

Injection moulding
technology and market
developments

ARBURG

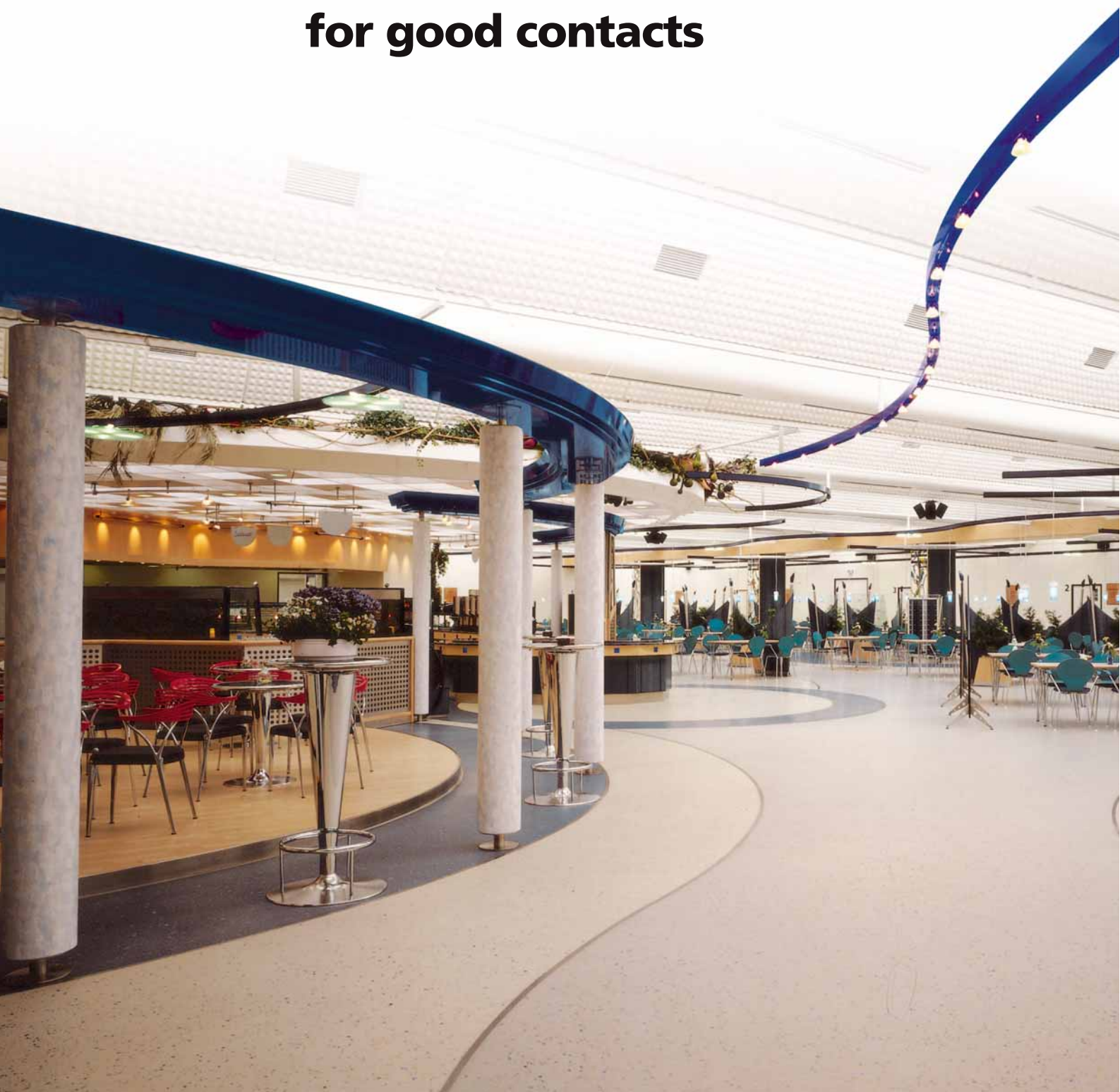
today

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■ The new ARBURG Allround Center: The ideal forum for good contacts



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IMPRINT

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EDITORIAL



"Communication" has recently become something of a watchword, and the concept of "worldwide communication" is nowadays a major factor in determining corporate success or failure. The widely debated "global village" is approaching inexorably at an ever increasing speed.

As an internationally operating enterprise, we cannot afford to ignore the changes which are taking place. On the contrary: It is our duty to take advantage of them in order to prepare for a more flexible, faster response to the increasingly stringent demands of the global market. To allow us to offer our customers the most efficient service and the best possible back-up at all times. Whether in Stuttgart or Hong Kong.

We believe that there are certain tendencies involved in this development which we are obliged to work against. Despite the fact that communication itself is becoming increasingly simpler, it is losing the all-important personal element.

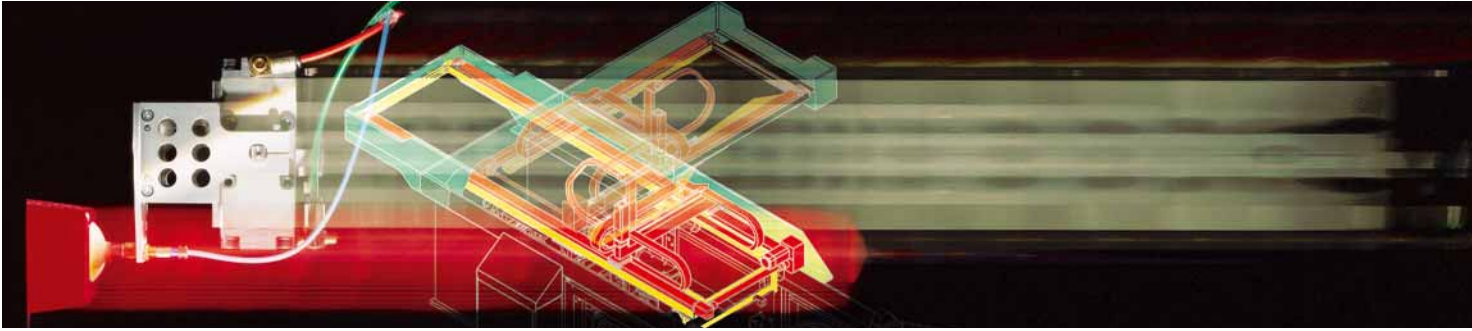
The opening of our new "Allround Center" is a bid to retain the human touch in the increasingly impersonal high-tech world of commerce. It is a centre designed to promote personal communication. Communication between experts and customers, tutors and trainees. And, importantly, between the members of our staff.

