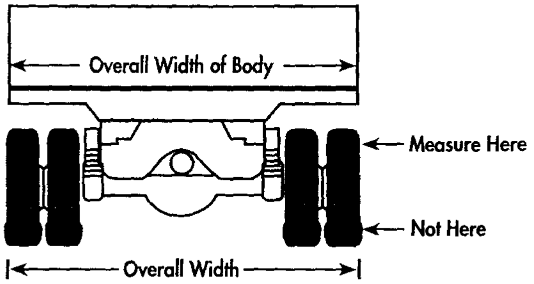
The clearances of **both front wheels must be measured** on both steering lock positions.

Clearances of front wheels must be checked turning wheels from full left lock to full right lock, since the minimum clearance might occur at some intermediate point.



6. **OVERALL WIDTH:**

When fitting larger tires, the overall width of the vehicle across the tires is increased by half of the increase in the cross section of each outside tire and the increase in offset of each outside wheel.



7. **SPARE WHEEL RACK:**

Always check the spare wheel rack to see that the tire will fit.

8. **LEGAL LIMITS:**

Most states have legal limits for vehicle carrying capacities, overall vehicle dimensions, and minimum ground clearances. Each of these factors must be taken into consideration.

MOUNTING AND DEMOUNTING PROCEDURES

A tire cannot perform properly unless it is mounted properly on the correct size rim or wheel. The following are general instructions for demounting and mounting Michelin tube-type and tubeless tires. For detailed instructions on mounting and demounting truck tires on particular types of rims and wheels, refer to the instructions of the rim and wheel manufacturer or the RMA wall charts.

1. **SELECTION OF PROPER COMPONENTS AND MATERIALS:**

a. All tires must be mounted with the proper Michelin tube and flap (if required) and rim or wheel as indicated in the application data books.

b. **Make certain that rim/wheel components are properly matched and of the correct dimensions for the tire.**

c. **Always fit a new Michelin tube in a new mounting.** Since a tube will exhibit growth in size through normal use, an old tube used in a new mounting increases the possibility of tube creasing and chafing, possibly resulting in failure.

d. **Always install a new flap in a new mounting.** A flap through extended use becomes hard and brittle. After a limited time, it will develop a set to match the tire and rim in which it is fitted. Therefore, it will not exactly match a new tire/rim combination.

e. **Always install new valve cores, and metal or hard plastic valve caps containing plastic or rubber seals.** On tubeless truck tire valves, replace the rubber grommet. For tires requiring 'O' Rings, be sure to install a new one at every tire change.

f. **Always use a safety device such as an inflation cage** or other OSHA approved device when inflating. Never stand over a tire or in front of a tire when inflating. Always use a clip on valve chuck and stand to the side when inflating.

2. TIRE AND RIM LUBRICATION:

It is essential that an approved vegetable oil base soap solution tire lubricant be used for mounting of tubeless and tube-type tires. The lubricant serves the following three purposes:

- Minimizes the possibility of damage to the tire beads from the mounting tools.
- Eases the insertion of the tire onto the rim by lubricating all contacting surfaces.
- Assists proper bead seating (tire/rim centering) and helps to prevent eccentric mountings.

A. **TUBELESS TIRES** - Apply lubricant to all surfaces of the bead area of the tire. When applying lubricant to the rim. lubricate the entire rim surface from flange to flange.

B. **TUBE-TYPE TIRES** - Apply clean lubricant to all portions of the tire bead area and the exposed portion of the flap using sufficient but sparing quantities of lubricant. Also lubricate the entire rim surface. Avoid using excessive amounts of lubricant which can become trapped between the tire and tube and can result in tube damage and rapid air loss.

CAUTION: It is important that tire lubricant be clean and free of dirt, sand, metal shavings or other hard particles. These particles may lodge between the tube and the flap edges resulting in splits in the tube. The following practice is recommended:

a. Use a fresh supply of tire lubricant each day drawing from a clean supply and placing the lubricant in a **clean** portable container.

b. Provide a cover for the portable container and/or other means to prevent contamination of the lubricant when not in use.

We suggest the following method, which has proven to be successful in minimizing contamination and preventing excess lubricant from entering the tire casing: Provide a special cover for the portable container which has a funnel-like device attached. The small opening of the funnel should be sized so that when a swab is inserted through the opening into the reserve of lubricant and then withdrawn, the swab is compressed, removing excess lubricant. This allows the cover to be left in place providing added protection. A mesh false bottom in the container is a further safeguard against contaminants. The tire should be mounted and inflated promptly before lubricant dries.

3. PREPARATION OF WHEELS, RIMS AND TIRES:

<u>Never weld or apply heat to a rim or wheel on which a tire is mounted.</u>

a. Always wear safety goggles or face shields when buffing or grinding rims or wheels.

b. Inspect wheel/rim assemblies for cracks, distortion, deformation of flanges, side rings, lock rings, etc. Using a file and/or emery cloth, smooth all burrs, welds, dents, etc. that are present on the tire side of the rim. Inspect the condition of bolt holes on the wheels.

c. Remove rust with a wire brush and apply a rust inhibiting paint.

d. Remove any accumulation of rubber or grease which might be stuck to the tire, being careful not to damage it. Wipe the beads down with a dry rag.

TUBE-TYPE TIRE MOUNTING/DEMOUNTING

WARNING

Any inflated tire mounted on a rim contains explosive energy. The use of damaged, mismatched or improperly assembled tire/rim parts can cause the assembly to burst apart with explosive force. If you are struck by an exploding tire, rim part or the air blast, you can be seriously injured or killed.

DEMOUNTING TUBE-TYPE TIRES

1. If a tire has been running underinflated or if any damage to the tire or wheel is suspected, the valve core should be removed prior to removing the tire/wheel assembly from the vehicle axle. This is to prevent a possible accident.
2. Before unlocking any side ring or lock ring, remove the valve core and allow the tire to deflate completely.
3. Remove all rim or wheel parts.

MOUNTING OF TUBE-TYPE TIRES

1. Insert the proper size Michelin tube into the tire and partially inflate (3 psi) to round out the tube (with larger sizes it may be necessary to use bead spreaders - see the next two sections for mounting instructions).
2. Insert the valve through the flap valve hole. (Make sure the reinforced patch which is directly over the flap valve hole is facing outwards. Then insert the remainder of the flap into the tire.
3. Check the flap wings to insure against folding. This is easily accomplished by placing your hand into one tire side, then the other, and then running your hand along the entire flap wing.
4. Inflate the tube until the flap is secured against the tire wall and the beads start to spread apart, making sure not to exceed 3 psi.
5. Apply a proper tire lubricant to both beads and the exposed flap. **Make sure that excess lubricant does not run down into the tire.**
6. Place tire, tube and flap on the wheel or rim, taking care to center the valve in the slot.
7. Fit side ring and lock ring, insuring that they are properly positioned, locked, and are correct for the 'fitment'.

MOUNTING OF TUBE-TYPE TIRES USING MANUAL SPREADERS:

1. Follow steps 1 through 3 of the "Mounting of Tube-Type Tires". However, before inserting the flap into the tire, position two bead spreaders in the following manner:
   a. Place the first at a 90° angle to the valve. (Flap is positioned between the spreader and the tube.)
   b. Place the second directly opposite the first.
   c. Spread the beads and insert the flap.
   d. Close the beads, remove spreaders.
2. Follow steps 4 through 7 of the "Mounting of Tube-Type Tires".

MOUNTING OF TUBE-TYPE TIRES USING AUTOMATIC SPREADERS:

1. Spread the tire beads.
2. Inflate the tube to approximately 3 psi.
3. Insert the tube into the tire. Apply a proper tire lubricant to the inside and outside surfaces of both beads and to that portion of the tube that appears between the beads. **Make sure that excess lubricant does not run down into the tire.**
4. Insert the valve through the flap valve hole. (As mentioned, the flap reinforced valve area must face outwards.) Insert the remainder of the flap into the tire.
5. Close the beads.
6. Follow steps 4 through 7 of the "Mounting of Tube-Type Tires".

INFLATION OF TUBE-TYPE TIRES

1. An air line with an extension (30" minimum), in-line gauge, and a clip-on valve chuck should be used for inflation. Remove valve core and lay the assembly flat on the ground. Using an OSHA approved restraining device, inflate partially to seat beads. While the tire is still in the restraining device, make sure all rim components are centered and locked properly. If not, the tire must be deflated, broken down, relubricated and reinflated.
2. Deflate the tire by removing the air line. This is to allow the tube to relax thus eliminating any wrinkles or uneven stretching that may have occurred during primary inflation.
3. Install the valve core and, using a safety cage, or other OSHA approved restraining device, reinflate the tire to the pressure shown on the sidewall in order to insure proper bead seating. Then adjust the tire to the proper operating pressure.
4. Reinspect the assembly for proper positioning of all components.
5. Check for leaks and install a suitable valve cap.
6. **Do not reinflate any tires that have been run underinflated or flat without careful inspection for damage.**

TUBELESS TIRE MOUNTING/DEMOUNTING

WARNING **Re-inflation of any type of tire/rim assembly that has been operated in a run-flat or underinflated condition (80% or less of recommended pressure), can result in serious injury or death. The tire may be damaged on the inside and can explode while you are adding air. The rim parts may be worn, damaged or dislodged and can explosively separate.**

DEMOUNTING OF TUBELESS TIRES

1. Before loosening any nuts, deflate the tire by removing the valve core.
2. With the tire assembly lying flat, break the bead seat of both beads with a bead breaking tool. Do not use hammers of any type.
3. Apply a proper tire lubricant to the tire beads, rim ledges and flanges.
4. Beginning at the valve. remove the tire using tire irons designed for this purpose. Starting at the valve will minimize chances of damaging the bead. Make certain that the flange with the tapered ledge that has the shortest span to the drop center is facing up. Always attempt to keep the bead not being worked by the irons, in the full depth of the drop center cavity.

MOUNTING TUBELESS TIRES

1. Replace valve seals and inspect valve stem for damage and wear. Replace valve stem if necessary.
2. Apply lubricant according to instructions on page 17.
3. With the short ledge up. lay the tire over the rim at the valve side and work it on with proper tubeless tire tools, making full use of the drop center well.
4. Do not use any kind of hammer. Bead damage may occur leading to tire destruction.

INFLATION OF TUBELESS TIRES

WARNING **Re-inflation of any type of tire/rim assembly that has been operated in a run-flat or underinflated condition (80% or less of recommended pressure), can result in serious injury or death. The tire may be damaged on the inside and can explode while you are adding air. The rim parts may be worn, damaged or dislodged and can explosively separate.**

1. Lay tire/wheel assembly horizontally and inflate to no more than 5 psi to position the beads on the flanges.
2. To complete the seating of the beads, place the assembly in an OSHA approved safety cage and inflate to 20 psi. Check the assembly carefully for any signs of distortion or irregularities from run flat.
3. If no damage is detected, continue to inflate to the maximum air pressure marked on the sidewall.
4. If beads do not seat, deflate tire, relubricate the bead seats and reinflate.
5. After beads are properly seated, adjust tire pressure to recommended operating pressure. Check valve core for leakage, then install suitable valve cap.

Never inflate or reinflate any tires that have been run underinflated or flat without careful inspection for damage, inside and out.

MOUNTING THE ASSEMBLY ON THE VEHICLE

When wheel assemblies are mounted on a vehicle, be sure that the valves do not touch the brake drums or any mechanical part of the vehicle.

Valves of dual tires should be diametrically opposite. Ensure that the inside valve is accessible in order that the air pressure can be checked and the tire inflated when necessary.

Tires mounted in duals must be matched so that the maximum difference between the diameters of the tires does not exceed ¼" or a circumferential difference of ¾". Failure to properly match dual tires will result in the tire with the larger diameter carrying a disproportionate share of the load. Mismatched duals can lead to rapid wear and excessive fatigue.

DUAL SPACING

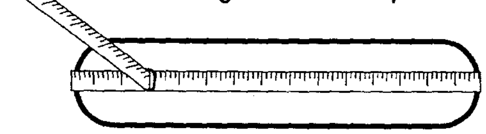
It is also important that sufficient space is provided between dual tires to allow air to flow and cool the tires and to prevent the tires from rubbing against one another.

To make sure dual spacing is correct, simply measure the two tires from center to center of the tread, and refer to the minimum dual spacing column in the application data books.

MEASURING TIRES IN DUAL ASSEMBLY

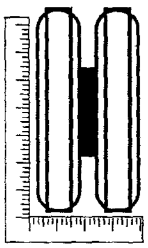
Measuring the circumferences of the tires with an endless tape after they are on the rims and inflated, but before they are applied to a vehicle, is the most accurate method. The endless tape, as the name signifies, is a tape made of ½" bending steel, one end of which passes through a slot at the other end of the tape and forms a loop. Measuring in this manner takes into account any irregularities in wear.

Measuring with Endless Tape

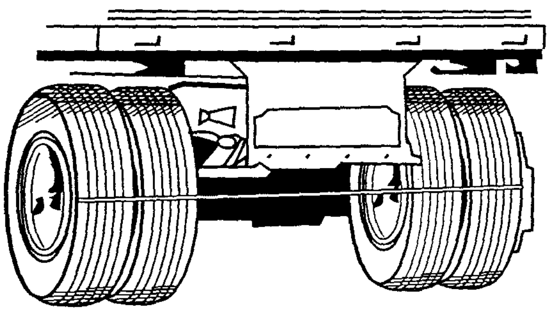


In checking tires already on a vehicle, either (a) a square (similar to but larger than a carpenter's square), (b) a string gauge, (c) a large pair of calipers, or (d) a wooden straight edge long enough to lie across the treads of all four tires, may be used.

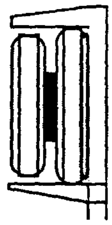
A) Use of a Square



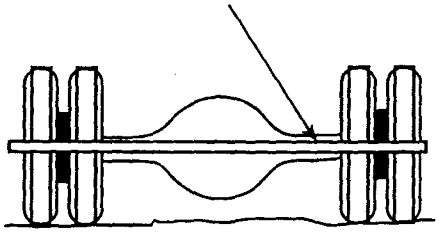
B) Use of String Gauge



C) Use of the Calipers



D) Use of a Wooden Straight Edge



MATCHING TIRES ON TANDEM AXLES

Tandem drive rear axles without an inter-axle differential necessitate that the eight tires be matched so that the average tire circumference on the one axle is within ¾" of the average tire circumference on the other axle.

