

BetaCAP60-3G FOR ACCURATE AND REPEATABLE DILUTION TWO ACTIVE COMPONENTS IN ONE DILUENT GAS

FUNCTIONS OF THE DILUTER

BetaCAP60-3G is characterized by the possibility of diluting three gases or mixtures: generally two active gases and a neutral gas (diluent gas) are used. Each of the two active gases (or mixtures) is at the same time gas to be diluted and diluting gas: to be diluted for the measurement of itself and diluting for the measurement of the other.

The possibility of diluting two mixtures with different dilution factors finds its main application in the measurement of interferences: in this case TG1 is the gas to be measured, TG2 the interfering gas and TG0 the diluent gas.

Each of the two active gases (TG1 and TG2) can be diluted in the range 0.833%...99.167% as well as 0% and 100%: the only condition to be respected is obviously that $K_{dil.}(TG1) + K_{dil.}(TG2) \leq 100\%$.



MAIN FEATURES:

- Dilutions carried out both in "60 discrete steps" mode with 1.667% spacing and in continuous mode, with free setting of the concentration value of the diluted gas, for both TG1 and TG2.
- PID electronic regulation of the differential pressures for each of the three inlet gases compared to the exit pressure from the capillaries. The regulation set is calculated based on the mathematical representation of the diluter and the physics of the flows in the capillaries
- Detection of 4 pressure measurements (three inputs and one output) and acquisition of max 4 measurement signals from the analyzer under test, with 16 bit resolution
- Automatic calculation and compensation of the effects due to the different viscosities of the incoming gases or mixtures and correction of the errors reported in the metrological certificate
- Internal circuits resistant to the majority of highly aggressive gases and/or solvents
- User interface with color graphic display and touch screen

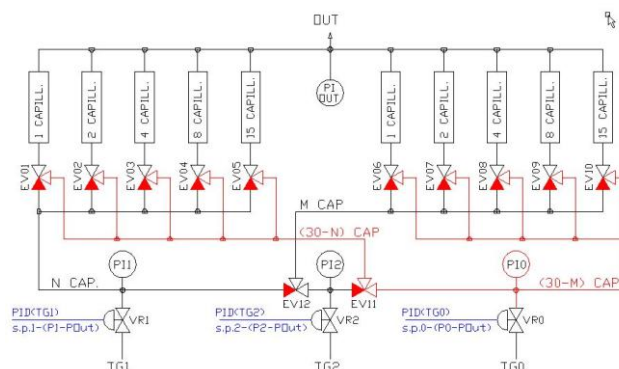
DILUTER DESCRIPTION

The instrument contains two CAP30 type dilution units which operate in a coordinated manner without the user having to worry about this. The dilution space is divided into 60 x 60 intervals. Two solenoid valves distribute the three incoming gases to the two dilution units, according to need: this function intervenes automatically depending on the dilution ratios that must be achieved.

Four relative pressure sensors, temperature compensated, are the reference variable for the three differential pressure regulators (inlet - outlet) which control the pressures at the ends of the capillaries. Through calculated set points, pressure regulation obeys two rules:

- The diluted gas flow is constant as the dilutions vary, and is set by the User.
- The pressures to be applied to the capillaries are calculated on the basis of the pneumatic circuit, the required function and the flow/pressure relationships well known thanks to Poiseuille physics.

A quick analysis of the equations on which the diluter operation is based tells us that, while the pressure ratio has an important influence on the precision of the dilution, the common mode value has an influence equal to 0.2%.



The pressure calibration procedure, managed simultaneously on all 4 sensors, takes this into account favoring the mutual alignment of the pressure sensors with respect to the common value, which depends on the reference used for the span calibration.

The construction of the BetaCAP60-3G dilutor respects the rules already applied for the consolidated predecessor BetaCAP30: all the gas passages and pneumatic components are obtained inside by crossing holes or in contact with the surface of a PVDF manifold (also available in stainless steel). Only the interface ways with the front panel are made with pipes and compression fittings.

The result is a compact, very robust construction, with reduced dead volumes, isothermal and with very low opportunities for leakage.

The materials in contact with the gases to be treated (PVDF, PTFE, PEEK, AISI 316L, Glass, Kalrez, Viton) are resistant to most gaseous components in the usual concentrations (as an option it is possible to replace Viton with Kalrez).

The availability of two virtually identical dilutors and the 2n progression of the number of capillaries for each group has also allowed the development of an interesting procedure for self-checking the quality of the dilutor, for determining errors (minimal differences in flow caused by uncertainties during the capillary selection process) and possibly for their automatic correction.

The test is obtained as a sequence of flow measurements, carried out with a multi-range meter supplied as an option, and has the characteristic of providing as a result the errors due to the imperfect coincidence of the capillary groups with the theoretical progression (2^N). An in-depth clarification of this information is necessary and is available at the link http://www.beta-strumentazione.it/wp-content/uploads/2019/09/AutoVerifica_CAP60.3G-1.pdf

To carry out the test, managed by a PC with a specific program, an optional module consisting of 5 different flow laminators and a single compensated differential pressure meter which communicates in serial with the dilutor is used. Any non-linearity of the set of 5 laminators does not influence the outcome of the test.