For the further development of a innovative enterprise, personal communication is, and will always remain, of extreme importance. It is an essential ingredient in the potpourri which makes up a "good working climate". This is your opportunity to find out more: This issue of "Today" includes, among a number of interesting features and articles, detailed information on the new "Allround Center". We also look forward to welcoming you in person at the Center.

Best regards,

Karl Hehl

Eugen Hehl



From one and the same mould: Handling technology from ARBURG

A wide range of specialized handling systems do exist which can be applied without problems to ARBURG Allrounders. However, these are basic devices generally requiring initial adaptation to the machine and application in question. To be in a position to offer customers no-compromise handling performance, ARBURG constructs its own specially designed handling systems.

The result is a series of integrated handling solutions whose mechanical, electrical and control engineering concept is tuned precisely to the Allrounder machines. By completely integrating all handling processes into the Selogica machine control system, it has been possible to implement a standardized operating philosophy opening up scope for universal programming possibilities.

The range of ARBURG part removal systems stretches from the simple picker right through to complete solutions including loading and outward transport.

The ARBURG integral picker

The integral picker is used in the Allrounder S, and is adapted ideally to the re-

quirements of this machine range. The handling device is placed as close as possible to the clamping unit, and has been designed to ensure maximum space savings in order not to impair access to the mould.

The picker is transported on a cam plate, with the starting position of the grab parallel to the clamping unit and the end position at right angles to the mould closure.

This design allows the picker to operate during the entire clamp movement sequence (removal and ejection) within the safety guard of the standard machine area. All the elements of the pickers are driven pneumatically. As it approaches the end positions, the picker movement is cushioned and electrically monitored.

The grab is fitted as standard with a pincer, other options include a part detection sensor, a vacuum grab and a rotary grab. Installation of a pincer with an opening angle of less than 30 degrees is another option.

The ARBURG picker

The "classical solution" in the form of a mounted picker also forms part of the ARBURG handling device

With its Allrounder injection moulding technology, ARBURG aims to develop and offer customer-specific solutions. Allrounder working positions, Vario and modular systems are all based on this underlying philosophy. The company is also keen to offer requirement-oriented systems when it comes to peripherals. Case in point: handling technology.

range. The device is pneumatically driven and controlled by limit switches. The entire removal process is integrated in the machine's operating cycle, and all removal functions can be programmed using the control editor of the Selogica. The picker also features simultaneous traversing of axes and optional part removal with different movements for good parts and rejects.

ARBURG NC handling device

The insertion and removal handling device is designed to cater to Allrounder V machines featuring Selogica control. Three NC axes powered by servomotors and integrated resolver technology ensure a high degree of positioning accuracy. Axis movements are freely programmable. The gantry-type device can be mounted longitudinally or transversely to the machine axis. The axes can be adjusted to suit customer and application-specific requirements.

The deposit pattern (matrix) is freely programmable, enabling the removal handling device to be used for depositing moulded parts on a conveyor belt, in a container, stacking unit or container changing unit.

The insertion and removal handling device is also capable of picking parts for insertion out of a magazine and transporting them into the clamping unit. With a comprehensive collision prevention system, the 3-axis NC handling devices also conform to the state of the art as regards safety. Once again, all required actions can be programmed completely using the Selogica machine control system.

Practical implementation

Right from the beginning of the development work, a team of specialists liaised closely with customers requiring a complete solution from ARBURG. Cooperation of this nature is aimed at creating an optimum overall system from the point of view of timing, costing, functional aspects and servicing convenience. Retrofitting of existing machines is also possible without problems.

The priority for ARBURG is to ensure that its customers are wholly satisfied with their individual injection moulding and handling solutions, through specialized engineering expertise and comprehensive dialogue between user and supplier.

Global sales strategy with a comprehensive service package



Heinrich Fritz
Managing Director Sales

The major world markets are growing ever closer together. This fact, and the diminishing length of economic cycles mean an ever greater effort on the part of innovative enterprises when it comes to the development and implementation of a clearly outlined, consistent, target-oriented and global sales strategy. ARBURG's Managing Director Sales Dipl.-Ing. Heinrich Fritz and his dedicated team intend to face this tough challenge with a consistent strategy over the coming years. Heinrich Fritz's operating division covers domestic and foreign sales, technical after-sales service, order and project processing as well as support for the international sales and service network.

ARBURG intends to secure its continued market success on the basis of a classical sales division structure, with the company's Lossburg headquarters responsible for German sales.

Four regional sales managers catering to the various regions lead a team of twenty decentrally located sales representatives. These receive application-related support not only from Lossburg but also from the ARBURG Technology Centers (ATC) in Radevormwald and Rednitzhembach.

Modern technology as a basis for efficient consultancy

Equipped with the latest communication technology, the sales representative can come up with just the right machine configuration and compile a custom-tailored quotation while still on the customer's premises.

Heinrich Fritz considers this new capability as a decisive step into the future. He aims, backed with this and similar state-of-the-art technology, to make ARBURG Germany's market leader. Accounting for a quota of almost 40% of ARBURG's total production output, Germany is the company's biggest and most important

single market.

According to official VDMA figures, in 1995 ARBURG sales accounted for 80% of total machines sold in the under 250 kN clamping force category, 58% in the 251 to 1000 kN category and still an impressive 24% of all machines sold in the 1001 to 4000 kN category. Taken over the whole size range, ARBURG's market share amounts to 47%.

Over 60% of Allrounders sold are destined for foreign markets. As Heinrich Fritz points out, this necessitates a comprehensive and strategic organization. In 1985, ARBURG launched the successive development of its own sales network for the world's most important markets with the foundation of its own sales subsidiary in France.

