

■ **ABS/ASR „D“-
„Cab“ - Version
Anti-Lock Braking System
for Commercial Vehicles**

■ **1st Edition**

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WABCO

Vehicle Control Systems
An American Standard Company

	Page
1. INTRODUCTION	4
2. SYSTEM FUNCTIONS	5
3. SYSTEM DESIGN AND COMPONENTS	8
4. ABS / ASR SYSTEM DESCRIPTION	10
5. OTHER COMPONENTS	17
6. INSTALLATION	26
7. ANNEX	31

1. Introduction

Anti-lock Braking Systems (ABS) or - to use another common term - automatic anti-lock systems - are used to prevent a vehicle's wheel from locking as a result of excessive operation of the service brake, especially on a slippery road surface. Thus lateral control on the wheels being braked is maintained even at full brake application or in panic braking situations to ensure the cornering stability and steerability of a vehicle or a tractor-trailer combination to the greatest possible physical extent.

At the same time, the objective is to optimize the utilization of the available adhesion coefficient between tyres and the road surface and thus vehicle retardation and stopping distance.

High-performance ABS for commercial vehicles was first introduced at the end of 1981 by Mercedes-Benz and WABCO after elementary systems had been used in the USA from the mid 70s.

System design and control principles of this 4-channel system with individual wheel control (4 sensors - 4 modulators, called **4S/4M** below) were subsequently highly successful in the European market for commercial vehicles and became the basis for a world-wide standard for all commercial vehicles with power brakes.

ABS and ASR have proved their value as 4- and 6-channel systems in commercial vehicles. The reliability of systems and components from series production is excellent, in spite of their complexity. The de-

mand is rising not only in Germany and Europe or Israel and Australia, but also in the USA and in Japan.

As is generally known, the EEC and other legal requirements demand automatic anti-lock braking systems for certain types of commercial vehicles.

It is these provisions and measures which have resulted in the even more widespread use of ABS and in greater numbers being produced; this in turn has allowed cost reductions to be implemented, in spite of keen competition. WABCO has now developed the 4th generation of ABS and ABS/ASR. The D-generation offers different variants in the form of modular system designs.

These are based on state-of-the-art electronics technology with high-performance micro computers, including data storage, and take into account recent diagnostic principles. The 4- and 6-channel ABS/ASR systems for commercial vehicles offer various interfaces for working together with electronic engine control systems and the optimal use of an integrated speed limiting facility. Special functions for both ABS and ASR operation are available for selection in off-road operations.

This document describes the basic elements and the operation, the design and the system configurations of these anti-lock systems for commercial vehicles. The subject of drive-slip control (ASR) is mentioned only briefly in the section on system functions.

2. System functions

2.1 Description of an ABS control cycle

In case of impending wheel lock, the brake pressure of the corresponding wheel will be decreased, held during expected or measured wheel re-acceleration and subsequently increased in steps after re-acceleration. The cycle is started again if the brake force is still too high for the actual friction level (adhesion).

Rear axle wheels are subject to individual control (IR), front axle wheels are subject to Modified Individual Regulation (MIR).

of the wheel. For this reason the brake pressure is quickly reduced and so wheel deceleration decreases. The time taken for wheel deceleration is determined by the hysteresis of the wheel brake and by the characteristic of the μ - λ slip curve in the unstable region.

Only after the wheel brake hysteresis has been overcome a continued reduction in pressure leads to a decrease in wheel deceleration.

At point 3 the wheel deceleration signal $-b$ drops below the threshold and the brake pressure is held at a constant level for a set time $T1$.

Normally, wheel acceleration will exceed the acceleration threshold $+b$ within this set time (point 4). As long as this threshold is exceeded, the brake pressure is kept constant. If (for example on a low-friction surface) the $+b$ signal is not generated within time $T1$, the brake pressure is further decreased by slip signal $\lambda 1$. During this control phase the higher slip threshold $\lambda 2$ is not reached.

At point 5, the curve falls below the threshold $+b$. The wheel is now in the stable region of the μ - λ slip curve.

Brake pressure is now rapidly applied for time $T2$ to overcome the brake hysteresis. The time $T2$ is fixed for the first control cycle and then recalculated for each subsequent control cycle. After the initial rapid phase, brake pressure is then increased more gradually by "pulses", by alternating pressure hold and pressure increase.

The basic logic demonstrated in this example is not fixed at all; it adapts to the corresponding dynamic response of the wheel to varying coefficients of friction, i.e. it implements an adaptive type of system control.

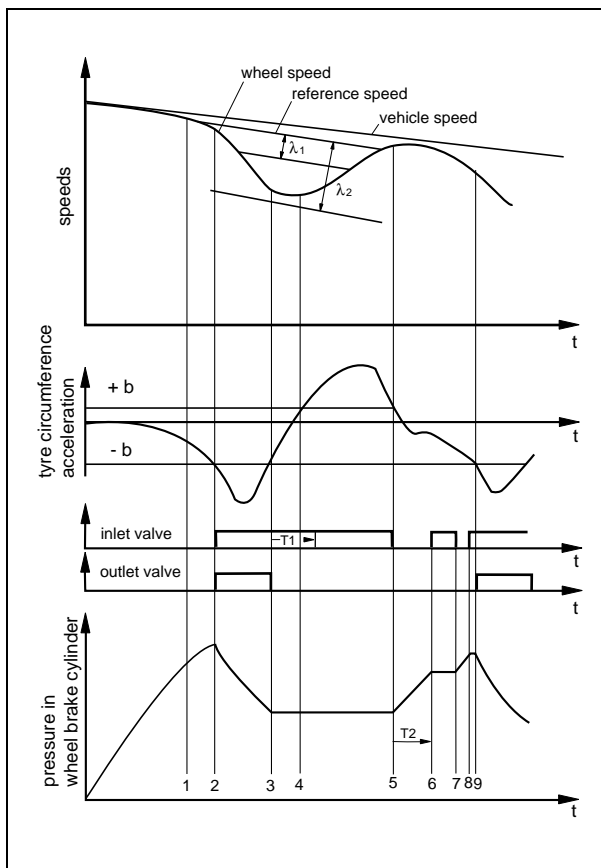


Fig. 1

Fig. 1 shows an example of a control cycle with the most important control variables, wheel deceleration threshold $-b$, wheel acceleration threshold $+b$ and slip thresholds $\lambda 1$ and $\lambda 2$.

As the brake pressure increases, the wheel is progressively decelerated. At point 1 wheel deceleration exceeds a value that can not physically be exceeded by vehicle deceleration. The reference speed, which up to this point had been the same as the wheel speed, now diverges and is reduced according to a fictitious vehicle retardation from point 2 (exceeding the $-b$ threshold) with a slower deceleration.

The deceleration threshold $-b$ is exceeded at point 2. The wheel now moves into the unstable region of the μ - λ slip curve at which point the wheel has reached its maximum braking force and any further increase in braking torque does not achieve any further deceleration of the vehicle but merely deceleration

All threshold values depend on several different parameters, such as driving speed, vehicle deceleration, etc.

The number of control cycles results from the dynamic response of the overall control system composed of the ABS-control - the wheel brake - the wheel - the road. Here, the frictional connection is of vital importance. In general, 3 to 5 cycles per second are performed, but significantly fewer on wet ice.

If an engine brake / retarder is used during an ABS control cycle, it is switched on or off by the ECU. For the purpose of front axle Modified Individual Control (MIR), the system compares the front wheel signals and modulates the pressure for both front wheel brakes. If, for example, control is activated on a front wheel

on a road surface with partially lower adhesion, the other wheel channel regulates the brake pressure so that pressure differences are built up (slowly, in graduated steps) to a limited maximum value.

In the event of a 4S/3M -or 6S/3M configuration being used, there is only one modulator on the front axle. The wheel locking first takes over ABS control of this axle. This results in a control process similar to Select Low which is called Modified Axle Control (**MAR**).

On 6x4 or 6x2 vehicles with a 6S/4M system, the same philosophy is used on the two rear wheels of one side which are controlled by one modulator. This type of system is called Modified Side Control (**MSR**).

2.1.1 Off-road ABS

The off-road mode can be used to allow more brake slip (temporary wheel lock) for braking on special surfaces. ECE R13 Supplement No. 7 requires the off-road ABS function to be reset as soon as the ignition is switched on again.

The vehicle manufacturer decides, according to vehicle type and application, whether this switch is fitted or not. Off-Road ABS disables ABS control at vehicle speeds of less than 15 km/h and allows greater brake slip up to 40 km/h. At speeds above 40 km/h there is no modification to ABS control.

The mode selected is indicated to the driver by the warning lamp (WL) which will flash slowly unless other events result in a permanently lit warning lamp. The speed ranges and the warning light function can be altered via parameter settings. The vehicle manufacturer has to record in the driver's handbook that the off-road mode may not be used in ordinary road traffic because the vehicle might not meet the requirements of ECE 13 Cat.1 in these circumstances.

2.2 ASR

In addition to ABS control, trucks and buses can be equipped with an Anti Spin Regulation ASR, also known as drive-slip control. ASR reduces the amount of wheel spin (drive slip). The philosophy of ASR is based on keeping the slip of spinning drive wheels compared to the non-driven front wheels within a range providing the best possible traction and stability.

Depending on the road conditions ASR will start engine and/or brake control, if excessive wheel slip has been detected. On a homogeneous road surface, control is mainly achieved by reducing the speed of the engine, and differential brake control will be limited to synchronizing the wheels. If μ -split conditions apply, differential brake control will put pressure only to the brake cylinders of the wheel which is spinning. The engine torque is thus transferred to the other wheel.

Engine control will not commence until both wheels spin or the slip of the spinning wheel exceeds a certain threshold. During differential brake control, the pressure is supplied by way of actuation of the differential brake valve. The brake

pressure of the wheel which is spinning is controlled by the corresponding ABS solenoid control valve.

To prevent pressure building up in the brake chamber for the driving wheel which is not spinning, the ABS solenoid control valve of this wheel will cut off brake pressure. This cut-off function is also available for the Z-axle modulators of a 6-channel system or optionally for a separate solenoid valve in case of a 4-channel system on a 6x2 vehicle. To prevent the foundation brake from overheating, the differential brake threshold is subject to a linear increase at vehicle speeds over 35 km/h, thus increasingly controlling slip by means of slowing the engine speed. When the vehicle's speed exceeds 50 km/h, differential brake control will not commence although any brake control in process will continue.

ASR for 6x4 vehicles with a 6S/4M or 6S/6M system takes the speeds and accelerations of both wheels of one side into account. In comparison to a 4S/4M system, this system is able to avoid spinning or locking of the driving wheels which have no sensors.

2.2.1 Traction mode

In deep snow or comparable conditions the traction can be increased by activating a special mode. By temporarily pushing the traction mode button for at least 150 milliseconds, the ECU switches to a type of ASR control with different thresholds and different engine/differential

brake distribution to allow higher slip ratios. Depending on the parameters set on the ECU, an ordinary switch may be used for this purpose. Activation of the ASR traction mode is confirmed by slow flashing of the ASR lamp to inform the driver that vehicle's stability might be impaired.

2.3 Speed limiter with proportional valve

The auxiliary output can be used for limiting the speed using a proportional valve and an ASR operating cylinder. These components actuate an injection pump and consequently modulate the speed of the vehicle.

An idle stop cylinder is needed for certain single-lever injection pumps.

The speed limiter meets ECE requirements. The speed limiting value is part of the parameter record and is stored in the EEPROM. The standard parameter record has a default speed limiting value set to 160 km/h

This value can be changed via the diagnostic interface. The minimum

value is 20 km/h For vehicles with non-synchronized gearboxes, the neutral position has to be allocated to the related input or additional equipment is necessary.

A second speed limiting value can be defined as part of the procedure for setting the parameters (lowest speed setting). When the speed setting switch is actuated, the current speed is stored and compared to the parameter value for the speed setting. The vehicle's speed is limited to the higher of the two values as long as the speed setting switch is actuated.

The signal from a tachograph which is connected to the C3/B7 input port

is required to give off between 2,400 and 24,000 pulses per kilometre. Suitable appliances are, for instance, the KIENZLE tachographs 1314 or 1318.

The ECU checks the input signal for plausibility and signalling errors. Any error is indicated by the warning lamp or ASR lamp if the vehicle is moving at a speed faster than 3 km/h

If no C3 signal is available, the wheel speed signals from the ABS/ASR system are used to limit the speed (does not comply with EC regulations!).

