cannon

polyurethane technology

"HE-System"

Cannon "HE-System"

A new Operator - Machine Interface for the Cannon piston metering machine

Fig. 1 - Typical "HE-System" configuration.

First presented in 1983, the Cannon HE piston metering machine has become a driving force behind the development of the Polyurethane World.

It's reliability, high precision and repeatability in dosing were immediately appreciated as the most significant features and several hundred HE models since have demonstrated this in each case.

The HE proved successful and irreplaceable where abrasive/charged, highly emulsified or high viscosity components were involved.

The ability of the HE to self-adjust was totally new at that time. It was supplied with a closed loop regulation system which allowed accurate control of the piston speed ensuring constant output and ratio of the components, regardless of variations in pressure within the circuit. Thus, the accuracy and systematic metering of the Polyol and Isocyanate are ensured, so guaranteeing the quality of the finished product.

Maintaining these highly successful main characteristics of the HE machine, Cannon now presents the "HE-System", with a totally new electronic control offering greater operating flexibility.

The component circuit

Components reach the tank after passing through self-cleaning filters (motorised version available on request). The tanks are pressurised with dry air blown from a frame-mounted air-dryer.

A double walled tank jacket containing hot and cold water keeps the temperature of the components in the tanks constant. Water heating is provided by electric resistances inserted in the jacket space, while cooling is effected by an external chiller unit. Slow scraper blade agitators guarantee absolute homogenisation of the components and uniformity of temperature throughout. Proportional band electronic thermoregulators maintain temperatures with a precision of ± 1°C. Available on request are tube-nest heat exchangers which can be mounted on the component return lines for further cooling in the event of rapid production cycles.

The pressurised components are sucked into the cylinders and then recycled at low pressure at the output required and with a 1:1 ratio. Pressing the pour button (or providing an external coded impulse), the operator can interrupt the low pressure recycle. The cylinders are filled in the minimum time allowed by the pump, a special valve prevents the return of components to the tank and the machine moves onto the next stage - high pressure recycling.

Data relating to the selected pour programme is then recalled from the memory and the control system, in a matter of seconds, positions the proportional valves at the preset values. When ratio and optimal pressures are reached, the operator is ready for the pouring stage. Cylinder-mounted encoders continuously read the component output values and the control system corrects any possible deviations from the values required. When the shot weight reaches the required value, the machine orders the closing of the mixing head. Pouring is stopped and the machine returns to a recycling stage at low pressure, ready for another pour.

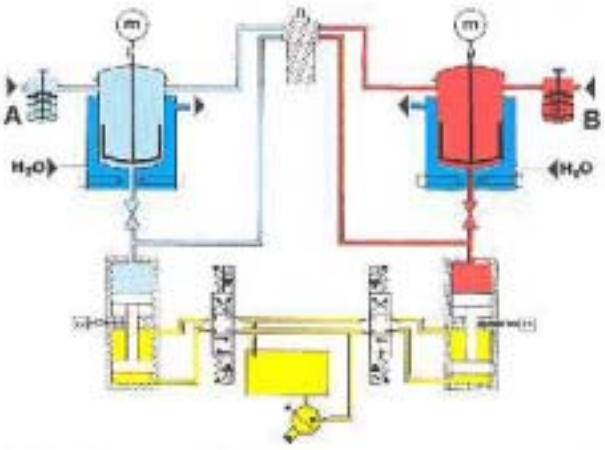
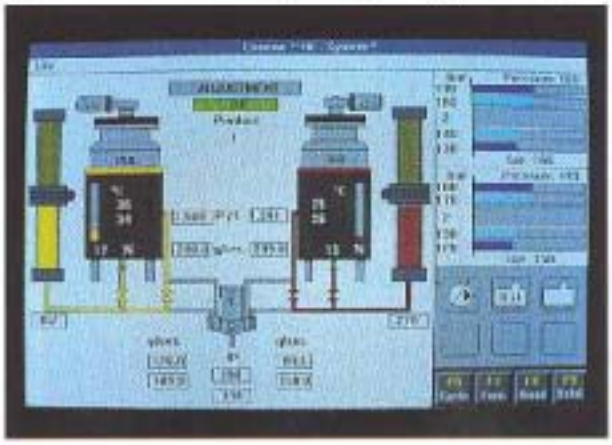


Fig. 2 - Components circuit.

Fig. 3 - Real-time monitoring of the pouring parameters.



Cannon "HE-System": economy and ergonomics

Reduced maintenance

The Cannon "HE-System" has been designed to reduce maintenance to a minimum, thus saving time and expense on spare parts since there are no rotating parts in contact with components. The dispensing pistons move in linear fashion at low speeds. In this way, any chance of leakage is virtually eliminated. Cylinders are designed to allow an extra stroke (50 mm) for easy seal changes. A period of about 40 minutes is all that is needed for this operation on both component cylinders (fig. 7).