21 branches around the world

Today, ARBURG Allround Sales & Service Centers exist in 15 countries around the world with a total of 21 locations. Coverage is most comprehensive in Europe, with branches in France, Spain, Italy, England, the Netherlands, Belgium, Switzerland and Poland.

Five ARBURG locations exist in the USA, and Asia is represented with a total of eight centres in Singapore, Malaysia, Indonesia, Thailand, Hong Kong and Japan.

Heinrich Fritz is able to confirm that creating the

company's own presence in the world's most important markets has proven to be the right approach, not only in terms of sales and consultancy, but primarily also when it comes to providing essential services by highly qualified staff on site. ARBURG also imposes the same stringent standards on its trading partners located in over 40 other countries around the world.

Further expansion of ARBURG's global presence

As Heinrich Fritz points out, ARBURG's strategy for further growth lies firmly entrenched in the further expansion of its export markets, and so in the globalization of its overall business in the three major economic growth regions Europe, North and South America and the Asian-Pacific region. ARBURG views the Asian-Pacific region as offering the greatest potential for growth in the medium term, and is accordingly continuing to expand its network of subsidiaries overseas as well as in Europe in a bid to strengthen its trading relationships worldwide. Over 80000 ARBURG Allrounder machines are operating in over 100 countries around the world, and the company intends to further expand this level in the future by pursuing the modular Allrounder product philosophy and sales

strategy outlined here.

Success through a perfected service back-up

Heinrich Fritz considers the field of customer services to play an important role in achieving this end. Servicing and after-sales back-up have traditionally assumed a high degree of importance at ARBURG. Speed is of the essence here, with 17 service centres and over 60 service technicians helping to provide an effective safety net to deal with any occurring problems. ARBURG servicing vehicles all carry some 5000 spare parts valued at over 100,000 DM as well as all the necessary measurement and calibration devices.

The company's international service activities are based on the motto "Service first, then sales". This policy, explains Heinrich Fritz, means that no ARBURG machine is ever supplied to a country without a qualified service back-up. This guarantees the existence of a fully functional, flexible service network, which Fritz sees as an essential factor in highlighting the image of German and predominantly ARBURG products as representative of an exemplary standard of quality.

But "Allround Service" means much more than this at ARBURG. For over 25 years, ARBURG has been passing its expertise on to its customers in the form of training courses. Every year, some 2500 candidates receive further training in Germany and several hundred more abroad.

Well over 40000 customers have already benefited from a variety of fundamental and advanced train-



ARBURG maintains 21 branches and trading contacts in more than 100 countries.

ing courses at ARBURG.

High-speed spare parts service

Another important aspect of an exemplary service back-up for Heinrich Fritz is the fast availability of spare parts. The state-of-the-art high bay warehouse in Lossburg guarantees fast, trouble-free availability.

Orders placed before 3.30 in the afternoon are dispatched the same day, Fritz is proud to report, that in urgent cases customers can be in possession of the required spares by nine the next morning. All service centres, foreign subsidiaries and a large number of the company's trade partners also maintain their own stock of spares to ensure the smooth running of this excellent service around the globe.

Online connections between Lossburg, the service centres, and the branches

in Europe and the USA guarantee direct accessibility of all spare parts inventories and consequently also minimal delivery periods. The ARBURG "global network", confirms Fritz, offers the benefit of unlimited communication capability and fast response to customer enquiries. Transparent inventories for spares and machines, technical specifications and master data as well as up-to-the-minute information on the status of machine orders and production represent major operational benefits.

Finally, customer support in the field of application technology represents an important pillar of the ARBURG service range. Experienced staff members provide support in the clarification of detail questions through to complete system engineering concepts. These include questions on material-specific moulding

design, material selection, process engineering, mould design, production design and automation. In Lossburg alone, just under 700 customer-specific tests were performed in 1995.

A team of some 500 staff members, representing around a third of the total ARBURG workforce, are concerned with addressing the needs of the company's customers around the globe. 230 of these alone operate outside of Germany, and this figure does not include the extensive force of specialists employed by trade partners. These statistics go a long way towards confirming ARBURG's sales strategy and illustrating the company's position as a pioneering force in national and international markets in the field of injection moulding technology.

Eaton: High tech for vehicles

With the creation of the Torbensen Gear and Axle Company way back in 1911, the foundations were being laid for a corporation which today numbers among the most important manufacturers of high-tech products and systems used in many sectors of industry: The Eaton Corporation, a joint-stock company based in Cleveland, Ohio. With almost 150 locations and producing plants to its name, today Eaton is one of the biggest producers in its field world wide.



Efficient organization down to the last detail:
The injection moulding department in Langenlonsheim

Today, Eaton's manufacturing range numbers over 40,000 different products. With a workforce of just under 52,000 spread over five continents, Eaton serves all the major global markets. Its turnover for 1995 reached the 6.8 billion USD level.

Where Eaton uses injection moulding technology

Points of contact between Eaton and ARBURG arise particularly in the fields of automotive components, switch production and control engineering. These are areas requiring a large proportion of plastic components.

The Langenlonsheim plant: Exemplary production using Allround injection moulding machines

The town of Langenlonsheim in the Rhine-Hessen region near Bad Kreuznach

is home to one of Eaton's European manufacturing plants. The plastics injection moulding department is concerned exclusively with producing parts for the automotive industry.

Eaton produces one of the world's largest ranges of switch, valve and control engineering components for use in vehicles. These include parts for air conditioning systems, speed control and engine management systems as well as switches used to control a range of functions in motor vehicles.

3-shift operation in the injection moulding department

Some 400,000 individual components are produced every day around the clock in three-shift operation. The injection moulding department specializes exclusively in high-precision, technically demanding plastic com-

ponents. The shot weights processed here range from 0.5 g through to 170 g. The vast majority of the 1000 different articles produced in Langenlonsheim every year are made using technical plastics. 200 different materials are used for injection, with the emphasis on polyamides, polycarbonates, PMMA, PBTP and POM.

Of the 66 machines in operation in the injection moulding department, 52 are ARBURG Allrounders. Of these, 44 are standard machines. Two Allrounders process two components, and another one processes three. The range of Allrounders at Eaton Controls is rounded off by five special machines adapted to meet company specifications.