Since any one tire of the size used with these axles may lose as much as 2½" in circumference due to normal wear and still be serviceable, it is readily seen that a wide difference in tire circumference may exist.

The best method of avoiding damage due to having tires of unequal circumferences is to inspect and match tires so that the average tire diameter on one axle is within ¼" of the average tire diameter on the other axle. Equal tire inflation at the pressures recommended by the tire manufacturer should be maintained.

TIRE MIXING

IMPROPER TIRE MIXING CAN BE DANGEROUS

Four Wheel Trucks: The Michelin "X" is a radial tire and for best performance it is recommended that the same size and type of tire be used on all four wheel positions. If only two Michelin "X" radials are mounted with two non-radials, the radials should be mounted on the rear. If tires of different types are mixed on a vehicle in any configuration, they should not be used for long periods and speeds should be kept to a minimum.

Mixing or matching of tires on 4-wheel drive vehicles may require special precautions. Always check vehicle manufacturers' Owners Manual for their recommendations.

Truck with more than four wheel positions: For best performance, it is recommended that radial and non-radial tires not be mixed in dual fitment.

Section Three

EXTENDING TIRE LIFE

Once the tires have been put into operation, it is important that they and the vehicle be properly maintained in order to obtain the maximum performance for which the tires have been designed.

MICHELIN

MAINTAINING THE TIRE

INFLATION PRESSURE

The most critical factor in tire maintenance is proper inflation. No tire or tube is completely impervious to loss of air pressure. To avoid the hazards of underinflation, lost air must be replaced.

Driving on any tire that does not have the correct inflation pressure is dangerous and will cause tire damage.

Any underinflated tire builds up excessive heat that may result in sudden tire destruction. The correct inflation pressures for your tires are a function of many factors including: load, speed, road surface and handling.

Consult a Michelin Truck Tire dealer or Michelin data books for the proper inflation pressures for your application. See the Introduction for complete listings of the Michelin data books.

Check inflation pressures on all your tires at least once a week, including spares, before driving when tires are cold, especially when vehicle is used by more than one driver.

Failure to maintain correct inflation pressure may result in sudden tire destruction, improper vehicle handling, possibly resulting in accident, and may cause rapid and irregular tire wear. Therefore, inflation pressures should be checked weekly and always before long distance trips.

Pressures should be checked when tires are cold; in other words, before they have been driven. The ideal time to check tire pressures is early morning. Driving, even for a short distance, causes tires to heat up and air pressures to increase.

Never bleed air from hot tires as your tires will then be underinflated. Make sure to check both tires in a dual fitment. Pressures should be the same.

Use an accurate tire gauge to check pressures. (Do not use "Tire Billys" to hit tires as an inflation check. This is an unreliable method.)

For optimum tire performance, it is usually best to use the tire inflation pressure shown in the application data books for the particular axle load. Exceeding this pressure could result in reduced traction and tread life.

However, for steering axle tires, it is often desirous to use inflation pressures greater than that shown in the application data books for the particular axle load. For example, to minimize irregular wear or to make steering easier, it is acceptable to increase the inflation pressure to a maximum of 20 psi above the value in the application data books. However, when operating the tire at maximum rated load never exceed the maximum sidewall specified pressure by more than 10% unless technical approval is obtained from Michelin Tire Corporation.

Following are two examples of applying the previous considerations to an operation where the user mounts new 275/80R22.5 XZA-1+ tires on a steer axle and desires to increase the air pressure in order to see if this will help alleviate the occurrence of irregular wear.

Example 1: If the axle load is 10,180 lbs., then the table in the data book specifies a corresponding pressure of 80 psi. So, the user can increase the pressure 15-20 psi above that to 95 or 100 psi.

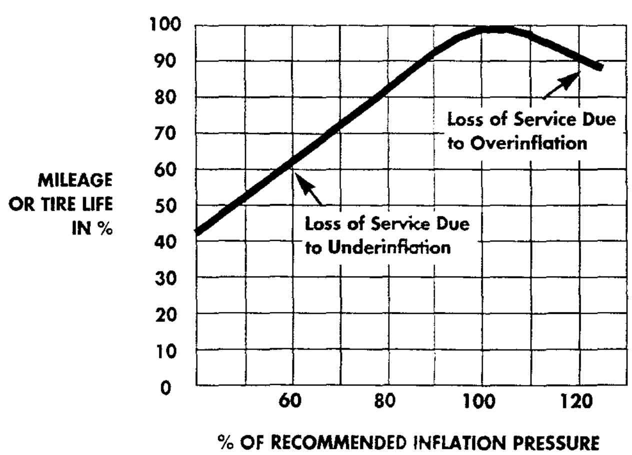
Example 2: If the axle load is 12,350 lbs., then the table in the data book recommends 100 psi. As this is the maximum load of the tire, only a 10% pressure increase is permitted. Thus the adjusted pressure would only be 110 psi.

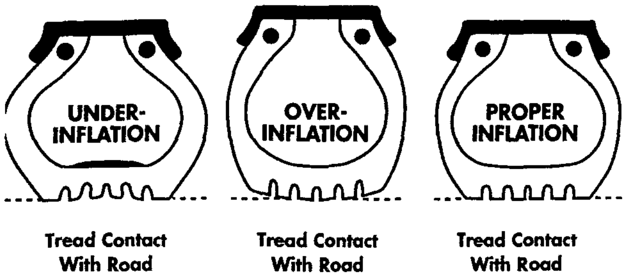
This procedure should not be applied "across the board". If you are getting satisfactory tire performance and wear with "table" pressures for a given load, then leave well enough alone.

Overinflation can increase road shocks and vibrations transmitted to the vehicle.

NOTE: In no case should the maximum capacity of the wheel/rim be surpassed. Consult wheel/rim manufacturer's specifications.

EFFECTS OF INFLATION PRESSURE ON TIRE LIFE





UNDERINFLATION
Causes abnormal tire deflection, which builds up heat and causes irregular wear.

OVERINFLATION
Causes tires to run hard and be more vulnerable to impacts. It also causes irregular wear.

PROPER INFLATION
The correct profile for full contact with the road for traction, braking capability and safety.

TIRE INSPECTION

While checking inflation pressures, it is a good time to **inspect your tires. Anytime you see any damage to your tires or wheels/rims, see any Michelin Truck Tire dealer at once.**

Before driving, inspect your tires, including the spare, and check your air pressures. If your pressure check indicates that one of your tires has lost pressure of 4 psi or more, look for signs of penetrations, valve leakage, or wheel/rim damage that may account for air loss.

If the tire is 20% below the maintenance air pressure it must be considered flat. Remove and inspect for punctures or other damage.

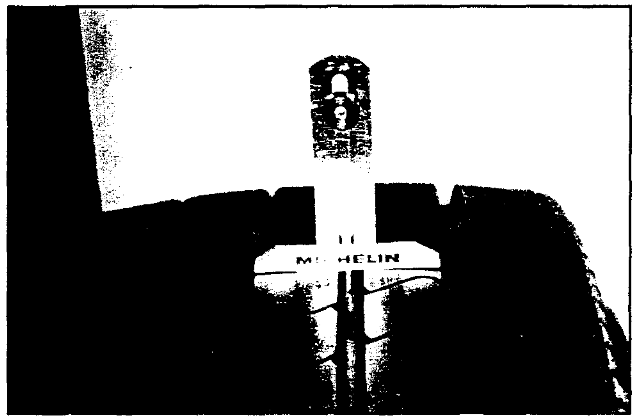
Always examine your tires for bulges, cracks, cuts or penetrations. If any such damage is found, the tire must be inspected by any Michelin Truck Tire dealer at once. Use of a damaged tire could result in tire destruction, property damage and personal injury.

DRIVE CAREFULLY

All tires will wear out faster when subjected to high speeds as well as hard cornering, rapid starts, sudden stops and frequent driving on surfaces which are in poor condition. Surfaces with holes and rocks or other objects can damage tires and cause vehicle misalignment. When you drive on such surfaces, drive on them carefully and slowly, and before driving at normal or highway speeds, examine your tires for any damage, such as cuts or penetrations.

TREAD DEPTH MEASUREMENTS

Tires should be measured for wear. This measurement can be taken in several spots across the tread and around the circumference. However, to calculate the remaining amount of rubber (knowing the new tire tread depth) for a given number of miles run, the measurement should always be taken at the same spot on the tread and as close to the center groove of the tire, as shown below:



WEAR BARS

Michelin "X" truck tires contain "wear-bars" in the grooves of the tire tread which show up when only $^{2}/_{32}$nds of an inch or less of tread is remaining. At this stage your tires must be removed. Tires worn beyond this stage are dangerous. (Federal law requires truck tires on front axles to have at least $^{4}/_{32}$nds of an inch tread depth.)

DO NOT OVERLOAD

The maximum load that can be put on a truck tire is dependent upon the speed at which the tire will be used. Consult a Michelin Truck Tire dealer or application data books for complete information on the allowable loads for your tires in your application. Tires which are loaded beyond their maximum allowable loads for the particular application will build up excessive heat that may result in sudden tire destruction, property damage and personal injury.

Do not exceed the gross axle weight ratings for any axle on your vehicle.

DRIVE AT PROPER SPEEDS

The maximum speed at which Michelin truck tires can be operated is indicated in the Michelin data books. See the Introduction for complete listings of the Michelin data books. This speed varies for each type of tire and depends on the type of application. Consult a Michelin Truck Tire dealer for assistance in determining the maximum speed for your application. Exceeding this maximum speed will cause the tire to build up excessive heat which can result in sudden tire destruction, property damage and personal injury. In any case, you should not exceed reasonable speeds indicated by the legal limits and driving conditions.

High speed driving can be dangerous and may be damaging to your tires.

When driving at highway speeds, correct inflation pressure is especially important. However, at these speeds, even with correct inflation pressures, a road hazard, for example, is more difficult to avoid. If contact is made, it has a greater chance of causing tire damage, than at a lower speed. Moreover, driving at high speed increases the time required to avoid accidents and bring your vehicle to a safe stop.

BALANCE AND RUNOUT

Under normal conditions, Michelin truck tires do not need to be balanced. Common practice is to check tire balance if a ride complaint is made by the driver. Before removing the tire-wheel assembly from the vehicle, check for radial and lateral runout. Excessive runouts can be caused by bent wheels and rims or improper mounting. If balance is still required, a simple static balance with bubble balancer or a wall mounted axle bearing and hub type gravity balancer should be sufficient.

Runout Limits:	RADIAL	LATERAL
Tire/Wheel Assembly	.125"	.125"
Wheel Only - Steel	.070"	.070"
Aluminum	.030"	.030"

Balance Limits:	STANDARD RIB	DEEP TRACTION LUG
20"/22.5"	120 in. oz.	180 in. oz.
22"/24.5"	130 in. oz.	200 in. oz.

ROTATION

Michelin "X" radial tires should be rotated only when necessary. If the tires are wearing evenly, there is no need to rotate. If irregular wear becomes apparent or if the wear rate on the tires is perceptively different (from axle to axle for drive tires and side to side for steer tires), then the tires should be rotated in such a manner as to alleviate the condition.

Rotation procedures such as those recommended by vehicle manufacturers may be followed.

Note: There is no restriction on criss-cross rotation.

STORAGE

All tires should be stored in a cool dry place indoors so that there is no danger of water collecting inside them. Serious problems can occur with tube-type tires when they are mounted with water trapped between the tire and tube. Due to pressurization, the liquid can pass through the inner liner and into the casing plies. This can result in sudden tire failure. Most of the problems of this nature have been due to improper storage which allowed water to enter the casing. This is a particular problem with tube-type tires because of the difficulty in detecting the water which collected between the tire and tube. When tires are stored, they should be stored in a cool place away from sources of heat and ozone such as hot pipes and electric motors. Be sure that surfaces on which tires are stored are clean and free from grease, gasoline or other substances which could deteriorate the rubber. **Tires exposed to or driven on these substances could be subject to sudden failure.**

CHAINS

In order to satisfy legal requirements in many states, the so called "chain laws" require the use of chains on truck tires. When the use of chains is required, the following recommendations should be followed:

1. Chains should only be utilized when necessary. The possibility of damage to the tire or the chain increases as driving speed and length of travel on the chains increases, and is especially increased

by use on dry pavement. As a general rule, chains should be utilized only as long as required, and vehicle speeds should be kept relatively low.

2. Since manufacturers have size recommendations for radial ply tires, no matter what type of "chain" they manufacture, these size recommendations must be adhered to for optimum utility and performance.
3. Always be sure to check for proper clearances between chain and vehicle.
4. Also follow closely the mounting instructions and procedures of the chain manufacturer.

RECOMMENDATIONS FOR THE USE OF DYNAMOMETERS

SEVERE DAMAGE can result in the crown area of radial truck tires when run on dynamometers for extended periods. Quite often the damage is internal and not discovered until after the vehicle has been put back in service.

In order to avoid the possibility of damaging radial "X" highway truck tires, adhere to the following time/speed restrictions and related test parameters: This applies to tire sizes with bead seat diameters of 19.5, 20, 22, 22.5, 24 and 24.5 inches.

NOTE: The times for the indicated speed in the chart are not additive.

	MAXIMUM TIME (MINUTES)	
Speed (mph)	On 8⅝" Dia. Rollers	On 18-20" Dia. Rollers
62 (Max.)	2.5	4
50	3.5	6
40	5	8.5
30	7.5	14
20	16	35
10	42	105

- Allow a two-hour cool-down between tests.
- These limits are for an empty vehicle with tire pressures as indicated on the tire sidewall for maximum load.
- Allow a one-hour cool-down after each test before loading vehicle.

The maximum allowable center to center distance between the two rollers in contact with a tire is a function of the sum of tire and roller diameter. This relationship is shown below:

$$\text{Maximum Roller Spacing} = \frac{\text{Tire Diameter} + \text{Roller Diameter}}{2} \times 1.15$$

For example:

	MAX. ROLLER SPACING	
Tire Size	8⅝" Dia.	18" Dia.
275/80R22.5	28"	33.4"
255/70R22.5	26"	31.4"

Note that in the above speed/time table a significant increase in time is allowed on the 18-20 inch versus the 8⅝ inch diameter roller. For example, at 30 mph time almost doubles from 7.5 minutes to 14 minutes.

