Hedrich vacuum systems  vacuum casting equipment
Raw materials
A vast variety of materials, such as Epoxy, Polyurethane, Silicone, Quartz Powder, Aluminum Oxide etc., are processed into reactive compounds in Hedrich casting equipment.

Storage & Handling
Until they are used, preferably the raw materials are stored in their original delivery containers. In the storage and handling of these containers, highest priority is placed on cleanliness and environmental friendliness.

Formulation
We offer custom designed formulation equipment for any resin system. These might range from manually loaded batch systems to fully automatic continuous formulation equipment.

Preparation
In order to efficiently dry and degas the raw materials, Hedrich offers conventional thin film degassers as well as state of the art continuous degassing equipment. When required, Hedrich offers drying systems specifically designed for handling powdery fillers. Solid resin systems are prepared in suitable melting ovens and degassing mixers.

Metering & Mixing
For metering the prepared raw materials in the desired ratio, positive displacement piston pumps are used. For metering unfilled polymer, occasionally gear pumps are used. Great care is taken to assure that the various metering pumps run in synchronization. Mixing of the metered raw materials is done through static mixers.

Vacuum casting
For vacuum casting, Hedrich builds casting tanks, which are fully customized for the components manufactured in them. Our offering includes the most basic manually loaded tanks to fully automatically loaded continuous tanks.

Automatic pressure gelation APG
Besides vacuum casting equipment, Hedrich offers equipment for pressure gelation APG. For this process, we offer the entire range of equipment required, from Vacuum preparation dispensing equipment, to molds and mold clamping machines.

Process Automation
State of the art computer controls and operator friendly man-machine interfaces are used, which guarantee flawless process control, complete documentation, and data logging of all process parameters.

Applications lab & process know how
Hedrich operates an applications lab, which allows testing in the vacuum casting as well as the APG processes. We offer to our customers to do their prototyping and subsequent pilot production in this lab. In cooperation with experienced partners, Hedrich offers extensive process coaching and consulting, as well as know how transfer in the fields we operate in.
CAST RESIN is used in a variety of electrical applications – however – preparation under vacuum is only required for applications in the field of energy distribution. Here we distinguish between two voltage ranges.

MEDIUM VOLTAGE by far has the highest consumption. For indoor applications or applications with very high fire rating, dry type transformers have become the norm in recent decades. Transformer coils up to 40 MVA are cast under vacuum on Hedrich equipment. Depending upon which transformer technology is being used, the resin systems are either unfilled, lightly-, or highly filled. In switchgear as well, cast resin is used in a large variety of components. In addition to common post insulators, complex switch housings, bushings, and instrument transformers are also made from cast resin.

IN HIGH VOLTAGE APPLICATIONS as well, cast resin is used up to 1000 kV. Compact SF6 switches require high quality spacers, bushings, and actuator rods made from cast resin. These components are classified as GIS parts (gas insulated switchgear). Since Quartz powder cannot be used as filler, because it forms silicic acid when it comes in contact with SF6, the filler of choice for these applications is Aluminum oxide. High voltage bushings up to 800 kV, nowadays are typically made in RIP (resin impregnated paper) technology. Here again, the leading manufacturers use Hedrich equipment, worldwide.

IN RECENT YEARS the demand for more compact, lighter and stronger electrical motors has led to an increase of cast resin usage in that industry. The superior mechanical properties of cast resins, in combination with the ability to engineer the thermal conductivity through the selection of special high performance fillers, give motor manufacturers an edge.
Supply and storage of cast resin components

**DAILY CONSUMPTION** volumes, as well as specific local conditions, control the way cast resin components are supplied.

**LIQUID CAST RESIN COMPONENTS** for low production volumes are typically supplied in pails of no more than 25 kg. The material is pulled into the degassing mixer by pressure difference. In order to reduce their viscosity, prefilled materials should be heated prior to charging the equipment. For higher consumption, 200 liter drums or 1000 liter totes are the more economical choice. In this case, two drums/totes of the same component are located above a small buffer vessel, which detects when one container runs empty and triggers the automatic switch over to the full standby container. This is specifically important in continuously operating production in order to avoid interruptions.