Restructuring in line with the latest research

In 1994, the injection moulding department un-

derwent complete restructuring. New power and supply networks designed especially in line with the production hall as well as a new water recooling system were integrated, and the reorganized production was separated into the sections of special machines, multiple-component technology and standard machines, and took into consideration team and technology objectives.

Personnel arrangements were also completely restructured in the department. The customary "shift foreman", for instance, has disappeared from the scene at Langenlonsheim. Now three teams made up of fitters, process supervisors and mould makers in conjunction with two team operators take charge of organization in and between the different groups and also share joint process responsibility.



Eaton: High Tech ...

Moulding Workshop", or IMW for short. The IMW, introduced with a view to minimizing operational and process engineering problems, has exercised a highly beneficial effect on production quality and on the working atmosphere.

The area set aside for the workshop in the centre of the department is used as a centre where all members of the workforce can obtain information regarding targets and specifications in the field of pre-production, but also as a forum where employees can air their own initiatives and initiate changes.

Topics discussed in the IMW include productivity, the latest developments and trends, department objectives and also processes relating to "Action" management.

The "Action Board" provides every staff member with the opportunity to draw the attention of colleagues and superiors to existing problems and to provide impetus towards a solution. These suggestions are then considered and implemented by the specializing departments responsible.

Within a one-year period, over 100 improvements have been implemented using this system, bringing about a drastic reduction in costs for reworking and scrap.

Another major benefit is staff motivation: The system allows each and every employee to experience at first hand how his or her ideas can be put into practice.

Plans for the future: Even higher quality, further improvement of customer services

Further modernization is going on all the time in the injection moulding department at Langenlonsheim. A complex material supply in-

More productivity, less scrap: Positive results for the production facilities design, mould production and injection moulding teams at Eaton in Langenlonsheim.



stallation has already entered the project planning phase. Teams have been set up to cooperate on a cross-departmental basis with a view to implementing quality improvements while simultaneously reducing costs. There are also plans afoot to optimize material flow, permitting even more effective "just-in-time" deliveries.

A success rate to be proud of

This complex process of reorganization has met with an outstanding degree of success in the Langenlonsheim injection moulding department. Head of pre-production Ralf Ackermann can boast higher productivity coupled with an important drop in rework and scrap.

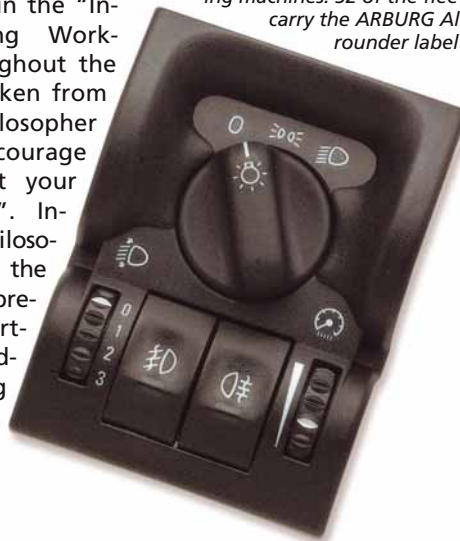
The motto underlying activities not only in the "Injection Moulding Workshop" but throughout the department is taken from the German philosopher Kant: "Have the courage to act on what your sense tells you". Inspired by this philosophy, together the members of the pre-production department have succeeded in encouraging individual work enjoyment and

satisfaction and, according to Ralf Ackermann, enhancing workplace safety.

Ackermann and his team have the utmost confidence in ARBURG when it comes to the solution of requirement-oriented injection moulding applications specific to their company's requirements.

The Langenlonsheim team appreciates the Allrounder machine engineering concept as hardwearing, economical and reliable - essential prerequisites for trouble-free, round-the-clock production. Ackermann also quotes ARBURG's comprehensive service back-up as a major purchase decision factor in its favour.

Some 1000 different articles are produced annually in Langenlonsheim on 66 injection moulding machines. 52 of the fleet carry the ARBURG Allrounder label



Gear manufacture: Saving time and money with injection moulding technology

The problems commonly encountered in the manufacture and reworking of gears moved ARBURG to consider alternative production methods. The injection moulding of powder materials, in particular the processing of metal powders for this application, proved a promising technique.

Conventional production methods and powder injection moulding: A comparison

The primary benefit offered by the injection moulding of metal powder as against traditional production methods is the reduced number of work stages involved. To produce a double gear with two different diameters on a single shaft, a total of 22 work steps are required when using conventional production methods.

The injection moulding technique, in contrast, involves only seven work stages. The process begins with injection moulding, followed by debinding, sintering, gauging and testing, surface hardening and grinding. Following a final inspection, the finished part is then packaged for delivery. This method eliminates not only elaborate gauging and quality inspection stages but also the assembly of multiple components and cleaning the individual parts.

The injection moulding of metal components also permits fully automatic production, meaning that the process is not only faster but



also more cost-effective than the traditional method.

Modification of part configuration

To allow injection moulding methods to be used in the manufacture of gear sets, certain adjustments to the part geometry were required. The solid shaft was configured as a hollow body in order to reduce weight and cut down on manufacturing cycles without influencing mechanical characteristics.

The thinner design used for the larger of the two gears meant material savings of some 6 grams per part, resulting in a weight reduction from 23.6 to 17.9 grams.

An additional benefit made possible through the injection moulding of metal parts was the facility for inscription of a company name, number code or manufacturing date without involving additional costs.

Material selection

The original material used for gear production was surface-treatable and case-

hardened C15 steel. This material is not available in powder form. For this reason, the choice of material was restricted to the low and high-alloy steels available in feedstock form.

One of the main requirements imposed on the selected powder material was its capacity for case hardening. The surface of the gears, in particular, must be hardened in order to withstand a high degree of abrasion, while the material of the "interior" must demonstrate sufficient tenacity to absorb occurring forces. Cost was another important factor in the choice of material, whereas no particular specifications were made with regard to corrosion.

The powder metal finally chosen was FeNi 2, whose low nickel content (below 4%) permits case-hardening. Although less hard and with a lower bending strength than the C15 steel originally used, it fully meets the specified values in terms of quality and resistance to wear.

