PLASTICS
HEAT TREATMENT
CASTING, PLASTIC FORMING, RESISTANCE WELDING AND 3D PRINTING
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About us

The Engineering Training Center specializes in providing trainings for engineers in the area of mechatronics and broadly defined engineering techniques. Our main training sections are:

- Visualization and control systems
- Mechanical engineering
- Material engineering
- Production quality
- Industrial robots
- Production quality management
- Machinery safety
- SIEMENS PLM

We organize workshops, conduct consultations, implementation advice and support; we sell software and systems automation products, as well as run measurements and tests for specific purposes.

EMT-Systems has been operating on the training market for many years. We offer innovative approach to training engineers and technicians working in different branches of industry. Our courses are based on comprehensive programs focused on the needs of maintenance services and designers working with CAD/CAM/CAE software. They are often created to suit the specific requirements of the customer.

Trainings offered by EMT-Systems are the guarantee of high quality and professionalism resulting from years of experience in developing course programs for firms, public institutions, education units and individual clients. Success of our clients is our best recommendation.

Our mission is to conduct highest quality trainings for industrial personnel to help them adapt to modern jobs using innovative technologies.

We help to identify training needs of each participant and suggest the optimal course path for them. Through the comparison of initial and final tests' results we monitor the increase in knowledge and skills, which automatically allows us to prove the effectiveness of our work.

EMT-Systems - training people since 2006
Because we are constantly improving the quality of our training services, we have implemented the Product Certification System according to the following standards:

- PN-EN ISO 9001:2015
- ISO 29990:2010

The awarded certificates encourage us to constantly improve and update our services.

We have received numerous awards and prizes:

- 2018 Innovation Laurel for the training: Chemoset and thermoset polymeric composites - introduction to polymer chemistry, composite properties and manufacturing methods.
- 2018 European Medal for all trainings in: „Industrial Robots”
- 2017 Training Company of the Year emblem received from Central Office of National Certification.
- 2017 European Medal for all trainings in: „Plastics”.
- 2016 Caesar of Silesian Business awarded at the solemn Business Centre Club gala.
- 2016 European Medal for the training „CNC1: CNC Operator/Programmer”.
- The prestigious Highest Quality Gold Emblem 2016 a grand prix in the category Services in the most pro quality program in Poland, organized under the patronage of the Polish Agency for Enterprise Development, Polish Committee for Standardization and Polish Forum ISO 9000.
- 2016 Training Company of the Year emblem received from Central Office of National Certification.
- 2015 Enterprise of the Future.
- 2014 Training Company of the Year emblem received from Central Office of National Certification.
- The award of the Marshal of the Silesian Voivodeship during the conference „Innowacja. Cię rozwija” Innosilesia.
Training laboratories
Participants can enjoy well-equipped training positions, which enable the practical exercises. We provide cutting-edge workstations built on the basis of actual components for industrial automation.

Experienced trainers
Trainers from the departments of maintenance and design firms with extensive technical knowledge to the design, implementation, and maintenance and repair of equipment and automation systems and high educational qualifications.

Training material and course documentation
Participants receive professional documentation in the form of textbooks, technical documentation, instructions and other publications. There is also the option of using materials and diagrams provided by the client.

Extra classes
Participants are entitled to participate in free extra classes on the chosen days, after the scheduled classes.

Training methodology
We focus on practical exercises and application of our tutors’ knowledge backed up by real-life examples. As a rule, 30% of time is devoted to theoretical training and 70% of time is designated to active forms of participation – workshops and exercises which allow the participants to gain practical skills on operating machines and systems.

Two different course types: open and closed
Such a solution provides the participants with the opportunity of choosing the best option. Open courses are aimed towards individual participants while closed courses are dedicated to firms.

Catering
For courses carried out in our training rooms we provide daily coffee breaks, hot and cold drinks, cookies and two course lunches.

Post-training and implementation support
We also provide support and help within the topics included in the courses in your everyday work.

The Engineering Training Center EMT-Systems is the authorized training partner for the leading producers: C-L, Zwick Roell, Hasco, NERŁO, Hürmak, Meusburger and IGUS. The contracts signed between the institutions enables us to run certified courses. Constant supervision of industrial partners ensures the highest quality of and access to the latest software and training materials.
Specialized courses in the field of material engineering and metallurgy

Course symbol: TS1

Course name: Plastics and their properties

Course aims:
- Having completed the course, participants have comprehensive knowledge about plastics: terms, design, classification, groups;
- Identify properties of plastics in operational and processing state and methods of their testing;
- Effectively select the processing parameters that are significant for the quality of the manufactured elements;
- Analyse the chemical and physical processes occurring in the process of plastics processing; independently assess the influence of components on the properties of plastics; analyse the influence of operational conditions on the properties of plastics.

