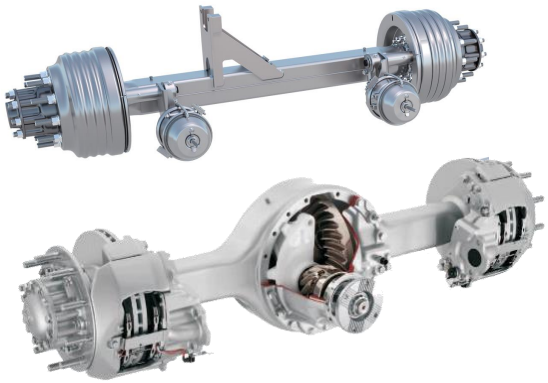
# Overview of 6 X 2 Axle Systems and New Generation Wide Base Single Tires for Highway Tractors

## Benefits and Issues Concerning Weight Regulations in Western States

## WASHTO Meeting

## September 10, 2014



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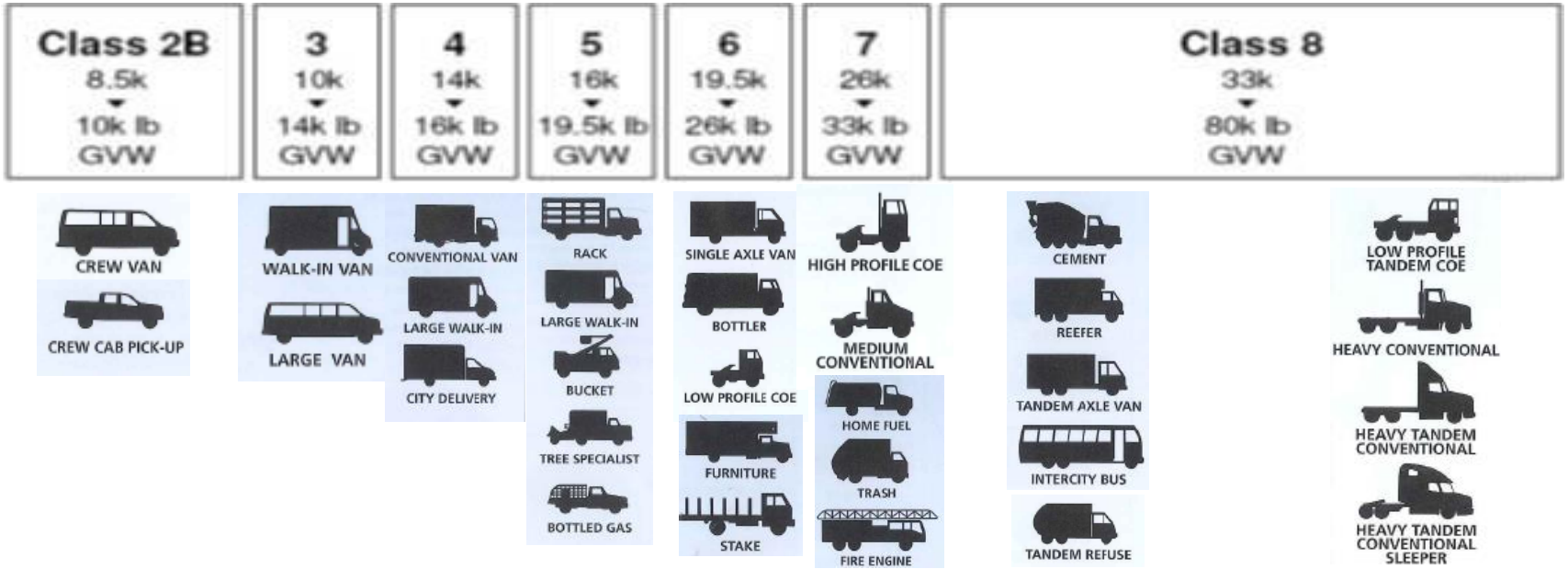
# Objective of Today's Discussion

- Provide overview of new 6 x 2 Axle Technology, including features and benefits.
- Provide overview of Next Generation of Wide Base Single Tires (NGWBST), including features and benefits
- Describe potential regulatory issue in several western states that restrict usage of these technologies.
- Discuss potential options for addressing this regulatory issue.