Comprehensive sinter tests

Before taking up production, detailed sinter tests were run to resolve important factors such as optimum furnace temperatures and atmospheric conditions, as well as part shrinkage.

The material blend was sintered in three different atmosphere types: In a vacuum, in nitrogen and hydrogen. Temperature levels reached 1140° and 1150°C (vacuum) respectively, and a uniform dwell period of 150 minutes was used.

The characteristics tested covered a number of different dimensions, the chemical composition of the parts before and after sintering, part density after sintering, part hardness after sintering and case hardening levels as well as surface properties.

Shrinkage of powder injection mouldings generally occurs isotropically, in other words evenly in all directions. To confirm this assumption, 25 mouldings of each gear size were taken from every batch and gauged at 12 defined points.

Test results

The tests confirmed that practically identical shrinkage took place in terms of length. Only one point at which there was a material accumulation demonstrated lower shrinkage.

The results obtained for diameter shrinkage were comparable to those for length. At the point with the greatest accumulation of material, shrinkage of the diameter was less marked than at the other gauged points.

The diameter of the shaft end furthest in distance from the injection point also demonstrated less shrinkage than the section at the filling point. This is due to the pressure differential existing during the forming phase of the injected part.

The material covering the longest flow path in the

mould is clearly somewhat colder and is therefore not capable of the same compression as the "hotter" material. This brings about a lower green density, which in turn leads to less shrinkage.

To prevent cracks or out-size pores forming in the green body, optimization of the filling process is necessary.

Result: OK

The results obtained substantiate that, contrary to expectation, shrinkage is not isotropic but varied. Longitudinal shrinkage is also greater than diameter shrinkage. The explanation for this are the long molecules of the binder, some of which harden to crystalline formations.

Despite this drawback, the injection moulding process does permit the manufacture of reproducible injection mouldings conforming to quality requirements.

During the sintering process, the chemical composition of the mouldings changes due to the gas atmosphere existing in the furnace. Decarburation, i.e. the removal of carbon in the sintered part by molecules in the hydrogen atmosphere during sintering, permits the finished gear sets to be surface hardened.

Surface roughness is approximately eight microns, which permits direct assembly without the need for subsequent machining.



It was back in 1983 that technicians at the Lossburg headquarters first began to consider a radically new system intended to replace conventional spray coating methods with the wet coating system used by the All-rounders. The change was motivated in part by the prospect of more stringent environmental regulations, and in part by the aim of integrating surfacing technology into the main production process.

Flexible coating of castings using minimal resources

Based on the experience of an output of 1500 to 1800 square metres of coated surfaces per 8-hour shift, ARBURG launched into concrete planning for its new cast coating system. The objective was to provide the most economical way of heating the castings to the curing temperature of the powder, while reducing the cooling phase after coating to a minimum. The often extreme weight of the castings can considerably complicate the handling process. The particularly rough surface finish of sand castings also necessitates a special treatment process.

Despite these complications, a decision was taken at ARBURG in favour of environmentally friendly powder coating, which completely eliminates unwanted waste and effluent. Only raw components are processed, with the machining process taking place after coating. This eliminates the need for masking work, reducing production time and eliminating the corrosion of unmachined parts in storage. The entire plant was to operate on a fully automatic basis and be integrated into the existing material flow.

The smallest casting to be coated using the new system weighed 40 kg and measured 0.3 x 0.2 x 0.15 metres, the biggest tipped the scales at 1500 kg and was 1.4 x 1.4 and 1.0 metres in size.

The pre-production trials necessary in the development of this type of plant were highly detailed, and were

performed on a step-by-step basis in every field of the process and plant engineering sector.

Versatile conveying system

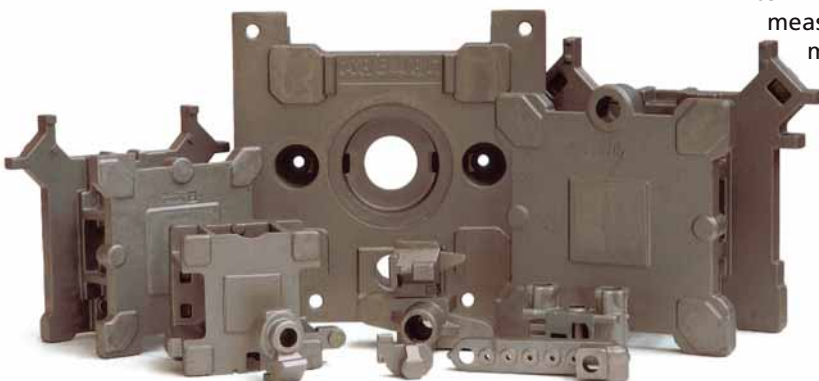
The cast coating plant operates using a conveying system comprising roller tracks, suspension chain conveyors and a rail-bound distributor truck. Workpieces are fed into the system using a simple technique. After positioning on the prepared truck carrier and keying the item number into the system, the workpiece-specific throughfeed program is selected by the computer, which conveys and processes the workpiece accordingly.

The various conveying systems are electrically and mechanically interconnected by means of interfaces. The distributor truck forms the nerve centre of the conveying system, running along rails and transporting the workpiece carriers between the individual stations of the coating plant. Loading and discharge to the individual stations on the left and right of the traversing path are performed by a telescopic fork. The traversing speed is 80 metres per minute.

Environmentally friendly preliminary treatment

Based on a rich fund of experience in the field of organic preliminary treatment gathered by ARBURG during other projects, the technicians in charge decided in favour of using a similar technique in this case.

The most immediately obvious advantage is the ability to degrease and phospho-



tize parts in a bath at room temperature. This process helps to filter out dirt and dust, as well as to discharge oil trapped in the phosphate layer. The long service life of the baths used for this process is another positive aspect of the system.

The degreasing process used during preliminary treatment of the castings works using with a dearomatized hydrocarbon as a solvent, which can be easily separated again from the exhaust air by means of a washing system. This method also permits the execution of a preliminary spray treatment, which offers decisive handling and safety benefits.