3. System design and components

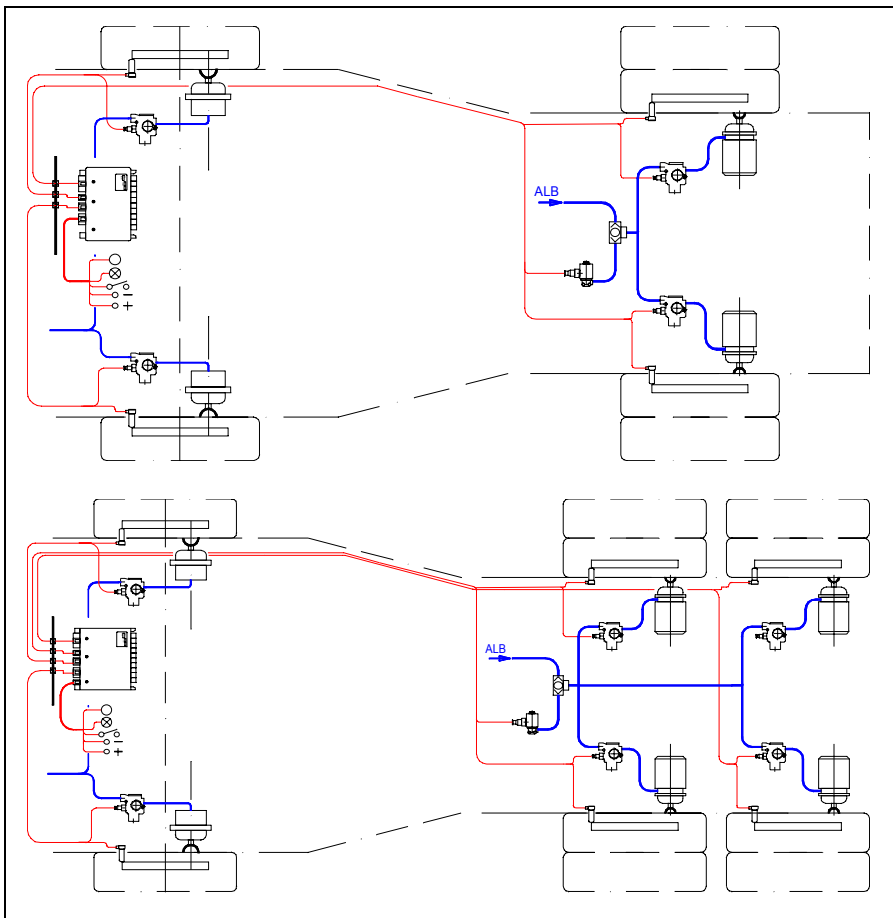
3.1 System description

The **Anti Lock Braking System (ABS)** for commercial vehicles comprises the following components:

- q 4 or 6 wheel sensors, sensor clamping bushes and pole wheels
- q between 3 and 6 solenoid control valves
- q **Electronic Control Unit (ECU)**
- q Warning lamp, diagnostic interface, relay or data interface for retarder control
- q switch for the ABS off-road function
- q harness for cab, frame, ground (3), power supply (fused)

In addition, **Anti Spin Regulation (ASR)**, also known as drive slip control, comprises:

- q differential brake valve
- q double check valve
- q ASR Lamp
- q push-button switch or normal switch for the ASR (ATC) traction mode function
- q engine control interface (SAE J 1922, SAE J 1939, PWM in/out, PRIO/PWM out) or depending on the ECU variant used
- q proportional valve
- q control (operating) cylinder
- q idle stop cylinder



The following may also be included:

- q a normal switch or push-button for the speed-setting function
- q a switch for temporarily switching of the limiting speed if the vehicle does not have a synchromesh gearbox.

For vehicles with two axles, the 4S-4M system is the best choice. For vehicles with three axles, the 6S-6M system is available. A compromise regarding system cost and performance is achieved if not every wheel has a sensor, i.e. is not individually controlled. Different ECU variants are available for this purpose.

Fig. 2

Vehicle	4 x 2	6 x 2	6 x 4	8 x 4
ABS - System				
4S - 3M	front axle: MAR rear axle: IR			
4S - 4M	front axle: MIR rear axle: IR	front axle: MIR 1 st rear axle: IR 2 nd rear axle: secondary control by sides	front axle: MIR 1 st rear axle: IR 2 nd rear axle: secondary control by sides	1 st front axle: MIR 2 nd front axle: secondary control by sides 1 st rear axle: IR 2 nd rear axle: secondary control by sides
6S - 4M	–	–	front axle: MIR rear axles: MSR	front axle: MIR rear axles: MSR
6S - 6M 6x2 ASR	–	front axle: MIR 1 st rear axle: IR 2 nd rear axle: IR	front axle: MIR 1 st rear axle: IR 2 nd rear axle: IR without ASR function	front axle: MIR 2 nd front axle: secondary control by sides 1 st rear axle: IR 2 nd rear axle: IR without ASR function
6S - 6M 6x4 ASR	–	front axle: MIR 1 st rear axle: IR 2 nd rear axle: IR without ASR function	front axle: MIR 1 st rear axle: IR 2 nd rear axle: IR	front axle: MIR 2 nd front axle: secondary control by sides 1 st rear axle: IR 2 nd rear axle: IR

4. ABS / ASR system description

4.1 Compatibility

The D-Version is not compatible with any of the A-, B or C-Versions because the cable harness and plugs of the ECU have been modified.

4.2 Electronic Control Unit (ECU)

For the 4S/4M (4S/3M) system, an ECU with 4 AMP Junior Power Timer plugs is used; for the 6-channel application, an ECU with 5 plugs is required. These plugs have been allocated to the power supply, the diagnostic and dashboard connections, and to the components of the cable harness for the wheels or axles.

For installation, either screws or a rack (not shown) may be used. Different variants are available for nominal voltages of 12 volt and 24 volt.

Any voltage or ground problems regarding the ABS-D ECU cause the whole system to be switched off.

For dimensions of the ECU's housing and the recommended fitting position, please refer to the outline drawing (see Annex). Any water ingress must be prevented. The ECU should not be sited near any heating elements.

4.2.1 Description of warning lamp

A special transistor grounds the warning lamp's output, either temporarily for bulb testing, or permanently if an error has been detected.

voltage supply, because bulb checks might be affected and interpreted as flash-code activation.

Test pulses check whether a load is connected. Dimming of the bulb for reduced brightness must not be done, especially not by switched

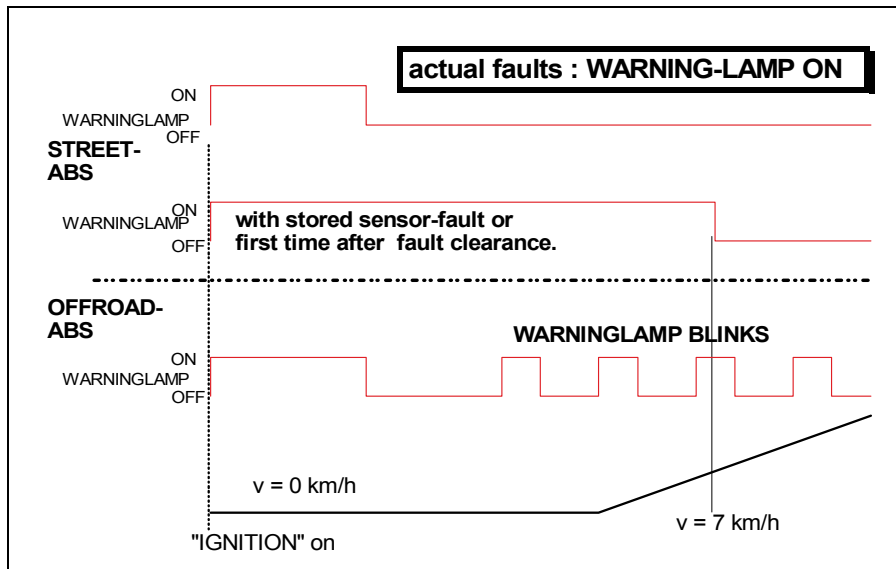
The bulb should have a maximum of 5 W. The system is capable of detecting a defective bulb.

4.2.2 Function when ignition is switched on and vehicle is still stationary

In the normal mode (on-road ABS) the warning lamp goes off in keeping with ECE R 13 Supplement 07 while the vehicle is stationary. The warning lamp indicates defective sensors

detected when the ignition was first switched on.

It is possible that maintenance work (changing the lining) increases the clearance of the sensors because the workshop staff failed to re-adjust them (pushing sensors home).



In order to prevent that the vehicle is driven before this has been put right, WABCO recommends that the error memory of the ECU is deleted when maintenance work has been done. This puts the ECU into its workshop mode. To leave this mode, the speed signals received from all wheels have to be measured again. When this has been achieved successfully, the ECU will automatically return to the normal mode.

4.2.3 Sensor input ports

Different types of inductive sensors can be connected. In order to prevent any interference potential, the induced sinusoidal sensor voltage is filtered.

Different types of errors are detected to permit selective deactivation.

Types of errors: interrupt and short circuit to ground or plus and crossed or wrong connections are detected even before the vehicle has moved off and stored in the error memory. Dynamic sensor defects are detected by analysing the signalling frequency (implausible signals such as erratic changes).

To allow the ECU to detect any clearance or wheel wobble on the brake test bench, the ECU for the

D-version has been designed in such a way that the peak-peak voltage is measured and its highest and lowest readings stored in the RAM for at least one wheel revolution.

This is designed for the inspection after installation; the ECU should not be disconnected from the system for this purpose.

It is important to know that the filtered sensor voltages may result in different values being measured using an oscilloscope or a multimeter. In normal operation, measuring supports the safety functions and helps identify any errors in the installation, such as excessive clearances, wrong installation of a pole wheel, or a soiled pole wheel.

4.2.4 Grounding of output stage for modulators

Every solenoid is connected between a switching (+) transistor and one of the two (diagonal) disconnecting (ground) transistors.

This allows redundant interruption of the valve current, thereby ensuring that a single defect does not cause

ABS to be switched off. If there is a defect inside the ECU, the system is partially or fully shut down. The transistors are checked periodically. A distinction is made between parting of a cable and a defective output stage.

4.2.5 Power output stage for modulators

The ECU concept is designed for between 3 and 6 modulators. The vehicle manufacturer chooses one of the different versions for the type of vehicle in question. Connection of a harness with a larger number of modulators causes the warning lamp to come on because the modulator output port which is not provided for is shorted to the warning lamp output port. Any cable harnesses with fewer modulators than the number defined for the respective system also causes the warning lamp to come on because the absence of these components is perceived as a defect.

Defects which might cause the modulator coils to be energized (transistor failure, external short circuit to battery) are identified within 100 milliseconds and the corresponding diagonal is switched off. Open circuit or short circuit conditions without active ABS control are identified within 10 seconds causing wheels to be selectively switched off.

4.2.6 Controlling engine brake or retarder

When ABS control is taking place, a switching transistor connects the input port of the engine's ECU or an external relay to ground. The transistor is checked periodically with

the other output ports. The parameters set on the ECU determine whether a parted cable can be detected.

4.2.7 ASR lamp

While ASR control is taking place, the ASR lamp is used to indicate any

defects in the ASR components, depending on the parameters set.

4.2.8 ASR shut-off

The D-version ABS allows the ASR function to be shut off via a switch if

the parameters have been set accordingly.

4.2.9 Output port of ASR lamp

A switching transistor supplies the ASR lamp and briefly grounds the output port for testing. Test pulses can now check whether a load is connected. No dimmer may be used to reduce the lamp's brightness.

This particularly applies if a voltage supply is connected. Dimming could be taken to mean that the flash code has been activated.

4.2.10 Output port of ASR DIF brake

Depending on the speed and slip values, this function is supported by engine control. When both wheels slip, the engine speed is reduced. In the event of any difference in the speeds of the wheels on the driving axle, the ECU connects battery voltage to the output port of the DIF

valve and applies the brake force via the differential brake valve (DIF).

Parted cables can be detected automatically or by an appropriate factory setting. Short to battery or ground is also detected.

4.2.11 Engine control

Different versions are provided with

- q SAE J1939 (CAN),
- q SAE J1922
- q PWM on/off (EDC, E-GAS) and
- q PWM for PROP valve

If the ECU of the ABS/ASR system finds a defect in engine control, the differential function is inhibited in order to prevent excessive strain on the brakes.

4.2.12 Neutral switch of transmission

On vehicles which do not have a synchromesh transmission, the speed limiting facility via the PROP valve is temporarily inhibited by this input signal in order to permit rev-

ving up for the purpose of changing gear. Any manipulation is perceived and stored.

4.3 Automatic recognition of periphery and setting of parameters for ASR and sustained-action brake (retarder)

4.3.1 Automatic learning function of the ASR component

In its original factory setting, the ECU can be used both for ABS applications only and for ABS with ASR and/or an integrated speed limiting facility. In order to ensure proper operation for all applications, the ECU stores any ASR components upon becoming aware of a 'permissible system' being used since it was first installed. This happens as soon as the expected component is recognized by the ECU connected.

The following systems have been defined as permissible systems:

- q A J1939/SAE interface by itself is an ABS component (i. e. retarder control) and is stored.
- q A proportional valve by itself can be one component of the speed limiting facility. The system is stored as 'permissible' if the first threshold speed is less than the preset value of 160 km/h

- q A differential brake valve with one of the above-mentioned engine control systems means that this is an ASR system which is stored as such.

Other systems are not permissible and are thus displayed as an 'ASR configuration error'.

Previously installed components can be reset by means of a flash code or other diagnostic equipment. This does not, however, apply to the proportional valve as a component of the speed limiting facility (first threshold value less than 160 km/h).

4.3.2 Wheel sensors

A wheel's revolution is picked up by means of a pole wheel which turns with the wheel, and a pulse-generating sensor.

The inductive sensor (fig. 3) comprises a permanent magnet, core and coil. The magnetic flux surrounding the coil is cut by the rotating motion of the toothed wheel inducing an AC voltage whose frequency is directly proportional to the wheel speed.

The WABCO sensor has been specifically developed for the arduous conditions of commercial vehicles use. The sensor is held in position by a special clamping bush made from corrosion-resistant spring material. This allows the sensor to be pushed up against the pole wheel during assembly. No clearance needs to be set. The action of the bush also provides tolerance for axle elasticity etc.

Fig. 3 shows a typical installation of toothed wheel (1), clamping bush (2) and sensor (3) on a front wheel. In such an arrangement the clamping bush should be mounted with a temperature-resistant and water-proof grease (e. g. silicone grease) in order to protect the hole in the steering knuckle from corrosion and dirt. The toothed wheel is installed in a similar fashion on the hub of the rear wheel. The sensor is securely mounted on the axle beam with a special stiff bracket.

The permissible range for the dynamic tire circumference/tooth number ratio is:

- q 2.74 ... 3.68 mm/tooth on all axles (-15 ... + 15 % to standard tyre, see pole wheel spec.)
- q 14% maximum deviation between front, rear and third axle

This means:

With a pole wheel with 100 teeth, the circumference can be between 2740 mm and 3680 mm if the axle deviation is < 14%.

