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[http://www.wabco.info/i/543](http://www.wabco.info/i/543)
1  List of abbreviations

<table>
<thead>
<tr>
<th>ABBREVIATION</th>
<th>MEANING</th>
</tr>
</thead>
<tbody>
<tr>
<td>APU</td>
<td>Air Processing Unit</td>
</tr>
<tr>
<td>C-APU</td>
<td>Compact Air Processing Unit</td>
</tr>
<tr>
<td>E-APU</td>
<td>Electronically Controlled Air Processing Unit</td>
</tr>
<tr>
<td>ECAD</td>
<td>Electrically Controlled Air Dryer (with system regeneration)</td>
</tr>
<tr>
<td>ECAS</td>
<td>Electronically Controlled Air Suspension</td>
</tr>
<tr>
<td>ECU</td>
<td>Electronic Control Unit</td>
</tr>
<tr>
<td>JED</td>
<td>WABCO Standards</td>
</tr>
<tr>
<td>MCPV</td>
<td>Multi Circuit Protection Valve</td>
</tr>
<tr>
<td>MK2</td>
<td>Name for compressor control method</td>
</tr>
<tr>
<td>PR</td>
<td>Compressor Power Reduction System</td>
</tr>
</tbody>
</table>

2  General Information

Copyright and trademark notice

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Any brand names, even if not indicated as such, are subject to the rules of the trademark and labelling rights.

Symbols used

Important instructions, information, or tips that you should always observe.

Reference to information on the Internet

List
General Information

Technical documents

- Open the WABCO INFORM Online Product Catalogue:
  [http://inform.wabco-auto.com](http://inform.wabco-auto.com)
- Search for documents by entering the document number.

The WABCO online product catalogue INFORM provides you with convenient access to the complete technical documentation.

All documents are available in PDF format. Please contact your WABCO partner for printed versions.

Please note that the publications are not always available in all language versions.

<table>
<thead>
<tr>
<th>DOCUMENT TITLE</th>
<th>DOCUMENT NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Processing Units – Application Guideline</td>
<td>815 XX0 224 3</td>
</tr>
</tbody>
</table>

*Language code XX: 01 = English, 02 = German, 03 = French, 04 = Spanish, 05 = Italian, 06 = Dutch, 07 = Swedish, 08 = Russian, 09 = Polish, 10 = Croatian, 11 = Romanian, 12 = Hungarian, 13 = Portuguese (Portugal), 14 = Turkish, 15 = Czech, 16 = Chinese, 17 = Korean, 18 = Japanese, 19 = Hebrew, 20 = Greek, 21 = Arabic, 24 = Danish, 25 = Lithuanian, 26 = Norwegian, 27 = Slovenian, 28 = Finnish, 29 = Estonian, 30 = Latvian, 31 = Bulgarian, 32 = Slovakian, 34 = Portuguese (Brazil), 35 = Macedonian, 36 = Albanian, 97 = German/English, 98 = multilingual, 99 = non-verbal

Structure of the WABCO product number

WABCO product numbers consist of 10 digits.

- Production date
- Type of device
- Variant
- Status digit

0 = New device (complete device)
1 = New device (subassembly)
2 = Repair kit or subassembly
4 = Component part
7 = Replacement device

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Exhaustive end-of-line tests
Quality standards < 50 PPM

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- 24-month product warranty
- Overnight delivery
- Technical support from WABCO
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- Access to diagnostics tools and support from the WABCO Service Partner network
- Straightforward claims handling
- Plus, of course, the confidence that the Original Equipment Manufacturers’ rigorous quality standards are met.

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Contact us if you need assistance:
- Find the right product
- Diagnosis support
- Training
- System support
- Order management

You can find your WABCO partner here:
3 Introduction

3.1 Scope

This document provides guidelines to install Air Processing Units in Commercial Vehicles (to serve the air brake system) with focus on
- installation conditions,
- drying performance,
- compressor control,
- oil and carbon products from the compressor,
- fixation,
- piping installation,
- exhaust noise.

The Multi Circuit Protection Valve (MCPV) is not included in this guideline.

The permissible operating conditions are defined in the technical data shown in the outline drawings and product specifications. They are subject to the recommendations for installation instructions given below. Any deviations require WABCO’s approval.

It is recommended to perform an application approval together with WABCO.