# EPA/NHTSA Final Rule – Phase 1

## GHG Emissions and FE Standards for Medium and Heavy-Duty Engines and Vehicles

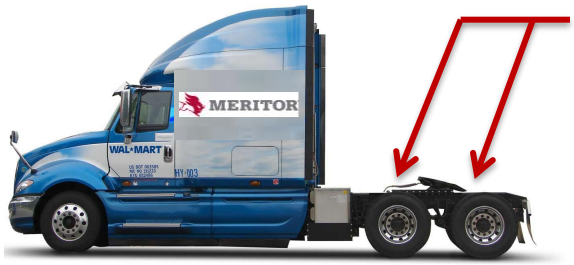



| Work | Vocational (Truck, Tractor) | Tractors |
|---|---|---|
| Heavy-duty pickups and vans | Light, medium, and heavy heavy-duty | Combination |

**Vehicle examples**

# Overview of 6x2 Axle Systems

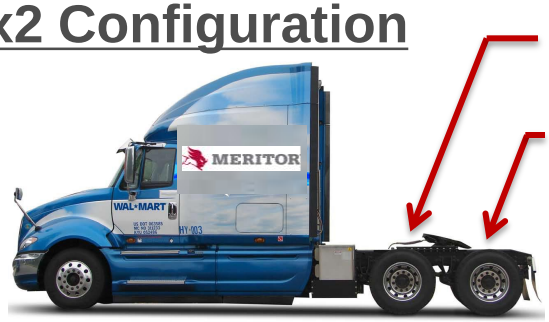
## 6x4 Configuration

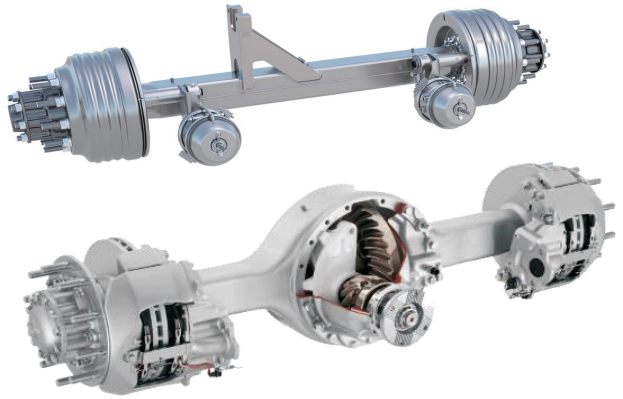



- **6** Wheel Ends
- **4** Wheel Ends Provide Drive
- Most Common Linehaul Setup

**"Live Tandem" (6x4) – 2 Driving Axles**

## 6x2 Configuration



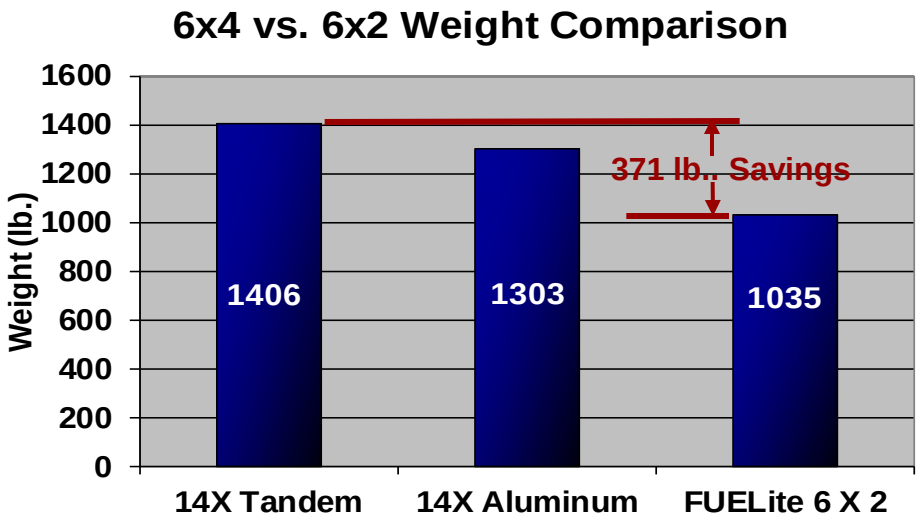
- **6** Wheel Ends
- **2** Wheel Ends Provide Drive
- 1 Single (Larger) Drive Axle

