REAL-WORLD LESSONS IN BRAKING

Presented by Ben Wight

ATA – Technical and Maintenance Conference - 2013

- Who we are
- Our role/experience in the industry
- Who I am

bisttecniks P/L
VEHICLE DESIGN - CERTIFICATION - ACCREDITATION

Who we are

- Engineering Company

- Majority of Trailer manufacturers (approx. 250 current clients)
- Truck Manufacturers
- Majority of parts suppliers – Truck and Trailer
- Larger fleet operators – prototype designs

bisitecniks P/L

VEHICLE DESIGN - CERTIFICATION - ACCREDITATION

What we do

- Certification & Compliance (IPA, VIA, VASS)
- Bisitecniks is a high volume Canberra customer
- Accreditation (NHVAS, PBS)
- Offer design services
- We specialise in testing truck and trailer:
  - Brakes
  - Suspensions
  - Control systems (air / hydraulic / electric)
  - FUPS, RFS, ADR noise level, Odometer testing, etc

- Been involved in development of ADR's, AS & VSB's since the 1980's.

Brakes & Testing

- Vehicle components

- ADRs 35 and 38 cover the brake design requirements for trucks and trailers.
  - Australian Design Rule 35/03 – *Commercial Vehicle Brake Systems*
  - Australian Design Rule 38/03 – *Trailer Brake Systems*

ADR35 & ADR38

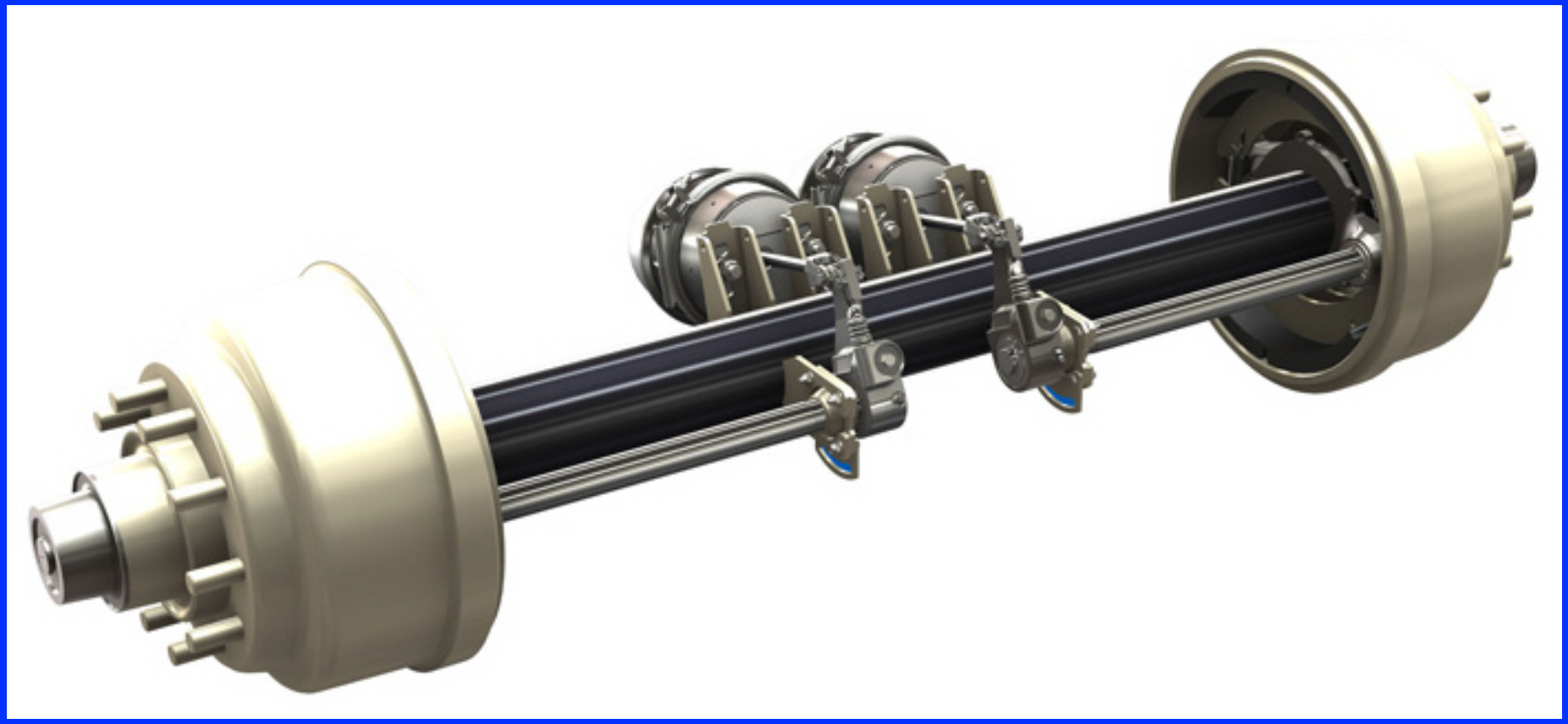
- For a truck to comply, what are some of the things that need to be tested?

- On road testing – Laden & Unladen
- Control system tests – application time response – RT rated PM's exhaust time response
- Air System checks – compressor recovery

ADR35 & ADR38 continued….

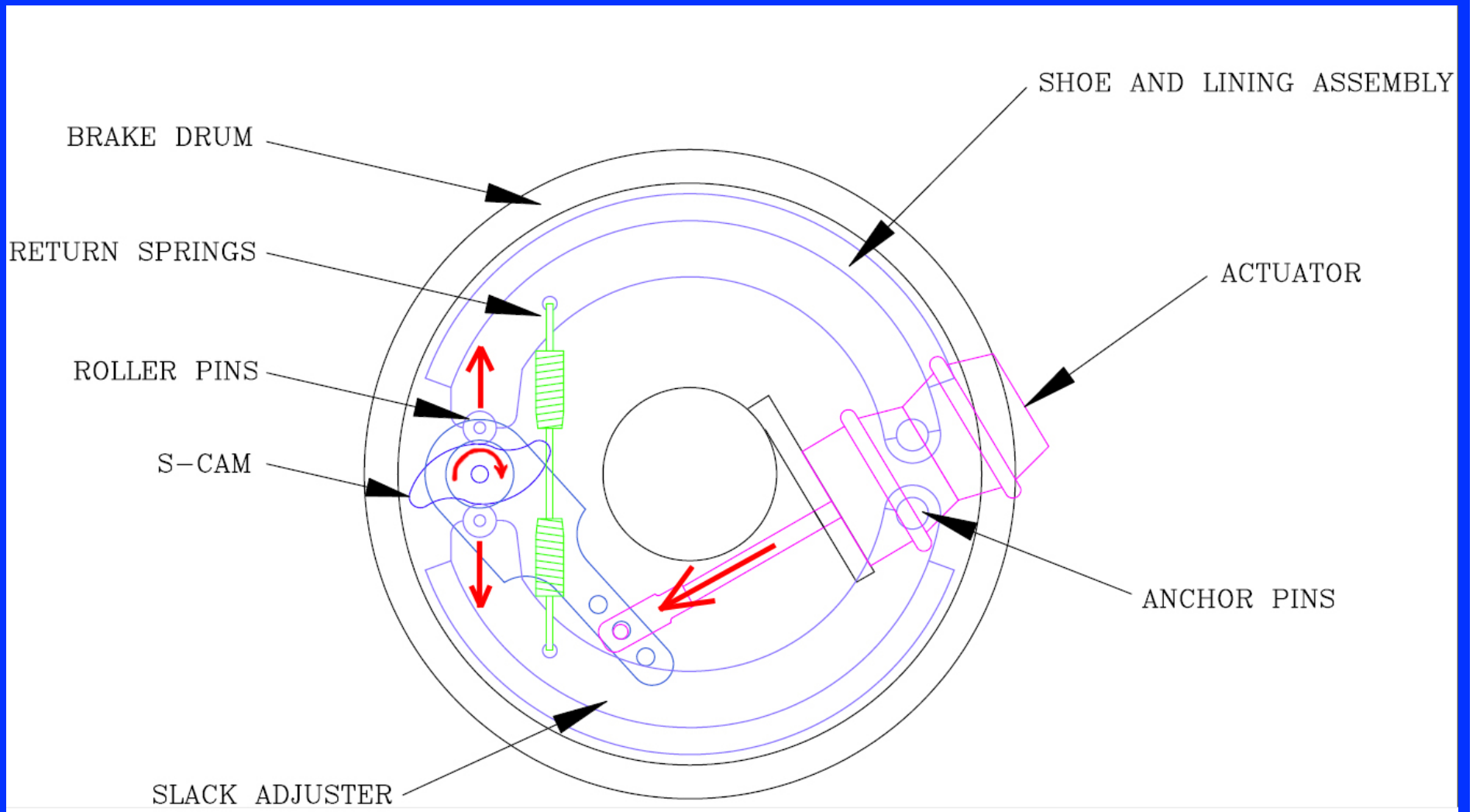
- Trailer testing requirements
- We test the following assemblies:
  - FB – Foundation Brakes
  - SS - Suspensions
  - CS - Control Systems
  - TB – Total Trailer Brake
- Each sub assembly is eligible for registration with the Department of Infrastructure & Regional Development.
- SARN

FOUNDATION BRAKES



FOUNDATION BRAKES

How they work (S-Cam)

