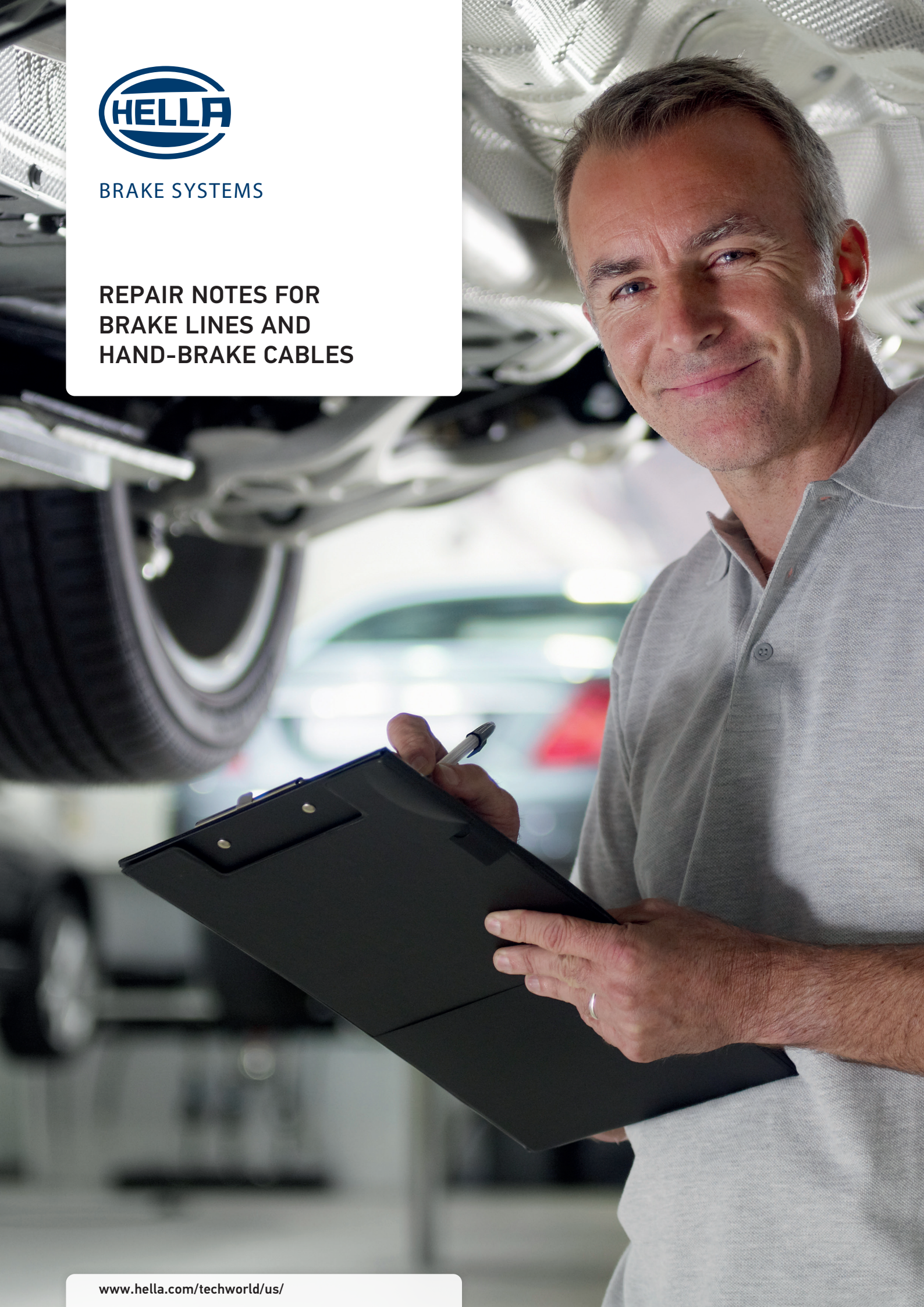


BRAKE SYSTEMS

REPAIR NOTES FOR BRAKE LINES AND HAND-BRAKE CABLES

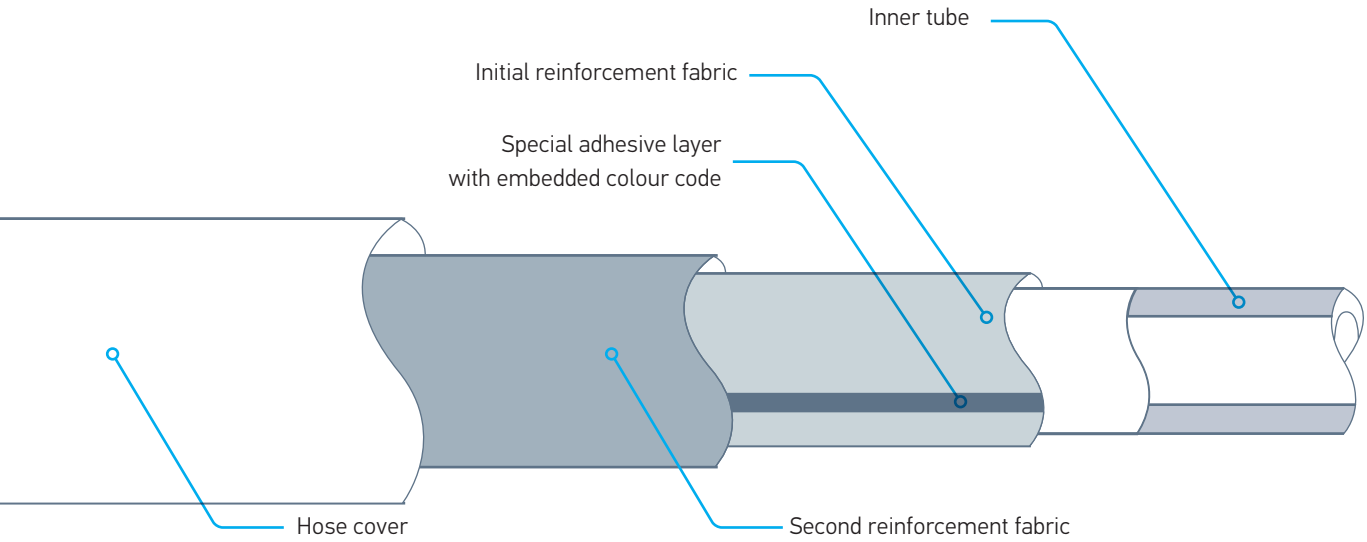
BRAKE HOSES AND BRAKE LINES

In hydraulic brake systems, brake hoses and brake lines are used to transfer brake fluid. Brake lines connect the actuation device such as the brake master cylinder to the hydraulic components of the wheel brake. Brake hoses are used in all moving areas between the body and chassis as flexible connecting lines.

With the integration of ABS-ESP and ASR systems in modern vehicles, the operative requirements placed on these assemblies have risen dramatically. Included among the main requirements are compressive strength, mechanical load-carrying capacity and thermal and chemical resistance.

Design of a brake hose

Brake hoses comprise a special rubber mixture and integrated braiding that considerably improves the strength of the hose and serves as a pressure support.



Brake lines are subjected to the following influences and loads:

- → Mechanical stress: Steering and spring movements of the vehicle
- → Weather influences: Heat, cold and ozone
- → External influences: Water, road salt and oil
- → Hydraulic pressure pulses: Pressure levels can momentarily increase to 180 bar in hydraulic brake systems

As a result of these influences, brake hoses and brake lines need exceptional pulse strength, robust connecting elements and high fatigue strength.

Legal regulations

The minimum requirements for demarcation, performance, mounting and connections of brake hoses for vehicles are defined in the SAE J 1401, FMVSS 571.106 and ISO 3996 standards.