To accommodate smaller tyre sizes, pole wheels with 80 teeth can be used. The range of permissible wheel circumference can then be between 2190 mm and 2940 mm. If front axle and rear axles have different pole wheels or tyres, none of the combinations may deviate from the tolerance range.

The sensor / pole wheel combinations generate signals with a frequency proportional to the wheel speed. ABS / ASR computes wheel speed and vehicle speed from these signals. Hub-type as well as miniature-type sensors or versions integrated in the bearings may be used provided they have been approved by WABCO for the ABS/ASR application.

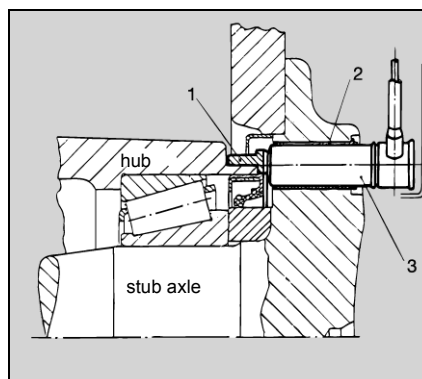


Fig. 3: ABS sensor installation – front axle –

4.3.3 ABS solenoid valve

When control is not active, the input pressure is passed on in full. During active control the pressure is modulated according to the wheel behaviour.

Several solenoid valve types are available.

The solenoid control valve, fig. 4, permits precise, graduated brake pressure modulation for ABS brake control. It is usually mounted on the frame of the vehicle, or, in exceptional cases, mounted on the axle. It comprises a double solenoid arrangement and two diaphragm valves. The extremely fast-acting solenoid valves merely affect the pilot chambers of the diaphragms.

These control the pressure in the brake chamber by virtue of the valve geometry.

The short reaction times and the ABS functions

- q pressure increase
- q pressure hold
- q pressure reduction

are basic requirements for a high

control performance while reducing air consumption to a minimum for ABS-controlled braking and ASR operation.

Pressure Increase

When not activated by the ECU of the ABS system, the diaphragm pilot chamber (2) of the inlet valve is open to atmosphere. The brake pressure at port 1 lifts diaphragm 3 and reaches the brake chamber in full through port connection 4. At the same time, the brake pressure flows past the non-energized armature (8) into diaphragm pilot chamber 6 and prevents the outlet valve from opening. When the driver reduces the brake pressure, air flows from of the brake chamber and back through port 1. In certain conditions the outlet diaphragm is also opened which allows the foundation brake to be released quickly.

Pressure hold:

When the solenoid at 10 is energized, brake pressure is admitted into control chamber 2 via the closing seal of armature 11. This causes the diaphragm valve to close, separating connection 4 from port 1, thereby preventing any further pressure increase in the brake cylinder.

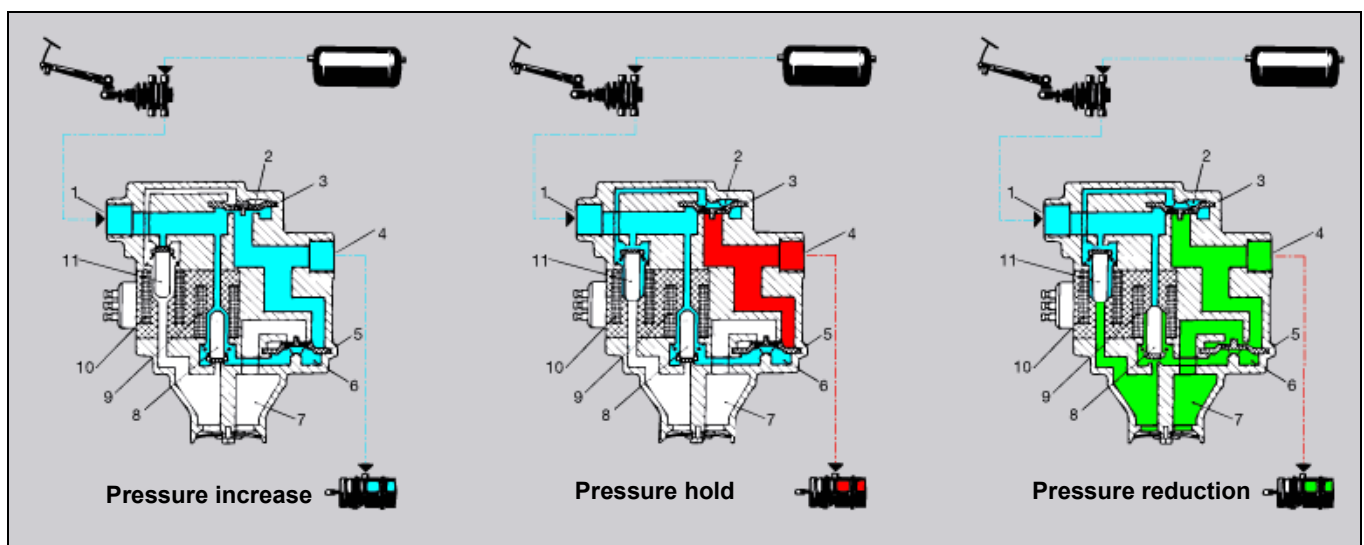


Fig. 4: Solenoid control valve

Pressure reduction:

Both solenoids are energized in the pressure-reduction phase. The activation of solenoid 10 as described in "pressure hold" causes the air supply to be cut off. At the same time, solenoid 9 is energized so that the diaphragm control area of the outlet valve is evacuated to atmosphere past the seal of armature 6. Now the brake pressure remaining in the brake chamber reaches the seal of diaphragm 5 and is evacuated. This process is muffled.

In the meantime, nearly all European competitors have adopted a similar design for their solenoid valves in an effort to achieve interchangeability. WABCO has also developed solenoid valve variants for special applications. One such variant has an adapter which can have a "snorkel" device fitted that gives the vehicle a wading capability. The same adapter can also accept an exhaust silencer when required.

The principles of design and function of the solenoid control valve have remained virtually unchanged in all four generations of WABCO ABS systems (A, B, C and D versions) for two- and multi-axle commercial vehicles.

4.3.4 Extension cables for sensors and modulators

To reduce the risk of installation errors WABCO offers different versions of extension cables. The con-

nectors on the sensors / modulator side are moulded.

ABS-valve		outline drawing, see Annex from page 38 on
DIN-Bayonet (left)	449 513 000 0	
DIN-Bayonet (right)	449 514 000 0	
M24x1 (left)	449 523 000 0	
M24x1 (right)	449 524 000 0	
ASR-valve		
DIN-Bayonet	449 515 000 0	
M27x1	449 521 000 0	
Sensor	449 751 000 0	

5. Other components

The components on the cab such as the warning lamp, push-buttons etc. are widely known.

The plugs of the ECU are AMP Junior Power Timers.

Regarding the cable harness, an important point must be taken into account:

For the cable harness of ABS D, either 4 or 5 connector housings must be provided.

		4 channel	6 channel
WABCO No.	894 110 091 4		
AMP No.	964 561 - 1	X	X
WABCO No.	894 110 092 4		
AMP No.	964 561 - 2	X	X
WABCO No.	894 110 093 4		
AMP No.	964 561 - 3	X	X
WABCO No.	894 110 094 4		
AMP No.	964 561 - 4		X
WABCO No.	894 110 095 4		
AMP No.	964 561 - 5	X	X

and Junior Power Timer contacts for

cable dimension		WABCO	AMP
0.5 to 1	mm²	894 070 734 4	927 779 - 3
> 1 to 2.5	mm²	894 070 829 4	927 777 - 3
0.5 to 1	PIN 15	894 070 831 4	927 771 - 9
> 1 to 2.5	on 18 PIN plug	894 070 832 4	927 768 - 9

5.1 ASR components

In addition to the ABS system components: sensor, solenoid control valve, ECU, warning lamp, Fig. 5 shows the additional components for drive-slip control (ASR) integrated in ABS for commercial vehicles with air brakes.

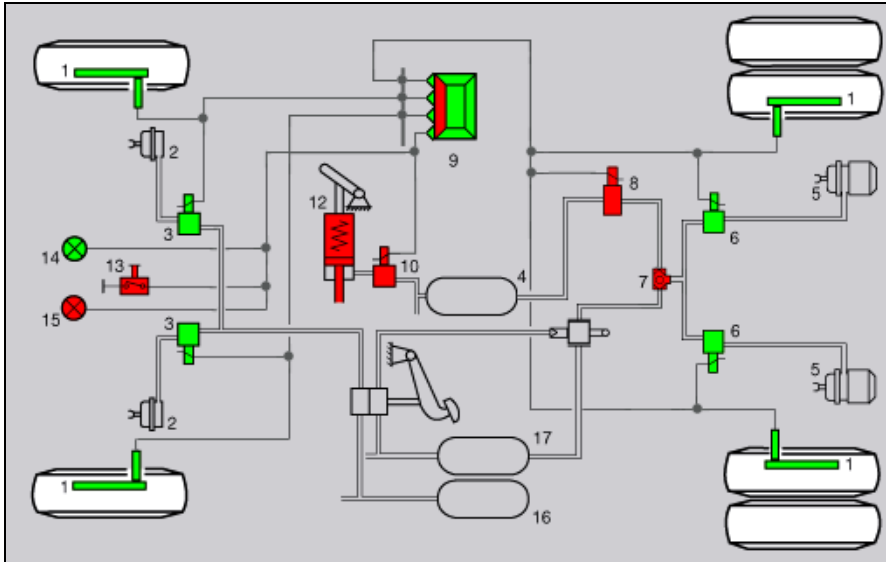


Fig. 5: 4-channel-ABS/ASR
2-axle commercial vehicle
with rear-wheel drive (4 x 2)

5.2 Data interfaces

The ABS D versions have different interfaces which are also used for the purpose of diagnostics. The following defined interfaces are being looked at in more detail:

- 1) SAE J 1922
- 2) SAE J 1939
- 3) SAE J 1587
- 4) ISO 9141 Mode 8 (JED 677)

– **SAE J 1922**

This standard defines a local network for heavy-duty commercial vehicles with a maximum of 4 electronic control units which exchange data on the network.

The electronic control unit for engine control has to begin its transmission no later than 2 sec-

onds after 'ignition on'. Otherwise the ABS control unit detects an error and the ASR control functions are inhibited. ASR engine control uses the 'torque limiting mode'. The engine's electronic control unit should follow the torque limiting requirements with a delay of no more than 150 milliseconds.

These are the ASR lamp which shows the driver that the ASR mode is active and thus indicates that the road surface is slippery, or that an ASR component may be defective;

the differential brake valve (8) which, when required, actuates the foundation brake via a double check valve (7) for a wheel which may otherwise be spinning, the

engine control cylinder (12) and the proportional valve (10) which automatically control engine output to reduce engine power, irrespective of driver control.

These engine components are not required if the vehicle in question is equipped with an electronic engine control system which the ABS / ASR system ECU can communicate with via a specific interface.

The transmission rate, hardware and protocol are defined in SAE J 1922 and SAE J 1708.

Electronic control units with this interface only exist together with the SAE J1587 interface used for diagnostics. This type of interface with 10 kBaud has been used for engines for years. SAE J1922 will be replaced by the SAE J1939 interface.

- **ABS/ASR functions via J1922:**
retarder control
ASR engine control
- **SAE J 1939**
This standard defines an electronic bus system on commercial vehicles (network). A common abbreviation for this is CAN (Controller Area Network). This modern interface is used for exchanging data at 250 kBaud between the electronic control units of a vehicle.
- **SAE J 1587 and ISO 9141 Mode 8**
These standards define the hardware requirements and the exchange of data in terms of diagnostics. External or on-board diagnostics can be achieved with this standard.
- **SAE J 1922**
The electronic engine interface uses pins 1 and 3 of the 17-pin plug.

5.3 Diagnostic interfaces

WABCO supplies ABS control units with diagnostic interfaces to ISO9141 or SAE J1587.

ISO 9141 Mode 8 (bi-directional mode) in combination with JED-677 (WABCO works standard) defines the exchange of diagnostic data between the ECU and onboard or external diagnostic equipment with an SAE J 1587 interface.

The D version of ABS transmits a signal with an updating rate of 500 ms. Any errors are automatically transmitted via SAE J 1587 without any query.

Configuration if SAE J 1939 version is used

If signals are transmitted via the SAE J 1939 interface, the ECU recognizes the system configuration which is then monitored during any switch-on phase. The connection with a proportional valve is detected automatically. If no parameter has been set for the speed limiting value, any proportional valve without a differential brake valve is perceived as an error. The differential brake valve without one of the above interfaces also causes an error to be reported.

The differential brake valve, together with one of the above interfaces,

defines the parameter (stored system) "ASR permitted". If the output of the differential brake valve detects an electrical load, it sets the parameter (stored system) "looking for parted cable active".

All components are detected automatically and added to the system being monitored. Only valid ASR systems are stored.

The retarder relay is always stored. ASR without a differential brake function (engine control only) requires special parameters to be set. The same applies to simulating differential lock (differential brake function without engine control).

SAE J 1587 versions

The standard ABS version for the SAE diagnostic system to SAE J 1587 is available at present with the engine interfaces to

- q SAE J 1922 interface version or
- q SAE J 1939 (CAS) interface version

in 12 and 24 volt types.