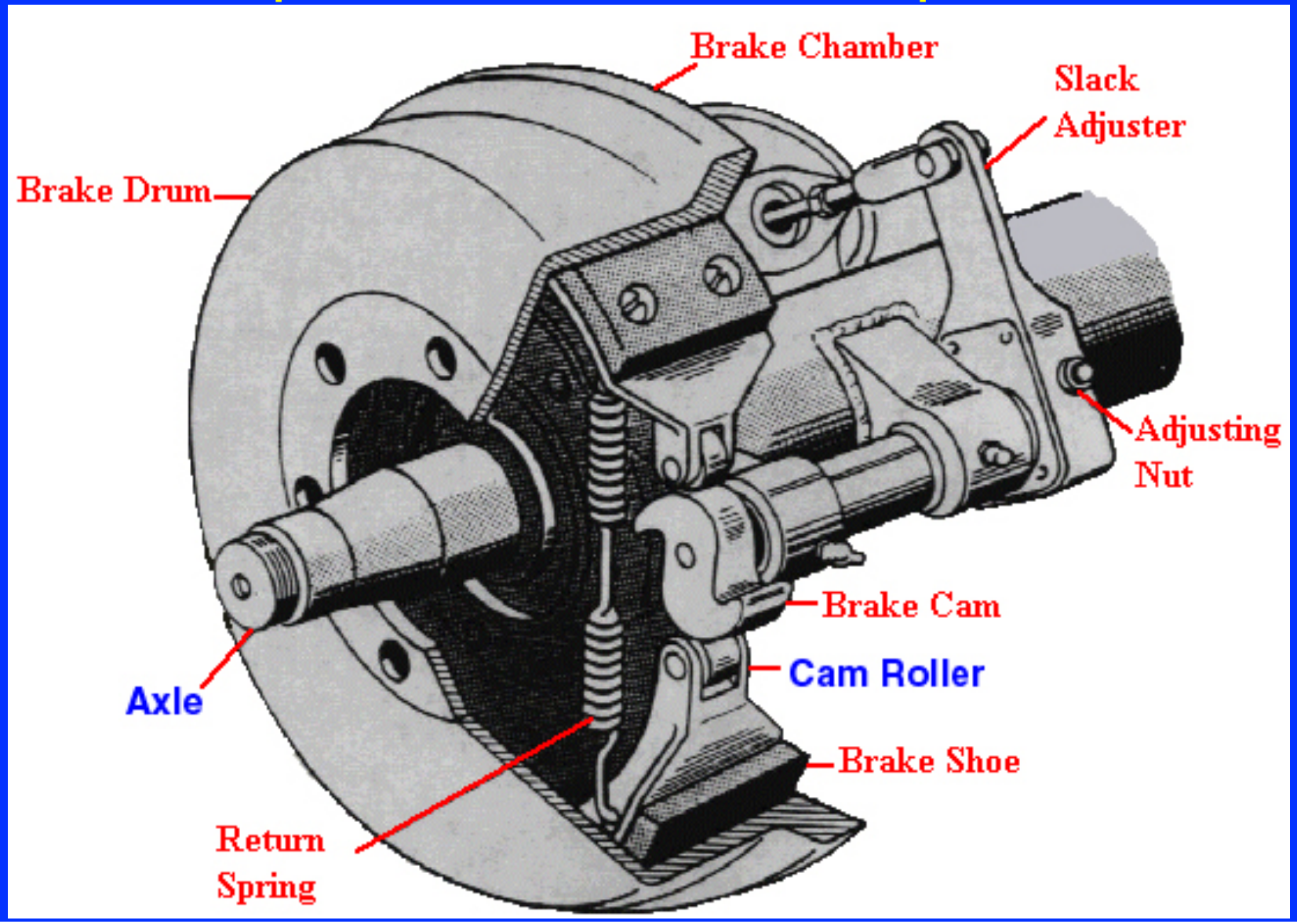


FOUNDATION BRAKES
Boosters/Actuators/Chambers

- Terminology
- Type 30 vs. Type 30/30

FOUNDATION BRAKES

What components contribute to performance?



FOUNDATION BRAKE
Testing

- What we measure:
  - 1.0E Brake torque
  - Park Brake torque
  - Gross Axle Load Rating (GALR)
  - Booster stroke
  - We record the other details (eg, booster size, slack adjuster length, tyres, etc)

- The approval is only valid for those components

FB TESTING continued….

- All testing is physical testing – on-road vs. dynamometer
- Measure average acceleration over a stop – either stopping time or distance
- Acceleration used to convert to a brake force
- With known tyre radius, axle brake torque can be calculated

- Cold service torques
- Fade test - GALR
- Park brake test
- Booster pushrod stroke
- Test report & SARN submission

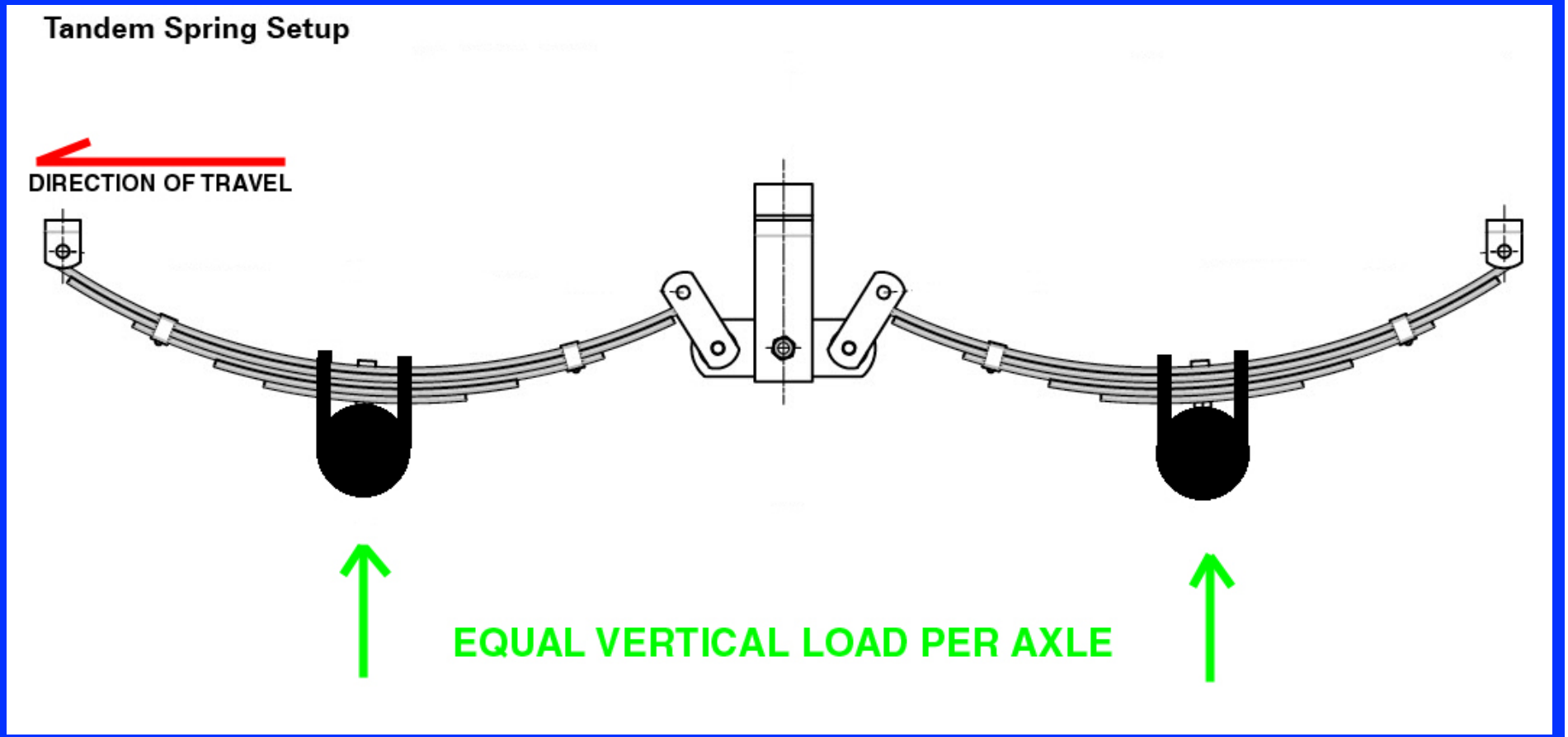
QUESTIONS ?

