
LFT
Laboratory for
Fluid Power and
Controls
With motion
in future

ABOUT US

1973

- Mag. Anton Stušek established of the Laboratory for Fluid Power and Controls

1994

- doc. dr. Jožef Pezdirnik became Head of the Laboratory

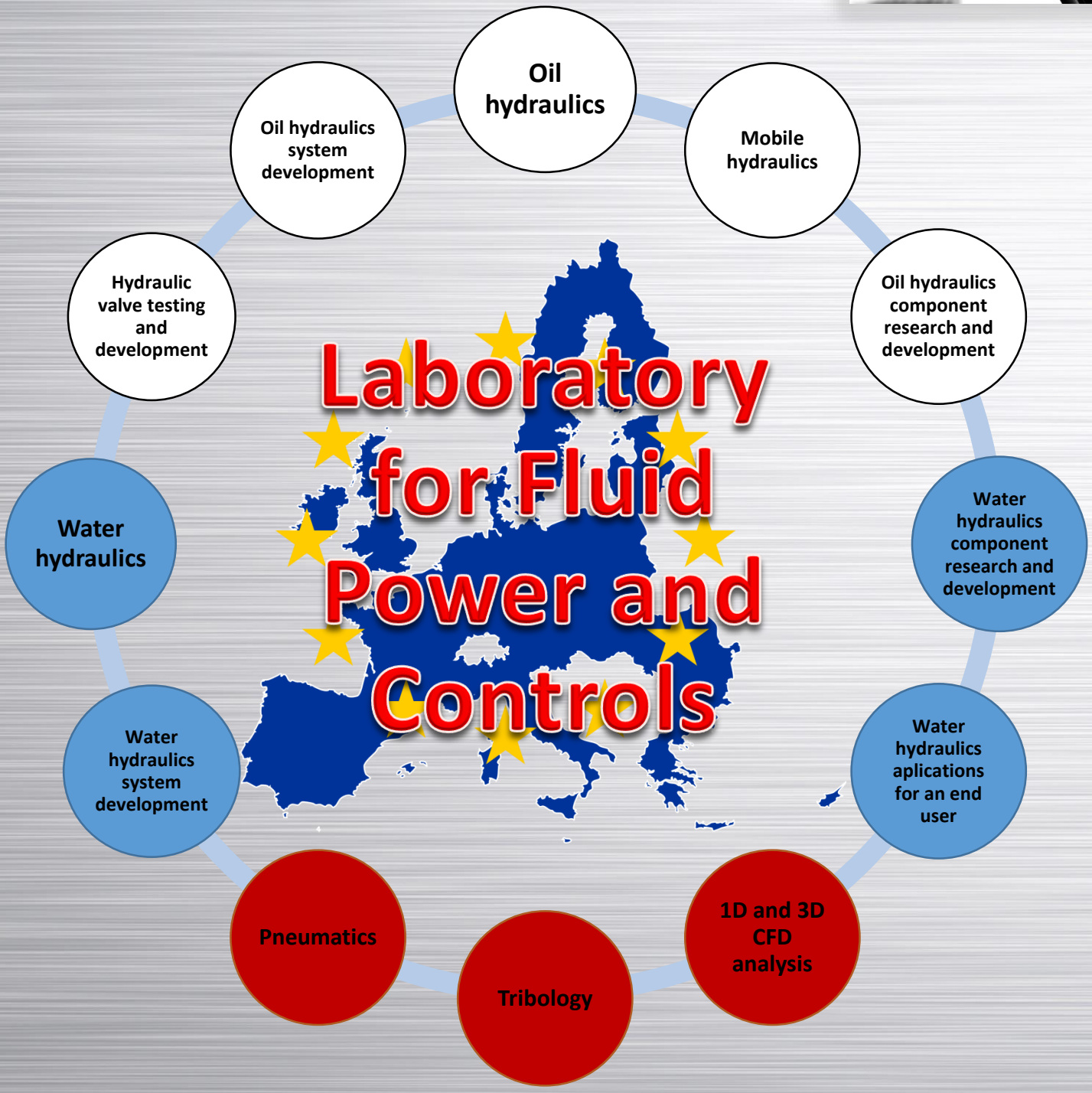
2012

- doc. dr. Franc Majdič became Head of the Laboratory

Our main researches:

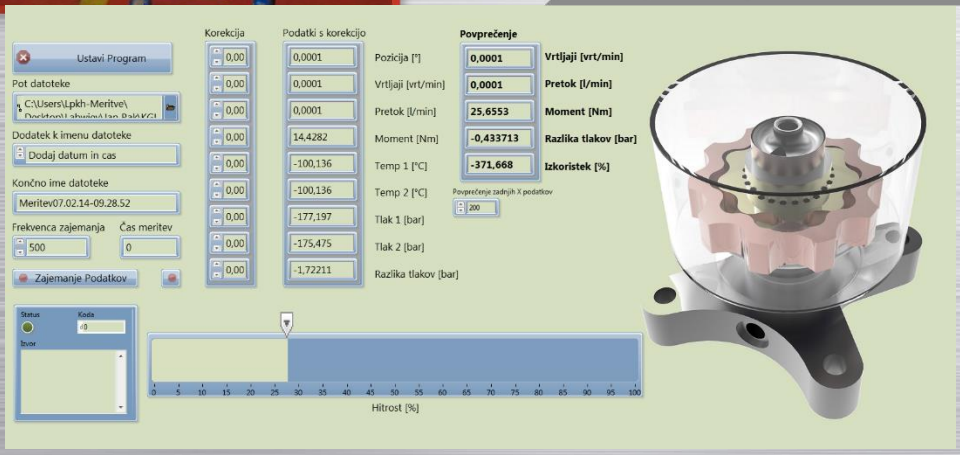
- Condition monitoring,
- Cleanliness of hydraulic fluid and filtration,
- Control Technology,
- Industrial and mobile hydraulic components – oil and water,
- Industrial and mobile hydraulic systems – oil and water,
- Pneumatic components and systems,
- 1D and 3D computational fluid dynamics – CFD,
- Finite element analysis – FEA,
- Tribology,
- Etc.

Field of development and



Fluid analysis, Condition monitoring and System control

- mobile measurements of the cleanliness of hydraulic fluid (ISO 4406, SAE AS4059, NAS 1638),
- mobile measurements of the presence of moisture in the hydraulic fluid,
- mobile filtration device for hydraulic fluid,
- online diagnostics and condition monitoring,
- diagnostic of oil and water hydraulic systems and components,
- diagnostic of oil, water and bio-degradable oil used as hydraulic fluid,
- noise measurement in laboratory (hydraulic pumps and motors, hydraulic valves, etc.)

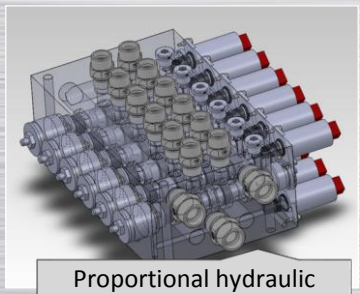


Hydraulic valves

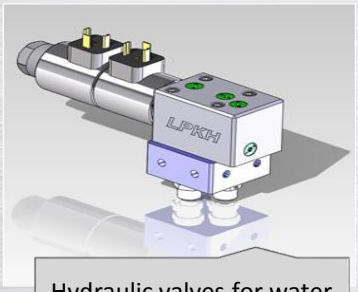
Our laboratory is proud to announce that it has many years of experience with development, improvement and testing of hydraulic valves for industry.

Projects which are relevant to this field:

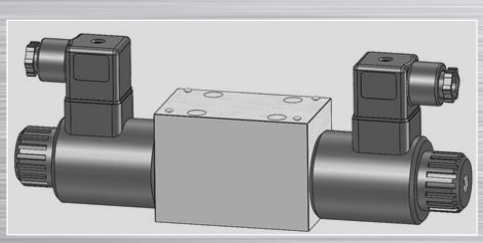
- oil conventional directional hydraulic valves,
- oil proportional directional hydraulic valves with solenoid,
- oil proportional directional hydraulic valves pressure regulated,
- oil servo directional hydraulic valves,
- oil digital hydraulic valves,
- oil hydraulic block for hydraulic valves,
- water conventional directional hydraulic valves,
- water proportional directional hydraulic valves with solenoid,
- digital hydraulics
- etc.