WARNING

If these times and/or speeds are exceeded, irreversible internal damage in the tire could result, leading ultimately to tire destruction.

When it is anticipated that a test will exceed these time speed values, use "slave" tires (a tire used in place of the normal tire).

MAINTAINING THE VEHICLE

Many tire problems can be traced to mechanical conditions in the vehicle. Therefore, to obtain maximum tire performance, vehicles must be properly maintained.

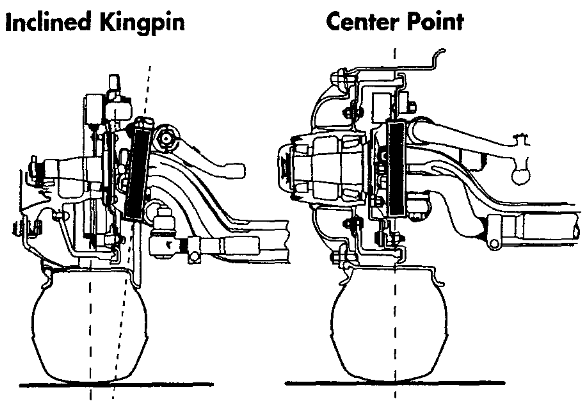
MAJOR VEHICLE FACTORS WHICH AFFECT TIRE LIFE:

ALIGNMENT

Alignment refers not only to the various angles of the steer axle geometry, but also to the tracking of all axles on a vehicle including the trailer. The dual purpose of proper alignment is to minimize tire wear and to maximize predictable vehicle handling and driver control. One of the challenges of meeting this goal is that alignments are typically performed on a static, unloaded vehicle sitting on a level floor. The vehicle then operates over varying contoured surfaces, under loaded conditions, with dynamic forces acting upon it. Predicting the amount of change between static/unloaded/level - versus - dynamic/loaded/contoured is difficult because many variables effect the amount of change. Variables such as Steering System Compliance (i.e. "play"), must be considered in making alignment setting recommendations. For this reason; there is no one static toe setting, that is the "best" for all vehicle configurations under all load conditions. It is sometimes necessary to modify static recommendations on a particular vehicle due to specific vehicle, load or usage conditions. The need for these modifications is "flagged" by observing tire wear and driver comments on handling.

STEER AXLE GEOMETRY

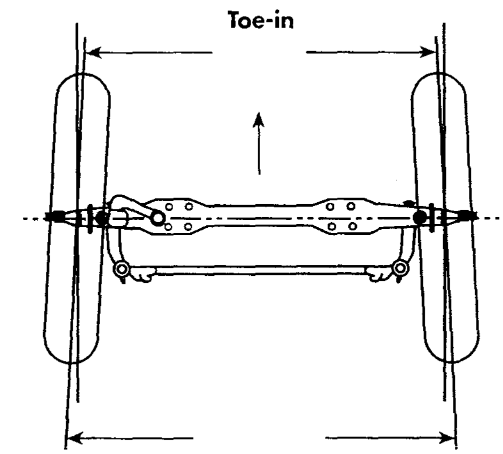
Since very few vehicles continue to use Center Point Steering, the following recommendations are based on the more common Inclined Kingpin Steer Axle Geometry.



TOE

Toe is typically the most critical alignment condition effecting steer axle tire wear. The purpose of setting toe at a given specification is to allow the tire to run straight during normal operating conditions. Too much toe-in results in scrubbing from the outside inward on both tires and too much toe-out results in scrubbing from the inside outward on both tires.

The toe measurement will probably change from unloaded to loaded conditions. The amount of change will vary with axle manufacturer, axle rating, and steering arm geometry; but it is still fairly predictable. The most popular Class 8, long haul 12,000 pound axles will change in the direction of toe-out about $\frac{1}{64}$" (.4mm) for each 1000 pounds of load increase on the steer axle. Cabover tractors with set-back-front-axles typically experience less steer axle change in load from bobtail to loaded than do other configurations. Wheelbase and fifth wheel location are also major factors effecting how much load change the steer axle will experience. A good prac-



tice is to measure vehicle toe both loaded and unloaded so that future settings can be made correctly on unloaded vehicles. Vehicles with identical "spec's" should be able to use the same setting once it is established. The recommended toe for the loaded condition is 1/32" (.8mm) toe-in. The 1/32" (.8mm) makes allowance for the toe-out effects of the dynamic forces the vehicle will encounter during operation.

The dynamic effects on toe are, unfortunately, less predictable; but are certain to occur. For vehicles with very little steering system compliance (i.e. "play") the recommended 1/32" (.8mm) toe-in is adequate and provides good tire wear. For vehicles with larger amounts of Steering System Compliance, more toe-in may be necessary so that a straight ahead tire position is reached in the dynamic condition. Large amounts of Steering System Compliance can exist on new vehicles as well as vehicles with considerable wear. Since compliance is difficult to predict, 1/32" (.8mm) is considered the best starting point for establishing a particular vehicle's toe spec. Actual tire wear may dictate that more toe-in is necessary for some vehicles.

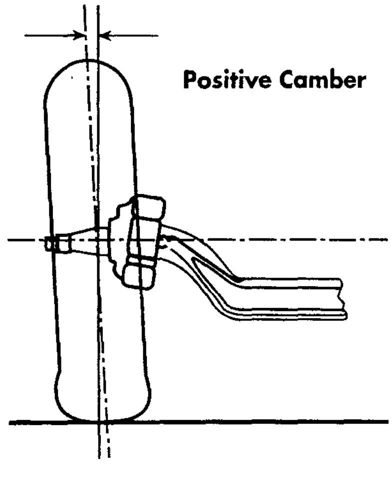
Toe can also be optimized for the camber on the particular axle in use. Both positive cambered axles and negative cambered axles are in wide use on heavy trucks. Tire wear on axles with positive camber (and minimal compliance) has been shown to be best with toe-in settings between 0 and 1/32" (.8mm). Tire wear on axles with negative camber (and minimal compliance) has been shown to be best with toe-in settings between 1/32" (.8mm) and 1/16" (1.6mm).

Toe Summary: 1/32" (.8mm) toe-in (loaded) is a good starting point for determining the best setting for a specific vehicle configuration. Actual tire wear results may dictate the need for more toe-in for some vehicles.

CAMBER

Steer axles with positive camber and steer axles with negative camber are both available on the market. Studies have shown that slightly negative camber reduces irregular tire wear and allows higher removal mileages. As discussed above, toe-in can be optimized for either positive or negative camber.

Camber adjustment by bending axles is **NOT RECOMMENDED** by Michelin. Consult the axle manufacturer if camber is found to be incorrect.

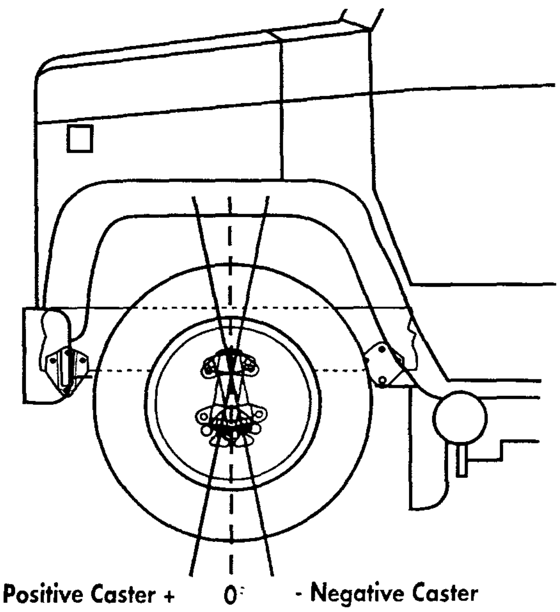


CASTER

Positive (+) caster is the backward tilt at the top of the kingpin when viewed from the side. Negative (-) caster is the forward tilt of the top at the kingpin when viewed from the side.

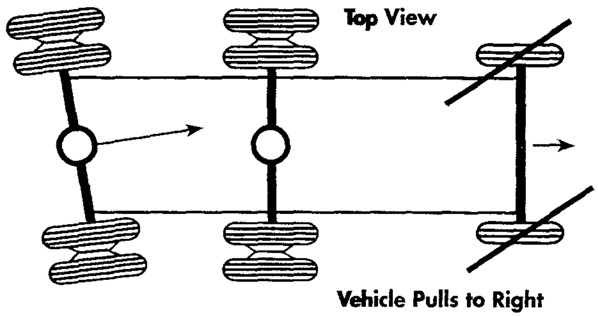
The purpose of caster is to provide self-aligning forces on the steer tires to stabilize the vehicle when driving straight down the road under braking, free wheeling, and power conditions.

Insufficient caster reduces stability and can cause wander. Excessive caster increases steering effort and can cause shimmy. Either of these conditions may also have a detrimental effect on tire wear. Caster is adjustable with shims. Adjusting only one side is not recommended. Both sides should be adjusted in 1/2 degree increments if required to improve handling. Caster on both sides should be equal or not more than 1/2 degree difference.



TANDEM AXLE PARALLELISM

Tandem axle parallelism is critical because it can have a detrimental effect on all ten tires on the tractor. Non-parallel drive axles tend to push the tractor into a turn in the direction that the axles ends are closest. In order for the vehicle to go straight the driver must correct by steering in the opposite direction. The vehicle can then go straight, but all ten tires are at an angle to the direction of travel which causes scrubbing. Excessive tandem axle non-parallelism is usually detected in steer tire wear. If one steer tire is scrubbing from the outside inward and the other steer tire is scrubbing from the inside outward, then tandem axle alignment is suspect.



ALIGNMENT RECOMMENDATIONS

Toe: 1/32" (.8mm) toe-in on loaded vehicle. Refer to the section on Toe (page 26).

Camber: Not adjustable. Settings for best wear: -1/4° to + 1/4° on loaded vehicle. Consult the axle manufacturer for specifications.

Caster: +2° to +4° Do not exceed recommedations without consulting OEM.

Tandem Axle Parallelism:
As close to 0 as possible. Do not exceed 1/8" (3mm) side to side difference.

TOE-OUT-ON-TURNS

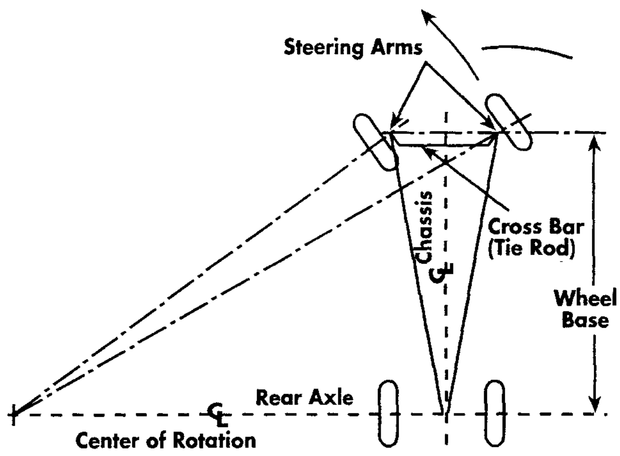
(TURNING RADIUS)

Toe-out-on-turns is the difference in the arcs described by the steering tires in a turn.

The purpose of toe-out-on-turns is to prevent the inside tire from scrubbing around a turn since the outside tire (loaded tire) determines the turning radius of the steer axle. This is accomplished by setting the steering axis (kingpin) and the tie rod end in the correct position. This is the Ackermann Principle.

Ackermann geometry is a compromise because it is designed for one turning radius and one wheel base. When the turning angle or wheel base changes, Ackermann provides only an approximation to minimize tire scrub.

Toe-out-on-turns is not adjustable but is measured and compared to the vehicle manufacturer's specifications to determine if a steering arm is damaged. This angle is more important on a city vehicle with its many turns than on a line haul unit.



Basic Ackermann Steering Diagram

PERIODIC ALIGNMENT CHECKS

An aggressive alignment preventative maintenance program should include the following periodic checks:

1. **Upon delivery of new vehicles.** Even though OEMs make a concerted effort to properly align vehicles at the factory, shifting and settling can occur during delivery. Camber and caster may not change much, but **Toe** and **Tandem Axle Parallelism** may change sufficiently to set up undesirable tire wear patterns if not corrected upon receipt.
2. **At the first maintenance check (between 10,000-20,000 miles).** If shifting and settling did not occur during delivery, it may occur during the first few thousand miles of operation.

Many OEMs recommend retorquing suspension/frame components after a few thousand miles of operation. A thorough alignment check should be made during this inspection (after the retorquing).

3. **When new steer tires are installed.** The steer tires coming out of service can tell a story of good or bad alignment. With this feedback an alignment program can continue to improve. Without feedback, the best an alignment program can do is stay at it's current level.

4. **When tire wear indicates a problem.** "Reading" tire wear can help identify alignment problems. Unfortunately, correcting the alignment does not necessarily correct the tire wear pattern once an undesirable wear pattern has been established.

ALIGNMENT EQUIPMENT

Alignment equipment exists that ranges from simple and inexpensive to sophisticated and costly. One factor that is common to all types of alignment equipment is that the person using it is extremely important to the resulting tire and vehicle performance! Some fleets have obtained excellent results with a good "scribe and trammel bar" and paying strict attention to **Toe** and **Axle Parallelism**. Other fleets establish permanent records, make adjustments more easily, have more information for troubleshooting, and obtain excellent results with the more expensive equipment. The common ground is that the person using the equipment understands it, uses it properly, and follows the procedures consistently.

Michelin developed the **Bib Alignment System** to provide a highly portable system that combines some of the best aspects of simplicity while still providing PC based adjustment calculations and a "print out" permanent record. The **Bib Alignment System** is an excellent tool for measuring and adjusting axle parallelism. It does not measure caster, camber or toe.

Heavy truck alignment has evolved to a precise science. The "field check" techniques may be used to detect a problem condition, but are **NOT RECOMMENDED** for making adjustments/corrections. Proper alignment equipment should be used.

