

AIRMOULD® – AQUAMOULD®



Fluid assisted injection molding
Technology working for you.

Battenfeld
world of innovation

What is fluid assisted injection molding?

Fluids are gases and liquids. The fluid injection process is an injection molding process in which a gas or a liquid is injected into the melt. The gas or the liquid is injected in such a way that cavities are formed in the molded part.

With fluid injection, it is possible to manufacture molded parts offering vital advantages:

- Quality improvement.
- Avoidance of sink points.
- Reduction of frozen stresses.
- Reduction/avoidance of warp.
- Reduction of the clamping force required.
- Reduction of cycle time.
- Weight reduction.
- Design possibilities.

Depending on the geometry of the molded parts and the desired properties, one or several of these improvements can be realized.

Gas assisted injection molding

There are two WITTMANN BATTENFELD gas assisted processes:

- **AIRMOULD® Internal gas pressure**
AIRMOULD® is the process developed and patented by WITTMANN BATTENFELD for gas assisted injection molding. The gas is injected into the melt and builds up an internal gas pressure.
- **AIRMOULD CONTOUR® External gas pressure**
Alongside this internal gas pressure process, WITTMANN BATTENFELD also offers the external gas pressure process AIRMOULD CONTOUR®. The gas is injected between the melt and mold cavity surface and presses the melt to the opposite side of the cavity surface.

Both processes, with their possibilities and advantages, are presented in detail below, and the components required for execution of the process are described.



Water assisted injection molding

Based on the experience of the process developers – the IKV Institute of Plastics Processing at RWTH Aachen – WITTMANN BATTENFELD developed the patented AQUAMOULD® water injection technology.

Both processes, AIRMOULD® and AQUAMOULD®, have their special advantages and complement each other. For a first assessment of the fields of application for both processes, it is helpful to look at the wall thicknesses of molded parts (see table below). Depending on the parts geometry, the plastic material and requirements specifications for the parts, either AIRMOULD® or AQUAMOULD® are recommended as suitable processes.

WITTMANN BATTENFELD supports its customers in their choice of the process and the plant components required.



Wall thickness	AIRMOULD®	AQUAMOULD®
Thick walled	X	X
Very thick walled	–	X
Thin walled	X	–
Thin walled + thick areas	X	X

AIRMOULD® – Gas assisted injection molding

There are two WITTMANN BATTENFELD gas injection processes:

- Internal gas pressure technique.
- External gas pressure technique.

AIRMOULD® Internal gas pressure technique

Different gas injection processes can be applied.

These are special mold techniques or equipment and control variants of the injection molding machine.

The type of internal gas pressure technology applied to a molded part depends on the part geometry, the raw material and the requirements on the product.

Internal gas pressure process

With the AIRMOULD® process and the AIRMOULD® modular system, all process variants can be executed.

The gas injection takes place, either through the AIRMOULD® machine nozzle or through AIRMOULD® injection modules, directly in the sprue or in the cavity.

After the filling is complete, the gas pressure is maintained long enough for the molded part to cool down sufficiently for dimensional stability.

Here, a uniform pressure is maintained over the whole gas channel, inhibiting volume contraction.

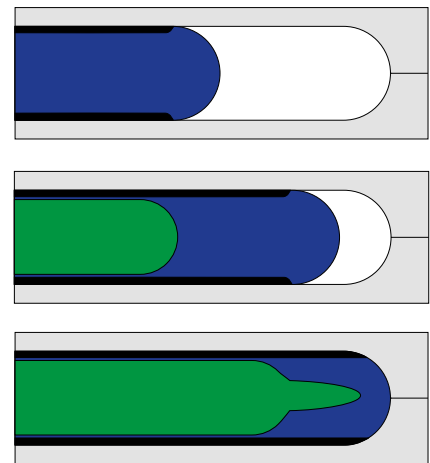
Before the mold is opened, the gas pressure is released and the nitrogen escapes into the environment.

In this way, molded parts can be achieved which are free of sink points and low in stress.

The different processes are:

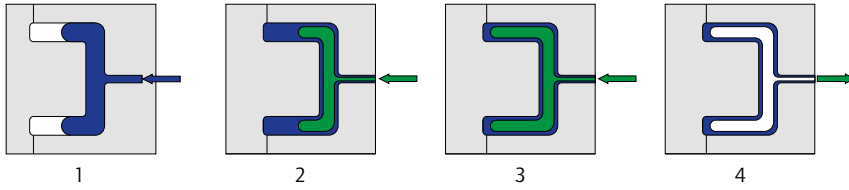
- Partial filling process.
- Shrinkage compensation process.
- Overflow cavity process.
- Melt back pressure process.
- Core pull process.
- Multifoam process.

AIRMOULD® from WITTMANN BATTENFELD is protected by a number of patents in Germany and abroad. Whether further licences are required must be determined from case to case, depending on molded part, process and location.



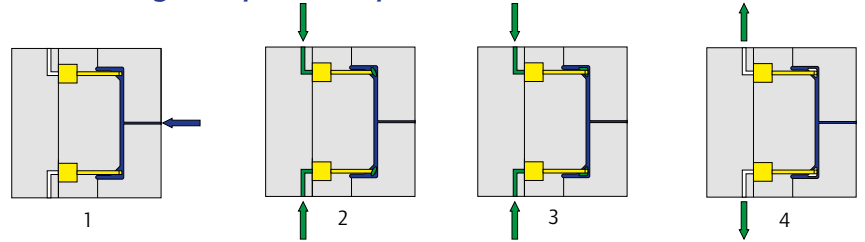
The AIRMOULD® Internal gas pressure processes in detail

