

# CVS-R03

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## CVS - R03

The CVS equipment has been engineered to perform emissions test from internal combustion engines, according to the latest requirements of all official International Emissions Regulations.



According to the CVS principle, during the test the whole exhaust flow of the engine is diluted with ambient air, in order to avoid water condensation and to freeze chemical reactions among the gases' components.

The total mixed stream is then metered by PDP (positive displacement pump) that maintain a constant volume flow rate and allows to vary the flow rate for obtaining the more suitable dilution factor for the tested vehicle.

A simultaneous sampling is performed by a constant flow pump that routes the gas to a sampling bag for analysis after the test.

Similar amount of dilution air is simultaneously collected in another bag thus allowing the evaluation of the background emissions that have to be deducted from the masses calculated in the diluted flow.

The system is equipped with 3 couples of bags so the test can be divided up to 3 parts.

As the final assessment is based on the volumetric concentration measurement of regulated compounds in a diluted exhaust stream, significant efforts have been aimed to two basic directions:

- Increase the concentration of measured components,
- Increase the accuracy and reliability of volume determination.

In order to comply with these tasks CVS-R03 is equipped with a variable speed pumping system (PDP) with fast pressure and temperature sensors at pump inlet. In this way it is possible to set the better dilution factor for the test and to get a real time control of the constant diluted flow.

### CVS basic unit

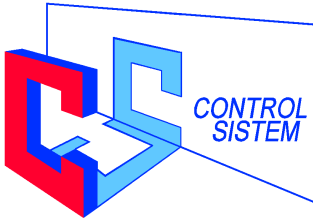


This part of the equipment is assembled in a compact cabinet with doors and removable panels and is housing the PDP pump, the cyclonic separator and the heat exchanger.

The required flow is automatically selected in a continuous range using a variable speed driver for the motor of PDP pump allowing a precise adjustment over the requirements of dilution for the specific engine type and size.

The flow control unit is provided with high accuracy absolute pressure and temperature transducers that exceed the requirements of European and US regulations for the emission equipment.

The wiring cabinet is equipped with a I/O system using a WAGO micro PLC with Ethernet connection to the control PC of the system.



Upstream the PDP pump section, 2 efficient heat exchangers are provided, with the task to maintain the temperature of the diluted flow in front of the pump in a very narrow temperature range.

A regulation routine in the standard software package takes care of the complete management of the warming function of the Sampling Unit and of the relevant alarms' detection.

Typical temperature regulation accuracy is +/- 2°C around the recommended set point of 40°C.

Constant flow gas sampling for the Bags filling function is provided through pumps and a flow rate controllers.

All internal piping and the components in contact with the diluted exhaust stream are manufactured in AISI 316 Stainless Steel; Teflon hoses are used with Stainless Steel high quality fittings.

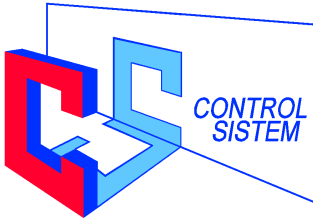
### **Bags sampler.**

In a single unit are collected all the sampling provisions for bags filling and the bags themselves, which are therefore well protected against mechanical damage.

The flow routing for the different functions is managed by a sampling module with modular manifold and distribution valves.

The exclusive design of the unit is engineered as a modular assembly, incorporating the shutters





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body, the pilot valves auxiliary blocks, the bags vacuum switches and also the housing for the complete electronic section, with the power drivers for the valves.

The manifold is designed to handle up to 8 fully independent sampling bags, 4 for diluted gas and 4 for dilution air.

The following pumps are assembled in the “service” section of the cabinet and provide for the activation of the flows:

- Dilution air: diaphragm sampling pump, flow rate 25 lpm,
- Diluted gas: diaphragm sampling pump, flow rate 25 lpm,
- Bags evacuation: rotary vane vacuum pump, flow rate 100 lpm,
- Bags purge line: diaphragm pump, flow rate 40 lpm.

The Tedlar Bags are suspended to independent rails inside a dedicated section of the cabinet, and provided with pressure sensors that allow to determine when the bags are full or empty.

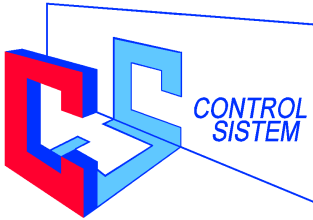
Programmable timers are also active in the control software as additional safety measure against bags overfilling.

### **Computer Control System.**

The control computer of the system is installed in the Bag Sampler unit and is engineered over a distributed I/O concept, based on a standard Ethernet network with dedicated nodes in any single piece of equipment of the complete equipment.

A standard Ethernet TCP/IP port is used on the Control PC and a Ethernet multiport switch is used to connect the connect the different WAGO I/O system of each CVS component.

Each I/O system is equipped with analog and digital I/O board to fully control the CVS equipment.