SUSPENSIONS

SUSPENSIONS

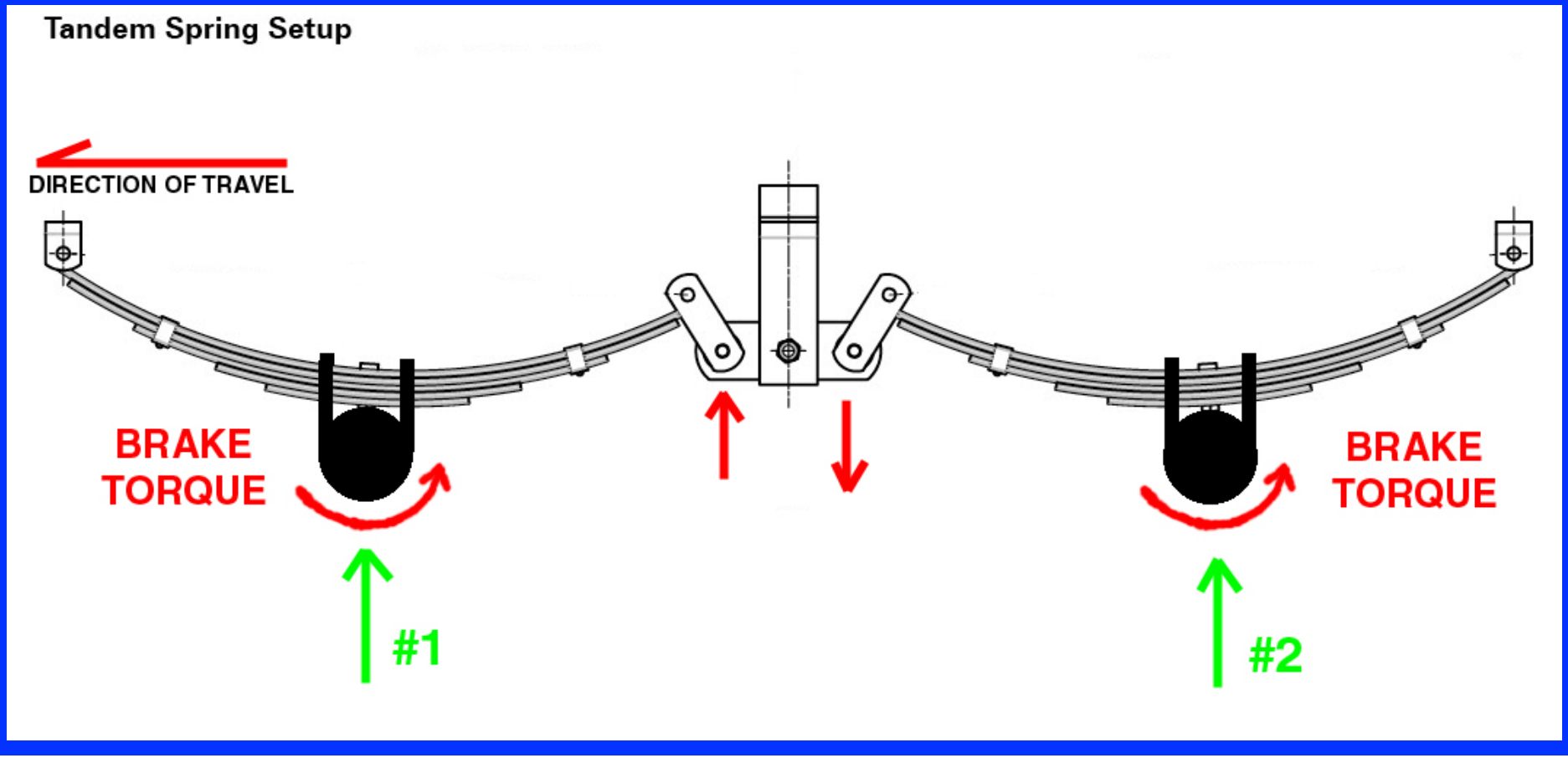
Metal Suspensions – Load Sharing

- ADR's specify that suspensions must load share



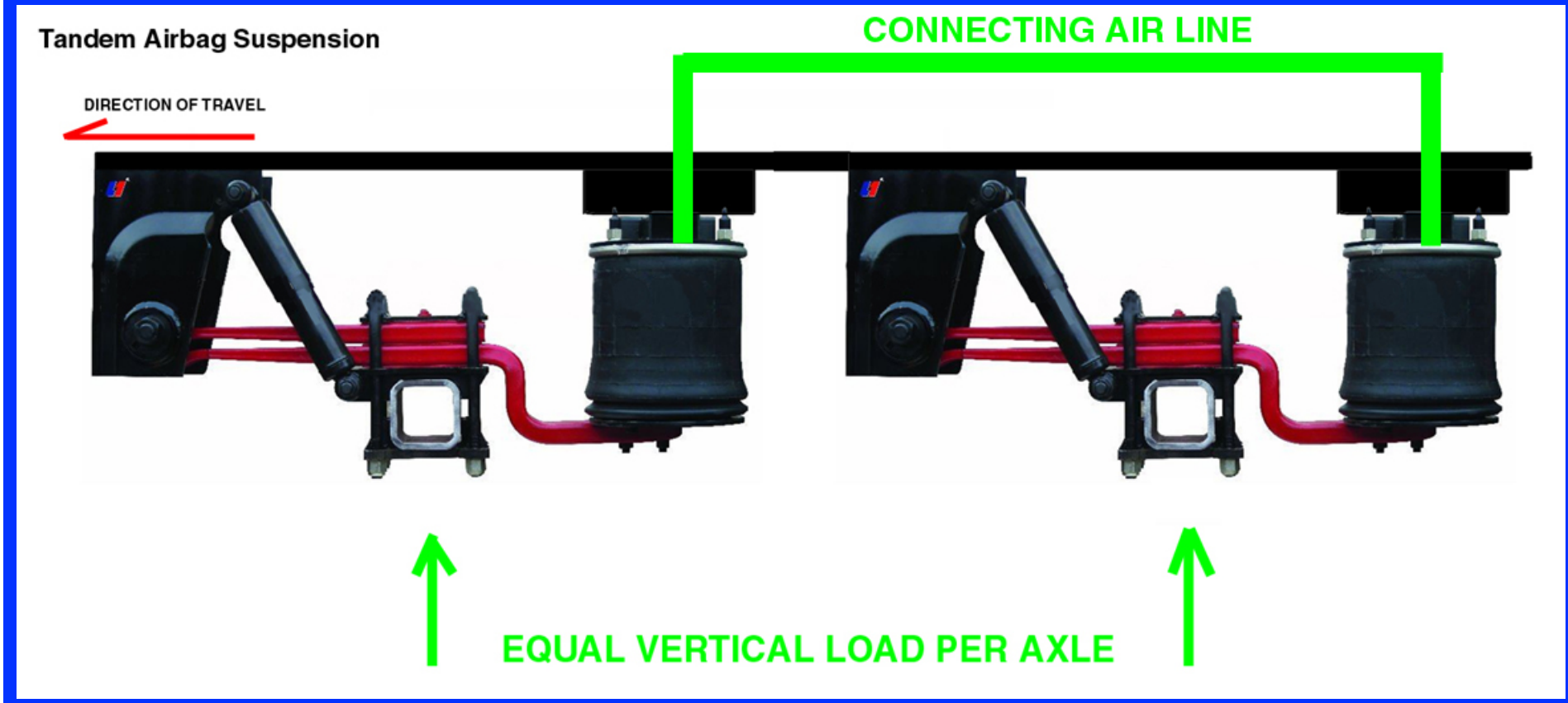
SUSPENSIONS
Metal Suspensions – Brake Reactivity

- Skid limit testing to measure brake reactivity



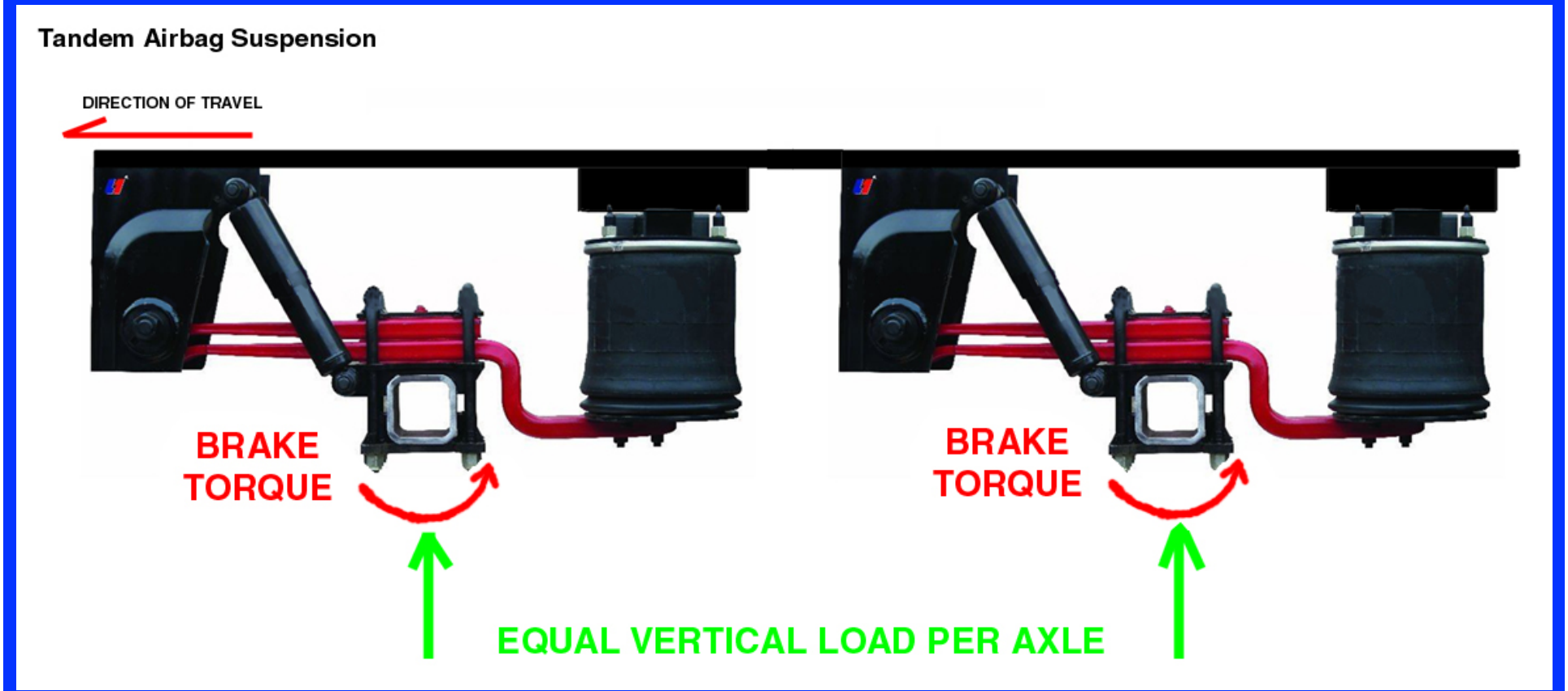
SUSPENSIONS

Air Suspensions – Load Sharing



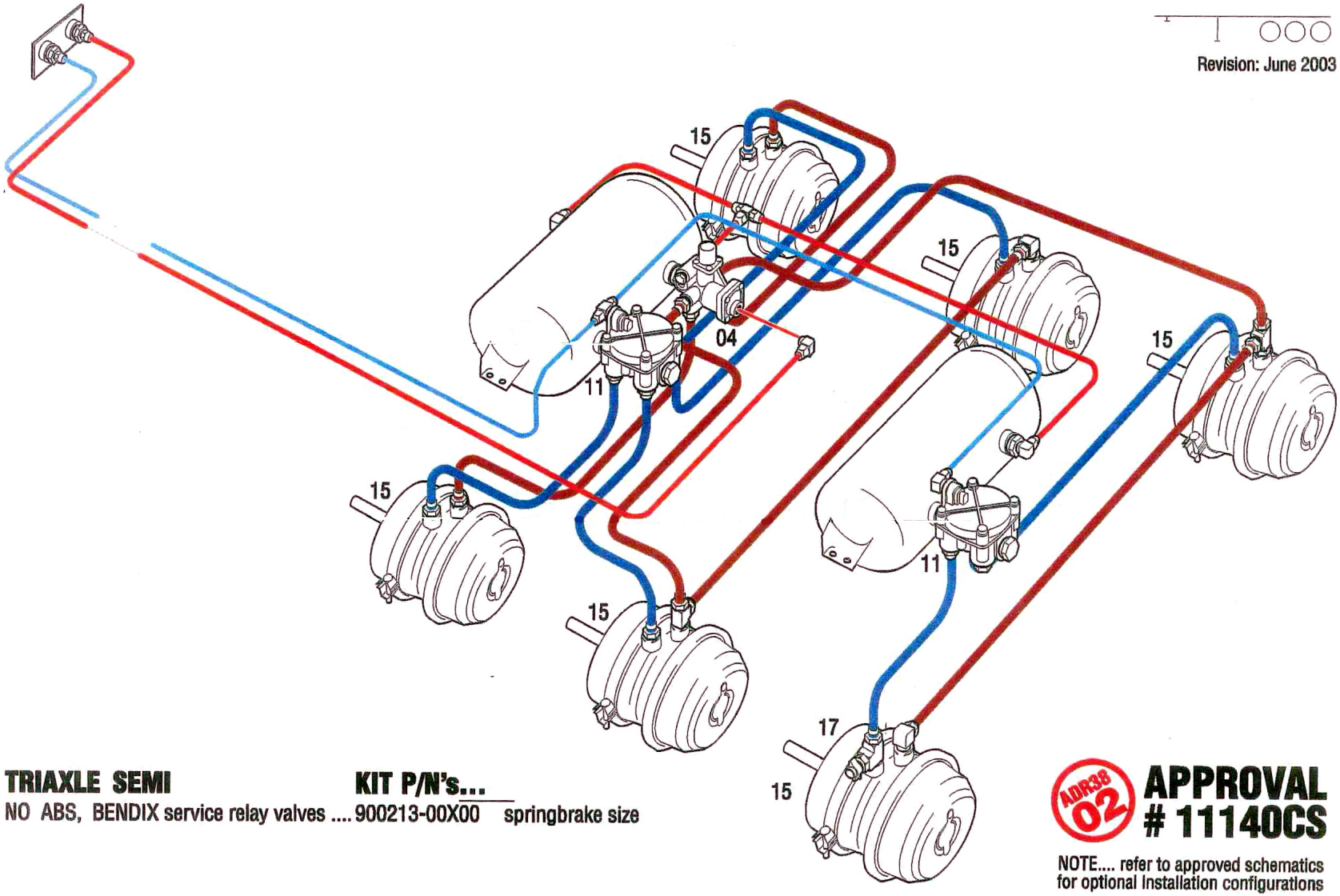
SUSPENSIONS
Air Suspensions – Brake Reactive

- No testing required



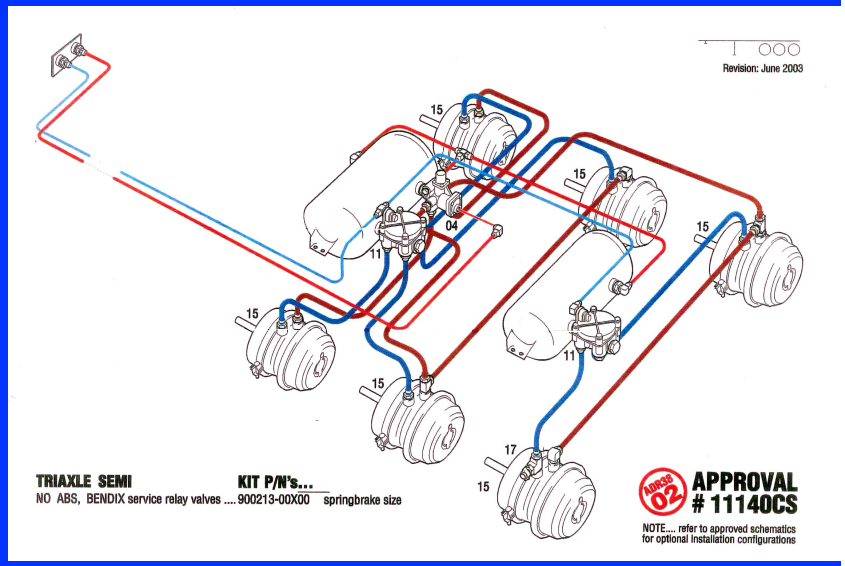
QUESTIONS ??

