Heavy-Duty Air Disc Brake Pads: Materials, Regulation & Field Performance

What heavy-duty air disc brake pads are made of, why copper left the formula, how much heat a loaded truck puts into its brakes, how corrosion ends pad life early — and what to check before you buy.

> **Who this is for:** fleet maintenance managers, owner-operators and parts buyers working with Class 7 & 8 air disc brakes. Sources are listed on page 11.

What you will learn

- Why a disc pad works harder than a drum lining — and what that demands of the pad
- What the friction material is made of, and how to read the edge code
- The copper rules: what they require, and why heavy-duty is the case to verify
- The energy math behind brake fade
- How road salt and deicers end pad life, and what resists them
- A buyer's checklist

Four numbers that frame this report

>50%
air disc brake adoption on North American Class 6–8 vehicles, up from ~25% in 2018 (Bendix, July 2024)

15.3 MJ
heat put into the brakes by one full stop of an 80,000-lb truck from 65 mph (TAG calculation, p. 6)

≤0.5%
copper allowed in N-level friction material in California and Washington since 2025

3 mm
friction left above the backing plate at which an air disc pad is replaced (WABCO)

EXECUTIVE SUMMARY

The pad is doing more work, under stricter rules

Air disc brakes are now the majority. Bendix reported in July 2024 that air disc adoption on North American Class 6–8 vehicles had passed 50%, up from about 25% in 2018. Every one of those brakes is a future pad sale — and a pad works harder than the drum lining it replaces: roughly one-half to one-third the surface area, two to three times the energy per square inch, and more than four times the application pressure (SAF-Holland, via *Fleet Equipment*).

Copper was regulated out. California and Washington limit copper in brake friction material to under 5% from 2021 and to 0.5% from 2025. California's law covers heavy-duty vehicles over 26,000 lb, but lets heavy-duty friction makers apply for deadline extensions through January 1, 2032 — so the compliance mark on the exact part is what counts.

Inputs are under tariff pressure. The Section 232 tariff on imported steel rose to 50% on June 4, 2025, and a 50% tariff on semi-finished copper products followed on August 1, 2025. Bloomberg reported on October 16, 2026 that US steel prices had climbed to a four-year high as the tariffs squeezed imports.

The bottom line up front

- **Semi-metallic is the heavy-duty norm.** Air disc pads are semi-metallic, with more than 50% ferrous content (*Fleet Equipment*).
- **Verify N-level on the part, not the brand.** The LeafMark with three leaves ("N") certifies the 2025 limits.
- **Corrosion ends pads early.** Deicers reaching the steel backing plate through chipped coating can make the friction material crumble off; galvanized plates and mechanically attached friction resist it (*Fleet Equipment*).
- **Heat is the other limit.** Phenolic resin binders begin to carbonize around 450°C (840°F), weakening the friction material (Motta et al., 2023). A long descent can put more than ten times the energy of a full stop into the brakes — which is why the engine brake carries the grade.

ANATOMY

What a heavy-duty disc pad is — and why it works so hard

A disc pad is friction material attached to a steel backing plate. The friction material is a composite: reinforcing fibers, fillers, friction modifiers and lubricants held together by a binder. The binder is most often a **phenolic resin**, chosen for its performance-to-price ratio and how well it wets the other ingredients; its weaknesses are brittleness and limited heat resistance (Motta, Fedrizzi & Andreatta, *Materials*, 2023).

Part	What it is	Why it matters
Friction material	Fiber, filler, modifier and lubricant composite in a phenolic resin binder	Sets friction level, wear and heat tolerance. The binder is the first thing heat attacks.
Backing plate	Steel plate carrying the friction material and the caliper clamp load	If its coating chips, deicers corrode the steel and the friction material can crumble off.
Attachment	Adhesive bond, or mechanical retention locking the friction to the plate	Mechanical attachment is stronger than an adhesive bond alone (*Fleet Equipment*, 2022).