**FOR FILLED COMPONENTS,** in order to avoid sedimentation of the filler, the lid of the delivery drum is replaced with one holding an agitation device or stirrer. This assures that over long production periods the mixture stays consistent.

**FILLERS** may be delivered in paper sacks of 25 or 40 kg, or in big bags of 500 to 1000 kg. For very high consumption, the filler may be provided by tanker truck. Dust free unloading and handling is most important because of health risks. Devices specifically designed for dust free unloading should be used for this task. In order to convey these mostly, extremely abrasive fillers, vacuum suction conveying systems like Hedrich’s compressed air – vacuum pump should be used. These systems can handle distances of 50 meters or more, reliably.
Innovative mixing technology for the best possible results

**FORMULATION** describes the creation of pre-mixtures or final reactive compounds, following the recipe specified by the supplier of the resin system. The amount of each individual ingredient, which together makes up the desired product, is typically specified by weight. One way to charge the mixer is to add the entire volume, which meets the required weight of the specific ingredient in the recipe. Another way is to keep adding material to the mixer until the specified target weight is reached.

In case of liquid ingredients, the amount of material added is typically determined by a volume counter. Alternatively the entire mixer can be mounted on load cells so liquid as well as powderous additions can be detected.

**IN BATCH FORMULATION**, the ingredients are supplied either into a final compound mixer or into two individual pre-component mixers. If these mixers act also as degassers the entire loading operation takes place under vacuum. If the machine is equipped with a continuous degasser downstream, the ingredients in the formulation mixers are handled in atmospheric condition. As a result of specifically shaped mixing blades used in these mixers, the mixture is sufficiently homogenous after a very short time and is then released to the continuous degasser.

**IN CONTINUOUS FORMULATION** all ingredients have to be added to the material stream at their desired ratio simultaneously and in real time. Employing a mixing extruder at the core of our continuous formulation technology, the powderous ingredients are fed to the extruder via a differential scale. In the first mixing zone of the Extruder’s mixing screw, the highest volume liquid ingredient is added. Due to the high shear forces in this zone, we achieve homogeneity of the mix within seconds. Additional mixing zones along the length of the extruder screw provide further homogenization as well as the chance to add additional liquid ingredients to the mix. The Extruder discharges the mixed product stream to a continuous degasser downstream.

**ADVANTAGES AT A GLANCE**

- Continuous formulation of large volumes without interruption
- On-demand-system: You only formulate as much product as your downstream process requires
- High shear in the mixing zone for superior homogeneity of th
Efficient degassing with Hedrich DEM and DLE degassers

FOR THE PREPARATION of cast resin, Hedrich offers a number of different degassing mixers. As a general rule, it can be said that for highly viscous polymers, degassing from a thin film is most efficient.

SINCE MANY YEARS, HEDRICH’s DEM thin film degassing mixer has proven to be fit for the task. At the core of this device there is a vertical pipe with conveying and mixing screw, which pushes the material upwards. Leaving the pipe, the polymer flows over a conical surface, which forces an ever decreasing film thickness. The resulting increase in surface area leads to a very efficient degassing result. In the sump of the vessel, an anchor shaped mixer turns close to the surface in order to avoid sedimentation of the fillers. Together, the conveying mixing screw and the anchor mixer make sure that the polymer is extremely well homogenized. The HEDRICH DEM thin film degassing mixer can be equipped with direct electrical heat or alternately be designed as a jacketed vessel with a liquid heat transfer medium like oil or water in forced circulation. In order to observe the degassing process an illuminated sight glass is mounted on the lid of the mixer. Liquid levels, pressure, and temperature are monitored with sensors suited for the task. HEDRICH DEM thin film degassing mixers are available in various volumes, depending on production requirements. For metering of the degassed polymer, positive displacement piston pumps are mounted to the outside of the mixer.