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The data acquisition section of the CVS PC Controller is managing a wide range of signals and control processes, which include:

- Absolute pressure at pump inlet
- Flow temperature at pump inlet
- Rotational speed of the PDP
- Real time flow rate calculation
- Water temperature in the conditioning circuit
- Regulation routine for the heat exchanger
- Bags vacuum signals
- Bags overfill signals
- Dilution air temperature
- Diluted gas temperature at sampling point

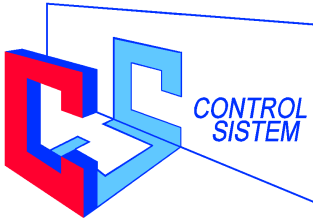
The software on the control PC is developed using Control Sistem standard INT900 system and is written in accordance to the US and European regulations and can indicate to the operator all the non conformities of the system to these regulations.

The acquired measures are visualized in real time and saved in a LOG file by the system are the followings:

The main function of the software are:

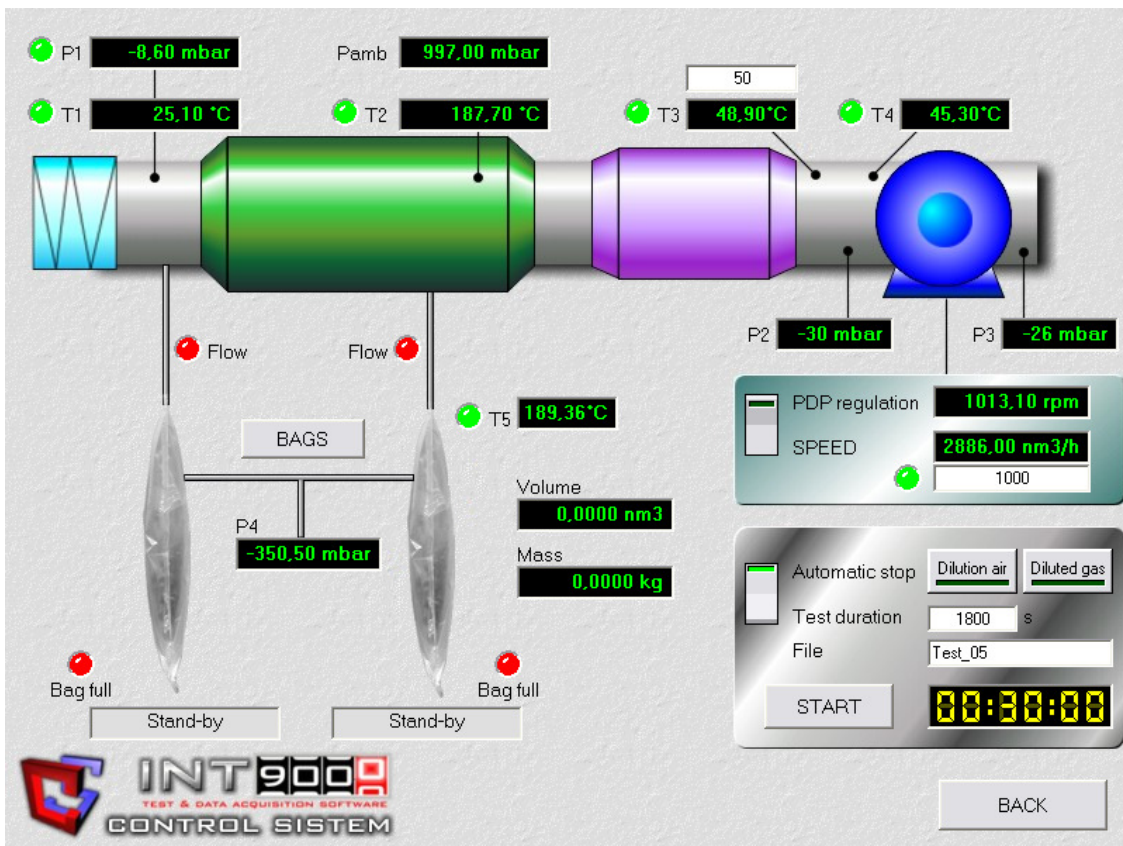
- monitoring the status of the system;
- visualization and logging of all alarms and warnings;
- selection of the working parameters of the system;
- regulation of the heat exchangers;
- regulation of the PDP;
- calculation and saving of the real instantaneous flow rate through the PDP using the pressure, temperature and speed transducers placed on the pump;



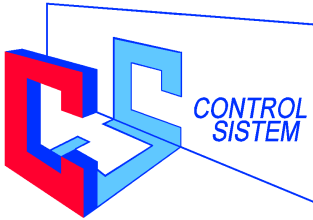


- calculation and saving of the total integral volume passed through the PDP for each step of the test;
- bags filling;
- connecting the bags with the gas analyzers;
- bags purging and evacuating
- checking possible leakages in the system;
- semiautomatic calibration procedure with simple operator interface and complete data calculation.

