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**Miscellaneous**
- Brake Application Approval Request Form
Important Information about These Guidelines

Purpose
The purpose of these Brake Application Guidelines is to provide original equipment manufacturer (OEM) builders of medium and heavy duty trucks with information about which Spicer® brake products are approved by Dana Corporation’s Commercial Vehicle Systems Division (Dana CVSD) for use in common vocational applications in the USA and Canada.

Use of Guidelines
These Guidelines apply to the specific on, on-off, and off highway vocational categories and axle applications which are listed, for vehicles operated in the USA and Canada. The categories equate to the commodity and service categories used by OEM truck builders. Within each category, Dana CVSD has approved the steer axle brake and drive axle brake applications shown in the table (subject to any applicable notes), provided that the vehicle falls within the “Definitions” and “Typical Vehicle Types” and meets the “General Requirements” set out for that category. Brake approval is based on gross axle weight rating (GAWR), static loaded radius of tire (SLR), air chamber size, brake adjuster length (S-cam brake only), and the brake lining material.

These Guidelines do not apply to the use of Spicer® brake products in vehicles operated outside the USA and Canada, in vocational categories or axle applications other than those specified herein, for duty cycles or ratings other than those listed herein, for vehicles with fixed liftable auxiliary axles (tag or pusher) or for any off-road applications. Approval for such uses may be requested on an individual basis by submitting a Brake Application Approval Request Form to the Dana CVSD Application Engineering Department at the address below.

Brake Warranties
Dana CVSD’s warranties for steer axle and drive axle brakes are set out in the Eaton® and Dana® Spicer® Truck Components Warranty Guide (TOWY-0900). Applications and installations must either meet the requirements of these Guidelines for automatic approval or be approved by the DANA CVSD Application Engineering Department. Failure to obtain application approval or the use of Spicer® brakes or their components in non-approved applications will void the Dana CVSD warranty coverage. Modification of the vehicle or brake configuration, changes in the vocational use, or service outside the limits of these Guidelines may void the Dana CVSD warranty coverage.

Questions
For answers to questions concerning these Guidelines or to request a Brake Application Approval Request Form for a use not covered by these Guidelines, contact one of the following:

<table>
<thead>
<tr>
<th>Roadranger™ Sales and Service Office</th>
<th>Dana Corporation</th>
</tr>
</thead>
<tbody>
<tr>
<td>800-826-HELP (826-4357)</td>
<td>Commercial Vehicle Systems</td>
</tr>
<tr>
<td>24 hours a day in the USA and Canada</td>
<td>P.O. Box 4097, Kalamazoo, MI 49003-4097</td>
</tr>
<tr>
<td></td>
<td>Phone: (800) 487-8301</td>
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</table>

Changes to Guidelines
These Guidelines are subject to change at any time, without prior notice, at the discretion of Dana CVSD. For updates visit www.roadranger.com

Effective Date: [February 15, 2003]
City Delivery

Definitions

- Pickup and delivery service within cities and/or suburban areas
- Operation on road surfaces of concrete, asphalt and maintained gravel
- Three (3) miles between starts/stops (typical)
- 100% load going/40% load return (typical)

Typical Vehicle Types

- Auto Transport Truck
- Moving Van
- Pickup and Delivery
- Tanker Truck
- Beverage Truck
- Municipal Truck
- Refrigerated Truck
- Flatbed Truck
- Newspaper Delivery
- Stake Truck

General Requirements

- Cam same for all steerable axle brakes
- Air chamber bracket assembly gusset and additional camshaft bracket support see page 45, attached to the axle housing when the:
  a. Brake centerline to air chamber centerline distance (BCCC dimension) is greater than 343 mm [13.5"]
  b. Application use type 30/36 or 36/36 Spring brake chambers.

  Note: The above support can be supplied by Dana CVSD or the vehicle manufacturer but must be approved by Dana CVSD Application Engineering Department.

- Air chamber bracket with gusset, see page 45, when the application includes any of the following components:
  a. Super single tire
  b. Type 30/36 or 36/36 Spring brake chambers
  c. High-articulation mechanical suspensions
  d. Two-speed axle or Planetary double reduction axles

- Applications for use in countries other than the USA and Canada must be reviewed by DANA CVSD Application Engineering.
- Vehicle manufacturer is responsible for air system design, parking and stopping distance performance.
- For all S-cam brake models the camshaft input torque is limited to 2545 N•m [22,500 in-lbs].
- Applications on vehicles with fixed or liftable auxiliary axles (tag or pusher) must be approved on an individual basis by the Dana CVSD Application Engineering Department, as auxiliary axles may impact the braking performance of the vehicle.

General Recommendations

- Cam same for all brake assemblies
- Dust shields for all applications
- Use Auxiliary retarders per TMC RP636
- Brake drum / Rotor material specification per SAE J431. Drum / rotor surface finish 4.57 micrometers [180 max microinch] and .38 mm [.015"] runout
- Brake air system balance per TMC RP632
- Due to legal maximum highway GAWR (17,000-20,000 lb.) per code of federal regulations, 23 CFR - chapter 1, part 658 and brake balance to trailers, brakes should be rated to 20,000 when used on structurally rated 23,000 GAWR drive axles.
- CD50 (synthetic) wheel end bearing lubricant on all steer axles with ESD (Air disc brake)
### Recommended Options

- **Wide Brake Package** for longer brake life to reduce operating cost, see page 34.
- **LMS** (Low-Maintenance System) brakes and hubs for extended lubrication intervals, simplified hub installation and reduced bearing endplay.
- **ESD** (air disc brake) on steer axles for improved braking performance.
- **ESD** (air disc brake) on all vehicle axles for improved fade resistance and stopping power.
- 19.5" wheel package for significantly reduced weight and lower frame height:
  - **Steer axle**: ES1504D or ES1506D
  - **Drive axle**: ES1508D
- **Spicer automatic brake adjusters (ABA)** for maximized S-cam brake performance

### Notes:

1. * - Indicates Combination lining block
2. Mixing of ESD (Air disc brakes) on steer axle and S-cam brakes (drive axle) require CVSD application approval.
3. Air system Crack pressure for ESD must be approved by CVSD Application Engineering.
4. For tractor applications only

### Brake Model Specifications

<table>
<thead>
<tr>
<th>Brake Model</th>
<th>Max. GAWR (lb)</th>
<th>Max. SLR (in)</th>
<th>Linings</th>
<th>Air Chamber Size (in²)</th>
<th>Brake Adjuster Length (in)</th>
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<td><strong>Steer Axle Brakes</strong></td>
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</table>

For all vocations additional lining options available. Submit application request for possible approval. All brakes shown meet FMVSS-121, S5.4 dynamometer requirements.

**Notes:**

1. * - Indicates Combination lining block
2. Mixing of ESD (Air disc brakes) on steer axle and S-cam brakes (drive axle) require CVSD application approval.
3. Air system Crack pressure for ESD must be approved by CVSD Application Engineering.
4. For tractor applications only
Construction

Definitions
- Construction vocation typically involves the movement of material and/or equipment to and from a job site.
- 90% of loaded operation on road surfaces of concrete, asphalt, gravel, crushed rock or hard packed dirt and up to 10% of loaded operation into sandy or muddy job sites.

Typical Vehicle Types
- Asphalt Truck
- Dump Truck
- Mixer
- Tank Truck
- Utility Truck
- Block Truck
- Ratbed Truck
- Semi-end dump
- Transfer Dump
- Wrecker
- Concrete Pumper
- Landscape Truck
- Snowplow/Snowblower
- Truck Mounted Cranes

General Requirements
- **Anti-compounding air system**
- **Cam same** operation for all steerable axle brakes and EB1807R brakes.
- Air chamber bracket with gusset for all construction applications, see page 45.
- Air chamber bracket assembly gusset and support, attached to the axle housing when the:
  - a. Brake centerline to air chamber centerline distance (BCCC dimension) is greater than 343 mm [13.5”]
  - b. Application use a type 30/36 or 36/36 Spring brake chambers.
  - c. Camshaft brackets with BCCC dimension of less than 8.12” does not require a gusset or additional support.

  **Note:** The above support can be supplied by Dana CVSD or the vehicle manufacturer but must be approved by Dana CVSD Application Engineering Department.
- Applications for use in countries other than the USA and Canada must be reviewed by DANA CVSD Application Engineering.
- Vehicle manufacturer is responsible for air system design, parking and stopping distance performance.
- For all S-cam brake models the camshaft input torque is limited to 2545 N•m [22,500 in-lbs.].
- Applications on vehicles with fixed or liftable auxiliary axles (tag or pusher) must be approved on an individual basis by the Dana CVSD Application Engineering Department, as auxiliary axles may impact the braking performance of the vehicle.

General Recommendations
- **Cam same** for all brake assemblies.
- **Dust shields** for all applications.
- Use **Auxiliary retarders** per TMC RP636.
- **Brake drum / Rotor** material specification per SAE J431. Drum / rotor surface finish 4.57 micrometer [180 max microinch] and .38 mm [.015”] runout.
- **Brake air system balance** per TMC RP632.
- **CD50** (synthetic) wheel end bearing lubricant on all steer axles with ESD (Air disc brake).
For all vocations additional lining options available. Submit application request for possible approval. All brakes shown with max GAWR less than 29,000 lb meet FMVSS-121, S5.4 dynamometer requirements. For all brakes shown with max GAWR of 29,000 lb and greater, FMVSS-121 is not applicable.

### Recommended Options

- **Wide brake package** for longer brake life to reduce operating cost, see page 34.
- **LMS** (Low-Maintenance System) brakes and hubs for extended lubrication intervals, simplified hub installation and reduced bearing endplay
- **ESD** (air disc brake) on steer axles for improved braking performance
- **ESD** (air disc brake) on all vehicle axles for improved fade resistance and stopping power
- **Spicer automatic brake adjusters** (**ABA**) for maximized S-cam brake performance

### Notes:
1. LS - Indicates Long stroke chamber
2. * - Indicates Combination lining block
3. Minimum drum weight of 54 kg (120 lb) is required
4. Mixing of ESD (Air disc brakes) on steer axle and S-cam brakes (drive axle) require CVSD application approval.
5. Air system **Crank pressure** for ESD must be approved by CVSD Application Engineering.

### Brake Model Specifications

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<thead>
<tr>
<th>Brake Model</th>
<th>Max. GAWR (lb)</th>
<th>Max. SLR (in)</th>
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Fire Service

Definitions
- Vehicles used to transport people and equipment for the purpose of extinguishing fires or ambulance service
- Mileage is typically under 20,000 miles per year
- Typical vehicle routes are three (3) miles between start and stop
- Multiple high deceleration stops are common
- Auxiliary retarders are common
- Higher parking performance required

Typical Vehicle Types
- Aerial Ladders
- Pumpers
- Aerial Platforms
- Ambulance
- Tankers

Vehicle Configuration
- 4 x 2, 4 x 4, or 6 x 4 straight trucks

General Requirements
- Anti-compounding air system
- Cam same operation for all steerable axle brakes and EB1807R brakes
- Air chamber bracket with gusset for all Fire Service applications, see page 45
- Air chamber bracket assembly gusset and additional camshaft bracket support see page 45, attached to the axle housing when the:
  a. Brake centerline to air chamber centerline distance (BCCC dimension) is greater than 343 mm [13.5”]
  b. Application use a type 30/36 or 36/36 Spring brake chambers.
  c. Camshaft brackets with BCCC dimension of less than 8.12” does not require a gusset or additional support.

  Note: The above support can be supplied by Dana CVSD or the vehicle manufacturer but must be approved by Dana CVSD Application Engineering Department.

- Applications for use in countries other than the USA and Canada must be reviewed by DANA CVSD Application Engineering
- Vehicle manufacturer is responsible for air system design, parking and stopping distance performance.
- For all S-cam brake models the camshaft input torque is limited to 2545 N•m [22,500 in-lbs].
- Applications on vehicles with fixed or liftable auxiliary axles (tag or pusher) must be approved on an individual basis by the Dana CVSD Application Engineering Department, as auxiliary axles may impact the braking performance of the vehicle.

General Recommendations
- Cam same for all brake assemblies
- Dust shields for all applications
- Use Auxiliary retarders per TMC RP636
- Brake drum / Rotor material specification per SAE J431. Drum / rotor surface finish 4.57 micrometer [180 max microinch] and .38 mm [.015"] runout.
- Brake air system balance per TMC RP632
- CD50 (synthetic) wheel end bearing lubricant on all steer axles with ESD (Air disc brake)
For all vocations additional lining options available. Submit application request for possible approval. All brakes shown with max GAWR less than 29,000 lb meet FMVSS-121, S5.4 dynamometer requirements. For all brakes shown with max GAWR of 29,000 lb and greater, FMVSS-121 is not applicable.

**Recommended Options**

- ESD (air disc brake) on steer axles for improved braking performance
- ESD (air disc brake) on all vehicle axles for improved fade resistance and stopping power
- Spicer automatic brake adjusters (ABA) for maximized S-cam brake performance

### Brake Model

<table>
<thead>
<tr>
<th>Brake Model</th>
<th>Max. GAWR (lb)</th>
<th>Max. SLR (in)</th>
<th>Linings</th>
<th>Air Chamber Size (in²)</th>
<th>Brake Adjuster Length (in)</th>
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</tbody>
</table>

- **Steer Axle Brakes**
- **Drive Axle Brakes**

For all vocations additional lining options available. Submit application request for possible approval.