Outline drawings
For product specifications please contact your WABCO partner. Outline drawings are available via WABCO product catalogue INFORM: http://inform.wabco-auto.com

3.2 Nomenclature

Figure 1: Nomenclature

* instead of MCPV (Multi Circuit Protection Valve) other circuit protection means may be used
3.3 Model types (unit)

Mechanical Air Dryer
- Compressor control: without or with governor
- Regeneration: with port for purge tank or with integrated purge tank or with system regeneration via valve or with two desiccant cartridges

Electrically Controlled Air Dryer
- Compressor control: with solenoid
- Regeneration: with system regeneration via solenoid (ECAD) or with integrated purge tank

APU
- Multi Circuit Protection Valve (MCPV) combined with Mechanical Air Dryer (M-APU) or Electrically Controlled Air Dryer (E-APU)

FuelGuard™ (E-APU)
- Electronically controlled APU with ECU and integrated pressure sensors
- Optionally with two desiccant cartridges

3.4 Compressor unloading methods

Line Unloading
In off-load mode the compressor is unloaded by the purge valve of the air dryer. The compressor pumps through the discharge line and air dryer exhaust to atmosphere.

Head Unloading (PR) / Clutch
In off-load mode the compressor is unloaded by mechanisms integrated in the cylinder head or by the clutch, both actuated via the control line. If there is some residual air flow from the compressor, it is vented to atmosphere via the purge valve, which opens at the same time.

Head Unloading / Clutch with turbo-charged compressors
In off-load mode the compressor is unloaded by mechanisms integrated in the cylinder head or by the clutch, both actuated via the control line. At the same time the inlet of the air dryer is closed via a turbo-cut-off valve. No air is vented to atmosphere.

MK2 control (head unloader / clutch)
In off-load mode the compressor is unloaded by mechanisms integrated in the cylinder head or by the clutch, both actuated via the control line. As the purge valve usually is not actuated at the same time, the exhaust of the air dryer is kept closed. No air is vented to atmosphere.

MK2 allows optimum fuel savings via electronic control. In off-load mode the discharge line is kept pressurized (not vented to atmosphere) so that during overrun phases the compressor pumps directly into the reservoirs after cut-in, without filling the discharge line first of all.
4 Installation (unit)

Storage before assembly
See JED-855 for storage periods and conditions.

Application temperature
See outline drawing and product specification.

Maximum operation temperature
See outline drawing and product specification.
If not otherwise stated, the maximum operating temperature is limited to max. 10% of the runtime and above the maximum application temperature the drying performance is generally reduced.

Painting time/temperature
- See outline drawing and product specification.
- If not otherwise stated, it is 1h/110°C without pressure and current.

Mounting location
- Frame mounting due to vibration constraints.
- Away from direct wheel splash to avoid impact of road debris/gravel, excessive corrosion or malfunction due to mud or icing.
For proper drying performance:
- Surrounding temperature must not be above ambient temperature.
- Exposed to / cooled by air draught.
- Away from heat sources.

Mounting orientation
According to outline drawing for proper drainage and breathing of internal chambers.

Bracket
Must be sufficiently robust to withstand vibrations; Finite Element calculation and/or tests recommended.

Material of mounting interface (for example screws)
Must comply with unit housing material with respect to contact corrosion.

Screw joint
Calculated (in accordance with VDI 2230, for example) to have sufficient strength.

Space to disassemble cartridge
Available according to outline drawing.
Breathers/exhaust

Must not be obstructed (no paint coating, undersealant, tape etc.) to avoid malfunction due to incorrect pressure in the internal chambers.

Silencer (exhaust line) assembly

Only use silencers that are suitable for air dryers. An incorrect silencer may be too loud or may detach itself or can be clogged by oil products. A wrong fitting/hose may detach itself or can burst.

No noise deflection.

Channelling the exhaust noise laterally away from the vehicle can lead to higher than permitted noise levels (according to regulations or customer requirements).

Purge impurity

Not visible.

Water together with some oil is sprayed out of the purge valve. Devices/parts hit by the spray may look dirty and can become slippery or contaminated.

Service of desiccant cartridge

See outline drawing and product specification (of unit and/or desiccant cartridge) for proper drying performance over the entire service life.

5 Compressor

Head unloader/clutch

Required in combination with an electrically controlled air dryer.

Maximum admissible number of actuations

Compatible with compressor control (software).

If the head unloader or clutch is actuated very frequently (due to software control, for example), this might reduce the service life of the head unloader/clutch. In this case a different compressor should be chosen, or the compressor needs to be replaced from time to time.