High recycling quota

Exhaust air occurring in the injection, extraction and drying zones is collected and purified with circulating water using a wet separator operating on the basis of the countercurrent principle. The solvent and water emulsion created by this process is guided via a special separator which separates the solvent phase from the water phase. The solvent is returned to the degreasing installation without further treatment, where it is reused. The water is pumped back to the wet separator. This process permits effluent values of up to 50 mg/m³ below the level of 150 mg/m³ stipulated by German air pollution legislation.

Optimized coating

The pre-treatment drying process heats the castings to a temperature of between 80 and 100°C. The heat produced in this way can be used for subsequent curing of the powder, as the parts are also coated while still warm. The heat supports sintering-on of the powder while the coating process is still going on, allowing a high air speed to be used subsequently during curing without running the risk of losing powder particles.

The thermal current created by the intrinsic heat of the parts also allows the reliable coating of grooves and undercuts, and permits the quantity of powder discharged to be reduced to a minimum.

The distributor truck moves the workpiece into the powder cabin, where it is positioned on a cross carriage and transported through.

The optimum operating mode is then selected depending the requirements imposed on the parts, as well as their shape and configuration. The cabin extraction system is arranged at floor level along the opening to the cabin in order to prevent the escape of powder to the outside. Two fully automated robots take care of the coating process itself.

Oven complex for flexible application

The oven complex used for pre-treatment drying and curing of the coated castings comprises three ovens, each of which has four individual compartments. In contrast to the remaining parts of the complex, the oven used for pre-treatment drying is heated indirectly. The installed rated heating output per oven is 560 kW, with the average power consumption of the complete oven complex totalling some 450 kW/h. The modular arrangement of oven compartments results in highly flexible application, avoids obstruction of certain parts by others, and allows parts to be dried for differing periods without major problems.

Cooling station heats service water

The workpieces are sprayed with cooling water in the cooling station by jets arranged in the ceiling. The medium used for cooling is recirculated water which is cooled in a heat exchanger. The recovered heat is fed to the plant's service water system.

Freely programmable control system

The entire installation is governed by a freely programmable control system, and graphically visualised on the monitor of an industrial PC. The controller monitors the complete installation and coordinates process sequences fully automatically. The item number entered for each casting is assigned with information such as the required drying time in the oven, the coating program and speed, as well as the indexing positions of the powder cabin and cooling time.

The operator is able to continuously document the current situation in the installation on screen. Available functions include the display and printout of op-

erating status and any errors or malfunctions in the system. The "end of shift" function permits the installation to be run empty without supervision

Above
Flexible conveying system

Below
External view of the coating cabin, where parts are automatically coated



CORPORATE HISTORY

ARBURG Evolution

Visitors to ARBURG can now cast their eyes over more than 70 years of corporate history in the company's own museum. In a total surface area of 350 m², the interested observer is offered a wealth of interesting information on ARBURG's beginnings and the many innovations which have contributed to the company's success.

The "ARBURG Story" begins back in the year 1923, when Arthur Hehl, a specialist in surgical mechanics, took up the production and sale of precision surgical instruments from his home.

Decisive for the development of the company as we know it today was the decision to produce flashlight devices, which was made in 1951. It was only the need to find a solution for a plug insulation problem that sparked the development of the first ARBURG injection moulding machine.

Visitors to the museum always express particular interest in this very first injection moulding machine, which technician and present-day company Chairman Karl Hehl made out of the parts of a detonated bridge back in 1956.

Only a year later, the first manually actuated injection moulding machine, the "C1" was introduced to the market, followed by a fully automatic injection moulding machine, the "C4b", of which more than 10,000 were sold worldwide.

The Allrounder concept was implemented for the first time in 1960. The ability to produce in 7 different working positions using a single machine made this concept a resounding success.

During the years that followed, a number of other machine series were developed on the basis of this concept. These developments, which are also on show to visitors in the "Evolution" centre, include the first hydraulic piston machine, the Allrounder 200, the Minirounder and the Allrounder 100.

The exhibition of mechanical engineering developments on show in the museum takes the visitor up until the mid-eighties. Later models on show are the first four tie-bar toggle machine, the Allrounder 305 ECO with on-screen control, and finally two models of the CMD series.

The development of the company premises is also illustrated for visitors to the "Evolution". Today's company headquarters in Lossburg are the result of numerous building phases which have produced a total usable area of around 100,000 m².

The survey provided of the company's product and machine range is documented by a rich variety of pictorial material.



ARBURG LOSSBURG

The new Allround Center and personnel can get to



The area is used both for in-house events and exhibitions. First to enjoy the generous facilities of the "Allround Center" were visitors to this year's in-house exhibition at ARBURG.

The focus of attraction in the new centre is undoubtedly the food preparation area. The kitchen is under the supervision of a permanently tenured chef and complies with the latest standards of hygiene.

Free-flow area and serving

Guests to the "Allround Center" are free to concoct their own menus from a rich variety of freshly prepared and attractively presented dishes in the free-flow area.

Behind the scenes, a whole team is working to satisfy the gastronomic expecta-

tions of staff and visitors alike. The entire catering service is kept completely separate from the rest of the company divisions, and access is only permitted to authorized personnel. The low temperature storage area and the supply and service rooms for the kitchen are located directly under the kitchen complex, connected by a separate freight elevator.

Convenient for training courses

The entire catering area is air conditioned. Just like the light system and sound system, the air conditioning can be controlled from a central computer system with touch screen capability.

The six training rooms used for customer training are directly connected to the catering area, making

: Where customers gather

Seating for 380 and unbeatable service: These describe none other than the new recreation and catering area in ARBURG's Lossburg headquarters. The 2000 square metre complex with its adjacent training rooms goes by the name of the "Allround Center", and is just as variable as the machines from which it gets its name.



this a convenient spot for relaxation during breaks in the often gruelling training schedule. A separate conference room accommodating 30 completes the facilities offered by the "Allround Center".

"Disposal center" for optimized processing of scraps

Food waste is centrally separated and disposed of in the "Disposal center". Crockery is arranged in specially prepared dishwasher baskets which are automatically fed into the industrial dishwasher and cleaned. The baskets are coded to permit different types of cleaning cycle to be applied for different types of crockery.