The partial filling process



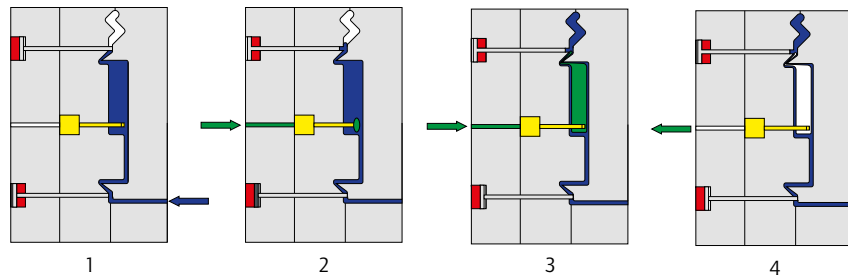
The partial filling process is also known as the standard internal gas pressure process. The cavity is prefilled with melt (1), then the gas is injected (2), which displaces the melt and causes the complete filling of the cavity. The gas pressure is maintained as holding pressure (3) and is released again before the mold is opened (4). When gassing through the AIRMOULD® machine nozzle, it is possible to seal the sprue.

The shrinkage compensation process



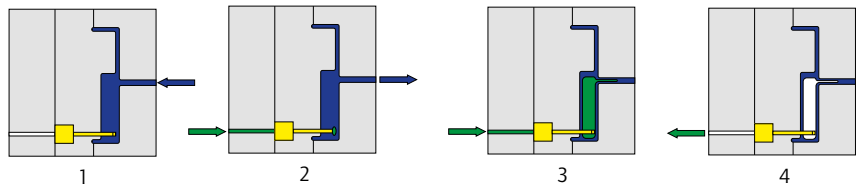
First, the cavity is completely filled with melt (1). Then nitrogen is injected as holding pressure (2) and acts to prevent shrinkage (3). The gas forms gas channels in the molded part, so it can still act during the cooling. The gas pressure inhibits sink marks. The gassing is carried out, depending on the molded part, through injection modules in the mold or through the AIRMOULD® machine nozzle. Before the mold is opened, the gas pressure is released again (4).

The overflow cavity process



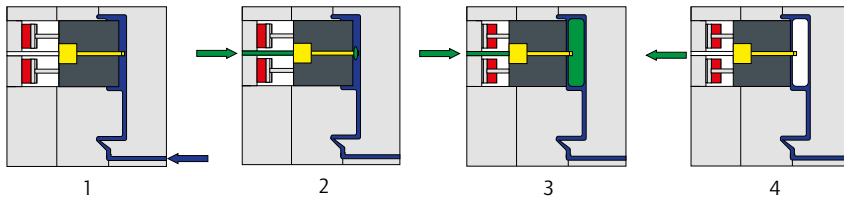
First, the cavity is completely filled with melt (1). If necessary, holding pressure is applied above the melt. The nitrogen is now injected (2), displacing melt from the cavity into the overflow. The gas pressure is maintained as holding pressure throughout the cooling (3) in order to inhibit shrinkage. Before the mold is opened, the gas pressure is released (4).

The melt back pressure process



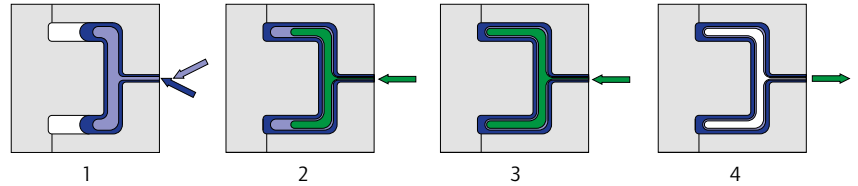
First, the cavity is completely filled with melt (1). If necessary, holding pressure is applied above the melt. The nitrogen is injected through an injection module into the gas channel at the end of the flow path (2), forcing melt back to the screw and barrel. Then the machine nozzle is closed. The gas pressure is maintained throughout the cooling period (3) to compensate for shrinkage and is released before the mold is opened (4).

The core pull process



The melt is first injected into the mold cavity volume, reduced by the inserted cores (1). Then, at the same time as the cores are withdrawn, the nitrogen is injected into the cavity through injection modules (2). The gas pressure is maintained throughout the cooling period (3) to compensate for shrinkage and is released before the mold is opened (4).

The multifoam process*



After injection of a specific quantity of skin material, the core material is injected. The volume, however, is not sufficient to fill the mold cavity (1). The filling is completed by the injection of nitrogen (2). The gas pressure is maintained throughout the cooling period (3) to compensate for shrinkage, and is released before the mold is opened (4). The gassing is carried out through an injection module directly into the mold cavity or through the AIRMOULD® machine nozzle. In this case, it is possible to seal the sprue with skin material. The multifoam process can also be combined with the mold and process techniques described above.

■ Plastic
■ Gas (Nitrogen)
■ Mold
■ Breathing core
■ Hydraulic system
■ Injection module

* ■ Skin material
■ Core material

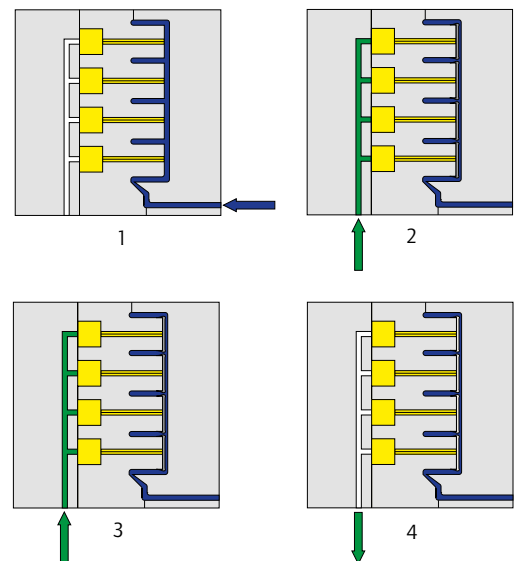
AIRMOULD CONTOUR® External gas pressure

In the conventional injection molding of ribbed molded parts, if the holding pressure is insufficient, there is a danger of sink marks occurring opposite the ribbed areas.

