INTERNATIONAL

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m+p ACON

Carbon Canister Preconditioning and Testing

- **Automated Canister Preconditioning according to EPA, CARB, Chinese and EU Regulations**
- **Working Capacity**
- **Stabilization, Aging**
- **Options**
  - ORVR Simulation
  - Gasoline Working Capacity (GWC)
  - Flow Resistance
  - Sealing Performance

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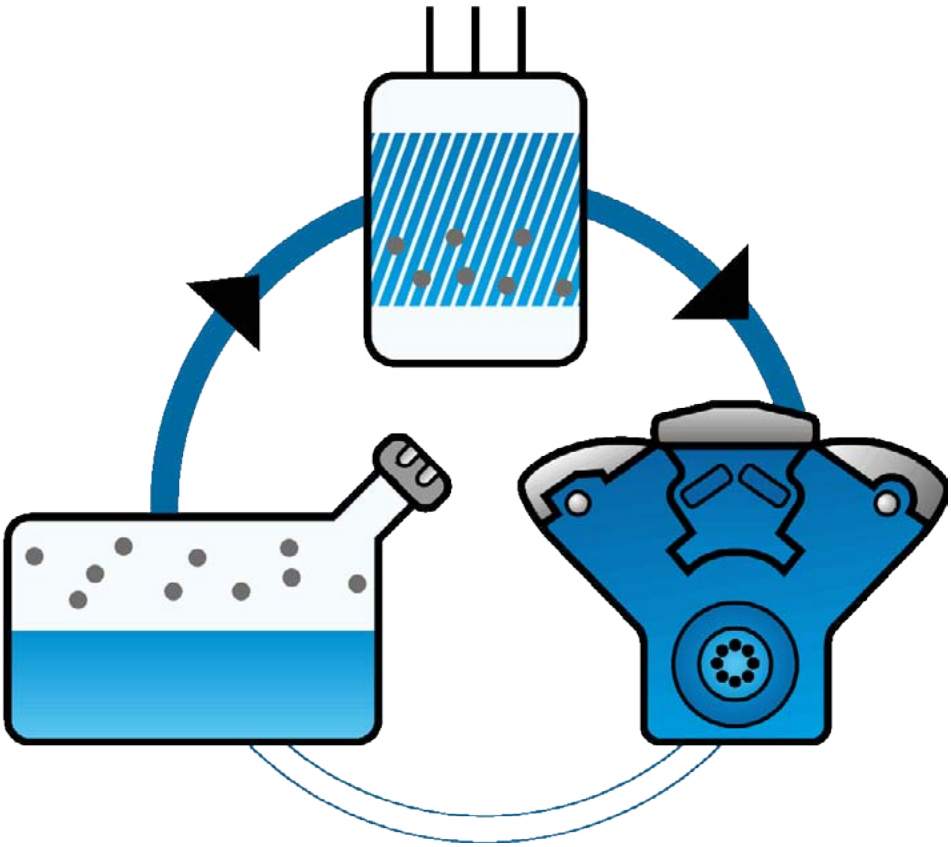


Introduction

A radical change has taking place in the last years in public opinion about the emissions from mobile sources. Driven by the warnings of scientists about the effects of global warming on climate changes many highly industrialized nations try to reduce the emissions of carbon dioxide which is the main reason for the global warming. Carbon dioxide is formed by burning fossil fuels in motor vehicles, heating systems and industrial processes.

Before this the emission reduction of noxious gases from vehicles was the main topic. But these emissions are still a major concern and the summer smog in the growing megacities is a big problem for the population in these areas.

Motor vehicles exhibit two major emission sources. The first are the tailpipe emissions. These gases are cleaned by catalytic converters and precise electronic motor management.

Global warming – summer smog (Quelle:„LosAngelesSmog“ von Massimo Catarinella - Wikipedia)

The other and not so obvious source is the evaporation of gasoline (hydrocarbons) from the tank and the intake of the engine. It is estimated, that a car loses about 20 g of gasoline per day when no evaporation reduction system is installed. Together with the losses of gasoline vapour during refuelling, this adds up to a huge amount of volatile organic compound (VOC) in the air.