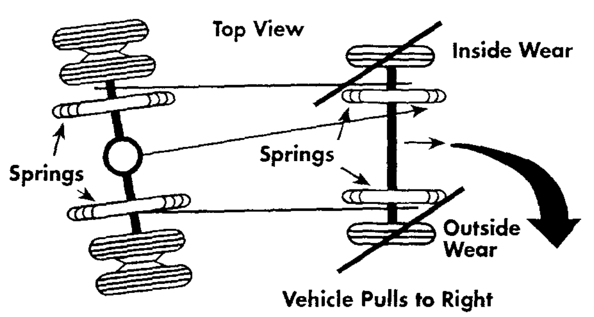
AXLE PARALLELISM AND TRACKING

In the straight-ahead position, the rear wheels of a vehicle should follow the front wheels in a parallel manner. Wheels that are out-of-track can cause excessive tire wear. Failure of the wheel to track is usually due to the following causes:

a. Master spring-leaf broken
b. Worn springs
c. Auxiliary leaves broken
d. Loose "U" bolts
e. Incorrect or reverse springs
f. Bent frame
g. Locating rods or torque rods improperly adjusted
h. Locating rod or torque rod bushings worn excessively

Failure of the wheels to track is usually quite visible when one follows the vehicle on the highway. It is possible that, due to one of the above causes, no uneven wear manifests itself on the rear tires but an uneven wear pattern may show itself on the front tires. This is because rear tires may push the vehicle off course and give some toe-out-on-turns in the straight-ahead position to the front tires. Hence, the driver makes a correction to offset the steering action caused by the rear wheels.

If the REAR axle of a vehicle is not at right angles to the chassis center line, the front tires are affected, showing misaligned wear. In the diagram below, the position of the rear axle of the vehicle has been altered because of a weakened left side spring - so that the rear axle on the left side is further from the front axle than the rear axle on the right side.



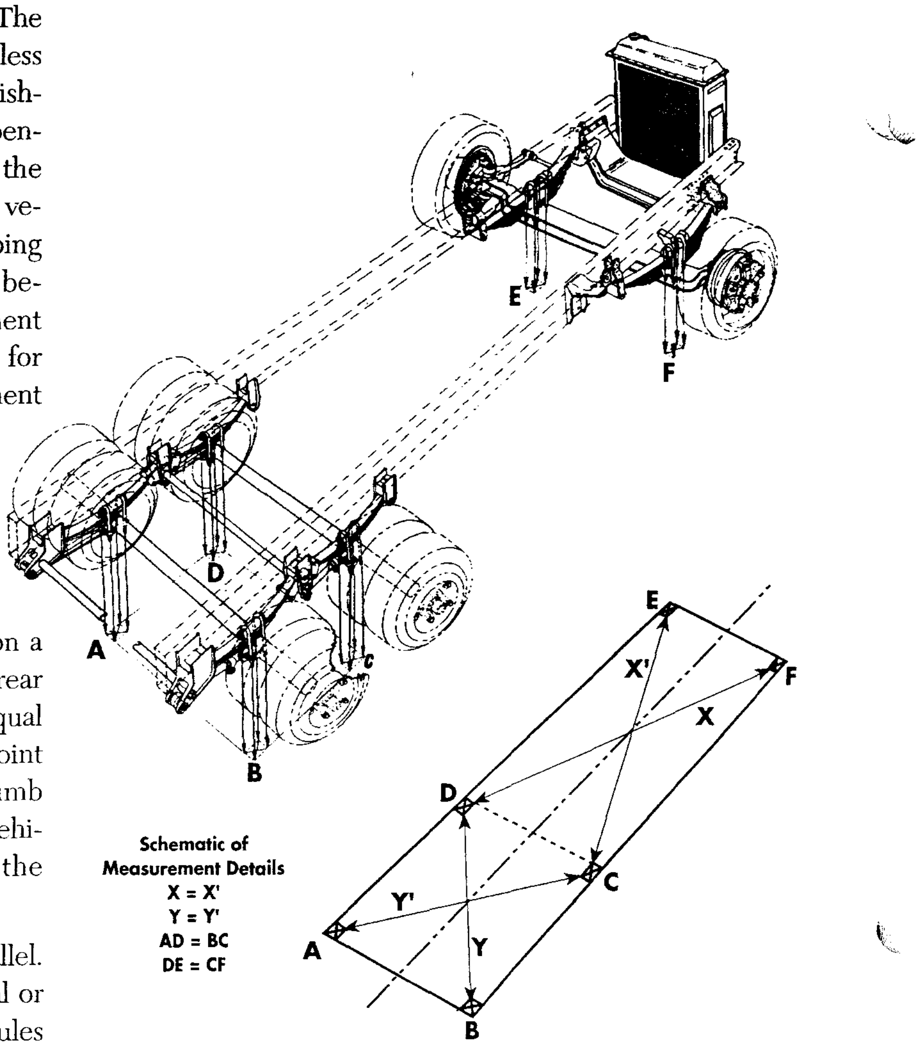
Toe-out on turns at these steer angles is not equal to zero.

In this diagram, the rear axle causes its wheels to point to the left side so that the rear end of the vehicle is, in fact, self-steered in that direction. The vehicle would then steer itself to the right - unless the driver takes corrective action. If the driver wishes to travel straight ahead, he will naturally compensate by turning his steering wheel. This action of the driver introduces toe-out-on-turns as though the vehicle were making a turn. The vehicle is not going around a turn; it is moving in a straight line - because the front wheels are toed-out. Misalignment wear patterns on the front tires may be apparent for this reason even though the front wheel alignment settings may be correct.

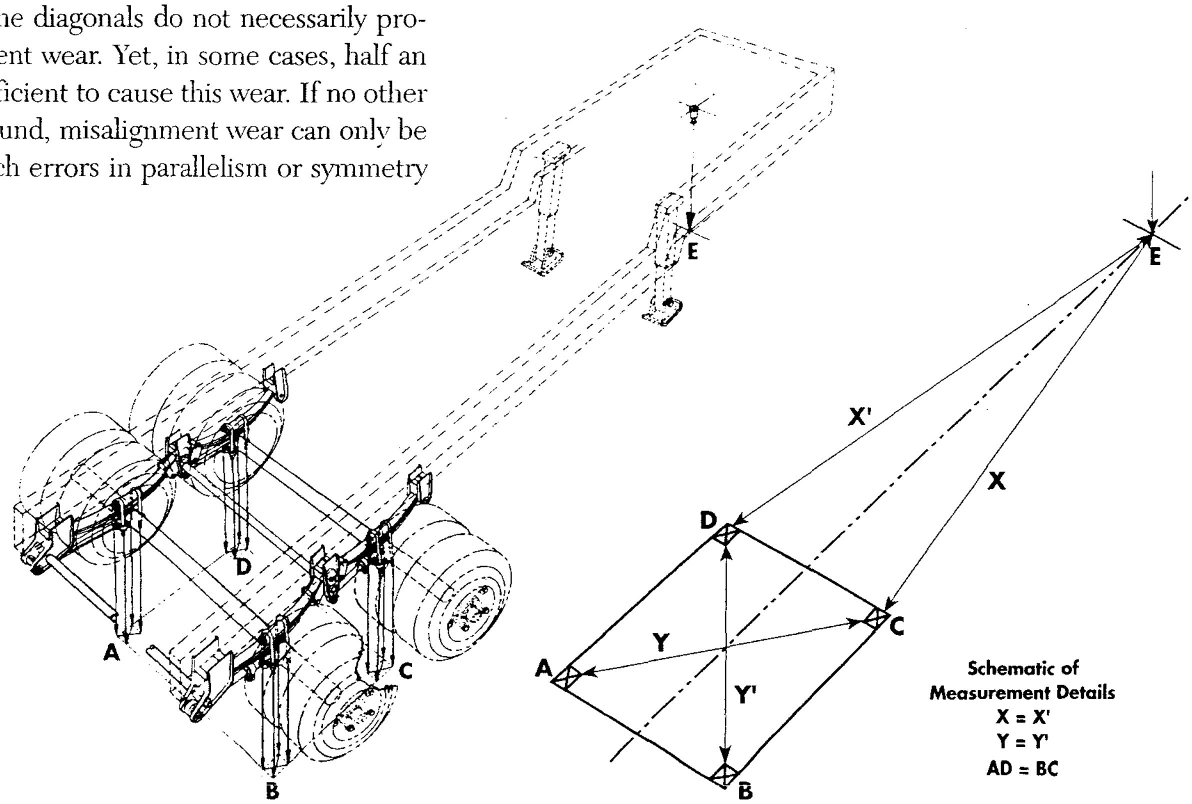
HOW TO CHECK AXLE PARALLELISM AND TRACKING:

With the vehicle fully loaded and relaxed on a flat surface, select two points on the front and rear axles. These two points on each axle must be equal distance from the chassis center (e.g., at the point where the springs meet the axles). Using a plumb line, mark four points on the ground, move the vehicle away and measure the distance between the marks as shown on the diagram.

If AD = BC and DE = CF, the axles are parallel. If X = X' and Y = Y', the wheels are symmetrical or tracking. It is difficult to lay down hard and fast rules since, in practice, variations of one inch in the readings found for the diagonals do not necessarily produce misalignment wear. Yet, in some cases, half an inch may be sufficient to cause this wear. If no other defect can be found, misalignment wear can only be attributed to such errors in parallelism or symmetry as may exist.

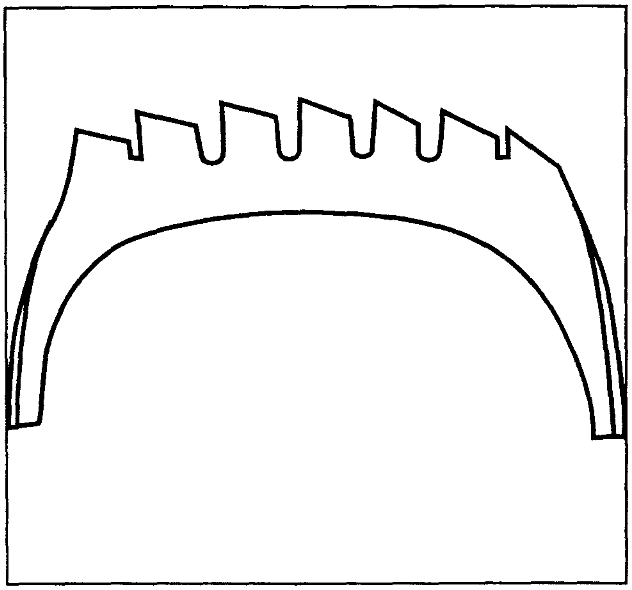


Schematic of Measurement Details
X = X'
Y = Y'
AD = BC
DE = CF

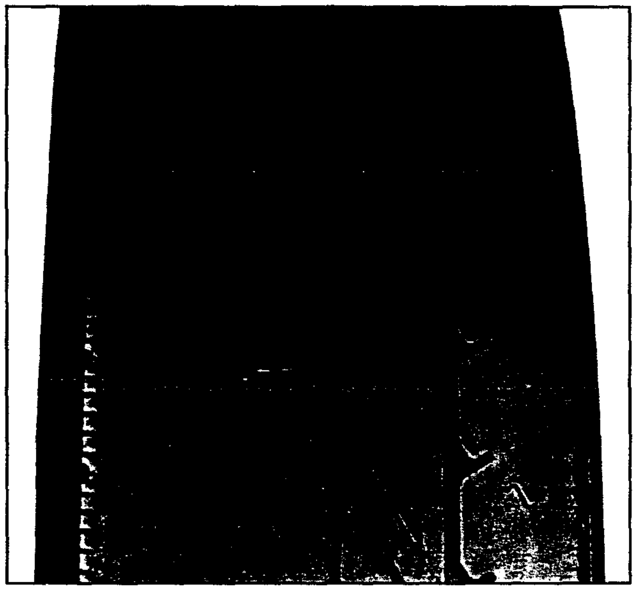


Schematic of Measurement Details
X = X'
Y = Y'
AD = BC

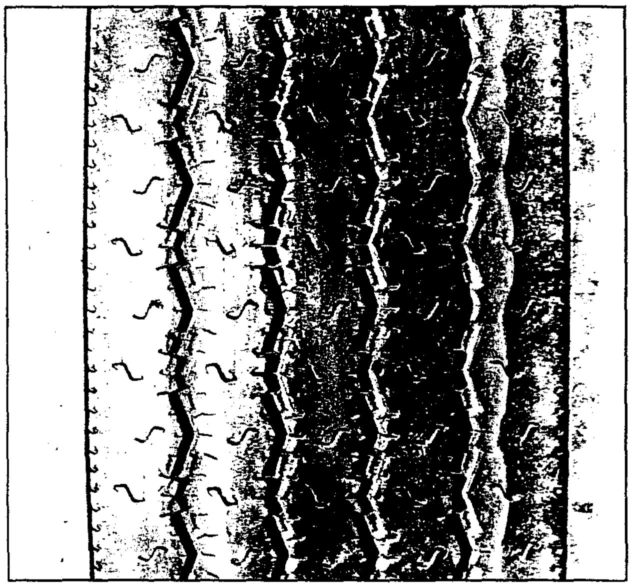
TIRE WEAR PATTERNS DUE TO MISALIGNMENT



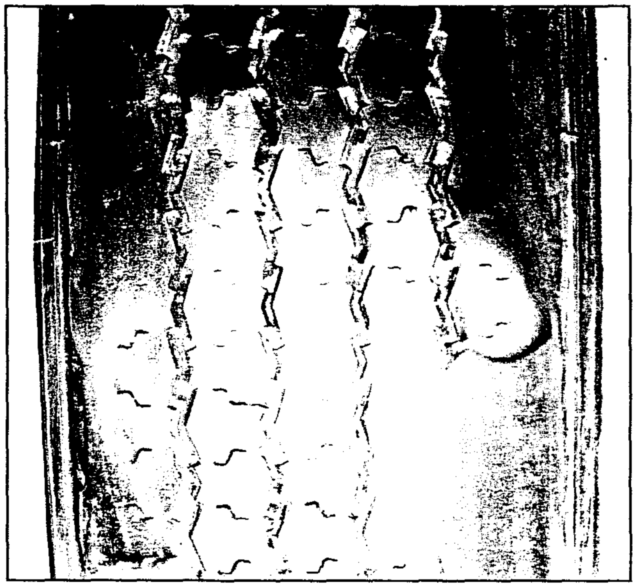
Toe Wear - The typical wear pattern that develops from excessive toe is a feather edged scuff across the crown. Excessive toe is usually seen on both steer tires.