Not only do the lines need to specify the manufacturer, but also the corresponding specification on the sleeve. A coloured label or a label stamped or pressed into the material displaying axial rotation should also be present on the hose. A white longitudinal line extending across the length of the hose is typically provided. When a replacement is carried out, only brake hoses that correspond to this standard should therefore be used.

HELLA brake hoses surpass all SAEJ1401 specifications to ensure that we live up to our claim of providing the very highest levels of quality and safety.

Troubleshooting

Brake lines and brake hoses are safety-relevant components and should be checked every time the vehicle is maintained. Typical defects are corrosion on the brake lines and damage to the hose lines.

These defects can be caused by accidents, improper assembly or aging. By carrying out a visual inspection, it is usually possible to detect cracks, bubble formation, corrosion or other external damage with minimal outlay.

Causes of failure

Bubble formation in transition areas Braided hose fitting

Cause:
Leak in the reinforcement

Cracking

Cause:
Aging, incorrect installation or mechanical overload

External damage, grizzly raise

Cause:
Damaged insulating layer caused by environmental influences, incorrect installation or mechanical overload

ASSEMBLY INSTRUCTIONS

The following points should be taken into account by the technician when carrying out a repair:

- → Mount brake hoses in a tension and contact-free manner
- → Avoid twisting the hose and causing chafe marks
- → Avoid contact with mineral oil and grease
- → Ensure sufficient clearance for steering and suspension movements
- → Avoid routing in the direct vicinity of exhaust systems
- → Avoid excessively small bending radii (> 40 mm)
- → Comply with the installation information provided by the brake and vehicle manufacturers

Note

Improper installation can negatively impact the driving characteristics of the vehicle and endanger lives.