**6x2 Tandem – 1 Driving Axle**

# Why is Fleet Interest in 6x2's Increasing?

- **Significant Weight Savings**
  - Eliminates one drive carrier
  - Eliminates inter-axle driveline
  - **371 lb.** vs. a 6x4 Tandem
- **More Efficient versus 6x4**
  - Use of newer, "high efficiency" carrier designs
  - Fewer Gearset Meshes
    - » A source of energy loss
  - Less Lubricant Churning Losses
    - » One sump vs. two

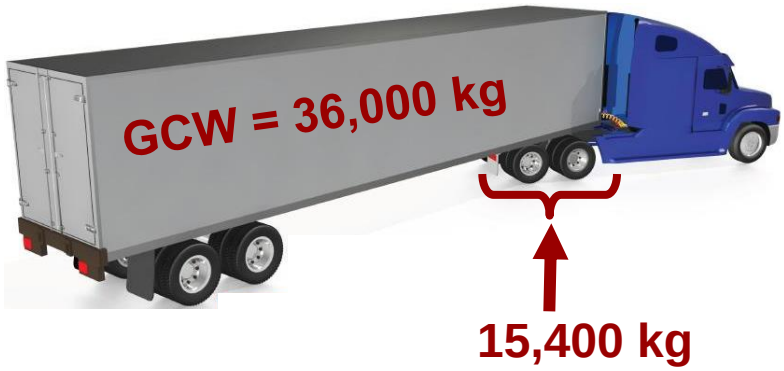
**2-4.6% fuel efficiency improvement**




Churning Losses as gear rotates through Sump are significant at high speeds

# Performance Concerns about 6x2's

- **Past Concerns have limited usage of 6x2 vehicles**
  - Significant concerns about traction, especially in adverse weather
    - A smaller percentage of the total combination weight is on the driving axle, so available traction is reduced:





**6x4 Configuration**

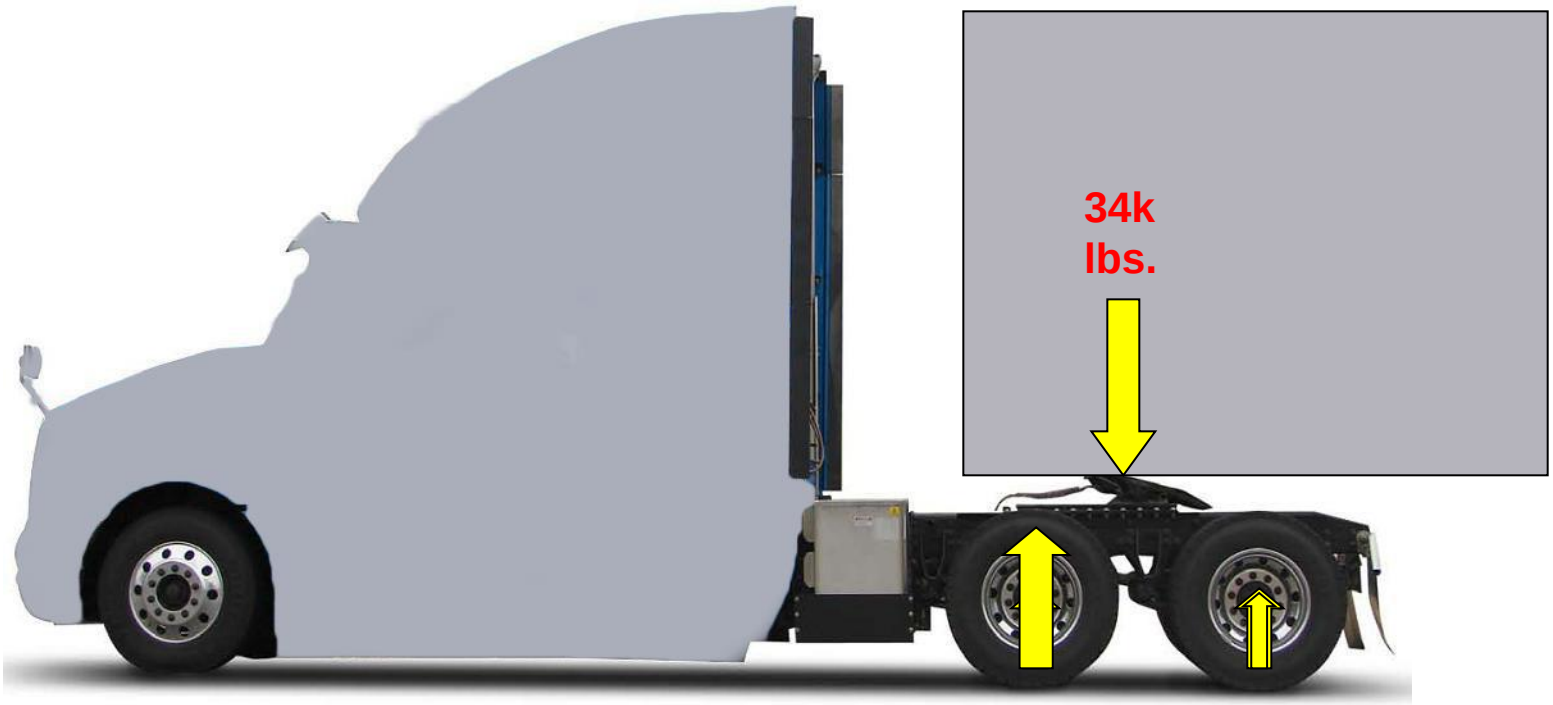
**% Total Load on Drive Axles = 42.8%**

**6x2 Configuration**

**% Total Load on Drive Axle = 21.4%**

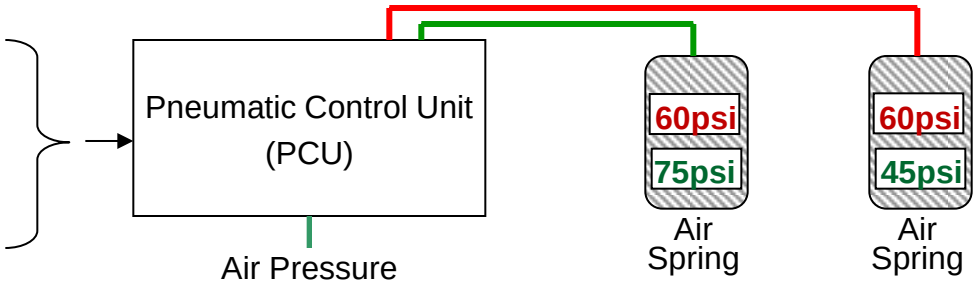
- **Newer 6x2 Axle Systems have overcome these issues while providing additional benefits**