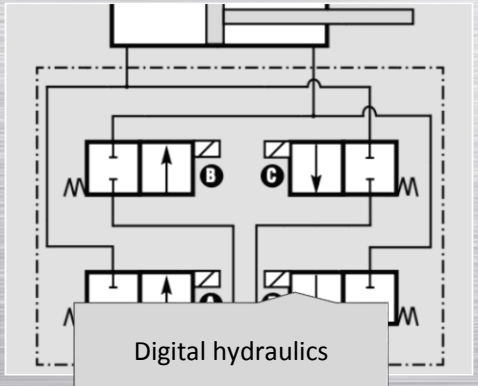
Proportional hydraulic valves for mobile hydraulics



Hydraulic valves for water industrial hydraulics



Hydraulic valves for oil industrial hydraulics

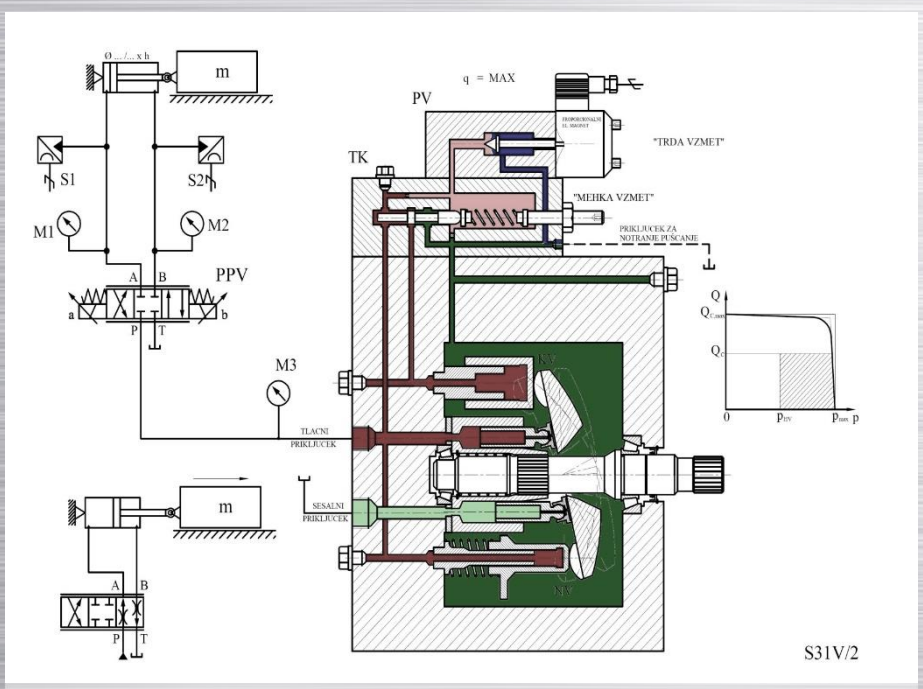


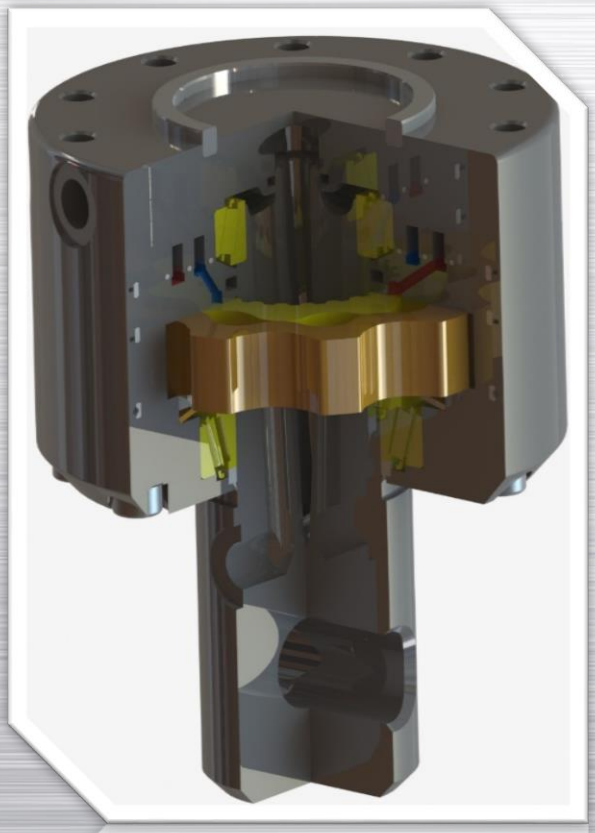
Digital hydraulics

Hydraulic Pumps and Motors

One of our most important projects was to help with development and testing of hydraulic rotator for high torque and low rotation speeds. Currently the hydraulic rotator is being mass produced by **Slovenian company**.