ADVANTAGES AT A GLANCE
• Fast and efficient preparation through thin film degassing technology
• Most homogeneous mix through high shear

FOR CONTINUOUS PREPARATION
HEDRICH offers its patented OTF degasser. As a function of its unique design, the HEDRICH OTF (on the fly) continuous degasser assures the most efficient degassing and homogenization of a broad range of polymers in one pass. Once the polymer has entered the degasser, it is distributed onto the cylindrical inner surface of the degasser in thin layers by means of specially shaped rotating blades. These blades assure that the surface of the polymer on the wall is renewed in each turn, thus allowing for the best possible degassing effect and homogenization. Since the polymer flows through the degasser in a continuous flow, no remixing with material of a lesser degree of degassing takes place. Without a doubt, HEDRICH’s OTF continuous degasser represents the most efficient, state of the art degassing device available anywhere.

ADVANTAGES AT A GLANCE
• Nearly wear and maintenance free design
• Suitable for most types of cast resins
• Fastest and most efficient degassing result
Depending on the demands of each application, Hedrich selects the appropriate metering device. Common to any of these solutions is the adherence to strict quality standards, which are essential to cast resin production. Monitoring and control of the metering accuracy are assured by applying the most accurate, state of the art measurement and control systems available.

Gear type metering pumps in special design are used with unfilled cast resin systems. Volume counts downstream measure and control that the correct flow is assured. With relatively little effort a simple but highly accurate flow control system for unfilled, liquid resin can be designed. If the gear pump is located between a vacuum mixer and the static mixer, we prefer to mount it inside the vacuum mixer, submerged in the liquid resin.

Advantages at a glance
- No vacuum leaks
- No magnetic coupling, rather a drive shaft
- Best possible stuffing of the pump
- Low overall height of the machine

DSP metering pumps are positive displacement piston pumps, which are either driven hydraulically or electrically by a linear motor. As mentioned earlier, for reasons of maintenance accessibility, Hedrich prefers to mount these pumps on the outside of the mixer. A large cross section inlet port assures fast and complete stuffing of the pump cavity in operation under vacuum, even if the resin is of high viscosity. If the resin is unfilled, we design the pumps piston from steel, sealed by a custom designed Teflon seal arrangement. When resin systems filled with abrasive fillers have to be metered, an extremely hard ceramic material is used for the pump piston and bushing. In order to seal the pump, a solution developed by Hedrich years ago is used, which we refer to as a cooled seal gap. Pumps equipped with this design are highly accurate and have a long service life, even in operation with abrasive fillers.
The development of high pressure metering pumps for highly filled resin systems revolutionizes the way modern mixing dispensing systems are going to be built in the future. This solution allows a miniaturization of all components, which carry reactive compound, thus enabling rapid temperature changes, resulting in reduced sedimentation of the fillers.

The high pressure metering pump is derived from Hedrich’s proven design of a compound pressure accumulator. It features a floating pump piston, which is driven and controlled hydraulically. The piston is held in suspension between hydraulic fluid and resin, practically resulting in identical pressures, both on the driving and driven side of the piston. This avoids the wear on the pistons edge, caused by internal leakage flow, in a conventional low pressure metering pump. The high pressure solution thus avoids the inherent problems operators of conventional low pressure metering pumps know all too well, such as: a loss in metering accuracy, the need for frequent sample taking, high wear, high maintenance, and frequent down time.

**ADVANTAGES AT A GLANCE**
- Designed for highly viscous, highly filled resin systems
- Wear free with no maintenance for years of operation
- High precisely controlled linear motion, with resolution in the micron range
- Miniaturization of downstream equipment possible
- Well exposed mounting position on mixer, resulting in good accessibility
- High pressures up to 100 bar possible

**HIGH PRESSURE METERING PUMP**

\[ P_1 = 100 \text{ bar} \]

\[ P_2 = 100 \text{ bar} \]
We offer the right approach with modern single line, or conventional two line solutions

MODERN SINGLE LINE cast resin plants are designed for high throughput and high efficiency. They offer the best possible return on investment while maintaining reasonably high flexibility. As described earlier, all ingredients of the resin system are added in their desired ratios and are degassed in HEDRICH’s continuous OTF degasser. If filler is required, premixing in a mixing extruder is necessary, before degassing.