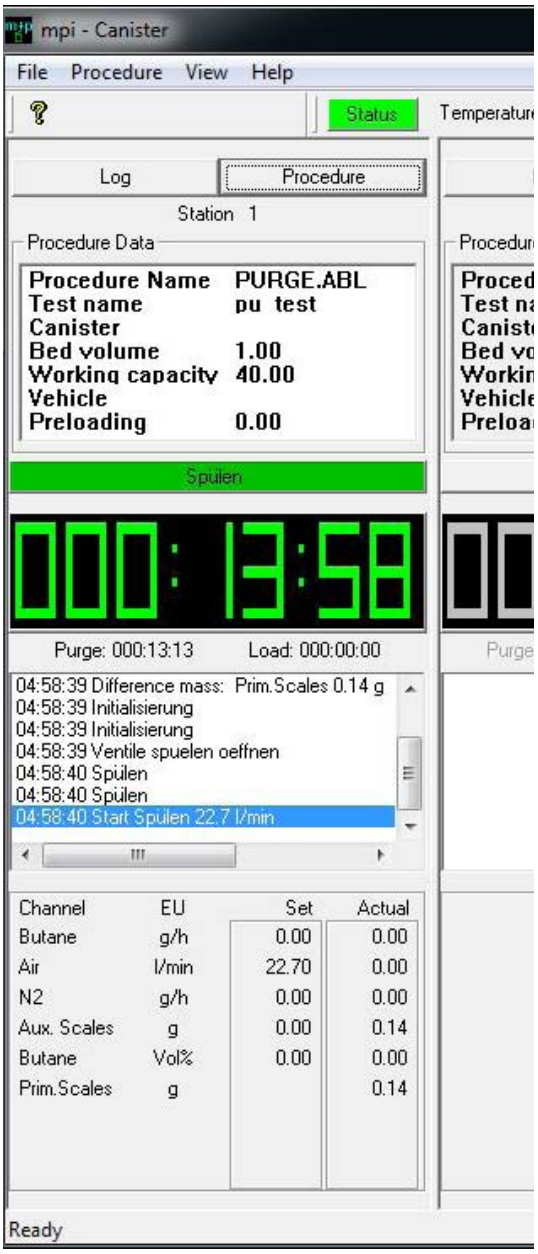
The critical factor is that these hydrocarbons together with sunlight and nitrogen oxide form the photochemical or summer smog with high concentrations of ozone other noxious substances.

The only way to prevent summer smog is to reduce the amount of hydrocarbons emitted into the atmosphere drastically. Today this is done in nearly all countries and the aim over the coming years is to reduce the amount emitted from vehicles to nearly zero, which requires a lot of technical expertise, regulations and testing procedures.

Different Carbon Canisters (Picture: Delphi)

The most important part for the reduction is the carbon canister which is a box of about 2 liters volume filled with specially prepared pellets of activated charcoal. This box is connected to the pressure relief outlet of the fuel tank and adsorbs all the fuel vapour escaping from the tank. The huge surface area of the charcoal adsorbs hydrocarbons.

Canister Preconditioning with m+p ACON under Windows™



Carbon canisters reduce the evaporative emissions of gasoline from the car's fuel tank. The strict EVAP tests measure the emitted amount of hydrocarbons during different typical situations: several drive cycles (running loss), parking with hot engine (hot soak), the three-day parking situation (diurnal) and only in some countries the refueling (ORVR). Environmental protection, especially the reduction of summer smog caused by traffic, requires stringent HC emission reductions. The carbon canister plays a key role for these reductions due to its ability to adsorb and desorb considerable quantities of gasoline vapour.

m+p international`s ACON system automatically preconditions vehicle canisters according to CARB, EPA, Chinese and EU regulations. It controls and monitors the preconditioning procedure, records the results and displays the current state on-line on the monitor. With m+p ACON, canisters are reliably prepared for the subsequent hydrocarbon emission measurements in the SHED chamber, saving time and manpower at the same time.

m+p ACON runs on an industrial or desktop PC under the Windows 10™ operating system. The clearly arranged user interface using Windows standard makes operation easy and convenient.

Main Features

Easy Operation

m+p ACON has a Windows 10™ user interface guaranteeing easy, reliable and quick operation.

Compact Hardware

The m+p ACON preconditioning system is modular by design. A 19“ rack of 34 HU (2040 mm) contains most of the electronics and houses the mass flow controllers, the gas leading parts and the two scales.