# System Operation - Load Transfer and Diff-lock

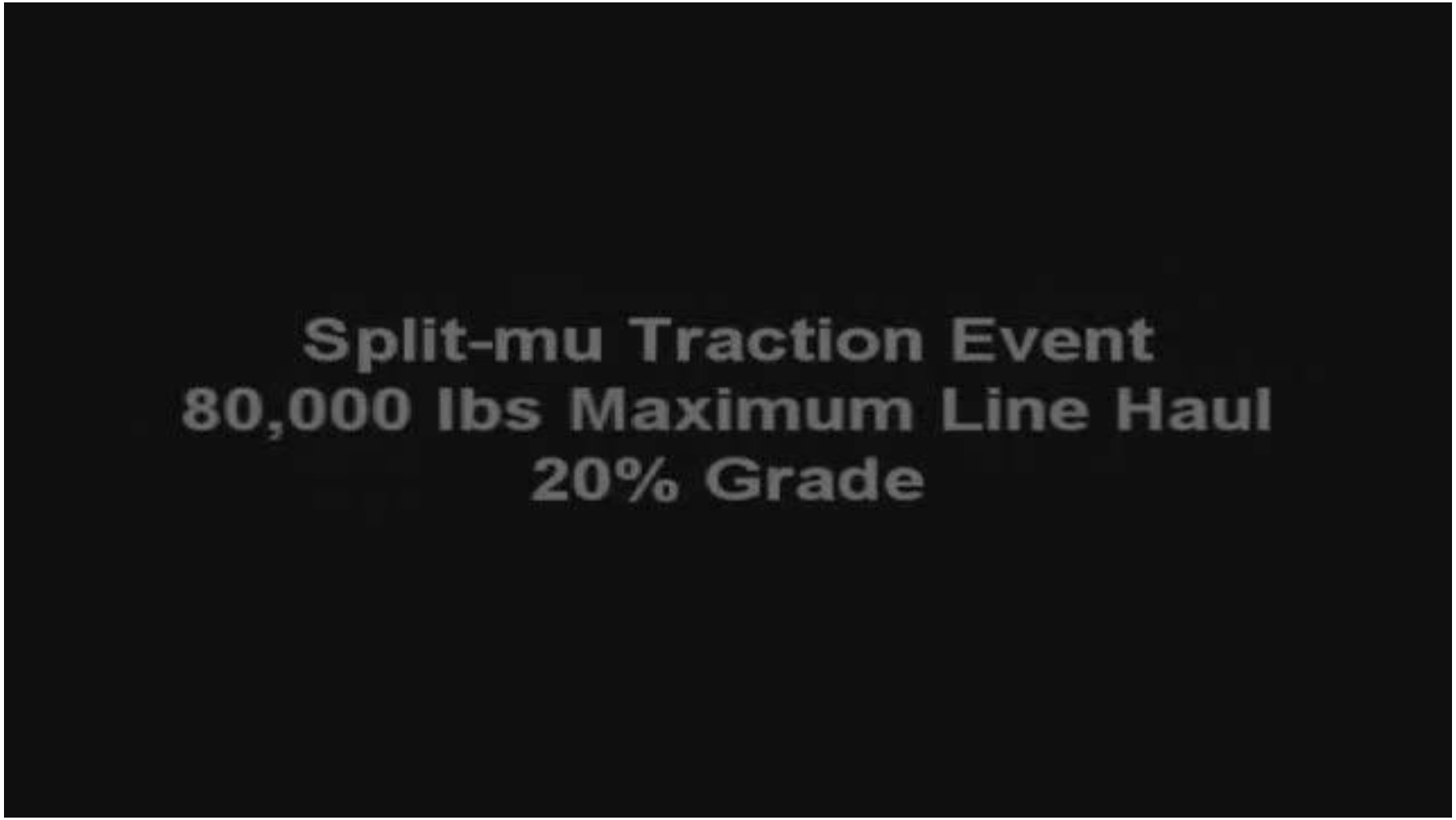



**Inputs**

- **Wheel Speed**
- **Vehicle Speed**
- **Mode Selected**
- **Spring Pressures**
- **ABS & Eng. Retarder Info**

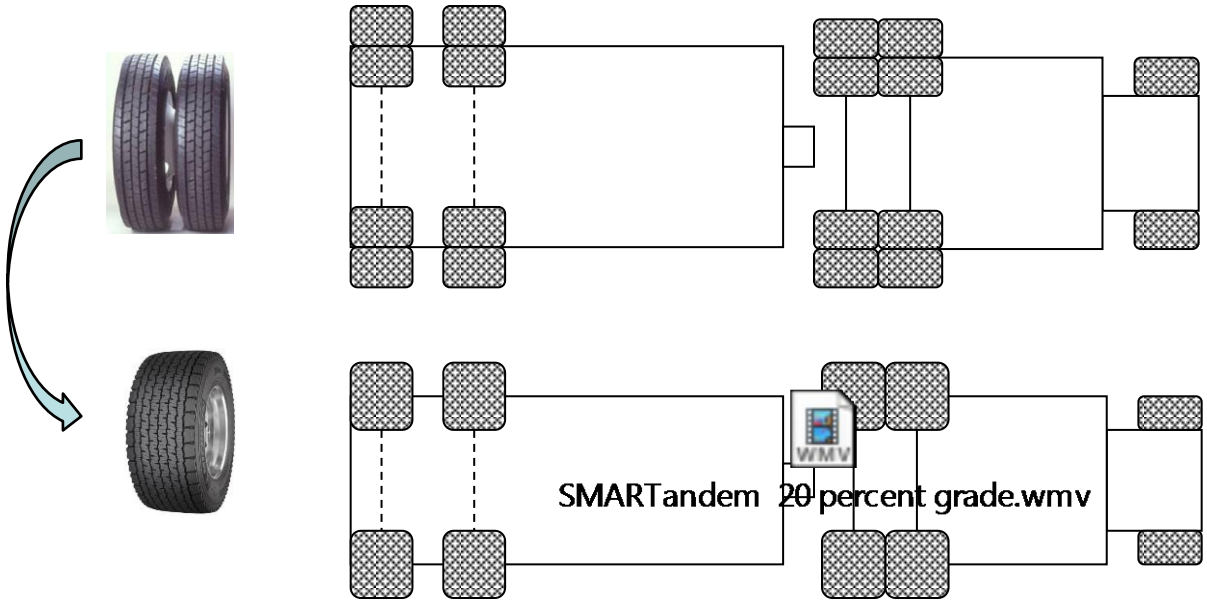


# Traction Performance of Advanced 6x2



# 18 Wheelers to 10 Wheelers

## New Generation of Wide Base Single Tires (NGWBST)




**18 wheels**
275/80R22.5
295/75R22.5
11R22.5

**10 wheels**
445/50R22.5
455/55R22.5
(~800 lbs. weight reduction)

- 2000 – present *
- Used by hundreds of fleets and thousands of drivers.
- Savings of > 150 million gallons of fuel.
- Reduction of > 1.5 million metric tons of $CO_2$ equivalent GHG
- * Based on industry standard rolling resistance testing of comparable tires and retreads.