USE OF THE DILUTER

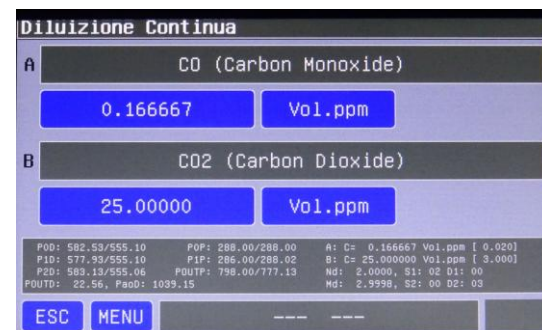
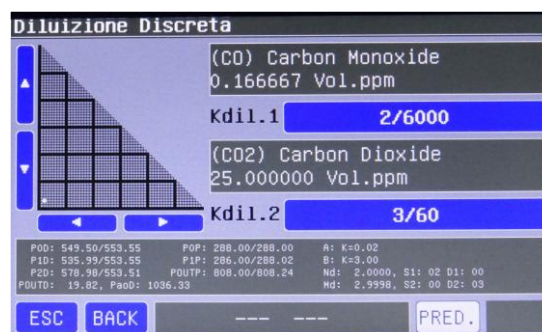
The menu on the side represents the area of possible dilutions: the three sides of the triangle represent the possible dilutions with only two components, while the internal area represents all the combinations of the three incoming gases.

For use, the operator is faced with a simple interface: color graphic display and touch screen, with which he selects the desired menu and sets the few parameters necessary to operate via the virtual numeric keypad.

In addition to the higher hierarchical level menus for selecting functions, the following menus are accessible (some password protected):

- correction of certified errors or errors resulting from the self-referential or traceable procedure (at the User's choice)
- Calibration of the four concentration measurement acquisition signals (the function is useful and necessary when using the optional PC software for automated tests)
- Calibration of the four pressure sensors (balancing obtained with non-traceable references)
- Setting the concentration values in the cylinders (the viscosities are calculated by the dilutor which automatically compensates if necessary)
- Setting the pressure set point P(TG0) for determining the diluted gas flow (P(TG1) and P(TG2) are calculated and created automatically).

Finally, the three operating menus for carrying out the tests locally (step mode or continuous mode) or remotely. The "Continuous" operating mode may seem unlikely to those who are unfamiliar with BetaCAP range. It's achieved thanks to the pressure adjustments with calculated setpoint: the dilutor chooses (also based on the viscosities of the applied gases, the most convenient distribution of capillaries and therefore manages the ratio between the applied pressures (at TG1, TG2 and TG0) in order to shift the actual dilution with respect to the



discrete value. As can be verified in the description of the calculations available on the site, the operation derives from the application of the rules (Poiseuille law) governing the physics of gaseous flows.

Once the desired dilution ratios have been selected (for TG1 and TG2) or the two desired output concentrations have been set, the solenoid valves that divide the three incoming gases and those corresponding to the different groups of capillaries can be activated to create the ratio set or deactivated en masse to implement the "Pause"

function. The operating menus also continuously indicate the gas pressures at the ends of the capillaries, the outlet pressure and the possible presence of alarms: in this way, the operator can check the regularity of operation at any time.

To carry out accredited tests, the User will activate the calibrations based on the results of the metrological certificate (if performed), while for non-accredited tests or checks of good functioning, it is possible to activate the calibration based on the results of the self-referential test (The low variance of the results is a guarantee of superior accuracy of the test)

TECHNICAL SPECIFICATIONS

Dilution Ratios :	Two independent dilutions can be made "in discrete steps" or continuously - 61 discrete steps (constant spacing 1.667%) - continuously in the range 0.8333%...99.1667%, including zero and span
Dilution uncertainty :	< 0.15% rel.
Dilution repeatability :	< 0.1 % rel.
Operating pressure:	between 200 and 2000 hPa rel. (up to 6 Bar input to the PID pressure regulators)
Diluted gas flow rate:	depends on the settable applied pressure (0.4...4 L/min.)
Input gas connections:	two gases to be diluted (possibly measuring and interfering) and a diluent gas
Output:	diluted gas
Connection type:	4 x 6 mm PVDF compression fittings (AISI316L on request)
Metrological certificate:	optional, from a LAT accredited European laboratory
Materials in contact with gas:	AISI 316, glass, PVDF, PPS, PEEK, Kalrez. Optionally, AISI316L, PEEK and Kalrez
Main analog measurements:	4 relative pressures (indication in hPa with 4 digits) with 16 bit resolution
Other measurements:	barometric pressure and diluter temperature
Measurements acquired:	4 measurement signals from the analyzer (isolated inputs in a group) with 16 bit resolution
Communication interfaces:	RS485 (including USB converter) with AK type open protocol
Electrical power supply:	from 100 to 240 Vac - 0.8 A max.
Dimensions and weights:	19" std. h 3UT prof. 250 mm or compact container (430 x 244 x 341 mm)