Notes:

1. LS - Indicates Long stroke chamber.
2. * - Indicates Combination lining block
3. Minimum drum weight of 54 kg (120 lb) is required
4. Mixing of ESD (air disc brakes) on steer axle and S-cam brakes (drive axle) require CVSD application approval.
5. Air system Crack pressure for ESD must be approved by CVSD Application Engineering.
**Heavy Haul**

**Definitions**
- Movement of heavy equipment or materials at legal maximums or special permit loadings
- Operation on road surfaces of concrete, asphalt and maintained gravel
- High horsepower engines and auxiliary gear boxes are typically used
- Vehicles may be equipped with two retarders
- 100% load going and empty return

**Typical Vehicle Types**
- Tractor/Trailer Combination:
  - Equipment Hauling
  - Flatbed
  - Lowboy
  - Steel Hauling

**General Requirements**
- Anti-compounding air system
- Cam same operation for all steerable axle brakes and EB1807R brakes
- Air chamber bracket with gusset for all Heavy Haul applications, see page 45
- Air chamber bracket assembly gusset and additional camshaft bracket support see page 45, attached to the axle housing when the:
  a. Brake centerline to air chamber centerline distance *(BCCC dimension)* is greater than 343 mm [13.5”]
  b. Application use a type 30/36 or 36/36 Spring brakes chambers.
  c. Camshaft brackets with BCCC dimension of less than 8.12” does not require a gusset or additional support.

  **Note:** The above support can be supplied by Dana CVSD or the vehicle manufacturer but must be approved by Dana CVSD Application Engineering Department.

- Applications for use in countries other than the USA and Canada must be reviewed by DANA CVSD Application Engineering.
- Vehicle manufacturer is responsible for air system design, parking and stopping distance performance.
- For all S-cam brake models the camshaft input torque is limited to 2545 N•m [22,500 in-lbs].
- Applications on vehicles with fixed or liftable auxiliary axles (tag or pusher) must be approved on an individual basis by the Dana CVSD Application Engineering Department, as auxiliary axles may impact the braking performance of the vehicle.

**General Recommendations**
- Cam same for all brake assemblies
- Dust shields for all applications
- Use Auxiliary retarders per TMC RP636
- Drum brake / Rotor material specification per SAE J431. Drum / rotor surface finish 4.57 micrometer [180 max microinch] and .38 mm [.015"] runout.
- Brake air system balance per TMC RP632
- CD50 (synthetic) wheel end bearing lubricant on all steer axles with ESD (Air disc brake)
Heavy Haul

For all vocations additional lining options available. Submit application request for possible approval.

All brakes shown with max GAWR less than 29,000 lb meet FMVSS-121, S5.4 dynamometer requirements. For all brakes shown with max GAWR of 29,000 lb and greater, FMVSS-121 is not applicable.

**Recommended Options**

- Wide brake package for longer brake life to reduce operating cost, see page 34
- LMS (Low-Maintenance System) brakes and hubs for extended lubrication intervals, simplified hub installation and reduced bearing endplay
- ESD (air disc brake) on steer axles for improved braking performance
- ESD (air disc brake) on all vehicle axles for improved fade resistance and stopping power
- Spicer automatic brake adjusters (ABA) for maximized S-cam brake performance

<table>
<thead>
<tr>
<th>Brake Model</th>
<th>Max. GAWR (lb)</th>
<th>Max. SLR (in)</th>
<th>Linings</th>
<th>Air Chamber Size (in²)</th>
<th>Brake Adjuster Length (in)</th>
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<tr>
<td><strong>Steer Axle Brakes</strong></td>
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<td><strong>Drive Axle Brakes</strong></td>
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</table>

For all vocations additional lining options available. Submit application request for possible approval.

Notes:
1. LS - Indicates Long stroke chamber.
2. * - Indicates Combination lining block
3. Minimum drum weight of 54 kg (120 lb) is required
4. Mixing of ESD (Air disc brakes) on steer axle and S-cam brakes (drive axle) require CVSD application approval.
5. Air system Crack pressure for ESD must be approved by CVSD Application Engineering.
Intercity Coach

Definitions
- Transporting people and sometimes light freight between cities and/or suburban areas
- Operation on road surfaces of concrete, asphalt, maintained gravel, crushed rock, or hard packed dirt
- High mileage operation
- Typical vehicle routes exceed 30 miles between start and stop
- No towed load allowed

Typical Vehicle Types
- Tour Coach
- Cross Country Coach

Vehicle Configuration
- 6 x 2 straight coach with non-liftable tag or pusher axles

General Requirements
- Anti-compounding air system
- Cam same operation for all brakes
- Air chamber bracket with gusset for all intercity coach applications, see page 45
- Air chamber bracket assembly gusset and additional camshaft bracket support see page 45, attached to the axle housing when the:
  a. Brake centerline to air chamber centerline distance (BCCC dimension) is greater than 343 mm [13.5”]
  b. Application use a type 30/36 or 36/36 Spring brake chambers.
  c. Camshaft brackets with BCCC dimension of less than 8.12” does not require a gusset or additional support.

  Note: The above support can be supplied by Dana CVSD or the vehicle manufacturer but must be approved by Dana CVSD Application Engineering Department.

  • Applications for use in countries other than the USA and Canada must be reviewed by DANA CVSD Application Engineering.
  • Vehicle manufacturer is responsible for air system design, parking and stopping distance performance.
  • For all S-cam brake models the camshaft input torque is limited to 2545 N-m [22,500 in-lbs].
  • Applications on vehicles with fixed or liftable auxiliary axles (tag or pusher) must be approved on an individual basis by the Dana CVSD Application Engineering Department, as auxiliary axles may impact the braking performance of the vehicle.

General Recommendations
- Dust shields for all applications
- Use Auxiliary retarders per TMC RP636
- Brake drum / Rotor material specification per SAE J431. Drum / rotor surface finish 4.57 micrometers [180 max microinch] and .38 mm [0.015"] runout.
- Brake air system balance per TMC RP632
- CD50 (synthetic) wheel end bearing lubricant on all steer axles with ESD (Air disc brake)
Intercity Coach

For all vocations additional lining options available. Submit application request for possible approval.

Recommended Options

- Wide brake package for longer brake life to reduce operating cost, see page 34
- LMS (Low-Maintenance System) brakes and hubs for extended lubrication intervals, simplified hub installation and reduced bearing endplay
- ESD (air disc brake) on steer axles for improved braking performance
- ESD (air disc brake) on all vehicle axles for improved brake fade resistance and stopping power
- 19.5" wheel package for significantly reduced weight and lower frame height:
  - Steer axle: ES1506D
  - Drive axle: ES1508D
- Spicer automatic brake adjusters (ABA) for maximized S-cam brake performance

<table>
<thead>
<tr>
<th>Brake Model</th>
<th>Max. GAWR (lb)</th>
<th>Max. SLR (in)</th>
<th>Linings</th>
<th>Air Chamber Size (in²)</th>
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<td>AD1550</td>
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<td>1,2</td>
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</table>

For all vocations additional lining options available. Submit application request for possible approval.

Notes:
1. Mixing of ESD (Air disc brakes) on steer axle and S-cam brakes (drive axle) require CVSD application approval.
2. Air system Crack pressure for ESD must be approved by CVSD Application Engineering.
Line Haul

Definitions

- Line Haul is moving different types of freight in high mileage operation (over 60,000 miles/year)
- Operation on road surfaces of good to excellent concrete or asphalt
- Typical vehicle routes exceed 30 miles between start and stop
- Typical vehicle configurations are 4 x 2, 6 x 2 and 6 x 4 tractor/trailer combinations and straight trucks

Typical Vehicle Types

- Auto Hauler
- Flatbed Trailer
- Refrigerated Freight
- Pipe Hauler
- Bulk Hauler
- General Freight
- Livestock Hauler
- Tanker
- Doubles
- Grain Hauler
- Moving Van
- Triples

General Requirements

- **Anti-compounding** air system
- **Cam same** operation for all steerable axle brakes
- Air chamber bracket assembly gusset and additional camshaft bracket support [see page 45], attached to the axle housing when the:
  a. Brake centerline to air chamber centerline distance (BCCC dimension) is greater than 343 mm [13.5”]
  b. Application use a type 30/36 or 36/36 Spring brake chambers.
  c. Camshaft brackets with BCCC dimension of less than 8.12” does not require a gusset or additional support.

  **Note:** The above support can be supplied by Dana CVSD or the vehicle manufacturer but must be approved by Dana CVSD Application Engineering Department.

- Use air chamber bracket with gusset for applications, [see page 45], when the application includes any of the following components:
  a. **Super single tire**
  b. Type 30/36 or 36/36 Spring brake chambers
  c. **High articulation suspensions**
  d. **Two-speed axle** or **Planetary double reduction axles**
- Applications for use in countries other than the USA and Canada must be reviewed by DANA CVSD Application Engineering.
- Vehicle manufacturer is responsible for air system design, parking and stopping distance performance.
- For all S-cam brake models, with the exception of the ES1504L, the camshaft input torque is limited to 2545 N•m [22,500 in-lb].
- Brake model ES1504L camshaft input torque is limited to 1490 N•m [13,200 in-lbs].
- Applications on vehicles with fixed or liftable auxiliary axles (tag or pusher) must be approved on an individual basis by the Dana CVSD Application Engineering Department, as auxiliary axles may impact the braking performance of the vehicle

General Recommendations

- **Cam same** for all brake assemblies
- **Dust shields** for all applications
- Use **Auxiliary retarders** per TMC RP636
- **Brake drum / Rotor** material specification per SAE J431. Drum / rotor surface finish 4.57 micrometers [180 max microminch] and .38 mm [.015"] runout
- Brake air system balance per TMC RP632
- Due to legal maximum highway GAWR (17,000-20,000 lb) per code of federal regulations, 23 CFR - chapter 1, part 658 and brake balance to trailers, brakes should be rated to 20,000 lb when used on structurally rated 23,000 lb GAWR drive axles.
- CD50 (synthetic) wheel end bearing lubricant on all steer axles with ESD (Air disc brake)
For all vocations additional lining options available. Submit application request for possible approval. All brakes shown meet FMVSS-121, S5.4 dynamometer requirements.

**Recommended Options**

- Wide brake package for longer brake life to reduce operating cost, [see page 34](#)
- LMS (Low-Maintenance System) brakes and hubs for extended lubrication intervals, simplified hub installation and reduced bearing endplay
- ESD (air disc brake) on steer axles for improved braking performance
- ESD (air disc brake) on all vehicle axles for improved fade resistance and stopping power
- 19.5" wheel package for significantly reduced weight and lower 5th wheel height:
  - Steer axle: ES1504D or ES1506D
  - Drive axle: ES1508D
- Spicer automatic brake adjusters ([ABA](#)) for maximized S-cam brake performance.

**Notes:**

1. Mixing of ESD (Air disc brakes) on steer axle and S-cam brakes (drive axle) require CVSD application approval.
2. Air system [Crack pressure](#) for ESD must be approved by CVSD Application Engineering.
Logging

Definitions
- Movement of logs, chips and pulp between logging sites and/or mill
- High horsepower engines are typically used in this vocation
- Typical vehicle routes are between three (3) and thirty (30) miles from start to stop
- 90% of loaded operation on road surfaces of concrete, asphalt, maintained gravel, crushed rock or hard packed dirt and up to 10% of loaded operation into sandy or muddy job sites
- 100% load going and empty return

Typical Vehicles Types
- Chip Hauler: Straight Truck with Trailer
- Log Hauler: Tractors with Pole Trailers

General Requirements
- Anti-compounding air system
- Cam same operation for all steerable axle brakes and BB1807R brakes
- Air chamber bracket with gusset for all logging applications, see page 45
- Air chamber bracket assembly gusset and additional camshaft bracket support see page 45, attached to the axle housing when the:
  a. Brake centerline to air chamber centerline distance (BCCC dimension) is greater than 343 mm [13.5”]
  b. Application use a type 30/36 or 36/36 Spring brake chambers.
  c. Camshaft brackets with BCCC dimension of less than 8.12” does not require a gusset or additional support.

  Note: The above support can be supplied by Dana CVSD or the vehicle manufacturer but must be approved by Dana CVSD Application Engineering Department.

- Applications for use in countries other than the USA and Canada must be reviewed by DANA CVSD Application Engineering.
- Vehicle manufacturer is responsible for air system design, parking and stopping distance performance.
- For all S-cam brake models the camshaft input torque is limited to 2545 N•m [22,500 in-lbs].
- Applications on vehicles with fixed or liftable auxiliary axles (tag or pusher) must be approved on an individual basis by the Dana CVSD Application Engineering Department, as auxiliary axles may impact the braking performance of the vehicle.