Course summary:
- Basic concepts related to polymers
- Molecular and supermolecular structure and its impact on plastics’ properties
- General categorization of polymers
- Physical states of plastics and their behaviour in particular states.
- Influence of additives on the properties of polymers
- Variability of properties of polymers
- Groups of properties for plastics
- Properties of plastics in the solid (performance) state
- Properties of plastics in the plasticized (processing) state
- Properties and application of the selected groups of polymers
- Determining mechanical and processing properties of construction polymers; Shore scleroscope hardness tests of elastomers
- Plastics testing methodology
- Selected aspects of recycling
- Identification of plastics

Duration: 4 days - 25 hours

Course type: Open training
Having completed the course, participants: have the knowledge about properties of materials in operational and processing state; have the knowledge about properties of particular groups of materials; know the rules of designing elements: bearings, gears, guideways; have the skills of selecting parameters and appropriate method for manufacturing elements; have the practical skills of performing strength calculations for elements made of plastics; possess the basic knowledge on replacing metal elements with their equivalents made of plastics.

**Course summary**
- Basic concepts related to polymers
- Molecular and supemolecular structure and its impact on plastics’ properties
- Physical states of plastics and their behaviour in particular states
- Properties of plastics in the solid (performance) state
- Variability of properties of polymer materials
- Introduction to strength of materials
- Methodology of tests on plastics
- Determining strength properties of the polymer construction material in the following tests
- Impact tests
- Shore’s method of determining hardness of elastomers
- Technological feasibility of components injected using plastics
- Strength characteristics of plastics
- Selected aspects of plastics fatigue
- Designing ribbed elements made of plastics
- Designing snap-fits
- Designing threaded and self-tapping joints
- Designing plug in connections involving plastics
- Designing slide bearings
- Designing gears made of plastics
- Plastic springs
- Principles regarding designing covers, bodies and housings

**Course aims**
- Have the knowledge about properties of materials in operational and processing state;
- Have the knowledge about properties of particular groups of materials;
- Know the rules of designing elements: bearings, gears, guideways;
- Have the skills of selecting parameters and appropriate method for manufacturing elements;
- Have the practical skills of performing strength calculations for elements made of plastics;
- Possess the basic knowledge on replacing metal elements with their equivalents made of plastics.

**Course type**
Open training

**Duration**
5 days - 35 hours
PLASTICS

Course symbol | T54
---|---
Course name | Plastics processing - extrusion
Course aims | Having completed the course, participants: have the complex knowledge about plastics processing by extrusion method; design the extrusion process; set the right parameters of the extrusion process; possess the knowledge about the extruder design; evaluate the quality of the extruded product; are able to prevent potential defects of the product.
Course summary | For closed trainings it is possible to tailor the program contents and didactic materials according to individual needs (within the merits range of the training).
- Revisiting basic concepts regarding polymeric materials; types of polymers
- Basics of worm plasticization
- Extrusion of plastics – basic concepts, technological parameters, products
- Extruder design
- Extrusion line structure
- Devices in the extrusion process
- Theoretical background for optimizing the extrusion process
- Typical problems encountered in the extrusion process and possible solutions
- Using extrusion in other processing technologies (extrusion blow molding, extrusion thermoforming, extrusion press)
Duration | Closed training
Course type | 2 days

Course symbol | T56
---|---
Course name | Exploitation of injection molds
Course aims | Having completed the course, participants: have the technical awareness necessary for working with injection molding machines; have the knowledge about operation principles of injection molding machines; are able to maintain injection molding machines in a good technical condition; independently assess and select a method of repairing damages in injection molding machines; can operate and repair hot runner systems.
Course summary | - Basic information about the injection process
- Injection mold design
- Types of gating systems
- Materials science in the design of injection molds
- Coatings in injection molds
- Utilization of molds
- Dimension adjustments of mold cavities
- Venting the mold cavity
- Operation of molds with heating channel systems
- Inspection of injection molds
- Spare parts inventory
- Methods for repair and regeneration of mold cavities
- Problems injection molds
Duration | Closed training
Course type | 2 days

Course symbol | T55
---|---
Course name | Designing injection molds
Course aims | Having completed the course, participants: identify particular elements of the injection mold; independently select the materials used for building injection molds; are able to use the engineering know-how for design purposes; are able to use the computer-aided design software.
Course summary | - Basic information about the injection molding process
- Dimensional accuracy of injection molded parts
- General design of the injection mold
- Input data for the injection mold project
- Principles for the selection of the number of cavities
- Structure of the mold cavity
- Principles for the design of gating systems
- Thermoregulation system of the injection mold
- Ejection of the molded parts
- Ejector system
- Connecting, fastening and guiding elements
- Principles of selecting materials for injection mold elements
- Categorization and standardization of the mold elements
- Computer-aided mold design
Duration | Open training
Course type | 3 days - 21 hours