Here, the sink marks and warp can be inhibited with AIRMOULD CONTOUR®. Unlike AIRMOULD®, in the case of AIRMOULD CONTOUR®, the nitrogen is not injected into the centre of the melt, but between the molded part and the mold cavity.

The sequence of the process is as follows:

First, the cavity is completely filled with melt (1). Then, through injection modules specially developed for AIRMOULD CONTOUR®, nitrogen is injected between the melt and the surface of the mold cavity (2). The gas pressure acts as a holding pressure cushion on the plastic, also keeping it in wall contact with the opposite side of the mold during cooling. During the cooling time (3), the nitrogen acts as holding pressure over a selected area, thus preventing the occurrence of sink marks opposite the ribbed areas on the visible side of the parts. Before the mold is opened, the gas pressure is released (4).



■ Plastic
■ Gas (Nitrogen)
■ Mold
■ Injection module

The AIRMOULD® Modular System

Different molded parts, machine sizes and areas of application require different internal gas pressure systems. For optimum adaptation to individual requirements and circumstances, WITTMANN BATTENFELD has developed the AIRMOULD® Modular System which supports both AIRMOULD® and AIRMOULD CONTOUR®.

The AIRMOULD® Modular System is a machine independent system, which can be used both on WITTMANN BATTENFELD injection molding machines and on machines from other manufacturers.

The AIRMOULD® Modular System consists of 4 basic components:

■ Compressor units

The gas used for this process is nitrogen, an inert gas, which does not react with the plastic material. The nitrogen is compressed to a sufficiently high pressure.

For applications with low gas consumption, the use of nitrogen bottles or manifolds is recommended.

For production lines with high nitrogen consumption, the compressor unit can be combined with a nitrogen generator to generate the nitrogen directly next to the machine.

■ Process control

The AIRMOULD® process can be monitored and controlled either via the machine's control system, or via a separate control cabinet or manual control unit.

■ Gas pressure regulation

The gas pressure is regulated by small pressure controller modules, which can be mounted close to the mold in order to ensure an optimal, cost-efficient process, with distances kept as short as possible.

■ Gas injection

The gas is injected either through the AIRMOULD® nozzle or via gas injection modules integrated directly in the mold.



Diagram: Modular System and injection molding machine

Compressor unit control

The graphic control system of the compressor unit is clearly structured and self-explanatory. All important data from the compressor and from the nitrogen generator as an option as well, are displayed on two pages, so that it is easy to check whether the equipment is functioning properly.

Thanks to modern electronics, the control system can be integrated in the corporate network, so that all settings and readouts of the equipment can be transmitted to any networkable PC.

The advantages of the control system:

- Self-explanatory, clearly structured.
- 5.7" TFT color display with touch screen.
- Networkable
- Password-protected against unauthorized operation.



DE compressor unit series

Type	Output		Devicy capacity ND kW	max. operating pressure bar	Storage capacity ltr	Weight* kg	Dimensions (DxWxH) mm
	NI/min	Nm ³ /h					
DE 130	130	7.8	4.0	330	50	690	1,734 x 789 x 2,077
DE 250	250	15	5.5	330	50	690	1,734 x 789 x 2,077
DE 450	450	27	7.5	330	50	710	1,734 x 789 x 2,077

*conditionally

The compressor units compress the nitrogen to a sufficiently high pressure for all AIR-MOULD® applications. One unit can supply several machines, depending on its capacity. Thanks to a modern control system, the compressor units can be operated by remote control via the corporate network.

The modular concept enables every compressor unit to be combined with a nitrogen generator at any time.

The advantages of DE appliances:

- Can be extended at any time by adding a nitrogen generator.
- Modern control system with remote control options.
- Modest space requirements.
- Large-volume accumulator.

Available with capacities from 130 to 450 NI/min as standard (other sizes upon request).



Nitrogen generators: SE series extension modules

Type	Output		Drive capacity ND kW	max. operating pressure bar	Storage capacity ltr	Weight* kg	Dimensions (DxWxH) mm
	NI/min 98 %	Nm ³ /h 98 %					
SE+DE 130	130	7.8	4.0 + 5,5	330	50	1,188	1,734 x 1,620 x 2,077
SE+DE 250	250	15	5.5 + 11	330	50	1,440	1,734 x 1,620 x 2,077
SE+DE 450	450	27	7.5 + 15	330	50	1,620	1,734 x 1,620 x 2,077

*conditionally

With the nitrogen generator extension modules from the SE series, every compressor unit can be extended to form a self-sufficient system.

The nitrogen is filtered from the ambient air by special filter membranes. The extension units are laid out to match the various compressor units from the DE series and can be retrofitted at any time without major expense.

The advantages of SE extension units:

- Independent operation, no logistics costs for replacing nitrogen bottles.
- Nitrogen purity at least 98 %.
- One control system for the entire equipment.
- Compact, sound-insulated unit.

Available with capacities from 130 to 450 NI/min as standard (other sizes upon request).



AIRMOULD® Pressure control and regulation

The gas pressure control system consists of the electrical control unit in combination with one or more pressure regulator or mono modules.

The electrical control unit is designed for use either as a stationary or as a mobile control system.

Stationary control unit UNILOG B6

Structure of the control unit

The stationary gas pressure control system consists of the electrical control unit integrated in the WITTMANN BATTENFELD machine control unit UNILOG B6 and one or more pressure regulator or mono modules.

The control system permits the operation of up to eight pressure regulator modules.