If the ABS control unit is being replaced on a vehicle that has no ASR, the following must be taken into account:

	Interface	Control / Function
ABS	without	
	DBR relay	sustained-action brake on/off
	SAE J1922 SAE J1587	– control retarder moment – status message (dashboard)
	SAE J1939 (CAN)	– control retarder moment – wheel speed message – status message (dashboard)
ABS+ASR (ATC)	DIF + SAE J1922	additional differential brake and engine control
	DIF + SAE J1939 (CAN)	see above

desired system on vehicle	on vehicle with		recognition	comments
	spare part	engine / retarder interface		
ABS	interrupt	DIFF brake		1) permitted
ABS + SAE J1922	interrupt	DIFF brake	2)	1) accepted, ABS interface is stored once recognized
ABS + SAE J1939	interrupt	DIFF brake	2)	1) accepted, ABS interface is stored once recognized
ABS + DIF + SAE J1922	interrupt	connected	error ³⁾	
ABS + DIF + SAE J1939	interrupt	connected	error ³⁾	
ABS + DIF + SAE J1922	connected	interrupt		accepted (ABS + SAE J1922)
ABS + DIF + SAE J1939	connected	interrupt		accepted (ABS + SAE J1939)
DBR relay (retarder)	DBR load interrupt		4)	storage of load once recognized, irrespective of ASR

Please note:

- 1) filament test, ASR-L on for shorter than ABS: no ASR
- 2) parted cable recognition if interface / load was recognized previously.
- 3) ASR configuration.
- 4) sustained-action brake relay (DBR) cable break if relay was recognized previously.

	spare part	on vehicle with		
desired system on vehicle	engine / retarder interface	DIFF brake	recognition	comments
ABS (v-limit = 160)	interrupt	interrupt		1) permitted
ABS + SAE J1939	interrupt	interrupt	2)	4) accepted, ABS interface is stored once recognized
ABS + PWM in / out v-limit < 160 km/h	interrupt	interrupt	5)	4) accepted, ABS interface is stored once recognized
ABS + PWM in / out v-limit = 160 km/h	interrupt	interrupt		4) recognized PWM interface is not stored but 4)
ABS + GB _{PROP} < 160 km/h	interrupt	interrupt	error 3)	1) end-of-production line / service
ABS + DIF + SAE J1939	interrupt		error 4).	
ABS + DIF + PWM in / out	interrupt		error 4)	irrespective of v-limit
ABS + DIF + GB _{PROP} v-limit < 160 km/h	interrupt		error 3)	
ABS + DIF + GB _{PROP} v-limit = 160 km/h	interrupt		error 4)	
ABS + DIF + SAE J1939		interrupt		accepted (ABS+SAE J1939)
ABS + DIF + PWM in / out v-limit < 160 km/h		interrupt		accepted (ABS + PWM in / out)
ABS + DIF + PWM in / out v-limit = 160 km/h		interrupt	error 4)	
ABS + DIF + GB _{PROP} v-limit < 160 km/h		interrupt		accepted (ABS + SL)
ABS + DIF + GB _{PROP} v-limit = 160 km/h		interrupt	error 4)	v-limit parameter must be set
WABCO standard setting for v-limit = 160 km/h (see ECU product spec.)				
DBR relay (Retarder)	DBR load interrupt		5)	storage of load once recognized, irrespective of ASR

Please note:

- | | |
|--|--|
| <p>1) filament test, ASR-L on for shorter than ABS: no ASR</p> <p>2) cable break recognition if interface was recognized previously.</p> <p>3) cable break</p> | <p>4) ASR configuration</p> <p>5) sustained-action brake relay (DBR) cable break if relay was recognized previously.</p> |
|--|--|

5.4 Diagnostic functions

Any errors detected are immediately stored in a non-volatile memory.

tion on'. Any errors relating to an interface are deleted as soon as data can again be exchanged via that interface.

The system's reactions depend on the type of error detected. Selective shut-down is not changed until 'igni-

5.4.1 Organisation of error memory

The error memory section of the EEPROM comprises 16 error addresses. It is used like a stack. If the EEPROM is empty initially, the first error is stored at the first address, the second error at the second address, etc. Similar errors do not require a new address; they increment the respective counter values. Up to address 8, different errors applicable to the same component (SID) can be stored.

whole area of the error memory, the storage of errors in addresses 9 to 16 is different. In this area, only one defect per component may be stored. In addition, every error address has a time counter which returns to its original setting when the error address is being set. When all addresses are occupied, any new error is stored at the address whose time counter shows the highest value (longest time without any repetition). Information pertaining to the final 4 addresses are stored irrespective of error repetition.

In order to prevent that one or several defective components fill the

5.4.2 Automatic deletion error marking error readout

An error which has been stored is deleted automatically if this component does not show any renewed error for 250 hours (resolution 1 h).

which standardises the numbers for the components which a part of the system (SID = Subsystem Identifier), provides another number for different error types (FMI = Fault Mode Identifier). A number for the error frequency is also stored and read out via diagnostics.

Benefits of automatic deletion:

- q The error memory is then empty if errors created during vehicle manufacture or maintenance were not deleted (although WABCO recommends to clear the error memory after production).

Error readout

Using diagnostic equipment, information on errors and defects can be read out and deleted. The time counter for automatic deletion can be read out and reset.

Numbers marking errors

Numbers which mark errors are used in accordance with SAE J 1587

5.4.3 Functional testing by diagnostics

By addressing only one modulator per diagnostics and measuring the brake force or pressure, any mix-up in the area of the valves and any leakage of an inlet valve can be detected. Leakages of the outlet valve can be detected like any other leakage within the braking system.

tween 12 volt and 24 volt relays or modulator coils. Their resistance depends on the actual temperature. The maximum tolerance for 12 volt components with a maximum temperature and the minimum tolerance for 24 volt components with a maximum temperature at -40°C could show the same readings. Integrated resistance measurement would also

The ECU is unable to distinguish be-

have to take into account the wide range of voltages.

WABCO recommends to measure these components and the resistance of the sensor insulation at least while the vehicle is being manufactured (cab, axles).

By turning only one wheel and reading out the wheel speed, the proper allocation of sensors can be checked.

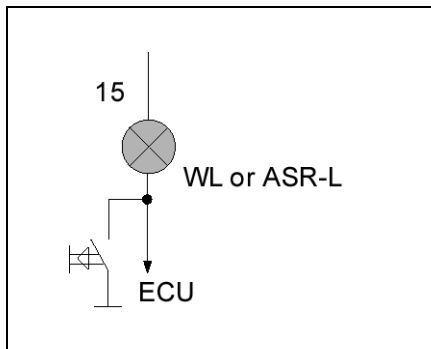
Any run-out deviation of the pole wheel and the clearance between sensor and pole wheel can be computed by reading out the analogue values of the minimum and maxi-

imum voltages of the sensor. For this purpose it is necessary to turn the wheel at a consistently slow speed, and the size of the pole wheel must be known.

The output voltage of the sensor depends on the clearance and the size of the pole wheel. The monitoring facility integrated in the ECU takes into account any excessive clearance in combination with small pole wheel sizes. In production, the clearance between the sensor and the pole wheel should be set properly.

WABCO offers different types of equipment for testing after final assembly.

5.4.4 Flash code



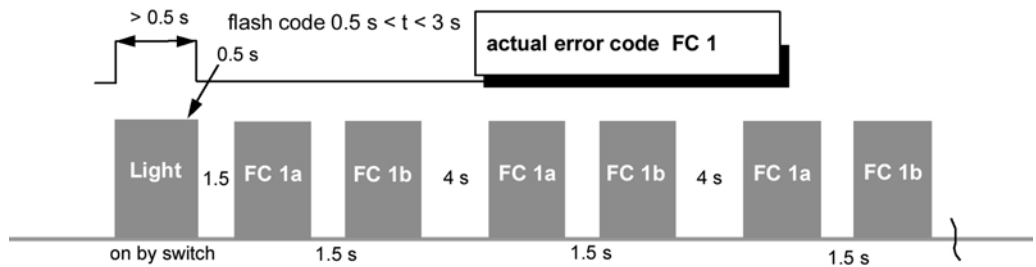
To activate the flash code, the warning lamp or the ASR lamp has to be grounded for a certain time by pushing a button. The type of lamp used depends on the type of ECU or the parameters set for it. The length of time the push-button is held down determines the mode. After releasing that push-button, the lamp is on for another 0.5 second to confirm that the push-button has been recognized and that the ECU has accepted stimulation of the flash code. Electronic Control Unit = ECU.

If an error is perceived, or if the lamp is grounded for longer than 6.3 seconds, the flash code is ended. If the flash code is stimulated (via the warning lamp) for longer than 15 seconds, a warning lamp defect might be perceived.

Testing equipment that grounds all dashboard lamps activates the flash code. ABS ECUs for such vehicles usually inhibit the flash code.

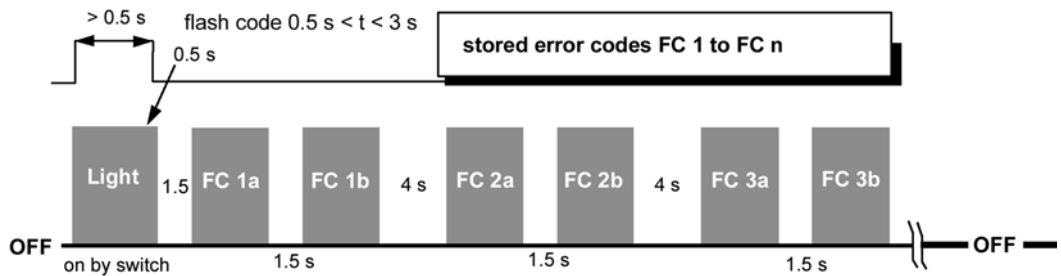
Diagnostic mode:

In order to activate the diagnostic mode, the push-button has to be held down for between 0.5 and 3.0 seconds.



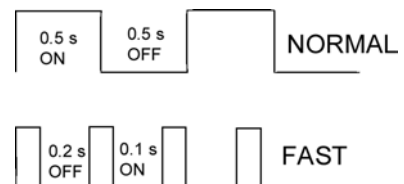
FC: error code // 1 to 8 //
 a: first part; b: second part
 see flash code list, page 27
 FC1 is repeated continuously if the error was detected after the ECU was switched on.
 If an error is detected during the "ignition on" phase (current error), this is flashed out. If several errors were detected within that phase, only the last one is flashed out. To end the flash code, the ignition has to be

switched off and then on again, or the vehicle has to move off (speed measured on more than one axle).
 If no current fault is detected, the last fault detected is the first one to be flashed out. Any subsequent indications may not show the errors in the order in which they occurred. The flash cycle ends when the last one of the errors stored has been flashed out.



FC: error code // 1 to 8 //
 a: first part; b: second part
 see flash code list, page 27

Flash code timing:



5.4.4.1 System mode: deleting errors stored:

The system mode is activated if the push-button was pressed for between 3 and 6.3 seconds. All errors stored are deleted only if there is currently no error. To end the flash code, the ignition has to be switched off and then on again, or the vehicle

has to move off (speed measured on more than one axle).
 The system code (a number) shows the system expected by the ECU and should be used to verify that the right ECU version is being used.

After activating the system mode, ASR (ATC) is inhibited to prevent ASR (ATC) errors being detected on the roller dynamometer and to permit higher differences in the speeds of the driving and steering axles. If an ECU is used which provides for stimulation of the flash code via the warning lamp, the ASR (ATC) lamp comes on to show that ASR (ATC) has been inhibited.

> 0.5 sec [ASR(ATC) reduces the engine torque for 10 sec.].

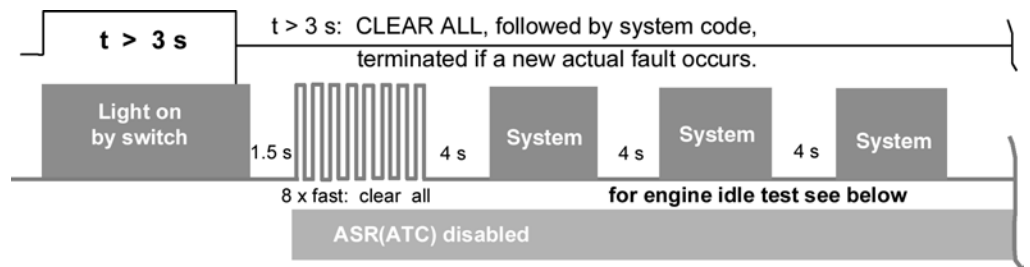
2. A recognized ASR (ATC) or retarder system can be reset (reconfiguration) by pressing the push-button three times > 0.5 sec. (the absence of components is confirmed). Reconfiguration is confirmed by four brief flashing pulses.

Two seconds after the system mode has been activated, other functions are possible:

No current error:
DELETION OF ALL ERRORS STORED

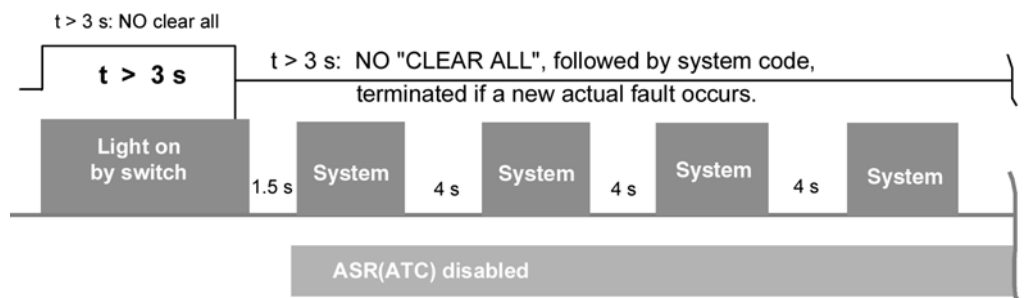
1. ASR (ATC) engine control can be tested by pressing the push-button twice for

Deletion is confirmed by 8 brief flashing pulses; this is followed by the system code being flashed out.



Current error:
like "no current error",

"DELETION OF ALL ERRORS STORED" is not possible.