CONTROL SYSTEMS



CONTROL SYSTEMS

Testing



- What we measure:
  - Coupling to booster app/exh
  - Coupling to rear service coupling application/exhaust
  - Relay valve input/output ratios
  - Spring brake valve function
  - We record the other details (eg, tanks, booster sizes/ stroke/volume, line lengths, fittings, etc)

- The approval is only valid for those components in the configuration as tested.

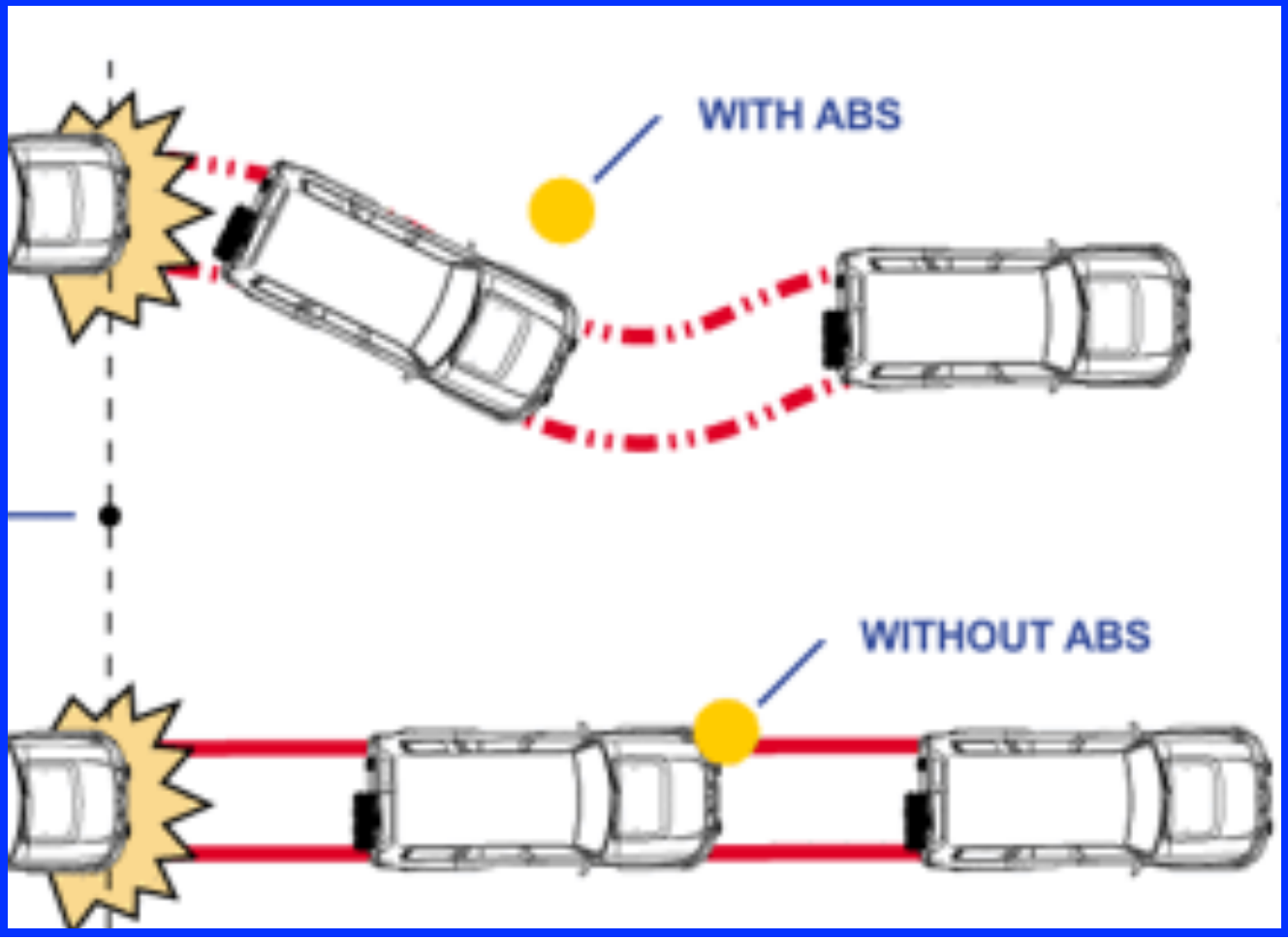
CONTROL SYSTEMS

Hi-Tech Options

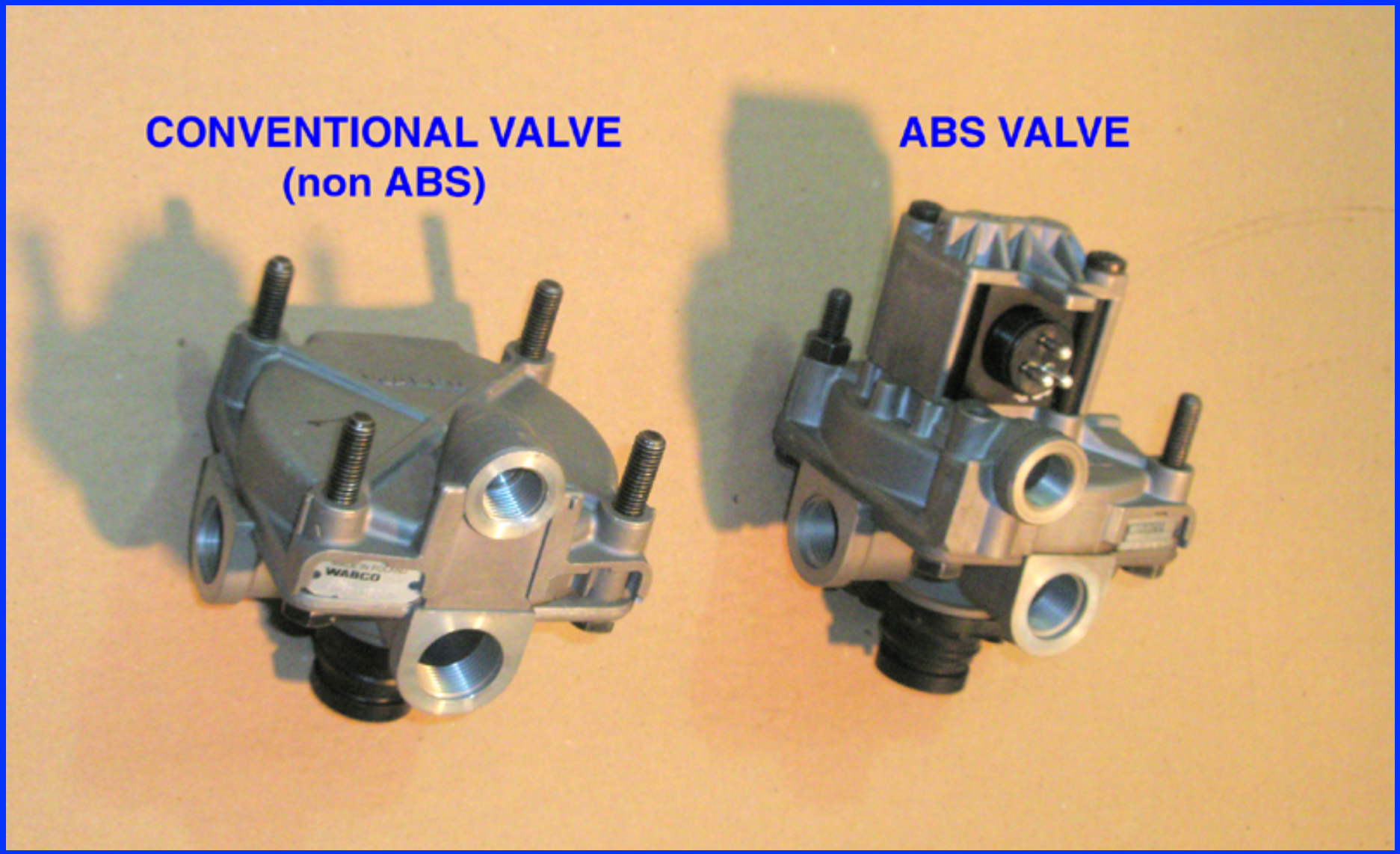
- ABS - Antilock Braking System
- LPV – Load Proportioning Valve
- EBS – Electronic Braking System