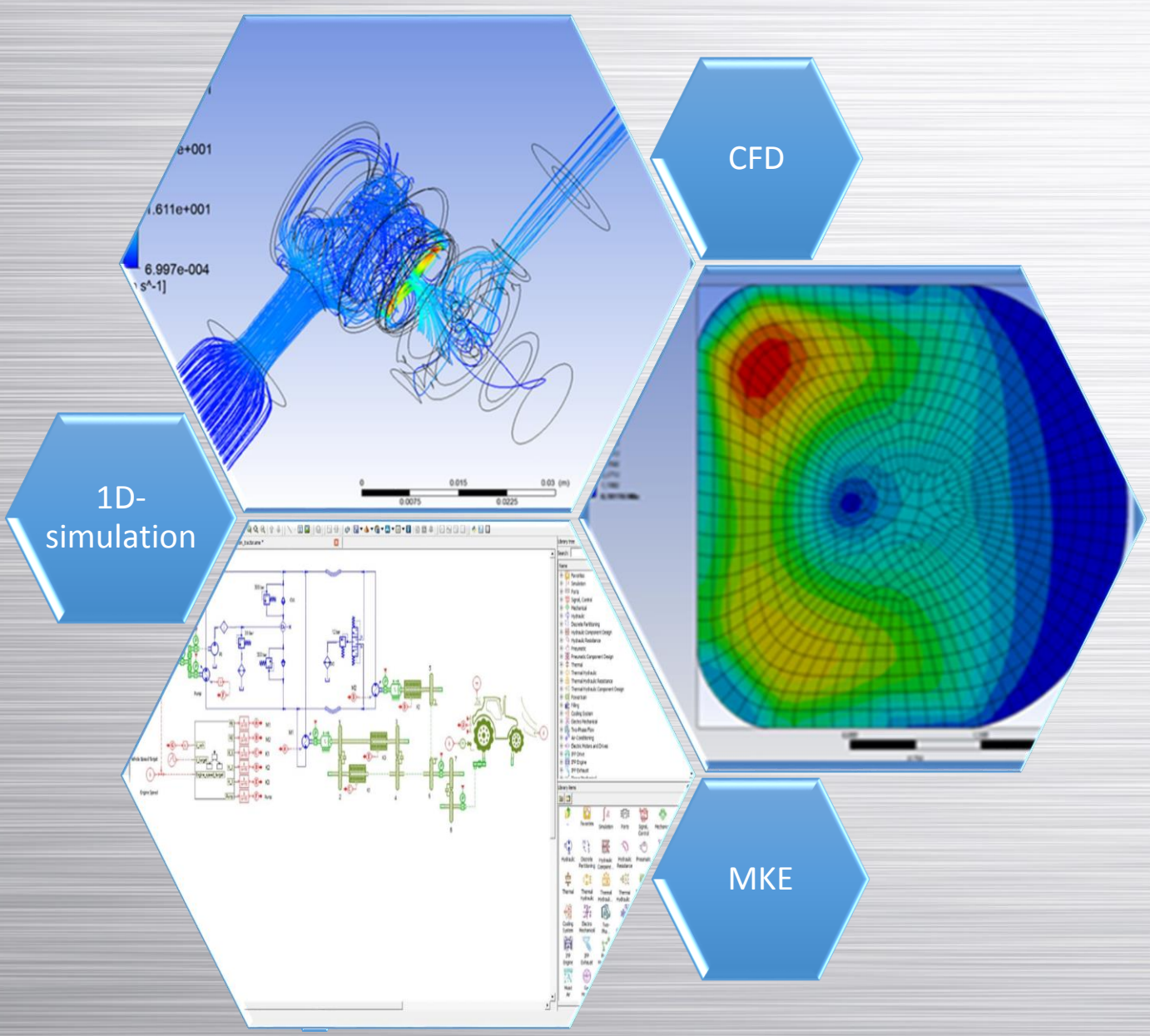
- development and testing of constant displacement hydraulic pump and motor (oil and water),
- development and testing of **variable** displacement hydraulic pump and motor (oil and water),





Simulations

In laboratory we are capable of making a Finite Element Analysis (**FEA**) and 1 Dimensional and 3 Dimensional Computional Fluid Dynamic Analysis (**CFD**).



Hydraulic accumulator and energy storage

Currently is on a daily basis increasing interest in the production of **hybrid vehicles.** In the case of commercial vehicles, the emphasis is on a combination of **oil hydraulics** and internal combustion engines. Here is a hydraulic accumulator irreplaceable, so we decided to develop a corrosion-resistant gas-piston hydraulic accumulator for high pressure for **oil** and **water hydraulics**.