Glasses and cups are not removed from the baskets after completion of the washing cycle, but are re-

turned to the "point of sale" without being touched by human hand. The plates are kept warm in special containers until required.

As regards the optimized use of energy, too, the cleaning system offers a highly interesting alternative. It is fitted with a heat recovery system which in turn is used for temperature stabilization of the service water. The dishwater is also recycled and used for the dishwasher rinse cycle.

Accounting through chipcards

Staff members using the facility pay for their meals using chip cards, while special guest cards are provided for guests and visitors.

Despite the application of all the latest technical conveniences, there are still a few outstanding details

"on the menu" which are just at the point of being implemented. An independent computer-controlled ordering and order scheduling system for the kitchen is in the pipeline. This will permit faster shopping and more flexible response to price fluctuations in the food sector.

Positive response

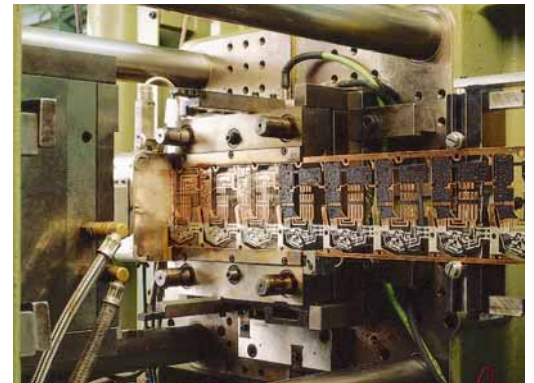
The new facility has met with the unreserved approval of customers and visitors, as well as ARBURG staff.

One of its most popular aspects is the self-service concept, which allows each individual to compose his or her own personal menu. The resounding vote of approval for the "Allround Center" which has been sounding loud and clear since its opening is clear proof that the quality and

choice of offered food are well up to scratch - because eating is much more than just keeping body and soul together...



Using techniques developed in the **company's own production facilities design department**, it is now possible to produce six different contact units using one machine and only a single injection mould



The special machine division:
Comprising exclusively ARBURG machines

Quality first: A claim and a philosophy put into practice at Langenlonsheim by personnel on their own responsibility

The application of new technologies, effective personnel qualification structures, more flexible working hours and variable shift models brought about an impressive increase in productivity as well as enhancing job satisfaction throughout the injection moulding department workforce.

Multi-component machines

Two and three-component injection moulding techniques are used primarily in Langenlonsheim for the manufacture of keys. High precision is the watchword here, primarily because

these are components in the user's direct line of vision. Part transparency is also an important factor, as it plays a vital role in ensuring an optimum signalling effect of the switch.

Three-component machines are also used for the manufacture of high-grade keys. A 420 M 800/100/100 Allrounder with a comprehensive peripheral package, a mould rotary platen and a complex hot runner system is used to fulfil the sophisticated functions involved here.

Special machines

In the special machine division, high-precision strip conductors are fed directly to the injection moulding machines, fully automatically coated to create contact units and then magazine.

This highly complex and interesting application is

performed at Eaton exclusively on injection moulding machines from ARBURG. Alongside a 320 D 500/210 Allrounder, this division also accommodates a 270 M 500/90 Allrounder, a 320 M 500/90 Allrounder and two 370 C Allrounders with 600 and 800 kN clamping force and 100 and 225 injection units respectively. The D and M Allrounders are configured as U-version machines with a vertically arranged injection unit for production on the parting line.

Quality assurance: Priority number one

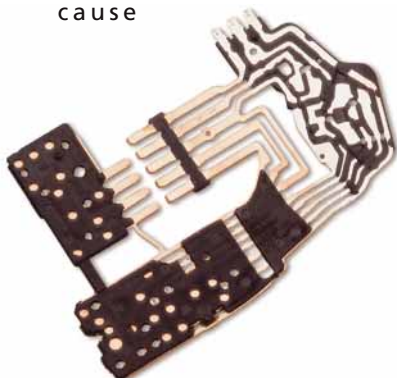
Quality control in the conventional sense is a thing of the past in the Langenlonsheim injection moulding department. The workforce is sufficiently highly qualified to perform its own testing. So-called "self-inspection" is carried

out according to testing and inspection schedules which include and stipulate all the quality-relevant characteristics to be tested.

The "EPIC" or "Eaton Plastics Initiative Council" is another of the company's quality promotion measures. Once a year, all those concerned with plastics processing from the whole company group meet to create an international forum for the exchange of valuable know-how and expertise.

Seeking and implementing problem solutions: The "Injection Moulding Workshop"

Ralf Ackermann, pre-production supervisor at Langenlonsheim with responsibility for the injection moulding department, has entered into previously uncharted territory with the introduction of the "Injection



An efficiently run spare parts service can go a long way towards minimizing costly machine downtime. When spares are needed, they should ideally be quickly available. With its computer-aided spare parts system, ARBURG has brought this important service down to a fine art. Ensuring a fast, effective spare parts service where and when it is needed has top priority for ARBURG.

All incoming spare parts orders are taken care of by an experienced team of experts, well drilled in all aspects of spare parts and special accessories to ensure fast, efficient processing. That the entire logistic process involved in each individual order is computer-aided goes without saying: It is

only with the backing of efficient data processing that speed, reliability and adherence to strict deadlines can be successfully combined.

Precise team work spells fast delivery

Customers in Germany placing an order for a spare part available from ARBURG

before 3.30 p.m. may generally expect to receive the required component by the next morning. This outstanding service claim is substantiated by ARBURG day in, day out. But what goes on "behind the scenes" to ensure trouble-free running of this exceptional customer service?

The secret lies first and foremost in effective team work. When a customer calls the ARBURG spare parts service, it is possible on the basis of the machine number to check instantaneously whether the required part is actually con-

tained in or will fit the specified machine. The order is then entered straight away on line into the computer system. It is possible to inform the customer imme-

Support from the computer
to pick the required components from the automatically delivered pallet



Always there when you need them



Completely computer-controlled
Ordered parts are retrieved from storage without human intervention

diately over the phone whether the required part is available, and also to quote the price.