ADVANTAGES AT A GLANCE
- Continuous formulation and preparation of reactive cast resin compound
- Continuous processing of the required fillers without pre-drying
- Fast and flexible changes to mixing recipe are possible
- Low thermal and mechanical stress induced into the mixed compound
- On demand system with low processing times of only a few minutes
- On demand production with no waiting periods for pre-preparation of polymer
- Designed for three shift operation 24/7
- Low investment, high ROI

CONVENTIONAL TWO LINE SOLUTIONS typically consist of 2 degassing mixers including metering pumps, as well as temperature control systems and vacuum pumps. Both major polymer system components, resin and hardener are first prepared separately and then automatically metered and mixed by a static mixing device.

ADVANTAGES AT A GLANCE
- Best suited for highly reactive cast resin systems with short pot life
- Low thermal and mechanical stress induced into the mixed compound
- Very flexible in accepting recipe changes, due to electronically controlled formulation

HEDRICH single line cast resin technology
HEDRICH two line technology
LARGE VOLUME COMPONENTS or those of small lot sizes, as well as product families with a high degree of variation, typically are cast in a casting tank under vacuum. Open molds are loaded into the tank by a variety of possible loading/conveying solutions. The casting tank may have one front door or be designed as a continuous tank with a door each in front and back.

IN ORDER TO SAVE SPACE, nowadays, we customarily offer rectangular casting tanks. Tubular tanks are slightly less expensive and are used especially when a vacuum/pressure cycle is used in order to improve the impregnation of dry type transformer coils etc. In such a case the front door is interlocked with a bayonet catch mechanism.

If the customer requires visual observation of the casting process, sight glasses are placed into appropriate positions on the side walls or ceiling of the casting tank. If solid resin systems are used, the sight glass is heated to prevent condensation of the resin on the cold glass. Internal illumination of the tank makes operation more convenient. Through flexible casting pipes connected to 3 way valves, a multitude of coils may be cast simultaneously according to the casting program selected. Alternately the stationary mold may be filled through a fixed casting nozzle or by means of a movable one, which is controlled via joystick by an operator.

THE MOST RECENT, patented development by Hedrich is a robotic arm that holds the casting nozzle. This allows positioning of the mold anywhere inside the casting tank and filling the mold by moving the nozzle only. This, in turn allows building a smaller casting tank, which is less expensive and saves space. The robotic arm can also be designed in such a way that it allows for variations in height of the mold.
Pressure gelation (APG), a process for efficient production

**FOR THE PRODUCTION** of frequently repeating components of identical shape, such as switchgear parts and instrument transformers, pressure gelation has become the production process of choice. This is an injection molding process, which takes place in hard, pressure resistant molds. The reactive compound is injected at very low pressure into a mold that is mounted openly on a mold clamping machine. For more complex parts like layered coils for instrument transformers or motor windings, the injection may take place under vacuum or SF6 gas. In rare cases pressure pots are used to fill the mold. To compensate for the shrinkage of the polymer when it gels up, pressure of the liquid, reactive compound is kept on the mold until gelation is finished and the mold can be opened to remove the part.

**IT IS COMMON** practice today to provide the reactive compound directly from the preparation system via metering pumps. It is interesting to note that components HEDRICH developed 30 years ago are still used effectively today to provide compound to multiple mold clamping machines.

**TYPICALLY TWO RING PIPES**, one each for the resin and hardener components, are used to convey the polymer to the mold clamping machines. Each mold clamping machine is provided with its discrete static mixer and compound pressure accumulator. During periods, when none of the molds requires injection of compound, the ring pipes are kept under circulation back into the preparation system in order to avoid sedimentation of the filler.

**A COMPOUND PRESSURE** accumulator CPA is present at each mold clamping machine. It provides for the necessary shrinkage compensation, which was described above. This frees up the ring pipe system to provide any further mold with reactive compound.