General Recommendations
- Cam same for all brake assemblies
- Dust shields for all applications
- Use Auxiliary retarders per TMC RP636
- Brake drum / Rotor material specification per SAE J431. Drum / rotor surface finish 4.57 micrometer [180 max microinch] and .38 mm [.015"] runout
- Brake air system balance per TMC RP632
- CD50 (synthetic) wheel end bearing lubricant on all steer axles with ESD (Air disc brake)
For all vocations additional lining options available. Submit application request for possible approval. All brakes shown with max GAWR less than 29,000 lb meet FMVSS-121, S5.4 dynamometer requirements. For all brakes shown with max GAWR of 29,000 lb and greater, FMVSS-121 is not applicable.

Recommended Options

- Wide brake package for longer brake life to reduce operating cost. [see page 34]
- LMS (Low-Maintenance System) brakes and hubs for extended lubrication intervals, simplified hub installation and reduced bearing endplay
- ESD (air disc brake) on steer axles for improved braking performance
- ESD (air disc brake) on all vehicle axles for improved fade resistance and stopping power
- Spicer automatic brake adjusters (ABA) for maximized S-cam brake performance

Notes:
1. LS - Indicates Long stroke chamber
2. * - Indicates Combination lining block
3. Minimum drum weight of 54 kg (120 lb) is required
4. Mixing of ESD (Air disc brakes) on steer axle and S-cam brakes (drive axle) require CVSD application approval.
5. Air system Crack pressure for ESD must be approved by CVSD Application Engineering.
Mining

Definitions
■ Movement of rock, ore, gravel and minerals between mine sites and delivery sites
■ High horsepower engines are typically used in this vocation
■ Typical vehicle routes are between three (3) and thirty (30) miles from start to stop
■ 90% operation on-highway and up to 10% into sandy or muddy job site
■ 100% load going and empty return

Typical Vehicle Types
  - Bottom Dump Trailer
  - Transfer Dump
  - Semi-End Dump
  - Hopper Trailer Combinations

General Requirements
• Anti-compounding air system
• Cam same operation for all steerable axle brakes and EB1807R brakes
• Air chamber bracket with gusset for all mining applications, see page 45
• Air chamber bracket assembly gusset and additional camshaft bracket support see page 45, attached to the axle housing when the:
  a. Brake centerline to air chamber centerline distance (BOCC dimension) is greater than 343 mm [13.5”]
  b. Application use a type 30/36 or 36/36 Spring brake chambers.
  c. Camshaft brackets with BOCC dimension of less than 8.12” does not require a gusset or additional support.
   Note: The above support can be supplied by Dana CVSD or the vehicle manufacturer but must be approved by Dana CVSD Application Engineering Department.

• Applications for use in countries other than the USA and Canada must be reviewed by DANA CVSD Application Engineering.
• Vehicle manufacturer is responsible for air system design, parking and stopping distance performance.
• For all S-cam brake models the camshaft input torque is limited to 2545 N-m [22,500 in-lbs].
• Applications on vehicles with fixed or liftable auxiliary axles (tag or pusher) must be approved on an individual basis by the Dana CVSD Application Engineering Department, as auxiliary axles may impact the braking performance of the vehicle.

General Recommendations
• Cam same for all brake assemblies
• Dust shields for all applications
• Use Auxiliary retarders per TMC RP636
• Drum brake / Rotor material specification per SAE J431. Drum / rotor surface finish 4.57 micrometer [180 max microrinch] and .38 mm [.015"] runout
• Brake air system balance per TMC RP632
• CD50 (synthetic) wheel end bearing lubricant on all steer axles with ESD (Air disc brake)
For all vocations additional lining options available. Submit application request for possible approval. All brakes shown with max GAWR less than 29,000 lb meet FMVSS-121, S5.4 dynamometer requirements. For all brakes shown with max GAWR of 29,000 lb and greater, FMVSS-121 is not applicable.

### Recommended Options

- Wide brake package for longer brake life to reduce operating cost, see page 34
- LMS (Low-Maintenance System) brakes and hubs for extended lubrication intervals, simplified hub installation and reduced bearing endplay
- ESD (air disc brake) on steer axles for improved braking performance
- ESD (air disc brake) on all vehicle axles for improved fade resistance and stopping power
- Spicer automatic brake adjusters (ABA) for maximized S-cam brake performance

### Notes:

1. LS - Indicates Long stroke chamber
2. * - Indicates Combination lining block
3. Minimum drum weight of 54kg (120 lb) is required
4. Mixing of ESD (Air disc brakes) on steer axle and S-cam brakes (drive axle) require CVSD application approval.
5. Air system Crack pressure for ESD must be approved by CVSD Application Engineering.

<table>
<thead>
<tr>
<th>Brake Model</th>
<th>Max. GAWR (lb)</th>
<th>Max. SLR (in)</th>
<th>Linings</th>
<th>Air Chamber Size (in²)</th>
<th>Brake Adjuster Length (in)</th>
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</table>
Motorhome

Definitions
• Vehicles generally used for non-commercial transportation and as traveling domiciles for families
• 100% loaded full time
• May pull small passenger car, SUV or pick-up truck
• Typical vehicle routes exceed 30 miles between start and stop
• Annual mileage will be under 30,000
• Typical operation is on paved roads and short distances within campgrounds and parks

Typical Vehicle Types
Recreational Vehicles

Vehicle Configurations
Straight coach type vehicles with towing ability:
4 x 2 straight coach
6 x 2 (with non-liftable tag or pusher axles)

General Requirements
• **Anti-compounding** air system
• **Cam same** operation for all steerable axle brakes
• Air chamber bracket assembly gusset and additional camshaft bracket support see page 45, attached to the axle housing when the:
  a. Brake centerline to air chamber centerline distance (BCCC dimension) is greater than 343 mm [13.5”]
  b. Application use a type 30/36 or 36/36 Spring brake chambers.
  c. Camshaft brackets with BCCC dimension of less than 8.12” does not require a gusset or additional support.

  **Note:** The above support can be supplied by Dana CVSD or the vehicle manufacturer but must be approved by Dana CVSD Application Engineering Department.

• Air chamber bracket with gusset for applications, see page 45, when the application includes any of the following components:
  a. **Super single tires**
  b. Type 30/36 or 36/36 Spring brake chambers.
• Dana CVSD Application Engineering approval for:
  a. Vehicle towing unbraked trailer vehicle.
  b. Applications for use in countries other than the USA and Canada must be reviewed by DANA CVSD Application Engineering.

• Vehicle manufacturer is responsible for air system design, parking and stopping distance performance.
• For all S-cam brake models the camshaft input torque is limited to 2545 N•m [22,500 in-lbs].

General Recommendations
• **Cam same** for all brake assemblies
• **Dust shields** for all applications
• Use **Auxiliary retarders** per TMC RP636
• **Brake drum / Rotor** material specification per SAE J431. Drum / rotor surface finish 4.57 micrometers [180 max microinch] and .38 mm [.015"] runout.
• **Brake air system balance** per TMC RP632
• **CD50** (synthetic) wheel end bearing lubricant on all steer axles with ESD (Air disc brake)
### Recommended Options

- Wide brake package for longer brake life to reduce operating cost, [see page 34](#).
- LMS (Low-Maintenance System) brakes and hubs for extended lubrication intervals, simplified hub installation and reduced bearing endplay.
- ESD (air disc brake) on steer axles for improved braking performance.
- ESD (air disc brake) on all vehicle axles for improved fade resistance and stopping power.
- 19.5" wheel package for significantly reduced weight and lower frame height:
  - **Steer axle**: ES1504D or ES1506D
  - **Drive axle**: ES1508D
- Spicer automatic brake adjusters ([ABA](#)) for maximized S-cam brake performance.

### Notes:

1. Mixing of ESD (Air disc brakes) on steer axle and S-cam brakes (drive axle) require CVSD application approval.
2. Air system [Crack pressure](#) for ESD must be approved by CVSD Application Engineering.

### Brake Model Specifications

<table>
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<tr>
<th>Brake Model</th>
<th>Max. GAWR (lb)</th>
<th>Max. SLR (in)</th>
<th>Linings</th>
<th>Air Chamber Size (in^2)</th>
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<td>ES420,450</td>
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<td>AD1550</td>
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<td>N/A</td>
<td>1,2</td>
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</tbody>
</table>

For all vocations additional lining options available. Submit application request for possible approval.

All brakes shown meet FMVSS-121, S5.4 dynamometer requirements.

For all vocations additional lining options available. Submit application request for possible approval.

All brakes shown meet FMVSS-121, S5.4 dynamometer requirements.
Oil Field

Definitions
■ Movement of production related products, supplies and tools between job sites
■ Movement of processing equipment and laboratories on job sites
■ Low mileage operation on road surfaces made of concrete, asphalt, maintained gravel, crushed rock or hard packed dirt

Typical Vehicle Types
Cementing Vehicle
Demolition
Drill Rig
Fracturing Truck
Geophysical Exploration
Rigging Truck
Tanker
Winch Truck

General Requirements
• Anti-compounding air system
• Cam same operation for all steerable axle brakes and EB1807R brakes
• Air chamber bracket with gusset for all oil field applications, see page 45
• Air chamber bracket assembly gusset and additional camshaft bracket support see page 45, attached to the axle housing when the:
  a. Brake centerline to air chamber centerline distance (BCCC dimension) is greater than 343 mm [13.5”]
  b. Application use a type 30/36 or 36/36 Spring brake chambers.
  c. Camshaft brackets with BCCC dimension of less than 8.12” does not require a gusset or additional support.

  Note: The above support can be supplied by Dana CVSD or the vehicle manufacturer but must be approved by Dana CVSD Application Engineering Department.

• Applications for use in countries other than the USA and Canada must be reviewed by DANA CVSD Application Engineering.
• Vehicle manufacturer is responsible for air system design, parking and stopping distance performance.
• For all S-cam brake models the camshaft input torque is limited to 2545 N•m [22,500 in-lbs].
• Applications on vehicles with fixed or liftable auxiliary axles (tag or pusher) must be approved on an individual basis by the Dana CVSD Application Engineering Department, as auxiliary axles may impact the braking performance of the vehicle.

General Recommendations
• Cam same for all brake assemblies
• Dust shields for all applications
• Use Auxiliary retarders per TMC RP636
• Brake drum / Rotor material specification per SAE J431. Drum / rotor surface finish 4.57 micrometer [180 max microinch] and .38 mm [.015"] runout
• Brake air system balance per TMC RP632
• CD50 (synthetic) wheel end bearing lubricant on all steer axles with ESD (Air disc brake)
For all vocations additional lining options available. Submit application request for possible approval. All brakes shown with max GAWR less than 29,000 lb meet FMVSS-121, S5.4 dynamometer requirements. For all brakes shown with max GAWR of 29,000 lb and greater, FMVSS-121 is not applicable.

### Recommended Options
- Wide brake package for longer brake life to reduce operating cost, [see page 34](#)
- LMS (Low-Maintenance System) brakes and hubs for extended lubrication intervals, simplified hub installation and reduced bearing endplay
- ESD (air disc brake) on steer axles for improved braking performance
- ESD (air disc brake) on all vehicle axles for improved fade resistance and stopping power
- Spicer automatic brake adjusters (ABA) for maximized S-cam brake performance

### Notes:
1. LS - Indicates Long stroke chamber
2. * - Indicates Combination lining block
3. Minimum drum weight of 54 kg (120 lb) is required

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<thead>
<tr>
<th>Brake Model</th>
<th>Max. GAWR (lb)</th>
<th>Max. SLR (in)</th>
<th>Linings</th>
<th>Air Chamber Size (in²)</th>
<th>Brake Adjuster Length (in)</th>
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</table>
Refuse

Definitions
- Vehicles used for residential refuse/recycle pickup, typically a high number of stops per mile
- Vehicles operated in commercial/industrial pickup, typically a low number of stops per mile
- Vehicles used in transfer/relocation on typically greater than 10-mile trips
- 90% of loaded operation on road surfaces of concrete, asphalt or maintained gravel and up to 10% of loaded operation into landfill, transfer or recycling sites

Typical Vehicle Types
- Front/Rear/Slide Loader
- Sewer/Septic/Vacuum Roll-Off
- Liquid Waste Hauler
- Scrap Truck
- Residential/Commercial Pickup
- Street Sweeper

General Requirements
- **Anti-compounding** air system
- **Cam same** operation for all steerable axle brakes and EB1807R brakes
- Air chamber bracket with gusset for all refuse applications, see page 45
- Air chamber bracket assembly gusset and additional camshaft bracket support see page 45, attached to the axle housing when the:
  a. Brake centerline to air chamber centerline distance (**BCCC dimension**) is greater than 343 mm [13.5”]
  b. Application use a type 30/36 or 36/36 Spring brake chambers.
  c. Camshaft brackets with BCCC dimension of less than 8.12” does not require a gusset or additional support.

  **Note:** The above support can be supplied by Dana CVSD or the vehicle manufacturer but must be approved by Dana CVSD Application Engineering Department.