Automatic Operation

m+p ACON controls the complete preconditioning procedure, displays the current state of the station, monitors the limit values and stores the data.

User-Definable Tests (Option)

The user specifies his own test procedures in a convenient way in addition to the integrated standard test procedures.

Preconditioning in the Vehicle

The canisters can either be removed from the vehicle or stay inside during the preconditioning procedure.

Purging

The purge air is sucked through the canister, controlled by a digital high-precision Brooks MFC in a special low-pressure drop configuration.

Gas Mixture Based on Mass Flows

The canisters are purged and loaded as per EPA/CARB/China/EU regulations. The gas mixture composed of nitrogen and butane is formed by means of two digital high-precision Brooks mass flow controllers.

Breakthrough Operation

An auxiliary canister which is placed on an electronic Sartorius scale (6 kg/0.01g) is used for loading to breakthrough. The scale is computer-controlled.

Second Scale for Test Canister

A second Sartorius scale (6 kg/0.01 g) is delivered for the test canister.

Working Capacity

The working capacity is determined by integrating the mass flow.

Stabilization

The vehicle canisters are stabilized computer-controlled. Realistic capacities can only be measured after several cycles.

Aging

Canisters have to prove their capacity during continuous loading/purging of up 150 or more cycles.

Self-Test

A self-test software checks the communication between parts of the station continuously and displays the result.

Protocol Generation

After preconditioning an automated protocol is generated for the necessary documentation.

Customizable Test Logs

The user can change the layout of all test logs according to his requirements.

Analysis

Export to XML files for analysis and graphical presentation.

Special Tests and Signals (Options)

Also leak check and differential pressure tests are possible.

Additional analog and digital inputs and outputs can be added.

Options:

Gasoline Vapour Loading (GWC)

Fuel vapour generation of up to 100 g/h,

ORVR Simulation

Up to 3600 g/h of butane with 50 vol.% of nitrogen.

m+p ACON Modular Hardware

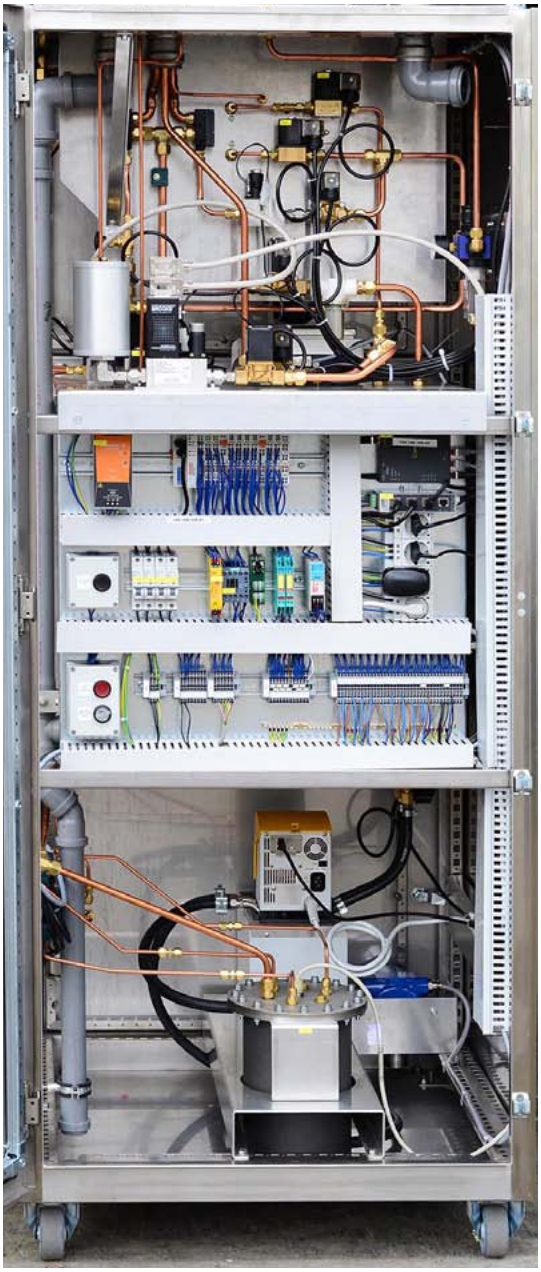
State-of-the-Art Hardware for Highest Requirements

The figures show the front and back of the 19“ rack as an example. The power supply for the valves and the mass flow controllers are located at top, the monitor and the PC next to the rack.

