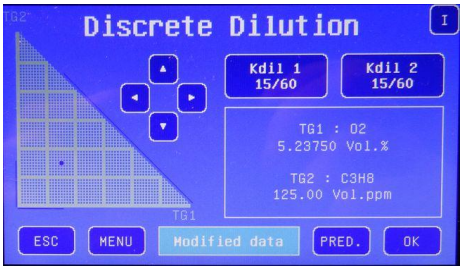
TO DILUTE TWO ACTIVE COMPONENTS IN A DILUTING GAS: BETACAP60-3G

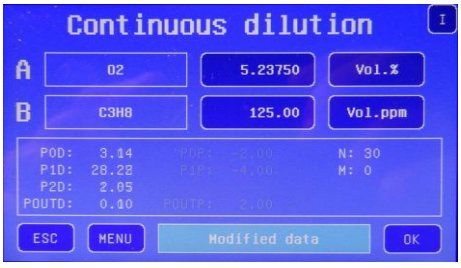
The diluter uses 60 equal capillaries and a solenoid valves network that directs to each capillary the first gas to be diluted, the second or the diluting gas.
In addition to the linearity tests (one-component) is then possible to perform tests of cross sensitivity, in which the concentrations of the gas to be measured and the interfering component can vary both between zero and 100% of the value entered in the diluter.
The main advantage of using the capillaries is in the extreme stability of performance: the fouling of the capillaries is the only possible cause of drift, but with gas from a cylinder (dry and clean), combined with the thrust of the air filtration of the gas inlet, drifts in the short and medium term are not detectable.

This results in:
- User Confidence in the quality of their work
- Long intervals allowed between successive metrological calibrations (high availability and low cost of ownership).

The instrument actually contains two diluting units that operate in a coordinated way without the user must deal with this. The space of the dilutions is divided into 60 x 60 intervals: the oblique line of the lower boundary corresponds to the various mixtures of the two active gases without the presence of the diluting gas.

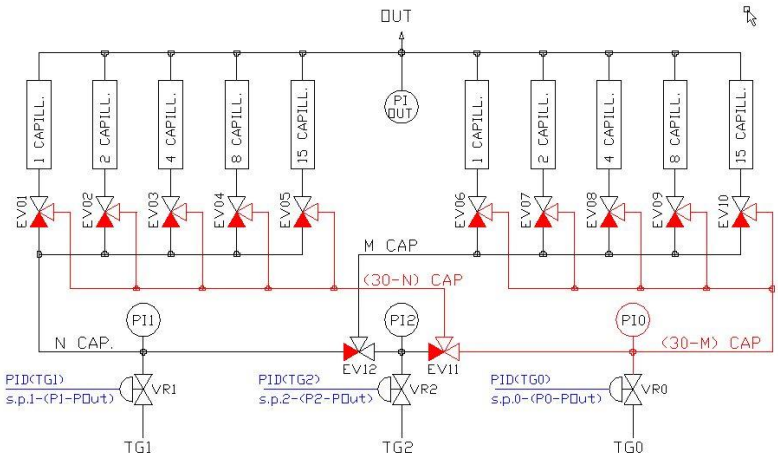


The operating menu shows very well the dilution space : two dilutions are available (moving the blue point on x axis and y axis. The diagonal of the triangle indicates the limit Kdil.1+Kdil.2 = 60:60. As all the BetaCAP gas dividers, this model too offers the operating mode "continuous", where the User may freely set the concentrations of two components (one in TG1 and the second in TG2) to test cross sensitivities, or just one to test linearity.



Two solenoid valves distribute the three incoming gas to the two dilution units, according to the dilution request : this function is automatically activated when it is required one of the components in a concentration greater than 50% of the content in the cylinder. Four pressure sensors are the reference variable for the three differential pressure controllers (inlet - outlet) that control the three incoming gas.
The aim is to ensure the balance of pressures, and therefore for the calibration of the 4 sensors do not require a pressure reference traceable: it is useful for the operator that the indicated values be nearly real, but it is only necessary that these are aligned between them. The reference for the zero calibration is the atmospheric pressure, while for the reference sensitivity the sole requirement is that the same

value of pressure is applied to all four sensors during calibration ; just close all inlets and supply the pressure to the outlet with a stable pressure.
The construction of the diluter BetaCAP60-2G respects the rules already applied for the consolidated predecessor BetaCAP30: all the way gas and pneumatic components are housed inside or on the surface of a manifold made by PVDF (also available in stainless steel). Only routes of entry / exit are made with pipes and compression fittings. The result is a compact, very rugged, with reduced dead volumes, and isothermal with very little chance of leaks.
The materials in contact with the gas to be treated (PVDF, PTFE, PEEK, AISI 316L, Glass, Kalrez, Viton) are resistant to most of the gaseous components in the usual concentrations (in option, we can replace the Viton with Kalrez and / or PVDF material with AISI 316L).