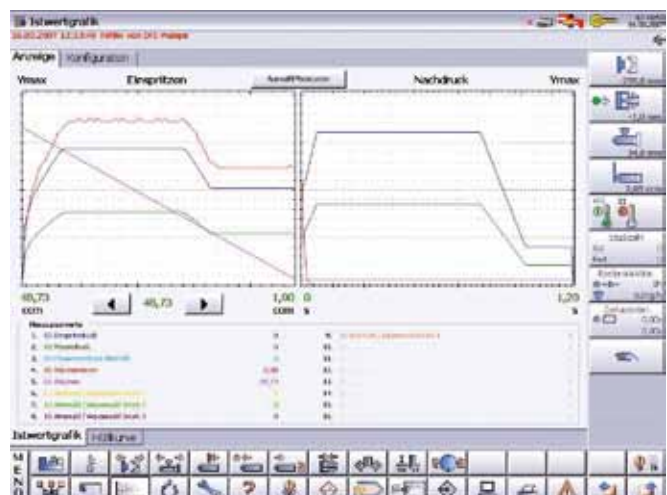
The pressure regulator modules are connected to the injection molding machine by a simple plug or piped fitting.



View of the AIRMOULD® select command screen

Features of the stationary control unit:

- The pressure profiles selected are displayed graphically.
- The actual value pressure curves for all pressure regulator modules can be displayed simultaneously.
- A particular advantage for the machine operator is the fact that the gas pressure curves can be displayed in one graphic, together with the machine graphs for the pressure values, distances, times etc.
- The data are saved together with the machine data.
- Data output via a USB flash drive.



Screen view: Actual value graphic

Mobile control unit UNILOG B6

Interface and programs

The mobile control unit is connected to the injection molding machine via an interface. The interface used is the EM 62 interface from VDMA, which is standardised for fluid injection. The AIRMOULD® interface developed by WITTMANN BATTENFELD also continues in use. WITTMANN BATTENFELD supplies suitable converters for adaptation to both interface types.

The mobile control unit may, for example, provide the following programs:

- Pressure monitoring program.
- Impulse program (automatic blow-out of the injection modules).
- Control of core pull functions (directional control valves).

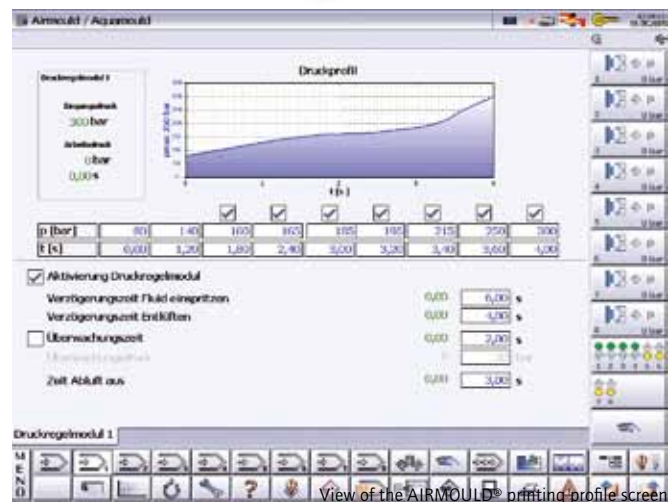
The signal exchange is tested with the diagnostics function. The safety functions and program elements guarantee the faultless operation of AIRMOULD® and AIRMOULD CONTOUR®.

Through the machine interface, depending on the design of the mold, various AIRMOULD® control components can be connected:

- If the gas injection takes place at one point only through an AIRMOULD® machine nozzle or through an injection module in the mold, a monomodule with a hand programming device, directly connected with the injection molding machine via the interface, is the least expensive solution.
- If two injection modules in the mold have to be controlled, two monomodules with a hand programming device can be directly connected via a duplex cable and the machine interface.
- If several injection modules in the mold have to be controlled, or core pull functions or mobile injection modules have to be operated, the mobile control unit is used. It can control up to eight pressure regulator or monomodules.

WinXP™ as operating system gives easy gateways to IT systems:

- 15" TFT color screen with unrestricted touch screen functions for operation and display.
- 2 rows of soft keys to select machine functions.
- Access authorization via USB flash drive.
- Access protected via password system.
- Freely configurable status bar.
- Logbook with filter function.
- Quality table, 1.000 storage depth.
- Internal data storage via USB connection or network.
- Online language selection.
- User configurable text.
- Hardcopy function.



View of the AIRMOULD® printing profile screen

Advantages of the mobile control unit with touch screen operation:

- Menu guided operator friendly operation.
- Pressure profile input with set curve and up to 9 freely programmable positions.
- All time indications with 1/100 s accuracy.
- Actual value graphic for pressure curves in profile form for up to 8 pressure control modules simultaneously.
- Up to 8 pressure control modules or monomodules can be connected.
- Compatible with all AIRMOULD®/AQUAMOULD® components, e. g. pressure control modules, monomodules.
- Program for control of cores (directional control valves): Software (standard), hardware (option).
- Diagnostic function (check of signal exchange).
- Manual operation function (check function injection modules and cores).
- Software for operating hours counter.
- Online selection of imperial and metric units.
- Operator manual incl. hydr., mech. and electric plans and diagrams online.
- Quality table, 1.000 storage depth, pressure integral monitoring for AIRMOULD®/AQUAMOULD®.
- Parts counter with good/bad part evaluation.
- Envelope curve monitoring (for 4 curves).
- Ethernet interface at the switch cabinet.
- Printing via USB connection or network.

AIRMOULD® Gas pressure regulation

Pressure control modules

The gas pressure is regulated by at least one pressure control module (blue housing) or one monomodule (yellow housing). The gas in the line between gas injection and pressure module is lost at every cycle. In order to minimize these gas losses, the connections should be as short as possible.