Why a disc pad works harder than a drum lining

½ – ⅓
the friction surface area of the equivalent drum lining

2–3×
the energy per square inch the pad must absorb

>4×
the application pressure of a drum shoe

~600°F
upper normal-service temperature of air disc brakes, vs ~300°F for drums

Area, energy and pressure: SAF-Holland; temperatures: Meritor — both via *Fleet Equipment*, "What you need to know about brake friction."

The consequence is simple: a pad that fits the caliper is not automatically a pad built for the load. Friction level, heat tolerance and attachment all have to be engineered for heavy-duty service.

FRICTION MATERIALS

What the friction is made of — and how to read it

Semi-metallic is the heavy-duty norm

Air disc brake pads are semi-metallic, with more than 50% ferrous content, while most drum linings are non-asbestos organic (NAO) with little or no ferrous content (*Fleet Equipment*). Metallic fibers such as steel wool combine mechanical strength and friction with high thermal conductivity (Motta et al., 2023) — the property a pad needs when it absorbs two to three times the energy per square inch of a drum lining.

Graphite and the copper replacement

Copper was valued for conducting heat. Graphite also conducts heat well and is often considered as a copper replacement. In an SAE study of a low-metallic pad with more than 20 wt.% copper removed, two graphite types at 15 wt.% each kept friction stable through the fade section — but performed differently, showing that the *form* of graphite matters, not just its presence (Daei, Majumdar & Filip, SAE 2015-01-2677).

Reading the edge code

The two-letter code on the pad edge follows the SAE J866 system: the first letter is the friction coefficient (μ) measured cold, the second hot. The letter bands are written into New York State regulation (15 NYCRR §53.4):

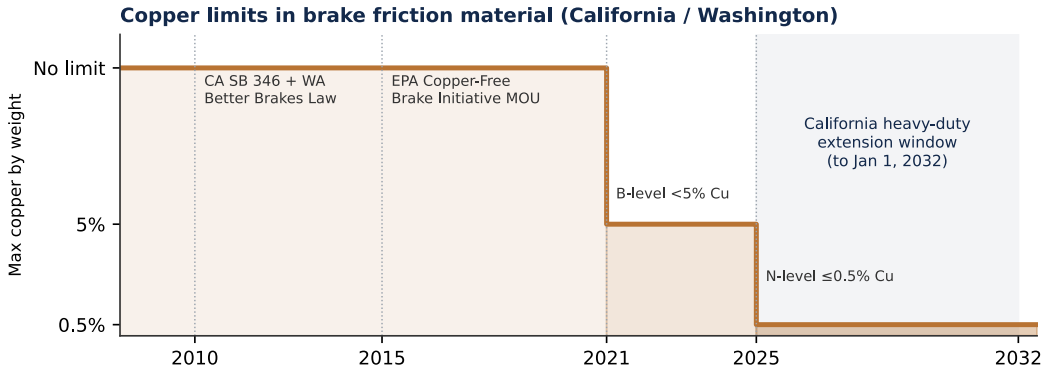
Letter	Coefficient of friction (μ)	Letter	Coefficient of friction (μ)
C	over 0.05, not over 0.15	**F**	over 0.35, not over 0.45
D	over 0.15, not over 0.25	**G**	over 0.45, not over 0.55
E	over 0.25, not over 0.35	**H**	over 0.55

So an "FF" pad holds μ 0.35–0.45 both cold and hot. The code classifies the material; it does not by itself prove stopping performance on a given vehicle.

> **Why the friction band matters — the physics.** Brake torque on a disc is $T = 2 \cdot \mu \cdot F \cdot r$, where F is the clamp force from the actuator and r the effective rotor radius. For the same air pressure and caliper, torque scales directly with μ: a pad running at μ 0.30 instead of 0.40 produces 25% less torque at the same pedal. That is why a replacement pad should match the friction band the brake was designed around.

REGULATION

The copper exit — what the rules require



Maximum copper in brake friction material under California SB 346 and Washington's Better Brakes Law.