Systems:

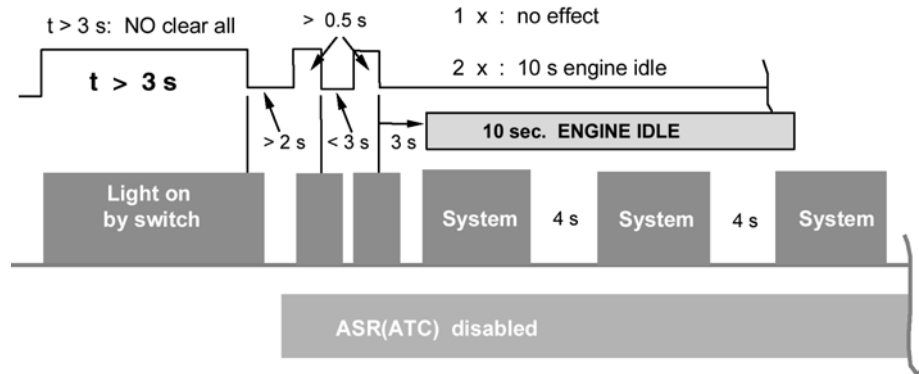
1 X 6S/6M (6x2 ASR)	6 X 4S/3M (VAR rear)
2 X 4S/4M	7 X 4S/2M (VAR both)
3 X 4S/3M (MAR/VAR front)	
4 X 6S/4M	
5 X 6S/6M (6x4 ASR)	

5.4.4.2 Functional testing of engine control

After pressing the push-button two more times, the ABS/ASR ECU causes the engine to idle for 10 seconds. The push-button has to be actuated twice for longer than 0.5 seconds, and the interval between

actuations must be shorter than 3 seconds.

The 10 seconds begin 3 seconds after the last actuation. At the same time, the system code is being flashed out.



5.4.4.3 Reconfiguration

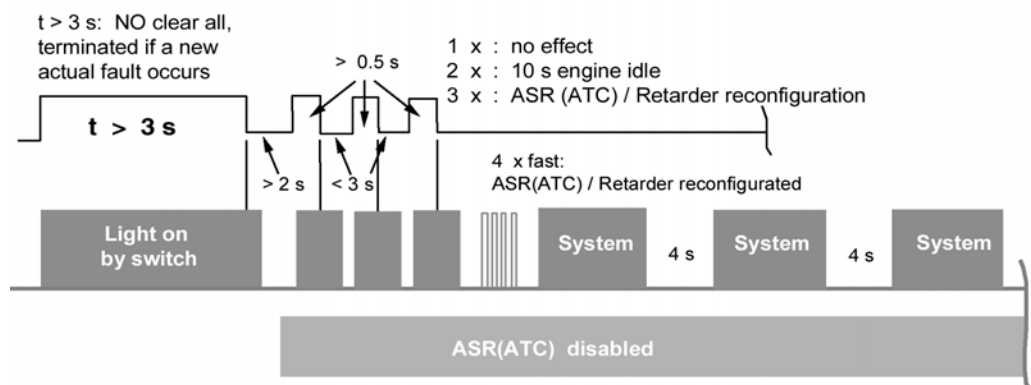
- q The ECU changes its basic setting (without ASR/ATC) to ABS/ASR(ATC) if a differential brake valve and engine control have been detected.
- q Once an SAE J1939 (CAN) interface has been detected **without** a differential brake valve, this interface is monitored as an extended ABS component.
- q Once a sustained-action brake relay (DBR outlet) has been detected or a retarder message received from the SAE J1939 interface (irrespective of parameter setting), this is also stored and monitored.

monitoring feature cannot be used on a vehicle that does not contain these components. Diagnostic equipment or the flash code can be used for reconfiguration.

To prevent unintentional reconfiguration, this function must be confirmed by pressing the push-button three times, as described above for functional testing of engine control. Before the system code is flashed out, 4 brief flash pulses confirm that the parameters are being changed.

The length of the ASR/ATC filament test shows whether the configuration includes ASR/ATC: no ASR/ATC - 1.5 sec., with ASR/ATC 3 sec. (similar to warning lamp).

Unless it has been subject to reconfiguration, an ECU with an extended



Roller dynamometer function:

On some roller dynamometers it is necessary to inhibit ASR/ATC to permit higher differences in the speeds between the driving axle and the steering axle. By activating the system mode, ASR/ATC is inhibited. If the flash code via the warning lamp is used, the ASR/ATC lamp comes on to indicate that ASR/ATC has been inhibited.

In order to prevent hazardous situations caused by brake force after ignition off/on, ASR/ATC is inhibited as long as there is such a difference in speeds after switching on the ignition. If this is the case, the ASR/ATC lamp will be on.

On vehicles **without** ASR/ATC, the detection of some errors is inhibited.

5.4.4.4 Flash code list

First part of error code (FC. a)	Second part of error code (FC. b)
1 NO ERROR	1 NO ERROR
2 ABS MODULATOR 3 SENSOR CLEARANCE 4 SENSOR short circuit/ interrupt 5 SENSOR defective / tyre size 6 SENSOR POLE WHEEL	1 FRONT RIGHT 2 FRONT LEFT 3 REAR RIGHT 4 REAR LEFT 5 3 rd AXLE RIGHT 6 3 rd AXLE LEFT
7 SYSTEM FUNCTION	1 DATA CONNECTION 2 ASR VALVE 3 SUSTAINED ACTION BRAKE RELAY 4 WARNING LAMP 5 ASR CONFIGURATION 6 ASR PROP/DIF LOCK/ STOP VALVE
8 ECU	1 UNDERVOLTAGE 2 EXCESS VOLTAGE 3 INTERNAL DEFECT 4 CONFIGURATION ERROR 5 GROUND CONNECTION

Error code	Repair instructions
2 . n	Check modulator cable. Inlet (IV) or outlet (OV) or joint cable is continuously or temporarily disconnected to shorted to ground or plus.
3 . n	Amplitude of sensor signal is too low. Check wheel bearing clearance, wheel wobble, push sensor in further. Check sensor wiring and plug-in connections for intermittent contact. Another possible cause: gear was engaged on slippery road surface causing a driving wheel to slip for 16 seconds.
4 . n	Check sensor cable. Interrupt, short to plus or ground or between cables IG/IGM has been detected.
5 . n	Check sensor cables and plugs for intermittent contact. Check pole wheel for any damage. Check if cables of two sensors have been confused. Tyres or number of teeth on pole wheel are different.
6 - n	Check pole wheel for any damage, missing teeth. Check for wobble. Check using WABCO Sensor Probe. Replace pole wheel as required. If clearance errors have also been stored, adjust the clearance (pushing in the sensor).
7 -1	ECU with PROP: Check cable and speedometer signal. C3/B7 signal calibration, check tyre sizes. gear lever shows "neutral" or has been manipulated. Electronic engine control: check interface wiring or other ECUs. High slip / dynamometer? One axle was much faster than others?
7 -2	Check cable. Output interrupt or shorted to ground or battery voltage.
7 -3	Check cable. Output interrupt or shorted to ground or battery voltage. ECU with SAE J1922 or SAE J1939: Check other ECUs. No communication via interface.
7 -4	Check cable and bulb. Was flash code button pushed down for longer than 16 sec?
7 -5	Check cable and parameters. A differential brake valve has been detected but no engine control feature. If "ASR self-learning" is inhibited, engine control feature CAN, PWM, PROP has been detected.
7 -6	Check cable. Output interrupt or shorted to ground or battery voltage.
8 -1	Check voltage supply and fuses. Supply voltage is too low at times.
8 -2	Check generator and battery. Supply voltage was too high for longer than 5 sec.
8 -3	Replace the ABS (ASR) ECU if the error occurs repeatedly.
8 -4	Wrong ECU or wrong parameter settings on the ECU.
8 -5	Check ECU ground wiring and shared valve lines IV/OV.

6. Installation

Some comments on installation:

Circuit schematic 841 801 277 0 on page 33 shows a 4S/4M-ABS/ASR system on a vehicle moving from left to right.

The 18-pin plug is provided for driver's cab functions and connected to the warning lamp, power supply, etc.

The circuit schematic for 6S/6M is included in the Annex.

The solenoid valve and the sensor on the left-hand side of the front axle are connected to the 6-pin plug.

The 9-pin plug comprises the right-hand side of the front axle, the signal for a proportional valve and the C3 input port (speedo).

The 15-pin plug connects the rear axle components including the ASR solenoid valve.

6.1 Important for installation

If the ABS valve is to be mounted on part of the steel frame which has not been surface-treated, the holes used to fasten the valve should be deburred and treated with a protective coating to prevent contact corrosion.

The output port (3) must point downwards. There must be a distance of 50 mm between the vent and any adjacent components to allow the pressure to escape.

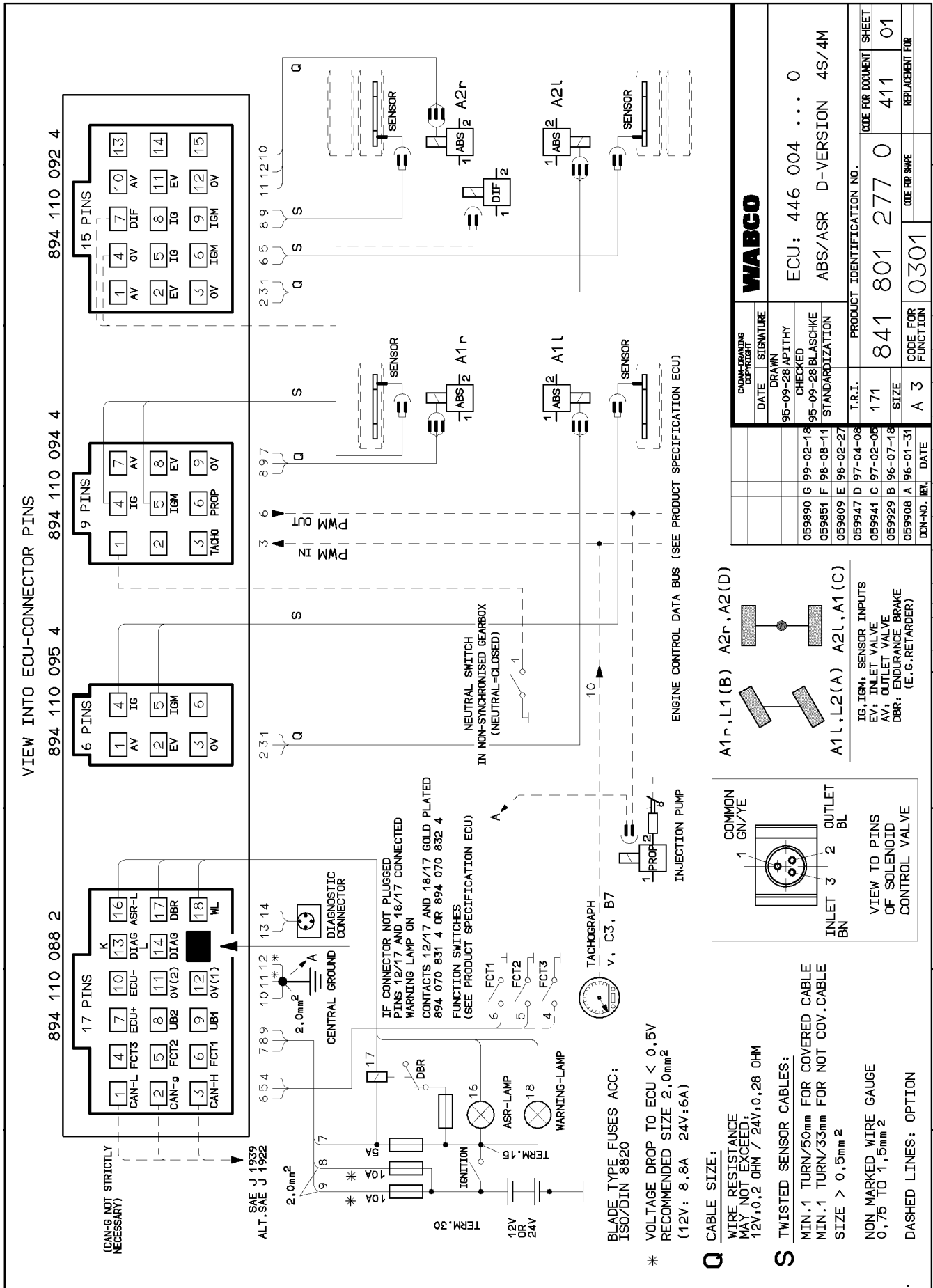
The product specifications for the individual components must always be adhered to.