WITTMANN BATTENFELD pressure modules are small, compact units. This permits their installation and mounting near the gas injection point, on the machine or on the mold. In this way, pressure regulation is guaranteed and nitrogen consumption is minimized. The connection is provided by short, low-volume high pressure gas hoses and electrical cables.

The gas pressure is regulated by high precision valves. The valves are directly electrically controlled and need no additional compressed air or hydraulics. Thanks to the special construction of the pressure regulator modules, there is precise pressure regulation and monitoring of both small and large gas volumes. The pressure control modules and monomodules are fitted with intake and output filters.

In order to protect the precise pressure regulator valves against fouling by volatile gaseous substances released from the plastic on depressurization, all pressure control modules and monomodules are equipped as standard with pressure relief through a separate quick relief valve with a silencer. This quick relief is also advantageous for large gas volumes.



Monomodules

For many applications, gas injection at only one point is sufficient. For these applications, the monomodules (yellow housing) have been developed.

The monomodules offer the same advantages as the pressure regulator modules.

The differences are in the electrical control system. This can take place as described here:

Two selectable operating modes:

- **Operating mode 1:**
Function as pressure regulator module in combination with the stationary machine control unit or the mobile control cabinet.
- **Operating mode 2:**
Function as autonomously working monomodule. In this case, neither the stationary nor the mobile control unit are required. The monomodules are programmed by means of the hand programming device.

The connection of the monomodules with the injection molding machine is made directly via the machine interface. Using the duplex cable, up to two monomodules can be directly connected to the interface with one injection molding machine.

Monomodule standard features:

- Allows for setting of 5 different gas pressures and times.
- Pulse program for purging of gas injection modules.
- Pressure sensing for detecting leakage in moldings.
- Freely selectable ramp functions for pressure variations.
- Compact design for positioning close to mold ensures minimizing gas usage because of short piping to gas injection.
- Standardized EUROMAP 62 interface.
- 10 language options freely selectable.
- 64 data sets can be stored.
- Monitoring of input pressure.



Quick pressure relief function for pressure control modules and monomodules:

- All pressure control modules and monomodules are equipped with readily accessible and easily replaceable intake and output filters.
- In order to protect the precise pressure regulator valves against fouling by volatile gaseous substances released from the plastic on depressurization, all pressure control modules and monomodules are equipped as standard with pressure relief through a separate quick relief valve with a silencer.
- This quick relief is also advantageous for large gas volumes.

AIRMOULD® Gas injection

Nozzles

For the injection of nitrogen through the machine nozzle, the AIRMOULD® nozzles were conceived to introduce the nitrogen into the heart of the plastic melt. The AIRMOULD® nozzles prevent nitrogen entering the screw cylinder during the gas injection.

The AIRMOULD® nozzle is designed as an open nozzle. It is used when no shut-off nozzle is required for the melt. This means that it can also be easily retrofitted on existing injection molding machines. Its special advantage is its compact size.

If, for reasons related to the raw material or the molded part, however, a shut-off nozzle is necessary, the AIRMOULD® nozzle head is connected with a pin or cross bolt shut-off nozzle.



AIRMOULD® Nozzle

Injection modules

Fixed injection modules are permanently integrated into the mold. They are used when the fitting direction of the module coincides with the release direction of the molded part.

If this is not the case, these modules can be built into a moving slide or equipped with a separate drive to move them back and forth. WITTMANN BATTENFELD has developed injection modules for AIRMOULD® with external diameters of three, five and eight millimeters in various standard lengths.

Advantages:

- **High gas throughflow**
For internal gas pressure injection molding, the gas pressure has to be built up quickly. All WITTMANN BATTENFELD injection modules therefore feature high gas throughflow.
- **Gas throughflow optimization**
All modules are tested for gas throughflow before delivery. This ensures that all gas modules of one diameter permit the same gas throughflow.
- **Easy installation**
The injection module is installed and sealed from the rear of the mold.
- **Easy cleaning**
If necessary, cleaning can be carried out in a few seconds by unscrewing the module head when the mold is open.
- **Optimum choice**
Modules with diameters of three, five and eight millimeters are available in standard lengths. This ensures the supply of spare parts, even at short notice.
- **Individual adjustment of immersion depth**
For optimum adjustment of the module's immersion depth, the adapter supplied can be ground to the required length. Any adjustment of the immersion depth necessary for optimization is also possible by straightforward grinding down of the adapter.
- **Small aperture in the molded part**
The aperture in the molded part corresponds with the diameter of the injection module.



Injection modules



Injection module with adapter

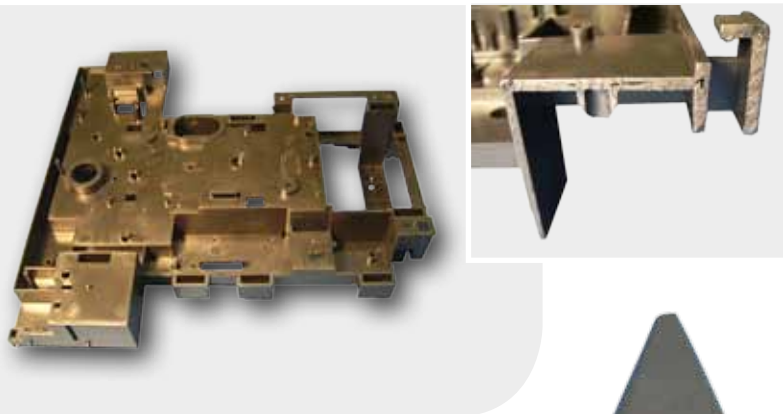
AIRMOULD® Modular System: configuration possibilities



AIRMOULD®







AIRMOULD®



Projectile injection technology

This fluid injection technology consists in driving a projectile through previously injected melt with the help of gas or water pressure. The projectile forms the hollow space. The fluid injection processes used are AIRMOULD® (gas injection technology) and AQUAMOULD® (water injection technology).