Why copper went. EPA estimates that before the state requirements, brake dust released about 1.3 million pounds of copper into California's environment (2010) and about 250,000 pounds into Washington's (2011). Copper in stormwater affects fish, amphibians, invertebrates and plants. A NOAA-collaborative study found that copper at 5 parts per billion impaired juvenile coho salmon's sense of smell: exposed fish failed to detect an alarm cue and were attacked after about 5 seconds on average, versus about 30 seconds for unexposed fish (McIntyre et al., *Ecological Applications*, 2012).

What the rules require

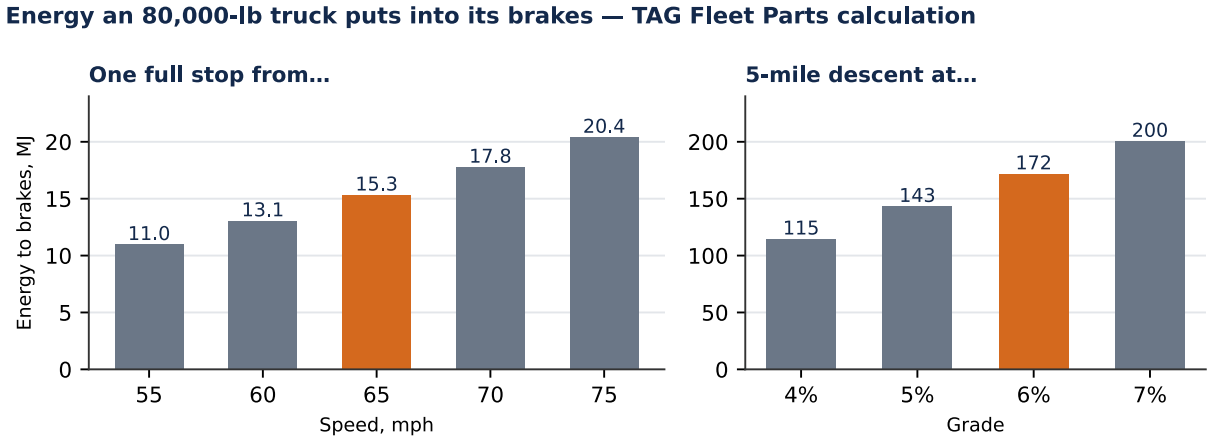
- **2010:** California SB 346 and Washington's Better Brakes Law enacted.
- **2014:** cadmium ≤0.01%; chromium(VI) salts, lead, mercury and asbestiform fibers ≤0.1% (California).
- **Jan 21, 2015:** EPA, the states and eight industry groups — including the Heavy Duty Manufacturers Association and the Truck and Engine Manufacturers Association — sign the voluntary Copper-Free Brake Initiative, extending the targets nationally.
- **2021:** under 5% copper by weight. **2025:** no more than 0.5% copper by weight.

> **Heavy-duty scope.** California's law defines heavy-duty vehicles as over 26,000 lb and has no weight exemption. It lets makers apply for one- to three-year extensions of the 2025 deadline; after 2030 only heavy-duty makers may apply, with extensions reaching **January 1, 2032**. Most heavy-duty pads are built to the 0.5% limit — but not necessarily all. Verify the exact part.

How to verify: the LeafMark

Washington Ecology defines three LeafMark levels: **A** (one leaf) — asbestos, cadmium, chromium, lead and mercury limited; **B** (two leaves) — also under 5% copper; **N** (three leaves) — all 2025 requirements met. Manufacturers certify compliance from accredited-laboratory tests, and proof must appear on pads and packaging sold in Washington.