ABS

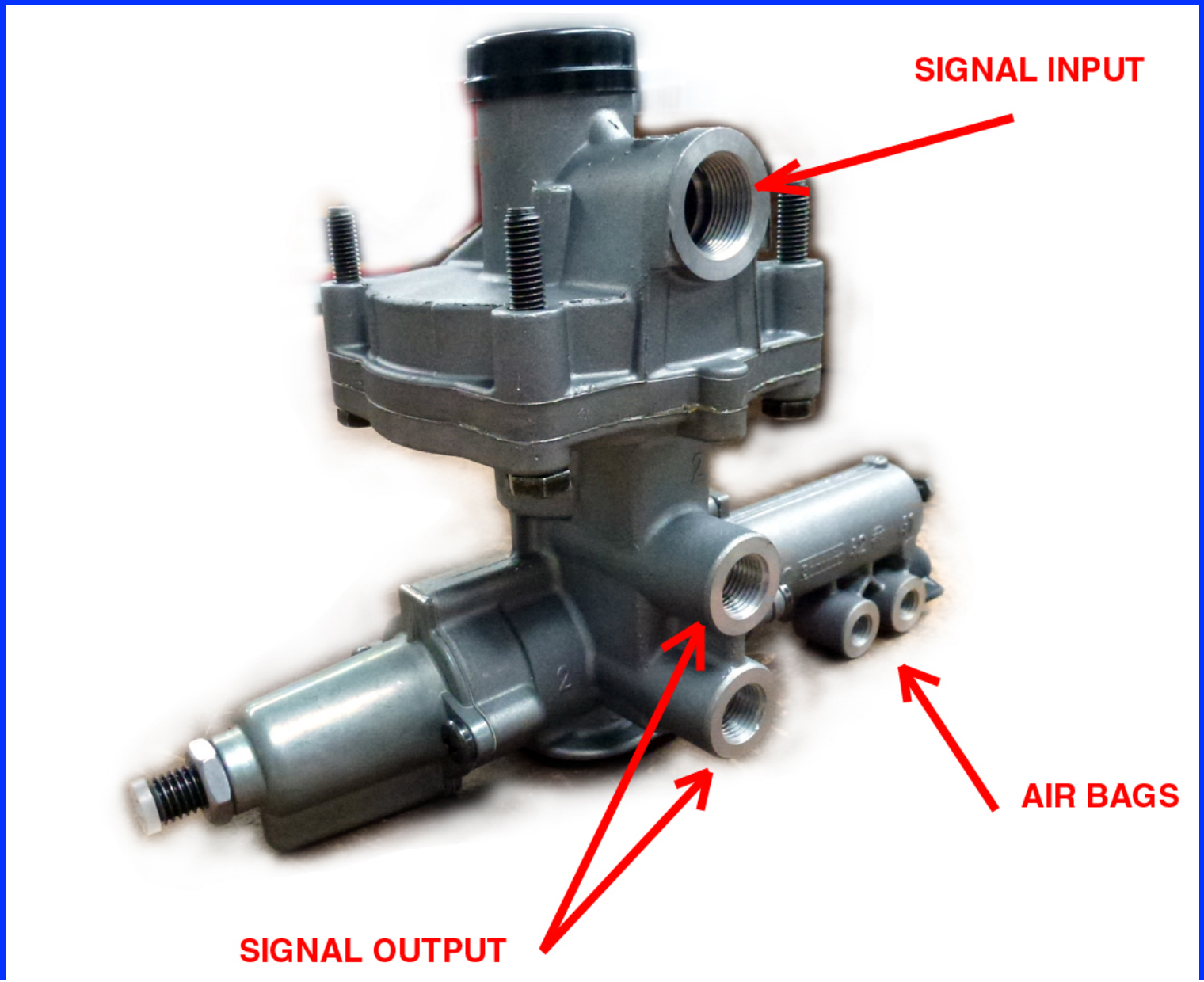
- Enables the vehicle to maintain directional stability
- Stopping distances will increase if ABS activates
- Gravel roads can cause problems
- Benefits outweigh the drawbacks



ABS
Valve Comparison



LPV



EBS

- ABS
- LPV
- ESP - Roll Stability
- CAN Features – electronic signaling/measuring/recording

EBS Performance

EBS Performance

QUESTIONS ???

ADR35 Truck brake testing

- What we test/measure:
  - Laden and unladen tests
  - Service Brake performance
  - Partial Failure tests
  - Fade test
  - Park Brake test
  - Control system tests – time response
  - Air System checks – compressor recovery
  - We record the other details (eg, tank sizes, vehicle details, etc)
- We often test vehicles because of a change in specification, or to chase higher ratings.

QUESTIONS ????

BRAKE RELATED OPTIONS

- Lift axles

BRAKE RELATED OPTIONS

- Auto Slack adjusters

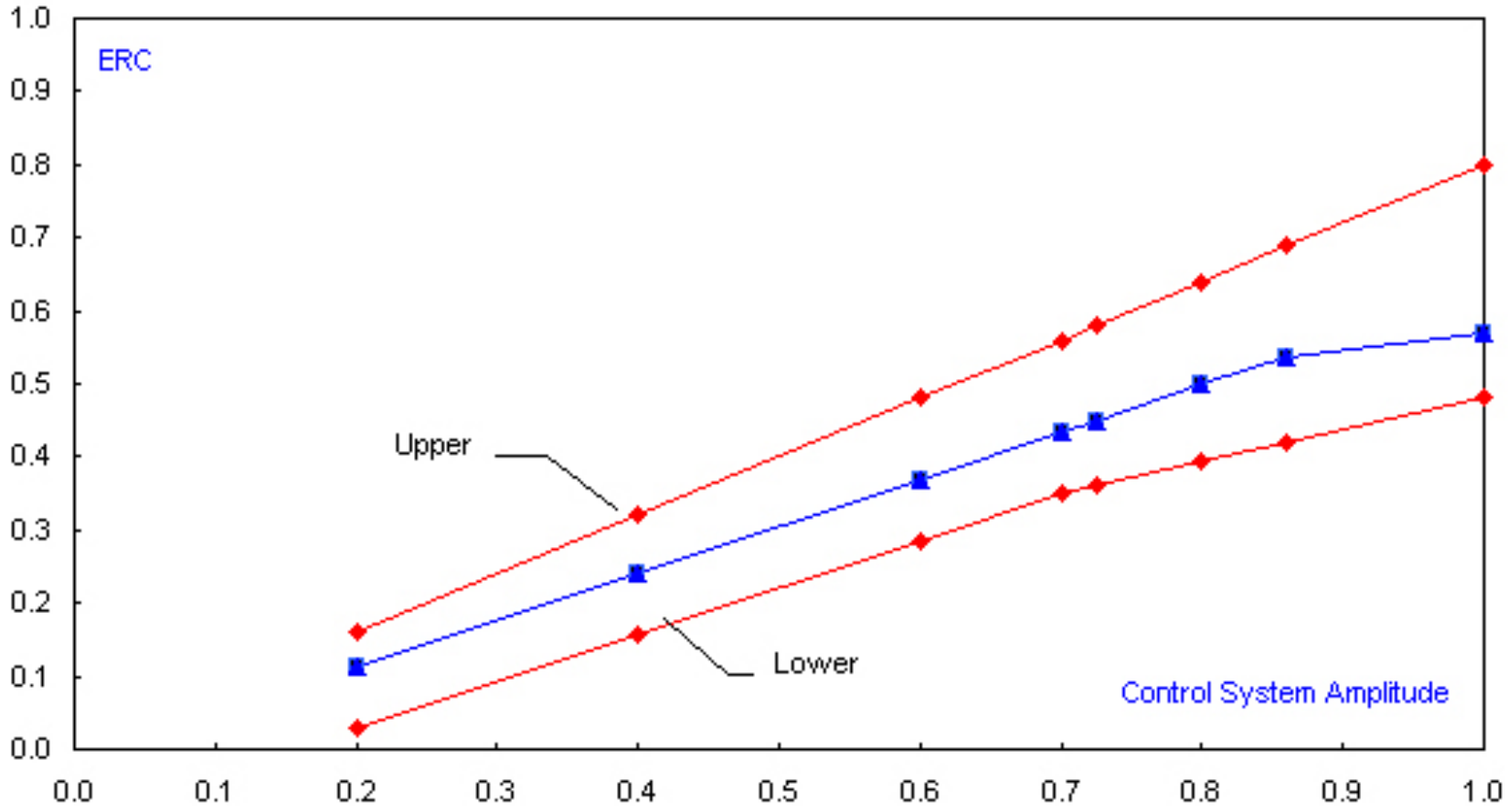
SUMMARY
Testing Trucks and Sub Assemblies

- Brakes
- Suspensions
- Control Systems
- Electronics
- Air Systems

- Either total vehicle (truck or trailer test) or approved calculations for trailers

ADR38 BRAKE CALCULATIONS

Triaxle Semi - 20t GTM - 11R22.5 - T24/30 @ 6"

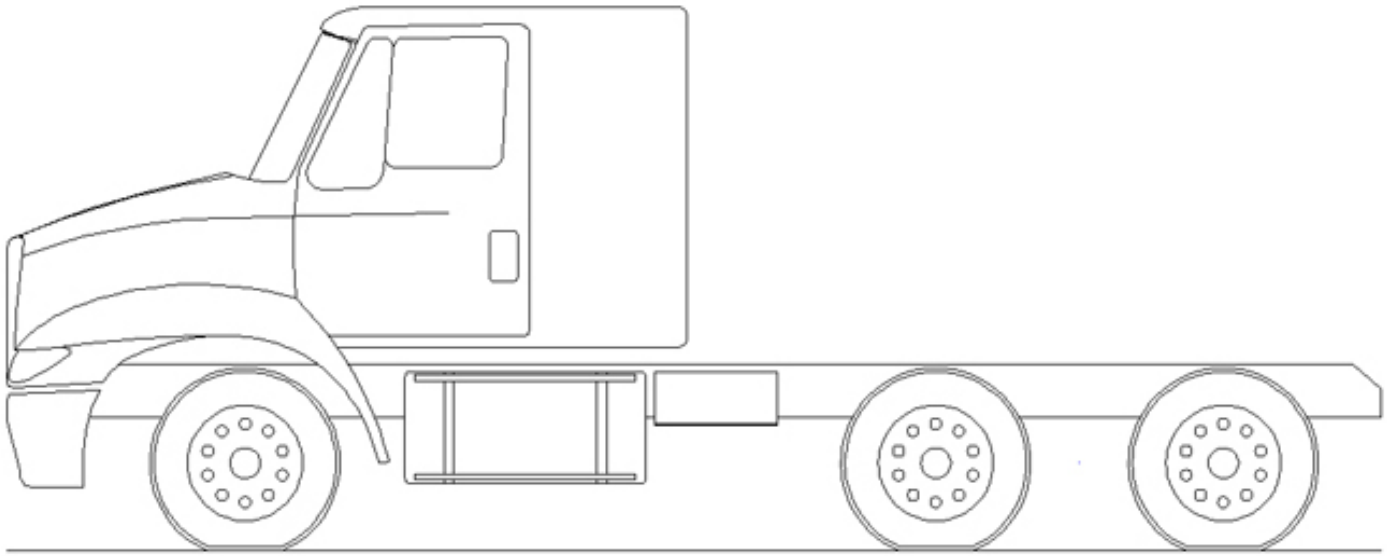


QUESTIONS ?????

ADR TESTING ISSUES

- Test sites
- Test loads
- Measuring stopping times & distances
- Consistency
- ADR procedures

ADR Testing Issues
Finding a suitable test site



			TOTALS
STATUATORY	6.0t	16.5t	22.5t
HIGHER MASS	6.5t	17.0t	23.5t
MANUF. RATING	7.0t	19.0t	26.0t

ADR Testing Issues

Finding a suitable test site

ADR Testing Issues
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ADR Testing Issues

Finding a suitable test site

ADR Testing Issues

Finding a suitable test load

ADR Testing Issues

Finding a suitable test load

ADR Testing Issues
Finding a suitable test load

ADR Testing Issues

Finding a suitable test load

ADR Testing Issues

Finding a suitable test load

QUESTIONS ??????