- Applications for use in countries other than the USA and Canada must be reviewed by DANA CVSD Application Engineering.
- Trucks equipped with remotely controlled neutral brake engagement valves must incorporate a pressure limiting device set to a maximum pressure of 60 psi and must supply air pressure to all service chambers on the vehicle.
- Vehicle manufacturer is responsible for air system design, parking and stopping distance performance.
- For all brake models the camshaft input torque is limited to 2545 N•m [22,500 in-lbs].
- Applications on vehicles with fixed or liftable auxiliary axles (tag or pusher) must be approved on an individual basis by the Dana CVSD Application Engineering Department, as auxiliary axles may impact the braking performance of the vehicle.

General Recommendations
- **Cam same** for all brake assemblies
- **Dust shields** for all applications
- Use **Auxiliary retarders** per TMC RP636
- **Brake drum / Rotor** material specification per SAE J431. Drum / rotor surface finish 4.57 micrometer [180 max microrinch] and .38 mm [.015"] runout
- Brake air system balance per TMC RP632
- **CD50** (synthetic) wheel end bearing lubricant on all steer axles with ESD (Air disc brake)
Refuse

For all vocations additional lining options available. Submit application request for possible approval.

All brakes shown with max GAWR less than 29,000 lb meet FMVSS-121, S5.4 dynamometer requirements. For all brakes shown with max GAWR of 29,000 lb and greater, FMVSS-121 is not applicable.

Recommended Options

- Wide brake package for longer brake life to reduce operating cost, see page 34
- **LMS** (Low-Maintenance System) brakes and hubs for extended lubrication intervals, simplified hub installation and reduced bearing endplay
- ESD (air disc brake) on steer axles for improved braking performance
- ESD (air disc brake) on all vehicle axles for improved fade resistance and stopping power
- Spicer automatic brake adjusters (**ABA**) for maximized S-cam brake performance

**Notes:**
1. LS - Indicates **Long stroke chamber**
2. * - Indicates **Combination lining block**
3. Minimum drum weight of 54 kg (120 lb) is required
4. Mixing of ESD (Air disc brakes) on steer axle and S-cam brakes (drive axle) require CVSD application approval.
5. Air system **Crack pressure** for ESD must be approved by CVSD Application Engineering.

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<tr>
<th>Brake Model</th>
<th>Max. GAWR (lb)</th>
<th>Max. SLR (in)</th>
<th>Linings</th>
<th>Air Chamber Size (in²)</th>
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</tbody>
</table>
Rescue

Definitions
- Specialized vehicles for rapid acceleration to crash sites away from hydrant hookups
- Operation on road surfaces made of concrete, asphalt, maintained gravel, crushed rock, hard packed dirt, or other similar surfaces for 90% of the time and into sandy or muddy crash sites for 10% of the time
- Low mileage operation
- High horsepower engines typically used in this vocation
- Auxiliary retarders are common

Typical Vehicle Types
- Airport Rescue Fire (ARF)
- Crash Fire Rescue (CRF)
- Rapid Intervention Vehicle (RIV)
- Emergency Service

Vehicle Configuration
- 4 x 4 or 6 x 6 straight trucks

General Requirements
- Anti-compounding air system
- Cam same operation for all steerable axle brakes and EB1807R brakes
- Air chamber bracket with gusset for all rescue applications, see page 45
- Air chamber bracket assembly gusset and additional camshaft bracket support see page 45, attached to the axle housing when the:
  a. Brake centerline to air chamber centerline distance (BOCC dimension) is greater than 343 mm [13.5"]
  b. Application use a type 30/36 or 36/36 Spring brake chambers.
  c. Camshaft brackets with BOCC dimension of less than 8.12" does not require a gusset or additional support.

  Note: The above support can be supplied by Dana CVSD or the vehicle manufacturer but must be approved by Dana CVSD Application Engineering Department.

- Applications for use in countries other than the USA and Canada must be reviewed by DANA CVSD Application Engineering.
- Vehicle manufacturer is responsible for air system design, parking and stopping distance performance.
- For all S-cam brake models the camshaft input torque is limited to 2545 N-m [22,500 in-lbs].
- Applications on vehicles with fixed or liftable auxiliary axles (tag or pusher) must be approved on an individual basis by the Dana CVSD Application Engineering Department, as auxiliary axles may impact the braking performance of the vehicle.

General Recommendations
- Cam same for all brake assemblies
- Dust shields for all applications
- Use Auxiliary retarders per TMC RP636
- Brake drum / Rotor material specification per SAE J431. Drum / rotor surface finish 4.57 micrometer [180 max microinch] and .38 mm [.015"] runout
- Brake air system balance per TMC RP632
- CD50 (synthetic) wheel end bearing lubricant on all steer axles with ESD (Air disc brake)
Rescue

For all vocations additional lining options available. Submit application request for possible approval. All brakes shown with max GAWR less than 29,000 lb meet FMVSS-121, S5.4 dynamometer requirements. For all brakes shown with max GAWR of 29,000 lb and greater, FMVSS-121 is not applicable.

**Recommended Options**

- ESD (air disc brake) on steer axles for improved braking performance
- ESD (air disc brake) on all vehicle axles for improved fade resistance and stopping power
- Spicer automatic brake adjusters (ABA) for maximized S-cam brake performance

### Brake Model

<table>
<thead>
<tr>
<th>Brake Model</th>
<th>Max. GAWR (lb)</th>
<th>Max. SLR (in)</th>
<th>Linings</th>
<th>Air Chamber Size (in²)</th>
<th>Brake Adjuster Length (in)</th>
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<td>21.5</td>
<td>AD1550</td>
<td>24</td>
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<td>4,5</td>
</tr>
</tbody>
</table>

Notes:

1. LS - Indicates Long stroke chamber
2. * - Indicates Combination lining block
3. Minimum drum weight of 54 kg (120 lb) is required
4. Mixing of ESD (Air disc brakes) on steer axle and S-cam brakes (drive axle) require CVSD application approval.
5. Air system Crack pressure for ESD must be approved by CVSD Application Engineering.
School Bus

Definitions
- Transporting students to and from school and/ or school related events
- Operation on road surfaces of concrete, asphalt, maintained gravel, crushed rock, or hard packed dirt
- Two (2) stops per mile are considered typical
- 100% load going / empty return (typical)

Typical Vehicle Types
- Front Engine Commercial Chassis
- Front Engine Integral Coach
- Rear Engine Integral Coach

Vehicle Configurations
- 4 x 2 straight bus

General Requirements
- Anti-compounding air system
- Cam same operation for all brakes
- Air chamber bracket with gusset for all school bus applications, see page 45
- Air chamber bracket assembly gusset and additional camshaft bracket support see page 45, attached to the axle housing when the:
  a. Brake centerline to air chamber centerline distance (BCCC dimension) is greater than 343 mm [13.5”]
  b. Application use a type 30/36 or 36/36 Spring brake chambers.
  c. Camshaft brackets with BCCC dimension of less than 8.12” does not require a gusset or additional support.
  Note: The above support can be supplied by Dana CVSD or the vehicle manufacturer but must be approved by Dana CVSD Application Engineering Department.
- Applications for use in countries other than the USA and Canada must be reviewed by DANA CVSD Application Engineering.
- Vehicle manufacturer is responsible for air system design, parking and stopping distance performance.
- For all S-cam brake models the camshaft input torque is limited to 2545 N·m [22,500 in-lbs].
- Applications on vehicles with fixed or liftable auxiliary axles (tag or pusher) must be approved on an individual basis by the Dana CVSD Application Engineering Department, as auxiliary axles may impact the braking performance of the vehicle.

General Recommendations
- Dust shields for all applications
- Use Auxiliary retarders per TMC RP636
- Brake drum / Rotor material specification per SAE J431. Drum / rotor surface finish 4.57 micrometers [180 max microinch] and .38 mm [.015”] runout
- Brake air system balance per TMC RP632
- CD50 (synthetic) wheel end bearing lubricant on all steer axles with ESD (Air disc brake)
For all vocations additional lining options available. Submit application request for possible approval.
All brakes shown with max GAWR less than 29,000 lb meet FMVSS-121, S5.4 dynamometer requirements. For all brakes shown with max GAWR of 29,000 lb and greater, FMVSS-121 is not applicable.

**Recommended Options**

- Wide brake package for longer brake life to reduce operating cost, [see page 34](#)
- **LMS** (Low-Maintenance System) brakes and hubs, extended lubrication intervals, simplified hub installation and reduced bearing endplay
- ESD (air disc brake) on steer axles, improved braking performance
- ESD (air disc brake) on all vehicle axles, improved fade resistance and stopping power
- 19.5" wheel package for significantly reduced weight and lower frame height:
  - **Steer axle**: ES1506D
  - **Drive axle**: ES1508D
- Spicer automatic brake adjusters (**ABA**) for maximized S-cam brake performance

**Brake Model**

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<tr>
<th>Brake Model</th>
<th>Max. GAWR (lb)</th>
<th>Max. SLR (in)</th>
<th>Linings</th>
<th>Air Chamber Size (in²)</th>
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Notes:

1. Mixing of ESD (Air disc brakes) on steer axle and S-cam brakes (drive axle) require CVSD application approval.
2. Air system **Crack pressure** for ESD must be approved by CVSD Application Engineering.
Transit Coach

Definitions
■ Transporting people in and around city or suburban areas
■ Operation on well-maintained highways and residential streets made of asphalt or concrete
■ Very frequent stops (nine per mile) are considered typical

Typical Vehicle Types
Airport Shuttle Qty Bus
Shuttle Bus Trolley

Vehicle Configurations
4 x 2 straight coach

General Requirements
• Anti-compounding air system
• Cam same operation for all steerable axle brakes
• Air chamber bracket assemblies with gusset for all transit coach applications, see page 45
• Air chamber bracket assembly gusset and additional camshaft bracket support see page 45, attached to the axle housing when the:
  a. Brake centerline to air chamber centerline distance (BCCC dimension) is greater than 343 mm [13.5”]
  b. Application use a type 30/36 or 36/36 Spring brake chambers
  c. Camshaft brackets with BCCC dimension of less than 8.12” does not require a gusset or additional support..

  Note: The above support can be supplied by Dana CVSD or the vehicle manufacturer but must be approved by Dana CVSD Application Engineering Department.

• Applications for use in countries other than the USA and Canada must be reviewed by DANA CVSD Application Engineering.
• Vehicle manufacturer is responsible for air system design, parking and stopping distance performance.
• For all brake models the camshaft input torque is limited to 2545 N•m [22,500 in-lbs].
• Extra heavy duty (severe service) Brake drum on steer, drive and auxiliary axles.

General Recommendations
• Cam same for all brake assemblies
• Dust shields for all applications
• Use Auxiliary retarders per TMC RP636
• Brake drum / Rotor material specification per SAE J431. Drum / rotor surface finish 4.57 micrometer [180 max microinch] and .38 mm [.015"] runout
• Brake air system balance per TMC RP632
• CD50 (synthetic) wheel end bearing lubricant on all steer axles with ESD (Air disc brake)
Transit Coach

For all vocations additional lining options available. Submit application request for possible approval.

All brakes shown with max GAWR less than 29,000 lb meet FMVSS-121, S5.4 dynamometer requirements. For all brakes shown with max GAWR of 29,000 lb and greater, FMVSS-121 is not applicable.

Recommended Options

- ESD (air disc brake) on steer axles for improved braking performance
- ESD (air disc brake) on all vehicle axles for improved fade resistance and stopping power
- Spicer automatic brake adjusters (ABA) for maximized S-cam brake performance

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<tr>
<th>Brake Model</th>
<th>Max. GAWR (lb)</th>
<th>Max. SLR (in)</th>
<th>Linings</th>
<th>Air Chamber Size (in²)</th>
<th>Brake Adjuster Length (in)</th>
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<td>20,000</td>
<td>21.5</td>
<td>AD1550</td>
<td>24</td>
<td>N/A</td>
<td>4,5</td>
</tr>
</tbody>
</table>

Steer Axle Brakes

Drive Axle Brakes

<table>
<thead>
<tr>
<th>Brake Model</th>
<th>Max. GAWR (lb)</th>
<th>Max. SLR (in)</th>
<th>Linings</th>
<th>Air Chamber Size (in²)</th>
<th>Brake Adjuster Length (in)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>ES1657D</td>
<td>20,000</td>
<td>21.5</td>
<td>ES420,600</td>
<td>30</td>
<td>6.0</td>
<td></td>
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<tr>
<td>ES1657D</td>
<td>22,000</td>
<td>21.5</td>
<td>ES600</td>
<td>30</td>
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<tr>
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<tr>
<td>ES1657S</td>
<td>26,000</td>
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<td>ES900,1050</td>
<td>30</td>
<td>6.0</td>
<td>3</td>
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<tr>
<td>ES1657M</td>
<td>26,000</td>
<td>22.0</td>
<td>ES1100,800*</td>
<td>30</td>
<td>6.0</td>
<td>2,3</td>
</tr>
<tr>
<td>ES1657H</td>
<td>32,500</td>
<td>22.7</td>
<td>ES1100</td>
<td>30</td>
<td>6.0</td>
<td>3</td>
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<tr>
<td>ES1658D</td>
<td>23,000</td>
<td>22.0</td>
<td>ES420</td>
<td>30</td>
<td>6.0</td>
<td></td>
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<tr>
<td>ES1658S</td>
<td>29,000</td>
<td>22.0</td>
<td>ES900,1050</td>
<td>30 LS</td>
<td>6.0</td>
<td>1,3</td>
</tr>
<tr>
<td>ES16510H</td>
<td>28,000</td>
<td>21.5</td>
<td>OM24</td>
<td>30</td>
<td>6.5</td>
<td></td>
</tr>
<tr>
<td>ESD225</td>
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<td>21.5</td>
<td>AD1550</td>
<td>24</td>
<td>N/A</td>
<td>4,5</td>
</tr>
</tbody>
</table>