MK2 compatibility

Required in the case of MK2 control (purge valve is closed during off-load).

A pressurized discharge line can affect the performance of compressor, head unloader or clutch in off-load mode and during cut-in.

If the compressor, head unloader or clutch is not compatible, use a combined unloader or an adapted software.

Turbocharging

If the compressor is turbocharged, unit must be equipped with turbo-cut-off valve.
Discharge line

Turbo-cut-off valve

If a turbo-cut-off valve is installed, the compressor must be compatible. The turbo-cut-off valve closes the inlet of the air dryer in off-load. This can affect the performance of compressor, head unloader or clutch in off-load mode and during cut-in.

Lubrication

See outline drawing, product specification and installation/application guideline of compressor.

Max. 3% fuel dilution of the oil is permitted. Fuel dilution leads to increased oil carry-over which can affect the compressed air system.

6 Discharge line

Design

- See outline drawing, product specification and installation/application guideline of compressor.
- No water traps (loops, sumps or low points) close to unit (the line must be routed strictly in downward direction if pipe wall temperatures are lower than the ambient temperature plus 50°C during a normal duty cycle).

Water pockets (sumps) collect water. If this water freezes (over night, for example), the line is blocked, see also figure 2. When the air dryer is at the same level or higher than the compressor, the discharge line must be conducted upwards immediately from the compressor output to a level beyond which the remaining discharge line can descend all the way down to the air dryer.

Figure 2: Temperature conditions to be observed for the discharge line

At normal operation conditions, the inlet temperature of the air dryer/APU \( T_{\text{in}} \) should be on average 25°C*** above the ambient temperature \( T_{\text{am}} \). This avoids freeze up of the discharge line and provides optimum drying performance.

* measured in the air system
*** figure depends on system pressure (see below)

The discharge line has to be descending and have no „water traps“ - at least from a point, at which the temperature of the discharge line \( T_{\text{desc}} \) on average and at normal operation conditions is 50°C above the ambient temperature \( T_{\text{am}} \).

So the line does not freeze up during a cold night after a warm and humid day (+30°C).

** measured on the (metal-)pipe
No devices such as an oil separator or ping tank must be installed within the discharge line. If such devices are used, WABCO’s approval is required.

Devices in the discharge line may affect the compressor control and regeneration. They can increase the volume and amount of air purged for regeneration, which increases fuel consumption and has an impact on the drying performance. An oil separator is not recommended, because normally the dryer is able to cope with the particulate material coming from the compressor.

Fixation

Avoid rattling, vibration and cold bridges.

The pipe has to be fixed firmly, but also thermally isolated from the frame and other supports. Cold bridges (like bulkhead fittings through frame) create locally low wall temperatures. In winter this can lead to local ice formation and blocking.

Total volume (including compressor, air dryer and devices in discharge line)

As small as possible.

The greater the volume the more air is purged for regeneration, which increases fuel consumption and has an impact on the drying performance.

Pressure peaks in discharge line

As small as possible.

See also outline drawing, product specification and installation/application guideline of compressor.

Pressure peaks in the discharge line are natural since the compressor does not pump continuously but in cycles. Pressure peaks higher than natural are dynamic pressure effects due to the design of the discharge line (with its length, volume and restrictions). Pressure peaks can stress the compressor and/or air dryer and increase fuel consumption. If a safety valve is also connected, it can open early.

Oil content in air

As small as possible. WABCO recommends that vehicle tests are carried out to check compatibility.

Oil and oil-related products coming from the compressor are carried along with the air stream. A portion of these substances covers the desiccant material, which reduces the drying efficiency.

Oil passing the unit can also affect system components like brake valves. It is recommended to use Air System Protector or Air System Protector PLUS cartridges to minimize the oil passing the unit.

Particle size

≤ 0.1 mm for proper tightness of the purge valve.

WABCO purge valves are very robust against particles which are even larger. Due to the vertical orientation there is little likelihood of particles accumulating or the valve seat capturing large particles (both of which cause leakages during pumping).
Leakages lead to longer compressor duty cycles and higher fuel consumption. In the worst case, the leakage is so great that the compressor is not able to fill the system properly.

**Substances**

Not harmful.

Oil-related substances can harm rubber components in valves (resulting in swelling, damage and leakage) and can affect the lubrication/friction of the devices in the system.

### 7 Unit inlet temperatures (°C)

**At normal duty cycle**

The optimum is 25°C - 30°C above ambient temperature (see figure 2, on page 9).