How much heat a loaded truck puts into its brakes



E = ½mv² for a stop; E = mgh for a descent. Highlighted: the reference cases used in this report.

```
Mass: 80,000 lb = 36,287 kg   (federal GVW limit, 23 CFR 658.17)
Full stop from 65 mph (29.06 m/s): E = ½ × 36,287 × 29.06² ≈ 15.3 MJ
5-mile descent at 6% (drop 483 m): E = 36,287 × 9.81 × 483 ≈ 172 MJ ≈ 11× the stop
```

Where the heat goes wrong

In normal service air disc brakes run up to about 600°F (≈315°C) (Meritor, via *Fleet Equipment*). Phenolic resin binders begin to carbonize around **450°C (840°F)**, lowering density, raising porosity and reducing structural integrity (Motta et al., 2023). The highest brake temperatures occur when braking from highway speed on long downgrades; too much heat can cause brake fade, brake damage or failure. Select a gear low enough to control speed before the descent and use the engine retarder (Saskatchewan Government Insurance, *Professional Driver's Handbook*).

CORROSION

How road salt and deicers end pad life early

What happens to a disc pad. Winter deicing chemicals are highly corrosive. Chips or nicks in the powder coat on some pads let them reach the metal backing plate, where they corrode the steel and can make the friction material crumble off, shortening pad life (*Fleet Equipment*, 2022).

The mechanism, documented on drum shoes. ArvinMeritor's 2009 white paper describes "rust-jacking": once coating wears away, oxidation can begin within about a night, and successive rust layers build up between the steel and the lining, pushing the lining up until it cracks. Magnesium chloride, calcium chloride and sodium chloride accelerate the corrosion of bare metal (*Heavy Duty Trucking*, 2009).

What resists it

Feature	Evidence
Corrosion-protected backing plate	Galvanized steel backing plates replace powder-coat paint for rust protection (NRS Brakes, cited by *Fleet Equipment*, 2022). Coating quality and resistance to micro-abrasion decide how soon bare steel is exposed (ArvinMeritor, 2009).
Mechanical attachment	Mechanically attached friction is stronger than adhesive bonding alone (*Fleet Equipment*, 2022).
Gentle washing and inspection	Rinse the undercarriage with a gentle hose stream, not a pressure washer, and inspect friction at every service (ArvinMeritor, 2009).

Corrosion at the rotor: stiction

Corrosion also works between pad and rotor. Iron from the corroding cast-iron disc migrates into the pad and forms oxides as it dries, bonding pad to rotor. Chloride environments such as winter conditions strongly increase susceptibility (Motta et al., 2023).

Inspection cadence

Check visually or by thickness every six months with wheels on and every 12 months with wheels off; replace air disc pads at **3 mm** of friction above the backing plate (WABCO, via *Fleet Equipment*).

COST DRIVERS

What sits behind the price of a pad

Input	Role in the pad	Cost signal
Steel	Backing plate; metallic fibers in semi-metallic friction	50% Section 232 tariff on imported steel since June 4, 2025. US steel prices at a four-year high on Oct 16, 2026 (Bloomberg).
Copper	Former friction ingredient; capped at 0.5% from 2025	50% tariff on semi-finished copper products since Aug 1, 2025.
Graphite	Thermally conductive copper replacement (SAE 2015-01-2677)	—
Phenolic resin	Binder holding the friction composite together	—
Zinc	Galvanizing on corrosion-protected backing plates	—

A dash means no dated price is quoted for that input.

> **What this means for buyers:** when a large share of a part's cost is steel under a 50% tariff, short quote-validity windows are the honest way to price on both sides of the counter. TAG's Disc Pad Price Tracker re-checks US seller prices weekly, so input-cost moves show up in real shelf prices rather than forecasts.

BUYER'S CHECKLIST

What to check before you buy a pad

- ✓ **Match the original application.** Use the pad specified for your caliper and axle. FMVSS 121 requires a loaded truck-tractor to stop from 60 mph within 250 ft — or 310 ft for three-axle tractors over 70,000 lb and four-or-more-axle tractors over 85,000 lb GVWR — and the vehicle is certified to it with its original brakes.
- ✓ **Read the edge code.** Confirm the replacement's cold and hot friction bands match the original. A lower band means proportionally less brake torque at the same air pressure (page 4).
- ✓ **Look for the LeafMark "N".** Three leaves certify the 2025 copper and heavy-metal limits. Heavy-duty extensions can run to 2032, so check the exact part.
- ✓ **Check the backing plate and attachment.** In salt and deicer country, ask for a corrosion-protected (e.g. galvanized) plate and mechanically attached friction.
- ✓ **Expect semi-metallic.** Air disc pads are semi-metallic with more than 50% ferrous content. If a pad is sold as something else, ask the seller to show it is approved for your caliper.
- ✓ **Replace at 3 mm.** Inspect every six months wheels-on and every 12 months wheels-off.
- ✓ **Compare price per mile, not per box.** Divide the set price by the miles it delivers in your duty cycle — measured on your own trucks.