Course symbol | T57
---|---
Course name | Blow Moulding
Course aims | Having completed the course, participants: have the knowledge of properties of plastics in their operational and processing state; have the knowledge of properties of particular groups of plastics; know basic techniques of manufacturing elements made of plastics (injection molding, extrusion and their modifications); are familiar with injection molding and extrusion blow molding; have the skills of designing the process of manufacturing elements using the blow molding technology; are familiar with plastics used in blow molding production; are able to select the method and set the parameters in the process of manufacturing.
Course summary | - Theoretical basics of the production process involving blow molders and thermoplastic materials
- Extrusion blow molding technology
- Injection blow molding technology
- Thermoplastic materials used in blow molding
- Influence of the particular parameters of the process on the quality of manufactured elements
- Processing parameters of the blow molding technology
Duration | Closed training
Course type | 2 days
## Course Summary

### Course T38: Chemoset and thermoset polymeric composites - introduction to polymer chemistry, composite properties and manufacturing methods

**Course aims**

- Familiar with selected aspects of polymer chemistry.
- Familiar with polymer materials and fillers used in manufacturing composites.
- Identify polymers as materials of specific performance characteristics.
- Have theoretical and practical basics of manufacturing composite structures using the selected methods.
- Have the practical skills of testing resins and composite materials.

**Course summary**

- Basic concepts in the field of composite materials.
- Division and characteristics of plastics.
- Chemical structure of polymers and the influence of chemical structure on their properties, with particular emphasis on chemically curing polymers.
- Discussion of the chemistry of the crosslinking process of selected resins.
- Producing a composite with manual lamination method using a gel coat, selected reinforcements and resins - discussion of the method.
- Creating a multilayer composite by infusion - a discussion of the process.
- Creation of a multilayer composite using a vacuum bag (vacuum bagging).
- Division of reinforcing materials (disperse phase) - powder and fibrous reinforcements and their properties.
- Influence of the polymer processing method on functional properties of composites.
- Properties of composites - research methods allowing to assess the quality of the composite.
- Fundamentals of composite materials manufacturing processes - methods: hand lamination, wet-up, spray-up, infusion, vacuum bagging, LRTM, RTM, beam method, autoclave and non-autoclave processing of pre-impregnated materials, pultrusion, castings and other.
- Preparation of composite samples for mechanical tests.
- Study of cross-linking processes - determination of gelation time, peak of exothermic cross-linking reaction.
- Quality assessment of composites and gel coat coatings.
- Testing of selected mechanical properties (resistance to bending, impact strength and hardness) of composites produced by the students on the first day of training.
- Discussion on the issues proposed by the participants.

**Duration**

3 days - 21 hours

**Course type**

Open training

### Course T39: Technical evaluation of the quality of polymer composites

**Course aims**

- Able to assess the quality of products made of composites.
- Can analyze the influence of manufacturing method on the quality of a ready component.
- Use thermography techniques in quality assessment.
- Use microscope techniques.

**Course summary**

- Selected aspects of theoretical basics of producing structural polymers as a matrix of structural composites (doroplasts).
- Basic reinforcement materials and their characteristics.
- Technical Data Sheets (TDS). Material Safety Data Sheets (MSDS).
- Initiators, accelerators, inhibitors, hardeners in polymerization reactions.
- Process regime and the effects of ignoring it (recipes, process parameters, ratio of matrix to reinforcement etc.).
- Review of composite production methods in the aspect of the potential characteristic defects.
- Classification of the composite quality according to PURSLOV.
- Technological defects.
- Locating defects in composites using non-destructive instrumental methods.
- Thermography in infrared.
- Microscope technique of optical tests using penetrants.
- Determining barrier thickness of protective layers.
- Hardness test according to BARCOLA GYJ-934-1.
- HDT test for matrix and composite PN-EN ISO 75-1, 75-2, 75-3 (A, B, C).
- Calculating specific gravity of a composite.

**Duration**

2 days - 14 hours

**Course type**

Open training
# 3D PRINTING

## Course 3D1
### Course name
FDM 3D printing technology – basic course

Having completed the course, participants: operate and maintain a 3D printer; have the knowledge about the basics of preparing a 3D model for printing; know the methods of diagnosing the problems of working with a FDM 3D printer.

### Course summary
- Introduction to construction and operation of printers in FDM technology
  - Materials – differences, parameters, application
  - 3D printing slicer software. Differences, operation, functions and basic hardware and material profiles.
  - G-code generating
  - Transfer of files to the printer
  - Operating the printer: starting a print, filament loading and changing, bed leveling, uild plate adhesion materials, removing the print form the bed.
- Printer maintenance:
  - Extruder clog cleaning, replacement of worn / damaged parts
  - Tensioning the belt, cleaning the slides
  - Hot-end cleaning, replacement of PTU bushing
- Software update
- Postprocessing:
  - Smoothing 3D prints
  - Resin spray
  - Mechanical treatment
  - Heat and chemical treatment
- Most common 3D printing problems
- Practical exercises:
  - G-code generating and transfer the files to the printer
  - Filament changing
  - Nozzle replacement
  - Bed leveling
  - Preparing the bed
  - Starting a print
  - Parameters optimization during the printing process (temperature, speed)
  - Printer maintenance
  - Postprocessing

### Course aims
- Having completed the course, participants: operate and maintain a 3D printer; have the knowledge about the basics of preparing a 3D model for printing; know the methods of diagnosing the problems of working with a FDM 3D printer.