The entire inventory of spare parts carried on each of the after-sales service vehicles operating throughout Germany can be accessed at any time on-screen. If a service technician is currently located in the vicinity of the customer, he can be informed on the European radio paging system and deliver the spare part directly with minimum delay.

Global spare parts network

95% of spare parts are directly available from ARBURG. But for that important 5% which are not in stock, ARBURG has devised a solution ensuring the fastest possible delivery: Using online connections, it is possible to access the inventories of almost all its branches and service centres around the world. If an urgently required spare



is available in one of these locations, it will be with the customer within 24 hours. The benefits of interlinking are naturally also utilized in the other direction.

Help is also at hand in cases of vital urgency. The spare parts service team member asks every customer when the spare part is required. In cases of extreme urgency, ARBURG can arrange for the part to be supplied to the customer before 9.00 a.m. the next day. Priority 2 cases are generally delivered before 12.00 a.m. An efficient system of cooperation between ARBURG and the contracted forwarding agent guarantees adherence to specified deadlines.

The telephone conversation between the customer and the spare parts service results in a computer print-out which serves as an order-picking document for preparation of the consignment. As no delivery note has yet been issued, at this preliminary stage, changes, for example of order quantity, or additional remarks can still be added.

Fully automated order picking

The consignment is put together for dispatch using a fully automated system. This system operates through the automatic removal of part containers from the high-bay, small parts and paternoster warehouses, which are then placed ready for manual order picking.

All the company's warehouses are equipped with the latest that modern logistics engineering can offer. ARBURG's parent plant in Lossburg, for example, boasts fully automated high-bay and small parts warehouses, which permit access to an active inventory of some 30,000 components. The high-bay warehouse is 121 metres long, 11 metres wide and 19 metres high. A total of three rack aisles, each equipped with automatic industrial trucks, accommodate 5600 pallets. The trucks move at a maximum speed of 160 metres per minute.

The in-house transport system conveys the picked items to the central shipping department, where they are packaged and prepared for dispatch.

The final delivery note which belongs in each packaging unit is then printed out and enclosed with the consignment. The contracted forwarding agent is then responsible for collection and delivery by the agreed deadline. The necessary shipping data is transmitted to the forwarder using the fastest, most cost-effective method available: by remote data transmission.

Another way in which communication between ARBURG and its customers is facilitated is using the T-Online ordering system. Any customer linked to the data transmission network can simply enter his or her order on a menu-guided basis using the prepared pages and receive instantaneous information on-screen regarding availability from stock and price.

Customers can place orders using the T-Online sys-

tem around the clock, although those preferring a more personal touch can contact one of the 21-strong spare parts service team in Germany Mondays to Fridays from 7.15 a.m.



Recycled packaging materials are used to manufacture wadding to ensure safe delivery of spares

right through to 5.00 p.m. on the central number 0 74 46/33-32 95 or by dialling direct through to one of the many personal extensions. The respective subsidiaries are responsible for spare part supply outside Germany.

RECYCLING AT ARBURG

Ready-to-ship stacking box made of recycled granulate

Environmental conservation has always assumed a central role at ARBURG. Right from the start, the company is at pains to ensure the minimal possible ecological damage through its manufacturing processes.

One of the key areas of emphasis in the corporate recycling strategy is the re-utilization of plastics. Whenever usable plastic wastes occur throughout the company, they are carefully collected, separated according to type and colour, and re-

used for a variety of functions in-house.

Parts and sprues occurring in the injection moulding workshop, the customer and after-sales service training centre, the technological research centre and from injection moulding trials, for instance, are collected and ground down. The material is used to mould stacking boxes with lids which are used as a

packaging material for the dispatch of small parts. The containers have received special approval from the Post Office.

The motivation behind this innovative packaging idea was

to put the plastic waste produced on a day-to-day basis at ARBURG to some sort of sensible secondary use.

The stacking box is just one of many ideas originating from within ARBURG for the responsible disposal of wastes as part of an integrated, comprehensive corporate concept.





Serge Cannito
Managing Director

In 1992, a second branch was opened in Izernore in order to guarantee a really effective all-round service through optimum customer proximity.

A surface area encompassing 1360 m² in Aulnay and another 1730 m² in Izernore accommodates not only demonstration and training facilities but also a comprehensive stock of spare parts. The on-line connection between the two sites guarantees an optimal spare parts service for the customer.

French companies can call on the accumulated expertise of a 23-strong workforce, with 4 of its members located at Izernore. The entire market is separated into 5 regions, each assigned to a sales engineer. The most important objective is to support our customers actively in finding optimal solutions. The servicing department comprises eight technicians, as well as Mr. Schaufelberger in charge of telephone based customer assistance, Mr. Fungere in charge of the train-

French branch celebrates 10-year jubilee

ARBURG S.A.R.L. in Aulnay-Sous-Bois was founded back in 1986, and under the capable management of Serge Cannito has been taking care of its French customers successfully for the past ten years. The French branch is moulded on the example of the parent plant in Lossburg: Allround quality - in terms both of its products and its service.

ing side and Mr. Fungere as head of technical support. There are five service vehicles on the road to answer customer calls, each equipped with a comprehensive selection of spares and sophisticated measuring equipment. All the service technicians can be contacted at any time on the European radio paging system to guarantee fast response to problems.

After-sales service planning is performed centrally from Aulnay-Sous-Bois. There are two servicing technicians also stationed in Izernore in order to react in the shortest possible time to customer requirements.

The accounts and finance department is led by Mr. Macabeth, while Ms. Merra and her team are responsible for order processing.

Backed by the high quality standard of ARBURG machines and the company's comprehensive service philosophy, the French branch has succeeded in claiming a market share of 18%. Despite its excellent record, the man-



The ARBURG branch in **Izernore**



The ARBURG branch in **Aulnay** near Paris

agement and staff have set themselves an ambitious target for the future: a further

systematic increase of the market share in the 15 to 200 ton clamping force category.

The French sales team



Bernard Ledrich
North-east Region



Phillippe Fuchs
North-west Region



Alain Froberger
Ile-de-France Region



Laurent Helm
South-east Region



Philippe Mascaro
South-west Region