The system has a complete local control for all the functions using the PC touch screen and keyboard.

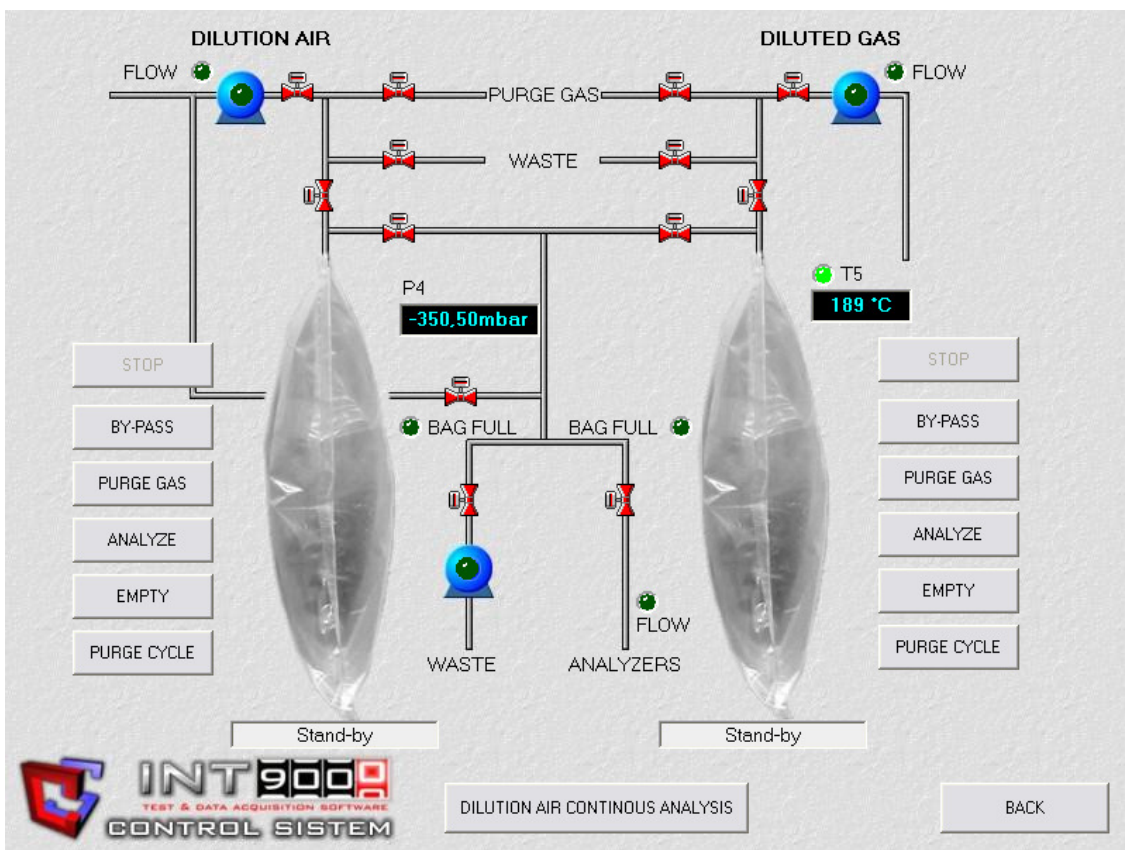


For the remote control from the main control unit, a standard communication protocol (AK protocol) through a serial port or a TCP/IP Ethernet connection is available.

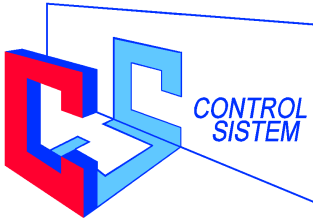


The PC is supplied with 2 Ethernet boards, one dedicated to the local network and the other dedicated to the external connection.

For all the signals managed in the system a recording function is available, particularly useful for troubleshooting, which provides Excel files with fully engineered data acquired up to 10 Hz frequency.







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The following main functions are available through a conveniently arranged Operator interface:

- Bags evacuation, purge and filling
- Bags analysis,
- Diluted gas analysis
- Monitoring of CVS flow rate,
- Calculation of integrated flow during each test's phase,
- System Mode monitoring,
- System Faults monitoring and warning,
- Manual selection of test phase,
- Complete I/O monitoring and check,
- Complete PDP calibration routine,
- Log of PDP calibrations and leak checks performed during the useful life of the equipment,
- Selection of the sampling flow rate to the bags.

### **Connection tailpipe to CVS.**

Fiberglass/silicon flexible hose with proper stainless steel termination to adapt different vehicle exhaust tailpipe configurations (1 side or 2 side).

The temperature range of the pipe is  $-40 +300^{\circ} \text{C}$

In this specific case, the proposed specification is: length 5 meter with an internal diameter of 150 mm.