### Duration
3 days - 21 hours

### Course type
Open training

## Course 3D2
### Course name
FDM 3D printing technology – advanced course

Having completed the course, participants: select and use the full potential of materials used in FDM technology; operate the slicers – enhance the properties and quality of prints; detect and solve mechanical problems; manage a farm of 3D printers; operate multi-head printers.

### Course summary
- Review of different types of printers in FDM technology
- Cutting software - advanced parameter management
- Detailed review of the materials with focus on technical materials
- Control system - review of open systems
- Control Gcodes M and G
- Review of defects in prints
- Remote printer operation, wifi, live view
- Printer farm management
- Printer farm management systems
- Multi-head printers
- Basics of modeling
- Basics of modeling for the purposes of 3D printing
- Reverse engineering – 3D scanning

### Course aims
- Having completed the course, participants: select and use the full potential of materials used in FDM technology; operate the slicers – enhance the properties and quality of prints; detect and solve mechanical problems; manage a farm of 3D printers; operate multi-head printers.

### Duration
3 days - 21 hours

### Course type
Open training

## Course 3D3
### Course name
3D printing technologies

Having completed the course, participants: select an appropriate additive manufacturing technology; know when to use and when not to use a 3D printer; choose a proper printer and materials for specific needs; be able to manage a 3D printer farm; are familiar with modeling for the purposes of FDM and reverse engineering – 3D scanning.

### Course summary
- Introduction to additive manufacturing technologies – comparison with other manufacturing technologies
- Types of additive technologies
- 3D light-cured resin printing – DLP, SLA, LCM, Polyjet, MJM
- 3D powder printing – SLS, SLM, DMLS
- 3d metal printing and other technologies
- FDM – past, presence, future
- Using FDM 3D printing in practice
- Types of printers in FDM/FFF technology
- Selecting the printer to meet your needs
- Overview of materials with focus on technical materials
- Cutting software – differences, advantages and disadvantages of different programs
- Multi-head printers
- Management of printer farm in LAN
- Printer farm management systems
- Basics of modeling for the purposes of FDM 3D printing
- Reverse engineering – 3D scanning

### Course aims
- Having completed the course, participants: select an appropriate additive manufacturing technology; know when to use and when not to use a 3D printer; choose a proper printer and materials for specific needs; be able to manage a 3D printer farm; are familiar with modeling for the purposes of FDM and reverse engineering – 3D scanning.

### Duration
3 days - 21 hours

### Course type
Open training
### HEAT TREATMENT

<table>
<thead>
<tr>
<th>Course symbol</th>
<th>OC1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course name</td>
<td>Heat treatment – basic course</td>
</tr>
<tr>
<td>Course aims</td>
<td>Having completed the course, participants: are able to use using iron-carbon diagram; are familiar with different types of heat treatment; are familiar with the processes of heating and cooling.</td>
</tr>
</tbody>
</table>
| Course summary | • Mechanical and technological properties of metals and evaluation methods of structure and properties.  
• Plastic forming of metals and their alloys: plastic deformation mechanisms.  
• Metalurgy.  
• Iron-carbon phase diagram.  
• Time-temperature transformation diagrams.  
• Quenching guidelines.  
• Heating devices.  
• Cooling devices.  
• Protective atmosphere in heat treatment.  
• Quenching and drawback treatment methods.  
• thermochemical treatment.  
• The analysis of heat treatment defects.  
• Annealing.  
• Precipitation hardening (aging hardening).  
• Thermal coating. |
| Duration      | 3 days - 21 hours |
| Course type   | Open training |

### Chemothermal treatment

<table>
<thead>
<tr>
<th>Course symbol</th>
<th>OC3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course name</td>
<td>Chemothermal treatment</td>
</tr>
<tr>
<td>Course aims</td>
<td>Having completed the course, participants: understand general aspects of thermo-chemical treatment of materials; have the knowledge of the technological aspects, selection of parameters and influence of parameters on performance characteristics of materials in case of thermo-chemical treatment processes.</td>
</tr>
</tbody>
</table>
| Course summary | • General principles of chemothermal treatment.  
• Diffusion alloying with nonmetallic chemical elements:  
  ▫ Carburing, nitriding, low-temperature carbonitriding, high-temperature carbonitriding, sulphuritriding, sulphonitriding.  
• Diffusion alloying with metallic chemical elements:  
  ▫ Oxidizing, vanadizing, aluminumizing, chloroaluminizing. |
| Duration      | 2 days |
| Course type   | Closed training |