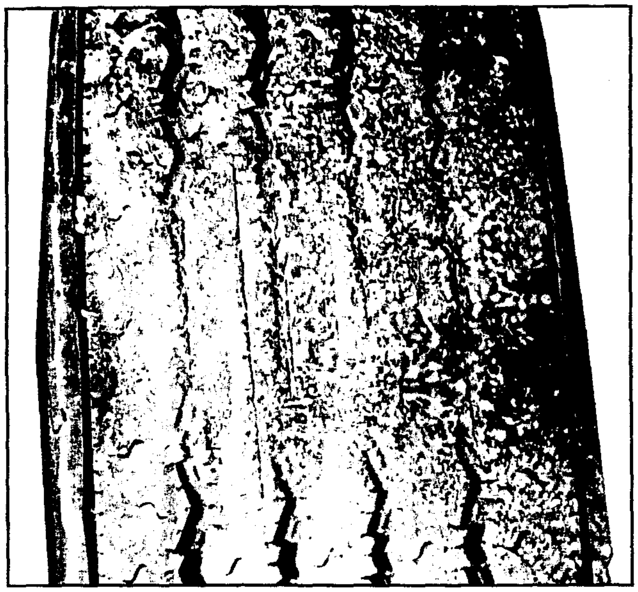
Camber Wear - If the axle has excessive camber, the tire will scrub off that shoulder. Camber wear is usually seen on only one tire.



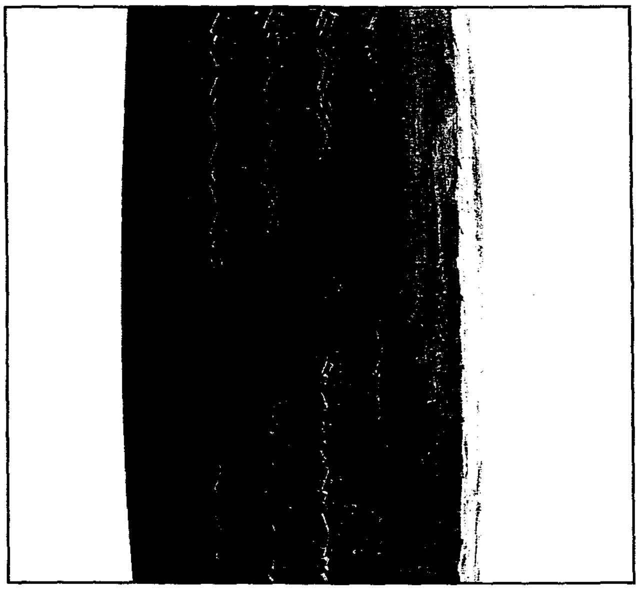
Free Rolling Wear - Wear at the edge of a rib circumferentially which may or may not affect the entire rib widths. Intermittent side forces due to wheel assembly instability cause contact pressure variations, resulting in this type of wear. Generally due to excessive looseness in suspension and/or steering components. Insufficient caster and excessive lateral tire/wheel runout also are contributing factors.



Cupping Wear - Any loose or worn component in truck steering or suspension systems can cause odd wear, cupping, and flat spots. Check for loose wheel bearings, steering gear lash, worn tie rod ends and king pins.



Flat Spotting Wear - Localized wear across the tread width. Causes include brake lock, brake imbalance, out of round brake drums, axle hop or skip. This type of wear pattern can also be caused by a tire being parked on a surface containing hydrocarbon oils, chemicals, solvents. The affected area of the tread will wear more rapidly, leaving a flat spot.



Diagonal Wear - Localized wear diagonally across the tread width. Side forces imposed by a combination of toe and camber create diagonal stress in the footprint of the tire. Localized wear patterns tend to follow this same direction creating diagonal wear. Causes include excessive toe setting, axle misalignment, excessive steering system elasticity, incorrect steering angle in turns, and excessive camber setting.

BRAKING SYSTEMS AND PROBLEMS

Air brake problems as they apply to tire wear and damages can be divided into two categories:

1. Brake imbalance can be the result of the air system, including valves, not actuating the brakes simultaneously. This may be the result of dirt, leaks and/or valve cracking pressure.

   In a tractor/trailer combination the more rapid brake application time now being used (up to twice as fast as pre FMVSS-121 systems) can result in a brake imbalance problem due to combinations of old tractors with new trailers or new tractors with old trailers.

   A third source of brake imbalance is the improperly adjusted slack adjuster. Any of these brake imbalance problems can result in one or more wheel positions locking up and flat spotting the tires.

2. Component problems, such as, out-of-round brake drums or unevenly worn brake shoes, also result in tires acquiring odd wear and flat spots.

SUMMARY OF TIRE PROBLEMS DUE TO BRAKES		
Problem	Possible Causes	Result
Brake Heat	1. Overuse on down grades due to improper gear. 2. Brake dragging due to mis-adjustment. 3. Repeated stops without cooling time.	Bead damage to the tire ranging from simple distortion to complete unwrapping of the casing from the bead wire.
Lock Up	1. Out-of-round brake assembly. 2. Slow release valves. 3. Mis-adjustment slack adjusters.	Flat spots and odd wear.

5TH WHEEL MAINTENANCE AND PLACEMENT

Placement of the 5th wheel can be determined by the need to properly distribute the load over the drive tandems and the steer axle for legal loads. It can also be placed to lengthen or shorten the overall length of the tractor-trailer unit. However, with sliding 5th wheels, many drivers place the 5th wheel to give the smoothest ride and easiest steering. The placement and movement of the 5th wheel can change the tire loading substantially, causing tire overload or tire underload conditions. Insufficient lubrication of the 5th wheel is a major cause of poor vehicle handling.

A 5th wheel in the most rearward position, combined with stiff front axle springs can cause the front tire to periodically unload, leading to vehicle shimmy and irregular tire wear. Vehicle manufacturers usually recommend a fifth wheel placement that results in payload transfer to the front axle. Improper front axle load distribution can adversely affect braking and handling which can result in excessive tire wear.

SUSPENSIONS

Forming the link between the truck and the tire, the suspension system provides a very important contribution to tire performance. The suspension must support the load and maintain the tire in the proper operating position on the road. If the suspension is in good operating order, the tires will track straight and be evenly loaded. This promotes slow, even wear and low tire cost-per-mile.

Different truck manufacturers use different suspension systems. Some of these are adjustable for making minor changes, and some are not adjustable. All suspensions have parts that move and are, therefore, subject to wear. Worn or broken suspension parts are one of the main causes of irregular tire wear and handling problems. (Ref. - Quick Checks For Front Suspension Faults on next page.) When observing irregular wear on a tire, first check for worn or broken front and rear suspension parts.

QUICK CHECKS FOR FRONT SUSPENSION FAULTS

SYMPTOM	POSSIBLE CAUSE
Thumps and Knocks from Front Suspension	Loose or worn ball joints Loose front suspension attaching bolts Missing adjusting shims Loose shock absorber mountings
Groans or Creaks from Front Suspension	Loose attaching bolts Bent control arm or steering knuckle Worn kingpins or kingpin bushings
Squeaks from Front Suspension	Coil spring rubbing on seat
Wander or Shimmy	Worn tie road ends Worn kingpins or kingpin bushings Loose suspension attaching bolts Weak shock absorbers Weak front springs Incorrect front end alignment
Frequent Bottoming of Suspension on Bumps	Weak front springs Weak shock absorbers
Front End Sag	Weak front springs
Irregular or Excessive Tire Wear	Incorrect front wheel alignment Worn kingpins or kingpin bushings Loose front suspension attaching bolts Weak shock absorbers Weak front springs Bent control arm or steering knuckle Worn tie rod ends Excessive steering system compliance
Floating, Wallowing and Poor Recovery from Bumps	Weak shock absorbers Weak front springs
Pulling to One Side While Braking	Worn kingpins or kingpin bushings Loose suspension attaching bolts Bent control arm or steering knuckle Weak front springs Weak shock absorbers
Rough Ride and Excessive Road Shock	Damaged shock absorbers Weak shock absorbers Weak springs Control arm shaft bushings need lubrication Worn kingpins or kingpin bushings
Excessive Steering Play	Worn kingpins or kingpin bushings Loose suspension attaching bolts Worn control arm shaft bushings Weak front springs Worn tie rod ends
Pulls To One Side	Worn kingpins or kingpin bushings Loose suspension attaching bolts Worn control arm shaft bushings Weak front springs Incorrect wheel alignment Bent control arm or steering knuckle
Hard Steering	Worn kingpins or kingpin bushings Incorrect front end alignment Bent control arm or steering knuckle

Section Four
REPAIRS

For more information on repair procedures, refer to "Michelin Radial Tire Repair Manual" No: MWT 40163.

MICHELIN

REPAIRS

Damaged Michelin truck tires are often scrapped even though they could give many more miles of service by being properly repaired. Procedures for the proper repairing of Michelin truck tires are contained in the **Michelin Radial Tire Repair Manual (MWT40163)**.

Repairs should only be done by personnel specially trained and equipped to perform these kinds of repairs. Improperly repaired tires are dangerous and can cause tire destruction, property damage and personal injury.

This section explains how to inspect a tire to see if it can be repaired, contains tables indicating allowable repair limits and the applicable patches to be used and explains how to repair punctures.

INSPECTION FOR REPAIR

A properly made repair can provide many additional miles of wear to an otherwise useless tire. However the tire must be carefully inspected to determine whether its condition justifies the cost of repairing, and if it can be safely reused under normal operating conditions.

Careful inspection is mandatory in the repair of radial tires. They should be checked thoroughly on a well-lighted spreader capable of completely revealing all damages, both inside and out.

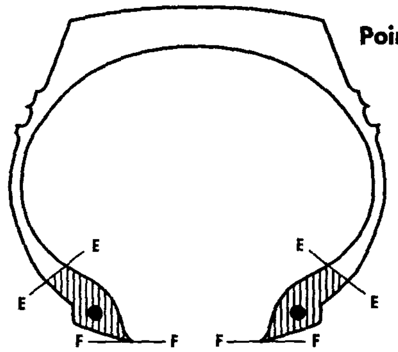
The finished repair should permit the tire to be reused in the type of service for which it was designed without limiting its future retreadability. Naturally, the performance of any tire will depend upon the conditions of use and the care with which it is operated and maintained.

As a general rule, never repair tires with:
- Damage caused by being run flat or underinflated (wrinkling, corrugations, dislocations, abrasions on the interior).
- Damages beyond repair limits.
- Sidewalls with noticeable creasing of radial ply (light truck).
- Broken or deformed bead wires.
- Ruptures, creases, or detachment of radial ply too great in length. (See table of repair limits.)
- Damage in the E-F zone (see drawing below).

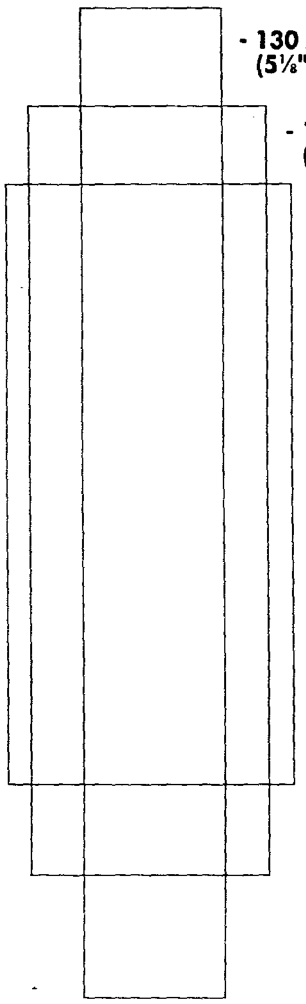
To repair tires with any one of these conditions would result in a tire that would not be safe for further use.

Point E to Point F

Sidewall and crown damages can be made to both steel and rubber. Point E to point F is restricted to repairs of rubber damage only. The measurement of which varies according to tire size. See pages 37 - 38 for limits.



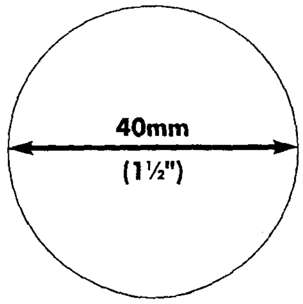
Point E to Point F



- 130 x 20mm (5⅛" x ¾")
- 100 x 30mm (4" x 1¼")
- 80 x 40mm (3⅛" x 1½")

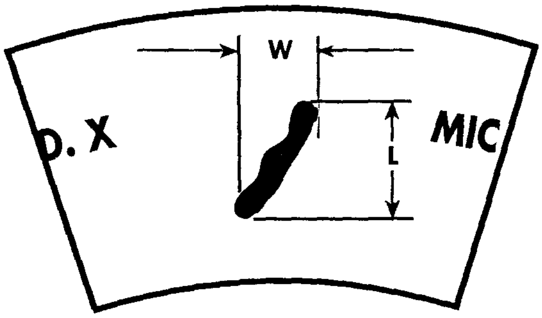
MAXIMUM INJURY SIZE (Sidewall)

MAXIMUM INJURY SIZE (Crown)

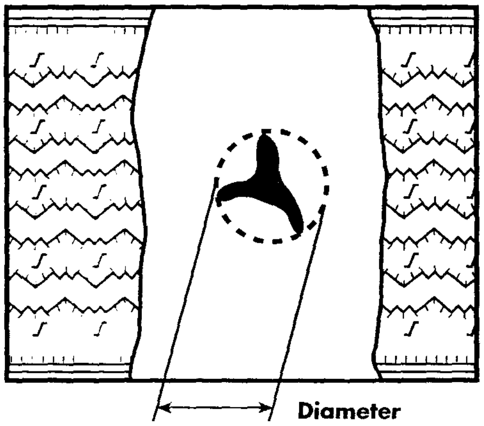


MEASURING DAMAGES

1. **RADIAL PLY DAMAGE:**
   The size is measured within a rectangle:
   L = Length of damage along the cords.
   W = Width of damage across the cords.



2. **CROWN PLY DAMAGE:**
   The size is determined by the maximum diameter of the damage measured on the innermost (crown) working ply.