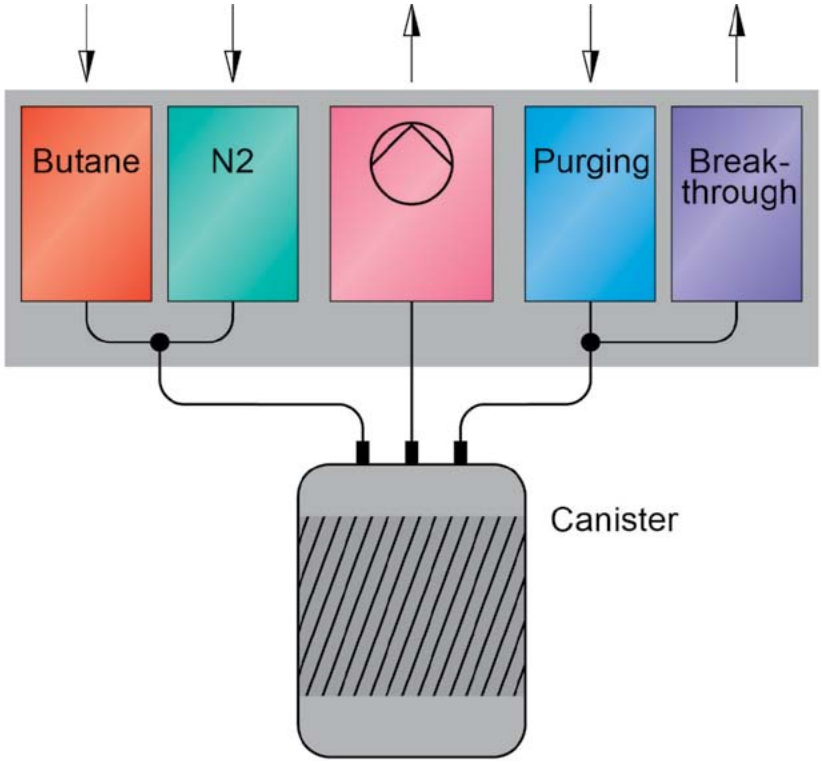
The lower part of the rack provides space for GWC part of the station.

Mass flow controllers, scales and Beckhoff fieldbus system communicate with the computer via LAN interfaces.

m+p ACON station front view



m+p ACON station rear view



The figure above illustrates the gas paths of the m+p ACON purging and loading station. The canister which may stay inside the vehicle is connected via hoses to the station.

Most preconditioning methods require that the canister is purged with ambient air first. The volume flow is typical at 22.7 l/min or 25 l/min.

The purge air volume flow is sucked through the canister as it is also done during vehicle operation. A pump operated by compressed air generates the flow, a mass flow controller is used for control. A special design ensures a low-pressure drop.

After the purge process the canister is loaded with a mixture of butane and nitrogen.

Depending on the regulations, m+p ACON will automatically stop the flow of butane and nitrogen to the canister, when the total flow of butane is greater than 1.5 times the capacity of the vehicle canister or when the canister is loaded to breakthrough.

In breakthrough mode an auxiliary canister which is placed on an electronic scale is connected to the vehicle canister to collect the butane vapour not absorbed.

As soon as the auxiliary canister gains 2 g, the load process will be terminated. The auxiliary canister will also be purged automatically.