### Thermal methods of producing surface layers

<table>
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<tr>
<th>Course symbol</th>
<th>OC4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course name</td>
<td>Thermal methods of producing surface layers</td>
</tr>
<tr>
<td>Course aims</td>
<td>Having completed the course, participants: have the knowledge of the basic methods of thermal modification of material surfaces; are familiar with technologically aspects of surface treatment of materials; know the thermo-chemical, thermo-physical and thermo-mechanical methods of surface treatment.</td>
</tr>
</tbody>
</table>
| Course summary | • Thermal methods:  
  ▫ Surface hardening of machine parts (induction, flame, immersion hardening), surface melting, surfacing, melting, dip coating (galvanization, aluminiumising, leading, copper plating).  
• Thermochemical methods:  
  ▫ CVD-aided saturation (APCVD, LPCVD, PACVD).  
  ▫ Alloying.  
• PVD thermophysical methods.  
• Thermomechanical methods (thermal spraying, plating). |
| Duration      | 2 days |
| Course type   | Closed training |

### Technology of heat treatment of machine and tool parts

<table>
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<tr>
<th>Course symbol</th>
<th>OC5</th>
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</thead>
<tbody>
<tr>
<td>Course name</td>
<td>Technology of heat treatment of machine and tool parts</td>
</tr>
<tr>
<td>Course aims</td>
<td>Having completed the course, participants: have the knowledge of the theoretical and practical basics of heat treatment of structural steel; are familiar with the influence of heat treatment on special steels; analyse the influence of heat treatment parameters on performance characteristics of the element, depending on the group of materials that’s being processed.</td>
</tr>
</tbody>
</table>
| Course summary | • Heat treatment of construction steel (forgings, springs, gear wheels, roller bearings).  
• Heat treatment of steel with special properties:  
  ▫ Corrosion resistant steel, acid resistant steel, stainless steel; heat resistant steel (valve steel, resistance steel, high-temperature steel); steel with special physical properties (soft magnetic steel, hard magnetic steel, nonmagnetic steel, steel with specific thermal expansion coefficient). |
| Duration      | 3 days |
| Course type   | Closed training |
### Casting

<table>
<thead>
<tr>
<th>Course symbol</th>
<th>Course name</th>
<th>Course aims</th>
<th>Course summary</th>
<th>Duration</th>
<th>Course type</th>
</tr>
</thead>
<tbody>
<tr>
<td>OD1</td>
<td>Basics of casting technology</td>
<td>Having completed the course, participants: have the theoretical knowledge about casting as the fundamental technique of manufacturing machine parts; are familiar with basic casting technologies and methods of manufacturing moulds and cores; know how to produce simple casting moulds using quartz-clay molding sand.</td>
<td>• Introduction to foundry casting - the oldest and basic technique of manufacturing machine parts; • Classification of casting techniques with particular focus on traditional methods based on sand mixtures; • Casting process from designing to finishing; • Methods of manufacturing moulds and cores; • Molding process (process of producing a mold) using quartz-clay molding sand – practical exercise.</td>
<td>2 days</td>
<td>Closed training</td>
</tr>
<tr>
<td>OC6</td>
<td>Defects of heat treatment products and quality control</td>
<td>Having completed the course, participants: have the knowledge of theoretical aspects of quenching and tempering; are familiar with disadvantages of quenching and tempering; are familiar with disadvantages of thermo-chemical and surface treatment of materials; know the rules of checking quality of products subjected to heat treatment and thermo-chemical treatment.</td>
<td>• Defects of hardening and tempering products; • Insufficient hardness and soft spots; inadequate mechanical properties; cracks after tempering; • Defects of thero-chemical and surface processing; • Deformations and warping; ardening and grinding cracks; internal oxidation; insufficient thickness of the layer; lowered hardness of the layer and insufficient hardness of the core; • Quality control of the products after heat and thermochemical treatment; • Health and safety regulations in heat treatment processes.</td>
<td>2 days</td>
<td>Closed training</td>
</tr>
<tr>
<td>OD2</td>
<td>Casting metal alloys and smelting methods</td>
<td>Having completed the course, participants: are familiar with materials (metal alloys) used for casts production; are familiar with the smelting processes in typical foundry furnaces; are able to prepare and perform the smelting process in an electric induction furnace.</td>
<td>• Classification of foundry furnaces – iron alloys and non-ferrous metals; • Tendencies in the development and application of modern casting alloys (Austempered Ductile Iron, vermicular cast iron, nickel superalloys, aluminum alloys, skeleton castings etc.); • Types of foundry furnaces and smelting processes: Electric arc furnace, electric induction furnace, cupola, other (less commonly used) types of foundry furnaces; • Calculating the material in the feed to sustain the smelting process in the foundry furnace – practical exercises; • Iron smelting in the electric induction furnace – practical exercises.</td>
<td>3 days - 21 hours</td>
<td>Closed training</td>
</tr>
<tr>
<td>OC7</td>
<td>Equipment for heat treatment processes</td>
<td>Having completed the course, participants: have the knowledge of different devices used in the process of heat treatment; analyse the influence of the used processing equipment on performance characteristics of the element.</td>
<td>• Stoves heaters (low temperature, medium temperature, high temperature equipment); • Equipment for generating controlled atmospheres; • Feed cooling equipment: • Quenching tanks; cooling Wells; presses and hardening equipment; cooling chambers; cold traps; • Washing equipment; • Control and measuring devices; • Furnace sets and systems; • Technological lines and centers.</td>
<td>2 days</td>
<td>Closed training</td>
</tr>
</tbody>
</table>
CASTING