In order to improve the production of larger components in the APG process, HEDRICH developed **UFC TECHNOLOGY (ULTRA FAST COMPOUND HEATER)**, which has been rewarded a patent as well. UFC boosts the temperature of the reactive compound before it is injected into the mold to well above preparation temperature. This results in a more rapid gelation and cuts cycle times by as much as 30%. Besides the higher output of the entire APG production cell, and as a result a higher ROI, UFC also results in a more homogenous gelation profile and a better, less stress prone product.

Most notably HEDRICH PG production systems, combined with Vogel molds and mold clamping machines give our customers the edge they are looking for in pressure gelation.
IN ORDER TO PRODUCE parts in the APG pressure gelation process, besides Hedrich mixing dispensing systems, one needs molds and mold clamping machines as well. Vogel, an enterprise of the Hedrich Group, is the first choice, when it comes to know how of the pressure gelation process and the expertise you need to make your APG production a success.

All components of the hardware needed to run APG are designed and built by Hedrich and Vogel so they fit together perfectly and function as one integrated solution. The specification of any APG production equipment is based on a solid understanding of the customer’s requirements. Vogel distinguishes itself from the competition, because of their unique long term experience in this field. This experience has been earned and deepened through hundreds of projects over decades of exposure to this technology. Hedrich and Vogel meet the highest quality standards by having control over their internal design and manufacturing process.

IN THE FIELD OF R&D for the advancement of the APG process, Vogel is in a league of its own as well. There is ongoing collaboration between Vogel and Hedrich’s applications lab, which assures that the solutions we offer to our customers are based on a solid set of production parameters. Vogel offers a broad selection of different mold clamping machines, from which our customers can choose. We customize these machines according to the customers’ requirements with various core pulling devices, fast mold exchange devices, etc. Based on the fact that the controls architecture for both companies shares common software and hardware solutions, the entire manufacturing recipe for a specific part is created and stored in one place. When this recipe is called up in the future, all process parameters are available instantaneously. This also allows for an operator friendly central man / machine interface and flawless logging of historical production data for after sales customer support and ISO 9000 quality assurance purposes.

ADVANTAGES AT A GLANCE
• Unique competence in mold design for any product
• Design and manufacturing right at the source
• APG process and mold development in Hedrich’s applications lab
• Turn-key projects are possible
• Vogel’s unique easy access machine frame design will be loved by your operators
• Common software and hardware architecture for Hedrich and Vogel
• Process and historical data stored in one place
Intelligent solutions for all aspects of process automation

**HEDRICH CAST RESIN** equipment is typically controlled by PLC controllers. We have experience with a variety of hardware solutions and select the one best fit for the complexity of the task.

**ALL VARIABLES OF THE CAST RESIN** process are measured, controlled, computed, and visualized. Typically we use a large TFT monitor with keyboard or a touch screen monitor.

**THE OPERATOR’S INTERFACE** is menu driven and a simplified graphical rendering of the entire process and all of the machine components is used to show the state of the process at a glance. The production process is displayed in real time, or as historical, or trend curves, which allows for rapid analysis and trouble shooting.

**FOR DECENTRALIZED DATA STORAGE**, data logging, or further processing of the data, it can be exported in the digital file format the customer requires. For archiving and back up an integrated DVD burner is standard.

**IF REQUESTED**, we can incorporate various types of hardware interfaces, which allow for the data to be sent to superimposed control systems or central servers. Additionally, the same hardware interface may also be used for remote service of the equipment. We have a group of software and process specialists who can log into the customer’s equipment online, trouble shoot it, or make process changes.
While the equipment is being installed and put into operation in the customer's plant, the most important part in the chain of services Hedrich offers begins. This is done by our experienced team of installation supervisors as well as software design engineers. The same personnel, who do the final assembly and functional check out in our shop, will install and start up that piece of equipment in your plant. During installation and start up, we try to involve the operators who will finally run the equipment, in order to give them the advantage of some early "on the job" training.

Once the equipment is put into operation we still feel responsible for its flawless performance. The experienced project manager, who you learned to appreciate before delivery of the equipment, is still available to you for technical support. Remote service, via modem or internet, can be performed on your equipment at short notice from our main location in Ehringshausen, Germany or through any of our service stations worldwide. However – if the support has to be more specific or more in depth, we will delegate one of our specialists, trained in the fields of mechanical engineering, process technology, or software design.