Oil is taken from the tank and, driven by a single motorpump, is sent to the proportional valves. By using a zero-setting output pump, the power used always corresponds to the real capacity of utilisation, thus resulting in a saving of energy.

Manual calibration operations have also been eliminated, thanks to the extreme precision of the digital control system which has enabled traditional ratio control devices (calibration heads) to be eliminated, thus providing considerable benefits as far as time and hygiene are concerned.

Fig. 7 - Cylinder in maintenance position for seals replacement.

Fig. 8 - Four "HE System" plant controlled by a host computer.

Ergonomics concept

The "HE-System" is equipped with a micro-processor control system comprising two different computers, in communication with each other via an optic fibre (a Programmable Process Controller and a Personal Computer).

The Programmable Process Controller (PPC) is fitted within the machine's electronic control panel and is dedicated to controlling the process and the machine function sequences (fig. 8).

The PPC is supplied complete with a set of cards to control signals to or from the field (mixing head, pressures, temperatures, outputs, etc.) for closed loop control and for controlling communication with the PC.

The personal computer (APC) is installed in its own console (fig. 9), complete with colour monitor and keyboard and is used to control the interface between machine and operator.

This software generates animated synoptics displayed on the monitor showing the machine and mixing head process parameters (outputs, ratio, pressures, temperatures, levels, etc.) fed to the APC via the PPC. These synoptics are created and modified according to the machine configuration.

Various software packages are also available for the "HE-System" to enable the general maintenance and production requirements of the machine to be met and to allow qualitative and quantitative production control:

- Programmed Maintenance, to inform the operator of the condition of the most critical equipment in relation to preset limits;
- Trouble-Shooting, which relates synoptics with alarms in order to identify the cause of malfunction;
- Production Diary, comprising a series of functions which allow the operator an efficient quantitative production control;
- Data Collection Package (DCP), used for the statistical analysis of the process parameters and final product certification.

Fig. 9 - The workstation PC 486.

Cannon "HE-System": industrial applications

A modular machine for different applications

Most of the Cannon "HE-System" machines have been coupled with a Cannon head-carrier Robot. The reasons for this are simple: the two machines are complementary, made for each other. The speed with which the "HE-System" changes the pour programme and the consistency of results emerging from this factor would be wasted if foam were placed manually in the moulds.

Cannon's cartesian Robot (capable of 4-axis programming) was created in order to automate pour operations in open moulds, favouring, in particular, those flexible foam pouring programmes for multi - hardness seats. In this situation, a one - mould pour programme is often called for and a different Isocyanate/Polyol ratio is required, along with a new pour operation - sometimes in the same mould areas where the first pour has already been distributed.

Other uses of "HE-System" and the Cannon Robot can be found in the field of back-foaming with energy managing foams for thermoplastic bumpers. Here, the Robot's precision features are an essential factor in perfect distribution of the foam in the highly defined bumper area, while high energy management performance is guaranteed only if the component ratio is kept between extremely precise and fine tolerance limits.

The photograph (fig. 10) shows a plant consisting of 2 "HE-System" and 2 Cannon Robots. The two dispensing units are intended for mutual assistance: in the event of one stopping, the other automatically feeds the two mixing heads. The machines, connecting pipes and cooling units are platform-supported.

The photograph (fig. 11) shows a platform - mounted "HE-System" which feeds four Cannon FPL* mixing heads for the manufacture of domestic refrigerators and freezers. The possibility of immediate output alternation between pours is an enormous advantage for the "HE-System" mounted on multihead installations.
Today, in fact, using a single Cannon "HE-System" foaming unit, it is possible to produce low output/fine detail components with extremely small dimensions (e.g. Cannon FPL 10) together with large pieces, the latter at high output and using wider diameter heads (Cannon FPL 18 or FPL 24).

For the direct application of a RIM-PU seal on fixed glass for cars and trucks (Glass encapsulation), an automatic plant with 4 "HE-System" connected with 12 FPL heads is used; these heads are working on 12 mould-carriers on which automatic trolleys with vacuum-suckers load and unload the glass (fig. 12).

The photograph (fig. 13) shows a special version: the "HE-System 700 Booster 25/13".
This accumulator machine is able to reach high outputs during pouring phase: 700 kg/min.

* FPL: Cannon patent.

Fig. 10 - 2 "HE-System" and 2 Robots backing each other.

Fig. 11 - "HE-System" for the Refrigeration Industry: the right output for every head.

Fig. 12 Multi-heads plant for glass encapsulation.

Fig. 13 - "HE-System 700 Booster 25/13" accumulator machine for output rate up to 700 kg/min.