Course symbol: OD3
Course name: Modern technologies of producing casts
Course aims: Having completed the course, participants: have the knowledge about the development of casting technologies, including mechanization, automation and robotization of casting processes; are familiar with concepts relating to modern pressure casting; have the skills of producing precise castings using lost wax technology.
Course summary:
- Tendencies in the development of the international casting industry
- Automated flask casting lines
- Automated flaskless casting lines
- Pressure casting as the most automated and robotized casting technology
- Combining casting technologies with other manufacturing techniques
- Production of precise castings using lost wax technology – practical exercise
Duration: 2 days
Course type: Closed training

Course symbol: OD4
Course name: Defects of castings and prevention techniques
Course aims: Having completed the course, participants: are familiar with terminology and causes of defects occurring in iron and non-ferrous metal alloys; know the rules and have the skills of casting technology optimization in order to minimize the risk of defects.
Course summary:
- Classification of casting defects and used terminology
- Standards relating to casting defects and castings quality
- Casting selection criteria
- Crystal defects
- Raw surface defects
- Breaks in continuity
- Internal defects
- Defect prevention techniques including:
  - Computer-assisted casting production process as a tool minimizing the risk of producing faulty defects
Duration: 2 days
Course type: Closed training

Course symbol: OD5
Course name: Resource and waste management in a foundry
Course aims: Having completed the course, participants: are familiar with current legal provisions with regard to industrial waste, including casting waste; have the knowledge on the methods of regenerating molding material; know the rules of casting process optimization with regard to resource management and minimizing the waste.
Course summary:
- Casting waste management regulations
- Methods of regenerating molding material – application, advantages and disadvantages
- Modern methods minimizing the use of different resources in fundamental casting processes and technologies
- Possibilities of utilizing casting waste in the foundry and other branches of industry
Duration: 2 days
Course type: Closed training

PLASTIC FORMING PROCESSES

Course symbol: OP1
Course name: Extrusion - basic course
Course aims: Having completed the course, participants: have the knowledge of extrusion shaping methods; are familiar with tools for cutting, bending and shaping; know how to design technological processes for extruded products.
Course summary:
- Extrusion - theoretical background
- Current trends regarding extrusion methods in industrial conditions
- Production of various extruded elements on mechanized, automated and robotized lines – examples and analysis
- Classification and characteristics of pressings
- Presing tools
- Machines and tools used in extrusion
- Comparison of extrusion to other manufacturing methods.
- Guidelines for designing technological processes for extruded products
- Possibilities of modifying properties of tool materials
- Materials used to manufacture spare parts
- Typical design and assembly-related mistakes regarding extrusion tools
Duration: 2 days
Course type: Closed training

Course symbol: OP2
Course name: Extrusion tailored training
Course aims: Having completed the course, participants: are familiar with the extrusion-based shaping methods; have the knowledge of the tools used in cutting, bending and shaping processes; have the skills of designing technological processes for the extruded products.
Course summary:
- Elementary terms: extrusion process, classification of pressings
- Classification of press tools and their functions: division into metal cutting tools, care cutters, metal bending tools, bending dies, shaping dies, drawing dies, rubber pads, hydraulic pressing tools.
- Progression and transfer press tools
- Possibilities of modifying properties of tool materials: heat treatment of extrusion tools; tool coatings, advantages and disadvantages of different coats.
- Materials used to manufacture spare parts: overview of steel materials and alloys with special properties used to manufacture spare parts for extrusion dies and presses; design rules of regenerating used extrusion dies; typical design and assembly-related mistakes regarding extrusion tools.
Duration: 2 days
Course type: Closed training
### RESISTANCE WELDING