> **Price per mile — worked example (illustrative numbers).** Set A: $120, lasts 100,000 miles → $1.20 per 1,000 miles. Set B: $90, lasts 60,000 miles → $1.50 per 1,000 miles. B is 25% cheaper per box and 25% more expensive per mile, before the labor of an earlier reline. The prices and mileages here are hypothetical; the method is what to use with your own records.

OUTLOOK

What to watch

- **Air disc adoption.** Past 50% of North American Class 6–8 vehicles by July 2024, from about 25% in 2018, with Bendix investing to double its production capacity. More air disc brakes means a larger pad aftermarket and more weight on correct pad-to-caliper matching.
- **The last heavy-duty copper extensions.** California allows heavy-duty extensions to January 1, 2032. After that date, no further extensions of the 0.5% limit are available in California.
- **Tariff-driven steel costs.** 50% Section 232 duties on steel (since June 2025) and semi-finished copper (since August 2025) remain in place; US steel reached a four-year high in October 2026.
- **Brake dust as an emission.** The EU's Euro 7 agreement sets brake-particle limits — 7 mg/km for cars (3 mg/km for battery-electric) and 11 mg/km for heavy vans (5 mg/km battery-electric). Euro 7 applies to new truck and bus types from May 29, 2028; the agreement summary we reviewed sets no brake-particle figure for them.

> **For TAG Fleet Parts customers:** the weekly Disc Pad Price Tracker watches US seller prices across FMSI groups, so these trends show up in actual shelf prices — not forecasts.

SOURCES

References

- **Law & government:** California SB 346 (2010), enrolled text; Washington Department of Ecology, Better Brakes Law; US EPA, Copper-Free Brake Initiative; 49 CFR 571.121 (FMVSS 121); 23 CFR 658.17; 15 NYCRR §53.4 friction codes; Saskatchewan Government Insurance, Professional Driver's Handbook — Braking; Colorado DOT truck safety fact sheet; Council of the EU, Euro 7 provisional agreement; European Parliament summary, Regulation (EU) 2024/1257.
- **Standards:** SAE J866 friction identification system (letter bands as codified in 15 NYCRR §53.4).
- **Academic research:** Motta, Fedrizzi & Andreatta, "Corrosion Stiction in Automotive Braking Systems," *Materials* 16(10):3710, 2023; Daei, Majumdar & Filip, SAE Technical Paper 2015-01-2677; McIntyre et al., *Ecological Applications*, 2012 (copper and coho salmon).
- **Engineering sources & trade magazines:** *Fleet Equipment*, "What you need to know about brake friction" (Meritor, SAF-Holland, WABCO); *Fleet Equipment*, "The best way to combat brake corrosion," Apr 1, 2022; *Heavy Duty Trucking* / ArvinMeritor white paper, June 2009; Bendix air disc brake capacity announcement, July 12, 2024.
- **Trade policy & markets:** Section 232 steel tariff to 50%, June 4, 2025; 50% copper tariff, Aug 1, 2025; Bloomberg, Oct 16, 2026.
- **TAG Fleet Parts calculations:** energy (p. 6), brake torque relation (p. 4) and price-per-mile method (p. 9).

> Educational content, not engineering advice. Always follow the caliper and vehicle manufacturer's approved friction specification. TAG Fleet Parts sells by quote; no selling prices appear in this report.

Revision 3 — October 2026 · Read online with updates at tagfleetparts.com/knowledge-center.