It is important to emphasize that we have during development phase tested at various pre-charge pressures and various types of gases.

Promotion of University of Ljubljana, Faculty of Mechanical Engineering

For Faculty promotion we made in the past two projects. One was based on Oil hydraulics and the other one was based on Water hydraulics.

Other

Other sections our laboratory participates on:

- Pneumatics,
- Tribology,
- Court expert opinion in field of hydraulics,
- Practical educations and diploma thesis,
- Doctorate thesis,
- **European Research & Innovation projects**,
- Etc.

Some of the past projects

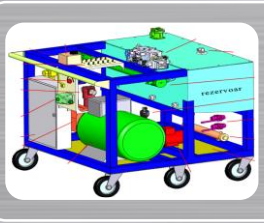
High pressure radial water piston pump *was developed and tested in Laboratory for Fluid Power and Controls. The main objective of the development of the pump was to prove the applicability of water, with or without bio-degradable additives against freezing, as a hydraulic fluid in hydraulic systems.*

Design and realization of hydraulic servo valve test stand *was the goal of this project. The main focus was on two stage servovalve and its theoretical basis. The main static and dynamic performances of the servovalve, such as: internal leakage, control flow, hysteresis and Bode diagram were made for the customer.*

This device for transporting and handling cargo is able to drive on rough terrain, over small thresholds. Intended for the workshops, construction sites, shops, and especially as a device to each house. It is made for transporting "Euro" pallet (transporting and lifting) and bulky loads. **Foldable, transportable and lightweight mobile forklift** *was made for the possibility of driving on the station wagon, pickup car, etc.*

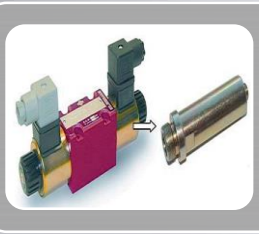
For internal use the calculation and the design of a **two-stage high pressure hand water pump** *was made. The water is used as a hydraulic fluid.*

The measurements of **the piston-type hydraulic accumulator** *were made for Laboratory use only. Measurements were carried out at three charging pressures (30, 60 and 90 bar) at different thermodynamic transformations, using* **three gases (nitrogen, argon and helium)** *and with the use of* **water and hydraulic oil.**



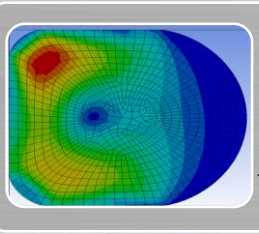
The accuracy and reliability of used proportional and servo valves is crucial for the quality of the production process. The ability to measure valve characteristics enables fast troubleshooting and good preventive maintenance action. For that purpose **a mobile hydraulic test rig for directional continuously operating valves** *was developed.*

Hydraulic rotators gerotor type *are used where high torque and low speeds are needed. The cooperation with the customer has led us to numerous awards and well-designed rotator, which is already in mass production.*

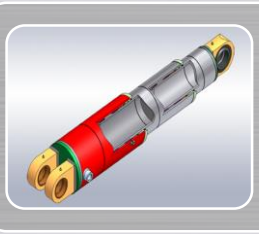


Reasearch of a conventional directional control valve *was divided into three parts. Measurements was the most important part and were carried out to determine the Δp-Q characteristic, p-Q characteristics, internal leakage, the impact of orifice in the P line and 5 chamber in valve. Results of the measurements were substantiated by threedimensional and onedimensional numerical calculations.*

Impact of radial grooves on the flow through the annular gap in hydraulics *is important for development of hydraulic valves. The impact of various annular gap geometries and radial grooves in variable pressure conditions and while using a wide variety of hydraulic fluids on flows through annular gaps were investigated at different flow regimes. Samples were made for the purpose of carrying out flow measurements.*

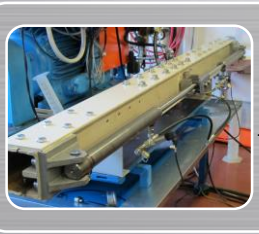


Research of **impact of selected hydraulic sealings on the friction.** *Project was divided into experimental and numerical part. Measurements were made at two different operating pressures in hydraulic cylinder, at two different speed of piston and for two different hydraulic fluid – water and oil.*



