Factors Effecting Traction and Handling

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Doug Jones
Customer Engineering Support Manager
Michelin North America, Inc.
Factors Affecting Traction and Handling
Agenda

• Influences - Surface and Weather
• Understanding Traction
• XDA5 vs. XD4 - Design
• Drive Tire Footprint Comparison
• How is Water Dissipated
  – New vs. Worn
• Summary/Conclusion
Understanding Traction

• A better understanding of traction issues …
  – What are the factors that have an influence (tractor/trailer configuration, tire design, load, tire pressure, environment. . .)
  – Weather – hot, cold, warm, dry, rain, damp, wet, sleet, snow, ice
  – Drive for the conditions
  – Braking - stopping distance versus speed
  – What is the situation (oily road at a stoplight, exit ramp …)
  – Road surface (concrete, grooved concrete, asphalt)
  – New or worn tires - what tread depth 30 - 13 - 8
Understanding Traction

• Types of Traction and Affects
  – Wet Traction
    • Speed (Impact)
    • Compound rigidity
  – Snow Traction
    • Speed (Impact)
    • Amount of load
  – Starting Traction
    • Low Risk
  – Braking Traction/Stopping Distance
    • Most Important
Understanding Traction

• Components of tire that induce traction
  – Surface area of rubber on the road (design footprint)
    • Most Important
  – Rubber Compounds effect rigidity
  – Edge Density
  – Tread Groove width
  – Sipes
  – Sculpture (Open vs. Closed shoulder)
II.2

Influence of road surfaces on the coefficient of friction

As an initial approximation, road surfaces can be classified into four categories.

It has been observed that the value of the coefficient of friction - or coefficient of grip - is on a dry road surface is always between 1 and 1.3*.

However, on a wet surface, the coefficient of grip is always worse and varies enormously with the nature of the surface.

* Values for \( v_{\text{max}} \)

N.B. There are no boundaries between these categories: one merges into the next.
ROUGHNESS and GRIP

- In order to grip, the tire must be in contact with the road surface, which activates the grip and adhesion
- In DRY WEATHER, traction depends very little on the type of surface
- In WET WEATHER, traction depends very much on the type of surface
DAMP

- On a **damp surface**, the friction (traction) is always worse and varies enormously with the type of surface.
- This is because a film of water between the rubber and the road prevents traction (**adhesion**) unless this film is broken.
WATER

• If the depth of water increases (wet surface), microroughness may become flooded
• Macroroughness continues to indent, drain and store, but there is a risk of aquaplaning at high speed
• Water therefore interferes with grip and the tires must be designed to disperse this water quickly and effectively by adjusting the shape of the contact patch, the tread pattern and the sipes
SNOW

• Changing from one type of road surface to another has more effect on grip than changing from one tread compound to another

• Depending on the temperature and the compaction caused by the passage of vehicles, snow passes through different states which are similar to other types of surface:
  – melting snow is similar to water
  – fresh, deep snow is similar to a crumbly surface compact, cold snow is like dry ice
ICE

• At very low temperatures, ice is dry and is similar to a microrough surface and produces micro-indentation and molecular adhesion. However, the surface can easily become flooded

• At temperatures between 23 and 32°F, the pressure of the tire on the road causes slight surface melting of the ice, which is in turn covered by a thin film of water. The ice is then like a flooded microsmooth surface

• Snow and ice are cold surfaces which require the use of tire compounds that function at low temperatures
TREAD DESIGN

• The shape of the tire's contact patch, its tread grooves and sipes, will push the water forwards and drain away part of the “bank” of water builds up in front of the tread. The water still creeping in between the contact patch and the road surface is then channeled into the tread grooves where it is “stored”. The tread rubber can thus break through the residual water film and restore direct contact with the road surface.

• The edges of the sipes or tread blocks, combined with the microroughness of the road surface, break through the film of water because of the high pressure surges they create.
TREAD DESIGN

- These three water dispersal stages occur between the leading and the lagging edge of the contact patch and correspond to three different transition zones called:
  - hydroplane (water depth > \(1/32\)"")
  - viscoplane (water depth: < \(1/32\)" with an oil film)
  - damp (intermittent residual film of water)
Traction Performance

Starting Wet

- All tires begin to lose starting wet traction with wear
- Most tires end up at the same level of traction performance in the last 10% of tread
- Look is important: the more edges / the better ... but the tread rubber is equally important

Starting Snow

- Once again most tires end up at the same level of snow traction in the last 50% of tread
- Look is also important; edges and small blocks are important
- All tires lose snow traction when worn

Braking Wet

- Very challenging to relate tests to real stopping power
- All tires have a significant drop in traction through the life.
- @7/32” remaining tread; Look + Rubber are very important
Tread Block Movement

Direction of Travel

Slip          Shear          Compression          Contact

Slippage phase          Shear phase
UNDERSTEER

• Understeer is the result of loss of lateral grip on the steer tires

• A vehicle which understeers tends to “travel in a straight line” when the driver is negotiating a bend. In more accurate terms, the vehicle will want to travel in a shallower curve than the intended one. This effect is amplified as the cornering speed increases. To counteract the “straight line“ tendency, the driver of an understeering vehicle has to increase the steer angle or slow down, or do both
OVERSTEER

• Oversteer is the result of the loss of lateral grip on the drive tires.

• A vehicle which oversteers has a tendency to take a path which is tighter than the intended bend. This effect is amplified when the speed increases. In fact, at high speed, the rear of the vehicle "swings out" and the front of the vehicle ends up pointing towards the inside of the bend. To correct the direction of travel, the driver must reduce the steer angle and, if the vehicle has front-wheel drive, accelerate.
Foot Print Comparison

New Footprints
30/32nds

Darker Areas indicate better grip

XD4 Open

XDA5 Closed
Foot Print Comparison

13/32nds

Darker Areas indicate better grip

XD4 Open

XDA5 Closed
Foot Print Comparison

8/32nds

Darker Areas indicate better grip

XD4 Open

XDA5 Closed
How is water dissipated

• Where does the water go?
  – Most water is pushed out of the way by the steer tires
  – Of the remaining water, 89-91% of the water exits on rear of the contact surface of tires
  – 4-6% is trapped by surface sipes
  – 0-4% is dissipated through OPEN shoulder channels
XD4 AT 55 MPH IN 5/32NDS WATER
NEW  30/32          WORN  13/32
(blinking footprint is on dry pavement)
XDA-5 AT 55 MPH IN 5/32NDS WATER
NEW 30/32  WORN 13/32
(blinking footprint is on dry pavement)
Summary

- The tire plays an important role, but the Driver plays an even bigger role.
- You now understand that -TRACTION is formed by factors beyond just the tread design, depth or compound.
- Driving CONDITIONS must be evaluated for safety.
- SPEED plays a significant role in how much traction you maintain.
Conclusions

• All tires lose some wet traction performance with wear
• Consistent performance throughout tire life is priority criteria
• An “open” tread design does not always equal better WET TRACTION
• Drivers make the difference
QUESTIONS???