ADR TESTING ISSUES
Stopping distance

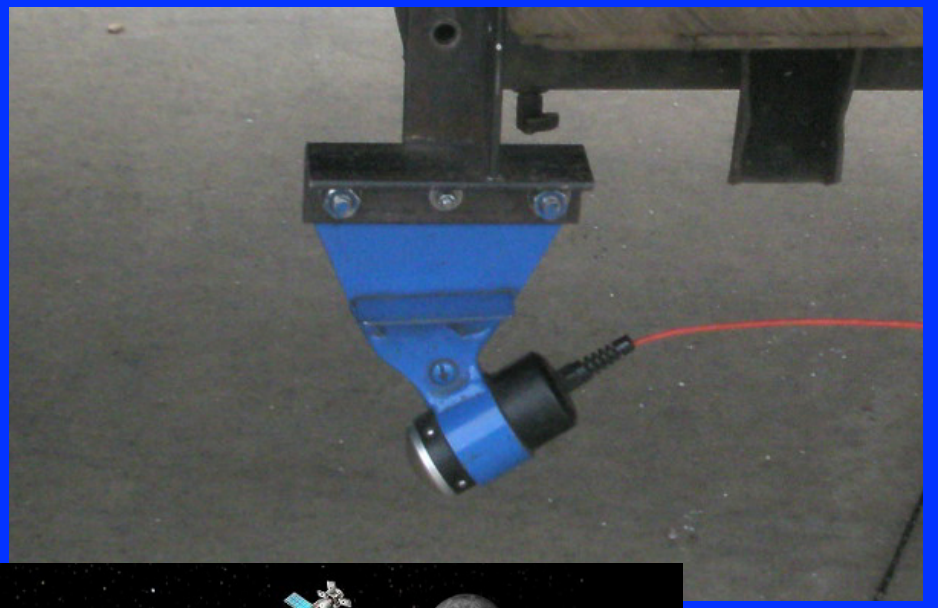
- What are the options?

HOW TO MEASURE???

STOPPING DISTANCE

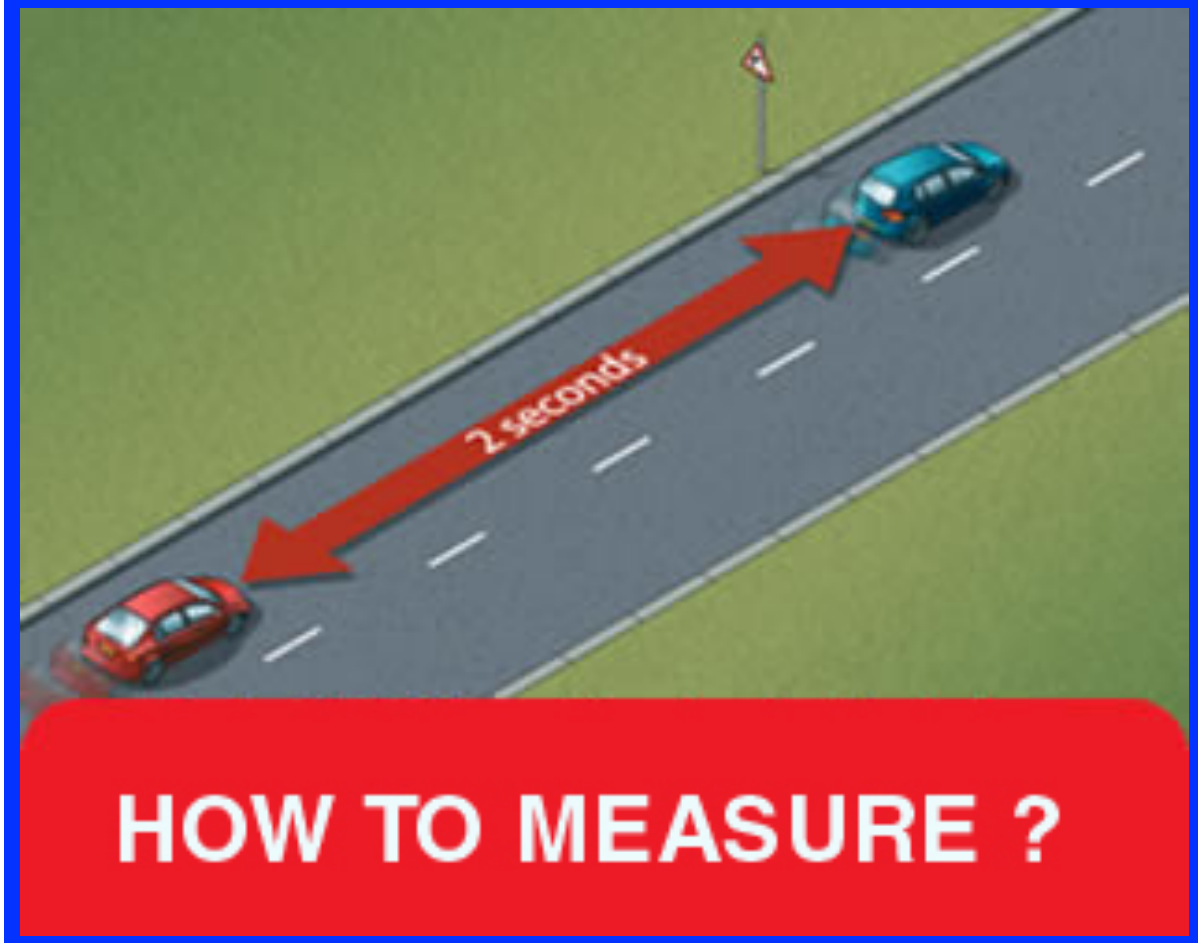
ADR TESTING ISSUES

Stopping distance



ADR TESTING ISSUES

Stopping time



ADR TESTING ISSUES

Consistency

- Consistency between tests
- Test gear
- Test site
- Temps
- Wind
- Driver

ADR TESTING ISSUES
ADR Lack of Procedures

- Follow the “intent” of the ADRs
- Fade testing
  - Guess a GALR
  - Cool down time
  - Expense
  - 20 conditioning stops then 1 performance stop
- Wind speeds
- CS testing
  - Booster brands / size / stroke / volume

QUESTIONS ???????

ADR Testing vs. The Real World

- Burnishing
- Weight Transfer under braking
- Contact Pressures
- Temperature Issues
- Control System I/O ratio boost
- Maintenance

BURNISHING

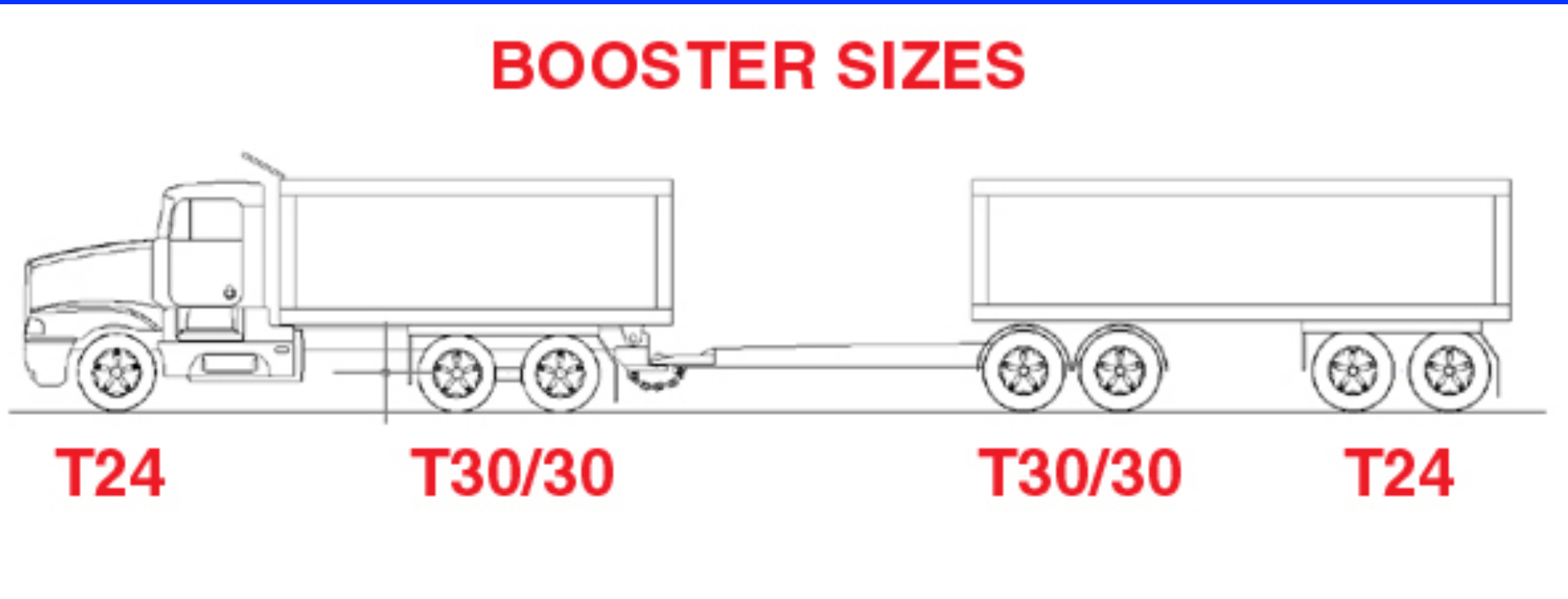
- ADR38 FB test procedure is to burnish the drum/linings until ~ 80% contact
- This may take several hundred burnishes
- Can equate to thousands of km's of highway use before brakes perform as tested
- Some truck OEM procedures are not to burnish
- Pads & linings behave differently after going through heat cycles

WEIGHT TRANSFER

- Rigid vehicles, regardless of how many wheels/axles, will experience weight transfer under braking (min. 2 axles)