# New Generation Wide Base Single Tires (NGWBS)

- 1908 - paired or dual tires to increase load capacity
- 1980's – "Super Singles" (385, 425/65R22.5)
- 2000 - NGWBS technology introduced
  - 445/50R22.5 or 455/55R22.5
- 8 manufacturers
  - » Michelin
  - » Bridgestone
  - » Yokohama
  - » Continental
  - » Goodyear
  - » Double Coin
  - » Hankook
  - » Linglong

# NGWBS on U.S. Highways – Q2 2013

## Average USA = 19%

5 – axle heavy vehicles on USA highways with at least 1 NGWBS-fitted axle group (2Q13)
→ 13% to 32% (regional variations).

- NGWBS application on 5-axle vehicles based on a highway survey of 2974 vehicles.

# 2014 Status

## New Generation Wide Base Single Tires (NGWBS)

- US permit-issued operation (O/S, O/W, LCV)
  - 8 states - KS, MN, MT, NY, SD, UT, WA, NV.
    - » "... each axle (non-steering) must have 4 tires ..."
    - » "... two tires at each end of each axle ..."
    - » ". tandem axle shall have tires of the same size and construction ."
    - » "… 500 lpi …"
    - » WASHTO "Guide for Uniform Laws and Regulations Governing Truck Size and Weight Among the WASHTO States"
      - WASHTO Guide Section 9.08 - 2010 COHT ballot/survey approval
        - "*Axles previously equipped with four tires may use two wide-base tires as replacement, providing existing axle weight regulations and tire manufacturer ratings are not exceeded.*".
        - "NGWBS" tire definition vs "Super Single WBT" already adopted into WASHTO Guide Chapter 1.

# “Advanced” 6x2’s and NGWBST – A Great Combination

- It is no surprise that fleets attracted to the benefits of Advanced 6x2’s are also interested in WBST:

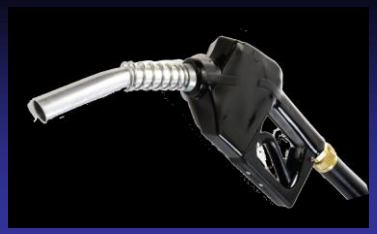
## *Weight Savings*

| | |
|---|---|
| 6x2 | 371 lb. |
| NGWBS | 800 lb. |
| Total Savings: | 1171 lb. |

Plus easier maintenance, inspection and inflation

## *Fuel Savings*

| | |
|---|---|
| 6x2 | 2-14.6% |
| NGWBS | 5-10% |
| Total Savings: | 7-14.6% |

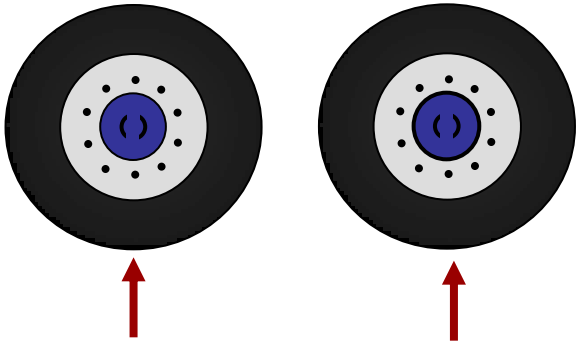


## *Expected Market Growth*

| | |
|---|---|
| Today( available since 2013) | <5% |
| 5 Year Projection | 15% |