m+p ACON Gas Preparation

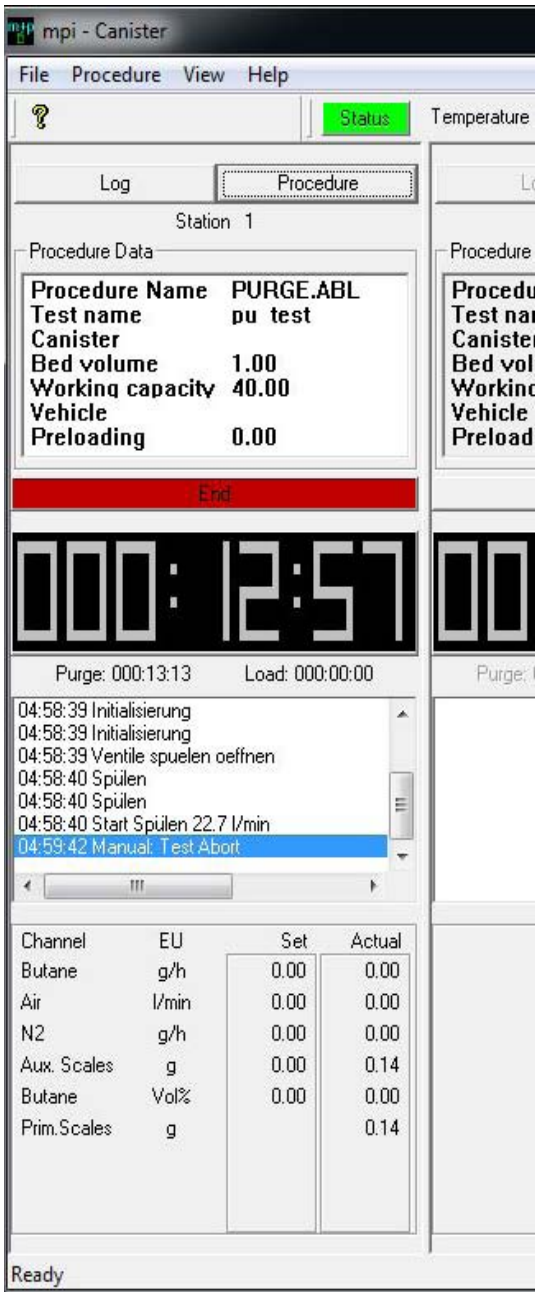
High-Quality Gas Preparation

The figure illustrates the purging and loading station. Copper piping with brass fittings or optional stainless steel piping with high-precision fittings are used.

An extraction system on building side draws out air continuously from the cabinet.

m+p ACON Software

Convenient State-of-the-Art Tools



- Display of the ambient conditions
- Pulldown menu restricted to those functions which are used only from time to time

Every purging and loading station has its own window for operation, input and display. You will enter the canister parameters in the upper part of the window. The current state of operation (e.g. „Purging“ or „Ready“) is displaced on a coloured bar.

In the middle of the window, you will find the purge and load times as well as the remaining time till the end of the preconditioning sequence (in large digits).

All events, results as well as warning and errormessages are written into a test log file. The current test log entries are displayed below the remaining time during the preconditioning process. Afterwards you can read and print the complete test log.

The lower part of the window contains the nominal and actual values of the mass flow controllers, the gas weight indicated by the scales and the portion of the butane by volume in the load flow.

Specifications

19“ Rack

(h x w x d: up to 2040 x 800 x 800 mm)
Can be equipped with up to four purging and loading stations.

Modular Purging and Loading Stations

Stable 19“ aluminium module for complete gas measurement and breakthrough determination.

Copper Piping

with precision brass fittings.

Optional Stainless Steel

Piping with stainless steel precision gas fittings.

Connections

Butane: 150 g/h
Nitrogen: 80 g/h
Compressed air: 6 bar
(free from oil and water)
Air extraction: min. 200 l/min.

Power Supply

230 V, 50 Hz, ca. 800 W.

Industrial or Desktop PC

Integrated or external.

High-Precision Mass Flow Controllers

Brooks MFC’s with bus interface.
Precision: ± 0.7% of the measuring value, ± 0.2% of the limit value of the measuring range.

Continuous Display

and limit check of the mass flows.

Prepared Test Procedures

enable preconditioning according to CARB, EPA/China and EU.

Breakthrough Determination

Electronic scales (Sartorius) with auxiliary canister for breakthrough determination.

Purge Air Volume Flow

22.7 l/min (or 25 l/min), option for up to 60 l/min.

Purge Air Preconditioning

Control of humidity and temperature (option).

Software Functions

Input, display and management of the parameters. Monitor displays up to four purging and loading stations in parallel. Display of the state of each station, purge and load times and the time remaining till the end of the preconditioning sequence (in large size). Recording of the test states, customizable test logs, data storage and filing.

Password Protection

Normal operation, test procedure editing (option) and system operator.

Operating System

Windows 10™.

Analysis

Export to XML files for convenient analysis and graphical presentation.

Options

Gasoline Vapour Loading

Gasoline Working Capacity (GWC).

ORVR Simulation

Up to 3600 g/h butane + 50 vol.% N2

Flow Resistance Measurement

according to different specs.

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