Cannon "HE-System": reliability

Electronic high pressure metering unit

The most important parameter in the production of Polyurethane is undoubtedly the ratio between the two principal chemical components, Polyol and Isocyanate. Precise and repetitive metering of these products is essential for high quality production. Having the ability to programme and carry out control of this parameter in a simple and rapid manner allows costs to be reduced and plant output to be increased.

Cannon has been examining this problem for years and, unable to find a sufficiently rapid and reliable system in the existing field of electronics, has developed its own system capable of self-adjustment to set values and of self-correction in real time: the Cannon "HE-System".

The Cannon "HE-System" is a PU metering unit which combines the advantages of high pressure technology with those derived from the use of electronic digital controls on a hydraulic circuit regulated by proportional valves.

What does self-setting mean?

All that's needed is to store, using a simple keyboard, of the data relating to each pour programme (shot weight, ratio, output). Every time a programme is entered, pressing a button or communicating a binary code, the machine recalls the stored data and sets up the component circuit. The constructional features of the machine ensure that the system is insensitive to variations in viscosity, pressure and temperature, thus guarantocing that the stored data is set up and kept in the machine, even when working conditions are not ideal.

What does self-adjusting mean?

This system permits a constant check on performance parameters during the pouring stage, comparing the parameters with the set values and adjusting, if necessary, output and ratio values in real time (fig. 4).

Machine configuration

The machine consists of:
- pressurised, jacketed component tanks supplied with a scraper blade agitator;
- a hydraulic unit consisting of tank, motor, pump, filter, proportional valves and dispensing cylinders;
- rigid and flexible connection piping;
- electronic programming and control panel.

The heart of the system

Component metering is effected by means of hydraulically driven metering pistons. Oil is taken from the tank and, driven by a single motor/pump unit, is sent to the proportional valves, one per cylinder. (fig. 5).

Each proportional valve controls the quantity of oil needed to give the required component output from the metering cylinders.

An encoder measures the speed and position of the cylinder, and, given the high resolution of the digital system employed, defines its output with extreme precision.

The position control card (CCP) compares this value with that stored in the machine. Should differences be noted between the theoretical and actual data, the servodrive intervenes immediately on the proportional valve controlling the output.

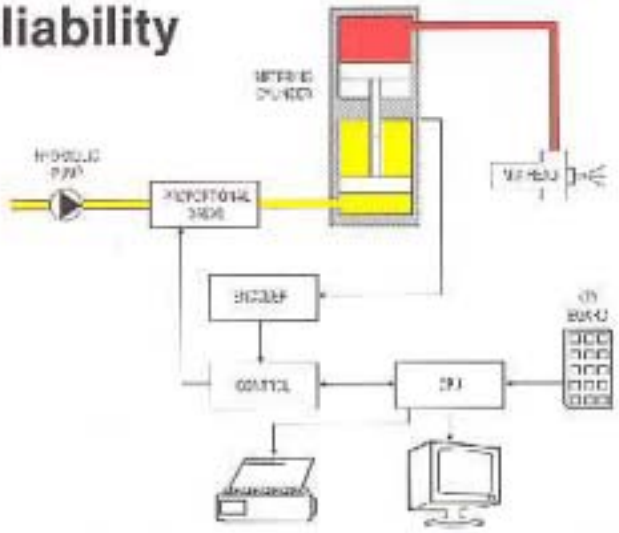


Fig. 4 - Closed-loop control.

Fig. 5 - Proportional valves.

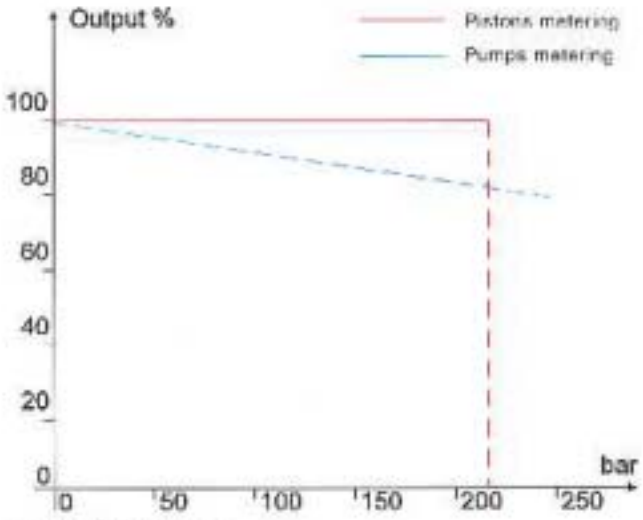


Fig. 6 - Output curve.