Notes:

1. LS - Indicates Long stroke chamber
2. * - Indicates Combination lining block
3. Minimum drum weight of 54 kg (120 lb) is required
4. Mixing of ESD (Air disc brakes) on steer axle and S-cam brakes (drive axle) require CVSD application approval.
5. Air system Crack pressure for ESD must be approved by CVSD Application Engineering.
Nomenclature

Spicer® Brake Model Identification

Dana Spicer S-cam Brake

ES-165-7 L

EB – Standard Brake
ES – Extended Service Brake

Drum Diameter
150 – 381mm [15”]
165 – 419mm [16.5”]
180 – 457mm [18”]

Configurations
D – Fabricated Shoe/Cast Spider ............ SAP
H – Cast Shoe/Heavy Cast Spider ............. DAP
L – Fabricated Shoe/Fabricated Spider ........ SAP
M – Fabricated Shoe/Heavy Cast Spider ........ DAP
R – Cast Shoe/Heavy Cast Spider ............. SAP
S – Reinforced Fabricated Shoe/Cast Spider ... SAP
SAP = Single Anchor Pin / DAP = Double Anchor Pin

Shoe Size [width]
4 – 102mm [4”]
5 – 127mm [5”]
6 – 152mm [6”]
7 – 178mm [7”]
8 – 219mm [8.63”]
10 – 254mm [10”]

Dana Spicer Air Disc Brake

ESD-225

ESD - Extended Service Air Disc Brake

Wheel Size
225 - For use with 22.5” wheels
**Nomenclature**

**Model Coverage**

**S-cam Brake**

<table>
<thead>
<tr>
<th>Model</th>
<th>Size (in.)</th>
<th>Configuration (Shoe, Spider, Anchor*)</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>ES-150-4L</td>
<td>15.0 x 4</td>
<td>381 x 102 Fabricated, Fabricated</td>
<td>SAP</td>
</tr>
<tr>
<td>ES-150-4D</td>
<td>15.0 x 4</td>
<td>381 x 102 Fabricated, Cast</td>
<td>SAP</td>
</tr>
<tr>
<td>ES-150-6D</td>
<td>15.0 x 6</td>
<td>381 x 152 Fabricated, Cast</td>
<td>SAP</td>
</tr>
<tr>
<td>ES-150-8D</td>
<td>15.0 x 8.63</td>
<td>381 x 219 Fabricated, Cast</td>
<td>SAP</td>
</tr>
<tr>
<td>ES-165-5D</td>
<td>16.5 x 5</td>
<td>419 x 127 Fabricated, Cast</td>
<td>SAP</td>
</tr>
<tr>
<td>ES-165-5L</td>
<td>16.5 x 5</td>
<td>419 x 127 Fabricated, Fabricated</td>
<td>SAP</td>
</tr>
<tr>
<td>ES-165-6D</td>
<td>16.5 x 6</td>
<td>419 x 152 Fabricated, Cast</td>
<td>SAP</td>
</tr>
<tr>
<td>ES-165-6L</td>
<td>16.5 x 6</td>
<td>419 x 152 Fabricated, Fabricated</td>
<td>SAP</td>
</tr>
<tr>
<td>ES-165-6H</td>
<td>16.5 x 6</td>
<td>419 x 152 Cast, Cast</td>
<td>SAP</td>
</tr>
<tr>
<td>ES-165-7D</td>
<td>16.5 x 7</td>
<td>419 x 178 Fabricated, Cast</td>
<td>SAP</td>
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<tr>
<td>ES-165-7H</td>
<td>16.5 x 7</td>
<td>419 x 178 Cast, Heavy Cast</td>
<td>DAP</td>
</tr>
<tr>
<td>ES-165-7L</td>
<td>16.5 x 7</td>
<td>419 x 178 Fabricated, Fabricated</td>
<td>SAP</td>
</tr>
<tr>
<td>ES-165-7M</td>
<td>16.5 x 7</td>
<td>419 x 178 Fabricated, Heavy Cast</td>
<td>SAP</td>
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<tr>
<td>ES-165-8L</td>
<td>16.5 x 8.63</td>
<td>419 x 219 Fabricated, Fabricated</td>
<td>SAP</td>
</tr>
<tr>
<td>ES-165-8D</td>
<td>16.5 x 8.63</td>
<td>419 x 219 Fabricated, Cast</td>
<td>SAP</td>
</tr>
<tr>
<td>ES-165-10H</td>
<td>16.5 x 10</td>
<td>419 x 254 Cast, Cast</td>
<td>DAP</td>
</tr>
<tr>
<td>EB-180-7R</td>
<td>18.0 x 7</td>
<td>457 x 178 Cast, Heavy Cast</td>
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</table>

**ESD (Air Disc Brake)**

<table>
<thead>
<tr>
<th>Model</th>
<th>Rotor Diameter (in.)</th>
<th>Caliper (6 bolt mtg. (Frame), 4 bolt mtg. (Frame))</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESD225</td>
<td>16.94</td>
<td>430 6 bolt mtg. (Frame)</td>
<td>Steer or Drive Axles</td>
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<tr>
<td>ESD225</td>
<td>16.94</td>
<td>430 4 bolt mtg. (Frame)</td>
<td>Steer Axles</td>
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</table>

* SAP = single anchor pin  
  DAP = double anchor pin
# Nomenclature

## Wide Brake Package

### Linehaul

<table>
<thead>
<tr>
<th>Steer Axle</th>
<th>Drive Axle</th>
</tr>
</thead>
<tbody>
<tr>
<td>GAWR (lb)</td>
<td>Brake Model</td>
</tr>
<tr>
<td>12,000</td>
<td>ES1655 L &amp; D</td>
</tr>
<tr>
<td>13,200</td>
<td>ES1655 L &amp; D</td>
</tr>
<tr>
<td>14,600</td>
<td>ES1656 L &amp; D</td>
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</table>

## City Delivery

<table>
<thead>
<tr>
<th>Steer Axle</th>
<th>Drive Axle</th>
</tr>
</thead>
<tbody>
<tr>
<td>GAWR (lb)</td>
<td>Brake Model</td>
</tr>
<tr>
<td>12,000</td>
<td>ES1655 L &amp; D</td>
</tr>
<tr>
<td>13,200</td>
<td>ES1655 L &amp; D</td>
</tr>
<tr>
<td>14,600</td>
<td>ES1656 L &amp; D</td>
</tr>
<tr>
<td>20,000</td>
<td>ES1657 L &amp; D</td>
</tr>
</tbody>
</table>

## Construction, Heavy Haul, Mining, Oil Field, Intercity Coach, Logging

<table>
<thead>
<tr>
<th>Steer Axle</th>
<th>Drive Axle</th>
</tr>
</thead>
<tbody>
<tr>
<td>GAWR (lb)</td>
<td>Brake Model</td>
</tr>
<tr>
<td>12,000</td>
<td>ES1655D</td>
</tr>
<tr>
<td>13,200</td>
<td>ES1655D</td>
</tr>
<tr>
<td>14,600</td>
<td>ES1656D</td>
</tr>
<tr>
<td>20,000</td>
<td>ES1657D (ES420)</td>
</tr>
<tr>
<td>22,000</td>
<td>ES1657D (ES600)</td>
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</tbody>
</table>
Nomenclature

ES-150-4L

Shoe Hold-down Spring and Guide Variation

Service our products
Parts Information
Nomenclature

ES-150-6D Steer Brake
Nomenclature

ES-150-8D

Service our products
Parts Information
Nomenclature


*Reinforced fabricated shoe

Note: Horse Collar 817009 and Spring 817017 to be used on steer axles greater than 14,600 with ES165-5L, ES165-5D, ES165-6L and ES165-6D brakes.

Service our products
Parts Information
Nomenclature

ES-165-7M Heavy-duty Brake / ES-165-6H, ES-165-7H, ES-165-10H Severe-duty Brake

Service our products
Parts Information
Service our products

Parts Information
1. Slider pin cap
2. Slider pin bolt
3. Boot retaining ring
4. Boot protection spring
5. Inner slide pin
6. Slider bushing
7. Caliper bridge
8. Slider boot
9. Pads
10. Pad retaining spring
11. Retaining bar screw
12. Retaining bar
13. Outer pin slide
14. Air chamber slide
15. Air chamber washer
16. Socket head screw (caliper housing to bridge)
17. Air chamber
18. Actuator plug
19. Actuator assembly extension
20. Adjuster mounting screw
21. Actuator assembly
22. Hub/rotor assembly (2 pieces)
23. Frame
24. Torque plate
25. Retainer
26. Hex head screw (torque plate to frame)
27. Caliper housing

Service our products
Parts Information
## Nomenclature

### Spicer® Brake Model Parts Identification for Shoes and Return Springs

<table>
<thead>
<tr>
<th>Shoe Return Spring</th>
<th>Shoe Return Spring</th>
<th>Shoe Return Spring</th>
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<tbody>
<tr>
<td><strong>ES-150-D</strong></td>
<td><strong>ES-150-4L</strong></td>
<td><strong>ES-150-7D</strong></td>
</tr>
<tr>
<td></td>
<td>Double Anchor Pin, Cast Shoe</td>
<td>Double Anchor Pin, Cast Shoe, Bolted Lining</td>
</tr>
<tr>
<td><strong>ES-150-6D</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EB-180-7R</td>
<td>ES-165-6H</td>
<td><strong>ES-165-10H</strong></td>
</tr>
<tr>
<td>Single Anchor Pin, Cast Shoe</td>
<td>Double Anchor Pin, Cast Shoe, Bolted Lining</td>
<td></td>
</tr>
</tbody>
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**ES-150-AD**
**ES-150-4L**
**ES-150-8D**
**ES-165-5D, 5L, 6D, 6L, 6H, 7D, 7L, 8D, 8L, 10H**
**ES-165-7M**
**ES-165-7H**
**EB-180-7R**

**ES-150-6D,**
**ES-165-5D, 5L, 6D, 6L, 7D, 7L**
# Nomenclature

## Brake Spiders

<table>
<thead>
<tr>
<th>Lightweight Fabricated Spider</th>
<th>Cast Spider</th>
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</thead>
<tbody>
<tr>
<td>Single Anchor Pin ES-165-XL</td>
<td>Single Anchor Pin ES-165-XD</td>
</tr>
<tr>
<td>X = 5, 6, 7, or 8 in. brake width.</td>
<td>X = 5, 6, 7, or 8 in. brake width.</td>
</tr>
</tbody>
</table>

- **Air Chamber Bracket Flange Shape for Fabricated Spider**
- **Spider Part No. Location**

<table>
<thead>
<tr>
<th>Cast Spider Double Anchor Pin</th>
<th>Reduced Envelope Steer Brake Cast Spider</th>
</tr>
</thead>
<tbody>
<tr>
<td>ES-165-7H, ES-165-7M, ES-165-6H and ES-165-10H</td>
<td>Single Anchor Pin ES-150-4D or ES-150-6D</td>
</tr>
</tbody>
</table>

- **Air Chamber Bracket Flange Shape for Cast Spider**
- **Spider Part No. Location**

<table>
<thead>
<tr>
<th>Stamped Spider ES-150-4L</th>
<th>Reduced Envelope Drive Brake Cast Spider</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Single Anchor Pin ES-150-8D</td>
</tr>
</tbody>
</table>

- **Air Chamber Brake Flange shape for ES/EB-150-4L**
- **Spider Part No. Location**

## Camshafts

- **Cam Head for EB-180 Brakes**: 1-3/8" Camshaft Part No. Location
- **Cam Head for ES-165 and ES-150 Reduced Envelope Brakes**: 1-1/8" Camshaft Part No. Location
Nomenclature

Air Chamber Bracket with Gusset

Single Gusset

Marion Support

MARION BRACKET SUPPORT 820188
WELDED BY CUSTOMER TO AXLE HOUSING
DRIVE AXLE HOUSING ARM SECTION
The following discussion details the operation of a typical S-cam air brake system on a single-axle tractor and trailer (see Figures 1 and 2).

Systems vary somewhat, depending on the manufacturer and on optional equipment and configuration, but all can be thought of as comprising three sub-systems:

**The Supply System** (See Figure 1)

The supply system, as the name implies, supplies pressurized air—the energy source for any air brake system.