<table>
<thead>
<tr>
<th>Course symbol</th>
<th>Course name</th>
<th>Course summary</th>
<th>Duration</th>
<th>Course type</th>
</tr>
</thead>
<tbody>
<tr>
<td>ZO1</td>
<td>Programming and parameterization of resistance welding machines – basic course</td>
<td>Having completed the course, participants: know the problems related to resistance welding technology; are familiar with the design, operating principles, operation of control systems in resistance welding systems; know about the explanation of the problems related to resistance welding technology for different types of materials; are able to select the appropriate parameters, such as: current values, contact force and welding times.</td>
<td>1 day</td>
<td>Closed training</td>
</tr>
<tr>
<td>ZO2</td>
<td>Programming and parameterization of resistance welding machines – advanced course</td>
<td>Advanced course is the extension to the basic course and additionally includes programming in one of the chosen controllers (Bosch, HWH, ARO, Serra)</td>
<td>2 days</td>
<td>Closed training</td>
</tr>
<tr>
<td>ZO3</td>
<td>Programming the adaptive weld control system made by BOSCH – specialist course</td>
<td>Having completed the course, participants: are familiar with of the problems related to resistance welding technology and principles of adaptive welding; know about the parameterization and activation of the system in the Adaptive mode; know how to optimize the welding process in the Adaptive mode.</td>
<td>2 days</td>
<td>Closed training</td>
</tr>
<tr>
<td>ZO4</td>
<td>Programming the adaptive weld control systems made by ARO – specialist course</td>
<td>Having completed the course, participants: are familiar with of the problems related to resistance welding technology and principles of adaptive welding; know about the parameterization and activation of the system in the Adaptive mode; know how to optimize the welding process in the Adaptive mode.</td>
<td>3 days</td>
<td>Closed training</td>
</tr>
<tr>
<td>ZO5</td>
<td>Basics of theory of resistance micro welding</td>
<td>The training course is intended for technologists, technicians, process engineers, employees of maintenance departments and employees responsible for the process of resistance welding used in the process of the production of small components and electronic connectors, electric motors, sensors, wiring, medical devices, lighting elements and many other devices requiring precise electric and mechanical connections.</td>
<td>1 day</td>
<td>Closed training</td>
</tr>
</tbody>
</table>
Our training laboratories enable the students to use industrial laboratory equipment and components provided by leading manufacturers – ZWICK/ROELL, Meusburger, IGUS. During classes, students do many practical exercises using diversified training and laboratory workstations.
Hurmak injection molding machine – series ECO 180

Hurmak ECO series is a traditional series of machines with a knee-joint system. The series offers eleven different models with clamping force of 100-750 tons.
A hydraulic injection molding machine is fitted with the energy saving system based on the Baumuller/Marzocchi servopump. The system works perfectly with company’s own KEBA software and it has been designed to achieve a long lasting balance between performance and operating costs.
The ECO series has been designed with simplicity, low operating costs and easy maintenance in mind. Just like in case of basic models, the machines of ECO series may be successfully used for special applications requiring high speed and precision, like manufacturing thin-wall products.

Robot manipulacyjny WITTMANN W 818

- Control system: WITTMANN CNC 8.3 with stop buttons
- Manual programmer
- Transmission by means of a gear wheel and rack
- 2 x Venturi vacuum circuit with digitally set differential pressure switch
- 1 x pneumatic 5/2 valve with a function of controlling the pneumatically operated elements of the gripper
- A robot featuring servo drives in all three axes
- A rotary axis
- Low noise levels and comfort of operation
Zwick/Roell ProLine 10 kN Tensile Testing Machine

The machine is used in functional component testing and standardized material testing. The machine features the equipment for tensile testing, bending and compressing with the extensometer for elongation measurement and a system-compatible table to set the machine and a PC:

- Fmax 10 kN,
- Table-top model,
- Two column load frame, H Series,
- 2 steel columns,
- 2 spindle drives with initial load that guarantee clearance-free machine operation,
- test area without the case: 1050 x 440 mm (height x width),
- brushless and maintenance free AC servo drive,
- test speed within the load range 0 – 10 kN: 0.0005 … 1000 mm/min,
- accuracy of the speed setting: 0.05 % of the preset value,
- positioning accuracy: +/-2 μm,
- innovative testControl II electronics.
Zwick Mflow plastometer
A plastometer is used to determine Melt Flow Rate (MFR) and Melt Volume Rate (MVR):

- The device determines MFR and MVR of plastics in compliance with standards: ISO 1133, ASTM D 1328, ASTM D 3364, NF T51-038, JIS K 7210
- Test loads included in the basic unit: 0.325 to 2.16 kg
- Elements: filler funnel, cleaning accessories, USB cable
- Power input: 500W
- Pressure point soft touch keypad
- LCD graphic display, backlit
- Test load range: 0.325 to 21.6 kg
- Temperature range: +50 degrees C to +450 degrees C
ZWICK Charpy Impact Tester

A device is used to test the impact strength of plastics. A classic drop weight testers function on the principle of a linear fall movement. A mass with an impact object is released from a height that is usually defined. Since no other measurement follows specimen penetration, these simple drop weight testers are used for go/no go analysis with the staircase method or in around-the-clock method.