This process is specially recommended for tubes and media conduits requiring a constant interior diameter with low wall thickness. Handles and other molded parts with large hollow spaces of constant diameter can also be produced with projectile injection technology.

Depending on the specific molded part, either a short shot process, an overflow process or a melt backpressure process is used in production.

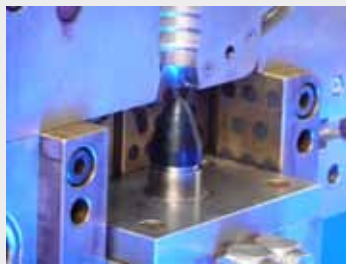
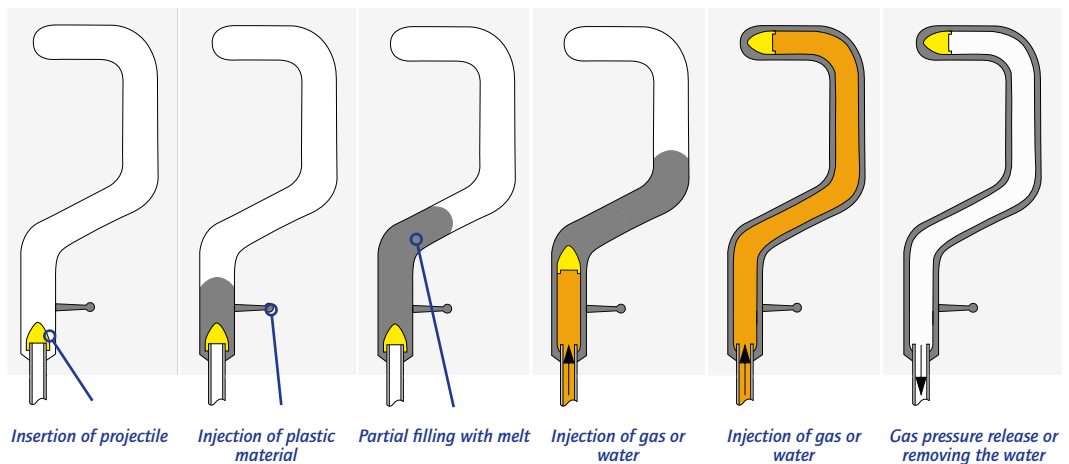
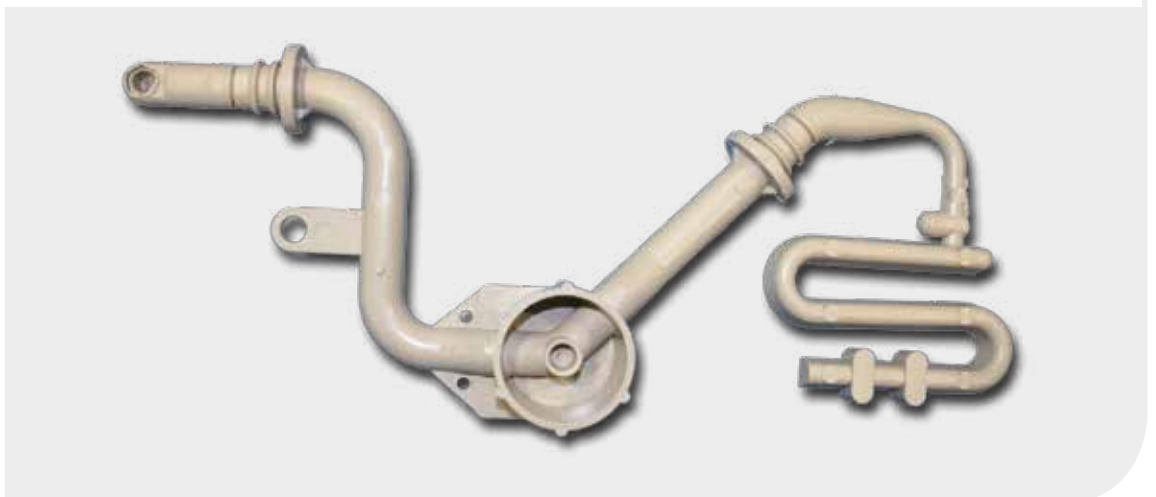


Photo: courtesy of IKV Aachen



Photo: courtesy of IKV Aachen





AQUAMOULD® – Water assisted injection molding

In the AQUAMOULD® process, water is injected directly into the melt.

Advantages:

- Short cooling times thanks to direct cooling of the plastic.
- Weight reduction thanks to cavities.
- Low warp molded parts.
- More uniform residual wall thickness distributions.
- Smooth cavity surfaces inside the molded part.
- Long cavities can be realized.
- Low costs for the medium, water.



AQUAMOULD® Water injection technology

The process technology in the AQUAMOULD® process is similar to the internal gas pressure process AIRMOULD®. The essential difference is that, in the case of AQUAMOULD®, water is injected instead of nitrogen.

With AQUAMOULD®, molded parts can be achieved which are not only free of sink points, but also low in stress.

The water injection technology is particularly suitable for the following product groups:

- Moldings in which the aesthetics dominate, e. g. handles, thick walled parts.
- Functional parts for which medium conducting channels are necessary, e. g. pipes, lines carrying media.

Internal water pressure process

In addition to the process of partial filling with plastic and subsequent complete filling of the cavity by the injection of water, there are other water injection processes. The type of internal water pressure technology applied to the molded part concerned depends on the part geometry, the raw material and the requirements on the product.