REPAIR LIMIT

ALLOWABLE REPAIR LIMITS AND APPLICABLE PATCHES:

REPAIR LIMITS - TRUCK TIRES (Millimeters Shown in Parentheses)

TIRE CROSS SECTION		E.F. ZONE	ERX SL 41 CROWN	ERX SL 41 L x W	ERX SL 43 CROWN	ERX SL 43 L x W	ERX SL 45 CROWN	ERX SL 45 L x W
8R		2½" (65mm)	¾" (20mm)	2⅜" x ¾" (60mm x 20mm) or 2¾" x ⅝" (70mm x 15mm) or 3⅛" x ⅜" (80mm x 10mm)	1" (25mm)	2[illegible]" x 1½" (70[illegible] x 40mm) or 3[illegible]" x 1¼" (80[illegible] x 30mm) or 4[illegible]" x ¾" (110[illegible] x 20mm) or 5[illegible]" x ⅜" (130[illegible] x 10mm)	1½" (40mm)	3⅛" x 1½" (80mm x 40mm) or 4" x 1¼" (100mm x 30mm) or 5⅛" x ¾" (130mm x 20mm)
8.25R 8.5 9R 9.00R 10R 10.00/90R 10.00R 11R 215/75R 225/70R	235/80R 245/70R 255/70R 255/80R 265/70R 275/70R 275/80R 285/70R 295/80R	3" (75mm)						
11.00R 12R 12.00R 13R 13/80 13.00R 14/80R 14.00R	18R 305/70R 305/75R 315/80R 365/80R 385/65R 425/65R 445/65R		⅝" (15mm)	1" x ¾" (25mm x 20mm) or 1½" x ⅝" (40mm x 15mm) or 2⅜" x ⅜" (60mm x 10mm)		2[illegible]" x 1" (55[illegible] x 25mm) or 2[illegible]" x ¾" (70[illegible] x 20mm) or 3[illegible]" x ⅝" (95[illegible] x 15mm)		

NOTE: The patches listed above are for **rim diameter sizes of 17.5" through 24.5"**. For 15" truck tires see "Repair Limits: Industrial Tires" on page 38. For 15", 16" and 17" light truck tires see "Repair Limits: Light Truck" on page 38.

REPAIR LIMITS: LIGHT TRUCK

TIRE CROSS SECTION	E.F. ZONE	MAXIMUM LIMITS BY PATCH SIZE: CROWN PLIES DIAMETER	MAXIMUM LIMITS BY PATCH SIZE: RADIAL PLY LENGTH X WIDTH	MICHELIN PATCH SIZE
30x9.50R15 LT215/75R15 LT235/85R16 31x10.50R15 LT235/75R15 7.50R16 32x11.50R15 7.00R15 8.75R16.5 33x12.50R15 LT225/75R16 9.50R16.5 LT195/75R15 LT245/75R16 7.50R17 LT205/75R15 LT215/85R16	2⅛" (55mm)	⅜" (10mm)	1¼" x ⅜" (30mm x 10mm)	ERX SL-21 4⅛" x 2¾"
		¾" (20mm)	2¾" x ¾" (70mm x 20mm)	ERX SL-23 6⅛" x 2¾"
		1" (25mm)	2" x 1" (50mm x 25mm)	ERX SL-41 7½" x 4"
7.00-16 7.50-16 7.50-17 8.00R16.5 8.75R16.5 9.50R16.5	2⅜" (60mm)	¾" (20mm)	1½" x ¾" (40mm x 20mm)	ERX SL-21 4⅛" x 2¾"
		¾" (20mm)	2¾" x ¾" (70mm x 20mm)	ERX SL-23 6⅛" x 2¾"
		1" (25mm)	2" x 1" (50mm x 25mm)	ERX SL-41 7½" x 4"

NOTE: Section repairs are not recommended for LT 14" rim diameter. The economics are not favorable, and the finished product seldom produces customer satisfaction.

REPAIR LIMITS: INDUSTRIAL TIRES

TIRE CROSS SECTION	E.F. ZONE	TYPE OF TIRE	CROWN PLIES DIAMETER	MAXIMUM REPAIRABLE DAMAGE LENGTH ALONG RADIAL PLY IN RELATION TO NUMBER OF DAMAGED CABLES	MICHELIN PATCH SIZE
5.00R8 6.00R9 6.50R10 7.50R10	1½" (40mm)	XZR - XZM XZR - XZZ - XZM XZR - XZM XZR	⅜" (10mm)	If 1 damaged cable - 1¼" (30mm) If 2 damaged cables - ¾" (20mm)	ERX SL-21
				If 1 damaged cable - 2¾" (70mm) If 2 damaged cables - 2" (50mm) If 3 damaged cables - 1½" (40mm) If 4 damaged cables - 1¼" (30mm)	ERX SL-23
7.00R12 7.00R15 7.50R15 8.25R15 10.00R15	1½" (40mm)	XZR - XZZ - XZM XZR - XZM XZR - XZZ - XZM	⅜" (10mm)	If 2 damaged cables - 1⅜" (35mm)	ERX SL-21
				If 2 damaged cables - 2¾" (70mm)	ERX SL-23
				If 2 damaged cables - 4¾" (120mm)	ERX SL-25
		XZR - XZZ - XZM XZZ	¾" (20mm)	Length x Width 2⅜" x 1⅛" (60mm) x (30mm)	ERX SL-43

SECTION REPAIR LIMITS: SPLIT REPAIRS

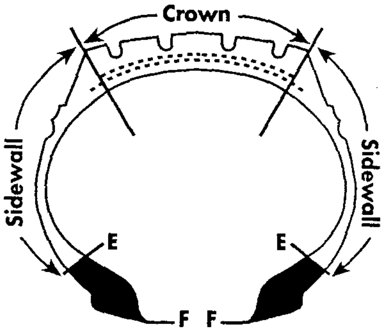
TIRE CROSS SECTION			MAXIMUM NO. CORDS DAMAGED	LENGTH OF SPLIT ALONG RADIAL PLY: ERX SL-21	ERX SL-23	ERX SL-25
6.50 7 7.50 8 8.25	8.5 9 9.5 10	275 295	2	¾" (20mm)	1½" (40mm)	2⅜" (60mm)
			-	1½" (40mm)	3⅛" (80mm)	4¾" (120mm)
11.00 12.00	13.00 14.00	315	1 cord only for these sizes	1½" (40mm)	3⅛" (80mm)	4¾" (120mm)

PUNCTURE REPAIRS

Punctures in the crown up to ¼" (6mm) in diameter and up to ⅛" (3mm) in the sidewall are to be repaired by filling the hole with a rubber based compound and placing a rubber radial repair unit on the inside of the tire. Injuries larger than ¼" (6mm) in the crown and ¹⁄₁₆" (2mm) in the sidewall must be processed in a full service repair shop using approved section repair methods.

Notes: Tires with speed ratings of H, V, Z, and W are restricted to puncture repairs in the crown only.

Puncture and section repairs may be made in all areas of the tire. The bead area (E-F zone) is a rubber repair only area.



E-F Zone Size	
Passenger Car	2⅛"
Light Truck	2½"
Truck	3

External, or outside-in. repair methods using sealants, string, rubber bands or rivet-type plugs are prohibited. The tire must be demounted and inspected for possible internal damage.

The following steps are required to satisfactorily repair punctures in MICHELIN radial tires:

1. Inspection
2. Cleaning
3. Wire Grinding
4. Cementing Puncture Hole
5. Filling Puncture Hole
6. Buffing for Repair Unit
7. Cementing Buffed Area
8. Applying and Stitching the Repair Unit
9. Regrooving (if necessary)

1. INSPECTION:

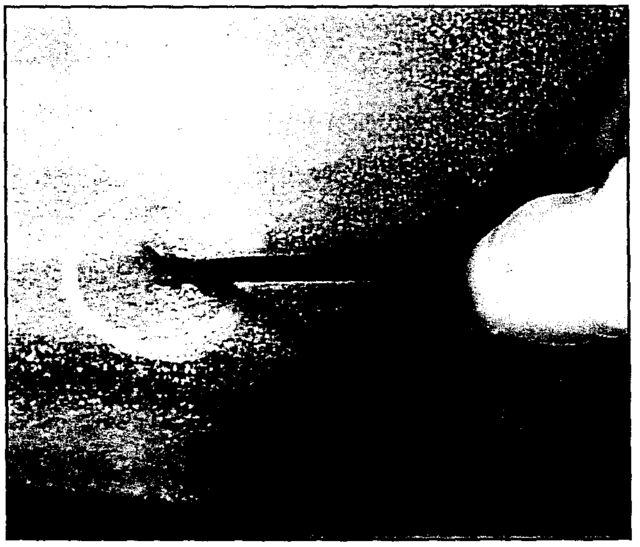
Mark the location of the puncture with tire crayon and remove the puncturing object. After the tire has been removed from the wheel, it must be placed on a spreader that will open the beads fully without buckling or distorting the tire.

Inspect the tire thoroughly, inside and out, for secondary damage or evidence of run flat damage that may result in the need for a major repair or to scrap the tire.

(INTERIOR DAMAGE CAUSED BY NAIL)

Dip a blunt probe in self-vulcanizing solution for lubrication and to coat the walls of the hole.

Do not use sticklebacks or rasping devices for probing, as you may cause unnecessary enlargement of the injury.



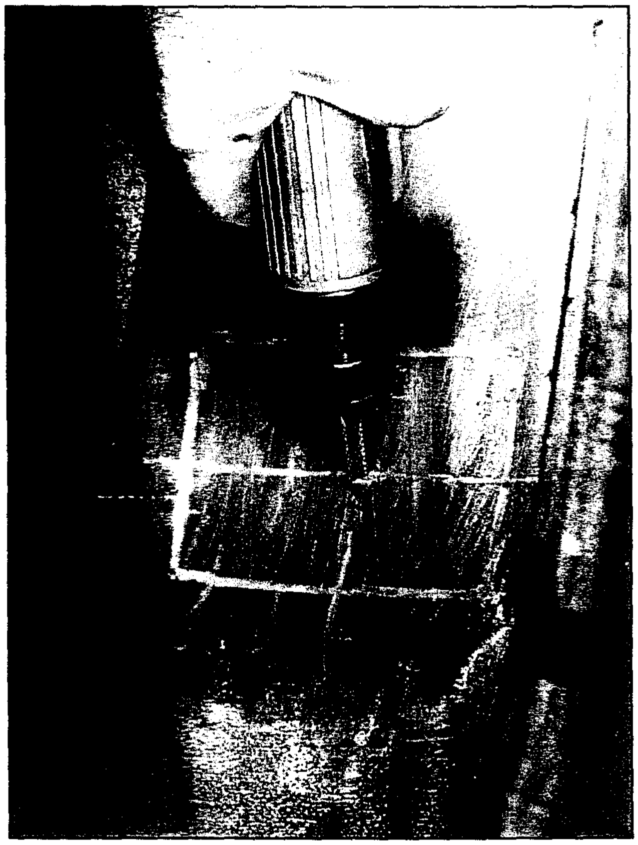
Carefully probe the hole to determine its size and direction. Make sure all traces of the penetrating object have been removed.

2. **CLEANING:**

A liquid rubber cleaner/buffer must be used to remove all traces of silicone lubricants on the inside of the tire that will affect adhesion. Spray or squirt the liquid onto the inner liner, and use a clean cloth or rubber scraper to obtain a uniform, clean dull black appearance.

3. **WIRE GRINDING:**

If any damaged wire filaments protrude into the inside of the tire they must be ground off. Use a small pointed ⅛" diamond carbide burr mounted in a low speed grinder to grind the ends flush with the liner surface. Wire cutters will not cut close enough. Do not enlarge the hole unnecessarily. If an aluminum oxide stone is used to trim back damaged wire, it must be mounted in a high speed (20,000 RPM min.) grinder.



4. **CEMENTING PUNCTURE HOLE:**

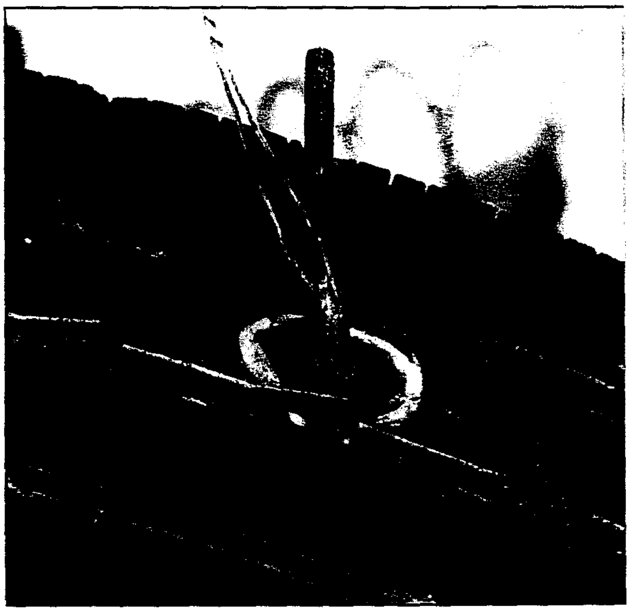
Apply cement liberally into the puncture hole by using a cementing tool or small brush.

If the hole is too small to allow cement to flow into it freely, it is best left alone, as it should not be enlarged needlessly.

5. **FILLING PUNCTURE HOLE:**

A great variety of materials are available on the market to fill puncture holes. These include but are not limited to Patch Plug Combination Units, Headless Inserts, and A&B Compound.

Use enough material to completely fill the puncture and extend beyond the exterior of the tire. Material should be flush with the surface of the tire both inside and out.