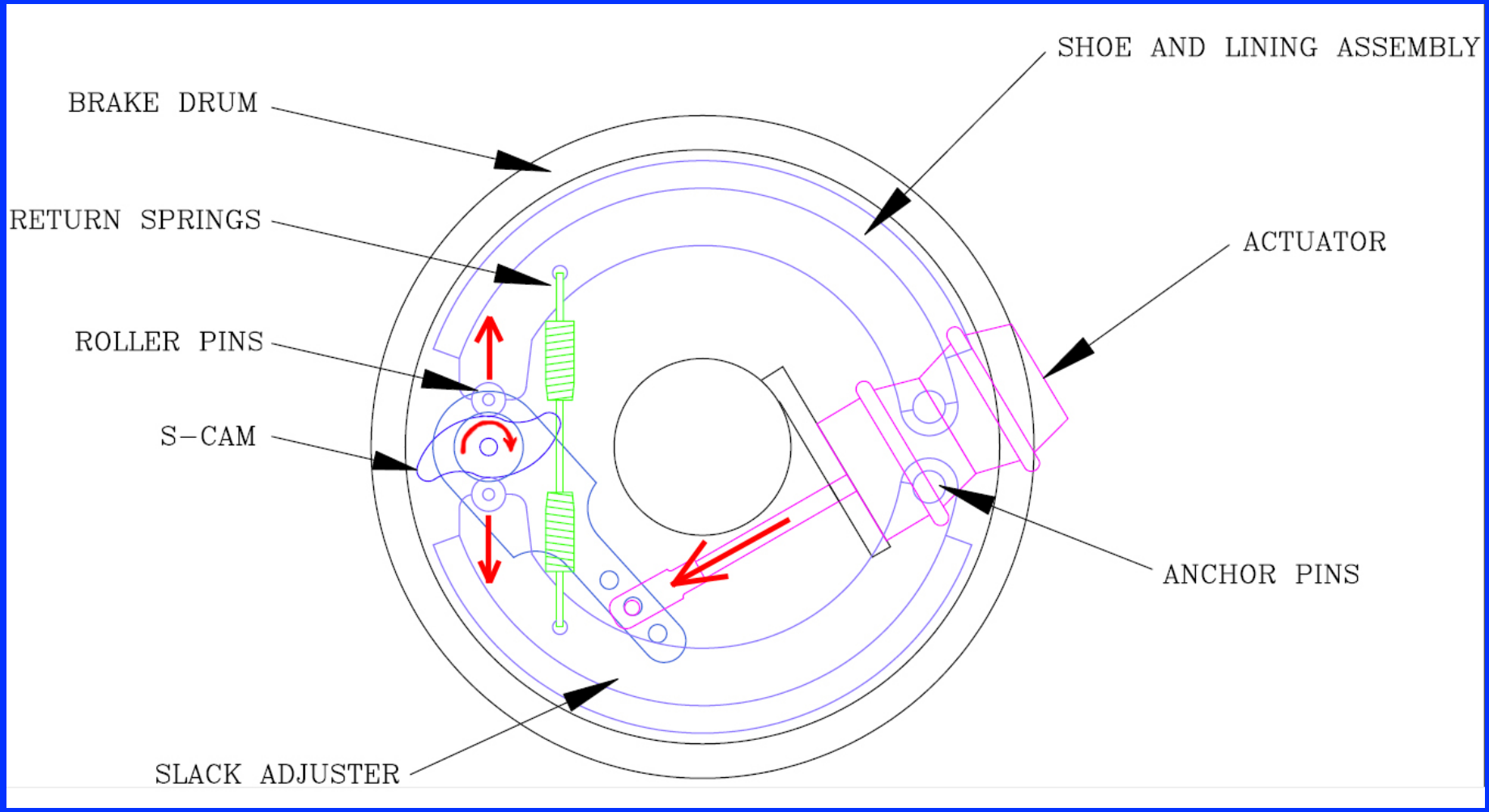
WEIGHT TRANSFER

Uneven brake wear



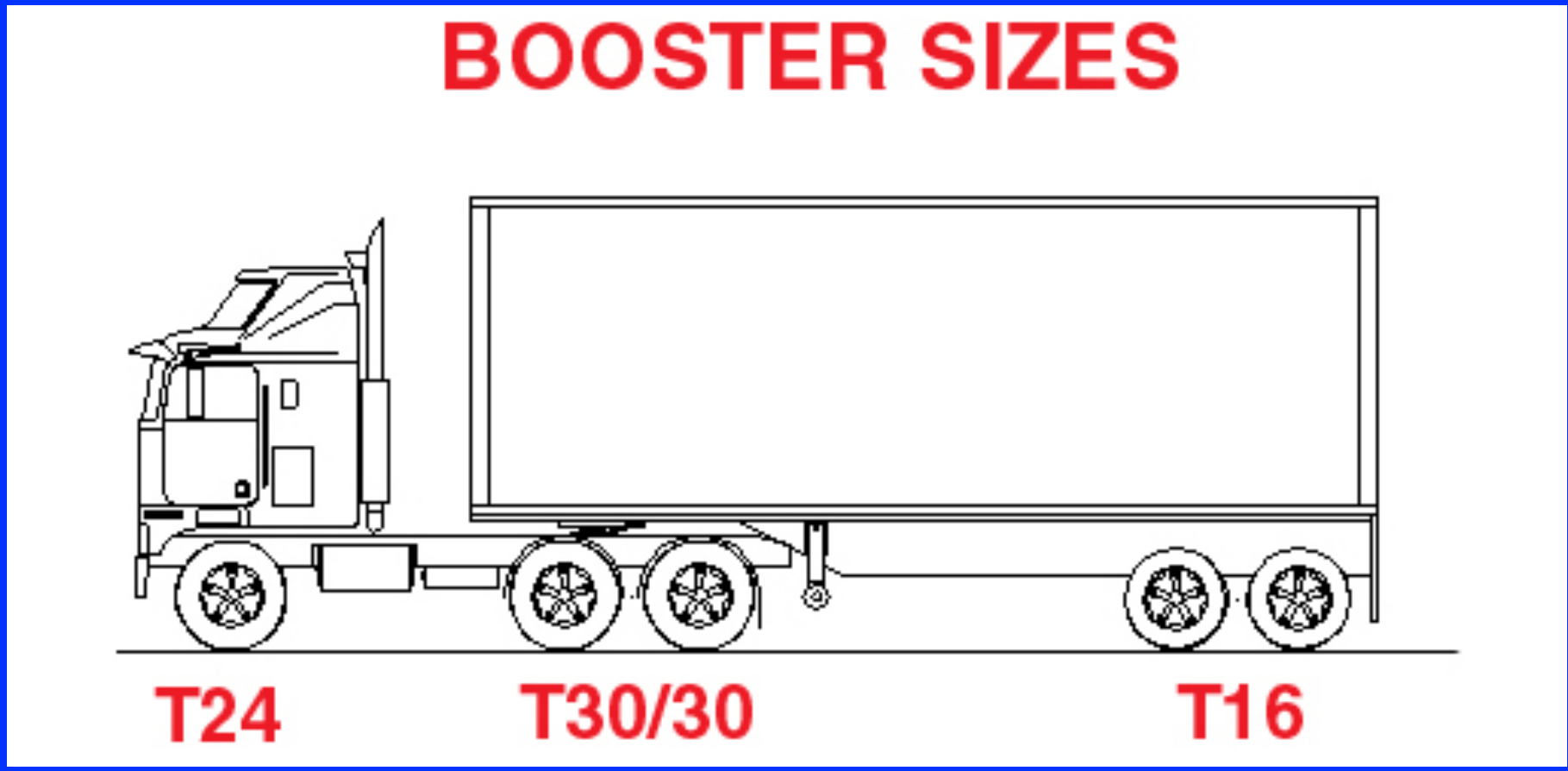
CONTACT PRESSURES

- Different size boosters will apply at different pressures
- Why is this a problem?



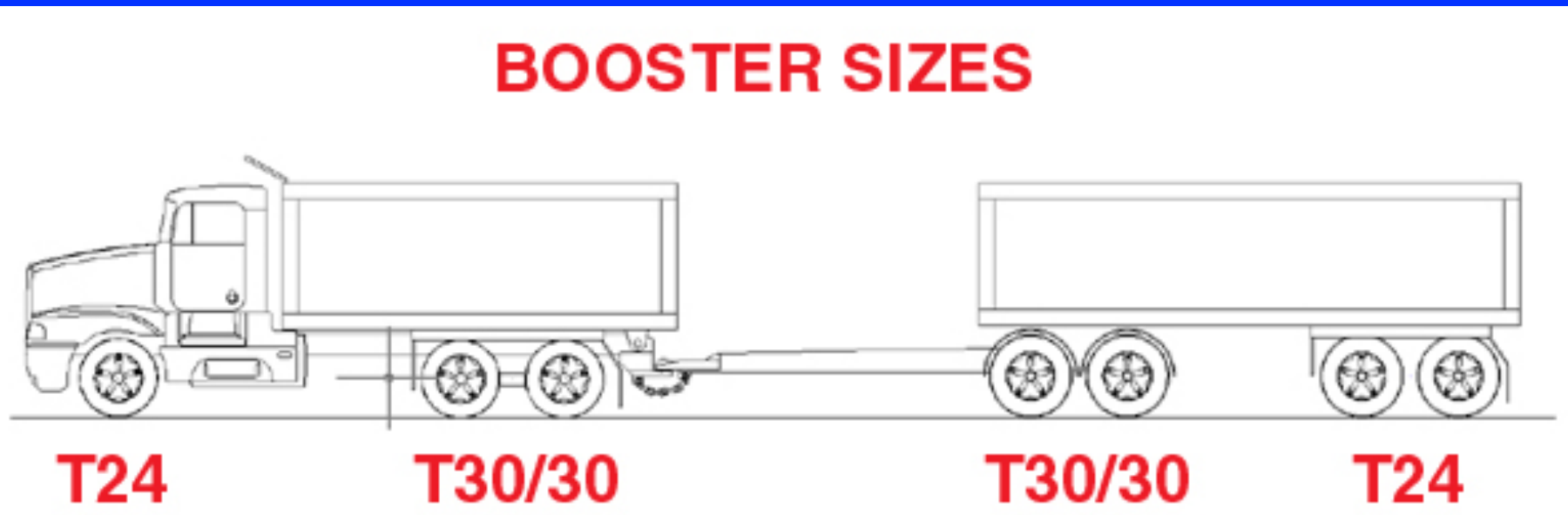
CONTACT PRESSURES

- Feather braking



CONTACT PRESSURES

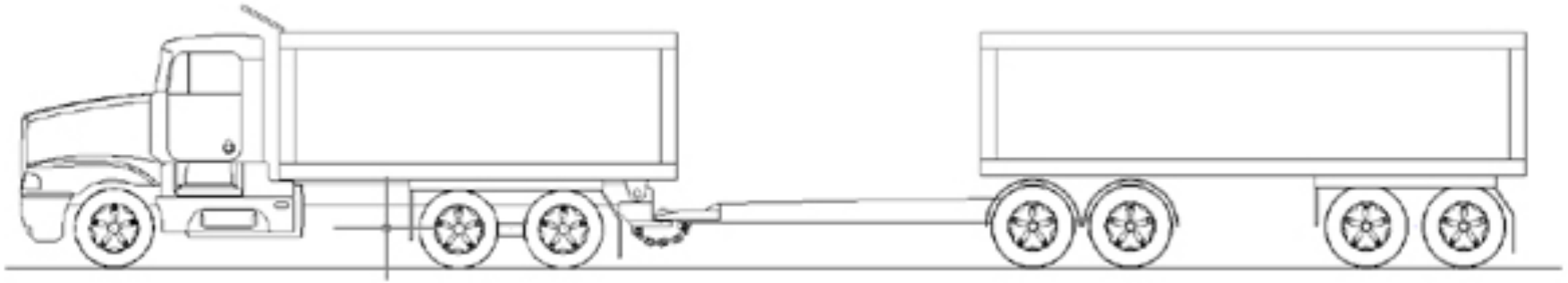
- Feather braking



TEMPERATURE ISSUES

- Uneven brake specs result in uneven temps
- ADR test parameters – max temps vs. real world temps.
- Linings are temperature sensitive – performance changes at low vs. high temps