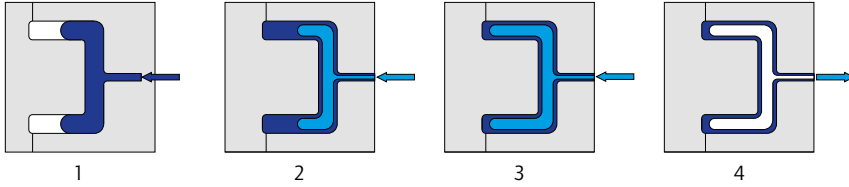
Applicable process options:

- Partial filling process.
- Ancillary cavity process.
- Melt back pressure process.
- Multifoam process.

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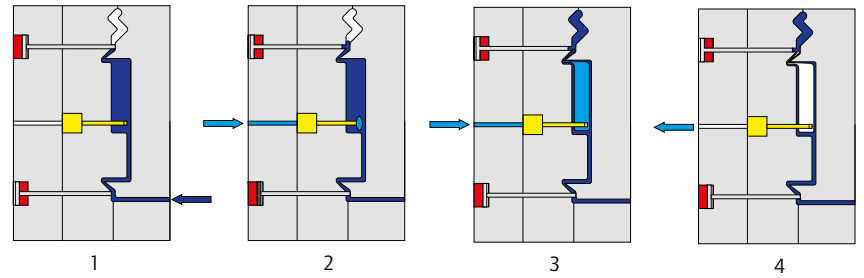
The AQUAMOULD® Internal water pressure processes in detail

The partial filling process



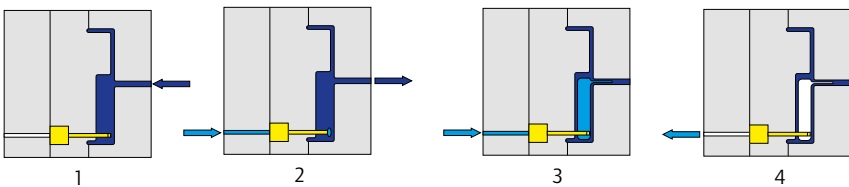
In the partial filling process, the cavity is pre-filled with melt (1), then water is injected (2), displacing the melt and causing the complete filling of the cavity. The water is injected through an AQUAMOULD® injection module into the sprue distributor or directly into the molded part. The water pressure is maintained as holding pressure (3) until the molded part has cooled down sufficiently. The water is drained off before the mold is opened (4).

The overflow cavity process



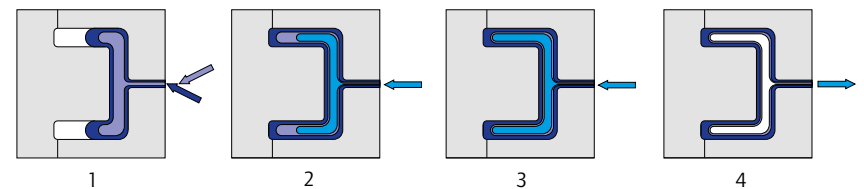
First, the cavity is completely filled with melt (1). If necessary, holding pressure is applied above the melt. The water is now injected (2), displacing melt from the cavity into the overflow. The water pressure is maintained as holding pressure (3) until the molded part has cooled down sufficiently. The water is drained off before the mold is opened (4).

The melt back pressure process



First, the cavity is completely filled with melt (1). If necessary, holding pressure is applied above the melt. The water is injected through an AQUAMOULD® injection module into the water channel at the end of the flow path (2), forcing melt back into the screw vestibule. Then the machine nozzle is closed. The water pressure is maintained as holding pressure (3) until the molded part has cooled down sufficiently. The water is drained off before the mold is opened (4).

The multifoam process*



After injection of a specific quantity of skin material, the core material is injected. The volume, however, is not sufficient to fill the mold cavity (1). The filling is completed by the injection of water (2). The water pressure is maintained as holding pressure (3) until the molded part has cooled down sufficiently. The water is drained off before the mold is opened (4). The multifoam process can also be combined with the mold and process techniques described above.

Plastic
 Water
 Mold
 Hydraulic system
 Injection module

*
 Skin material
 Core material

Das AQUAMOULD® Modular System

Pressure generation units

The water must be compressed to a sufficiently high pressure for injection.

Water pressure control

The water pressure is regulated. Regulation of the pressure takes place by means of compact pressure regulation modules. It is controlled either through the machine control system or by a separate control unit.

Water injection

The water is injected through AQUAMOULD® injection modules fitted directly in the mold. All AQUAMOULD® components are mutually compatible. This means that the optimum system can be constructed for the application.

Pressure generation units – Series WE

Type	Final pressure	LP Pump	HP Pump	Water delivery	Reservoir	approx. Dimensions	approx. Weight
	bar	kW	kW	ltr/h	ltr	mm	kg
WE 60	330	0.37	1.1	60	1 x 32	1,950 x 800 x 1,800	480
WE 100	330	0.37	1.5	100	2 x 32	1,950 x 800 x 1,800	530
WE 200	330	0.37	3.0	200	2 x 32	1,950 x 800 x 1,800	610

The pressure generation units of the WE series for AQUAMOULD® are constructed as compact, noise-insulated units and mounted on wheels. Water of drinking water quality is used. All parts in contact with water are made either of copper (low pressure region) or stainless steel (high pressure region).

The connection to the injection molding machine is provided by stainless steel pipes, high pressure gas hoses and screwed fittings.

Standard pressure generation units for water are supplied with outputs from 60 to 200 l/h. Other sizes are available on request.

Advantages:

- High performance, compact units.
- Low space requirement.
- Supply of two injection molding machines simultaneously (option).
- High water injection performance thanks to reservoir system.