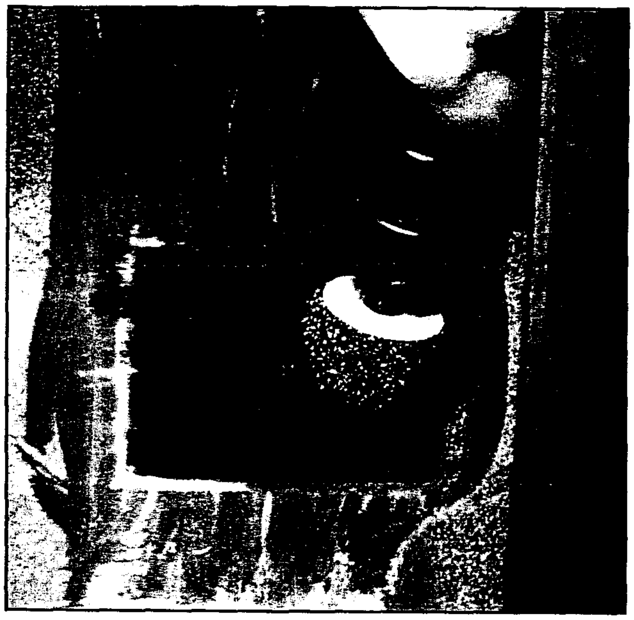
Headless Rubber Inserts (Stems) or Patch Plug Combinations may be inserted in several ways. Refer to the individual supplier's instructions for proper use.

Cut the insert off about ⅛" higher than the surface of the liner.

6. **BUFFING FOR REPAIR UNIT:**

Use a wire brush or a fine grit buffing wheel in a low speed grinder (less than 5,000 rpm) to buff the insert flush with the liner surface. Lightly buff the area the repair is to cover to an even velvet-like RMA-1 texture. Remove all traces of the venting ribs in the repair area. Do not buff through the inner liner or expose any cords of the radial ply.

Remove all buffing dust and debris from inside the tire with a vacuum cleaner. Brush the buffed area with a hand held, soft wire brush to remove all loose particles.



7. **CEMENTING BUFFED AREA:**

Apply a liberal coat of cement to the buffed area. Move the puncture to the up position i.e. 12 o'clock to achieve even drying, as solvents are heavier than air.

Let dry 10-15 minutes depending on humidity.

Refer to the repair material supplier for preferred drying times.

8. **APPLYING AND STITCHING THE REPAIR UNIT*:**

Carefully remove the backing from the adhesive side of the repair unit, taking care not to touch the tacky surface.

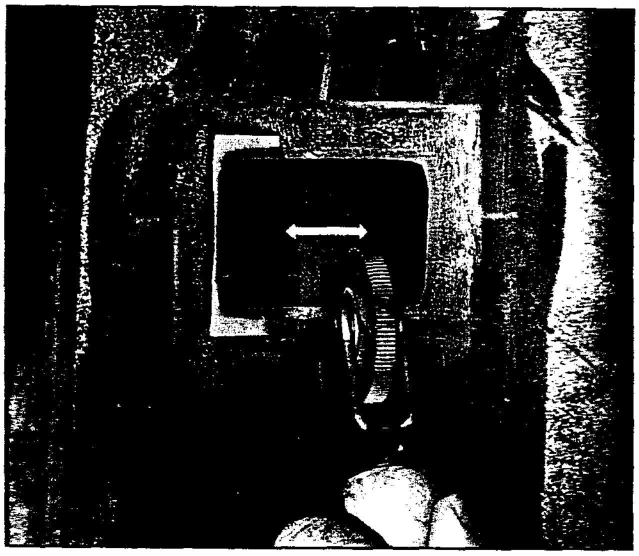
With the beads of the tire relaxed in their normal parallel position, center the patch over the hole and stitch it down thoroughly from the center outwards.

Use a corrugated stitcher to make sure that the edges are down tight without creases and folds.

*** Check manufacturer's instructions for cementing the repair.**

Remove the transparent covering from the top of the repair unit.

Remount the tire to recommended pressure and check for leaks. (Refer to Section Two when remounting the tire.)



Section Five
RETREADING

For more information on retreading, refer to
"Michelin Truck Tire Retreading Manual" No. MWT40164.

MICHELIN

For more information on retreading; refer to **Michelin Buff Width/Tread Width Cross Reference, Buff Recommendations (MWT-40708)** and **Michelin Truck Tire Retreading Manual (MWT40164).**

TIRE MIXING

Four Wheel Trucks: The Michelin "X" is a radial tire and for best performance it is recommended that the same size and type of tire be used on all four wheel positions. If only two Michelin "X" radials are mounted with two non-radials, the radials should be mounted on the rear. If tires of different type are mixed on a vehicle in any configuration, they should not be used for long periods and speeds should be kept to a minimum.

Mixing or matching of tires on 4-wheel drive vehicles may require special precautions. Always check vehicle manufacturers' Owners' Manual for their recommendations.

Trucks With More Than Four Wheel Positions: For best performance, it is recommended that radial and non-radial tires not be mixed in a dual fitment.

RETREADING

The purpose of this section is to provide the retreader with the basic procedures required to properly retread the Michelin radial tire.

By itself, its use should not be considered as a guarantee for the proper processing of a retreaded tire, nor is it meant to be used as a substitute for a regular training program.

It has been designed to be used as a "working tool" for the new or inexperienced employee, or as a reference manual for the experienced person.

Since Michelin radial tires are manufactured to very precise tolerances, it is necessary for similar standards of accuracy to be maintained during the retreading process. Suitably designed modern equipment for radial tires must be provided in the retread shop. The proper tread designs, tread width. tread compound and tread depths, must be selected according to the type of tire and its anticipated service.

The tire must be processed with precision to maintain the design characteristics of the Michelin radial. As there is very little margin for error when retreading radial tires, perfection should be the only standard acceptable.

For more information refer to the Michelin Truck Tire Retreading Manual (MWT40164) or contact your local Michelin Representative.

BUFF RADIUS

Charts giving radius specifications should be available and referred to on each tire.

The correct radius makes it possible to achieve the correct profile and an even distribution of the residual rubber covering the belt package. The amount of residual rubber (undertread) covering the belt package should be equal in depth across the surface of the belt package. (Photo A)

Too flat a radius can leave too much rubber on the shoulders of the tire. This leads to higher operating temperatures in the shoulder. (Photo B)

Too round a radius leaves too much rubber on the center of the tire. This leads to higher operating temperatures in the center. (Photo C)

After buffing, a radius template should be used to verify the buffed radius of the finished tire. (Photo D)

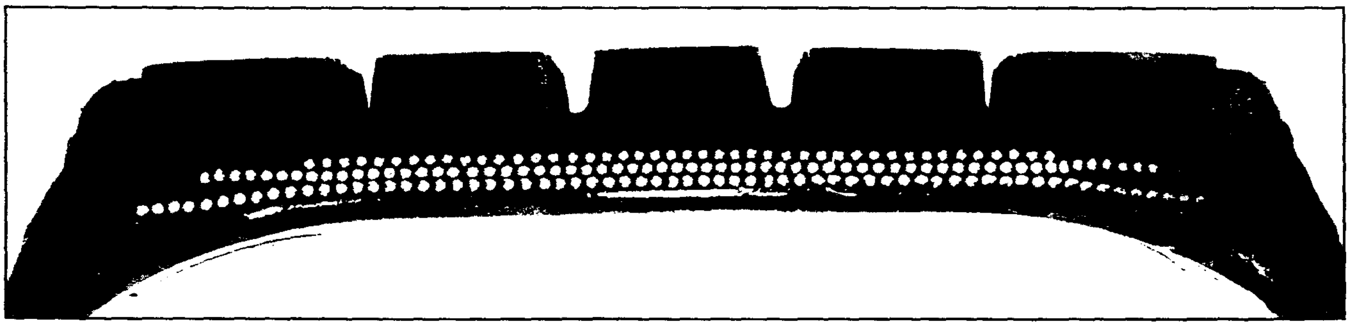


Photo A: Equal undertread

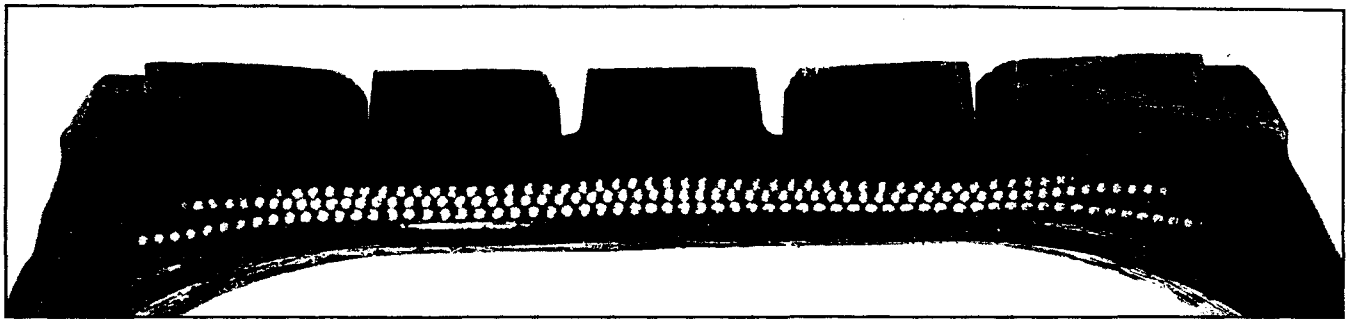


Photo B: Too flat

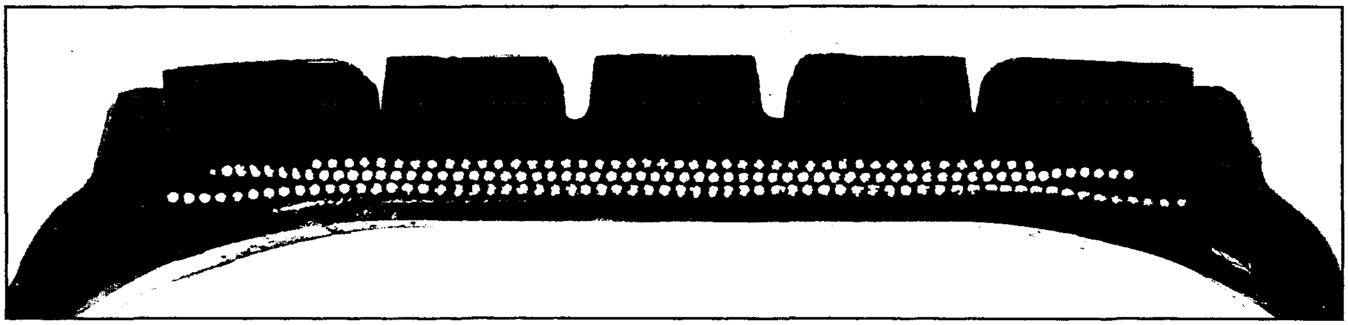


Photo C: Too round

UNDERTREAD

The amount of residual rubber (undertread) covering the belt package should be equal in depth across the surface of the protector belt. **The amount of remaining undertread should be less than 3/32 of an inch.**

Too much undertread leads to higher operating temperatures. (Photo E)

The remaining undertread must be measured on every tire to verify that less than 3/32 of an inch of rubber remains. This can be done by making a pilot skive (Photo F) or by using an electronic measuring device (Photo G).

Too much undertread at buff makes for too much undertread in the finished product. (Photo H) **Control each step.** The total amount of undertread should be no greater than what the tire was designed to contain.

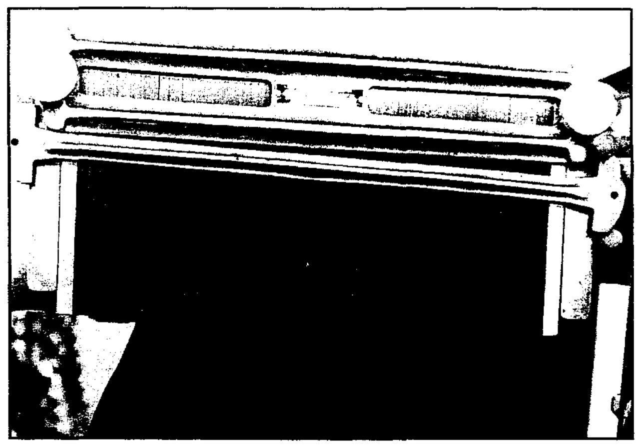


Photo D: Verify the radius on every tire

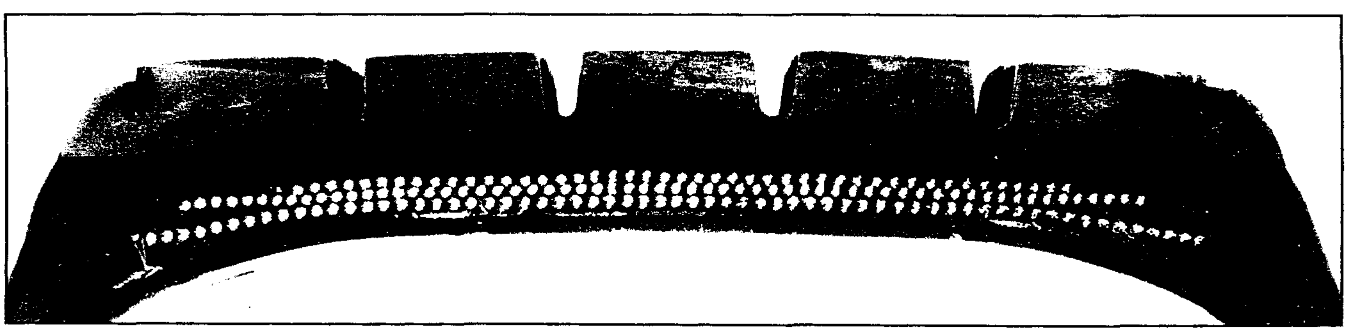


Photo E: Excess Undertread

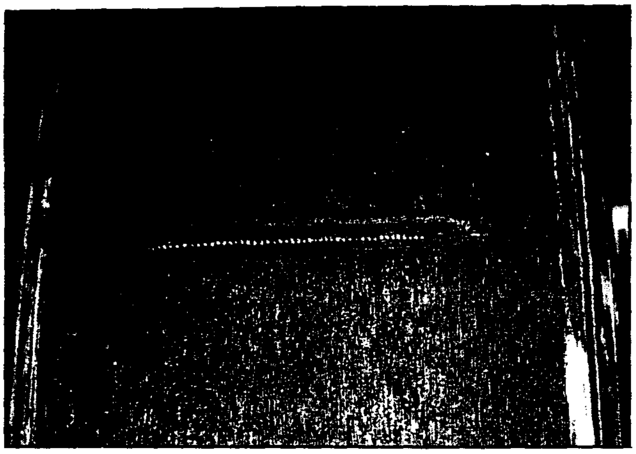


Photo F: Pilot skive

Photo G: Electronic device

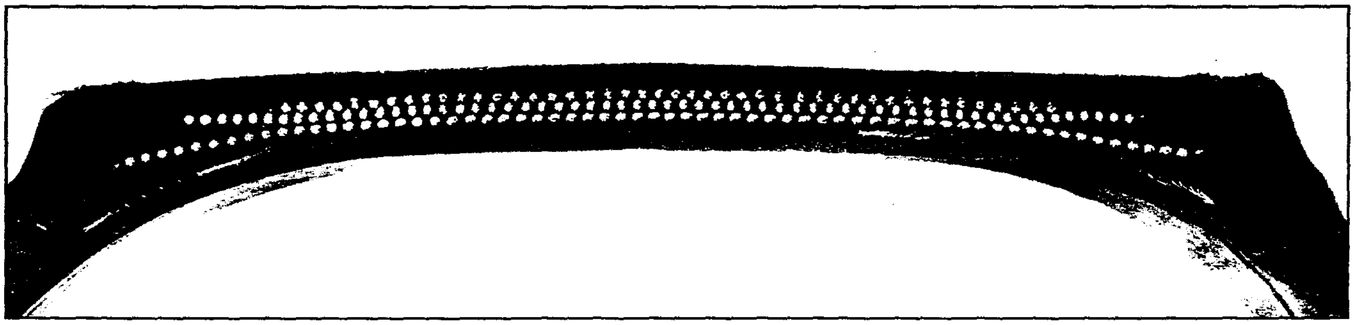


Photo H: Too much total undertread

BUFF WIDTH

Charts giving width specifications should be available and referred to on each tire.

