

## REGIONAL TRAINING CENTRE FOR PNEUMATIC AND HYDRAULIC DRIVES

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**Abstract.** The degree of complexity and refinement of fluidic drives has known a permanent growth, requiring the existence of an adequate training system of staff working with pneumatic and hydraulic equipment. The updating of knowledge related to fluidic drives and automation has become a necessity of high priority, calling for an increased frequency of personnel training sessions.

The paper presents the achievement within the Transilvania University of Braşov of such a training facility in the field of fluidic drives and automation. The structure of the Regional Training Centre for electro-pneumatic and hydraulic automation is presented, as well as the delivered course modules and the state-of-the art endowment of the centre.

**Keywords:** pneumatic and hydraulic drives

The continuously growing requirements related to the performance parameters of manufacturing systems trigger the competition of various driving modalities: mechanical, electrical or fluidic. This yields the natural improvement of each type of drive and their convergence towards maximised performance.

Fluidic drives, pneumatic and hydraulic, tend to hold an increased weight in the design of modern industrial systems. These drives are implemented in varied branches of industry, like machines manufacturing, metallurgy, mining and oil industry, and are included by the structure of building equipment, agricultural machines, machine-tools, robots, military and transport equipment, etc.

Compressed fluid used as an agent in actuating and control systems plays an important role both in actual fluidic systems and in combinations of these with electric drives and electronic control devices, lending itself to extremely varied ranges of temperature, humidity or external pressure. Fluidic drives and controls in technical and industrial applications hold an increasing importance. Their degree of complexity and refinement grows continuously, requiring the permanent enlarging of the proficiency of staff working in this field. Updating the knowledge of the personnel employed in industrial companies has become a necessity of high priority, the frequency of training sessions

increasing accordingly.

This is the rationale behind the establishing within the Transilvania University of Braşov, as part of the department of Economic Engineering and manufacturing Systems of the Regional Training Centre for electro-pneumatic and hydraulic automation, in cooperation with the Bucharest branch office of FESTO Ltd. of Germany.

The main aim of the Regional training Centre is to satisfy the training needs of industrial staff in the region of Braşov, by implementing the FESTO model, developed and tested in Western Europe. The equipment of the centre is also used by the students of the Transilvania University of Braşov, for modules taught as part of the graduate courses and the Masters' course in Automation of Manufacturing Systems.

The activities carried out within the Training Centre relate to the following aspects:

- Promoting fluidic automation on the regional market of central Romania, by means of specialist seminars and training courses following the FESTO model;
- Continued training activities of specialist staff from industry;
- Research-development-innovation activities.

As part of the latter activity worth mentioning are the ongoing studies of the operational behaviour of pneumatic muscles, as novel elements of the pneumatic drives of industrial equipment.

The Regional Training Centre for electro-pneumatic and hydraulic automation includes a Fluidtronics laboratory, endowed with latest generation FESTO components, training being based on the "learning by doing" principle.



Figure 1. Fluidtronics Laboratory

The training capacity of the laboratory is of maximum 16 persons/training session, the ideal number being 6 – 10. The offered modules are:

- Applied pneumatics;
- Applied electro-pneumatics;
- Applied hydraulics;
- Applied electro-hydraulics;
- Programmable Logic Controllers (PLCs).

Modules focusing on pneumatic drives are structured on three levels of training: beginners, medium and advanced, targeting both graduate and high school (or vocational school) level staff. One training session has a duration of three or four days, depending on the course module requested by the beneficiary.

Modules focusing on hydraulic drives are structured on two levels of complexity: beginners and advanced.

The laboratory is endowed with state-of-the-art equipment, an important aspect relating to the fact that all components are of industrial type, thus removing the barrier between the educational and the industrial environment. Most of the components have rapid mounting systems, so that circuits and interfaces can be built speedily, safely and with minimum effort. Hence the time assigned to setting up fluidic circuits is considerably reduced, allowing longer intervals for the actual training.

The syllabi for the modules of applied pneumatics and electro-pneumatics were conceived such as to support the course participants to gain certain knowledge and practical skills:

- Reading and interpreting the symbols of pneumatic and electro-pneumatic apparatus and diagrams, according to ISO 1219;
- Interpreting and representing of pneumatic and electrical diagrams and cyclograms;
- Knowing the structure, operation and control of typical pneumatic apparatus;
- Knowing and interpreting the technical documentation of the available equipment;
- Knowing the modalities of basic maintenance of typical and special pneumatic and electro-pneumatic systems;
- Devising of automation solutions of low complexity for the operational optimisation of the working machines;
- Gaining practical skills in working with pneumatic apparatus;
- Identify and locate the defects in an electro-pneumatic system, by applying diagnosis algorithms.



Figure 2. Examples of pneumatic apparatus used for training

The hydraulic drives and automation modules pursue the following directions of competence:

- Basic hydraulics:
  - Symbols used for apparatus and equipment according to ISO 1219;
  - Hydraulic diagrams; instruments and modalities of representation of the operation of hydraulically driven machines;
  - distributors; structure, operation, adjustment, specific problems;
  - devising of hydraulic automation solutions of low complexity.

- Advanced hydraulics:
  - valves; logic elements; flow regulators; pressure valves; specific problems;
  - linear and rotating hydraulic motors; structure, operation, adjustment, specific problems;
  - special hydraulic apparatus; filters, accumulators;
  - maintenance of typical and special hydraulic systems;
  - devising of hydraulic automation solutions of medium complexity;
  - utilisation of dedicated software for the design of hydraulic diagrams and processing of system data.