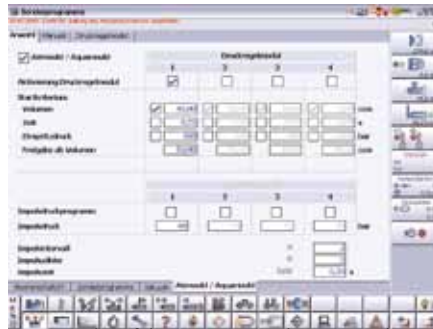
AQUAMOULD® Pressure control and regulation

The injection of water is carried out with regulated pressure, which has a direct influence on the delivery volume. The water pressure control system consists of the electrical control unit in combination with one or more water pressure regulator modules.

Stationary control unit UNILOG B6

The stationary pressure control system consists of the electrical control unit integrated in the WITTMANN BATTENFELD machine control unit UNILOG B6 and of up to eight water pressure regulator modules. The control system permits the operation of up to eight pressure regulator modules. The pressure regulator modules are connected to the injection molding machine by a simple plug or piped fitting.

The pressure profiles selected are displayed graphically. The actual value pressure curves for all pressure regulator modules can be displayed simultaneously. A particular advantage for the machine operator is the fact that the gas pressure curves can be displayed in one graphic,



View of the AIRMOULD® select command screen

together with the machine graphs for the pressure values, distances, times etc.



Screen view: Actual value graphic

The data are saved together with the machine data, with data output via a USB flash drive.

Mobile control unit UNILOG B6

The mobile control unit is connected to the injection molding machine via an interface. The interface used is the EM 62 interface from VDMA, which is standardized for fluid injection.

The mobile control unit provides the following programs:

- Pressure monitoring program.
- Control of the opening and closing function of the water injection modules.
- Control of core pull functions (directional control valves).

Advantages of the mobile control unit with touch screen operation:

- Menu guided operator friendly operation.
- Pressure profile input with set curve and up to 9 freely programmable positions.
- All time indications with 1/100 s accuracy.
- Actual value graphic for pressure curves in profile form for up to 8 pressure control modules simultaneously.
- Up to 8 pressure control modules or monomodels can be connected.
- Compatible with all AIRMOULD®/AQUAMOULD® components, e. g. pressure control modules, monomodels, pressure motion modules.
- Program for control of cores (directional control valves): software (standard), hardware (option).
- Diagnostic function (check of signal exchange).
- Manual operation function (check function injection modules and cores).
- Software for operating hours counter.
- Online selection of imperial and metric units.
- Operator manual incl. hydr., mech. and electric plans and diagrams online.
- Quality table, 1,000 storage depth, pressure integral monitoring for AIRMOULD® and AQUAMOULD®.
- Parts counter with good/bad part evaluation.
- Envelope curve monitoring (for 4 curves).
- Ethernet interface at the switch cabinet.
- Printing via USB connection or network.



WinXP™ as operating system gives easy gateways to IT systems:

- 15" TFT color screen with unrestricted touch screen functions for operation and display.
- 2 rows of soft keys to select machine functions.
- Access authorization via USB flash drive.
- Access protected via password system.
- Freely configurable status bar.
- Logbook with filter function.
- Quality table, 1,000 storage depth.
- Internal data storage via USB connection or network.
- Online language selection.
- User configurable text.
- Hardcopy function.

AQUAMOULD® Water pressure regulation

Pressure control modules

The regulation of water pressures is carried out by pressure control modules. The compact construction of the AQUAMOULD® pressure control modules permits their installation in the immediate vicinity of the mold, providing very precise regulation and minimizing pressure drop and performance losses in the water injection.

The water pressure is regulated in profile form. This results in an optimum influence on the water volume delivery during injection and on the water pressure during the holding and cooling phases.

Leakage-free proportional valves with a water throughflow of up to 500 ml/s regulate the water pressure precisely when injecting either small or large volumes of water. As the valves are directly electrically controlled, a pressure or hydraulic oil supply is not necessary.



Water injection

AQUAMOULD® Injection modules

The water is injected directly through injection modules in the mold.

The demands on injection modules are:

- Small construction.
- Large section for water flow.
- Opening and closing function.
- Leakage-free.
- Simple assembly.

Advantages:

- Safe separation between water and oil.
- Position control by proximity switch.
- Easy fitting.



Water removal from the molded part

In order to empty the water out of the molded part with the mold closed, the following solutions have proven effective:

Gravity removal

If the geometry of the molded part and the fitting position of the mold permit, the water in the molded part can be removed from the part through the AQUAMOULD® pressure regulator module.

Blowing out with compressed gas

If a second injection module is fitted at the end of the channel formed by the water, the gas injected through this module, e. g. compressed air, can expel the water in the cavity through the AQUAMOULD® injection module.

Alternating compressed air feed

If alternating compressed air is input through the water injection module and the geometry of the molded part and the fitting position of the mold permit, the water in the molded part can be removed through the water injection aperture.

Vacuum removal

By the application of a vacuum, the water can be removed through the AQUAMOULD® injection module.

The AQUAMOULD® Modular System is optimally tuned to the requirements of the AQUAMOULD® process and has proven itself in practice.

The competence of the machine manufacturer gives the user of the AQUAMOULD® process the assistance he requires in the design and selection of the most suitable AQUAMOULD® system.

WITTMANN BATTENFELD is offering the following services:

- Support from conception to series production.
- Molding design for the process.
- Specification of melt and gas or water injection.
- Design of injection molding machine, mold, AIRMOULD® or AQUAMOULD® Modular System, automation.
- Complete production solutions, including all components required, for AIRMOULD® or AQUAMOULD®.
- Trials in a WITTMANN BATTENFELD technical facility.
- Training courses at WITTMANN BATTENFELD or on the customer's premises.



Technology working for you.

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