The key player in this sub-system is an engine-driven air compressor (1). A governor (2), which may be integral with the compressor, controls the compressor’s output by unloading or cycling it. Pressure is generally maintained at 100 to 120 psi, and is monitored by the driver by means of dash-mounted pressure gauges (3). A low-pressure switch (4) senses system pressure and sends an electrical signal to a dash light and/or buzzer to alert the driver when air pressure falls below 60 psi.
Air Brake Basics

Air reservoirs, three per tractor and one or two per trailer, store the compressed air until it is needed to actuate the brakes.

Check valves (5) prevent pressurized air in the primary and secondary reservoirs from passing back through the compressor while it is not running.

A safety or "pop-off" valve (6) is usually installed in the reservoir closest to the compressor. In the event of system over-pressurization, the safety valve allows air to escape, preventing damage to airlines, reservoirs and other components.

The reservoir closest to the compressor is often referred to as a wet tank, since that is where atmospheric moisture—the number one enemy of air brake systems—condenses in the greatest quantities. Reservoirs are equipped with drain valves (7) so water can periodically be eliminated. These can be manual or automatically operated. Alcohol is sometimes introduced into air systems operating in cold climates to prevent water from freezing and plugging airlines.

An aftercooler is an optional device that condenses and eliminates most of the water from an air system, but it is generally acknowledged that an air dryer (8) does a superior job in this capacity. An air dryer is a canister that usually contains a bed of desiccant material. As air passes through the material, moisture, as well as oil blow-by from the compressor, is captured by the material.

The Control System (See Figures 1 and 2)
The control system consists of a series of pneumatic valves that direct air and control pressure to appropriate components. Although discussed here individually, different valves are often combined in a common housing.

The main valve is the dual-control foot valve (9), so called because it is actually two valves that operate simultaneously, in response to input from the driver’s foot at the brake pedal.

Figure 1
Air Brake Basics

Two valves are necessary because, after the wet tank output the system splits into two separate brake circuits. Air downstream of the wet tank is divided between primary and secondary reservoirs. The split system ensures that, in the event of a failure, the entire system will not become inoperative, and the truck can be brought to a controlled stop.

When the brake pedal is depressed, air flows from the primary reservoir and through the primary portion of the dual-control foot valve to actuate the rear axle brakes. Meanwhile, air flows from the secondary reservoir, through the secondary portion of the dual control foot valve, to actuate the front axle brakes. A two-way check valve (10) senses primary and secondary supply pressure, and allows the dominant pressure to actuate the trailer brakes. Primary air can also be manually supplied to the trailer by means of a hand valve, (11) usually located on or near the steering column.

Two-way check valves are also used to allow dominant pressure to activate the stop light switch (12), and to release the parking brakes. Federal Motor Vehicle Safety Standard (FMVSS) 121 requires that the driver be able to release the parking brakes at least once from the cab, in the event of a failure in either circuit.

Relay valves (13) are used on trailers and on the rear axles of long-wheel-based tractors to minimize delays of brake application due to length of plumbing. These valves are directly supplied with unmodulated air pressure, and use air from the dual-control foot valve or manual trailer valve as a signal to quickly direct air to the brakes they serve.

Relay valves come in a variety of "crack" pressures. Crack pressure is the air pressure value required at the input from the foot valve before the relay valve will send air pressure to the brakes controlled by that valve.

Crack pressure is an important element of brake timing and balance, and is determined, axle by axle, by how heavily loaded the axle served by a valve is, how big its brakes are, and how aggressive the linings are on those brakes.

A valve that cracks at too low a pressure for a given axle can cause premature application, wheel lockup and trailer pushing, if the affected axle is on the tractor. Too high a crack pressure can cause delayed application, insufficient braking and trailer pushing, if the affected axle is on the trailer.

After a stop, when the driver lifts his foot from the brake pedal, an optional quick release valve (14) allows brake actuation air to be quickly exhausted near the brakes it serves, rather than having to travel back through the supply line, thus speeding brake release time.

Dash-mounted valves (15 and 16) control air pressure to the parking brakes. In most cases, these are spring brakes, so called because when no pressure is supplied, the brakes are applied by means of a spring. When air pressure is supplied, spring force is overcome and the brakes are released. More on that a little later.

A tractor protection valve (17) senses pressure in one or both lines that carry air to the trailer. These lines are connected to the trailer by means of quick-connect air fittings called “Gadhand”. When there is no pressure in the line(s) due to trailer breakaway or a gross air leak in the trailer circuit-the valve closes to maintain air pressure in the tractor circuit. In everyday use, the valve also works in conjunction with the dash-mounted trailer parking brake valve (16), to shut off air to the trailer circuit before disconnecting tractor from trailer.

The spring brake (or multi-function) valve limits the air pressure used to keep the trailer parking brakes off and, by means of an integral check valve, isolates a failed reservoir, which would otherwise cause the parking brakes to be automatically applied.
Air Brake Basics

The Foundation Brakes (See Figures 1, 2 and 6)

When the brake pedal is depressed, air pressure is directed to brake chambers (19) at each wheel end. Brake chambers consist of a pressure housing, diaphragm and pushrod. As air pressure is exerted on the diaphragm, the pushrod on the other side of the diaphragm is extended.

The force the pushrod exerts is the product of the amount of air pressure applied in psi, and the area of the diaphragm in square inches. For example, 60 psi, applied to a chamber with a 16-sq.-in. diaphragm would create a force at the pushrod of 960 lbs. A 60-psi application to a chamber with a 30-sq.-in. diaphragm would yield 1,800 lbs of pushrod force. Improperly matched brake chambers, therefore, can cause severe brake balance problems.

The pushrod is connected to one end of a lever called an automatic brake adjuster (ABA)—formerly called a slack adjuster (20). For simplicity in this article, this component will be referred to as the ABA. The other end of the ABA is connected to a shaft that runs perpendicular to the plane formed by the pushrod and slack adjuster. As the pushrod is extended, the shaft rotates.

The shaft, in turn, is connected to an S-shaped cam between the brake shoes. As the shaft rotates, so does the cam. The brake shoes are forced apart and against the brake drum, creating the friction needed to slow the vehicle. The amount of friction produced is determined, in part, by the size of the brakes, the coefficient of friction (aggressiveness) of the brake lining material, and mass and heat rejection potential of the drum.
Lining or brake block aggressiveness is indicated by means of edge coding on the material itself. Two problems with this identification method are:
- the coding is difficult, if not impossible, to read once the linings are well-worn; and,
- the testing of a 1.0 sq. in. sample of lining to SAE J661a produces a two-letter “friction identification code” (EE, FF, GH, etc.). This is not considered a good indicator in determining performance on a full-sized brake.

The ABA is equipped with an adjusting mechanism to compensate for brake lining wear. All modern brake adjusters accomplish this adjustment automatically. Since Oct. 1994, all air-braked vehicles produced for operation in North America must be equipped with ABA’s. ABA’s fall into two design classifications: 1) Clearance sensing brake adjuster (Spicer preferred) and 2) Stroke Sensing.

### Brake Chamber Force Effect

<table>
<thead>
<tr>
<th>Brake chamber type</th>
<th>9</th>
<th>12</th>
<th>16</th>
<th>20</th>
<th>24</th>
<th>30</th>
<th>36</th>
<th>50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effective area of diaphragm (sq in)</td>
<td>9</td>
<td>12</td>
<td>16</td>
<td>20</td>
<td>24</td>
<td>60</td>
<td>36</td>
<td>50</td>
</tr>
<tr>
<td>Pounds force developed with 60 psi</td>
<td>540</td>
<td>720</td>
<td>960</td>
<td>1200</td>
<td>1440</td>
<td>1800</td>
<td>2160</td>
<td>3000</td>
</tr>
</tbody>
</table>

*Effect of brake chamber type (diaphragm area) on pushrod output force, with constant 60-psi application.*

The brake adjuster has another function. It is essentially a lever, and a lever multiplies force in proportion to its length. A 6-in. long brake adjuster converts 1,000 lbs of force at the pushrod to 6,000 lbs-in. torque at the camshaft.

The brake adjuster’s length and the brake chamber’s size are two variables commonly altered to meet braking requirements. The product of these two values is expressed as the “AL factor.” This factor, when multiplied by 60 psi air pressure, is the industry standard for braking calculations.
Air Brake Basics

For example, 60 psi, applied to a chamber with a 16-sq-in. diaphragm (the "A" part of the AL factor) would create a 960-lb pushrod force (see Figures 3 and 5). Multiplied by a 6-in. brake adjuster (L), the actual torque on the brake camshaft would be 5,760 lbs-in.

While it’s good to understand the AL factor, be cautioned against its use as a sole means of determining brake specifications, as it doesn’t take into account component deflection and other variables.

In addition to applying the service brakes used in everyday driving, the brake chambers on the rear tractor axles and on the trailer axles apply the parking brakes. These brake chambers, (spring brakes), incorporate a second chamber, containing a second diaphragm and a powerful spring.

When the vehicle is parked, the dash valves are pulled out. This exhausts spring brake hold-off air, allowing the spring to apply the parking brakes. In the event of a loss of system pressure, hold-off air pressure is, in most cases, overcome by the parking brake spring, and the brakes are automatically applied to provide emergency stopping (see Figure 5).

When the vehicle is in use, the dash-mounted parking brake valves are in the "run" (pushed-in) position. This supplies air pressure to the spring chamber, on the side of the diaphragm opposite the spring. Air pressure acting on the diaphragm compresses the spring, and the parking brakes are held off. This does not affect the operation of the service brakes.

Figure 4

Piston-type spring brake (a second diaphragm is commonly used in place of piston). In normal "run" mode, system pressure overcomes spring pressure, and parking brake is held off. During normal service brake application, service air acts on diaphragm in right hand chamber, and is not affected by spring brake. In emergency or parking operation, air is exhausted from left-hand chamber. Spring force moves pushrod to right, applying parking brake.

Figure 5

Action of chamber on brake adjuster (automatic-type shown). A properly set adjuster forms a 90° angle with pushrod when lining contacts the drum.
Per FMVSS 121, the parking brakes must be able to hold a vehicle, loaded to its gross weight rating, stationary on a smooth, dry, concrete roadway, facing uphill or downhill on a 20% grade. In the emergency mode, the parking brakes must be able to exert a retarding force equal to 28% of the gross axle rating.

A common option, called anti-compounding, prevents additional pressure (from an inadvertent application of the service brakes) from being added to the pressure already being exerted by a parked spring brake.

With this option, when the parking brakes are on and a service brake application is made, a double check valve sends air pressure to the hold-off side of the spring brake chamber, cancelling the redundant, potentially harmful, force of service-application air pressure.

Figure 6

Foundation brake operation. When pushrod is extended, brake adjuster, camshaft, S-cam rotate. S-cam spreads brake shoes apart and against brake drum.
ABA The abbreviation for Automatic Brake Adjuster. Also called an Automatic Slack Adjuster (ASA), this is a lever connecting the brake chamber push rod with the foundation brake camshaft. It provides torque to rotate the brake camshaft when the brake treadle is depressed. It also provides a means of adjusting clearance between brake shoes and the drum to compensate for lining wear. Some brake adjusters require manual adjustment.

ABS The abbreviation for Antilock Brake System. ABS electronically monitors wheel speed and prevents wheel lock-up by rapidly cycling the brakes during panic stops and when stopping on low-friction surfaces.

ABS control valves Control valves that are actuated by the ABS Electronic Control Unit (ECU) to ensure wheels are optimally braked. On a tractor, they are called ABS modulator valves. On a trailer, they're called ABS relay valves.

Actuate To initiate mechanical motion of a brake system component.

Actuator A device which physically initiates mechanical motion of a brake system component.

ADR-35 Australian design rule

Aftercooler Optional device that condenses and eliminates water from air pressurized by the compressor.

Air build-up Process of compressor building (increasing) pressure to a predetermined maximum level (usually 100-120 psi) within the brake system air tanks.

Air compressor Engine-driven via a belt or direct gear, the compressor pressurizes the air tank.

Air compressor cut-out Predetermined point at which the air governor halts compression of air by the compressor.

Air disc brakes Air-actuated brakes, which, upon application, employ a caliper to clamp two brake pads against a rotor. Air discs, compared with drum-type brakes, have superior ability to resist fade.

Air dryer A filter, typically containing a desiccant, which is installed between the compressor and service reservoir to remove water and vapor plus oil blow-by from the compressor.

Air gauge Dash-mounted gauge indicating air pressure in terms of pounds per square inch (psi).

Air governor Controls the compressor unloader mechanism and also maintains system air pressure between predetermined minimum and maximum levels (usually, between 90-120 psi).

Air system balance Can be separated into two different aspects, pressure level balance and timing balance. Air system balance deals primarily with the vehicle air system components that directly control the actuation of the service brakes during normal stops, foot control valve, check valves, relay valves and their arrangement or system design.

Air tank A reservoir for compressed air. Typically, a combination vehicle has several tanks: three in the tractor and one per trailer. The tractor’s supply air tank (formerly "wet tank") receives air from the compressor and delivers it to the primary and secondary air tanks in the tractor. A check valve on each tank prevents total air loss in the event of a leak.

Alcohol evaporator Optional device, installed in compressor discharge line between the compressor and supply air tank, which injects alcohol mist into the air flow to reduce the risk of freezeup. It’s not normally used in a vehicle with an air dryer.