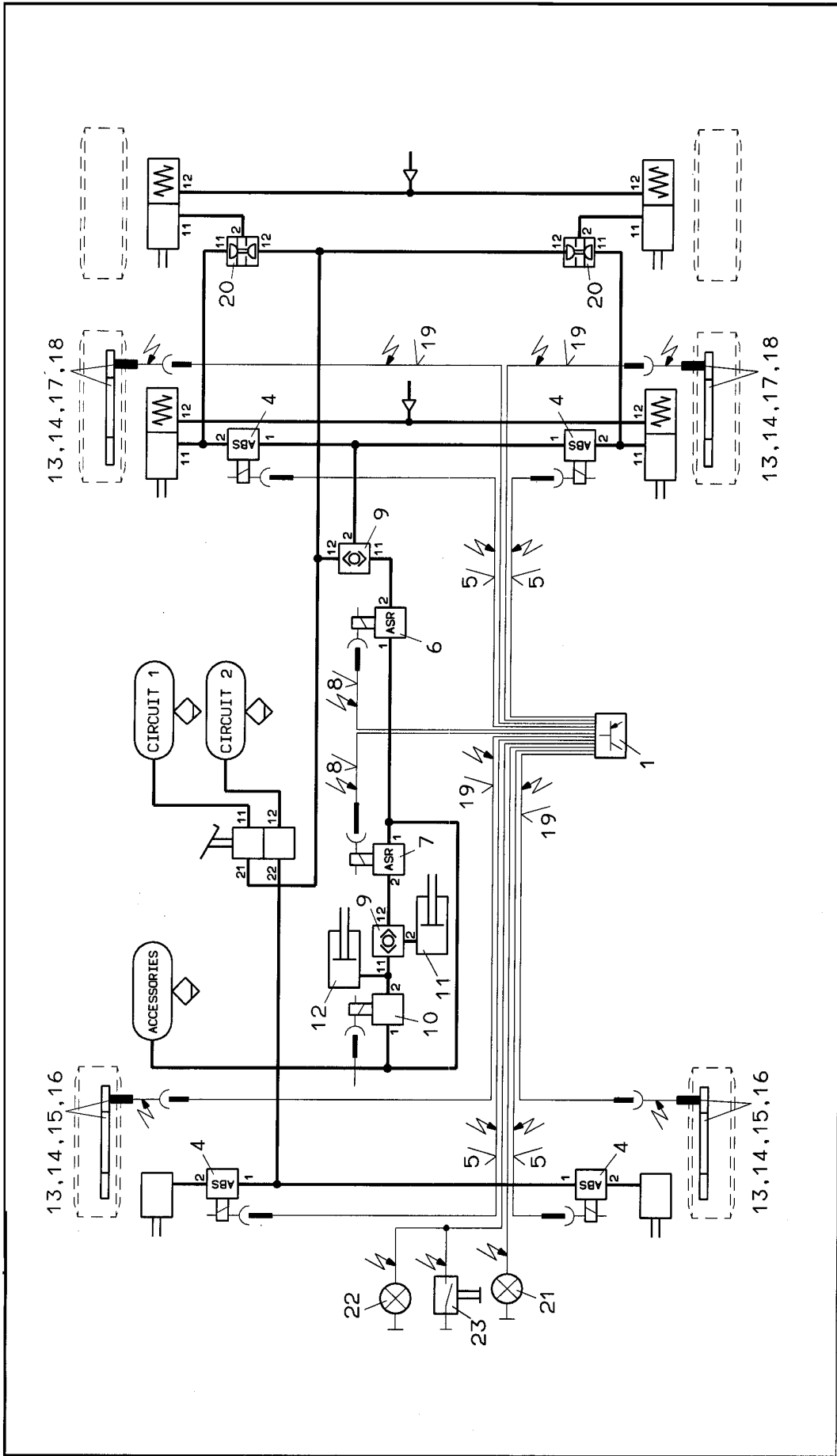
Grease must be used for fitting bush and sensors.

Approved types of grease:

Staborags NBU (1 Kg)	830 502 063 4
5 g tube	068 4
Complete Sensor Set (clamping bush + grease)	... 578 0 441 032 921 2
Complete Sensor Set (clamping bush + grease)	... 579 0 441 032 922 2

Annex



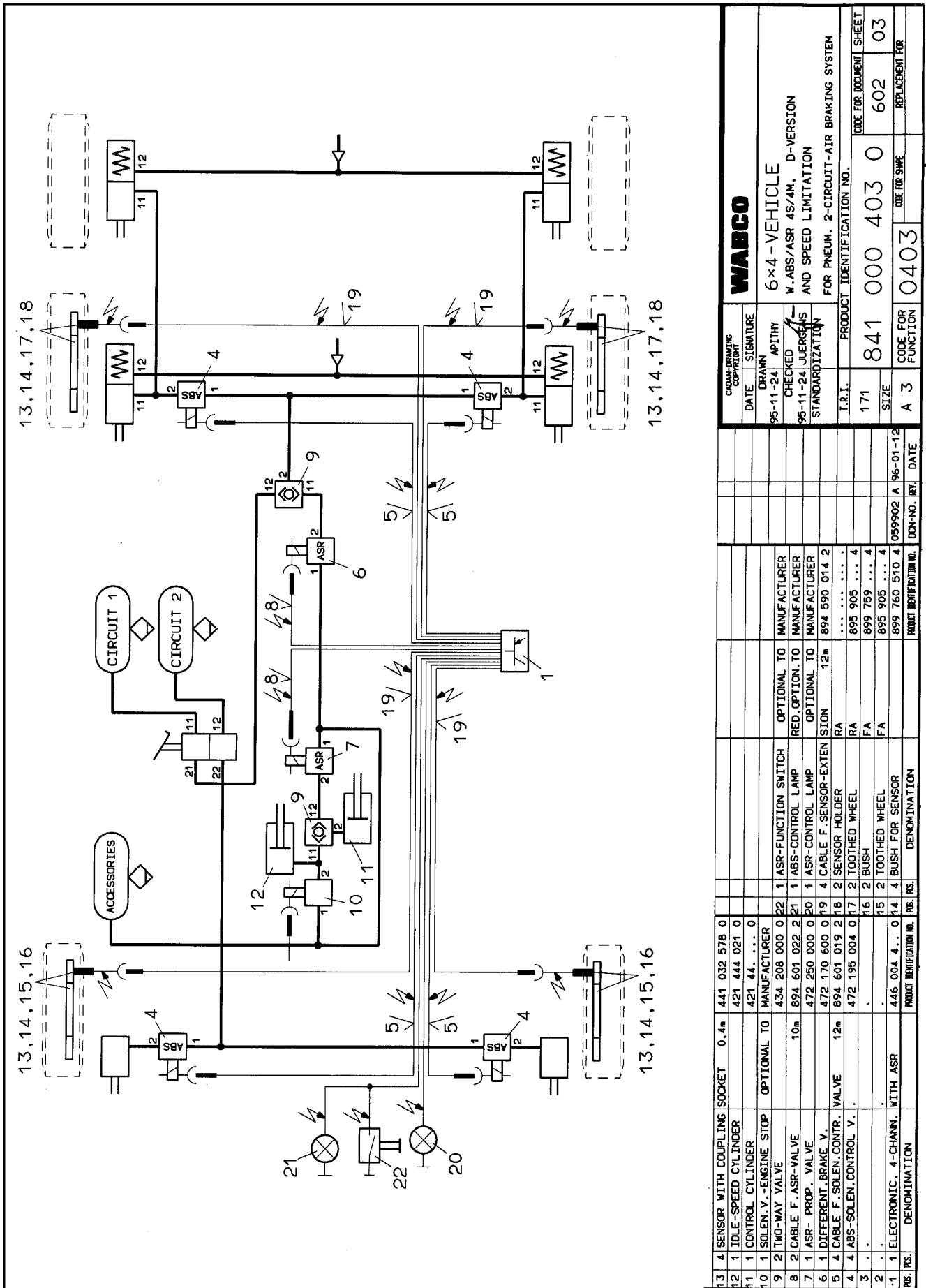


WABCO		DATE		SIGNATURE		DRAWN		CHECKED		DATE		SIGNATURE		DRAWN		CHECKED		DATE	
		95-11-24		APITHY		95-11-24		JUERGENS		95-11-24		JUERGENS		95-11-24		JUERGENS		95-11-24	
		171		841 000 402 0		841 000 402 0		841 000 402 0		841 000 402 0		841 000 402 0		841 000 402 0		841 000 402 0		841 000 402 0	
		A 3		0403		0403		0403		0403		0403		0403		0403		0403	
		059902 A		96-01-12		059902 A		96-01-12		059902 A		96-01-12		059902 A		96-01-12		059902 A	
		12m		894 590 014 2		12m		894 590 014 2		12m		894 590 014 2		12m		894 590 014 2		12m	
		16		899 759 ... 4		16		899 759 ... 4		16		899 759 ... 4		16		899 759 ... 4		16	
		15		899 759 ... 4		15		899 759 ... 4		15		899 759 ... 4		15		899 759 ... 4		15	
		14		899 759 ... 4		14		899 759 ... 4		14		899 759 ... 4		14		899 759 ... 4		14	
		13		899 759 ... 4		13		899 759 ... 4		13		899 759 ... 4		13		899 759 ... 4		13	
		12		899 759 ... 4		12		899 759 ... 4		12		899 759 ... 4		12		899 759 ... 4		12	
		11		899 759 ... 4		11		899 759 ... 4		11		899 759 ... 4		11		899 759 ... 4		11	
		10		899 759 ... 4		10		899 759 ... 4		10		899 759 ... 4		10		899 759 ... 4		10	
		9		899 759 ... 4		9		899 759 ... 4		9		899 759 ... 4		9		899 759 ... 4		9	
		8		899 759 ... 4		8		899 759 ... 4		8		899 759 ... 4		8		899 759 ... 4		8	
		7		899 759 ... 4		7		899 759 ... 4		7		899 759 ... 4		7		899 759 ... 4		7	
		6		899 759 ... 4		6		899 759 ... 4		6		899 759 ... 4		6		899 759 ... 4		6	
		5		899 759 ... 4		5		899 759 ... 4		5		899 759 ... 4		5		899 759 ... 4		5	
		4		899 759 ... 4		4		899 759 ... 4		4		899 759 ... 4		4		899 759 ... 4		4	
		3		899 759 ... 4		3		899 759 ... 4		3		899 759 ... 4		3		899 759 ... 4		3	
		2		899 759 ... 4		2		899 759 ... 4		2		899 759 ... 4		2		899 759 ... 4		2	
		1		899 759 ... 4		1		899 759 ... 4		1		899 759 ... 4		1		899 759 ... 4		1	
		0		899 759 ... 4		0		899 759 ... 4		0		899 759 ... 4		0		899 759 ... 4		0	

7.

ABS-D

Brake Diagram 841 000 403 0



WABCO	
DATE	SIGNATURE
95-11-24	APITHY
CHECKED	95-11-24 JUEGENS
STANDARDIZATION	
FOR PNEUM. 2-CIRCUIT-AIR BRAKING SYSTEM	
PRODUCT IDENTIFICATION NO.	
171	841 000 403 0
SIZE	CODE FOR DOCUMENT SHEET
A 3	602 03
CODE FOR FUNCTION	REPLACEMENT FOR
0403	

VERSION AUSFUEHRUNG VARIANTE VARIANTE

WABCO-16-JED-369

WEEK AND YEAR OF MANUFACTURE FERTIGUNGSWOCHE UND JAHR SEMAINE ET ANNEE DE FABRICATION SETTIMANA E ANNO DI FABBRICAZIONE

PART NO. TEILE-NR. * NO. DE PIECE CODICE

PRI-NR. * [m]

WABCO 449 52... 0

LENGTH LAENGE LONGUEUR LUNGHEZZA

RESISTANT TO BESTAENDIG GEGEN RESISTANT A RESISTENTE A

TYPE OF PROTECTION (IN CONNECTION WITH PLUG) SCHUTZART (IN VERBINDUNG MIT STECKER) MODE DE PROTECTION (DANS CONNECTION AVEC FICHE) TIPO DI PROTEZIONE (IN RELAZIONE CON SPINA)

FOR FURTHER TECHNICAL DATA SEE PRODUCT SPECIFICATION WEITERE TECHNISCHE DATEN SIEHE PRODUKT SPECIFIKATION POUR AUTRES DONNEES TECHNIQUES VOIR PRODUIT SPECIFICATION PER ULTERIORI DATI TECNICI VEDERE SPECIFICA DI PRODOTTO

CODE OF LENGTH LAENGENKODIERUNG CODE DE LA LONGUEUR CODICE DEL LUNGHEZZA

PART NO. TEILE NR. NO. DE PIECE CODICE

EXAMPLE BEISPIEL ESEMPIO

MIN/MAX LENGTH LAENGE MIN/MAX LONGUEUR MIN/MAX LUNGHEZZA

TOLERANCES TOLERANZEN TOLERANZA

THREE CORE CABLE LETTLING DREIADRIG CABLE A TROIS CONDUCTEURS CAVO A TRE CONDUTTORI

STRAIN RELIEF CABLE ZUGENTLASTUNG KABEL ARRET DE CABLE SCARICO DI TRAZIONE DEL CAVO

THERMAL RANGE OF APPLICATION THERMISCHER ANWENDUNGSBEREICH GAMME D'APPLICATION THERMIQUE CAMPO DI APPLICAZIONE TERMICA

ABRASION RESISTANT PRINT ABRIBESTER AUFDRUCK IMPRESSION RESISTANT A L'ABRASION IMPRONTA RESISTENTE ALL'ABRASIONE

* ABRASION RESISTANT PRINT ABRIBESTER AUFDRUCK IMPRESSION RESISTANT A L'ABRASION IMPRONTA RESISTENTE ALL'ABRASIONE

RESISTANT TO BESTAENDIG GEGEN RESISTANT A RESISTENTE A

TYPE OF PROTECTION (IN CONNECTION WITH PLUG) SCHUTZART (IN VERBINDUNG MIT STECKER) MODE DE PROTECTION (DANS CONNECTION AVEC FICHE) TIPO DI PROTEZIONE (IN RELAZIONE CON SPINA)

FOR FURTHER TECHNICAL DATA SEE PRODUCT SPECIFICATION WEITERE TECHNISCHE DATEN SIEHE PRODUKT SPECIFIKATION POUR AUTRES DONNEES TECHNIQUES VOIR PRODUIT SPECIFICATION PER ULTERIORI DATI TECNICI VEDERE SPECIFICA DI PRODOTTO