The curve (fig. 6) shows the output through the valve in terms of adjustment of the distributor. The latter has been designed to guarantee that a linear variation of the oil output corresponds with the linear variation of its position: the distributor's resolution, that is, the minimum adjustment possible, is equivalent to 1/1000 of the maximum adjustment. To this variation corresponds an output adjustment to 1/2000 of the instantaneous output. This feature provides equal adjustment percentage precision both at the minimum and maximum output value permitted by this type of distributor.

In practical terms, the machine operates at a constant output, regardless of possible pressure variations in the circuit, a feature which can be particularly appreciated in plants where machine and head are far apart.

Response time of the whole system is only 28 msecs and allows ratio adjustment in less than 0.2 secs.

cannon "HE-System": flexibility

Air dryer

Double column dryer model with automatic regeneration. It eliminates all traces of humidity from the compressed air, thus avoiding problems of unwanted reactions with the components contained in the tanks. Drying capacity: 9000 Nl/h at 6 bar.

Dispensing cylinders

These determine the maximum size of the piece which can be obtained: available in 3, 7, 13 and 25 litre versions (gross component volume)

Laboratory tanks

Owing to their smaller dimensions compared with production purpose tanks (70 gross liters instead of 330), they allow reduction of the miminum quantity usable in the machine for the setting up of new formulations and short pour test runs.

Capacitance levels

Level sensors with 4 working positions mounted on the tanks: they replace traditional float systems. Calibration for various minimum and maximum values is possible and there are no moving mechanical parts. Available with analog or digital display.

Heat exchangers

Tube-nest heat exchangers mounted on pipes carrying components to the tanks. Recommended for all those applications where there could be problems of component overheating during recycling (fast cycles, long piping, viscous components).

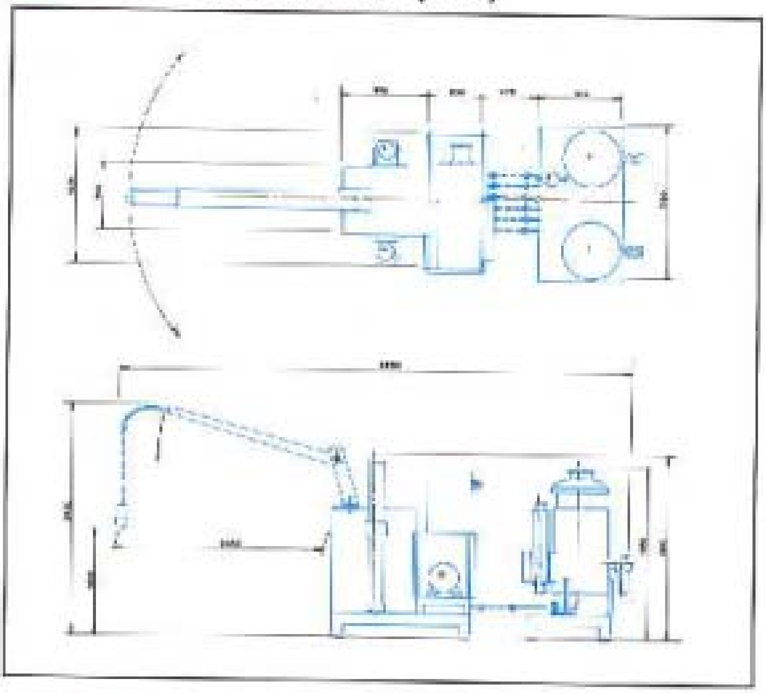
Fig. 14 - Heat exchangers.

Technical characteristics

Information

- Available volume for pouring: 92% of cylinder volume.
- Shortest pouring time: 0.2 sec (80 msec).
- Self-adjustment time (closed-loop): 0.028 sec (28 msec).
- Error on average value of ratio during shot: ±0.5%
- Digital acquisition of output, free from calibration and error compensations.
- Available memory: 256 kbytes on 4 dedicated microprocessors.
- 99 pouring programs, expandable to 999.
- Electronic programming table.
- Supplied in the basic configuration with 24 Digital Inputs, 8 Analogic Inputs, 16 Digital Outputs, 4 Outputs at 110 V.
- 4 Analog Inputs available for further functions (mould temperature control, CCS, AND, etc.) displayed on the monitor.
- Available in 220/380/440 Volts, 50 and 60 Hz.
- Compressed air 6 bar minimum.

Overall dimensions (mm)



The range

* Average specific gravity 1.1 g/cc

MODEL	"HE-System" 40	"HE-System" 60	"HE-System" 90
Max output kg/min*	0-43	0-70	0-110
Power absorbed kW	20	30	48

Minimum outputs

* Ratio oil/component 2:1

OUTPUT	CYLINDER VOLUME (lL)					
	3*s	3	7	13	25	50
cc/sec	15	25	50	100	200	200

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