Compressing of air and subsequent cooling leads to condensation of water. The lower the inlet temperature the more water condenses before it reaches the air dryer. This improves the drying performance since the air dryer has to process less water.

During winter, however, there is the risk of freezing. In order to avoid this the air dryer inlet temperature should be at least 25°C - 30°C above ambient temperature during normal compressor duty cycles. The exact (theoretical) figure depends on the system pressure level:

<table>
<thead>
<tr>
<th>System pressure [bar]</th>
<th>8.5</th>
<th>10</th>
<th>12</th>
<th>15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature difference to ambient air [°C]</td>
<td>25</td>
<td>26.5</td>
<td>28</td>
<td>30</td>
</tr>
</tbody>
</table>

With such a temperature difference no water will condensate, or if water does condensate, the inlet temperature is above 0°C where no freezing takes place.

In practice this condition is not always achievable. A tolerance of ±5°C is acceptable. If the inlet temperature is permanently higher, the drying performance is degraded. This can be offset by more air for regeneration. If the inlet temperature is permanently lower, there is a risk of freezing, but only in case the ambient relative humidity is 100%. If an ice film forms on the inner wall, the heat transfer is changed (reduced) and the air no longer cools down to the same extent. The formation of ice will be stopped. A thin ice film is not a problem if the discharge line has an appropriate inner diameter.

If the compressor creates a carbon coating on the inner wall, the heat transfer is also affected (as it is the case with an ice film). In this case the inlet temperature target can be slightly lower than mentioned above with a new discharge line.

With some types of oil and low inlet temperatures, emulsion in the inlet of the air dryer may be observed. This phenomenon normally disappears when the inlet temperature is increased.

**When filling up the system**

≤110°C to avoid (pre-)damage of air dryer components when pumping up a (cold) vehicle based on ECE-R13 Appendix 7, A.2. with the engine at full speed and the reservoirs for the auxiliary equipment not isolated.
8 MCPV

Regeneration backflow

Must be provided for system regeneration.

In order to determine the correct settings for a wide range of applications, conventional air dryers (with regeneration valve) should ideally have a backflow from all the reservoirs that the compressor fills (reservoirs with a lower pressure level can be ignored).

For a correct diagnosis, electronic control units must know which reservoirs do not have a backflow.

Inner Diameter

≥ 11 mm. A flow restriction in the MCPV increases the back pressure for the compressor, which stresses the compressor and increases fuel consumption. It can also affect the function of the mechanical governor and can impact the system regeneration.

9 Wiring harness

Plugs, contacts and contact materials

According to supplier specifications and product specification of the unit.

Wire cross-section

Compatible with current.

Cables

Connection cables compatible with heater or solenoid are available at WABCO, see Product Informations Air Dryer (Single Cannister) 432 4XX XXX 0 or Product Informations Air Dryer (Twin Cannister) 432 4XX XXX 0.

Cable installation

According to supplier specification.

If no supplier specification is available, the WABCO installation instructions for cables 449 000 000 0 may be applied, available via WABCO product catalogue INFORM: http://inform.wabco-auto.com

WABCO does not take responsibility for the correctness of the instructions.

Gauge pressure sensor breathing

According to product specification of the unit.

As a gauge pressure cell measures pressure relative to atmosphere, there must be a connection to atmosphere. In many cases this is implemented via the cable.
10 Piping

Installation

- No sharp bends to avoid flow restrictions.
- No constriction by fasteners to avoid flow restrictions.
- Away from heat sources
  
  When Polyamid pipes are heated, plasticizer (BBSA) is evaporated into the compressed air. This can affect the valves, causing swelling of rubber components, for example.

Volume control line PR

\[ \leq 50 \text{cm}^3 \] including the compressor volume - to avoid malfunction of the integrated mechanical governor.

Leakage control line PR

\[ \leq 8 \text{cm}^3/\text{min} \] to avoid malfunction of the integrated mechanical governor.

Stand-alone governor

Connect directly to the control port of the unit.

Purge tank

Port is located at the bottom so that any water is drained.

Check valves

- With system regeneration no check valves must be installed between the unit and the reservoirs.
  
  See chapter "8 MCPV", page 12.

- No check valves must be installed between the unit with integrated governor and the first reservoirs that communicate the system pressure to the governor and supply the compressor control line.

No consumers

No consuming valves or other devices must be installed between (or connected to the line between) the unit and the reservoirs which affect the communication.