GENERAL OCCUPATIONAL SAFETY DATA SHEET

GENERAL TECHNICAL DATA

DOC. CODE: WABCO

DATE: 95-03-17

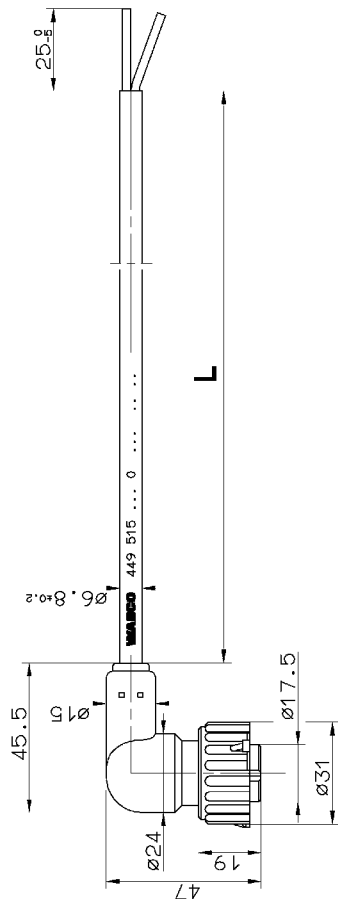
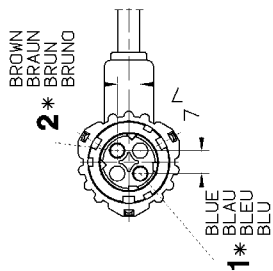
REVISION: 01

PRODUCT IDENTIFICATION NO.: 449 522 000 0

SIZE: A 2

DATE: 05/924 1 x A 95-04-13

Cable for ASR Valve
Plug "DIN Bayonet"



CODE OF LENGTH LAENGCODIERUNG CODE DE LA LONGUEUR CODICE DEL LUNGHEZZA	ORDER NUMBER BESTELLNUMMER NUMERO DE COMMANDE NUMERO DELL'ORDINE	449 515 000 0	L [m]
EXAMPLE BEISPIEL EXEMPLE ESEMPIO	L = 2m 449 515 020 0		
MIN/MAX LENGTH LAENGE MIN/MAX LONGUEUR MIN/MAX LUNGHEZZA	L _{min} = 0.1m L _{max} = 20.0m		
TOLERANCES TOLERANZEN TOLERANCES TOLERANZA	L ≤ 10m ±0.050m L > 10m ±0.075m		

SURFACE PROTECTION :
OBERFLÄCHENSCHUTZ : S_n
PROTECTION DE SURFACE :
PROTEZIONE SUPERFICCI :

2-CORE CABLE
LEITUNG 2-ADRIG
CABLE A 2 CONDUCTEURS
CAVO A 2 CONDUTTORI

THERMAL RANGE OF APPLICATION
THERMISCHER ANWENDUNGSBEREICH
GAMME D'APPLICATION THERMIQUE
CAMPO DI APPLICAZIONE TERMICA

TYPE OF PROTECTION (IN CONNECTION WITH PLUG)
SCHUTZART (IN VERBINDUNG MIT STECKER)
MODE DE PROTECTION (DANS CONNECTION AVEC FICHE)
TIPO DI PROTEZIONE (IN RELAZIONE CON SPINA)

RESISTANT TO
BESTÄNDIG GEGEN
RESISTANT A
RESISTENTE A

AIR, WATER, MINERAL OIL, PETROL, DIESEL OIL, SALT SPRAY
LUFT, WASSER, MINERALÖL, BENZIN, DIESELÖL, SALZSPRUEHNEBEL
AIR, EAU, HUILE MINERALE, ESSENCE, GASOIL, BROUILLARD, SALIN
ARIA, AQUA, OLIO, MINERALE, BENZINA, GASOLIO, NEBBIA, SALINA

** DIN 16901-150

GENERAL SPECIFICATION:	IP-54	*
FURTHER TECHNICAL DATA:	SHEET	TO
DOC. CODE:	GENERAL TELEMARKS	
CLASS	RANGE OF NOMINAL IDENTIFIERS (# NR)	
1)	> 90	>160
2)	5150	5400
3)	0	310
4)	0	40
5)	2.0	3.5
6)	5.0	6.5
TYPED VALUES ACC. ISO 4289 / ISO-182		
1) TOLERANCE CLASS APPLIED ORDERWIDE		
DATE	REV.	DATE
96-05-22	WEBER	96-05-22
96-05-22	OVERHAUSE	96-05-22
96-05-22	IDENTIFICATION:	96-05-22
SCALE	PRODUCT IDENTIFICATION NO.	
1:1	449 515 000 0	
SIZE	DOC. CODE	653
A 2	REPLACEMENT FOR	884.010.105.0

WABCO

CABLE WITH SOCKET
KABEL MIT GERÄTESTECKDOSE
CABLE AVEC PRISE DE COURANT
CAVO CON PRESA DI CORRENTE

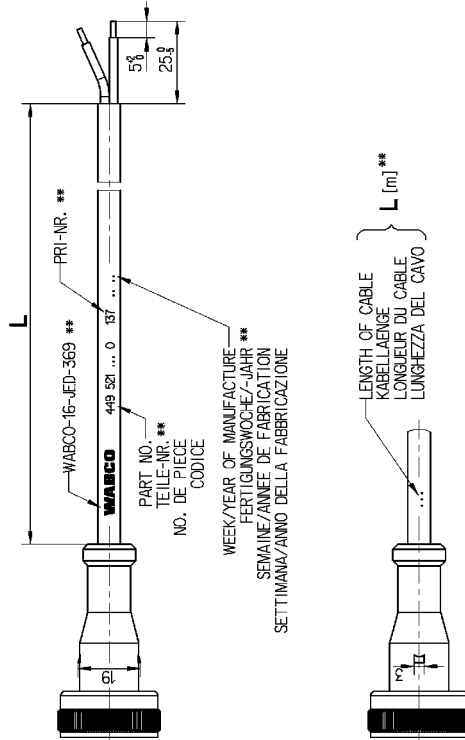
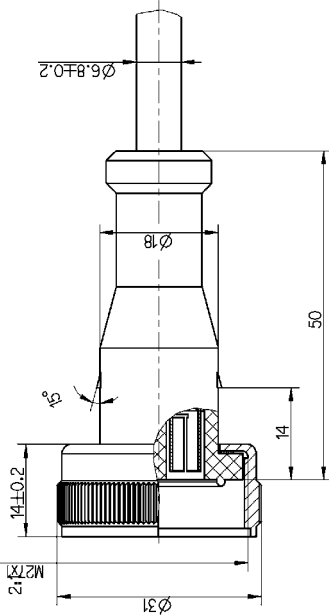
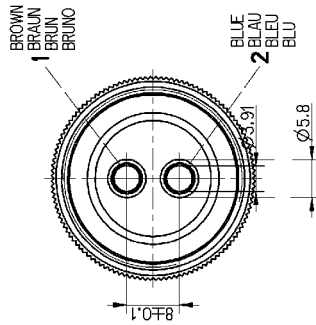
Cable for ASR Valve

Plug "M 27x1"

ABS-D

7.

CODE OF LENGTH LAEMENCOODIERING CODE DE LA LONGUEUR CODICE DEL LUNGHEZZA	449 521 □ □ □ 0	L [m]
PART NO. TEILE NR. NO DE PIECE	449 521 □ □ □ 0	
CODE CODICE		
EXAMPLE BEISPIEL ESEMPIO	L = 15 m 449 521 150 0	
MIN/MAX LENGTH MIN/MAX LAENGE MIN/MAX LONGUEUR MIN/MAX LUNGHEZZA	L _{min} = 0,1m L _{max} = 20m	
TOLERANCES TOLERANZEN TOLERANZE	L < 10m ±0,060m L > 10m ±0,075m	



** ABRASION RESISTANT PRINT
ABRIEBFESTER AUFDRUCK
IMPRESSION RESISTANTE A L' ABRASION
IMPRONTA RESISTENTE ALL' ABRASIONE

TWO CORE CABLE
LEITUNG ZWEIADRIG
CABLE A DEUX CONDUCTEURS
CAVO A DUE CONDUTTORI

THERMAL RANGE OF APPLICATION
THERMISCHER ANWENDUNGSBEREICH
GAMME D'APPLICATION THERMIQUE
CAMPO TERMICO D'APPLICAZIONE

RAL 9001

PUR
2x1,5mm²

-40 °C...+80 °C

RESISTANT TO AIR, WATER, MINERAL OIL, PETROL, DIESEL OIL, SALT SPRAY
BESTÄNDIG GEGEN LUFT, WASSER, MINERALÖL, BENZIN, DIESELÖL, SALZSPRIENNEBEL
RESISTANT A AIR, EAU, HUILE MINÉRALE, ESSENCE, GASOIL, BROUILLARD SALIN
RESISTENTE A ARIA, AGUA, OILIO MINERALE, BENZINA, GASOLIO, NEBBIA SALINA

TYPE OF PROTECTION (IN CONNECTION WITH PLUG)
SCHUTZART (IN VERBINDUNG MIT STECKER)
MODE DE PROTECTION (DANS CONNECTION AVEC FICH)
TIPO DI PROTEZIONE (IN RELAZIONE CON SPINA)

FURTHER TECHNICAL DATA SEE PRODUCT SPECIFICATION
WEITERE TECHNISCHE DATEN SIEHE PRODUKT SPEZIFIKATION
POUR AUTRES DONNÉES TECHNIQUES VOIR PRODUIT SPECIFICATION
PER ULTERIORI DATI TECNICI VEDERE SPECIFICA DI PRODOTTO

* DIN 16901-150

GENERAL SPECIFICATION:	JED-334.0 *	DATE	
FURTHER TECHNICAL DATA:		DATE	
DOC. CODE:		DATE	
RANGE OF NOMINAL DIMENSIONS (± mm)			
CLASS	1) ≤ 50	2.0	±0.5
	> 50 > 180	1.5	±0.4
	180 < 400	2.0	±0.5
	400 < 600	2.0	±0.5
	600 < 800	3.0	±0.6
	800 < 1000	3.5	±0.7
	1000 < 1500	5.0	±1.0
	1500 < 2000	6.5	±1.2
TAPPED HOLES ACC. 180 4339 / JED-152			
DWG-NO.	A 99-06-15	DATE	
REV.	A 2	DATE	
* DIN 16901-150			
PROTECTOR DRAWING	DATE	SIGNATURE	
DATE		SIGNATURE	
99-06-15		99-06-15	
99-06-15		99-06-15	
EXPERT CODE		EXPERT CODE	
7, 6 0		7, 6 0	
MASS		SCALE	
/ 160		/ 160	
SIZE		SIZE	
160		160	
PRODUCT IDENTIFICATION NO.			
449 521 000 0			
DOC. CODE			
653			
REPLACEMENT FOR			
1/1			
FUNCTION CODE			
11			
WABCO			
CABLE WITH SOCKET			
KABEL MIT GERÄTESTECKDOSE			
CABLE AVEC PRISE DE COURANT			
CAVO CON PRESA DI CORRENTE			

STRAIN RELIEF CABLE
ZUGENTLASTUNG KABEL
SCARICO DI TRAZIONE DEL CAVO

TWO CORE CABLE
LEITUNG ZWEIADRIG
CABLE A DEUX CONDUCTEURS
CAVO A DUE CONDUTTORI

BEND RADIUS CABLE
BIEGERADIUS KABEL
RAYON DE COURBURE DE CABLE
RAGGIO DI CURVATURA DEL CAVO

THERMAL RANGE OF APPLICATION
THERMISCHER ANWENDUNGSBEREICH
GAMME D'APPLICATION THERMIQUE
CAMPO DI APPLICAZIONE TERMICA

MAX. 150N $\phi=20^\circ\text{C}$

PUR $2 \times 0,75\text{mm}^2$

R 15 MIN. $\leq 90^\circ$

$-40^\circ\text{C} \dots +80^\circ\text{C}$

CODE OF LENGTH
LAENGCODIERUNG
CODE DE LA LONGUEUR
CODICE DEL LUNGHEZZA

ORDER NUMBER BESTELLNUMMER NUMERO DE COMMANDE NUMERO DELL'ORDINE	449 751 0 0
EXAMPLE BEISPIEL ESEMPIO	L = 1,22m 449 751 122 0
MIN/MAX LENGTH LAENGE LONGUEUR LUNGHEZZA	L _{min} = 0,1m L _{max} = 9,99m
TOLERANCES TOLERANZEN TOLERANZE	L ≤ 2m ±0,020m L > 2m ±0,050m

GENERAL IDENTIFICATION: 449-754

DOC. CODE: SHEET: TO:

GENERAL TOLERANCES

CLASS	1)	2)	3)	4)	5)	6)	7)
FINISH	0,8	1,0	1,6	2,0	3,0	4,0	5,0
HOLES	0,0	0,5	0,5	0,5	0,5	0,5	0,5

TAPPED HOLES ACC. TO: ISO 8039 / ISO 8038

1) TOLERANCE CLASS APPLIED OTHERWISE

PART NO.
TEILE-NR.
NO. DE PIECE
CODICE

WABCO 449 751 ... 0

WEEK AND YEAR OF MANUFACTURE
FERTIGUNGSWOCHE UND JAHR
SEMAINE ET ANNEE DE FABRICATION
SETTIMANA E ANNO DI FABBRICAZIONE

LENGTH
LAENGE
LONGUEUR
LUNGHEZZA

L [m]

* SURFACE PROTECTION
OBERFLAECHENSCHUTZ
PROTECTION DE SURFACE
PROTEZIONE SUPERFICIE

RESISTANT TO
BESTAENDIG GEGEN
RESISTANT A
RESISTENTE A

AIR, WATER, MINERAL OIL, PETROL, DIESEL OIL, SALTS PRAY
LUFT, WASSER, MINERALOEL, BENZIN, DIESEL OEL, SALZSPRUEHNEBEL
AIR, EAU, HUILE MINERALE, ESSENCE, GASOL, BROUILLARD, SALIN
ARIA, ACQUA, OLIO MINERALE, BENZINA, GASOLIO, NEBBIA, SALINA

TYPE OF PROTECTION (IN CONNECTION WITH SOCKET)
SCHUTZART (IN VERBINDUNG MIT KUPPLUNGSDOSE)
MODE DE PROTECTION (DANS CONNECTION AVEC SOCLE)
TIPO DI PROTEZIONE (NELLE INDUTTIVO CON SPINDOTTO)

Ag

EN 60529/IEC 529

IP 68

CHARACTERISTICS
DATE: 96-06-12
DESIGNER: WEIBER
DRAWN: 96-06-12
TECHNICAL MANAGER: ...
DATE: 96-06-12

WABCO

CONNECTOR PLUG WITH CABLE
KUPPLUNGSSTECKER MIT KABEL
FICHE DE COUPLAGE AVEC CABLE
CONNETTORE CON CAVO

PRODUCT IDENTIFICATION NO.