Figure 3. Hydraulics training bank

The electro-pneumatic drives training modules target the following:

- knowing the electro-hydraulic commands;
- knowing the electrical apparatus used in electro-hydraulic drives;
- electromagnets, contacts, switching, temporisation and pressure relays, electric counters;
- inductive, capacitive, optical and magnetic sensors;
- basic electrical circuits for electro-hydraulic automation;
- techniques for the achievement of diagrams with relays;
- sequential automation with relays; methods for sequential and cascade switching;
- devising and verifying automation diagrams;
- maintenance and repair of electro-hydraulic systems.

The figures below show some of the banks of the Fluidtronics laboratory, equipped with pneumatic and hydraulic apparatus. Figure 4 shows

the bank holding a PicAlfa type module designed for the manipulation of various objects, and figure 5 shows a mini-press driven by a pneumatic muscle:



Figure 4. Electro-pneumatic manipulator system with gripper

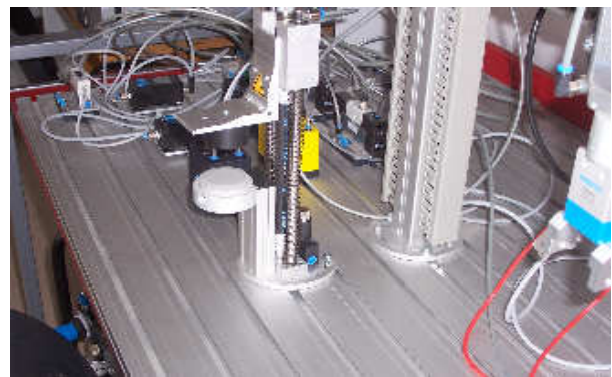


Figure 5. Mini-press driven by a pneumatic muscle

The Regional Training Centre for electro-pneumatic and hydraulic automation is also endowed with the IT equipment required by the training programme. Course participants are made available latest generation software for the design, verification and simulation of pneumatic, hydraulic and electric diagrams, software of FluidSIM 4 H and P type. Also FluidLab H and P programmes are available, designed for connecting various categories of sensors (pressure, flow, temperature) to the computer. This software allows real time study and plotting of the variation curves of pressure and air or oil flows through the different components mounted on the banks.

The training course modules in programmable logic controllers are based on a mobile production station (MPS) of “pick & place” type, endowed with a PLC pf SIMATIC S7-300 type.

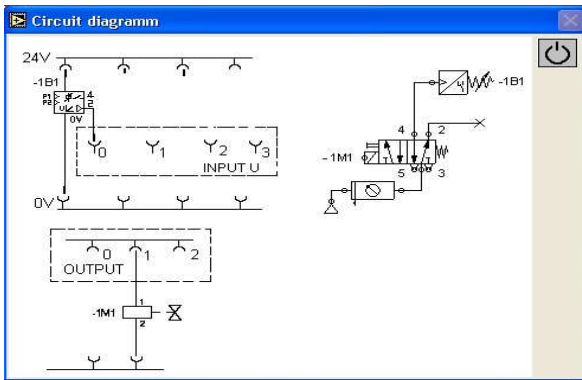


Figure 6. A FluidLab P screen

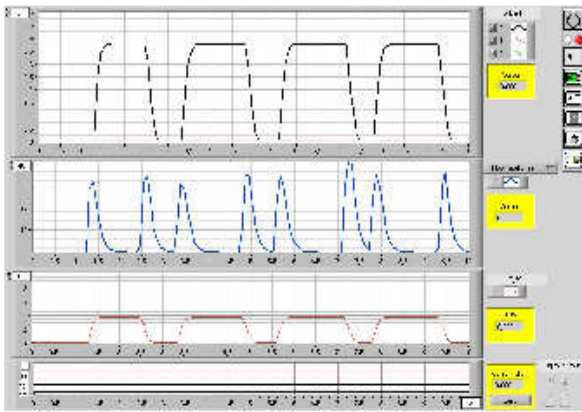


Figure 7. Real time visualising of pressures, flows and temperatures



Figure 8. MPS of "pick & place" type

The modular concept of the SIMATIC S7-300 offers professional PLC technology from

the market leader, Siemens. With various CPUs, CPs and I/O modules, the S7-300 meets all automation requirements.

The S7-300 facilitates the use of a wide range of fieldbuses such as AS-interface, Profibus DP and Ethernet.

The STEP 7 programming environment makes all industrially used PLC programming languages available: STL, LDR, FCH, STEP 7-SCL, STEP 7-GRAPH, STEP 7-HiGraph.

These modules aim at supporting course participants in acquiring the following knowledge:

- Basic design of a Simatic S7 control system
- Input and output module tasks
- The three programming languages: FCH, LDR and STL
- Basic command set for SIMATIC S7
- Creating, loading and testing simple programs
- Using the status display
- Signal storage
- PLC timer
- Archiving and decompressing of PLC programmes

By its high level educational and training offer made available, the Regional Training Centre for electro-pneumatic and hydraulic automation has become a key supporting element for the industrial environment of the region of Braşov.

#### Acknowledgement

*This research project has been supported by a Marie Curie Transfer of Knowledge Fellowship of the European Community's Sixth Framework Programme under contract number MTKD -CT-2004-014249.*

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