AL factor A mathematical expression of the brake adjuster and brake chamber combination. "A" equals the effective area, in square inches, of the brake chamber (e.g., Type 30 chamber has effective area of 30 sq.-in.). "L" equals the effective length, in inches, of the slack adjuster. For example, 30 x 6 in. = 180 AL factor.

Analog processing A method of processing information used in older ABS control units. Today’s Electronic Control Units (ECUs) use digital processing, which is many times faster and more reliable.
**Anchor pin**  A pin or pins used to retain brake shoes within the brake assembly.

**Anti-compounding**  Basically, an optional system that prevents application of service brakes from compounding (adding to) the force exerted by parking brakes.

**Antilock**  A safety-oriented system that senses wheel rotation (at one or more axles) during braking and cycles the brakes to prevent locking those wheels.

**Application time**  Time elapsed between depression of the brake treadle and engagement of the linings with the drums (or, per RMVSS 121, the point at which all service chambers reach 60 psi).

**Application valve**  Air valve, such as foot valve or trailer control valve, which controls the pressure delivered to brake chambers.

**Automatic slack adjuster**  See ABA.

**Automatic traction control (ATC)**  Also called ASR, it’s an optional system that is available on 4- and 6-channel ABS systems. Automatic traction control minimizes wheel slipping during acceleration by controlling both the engine throttle and brake pressures.

**Auxiliary retarders**  See Retarders.

**BOCC dimension**  Distance from the center of the brake shoe to the centerline of the brake chamber.

**Bell-mouthed drum**  Drum with variation of inner diameter (i.e., greater at open end), preventing full contact with brake lining.

**Blue drum**  Brake drum with friction surface turned blue from high temperature. High temperature may result, for example, from dragging of brakes caused by weak return springs. Blue drum also may result from lack of brake balance.

**Brake adjuster**  See ABA.

**Brake balance**  Basically, balance is achieved when all brakes on all axles do their fair share of the work. The four types of brake balance are: pneumatic, thermal, timing, and pressure level.

**Brake block**  Friction material or lining attached to a brake shoe. Disc brakes use pads with friction material.

**Brake chamber**  Device inside which a diaphragm converts air pressure to mechanical force, via a push rod, for brake actuation. Consists of service chamber or service chamber/spring chamber. For example: A 30/36 chamber consists of a Type 30 service chamber and a Type 36 spring chamber. See Service brakes/Spring brake.

**Brake chamber diaphragm**  Bellows-type device within brake chamber that converts air pressure to mechanical force via a push rod. The size of the brake chamber correlates with the effective area of the diaphragm. A Type 30 chamber diaphragm has an effective area of 30 in.

**Brake drag**  Failure of one or more brakes to release immediately and/or completely after a driver removes his foot from the brake treadle. Constant drag, unrelated to a brake application, also can exist. See Quick-release valve.

**Brake drum**  Attached to the hub. Absorbs kinetic energy from the shoe and lining assembly and transfers heat away from the brake surface to dissipate the heat into the atmosphere over time. The majority of drums are entirely of cast iron. Generally these are divided into three service-rating codes based on application. There is standard duty, heavy duty, and extra heavy duty (severe service). In addition, there are inboard mounted drums (with spoke wheels) and outboard mounted drums (with hubs). The other brake drum is the steel jacketed type. This consists of a steel mounting face with a cast iron braking surface insert.
Glossary

Brake fade  There are many types and causes of braking fade. Fade may result, for example, from a reduction in friction between linings and drums caused by exposure to water. Most typically, however, fade involves a reduction in braking force experienced when dragging brakes on a long grade. If brakes are maladjusted, an overheated drum may expand to the degree that push rod travel is insufficient to fully actuate the brakes. This is one example of mechanical fade, which also may result from various mechanical defects (e.g., scored drums) within the foundation brake system. In contrast, heat fade occurs when linings overheat and become less aggressive. Gradual and predictable fade is desirable as a warning.

Brake proportioning  Optional safety-oriented system, often called "bobtail proportioning," for limiting drive-axle brakes while a tractor is operated without a trailer. Also, system that varies individual axle braking effort in response to weight or other variable.

Brake treadle  Functionally, the brake pedal – a mechanical lever attached to the foot brake valve.

Breakaway valve  Upon accidental separation of trailer(s), a tractor protection system that prevents air loss from the power unit. See Tractor protection valve.

Burnish  The conditioning or "seasoning" of a brake lining by wear and temperature via a test procedure or in-service operation.

Caliper  In an air disc brake system, the clamping device containing friction material mounted to pads. When actuated, the caliper applies braking force to both sides of the rotor.

Cam same / Cam opposite  As can be seen in this force vector comparison, the direction of the application force is different between cam same and cam opposite. In the cam same, the primary shoe roller is pushed out and down which allows the shoe crown balance to work as designed. In the cam opposite, the primary shoe roller is pushed out and up which tends to allow the cam end of the shoe to be pushed against the drum instead of the center of the shoe. This allows the shoe to energize itself and increases torque output (slightly) over a cam same brake. Also in some cases with certain combinations of hardware and lining materials, cam opposite brakes are noisy. Of course the question comes to mind "why have a cam opposite brake if it is a disadvantage"? The answer is that some suspension systems do not have enough clearance to allow chamber brackets to be mounted in the proper location to allow cam same brakes.

Channel / ABS  The number of channels in an ABS system refers to the number of valves its Electronic Control Unit (ECU) is capable of independently controlling.

1-Channel ABS  A system design that uses two wheelspeed sensors and one control valve (2S/1M). This is the most popular system for most trailers. It is called tandem control.

2-Channel ABS  A system design that uses two or four wheelspeed sensors and two control valves (2S/2M or 4S/2M). The ABS monitors wheel speed and avoids wheel lock-up on one axle while braking on low-friction surfaces or in emergency situations by rapidly cycling the brakes on the wheel ends of two axles. Commonly used on trailers.
Glossary

4-Channel ABS A system design that uses four wheelspeed sensors and four ABS control valves (4S/4M) on a two-axle truck or tractor. A 4-channel system can also be used on a three-axle vehicle, controlling the left and right side drive axle wheels in pairs. This popular system, which offers an optimum blend of performance and economy, is the most common system on trucks, tractors and buses.

6-Channel ABS A system design that features six wheelspeed sensors and six ABS control valves (6S/6M) to individually monitor and control all six wheels of a three-axle truck or tractor. This type of system provides the highest available level of ABS control. It's commonly used on vehicles with lift or tag axles.

Check valve A one-way check valve is used, for example, to prevent air from bleeding back out of a reservoir. A two-way check valve activates selectively; for instance, by drawing air for brake application from the most-highly-pressurized reservoir (primary or secondary).

Clearance sensing brake adjuster Senses force when brake lining contacts the drum to adjust lining to drum clearance.

Clevis pin Pin connecting the arm of a slack adjuster to a brake chamber push rod yoke.

CMVSS-121 Canadian Motor Vehicle Safety standard 121 for air brake vehicles

Combination lining block Two different lining materials on the same brake shoe. The higher friction material is on the cam end of the brake shoe with the lower friction material on the anchor end.

Connectors/ABS Sealed, corrosion-resistant plugs that link the ABS wiring system to the Electronic Control Unit (ECU), wheel speed sensors and modulator or relay valves using a shielded wiring harness.

Control algorithm The computer commands programmed into the Electronic Control Unit (ECU) to control brake actuation under impending wheel lock-up.

Cracked drum Brake drum cracked all the way through by excessive heat build-up (perhaps signifying inadequate drum weight, and/or driver abuse and/or resurfacing of a drum beyond the manufacturer's limit).

Crack pressure Minimum air pressure, expressed in pounds per square inch (psi), required to open an air valve.

Diagnostics/ABS A component-by-component self check performed each time the truck's ignition is turned on. An independent microprocessor also checks the system continuously during vehicle operation.

Diagonal system/ABS A brake system design that divides the ABS into two circuits (front wheel on one side with rear on the other side, and vice versa) to allow partial system function should one diagonal malfunction.

Digital processing/ABS The latest processing technology that is many times faster and more reliable than analog processing.

Disc brake A foundation brake system consisting of a flat disc or rotor on either side of which are friction pads. Equal and opposite forces are applied to these pads to press their working surfaces into contact with the braking path of the rotor.

Double diaphragm chamber Generates force output by utilizing two separate diaphragms, one in the service chamber, and the other inside the spring chamber. Double diaphragm brake chambers are the most common in North America for general truck/tractor application.

Drain valve Used to drain oil and water from air reservoirs. Valve may be manual or automatic in operation. Automatic versions, which may be heated electrically to prevent the valve freezing open, often are referred to as spitter valves.

Drum brake A brake system in which two brake shoes with friction material expand into a rotating drum.
**Dual brake system**  A redundant air system (primary and secondary) designed to retain braking ability in the event one system fails.

**Duplex gauge**  Essentially, a diagnostic device incorporating two separate air gauges with a common housing and utilizing indicator needles of different colors. Device is used to diagnose brake system imbalance within a combination vehicle via simultaneous connection to two points (such as the tractor gladhand and a trailer brake chamber). It’s also used as a dash gauge for dual reservoirs.

**Dust shield**  Plate made of metal or polyethylene that’s mounted inboard of the brake drum to minimize entry of dirt and road splash.

**EBS**  The abbreviation for Electronic Braking System, or brake-by-wire. A system in which the control signal is sent electronically, rather than pneumatically, although the actual service application is still made by air pressure.

**ECE-13**  Uniform provisions concerning the approval of vehicles with regard to braking in Europe

**ECU/ABS**  The abbreviation for Electric Control Unit, is a microprocessor that evaluates how fast a wheel is rotating. The electrical signals generated by the inductive sensors pick up impulses from toothed rings that spin with the wheel.

**Edge codes**  Developed by Friction Materials Standards Institute, a double letter code (e.g., EE, FF, GG, FG) printed on the edge of a brake block to designate its range of aggressiveness.

**EEC**  on the approximation of the laws of the member states relating to the braking devices of certain categories of motor vehicles and their trailers. Published in the official journal of European Communities

**Emergency brake system**  Not a separate system, emergency braking (in the event of air loss) involves various portions of the parking and service brake systems. See Spring brake.

**Engine brake**  One type of retarder. An optional device that converts a diesel engine into a power-absorbing air compressor to slow a vehicle on downgrades.

**Exhaust brake**  One type of retarder. An optional device that uses engine exhaust back pressure to slow a vehicle on downgrades.

**Fail-safe/ABS**  If antilock brake system should fail during vehicle operation, a dash light warns driver that ABS is disengaged. Meanwhile, the tractor’s pneumatic system returns to normal relay valve functions and maintains standard air brake performance.

**Fault codes/ABS**  A series of codes displayed by the self-diagnostic portion of the ABS unit, isolating the section of the system that is now or has malfunctioned.

**FMVSS-121**  Federal Motor Vehicle Safety Standard - 121 for air braked vehicles.

**Foot valve**  A foot-operated valve controlling air pressure delivered to the brake chambers.

**Force balance**  Optimum stopping capability requires tire to road retarding forces in proportion to the loads on that axle, not the rating of that axle.

**Foundation brake balance**  Foundation brake balance deals with the brake itself, (not including the air system) brake lining, tire size, air chamber, slack length, etc. Can be separated into two different aspects, torque balance and thermal balance between different axles.

**Foundation brake system**  Term inclusive of mechanical components involved in providing braking force (i.e., brake chambers, slack adjusters, brake drums, rotors and brake linings).

**Frame (disc brake)**  structural element which supports caliper and mounts brake assembly to torque plate.

**Front axle limiting valve**  See Ratio limiting valve.

**GAWR**  The abbreviation for Gross Axle Weight Rating, is the total weight capacity of the axle (single, tandem, or tridem).
Glossary

**GCWR** The abbreviation for Gross Combination Weight Rating, is the total weight capacity of a combination vehicle, (tractor and trailer) as determined by axle ratings. It includes the weight of the vehicle and payload.

**Gladhand** Mechanical connector used to attach a tractor's or converter dolly's service (i.e., control) and emergency (i.e., supply) air lines to those on a trailer.

**Greased-stained drum** A brake drum with discoloration of friction surface caused by, for example, improper greasing of brake camshaft.

**Gusset** A reinforcement welded to the camshaft bracket to provide additional support for severe service applications. See page 45.

**GVWR** The abbreviation for Gross Vehicle Weight Rating, is the total weight capacity of a single vehicle, as determined by axle ratings.

**Hand valve** See Trailer control valve.

**Heat-checked drum** Brake drum with hairline cracks on friction surface caused by thermal cycling. Mild checking normally does not require drum replacement.

**Heat-spotted drum** Brake drum with a pattern of hard, slightly raised dark spots of martensite on its friction surface. Caused by localized overheating and sudden cooling, those spots should be ground off to prevent drum cracking, uneven lining wear and loss of braking efficiency. If spots cannot be removed, the drum should be discarded. Heat spotting is promoted by light and steady braking on downgrades.

**High articulation suspension** Type of suspension for off-road activity. Greater articulation or suspension travel is required to keep tires in contact with the ground.