WBS	SCALE	REV	DATE	REV	DATE
449 751 000 0	2:1	1	142		
	(1:1)				

DOC. CODE: SHEET: TO:

GENERAL TOLERANCES

CLASS	1)	2)	3)	4)	5)	6)	7)
FINISH	0,8	1,0	1,6	2,0	3,0	4,0	5,0
HOLES	0,0	0,5	0,5	0,5	0,5	0,5	0,5

TAPPED HOLES ACC. TO: ISO 8039 / ISO 8038

1) TOLERANCE CLASS APPLIED OTHERWISE

PROTECTION CAP
SCHUTZKAPPE
CAPUCHON
PROTECTORIO

WABCO-NR. L (mm)

441 032 808 0	400
441 032 809 0	1000

WEEK AND YEAR OF MANUFACTURE
FERTIGUNGSWOCHE UND JAHR
SEMAINE ET ANNEE DE FABRICATION
SETTIMANA E ANNO DELLA FABBRICAZIONE

OPTIONAL PERMISSIBLE
WAHLWEISE ZULASSIG
FACULTATIF ADMISSIBLE
FACOLTATIVA AMMISSIBILE

THERMAL RANGE OF APPLICATION FOR SENSOR
THERMISCHER ANWENDUNGSBEREICH FUER SENSOR
GAMME D'APPLICATION THERMIQUE POUR CAPTEUR
CAMPO TERMICO D'APPLICAZIONE DEL SENSORE

THERMAL RANGE OF APPLICATION FOR CABLE
THERMISCHER ANWENDUNGSBEREICH FUER KABEL
GAMME D'APPLICATION THERMIQUE POUR CABLE
CAMPO TERMICO D'APPLICAZIONE DEL CAVO

THERMAL RANGE OF APPLICATION FOR CONNECTOR SOCKET
THERMISCHER ANWENDUNGSBEREICH FUER KUPPLUNGSDOSE
GAMME D'APPLICATION THERMIQUE POUR CONNECTEUR FEMELLE
CAMPO TERMICO D'APPLICAZIONE DEL CONNETTORE

FURTHER TECHNICAL DATA SEE PRODUCT SPECIFICATION
WEITERE TECHNISCHE DATEN SIEHE PRODUKT-SPEZIFIKATION
AUTRES DONNEES TECHNIQUES VOIR PRODUIT SPECIFICATION
ULTERIORI DATI TECNICI VEDERE SPECIFICA DI PRODOTTO

INSTRUCTIONS OF INSTALLATION SEE ADAPTATION SPECIFICATION
EINBAUWEISE SIEHE ADAPTATIONS-SPEZIFIKATION
INSTRUCTIONS D'INSTALLATION VOIR SPECIFICATION D'ADAPTATION
ISTRUZIONI D'INSTALLAZIONE VEDERE SPECIFICA D'ADATTAMENTO

DEGREE OF PROTECTION (IN CONNECTION WITH PLUG)
SCHUTZART (IN VERBINDUNG MIT KUPPLUNGSSTECKER)
DEGRE DE PROTECTION (DANS CONNECTION AVEC CONNECTEUR MÂLE)
GRADO DI PROTEZIONE (IN COLLAGAMENTO CON SPINOTTO)

∅16111

∅12.6±0.08

∅16±0.1

56±0.1

∅4.4±0.2

80±0.1

22

19

9.8

20.6

16.11

57±0.1

40

7

6

56±0.1

16±0.1

12.6±0.08

25

25

25

PROTECTION CAP
SCHUTZKAPPE
CAPUCHON
PROTECTORIO

WABCO-NR. L (mm)

441 032 808 0	400
441 032 809 0	1000

WEEK AND YEAR OF MANUFACTURE
FERTIGUNGSWOCHE UND JAHR
SEMAINE ET ANNEE DE FABRICATION
SETTIMANA E ANNO DELLA FABBRICAZIONE

OPTIONAL PERMISSIBLE
WAHLWEISE ZULASSIG
FACULTATIF ADMISSIBLE
FACOLTATIVA AMMISSIBILE

THERMAL RANGE OF APPLICATION FOR SENSOR
THERMISCHER ANWENDUNGSBEREICH FUER SENSOR
GAMME D'APPLICATION THERMIQUE POUR CAPTEUR
CAMPO TERMICO D'APPLICAZIONE DEL SENSORE

THERMAL RANGE OF APPLICATION FOR CABLE
THERMISCHER ANWENDUNGSBEREICH FUER KABEL
GAMME D'APPLICATION THERMIQUE POUR CABLE
CAMPO TERMICO D'APPLICAZIONE DEL CAVO

THERMAL RANGE OF APPLICATION FOR CONNECTOR SOCKET
THERMISCHER ANWENDUNGSBEREICH FUER KUPPLUNGSDOSE
GAMME D'APPLICATION THERMIQUE POUR CONNECTEUR FEMELLE
CAMPO TERMICO D'APPLICAZIONE DEL CONNETTORE

FURTHER TECHNICAL DATA SEE PRODUCT SPECIFICATION
WEITERE TECHNISCHE DATEN SIEHE PRODUKT-SPEZIFIKATION
AUTRES DONNEES TECHNIQUES VOIR PRODUIT SPECIFICATION
ULTERIORI DATI TECNICI VEDERE SPECIFICA DI PRODOTTO

INSTRUCTIONS OF INSTALLATION SEE ADAPTATION SPECIFICATION
EINBAUWEISE SIEHE ADAPTATIONS-SPEZIFIKATION
INSTRUCTIONS D'INSTALLATION VOIR SPECIFICATION D'ADAPTATION
ISTRUZIONI D'INSTALLAZIONE VEDERE SPECIFICA D'ADATTAMENTO

DEGREE OF PROTECTION (IN CONNECTION WITH PLUG)
SCHUTZART (IN VERBINDUNG MIT KUPPLUNGSSTECKER)
DEGRE DE PROTECTION (DANS CONNECTION AVEC CONNECTEUR MÂLE)
GRADO DI PROTEZIONE (IN COLLAGAMENTO CON SPINOTTO)

1:1

∅16111

∅12.6±0.08

∅16±0.1

56±0.1

∅4.4±0.2

80±0.1

22

19

9.8

20.6

16.11

57±0.1

40

7

6

56±0.1

16±0.1

12.6±0.08

25

25

25

PROTECTION CAP
SCHUTZKAPPE
CAPUCHON
PROTECTORIO

WABCO-NR. L (mm)

441 032 808 0	400
441 032 809 0	1000

WEEK AND YEAR OF MANUFACTURE
FERTIGUNGSWOCHE UND JAHR
SEMAINE ET ANNEE DE FABRICATION
SETTIMANA E ANNO DELLA FABBRICAZIONE

OPTIONAL PERMISSIBLE
WAHLWEISE ZULASSIG
FACULTATIF ADMISSIBLE
FACOLTATIVA AMMISSIBILE

THERMAL RANGE OF APPLICATION FOR SENSOR
THERMISCHER ANWENDUNGSBEREICH FUER SENSOR
GAMME D'APPLICATION THERMIQUE POUR CAPTEUR
CAMPO TERMICO D'APPLICAZIONE DEL SENSORE

THERMAL RANGE OF APPLICATION FOR CABLE
THERMISCHER ANWENDUNGSBEREICH FUER KABEL
GAMME D'APPLICATION THERMIQUE POUR CABLE
CAMPO TERMICO D'APPLICAZIONE DEL CAVO

THERMAL RANGE OF APPLICATION FOR CONNECTOR SOCKET
THERMISCHER ANWENDUNGSBEREICH FUER KUPPLUNGSDOSE
GAMME D'APPLICATION THERMIQUE POUR CONNECTEUR FEMELLE
CAMPO TERMICO D'APPLICAZIONE DEL CONNETTORE

FURTHER TECHNICAL DATA SEE PRODUCT SPECIFICATION
WEITERE TECHNISCHE DATEN SIEHE PRODUKT-SPEZIFIKATION
AUTRES DONNEES TECHNIQUES VOIR PRODUIT SPECIFICATION
ULTERIORI DATI TECNICI VEDERE SPECIFICA DI PRODOTTO

INSTRUCTIONS OF INSTALLATION SEE ADAPTATION SPECIFICATION
EINBAUWEISE SIEHE ADAPTATIONS-SPEZIFIKATION
INSTRUCTIONS D'INSTALLATION VOIR SPECIFICATION D'ADAPTATION
ISTRUZIONI D'INSTALLAZIONE VEDERE SPECIFICA D'ADATTAMENTO

DEGREE OF PROTECTION (IN CONNECTION WITH PLUG)
SCHUTZART (IN VERBINDUNG MIT KUPPLUNGSSTECKER)
DEGRE DE PROTECTION (DANS CONNECTION AVEC CONNECTEUR MÂLE)
GRADO DI PROTEZIONE (IN COLLAGAMENTO CON SPINOTTO)

1:1

∅16111

∅12.6±0.08

∅16±0.1

56±0.1

∅4.4±0.2

80±0.1

22

19

9.8

20.6

16.11

57±0.1

40

7

6

56±0.1

16±0.1

12.6±0.08

25

25

25

PROTECTION CAP
SCHUTZKAPPE
CAPUCHON
PROTECTORIO

WABCO-NR. L (mm)

441 032 808 0	400
441 032 809 0	1000

WEEK AND YEAR OF MANUFACTURE
FERTIGUNGSWOCHE UND JAHR
SEMAINE ET ANNEE DE FABRICATION
SETTIMANA E ANNO DELLA FABBRICAZIONE

OPTIONAL PERMISSIBLE
WAHLWEISE ZULASSIG
FACULTATIF ADMISSIBLE
FACOLTATIVA AMMISSIBILE

THERMAL RANGE OF APPLICATION FOR SENSOR
THERMISCHER ANWENDUNGSBEREICH FUER SENSOR
GAMME D'APPLICATION THERMIQUE POUR CAPTEUR
CAMPO TERMICO D'APPLICAZIONE DEL SENSORE

THERMAL RANGE OF APPLICATION FOR CABLE
THERMISCHER ANWENDUNGSBEREICH FUER KABEL
GAMME D'APPLICATION THERMIQUE POUR CABLE
CAMPO TERMICO D'APPLICAZIONE DEL CAVO

THERMAL RANGE OF APPLICATION FOR CONNECTOR SOCKET
THERMISCHER ANWENDUNGSBEREICH FUER KUPPLUNGSDOSE
GAMME D'APPLICATION THERMIQUE POUR CONNECTEUR FEMELLE
CAMPO TERMICO D'APPLICAZIONE DEL CONNETTORE

FURTHER TECHNICAL DATA SEE PRODUCT SPECIFICATION
WEITERE TECHNISCHE DATEN SIEHE PRODUKT-SPEZIFIKATION
AUTRES DONNEES TECHNIQUES VOIR PRODUIT SPECIFICATION
ULTERIORI DATI TECNICI VEDERE SPECIFICA DI PRODOTTO

INSTRUCTIONS OF INSTALLATION SEE ADAPTATION SPECIFICATION
EINBAUWEISE SIEHE ADAPTATIONS-SPEZIFIKATION
INSTRUCTIONS D'INSTALLATION VOIR SPECIFICATION D'ADAPTATION
ISTRUZIONI D'INSTALLAZIONE VEDERE SPECIFICA D'ADATTAMENTO

DEGREE OF PROTECTION (IN CONNECTION WITH PLUG)
SCHUTZART (IN VERBINDUNG MIT KUPPLUNGSSTECKER)
DEGRE DE PROTECTION (DANS CONNECTION AVEC CONNECTEUR MÂLE)
GRADO DI PROTEZIONE (IN COLLAGAMENTO CON SPINOTTO)

GENERAL SPECIFICATION:	JED-334.0
FURTHER TECHNICAL DATA:	
DOC. CODE:	
GENERAL TOLERANCES	
RANGE OF NOMINAL DIMENSIONS (± mm)	
CLASS	> 50 > 180
FINE	0.5 ≤ 180 ≤ 1001 > 400
MEDIUM	1.0 2.0 3.0 4.0
COARSE	2.0 3.5 5.0 6.5
TAPPED HOLES ACC. ISO 4038 / JED-152	
1) TOLERANCE CLASS APPLIED CROSSHAURED	
PROBES DRAWING DATE	00-03-03
DATE	00-03-03
DRAWN BY	HEBELER
EXPERT CODE	7 6 0
SCALE	1:1
SIZE	A 2
DATE	00-07-02
REV.	01
DOC. CODE	653
REPLACEMENT FOR	441 032 810 0
FRAGMENT NO.	0.1
PRODUCT TYPE	INDUCTIVE SENSOR WITH SOCKET
INDUCTIVE SENSOR WITH SOCKET	
STARSENOR MIT KUPPLUNGSDOSE	
CAPTEUR AVEC CONNECTEUR FEMELLE	
SENSORE INDUTTIVO CON CONNETTORE	
PRODUCT IDENTIFICATION NO.	441 032 810 0
DOC. CODE	653
SHEET	1/1
WABCO	