You can find Hedrich equipment in all four corners of the world. Should you need technical support at short notice, our service hot-line is available to you 24/7. You will be assisted by a competent engineer, who will manage this service call responsibly and arrange for further service support if necessary. In addition, we offer service contracts or calibration service on site, to assure reliable performance of your Hedrich cast resin production plant.

We place a special emphasis and the highest priority onto our spare parts service. Genuine Hedrich parts will assure reliable production and a long service life of your equipment.

You can always count on us for good advice and flexible solutions, which are based in many years of experience as well as a high level of education and training of our people. This is not only true for our parts service but for our entire service offering as well. You can count on that!

Hedrich’s service offering at a glance
- Competent people in installation and start up
- 24 hour service hot line
- On site maintenance and repair
- Responsive spare parts service
- Remote service
- Maintenance and service contracts
- Customer training
- Experienced people

Service Plus. Your equipment – Our responsibility, Always
Our applications and R & D lab –
the basis for your success

AT OUR MAIN LOCATION we operate
an applications lab, which is equipped to
do basic- and applied research and
development in vacuum casting as well
as pressure gelation. This is the perfect
setting to do your prototyping as well as
pilot production.

IN COOPERATION with experienced
partners, Hedrich offers extensive
process coaching and consulting as well
as know how transfer in the fields we
operate in. Our applications lab was cre-
ated in order to give all customers of
Hedrich Group that little bit of extra
security and confidence that often times
determines if a decision will prove to be
successful. Here, the design of a product
can be tested, modified, and retested,
before the first piece of steel, to build
the production machine, is cut. Addi-
tionally the ability to use our applications
lab for pilot production speeds up your
“time to market” when you introduce
new products.

BEING COMMITTED TO OUR MARKET
and to our customers, we make sure that
the lab is equipped with the most mod-
ern equipment for processing Epoxy, PU,
and LSR Silicone. Epoxy cast resin-, Polyurethane- and LSR Silicone mixing
dispensing systems are available and are
combined with three mold clamping
machines. In order to have the possibility
for around the clock operation and show
what can be done in the automation of
pressure gelation, a robot is performing
operator functions.

APG MOLDS needed for your research
program in our lab can be provided by
you or built by us. The applications
lab also houses a very well equipped
materials testing lab, making sure that
the physical properties of the prototypes
made there are meeting your expecta-
tions. This installation makes an impres-
sive statement that Hedrich is committed
to research and development as the core
strength of our company. Today and in
the future!
Our product ranges

**Moulds and clamping machines**
- For automatic pressure gelation (ADG)
- For vacuum casting
- For silicone application (LSR)
- Dosing equipment for silicone
- Handling systems for clamping machines

**Equipment for cast resin insulation**
- Vacuum casting equipment
- Automatic pressure gelation equipment (APG)
- Meter-Mix-Dispense-equipment

**Equipment for oil-paper insulation**
- Vacuum drying & impregnating equipment (VPI)
- Vapour-phase equipment
- Vacuum hot air circulation drying equipment
- Low-frequency drying equipment
- Vacuum drying and filling equipment
- Vacuum cable impregnating equipment
- Vacuum oil purification equipment

**Thin film coating equipment**
- Single and multi-chamber equipment
- High-vacuum handling systems
- High-throughput in-line systems
- Equipment for cleaning & activating surfaces

**Vacuum pumping units**
- Stand-alone
- Integrated into complete units

**Winding technology**
- Fully automated layer winding machines for instrument and distribution transformers
- Conventional layer winding machines for distribution transformers, traction transformers, reactors and similar products
- Special applications for winding technologies

Greifenhalter Straße 28 | 35630 Ehringshausen-Katzenfurt / Germany
phone + 49 (0) 6449 929-0 | fax + 49 (0) 6449 929-149 | e-mail: hedrich@hedrich.com

Hedrich Vacuum Systems. The worldwide leading supplier in vacuum engineering. For more information visit [www.hedrich.com](http://www.hedrich.com)