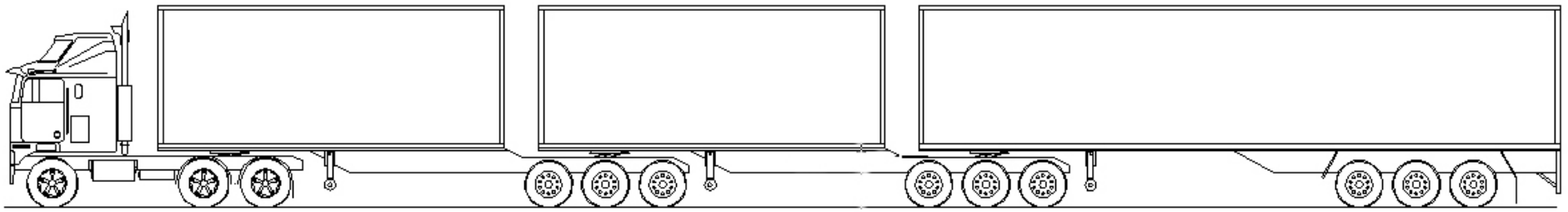
BOOSTER SIZES



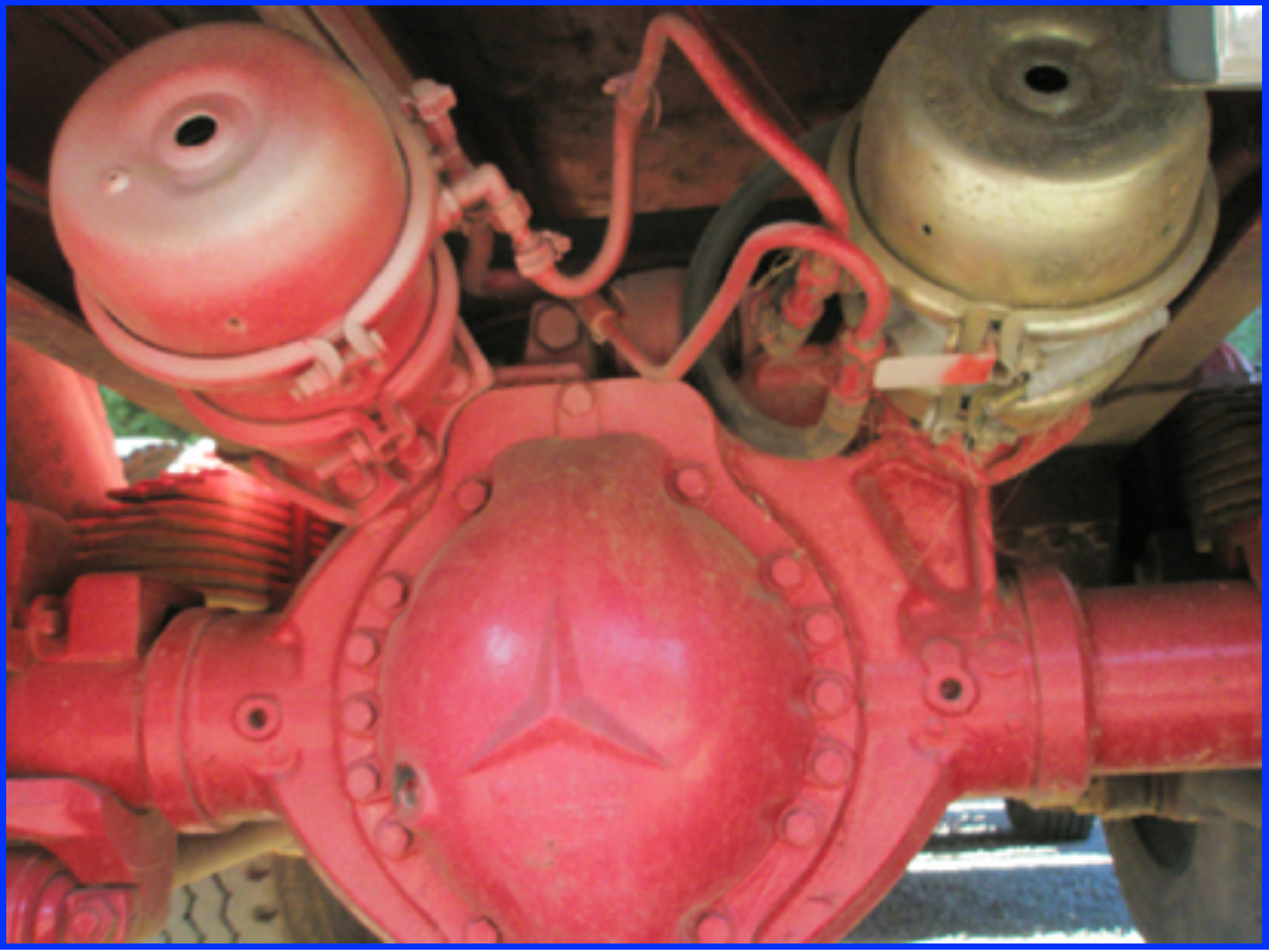
CONTROL SYSTEM IO RATIOS
Boost Between Trailers

- Long BD or RT combinations
  - Some control systems use 1:1 relay valves. ie. 100% output
  - Some control systems use ‘boost’ valves. ie. 110% output.

CONTROL SYSTEM VALVE - I/O RATIO BOOST
110% x 110% x 110%



MAINTENANCE



MAINTENANCE

MAINTENANCE

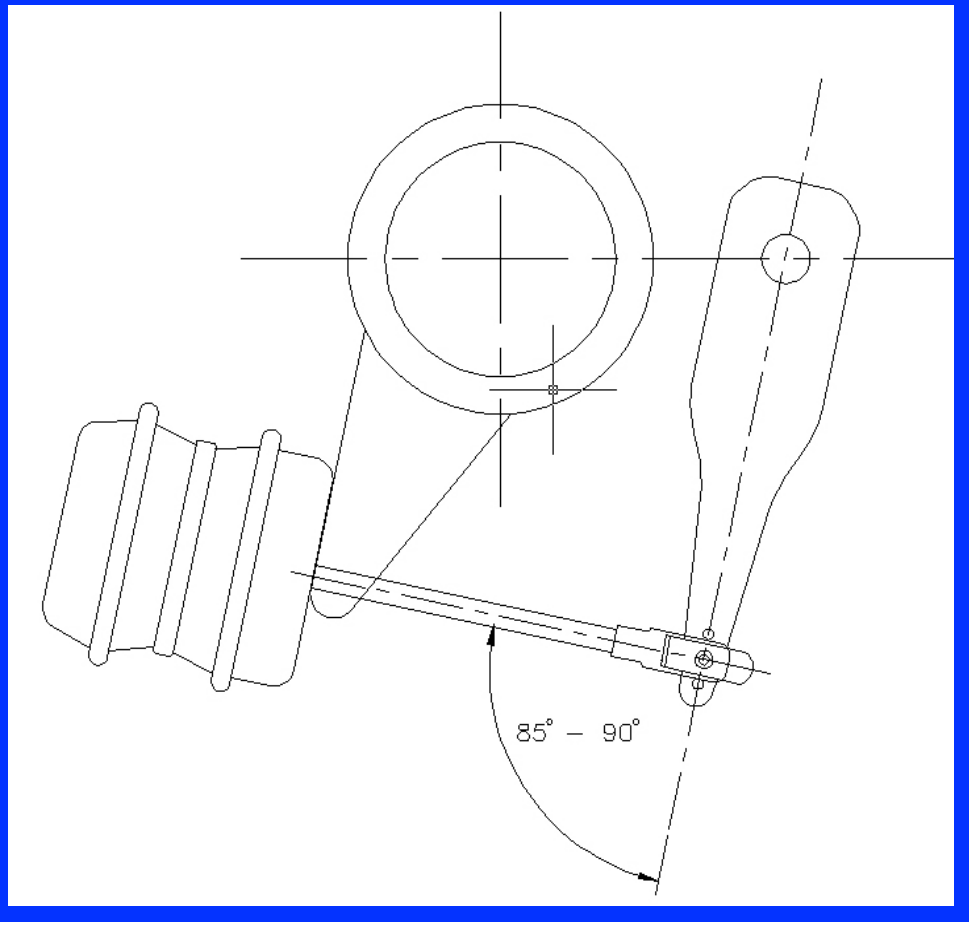
MAINTENANCE

- Retain original size boosters as fitted to vehicle
  ~ 25% change in brake performance

- Don’t change slack adjuster settings
  ~20% change in brake performance

- Use like for like replacement
  - Boosters
  - Relay valves
  - Tyre size

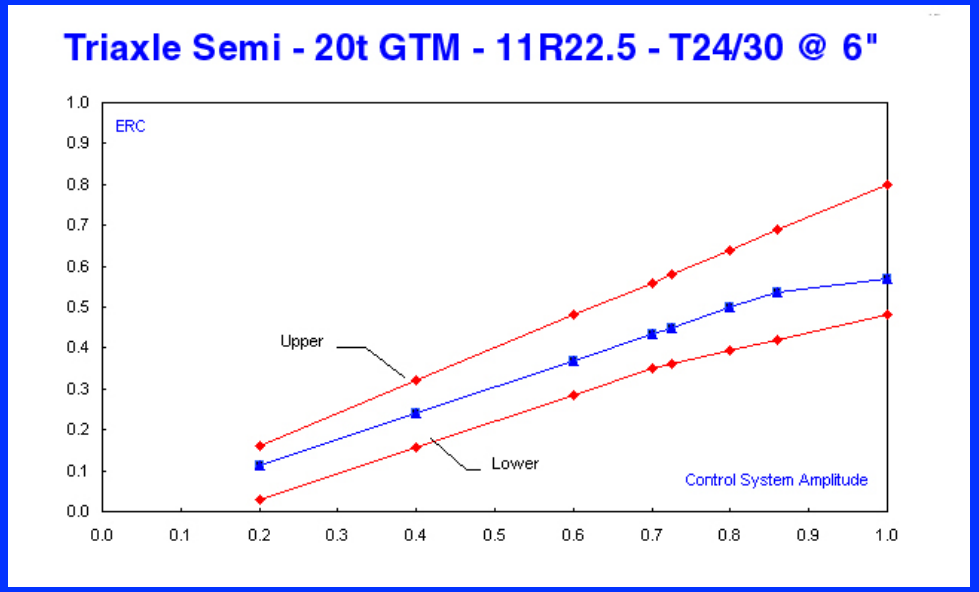
- Control Systems
  - Line lengths
  - Hose type
  - Fitting style
  - Tank size / number



Questions ??????????

REAL WORLD BRAKE PERFORMANCE

- Brake performance
  - 0.38g decel for trucks
  - 0.45g decel for PM's and semi's
    - Stopping distances ~ 31m @ 60km/h / 86m @ 100km/h
  - Fade resistance
  - Park & Emergency
- Balanced braking



- Safer combinations including new technology

Questions ??????????????