# The Regulatory Issue

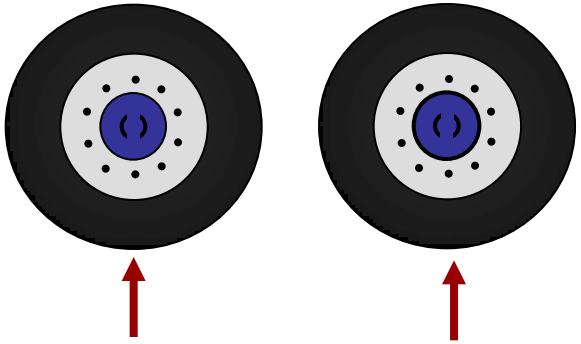
**Max Permitted Loading Of Axle with NGWBS (based on 500 lb per inch)**



17,200 lb.. Drive Axle

17,200 lb.. Tag Axle

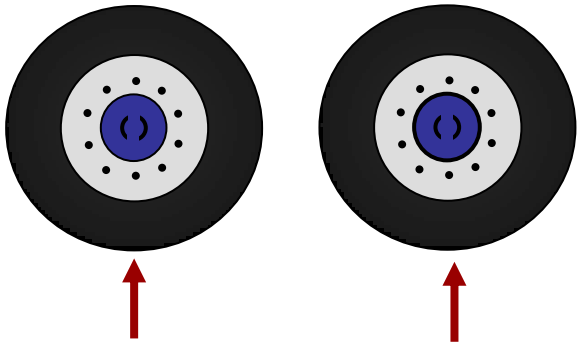
**"Advanced" 6x2 - Nominal**



17,000 lb.. Drive Axle

17,000 lb.. Tag Axle

**"Advanced" 6x2 – Load Transfer**



20,000 lb.. Drive Axle

14,000 lb.. Tag Axle

During load transfer event, load on drive axle exceeds 17,200 lb., and WBST loading exceeds 500 lb. per inch

# Regulatory Issue – Key Points to Consider

- The duration of a load transfer event is short. (Meritor's system times out at 80 sec; Meritor WABCO system restores equal split above 25 mph).
- The frequency of such load transfer events is low, less than 3% of the time or 3% of distance traveled.
- The maximum load on the drive axle during a load transfer event ***does not exceed single axle load limits*** imposed by state (NGWBS tire load per inch limit is temporarily exceeded).
- Loading during load transfer event is well within design limits for WBST.
- The improved traction and mobility offered by these advanced systems provides improved safety and vehicle stability.

# Regulatory Issue: Key Points to Consider

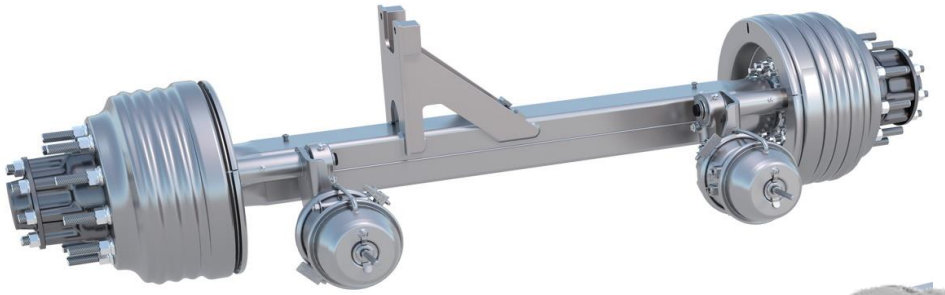
- **Benefits to Fleets**
  - Greater Fuel Efficiency (approximately **7-15%** combined when WBST are used on 6x2 vehicles
  - Reduced Weight – Nearly **1200 lb.**. savings combined. Improved fuel economy and/or allows greater payloads.
- **Benefits to the States and the General Public**
  - Reduced Vehicle Emissions – 10% Fuel Savings ~ 10% Reduction in Greenhouse Gas Emissions
  - Truck maintenance and inspection with NGWBS tires is simplified over duals (eliminates concerns about tire pressure differentials and unmatched sizes that affect tire load sharing).
  - More Productive Fleets = Increased business, revenues, and a more robust economy.

# Request to Regulatory Authorities
## (in states that impose 500 lb per in. limit on NGWBS tires)

**We respectfully request that you consider some means of acknowledging the compliance of these "advanced" 6x2 systems equipped with NGWBS tires. This can be accomplished by:**

- An instruction
- A "waiver"
- An exception
- Adoption of a less vigorous interpretation of the regulations
- A footnote to the current regulation exempting WBST installed on "advanced" 6x2's with electronically controlled air suspensions from the 500 lb. per in. limit.
- A formal change to the regulations

# Thank You!

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