SERVICE INFORMATION FOR HAND-BRAKE CABLE

As required by law, multi-track vehicles must have two brake systems that operate independently from each other. A parking brake system is also required in addition to the service brake system. The parking brake, also called a hand brake, is designed to prevent a vehicle that has come to a stop or has been parked from rolling away. When the mechanical hand brake is actuated by pulling on the hand-brake lever, brake force is transferred via cables to the wheel brakes of the rear axle.

The hand-brake cables are steel cables that are routed in tubes or metal hoses - also called Bowden cables. The brake cables are adjusted using additionally installed adjustment devices. To protect against the effects of weather such as water and dirt, Bowden cables are sheathed in plastic.

Hand-brake cables are subjected to the following influences or loads

- → Mechanical stress caused by: Tensile force generated during actuation or axle or spring movement of the vehicle
- → Weather influences: Heat, cold or and ozone
- → External influences: Water, road salt and oil

As a result of these influences, brake cables need exceptional tensile strength, robust sleeves, high-quality connecting elements and high fatigue strength.

A defective hand-brake cable is only noticeable when the parking brake fails.

Reasons for failure can be:

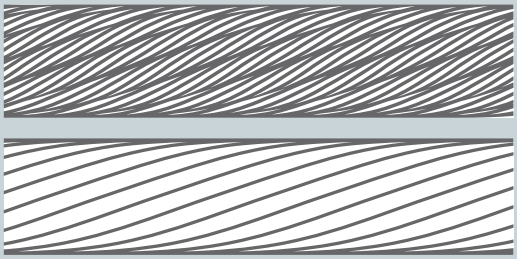
- → Undesired elongation of the hand-brake cables
- → Changed elasticity as a result of overloading and hyperextension of the cable
- → Compromised ease of motion
- → Humidity and frost can cause the cables to seize, or freeze up
- → Damaged sleeves or dust-protection collars can lead to direct exposure to water or dirt that can corrode and jam the cables
- → Mechanical damage to sleeves or wire cables caused by incorrect installation or overload

The following defects can occur

- → No or little braking effect
- → Uneven braking effect
- → Parking brake cannot be released

There are two main types of steel cable installed in hand-brake cable systems (see figure).

Only tested, high-quality materials are used to manufacture HELLA hand-brake cables. The steel cable used - with its special properties with respect to robustness and flexibility - is also always chosen in direct relation to the vehicle and braking system fitted.



Top: Steel cable comprising several cable strands
Bottom: Steel cable comprising braided wires

TROUBLESHOOTING AND INSPECTION

Hand-brake cables can only be correctly adjusted if all components of the hand-brake system are fully functional. By carrying out a visual inspection, it is usually possible to detect chafing, cracks, corrosion and other external damage with minimal outlay. Check exposed wire cables for breakage or splitting and replace if necessary. Check deflection rollers and guides for ease of movement and proper operation.

Notes on checking mechanically actuated hand-brakes

- → The braking effect should be checked on a brake test stand
- → No braking effect should be present when the first detente of the hand-brake lever is engaged
- → The difference in the wheel circumference forces between the left and right wheels may not deviate by more than 30 percent from the highest value
- → It must be possible to perform wheel lock braking with the parking brake
- → If the actuation travel of the hand-brake lever is too long, the parking brake should be readjusted

Basic adjustment of the parking brake should be carried out when

- → The brake shoes of the drum brake are replaced
- → A brake caliper with integrated hand-brake device is replaced
- → Adjustment devices are replaced or reset
- → The actuation travel is too long
- → The hand-brake cables are replaced

The repair notes issued by the respective vehicle manufacturers must be observed in this context.

ASSEMBLY INSTRUCTIONS

The following points should be taken into account by the technician when carrying out a repair:

- → Mount brake cables in a tension and contact-free manner
- → Avoid twisting and chafing
- → Apply an appropriate amount of grease to connecting elements in areas where movement takes place
- → Ensure sufficient clearance for steering and suspension movements
- → Avoid routing in the direct vicinity of exhaust systems
- → Comply with the installation information provided by the brake and vehicle manufacturers!

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