If air is drawn from the line to the reservoir, a dynamic pressure drop develops in the line. This can affect the operation of the mechanical governor (such as frequent or poor switching).

For example, if ECAS or other systems have no dedicated reservoir, they draw the air from other reservoirs when filling the cylinders/bellows. If these cylinders/bellows are quite large and the nominal width of the valves filling them is also large, a high flow rate is generated from the reservoirs to the cylinder/bellows. This will cause a pressure drop in the line. If the unit is connected to this line, the pressure drop is „visible“ also for the mechanical governor and can affect it.

If the pressure sensor is connected to such a line, the electronic control can be affected as well.
Fittings

No elbow/banjo fittings to avoid flow restrictions. Use of such fittings will increase the back pressure for the compressor, which strains the compressor and increases fuel consumption. The way air is shared between the circuits can also be affected.

Fitting material

Must comply with housing material with respect to contact corrosion.

11 Inner diameter

Choose inner diameters according to the table below to prevent flow restrictions and provide proper flow passage.

<table>
<thead>
<tr>
<th></th>
<th>Pipes [mm]</th>
<th>Fittings [mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>to purge tank</td>
<td>≥4</td>
<td>≥3</td>
</tr>
<tr>
<td>control line PR</td>
<td>≥4</td>
<td>≥3</td>
</tr>
<tr>
<td>exhaust air dryer</td>
<td>≥18</td>
<td>≥17</td>
</tr>
<tr>
<td>outlet air dryer</td>
<td>≥12</td>
<td>≥11</td>
</tr>
<tr>
<td>outlet ports MCPV</td>
<td>≥9</td>
<td>≥8</td>
</tr>
</tbody>
</table>

Flow restrictions

- Flow restrictions in the air dryer exhaust have an impact on the drying performance.
- Flow restrictions at the air dryer outlets and the MCPV increase the back pressure for the compressor, which strains the compressor and increases fuel consumption.

12 Pressures (bar)

Drop at air dryer outlet directly after Cut-Out

The pressure drop should be ≤ 0.05 bar to avoid malfunction of the mechanical governor and to minimize the impact on the system regeneration.

In critical applications (high compressor flow rate and/or long pipes to the reservoirs) it might be necessary to use pipes with larger than recommended inner diameters, see chapter "11 Inner diameter", page 14.

Pressure drop due to consumers

≤0.5 bar

See "No consumers", page 13.

Static pressure in control line during off-load

Must be compatible with the compressor requirements for the signal characteristics.
Drying performance

This must be observed for proper operation and a long service life of the compressor’s head unloader (or clutch). With a mechanical governor, this has to be checked at different engine/consumption speeds.

Residual pressure in control line during on-load mode

Must be compatible with the compressor requirements for the signal characteristics.

This must be observed for proper operation and a long service life of the compressor’s head unloader (or clutch). With a mechanical governor, this has to be checked at different engine/consumption speeds.

In air dryer during regeneration at average compressor speed

The pressure needs to be as low as possible.

During regeneration the back pressure in the cartridge has an impact on the drying performance.

13 Durations

Average duty cycle (%)

Should not impact regeneration.

The duty cycle is an important parameter for the layout of the regeneration. It is a factor in determining the amount of air that passes through the desiccant cartridge per cycle. It should be measured during normal vehicle operation.

Signal speed in control line during cut-out and cut-in

Must be compatible with the compressor requirements for the signal characteristics.

This must be observed for proper operation and a long service life of the compressor’s head unloader (or clutch). With a mechanical governor, this has to be checked at different engine/consumption speeds.

14 Drying performance

Average amount of air pumped per cycle

Must be compatible with the desiccant cartridge requirements (≤ 750 dm³ free air for WABCO spin-on cartridges) within the limits of the water adsorption capacity of the desiccant cartridge.

Maximum amount of air pumped per cycle w/o regeneration

Must be compatible with the desiccant cartridge requirements one-time (≤ 3000 dm³ free air for WABCO spin-on cartridges) within the limits of the water adsorption capacity of the desiccant cartridge.
Drying performance

Dewpoint depression (DPD)

20°C - 30°C for proper protection against water condensing in the system (including some margin for degradation over the service life).

The drying performance is controlled by the regeneration. For mechanical air dryers the regeneration parameters (size of purge tank or size regeneration orifice or setting (delta_p) of the regeneration valve) have to be adjusted to the application.

It is recommended to consult WABCO on determining the parameters (done by calculation based on a questionnaire).
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