**Hold-off spring** A spring within a relay valve or quick release valve that's designed to retard valve operation until a predetermined amount of air pressure is exerted. See Crack pressure.

**Hysteresis** Difference between the amount of pressure needed to open a valve and the pressure drop needed to close it.

**Inversion valve** Valve used on trucks to release air from the parking brake chambers and apply the rear brakes if the rear air reservoir fails.

**Jackknife** Uncontrollable articulation of a tractor-trailer typically resulting from lock-up or spinning of tractor drive axle(s). The risk of jackknife is greatest on a slippery road with an empty or lightly-laden trailer in tow.

**Jake brake** Trademark of engine brakes by the Vehicle Equipment Division of The Jacobs Manufacturing Co. See Engine brake.

**Leak-down test** A common method of checking for air leaks. With the engine off, vehicle stationary, the air system at maximum governed pressure and all service brakes fully applied, there should be no more than a 3 psi/min. air loss noted on the dash-mounted pressure gauge for straight trucks; 4 psi/min. for combination vehicles.

**Lining growth** Permanent swelling of brake lining resulting from heat exposure.

**LMS** Refers to low maintenance system. LMS optional packages are either lube for life or annual lube.

**Long stroke chamber** A brake chamber designed to permit longer-than-normal push rod travel without exceeding its readjustment limit. For example, a regular, clamp-type, Type 30 chamber has a readjustment limit of 2 in. A longstroke version of that chamber has a readjustment limit of 2-1/2 in.

**Low-pressure warning device** Pressure-sensitive electrical switch that actuates an in-cab buzzer and warning light when air pressure falls below a predetermined level (typically, 60 psi).

**Marion Support** a “tear-drop” shaped support which fits over the camshaft barrel located between the chamber bracket and the automatic brake adjuster (ABA). The Marion Support is welded to the axle housing after the brake assembly is mounted to the axle. This is an optional means of support where the BOCC dimension is 13.5” or longer. See page 45.

**Multiplexing** A means of sending discreet electrical signals to multiple devices along a common pair of wires.
Neutral engagement valve  A component of pneumatic system which permits the service brake to be applied when the transmission is in neutral and the driver is out of the cab. Typically found on refuse trucks.

Out-of-round drum  Brake drum with variations in its inner diameter, causing reduced braking efficiency. An out-of-round drum often can be machined, within manufacturer's limits, to restore concentricity.

Oversized drum  Refers to a brake drum having an inner diameter greater than the discard diameter marked on the drum by its manufacturer.

Parking brake  See Spring brake.

Parking brake priority  A type of trailer brake control valve which prioritizes delivery of air for quick release of a trailer's parking brakes after being hooked to a tractor. Charging a trailer's service reservoirs, to provide braking ability, is a secondary concern.

Pawl  A mechanical device allowing rotation in only one direction. One type consists of a hinged tongue, the tip of which engages the notches of a cogwheel, preventing backward motion.

Piston type chamber  Incorporates a piston in place of the diaphragm inside the spring chamber. This chamber will provide approximately 30% to 40% higher pushrod output for parking. The service chamber, however, still utilizes a diaphragm. Piston type chambers are more common in Europe and also for transit buses in North America.

Planetary double reduction axle  The double reduction axle provides greater overall gear reduction and is ideal for peak torque development and transmission. This feature makes the axle desirable for starting heavy loads in adverse terrain. The first reduction is through the primary gearing. The second reduction is with adjacent planetary gearing.

PLC  The abbreviation for Power Line Carrier—a form of multiplexing wherein a discreet electrical signal is sent along a wire already carrying power for another purpose. PLC technology is used in tractor/trailer communications, allowing more utility than the standard, J-56O, 7-pin connector could otherwise afford.

Pneumatic balance  Achieved when individual air chambers receive the air pressure required for each brake in the system to do its fair share of the work. Lack of pneumatic balance is most likely at low brake application pressures, rarely during panic stops.

Pneumatic timing balance  Achieved when individual air chambers sequentially receive air within a timeframe that ensures each brake in the system will do its fair share of the work. In a combination vehicle, lack of proper timing is likely to occur because tractor brakes receive air faster than trailer brakes. See Trailer push.

Polished drums  A brake drum with a friction surface polished to a mirror-like finish by unsuitable brake linings. Remove gloss from drum with 80-grit emery cloth.

Pop-off valve  Jargon for a pressure-relief valve, installed in the service reservoir or wet tanks as insurance against over-pressurization.

Pressure differential  Difference between the inlet and outlet air pressure of an open brake valve. Also, difference in air pressure between any two points within a brake system.

Pressure level balance  Is obtained when all of the vehicles brake chambers are receiving the required level of air pressure (once pressures have stabilized). This does not necessarily mean the same pressure. Different design brakes on the same vehicle may require different levels of air pressure. Pressures may be varied on different axles to compensate for different size brakes or different amount of underbody cooling received by the brakes.
**Glossary**

**Pumping the brakes**  Phrase denoting a rapid series of brake application (a.k.a. fanning) used to avoid locking brakes on axles during sudden stops. Phrase also may apply to a slower series of heavy brake application (a.k.a. snubbing) used in an attempt to prevent brake overheating and resultant fade on long downgrades.

**Push rod**  A rod, protruding from a brake chamber, which is connected to the arm of a slack adjuster via a clevis pin.

**Quick-release valve**  Designed to reduce the chance of brake drag, a valve that speeds the process of exhausting air from brake chambers when driver releases the brake treadle.

**Radio Frequency Interference (RF)**  External interference or false signals from such sources as radar, citizens-band radio, other types of radio transmissions and television signals. While the effects of this interference on ABS was a concern during the 1970s, today’s technology has virtually eliminated the problem.

**Ratio limiting valve**  Automatically regulates application pressure to steer axle during normal braking. Progressively harder braking, however, will progressively increase steer axle braking until maximum torque is applied.

**Relay valve**  Valve located near a reservoir that is activated by a control signal from another valve that usually is farther away. It’s used to speed the application of brakes on drive and trailer axles.

**Release time**  Time between release of brake treadle and total disengagement of brake linings and brake drums. Or, per FMVSS-121, that time required to reduce pressure to 5 psi from 95 psi within all service chambers.

**Retarder**  Auxiliary braking device such as engine brake, exhaust brake, hydraulic retarder or electric retarder.

**Return springs**  Springs which retract brake shoes upon release of the brake treadle.

**Roll-over**  Jargon denoting that an S-cam has traveled beyond its designed stopping position during brake application.

**Rotor**  Braking surface for disc brake system. On heavy trucks the rotor is generally cast iron and has vented design. The rotor can be either separate or integral to the hub.

**SAE (Society of Automotive Engineers)**  An international organization of automotive/truck/bus engineers who develop test procedures and requirements for all ground transportation vehicles and their components.

**S-cam brake**  Type of brake where mechanically-induced rotation of an S-shaped cam forces brake linings against the brake drum.

**Scored drum**  Brake drum with a grooved friction surface, resulting in excessive lining wear. Severe scoring requires that a drum be machined, within manufacturer’s limits, before replacing the linings.

**Service brake priority**  A type of trailer brake control valve which prioritizes delivery of air to a trailer’s service reservoirs, to provide braking ability, after being hooked to a tractor. Releasing a trailer’s parking brakes is a secondary concern.

**Service brakes**  As opposed to spring or parking brakes, that portion of the brake system used for normal brake application.

**Slack adjuster**  Also called a brake adjuster, this is a lever connecting the brake chamber push rod with the foundation brake camshaft. It provides torque to rotate the brake camshaft when the brake treadle is depressed. It also provides a means of adjusting clearance between brake shoes and the drum to compensate for lining wear. Some models are automatic while others require manual adjustment. See ABA.

**Speed sensor/ABS**  An electromagnetic device that, in conjunction with a rotating toothed wheel, generates an electrical signal proportional to the wheel speed and transmits the information to the ABS Electronic Control Unit (ECU).
Glossary

Spitter valve  Slang for automatic drain valve. See Drain valve.

Split-coefficient surface  Also called split-M (split-Mu), a road condition where one side of a lane has low friction and the other has high friction (example, the left side of the lane is ice covered, the right side is dry). A 2, 4 or 6-channel ABS system (antilock brake system) with individual wheel control will provide optimum stability and stopping-distance performance under these conditions.

Spring brake  Generally refers to a tandem-chamber brake actuator that incorporates an air-applied service brake chamber and an air-release/spring-applied parking or emergency brake chamber. Spring brakes apply upon sudden air loss (emergency mode) or activation of a dash-mounted parking brake control. Spring brakes remain applied until that chamber is recharged with air or the spring is manually compressed or caged.

DISASSEMBLY OF A SPRING BRAKE IS DANGEROUS. ONLY TRAINED MECHANICS SHOULD ATTEMPT THE PROCEDURE. The spring portion often is referred to as the piggyback. Spring brakes generally come in two types: double diaphragm or piston type.

Static loaded radius (SLR)  Distance, expressed in inches, from the center of a tire/wheel assembly to the pavement, measured when mounted on a vehicle and loaded to its maximum rated capacity.

Stopping distance  The distance traveled by a vehicle on a road between the initial brake pedal movement and a full stop.

Stopping time  The time elapsed between the initial brake pedal movement and a full stop.

Stroke  Refers to a total distance traveled by a brake chamber push rod or slack adjuster arm during brake application.

Stroke Sensing  ABA Excessive stroke caused by lining wear raises the actuator rod during brake apply. The spiral serrated activator will jump over serrations on the the spring loaded pawl if adjustment is required. Actual brake adjustment is made on the return stroke.

Super single tire  Specially designed tire used in lieu of dual tires in certain line haul rigs and local gasoline tankers. Super singles can reduce maintenance and/or save hundreds of pounds of tire weight when compared to duals.

Supply air tank  The air reservoir immediately downstream of the air compressor. See Wet tank.

Swept area  The total surface area of the drum or rotor of a brake that comes in contact with the friction material during one revolution of the wheel. In general, the more swept area a brake has, the cooler it will operate.

Tag/Pusher axle  A "dead axle" (no driving capability) used to give vehicle more weight carrying capacity. A pusher axle is ahead of the drive axle. A tag axle is behind the drive axle. This type of axle may have the capability of being raised or lowered and some are made to be steerable.

Thermal balance  Is achieved when all brakes are operating at the same temperature. If the proper thermal balance was achieved both the tractor and trailer brakes would see the same temperature throughout any given braking cycle on some vehicles, steer axle brake temperatures should be somewhat below drive brakes to avoid aggressiveness and pull.

Threaded drum  Brake drum improperly resurfaced on a lathe, resulting in a friction surface akin to that of a scored drum.

Timing balance  Is achieved when all brake chambers are receiving the required air pressure within an appropriate time from application. Due to the nature of long vehicle air systems, air cannot be expected to arrive at all axles at the exact same time.

TMC  The Technology & Maintenance Council; an organization consisting of fleet operators, independent truckers, truck manufacturers, component manufacturers, government agencies, media and academia whose primary goal is to communicate the latest and best vehicle maintenance procedures to the end users. These maintenance procedures are communicated to the trucking industry in the form of Recommended Practices (RP).
**Glossary**

**Torque balance** Achieved when individual brakes exert the degree of braking force required for each brake in the system to do its fair share of the work.

**Torque Plate** A plate used to mount the disc brake frame to the axle brake flange or steer knuckle.

**Tractor protection valve** Isolates tractor air system in event of a trailer breakaway or dangerous decrease in the tractor’s reserve air, but is typically applied (via dashmounted control) before disconnecting a trailer.

**Trailer control valve** Hand-operated valve, located on (or adjacent to) the steering column, which permits independent control of the trailer brakes. Also known as the trolley valve or hand valve.

**Trailer push** Caused by the tractor braking prior to the trailer and/or with greater torque. Even with “perfect” brake balance, the trailer pushes the tractor to some extent since the tractor brakes absorb part of the trailer’s load.

**Trailer swing** Articulation of the trailer caused by locking the trailer brakes.

**Treadle valve** Foot-operated brake actuation valve.

**Trolley valve** See **Trailer control valve**.

**Turned drum** A brake drum that has been resurfaced on a lathe to remove scoring or other defects. Stay within manufacturer’s limits.

**Two-speed axle** A drive axle having two selective gear ratios. Used primarily for export and most popular with 5-speed transmissions to provide a fast ratio for top speed and a slower ratio for greater pulling power.

**Warning light/ABS** An indicator light on the truck or tractor instrument panel that illuminates to indicate the status of the ABS system. On trailer ABS, the indicator light may be located on the trailer body where the driver or maintenance personnel can easily see it.

**Wedge brakes** As opposed to a brake applied by an S-cam, this type of brake is applied by a single or double wedge-type mechanism. This type of brake is self-adjusting and, as such, does not utilize an external brake adjuster.

**Wet tank** Also known as the supply air tank, that reservoir nearest to the air compressor where water and oil are most likely to accumulate (assuming the lack of a functional air dryer).

**Wide brake package** see page 34

**Worm gear** Component of brake adjuster. The worm and worm gear provide for adjusting lining-to-drum clearanc
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