The correct width makes it possible to achieve the correct profile which allows the design of the tire to evenly distribute stresses.

A tape measure should be used to verify the casing width after buffing each tire but prior to trim. **The largest possible tread should be used.** (Photo I)

After choosing the correct tread, place a sample on the tire and mark the amount of shoulder trim needed. The amount of shoulder trim can be from no trim to a maximum trim of 3/16 of an inch per shoulder. (Figure 1) The trim for mold cure can be up to 3/4 of an inch per side but the final cure dimensions should return the tire to within 3/16" per shoulder of the tires original width dimensions.

The shoulder trim angle should not create a trim length greater than ½ of an inch. (Figure 1)

Photo I: Measure for largest tread

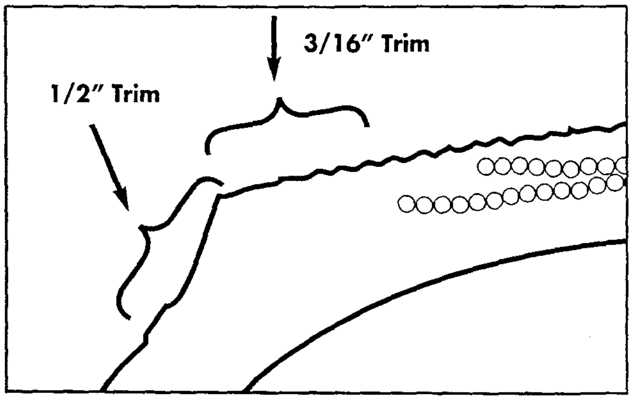


Figure 1

Section Six
COST ANALYSIS

MICHELIN®

COST ANALYSIS

Each fleet operation is different, but there is one consistent goal and that is to achieve the best possible operating cost. This section is designed to provide a guide to determining a Cost Per Mile (CPM).

The simplest CPM is found by dividing the price of the tire and any retread by the total mileage. While this is an easy calculation, it can be very misleading by ignoring many of the added benefits of the tire or the transfer of residual casing value from one life to another.

Determining CPM by wheel position could provide an important gauge for performance since each wheel position is a very special case with unique operating requirements. Here are some of the key elements that need to be considered in any analysis:

1. Total mileage
2. Residual casing values or casing resale value
3. Requirements of the specific wheel position (steer, drive tire)
4. Repairability
5. Retreadability
6. Fuel efficiency
7. Total expected casing life

An estimate of the CPM obtained by different tires in different wheel positions is shown in the examples below.

STEER AXLE

a. An XZA-1+ New Tire Price (estimate)	350.00
b. Residual Casing Value (estimated)	- 90.00
c. Total Miles (estimated)	÷ 120,000
d. CPM	= $ .0022 per mile

DRIVE AXLE

a. An XDHT New Tire Price (estimate)	350.00
b. Residual Casing Value (estimated)	- 90.00
c. Total Miles (estimated)	÷ 250.000
d. CPM	= $ .00104 per mile

YOUR OPERATION	STEER	DRIVE	TRAILER
a. New Tire Price	______	______	______
b. Residual Casing Value	______	______	______
c. Total Miles	______	______	______
d. CPM	______	______	______

There is more to cost per mile calculations than treadwear alone, for instance:

FUEL SAVINGS

Tires are a major component in the operating efficiency of the vehicle. Most of the over the road trucking industry is radialized, but the latest Michelin Advanced Technology tires are built to maximize energy conservation and can provide a fuel savings of 3% to 9% compared to competitors' radial tires.

In the same way, all other benefits derived from the use of Michelin radial tires impact the final cost per mile.

- Reduced downtime due to flats
- Softer ride - greater payload and vehicle protection
- Excellent retreadability and repairability

To calculate potential fuel savings:

A. Cost of Fuel/Gal.		$ ________
B. Annual Miles		________
C. MPG of the Vehicle		________mpg
D. Total Estimated Fuel		________
	B ÷ C =	gal________
E. % Fuel Savings		% ________
F. Estimated Fuel Savings	(E x D) =	gal________
	(F x A) =	$ ________

Section Seven
APPENDIX

GENERAL INFORMATION

Units

Quantity	S.I. Units	Other Units
Length	m (meter)	1 inch (") = 0.0254 m or 25.4 mm 1 mile = 1609 m (1.609 km) 1 kilometer = 0.621 mile
Mass	kg (Kilogram)	1 pound (lb) = 0.4536 kg 1 kilogram (kg) = 2.205 lbs.
Pressure	kPa (Pascal)	1 bar* = 100 kPa 1 psi = 6.895 kPa 1 pound per square inch 1 kg/cm² - 98.066 kPa
Speed	m/s (meter per second)	1 kilometer per hour (kph)* = 0.27778 m/s 1 mile per hour (mph) = 0.4470 m/s (or 1.60935 kph)

* Non S.I. unit to be retained for use in specialized fields.

Load Range/Ply Rating

B - 4	F - 12	L - 20
C - 6	G - 14	M - 22
D - 8	H - 16	
E - 10	J - 18	

Pressure Unit Conversion Table

kPa	bar	lb/in²*	kg/cm²*
100	1.0	15	1.0
150	1.5	22	1.5
200	2.0	29	2.0
250	2.5	36	2.5
300	3.0	44	3.1
350	3.5	51	3.6
400	4.0	58	4.1
450	4.5	65	4.6
500	5.0	73	5.1
550	5.5	80	5.6
600	6.0	87	6.1
650	6.5	94	6.6
700	7.0	102	7.1
750	7.5	109	7.7
800	8.0	116	8.2
850	8.5	123	8.7
900	9.0	131	9.2
950	9.5	138	9.7
1000	10.0	145	10.2
1050	10.5	152	10.7

* Values in psi and kg/cm² rounded to the nearest practical unit.

Speed Symbol

The ISO* SPEED SYMBOL indicates the speed at which the tire can carry a load corresponding to its Load Index under service conditions specified by the tire manufacturer.

Speed Symbol	Speed		Speed Symbol	Speed		Speed Symbol	Speed	
	(kph)	mph		(kph)	mph		(kph)	mph
A1	5	2.5	A7	35	22.5	F	80	50
A2	10	5	A8	40	25	G	90	55
A3	15	10	B	50	30	J	100	62
A4	20	12.5	C	60	35	K	110	68
A5	25	15	D	65	40	L	120	75
A6	30	20	E	70	43	M	130	81
						N	140	87

* International Standardization Organization

Load Index

The ISO LOAD INDEX is a numerical code associated with the maximum load a tire can carry at the speed indicated by its SPEED SYMBOL under service conditions specified by the tire manufacturer. (1 kg = 2.205 lbs.)

LI	kg	lbs	LI	kg	lbs	LI	kg	lbs	LI	kg	lbs	LI	kg	lbs	LI	kg	lbs	LI	kg	lbs	LI	kg	lbs
0	45	99	35	121	267	70	335	740	105	925	2,040	140	2,500	5,510	175	6,900	15,210	210	19,000	41,890	245	51,500	113,540
1	46.5	102	36	125	270	71	345	760	106	950	2,090	141	2,575	5,680	176	7,100	15,650	211	19,500	43,000	246	53,500	117,950
2	47.5	105	37	128	280	72	355	780	107	975	2,150	142	2,650	5,840	177	7,300	16,090	212	20,000	44,100	247	54,500	120,150
3	48.7	107	38	132	290	73	365	800	108	1,000	2,200	143	2,725	6,010	178	7,500	16,530	213	20,600	45,420	248	56,000	123,480
4	50	110	39	136	300	74	375	830	109	1,030	2,270	144	2,800	6,170	179	7,750	17,090	214	21,200	46,750	249	58,000	127,890
5	51.5	114	40	140	310	75	387	850	110	1,060	2,340	145	2,900	6,390	180	8,000	17,640	215	21,800	48070	250	60,000	132,300
6	53	117	41	145	320	76	400	880	111	1,090	2,400	146	3,000	6,610	181	8,250	18,190	216	22,400	49,390	251	61,500	135,580
7	54.6	120	42	150	330	77	412	910	112	1,120	2,470	147	3,075	6,780	182	8,500	18,740	217	23,000	50,700	252	63,000	138,890
8	65	123	43	155	340	78	425	940	113	1,150	2,530	148	3,150	6,950	183	8,750	19,290	218	23,600	52,040	253	65,000	143,300
9	58	128	44	160	350	79	437	960	114	1,180	2,600	149	3,250	7,170	184	9,000	19,840	219	24,300	53,580	254	67,000	147,710
10	60	132	45	165	360	80	450	990	115	1,215	2,680	150	3,350	7,390	185	9,250	20,390	220	25,000	55,120	255	69,000	152,120
11	61.5	136	46	170	370	81	462	1,020	116	1,250	2,760	151	3,450	7,610	186	9,500	20,940	221	25,750	56,780	256	71,000	156,530
12	63	139	47	175	390	82	475	1,050	117	1,285	2,830	152	3,550	7,830	187	9,750	21,500	222	26,500	58,430	357	73,000	160,930
13	65	143	48	180	400	83	487	1,070	118	1,320	2,910	153	3,650	8,050	188	10,000	22,050	223	27,250	60,070	258	75,000	165,340
14	67	148	49	185	410	84	500	1,100	119	1,360	3,000	154	3,750	8,270	189	10,300	22,710	224	28,000	61,740	259	77,500	170,660
15	69	152	50	190	420	85	515	1,130	120	1,400	3,090	155	3,875	8,540	190	10,600	23,370	225	29,000	63,940	260	80,000	176,400
16	71	157	51	195	430	86	530	1,170	121	1,450	3,200	156	4,000	8,820	191	10,900	24,030	226	30,000	66,150	261	82,500	181,880
17	73	161	52	200	440	87	545	1,200	122	1,500	3,310	157	4,125	9,090	192	11,200	24,690	227	30,750	67,790	262	85,000	187,390
18	75	165	53	206	450	88	560	1,230	123	1,550	3,420	158	4,250	9,370	193	11,500	25,360	228	31,500	69,460	263	87,500	192,900
19	77.5	171	54	212	470	89	580	1,280	124	1,600	3,530	159	4,375	9,650	194	11,800	26,020	229	32,500	71,660	264	90,000	198,450
20	80	176	55	218	480	90	600	1,320	125	1,650	3,640	160	4,500	9,920	195	12,150	26,790	230	33,500	73,870	265	92,500	203,920
21	82.5	182	56	224	490	91	615	1,360	126	1,700	3,750	161	4,625	10,200	196	12,500	27,560	231	34,500	76,070	266	95,000	209,440
22	85	187	57	230	510	92	630	1,390	127	1,750	3,860	162	4,750	10,470	197	12,850	28,500	232	35,500	78,280	267	97,500	214,950
23	87.5	193	58	236	520	93	650	1,430	128	1,800	3,970	163	4,875	10,750	198	13,200	29,100	233	36,500	80,480	268	100,000	220,500
24	90	198	59	243	540	94	670	1,480	129	1,850	4,080	164	5,000	11,020	199	13,600	29,990	234	37,500	82,690	269	103,000	227,370
25	92.5	204	60	250	550	95	690	1,520	130	1,900	4,190	165	5,150	11,350	200	14,000	30,870	235	38,430	85,430	270	106,000	233,730
26	95	209	61	257	570	96	710	1,560	131	1,950	4,300	166	5,300	11,690	201	14,500	31,970	236	40,000	88,200	271	109,000	240,300
27	97.5	215	62	265	580	97	730	1,610	132	2,000	4,410	167	5,450	12,020	202	15,000	33,070	237	41,250	90,940	272	112,000	246,960
28	100	220	63	272	600	98	750	1,650	133	2,060	4,540	168	5,600	12,350	203	15,500	34,180	238	42,500	93,710	273	115,000	253,530
29	103	227	64	280	620	99	775	1,710	134	2,120	4,670	169	5,800	12,790	204	16,000	35,280	239	43,750	96,470	274	118,000	260,190
30	106	234	65	290	640	100	800	1,760	135	2,180	4,810	170	6,000	13,230	205	16,500	36,380	240	45,000	99,210	275	121,000	266,760
31	109	240	66	300	660	101	825	1,820	136	2,240	4,940	171	6,150	13,560	206	17,000	37,480	241	46,250	101,960	276	125,000	275,580
32	112	247	67	307	680	102	850	1,870	137	2,300	5,070	172	6,300	13,300	207	17,500	38,590	242	47,500	104,720	277	128,500	283,290
33	115	254	68	315	690	103	875	1,930	138	2,360	5,200	173	6,500	14,330	208	18,000	39,690	243	48,750	107,470	278	132,000	291,060
34	118	260	69	325	720	104	900	1,980	139	2,430	5,360	174	6,700	14,770	209	18,500	40,790	244	50,000	110,250	279	136,000	299,880

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