Analog Shore hardness testers

During our training courses, we use analog hardness testers with tripods for Shore A and D durometers and sets of 3 rubber durometer scales of Shore A and D.
Polymeric materials for identification

During practical part of the training course in plastics each participant receives a set of samples and a list of plastics to identify. Plastics that we use for the identification purposes are: PE, PP-R, CPVC, PP, PVC, PCV, ABS, PC, PCV SP, PMA, PMMA, PET, PE, high-density PE, PA, POM, PTFE, POM-C, PEEK, PETP, PU.

Preparing the samples for testing

The participants, with no assistance, prepare samples for tests, for instance using Shore durometers.

Samples and plastics granulates for laboratory testing

For all testing purposes, we use specially prepared samples. The underlying objective in testing the molding materials is a high degree of repeatability. It requires limiting the number of sample types:

- Dumbbell-shaped specimens for strength tests made of 7 types of plastics (PMMA, HDPE, PP, PC, PS, PA, PAGF30)
- Beams for impact tests made of 7 types of plastics (PMMA, HDPE, PP, PC, PS, PA, PAGF30)
- Granulates to determine the melt flow rate made of 8 types of plastics (POLYETHYLENE HD, POLYPROPHYLENE HP 456J, POLYPROPHYLENE HP 500N, PC 1220 U, POLYSTYRENE S35, POLYAMIDE PA6, PA66 G30, PMMA 205)
Ready elements and work pieces made of plastics
The laboratory is also equipped with a variety of ready products made of plastics – elements of car upholstery, cases, bearings made of plastics, industrial joints, car light. Elements are used to present exemplary work or defects.
3D PRINTERS
Participants of basic and advanced courses in FDM 3D Printing have at their disposal individual workstations designed for practical exercises in 3D printing. The workstations are equipped with popular printers, filaments, formulations and software as well as numerous examples of printouts. Each student works with the latest Ultimaker 3 printer. The laboratory is also equipped with printers by other manufacturers, such as for example Prusa i3 MK3 with enhanced extruder and computers with dedicated software: Cura and Slic3r.

For practical part of the training we use the following printers:

- Prusa i3 MK3 (individual workstations)
- Ultimaker (individual workstations)
- Raise 3D

We use sets of filaments from a renowned producer NOCTUO. Solutions offered by NOCTUO combine verified formulas and highest quality materials. During the course we print with: PLA, UltraPLA, ABS, Nylon, Carbon, Flex and MediFlex.

The laboratory is also equipped with a set of many ready products printed in FDM technology. These elements are used to present exemplary specimens or defects.
Heat Treatment Laboratory

Courses codes: OC1-OC7

Participants of the courses have at their disposal equipment and machines available in a given workplace. We can also use the documentation provided by the client.
Trainings can be conducted at client’s premises (foundry) or in EMT-Systems training rooms. In this case, some classes take place in laboratories of our partner school, equipped with all tools and materials necessary to practice the forming process and to examine molding material properties.
Participants of the courses have at their disposal equipment and machines available in a given workplace. We can also use the documentation provided by the Client – presses, extrusion dies.

We can also use client’s laboratories to perform sheet metal formability test using Erichsen method.
Experts

Our trainers are industry as well as higher education representatives with a lot of experience in implementation and research. They also work closely with large manufacturers. Their experience is based on many years of working in industries as technologists in plastics production, heating and moulding processes, resistance welding and casting.

The trainers have a lot of experience in tailoring the courses to the needs of the clients and the technology used in metalworking and plastic production. They have also designed parts and tools used in the production processes.
Training Areas

**Mechanical Engineering**
- Industrial Pneumatics
- Power Hydraulics
- Training courses in Operating and Programming CNC lathe and milling machines
- Conventional Machine Tools
- Mechanical Engineering
- Machine Diagnostics

**Visualization and Control System**
- Electrical Engineering and Automation
- SIEMENS S7-300/400
- SIEMENS S7 Migration STEP 7 - TIA Portal
- SIEMENS S7-300/400 TIA Portal
- SIEMENS S7-1200 TIA Portal
- SIEMENS S7-1500 TIA Portal
- SIEMENS S7-SCL/GRAPH in TIA Portal
- SIEMENS Safety Integrated
- HMI/SCADA
- Industrial Networks
- SIMATIC PCS7
- CODESYS
- Drive Systems
- Industrial Sensors
- MITSUBISHI
- C/C++ Programming

**Material Engineering**
- Plastics
- 3D Printing
- Heat Treatment
- Casting
- Plastic Forming
- Resistance Welding

**Industrial Robots**
- FANUC
- ABB
- KUKA
- WITTMANN

**Production Quality Management**
- Total Productive Maintenance
- SMED Methodology
- FMEA Methodology
- Lean Manufacturing

**Siemens PLM**
- SIEMENS NX
- SIEMENS Solid Edge

**Production Quality**
- Quality Management
- Metrology
- Analysis of Measurements

**Machinery Safety**
- Standards and Directives for Machinery
- Safety Systems
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W broszurze wykorzystano również zdjęcia stanowiące własność Siemens AG. Wszelkie prawa zastrzeżone.

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