The availability of two virtually identical dilutors, and the progression 2n of the capillaries number for each group, has also allowed the application of an interesting procedure for the self-verification of the diluter quality, determining the errors (minimum differences between the flows caused by uncertainties in the process of selection of the capillaries) and for the automatic compensation of the same. This verification and automatic compensation of errors is available both as a local function and as a PC software package : in this second case, a printable report specifies individual deviations and provides downloading the errors table to the diluter. An internal flow meter using laminating elements is included.
The proof is obtained as a series of 5 short sequences (2 or 3 steps per sequence) in which equal flows are measured by an optional internal flow meter. Just to give an idea of the process we indicate some of the first two steps
First step : the "one capillary" group left side is selected as internal reference (error zero), the flows through the two groups with one capillary are compared and the error of the right side group is calculated.
Second step : the two "one capillary" groups are measured in parallel and the result is compared with the flow measured subsequently on the two "two capillaries" groups. This allows the calculation of both two capillaries groups error.
The following steps do repeat the same concept. A presentation of the procedure may be downloaded at the link : *http://www.beta-strumentazione.it/wp-content/uploads/2019/09/CAP60.3G-SelfTest.pdf*
This procedure may also be followed by an accredited laboratory, using external traceable flow meters for metrological calibration.
The advantage of the above procedure is that the errors of flow are calculated by comparing two flows that are very close (identical capillaries indicate zero error) and therefore is totally unaffected by the non-linearity error of the instrument meter. Changing phase (changing the number of capillaries in the groups), measuring conditions may change, then the more suitable measuring range may be used in each testing phase, assuring high measuring resolution.
The time required is about 30 minutes, using the inbuilt laminating flow elements (less than one minute for each measurement phase), whereas, after the time of stabilization, analog data acquisition may be averaged with optimal accuracy.
Paper rivers may be written about the "metrological correctness" of the procedure, but the results do comply with regular metrological tests end are even more repeatable... you can get your idea yourself.

TECHNICAL SPECIFICATIONS:

Dilutions: 60 x 60 combinations between 60/60:0:0 (just measured gas), 0:60/60:0 (just interfering gas), 0:0:60/60 (just diluting gas)

Dilution Uncertainty: (before calibration) better than 0,3% rel. + 0,005% of the input conc.
(after calibration**) better than 0,1%rel. + 0,002% of the input conc.
** calibrating laboratory uncertainty is not considered

Pressures regulation : electronic type with PID function for $P_{(TG1)}$ - $P_{(OUT)}$, $P_{(TG2)}$ - $P_{(OUT)}$, $P_{(TG0)}$ - $P_{(OUT)}$, The user sets the point of P(TG0) to get the wanted output flow, and both P(TG1) and P(TG2) are calculated and controlled with repeatability < ± 1 mbar

Flow of diluted gas: about 4 liters / min. with pressures adjusted to 2000 hPa rel. Lower flows may be set by the user by reducing proportionally the P(TG0) set point.

Indicated measurements: 4 pressure measurements,
two ancillary measures (ambient pressure and internal temperature).

Acquired measurements : 4 concentrations, received by the analyzer to be tested and used by the optional PC software to perform automatic testing

Local interface: color graphic display with touch screen

Remote interface : RS485 port (with USB converter cable) and open protocol type AK

Calibrations: Relative pressure sensors may be easily matched (zero offset and equal sensitivity) with not traceable references : that's enough to prevent dilution errors due to pressures measurement drift
A special procedure and an internal flow meter is available to calculate diluting errors by a series of measuring flows

Dimensions : Compact plastic case 43 x 24.4 x 34.1 cm with handle and shoulder strap or
19 "Rack 3HU: 483 x 132 x 300 with or without plastic shock protection case
Weight approx 9 kg
With shocks protecting case : 530 x 200 x 355 Weight 10 kg

Options: Multiple selection of one of the two active gases (6 choices) and the diluting gas (2 choices)
Pre-dilution 100:1 to reach total dilutions (just one gas input) up to 12.000 : 1

The 19" rack version

Be.T.A. Strumentazione Srl
Solo diluitori di gas, ma .....

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