High–pressure test of a hydraulic cylinder *was based on customer's requirements. Numerical calculations for each part of the hydraulic cylinder were compared with measurement results made during high-pressure test of the tested subject. Hydraulic cylinder had successfully passed our requirements.*

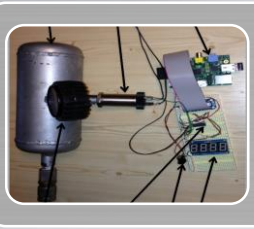
For customer needs **a hydraulic device for precise vertical positioning and holding the load at the desired position** *was developed. The requirements were achieved for allowed deviation from the desired position of the vertical loaded hydraulic cylinder piston rod in the range <0,1 mm for mass of 1000 kg.*



Three different dynamic tests were carried out to accomplish **permanent dynamic tests of hydraulic cylinders.** *In the first test, endurance seals on piston and in the flange were examined, in the second test, the pressure durability of the hydraulic cylinders was controlled, in the third test, the durability of hydraulic cylinders during loading with external traction was surveyed.*

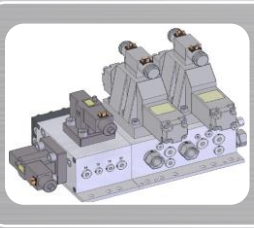
The reconstruction of **a hydraulic device for fabric unwinding** *was interesting project for our laboratory. Based on calculations and simulations, the appropriate hydraulic components were chosen and connected into hydraulic system.*

The project was based on the research of measurements carried out on a prototype **piston-type hydraulic accumulator.** *Measurements on the hydraulic accumulator were carried out under different levels of charging pressure, in different positions of the accumulator (horizontal and vertical), with various thermodynamic transformations of gases and with different working fluids. Results of the measurements were substantiated by analytical calculations and then compared.*

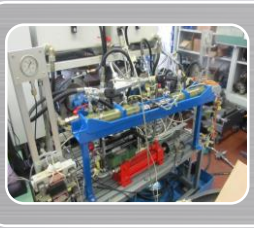


This is the solution for **a new hydraulic forklift truck scale.** *With the overview of the known solutions, we could determine the key requirements and functions of such scale. We thoroughly tested this prototype in a number of experiments set in our laboratory. The results led us to make out an actual hydraulic forklift truck scale mounted on an multi-directional side load forklift truck.*

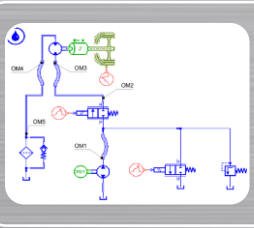
Our task was to design **water hydraulic excavator**, *which will be only used for loading bulk loads and not for digging. On hydraulic arm are four hydraulic cylinders, which are intended for lifting/lowering arm, for contraction, for closing/opening the spoon and last for rotation of the arm.*



The development of **a hydraulic valves testing machine** *has been investigated. According to the function and aim of the testing machine, the main dimensions were determined. The aim was to find such a constructional base which would enable the highest number of possible applications, regarding the mounting of test valves as well as of measuring equipment. A testing machine was projected and built.*



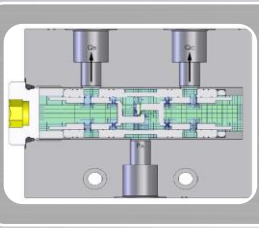
Hydraulic systems with **load sensing** *were analyzed at different testing conditions. With the combination of experimental and numerical part, we got a good starting point for the design of* **a new test rig**.



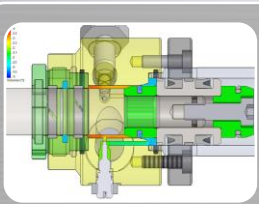
Hydraulic drive screw conveyor for final silo cleaning *was investigated and compared with electric motor screw conveyor. Hydraulic calculations were made to determine the basic hydraulic components.*

The company turned to us with **a brake valve** *problem. Measurements of the brake valve have been made on the test rig that had been designed in the Laboratory for Fluid Power and Controls. Furthermore, a hydraulic scheme was prepared and appropriate hydraulic components were chosen and installed on the appropriate supporting structure.*

Design, calculation and build procedure of **a piston-type accumulator** *were made. Hydraulic fluid, used in the experiment, was water, which was taken into consideration when making the first design concept. Hydraulic accumulator calculations were made according to obligatory standards and regulations. A prototype was manufactured, and the certificate of the European pressure directive PED 97/23/EC, affixing the CE marking, was aquired.*



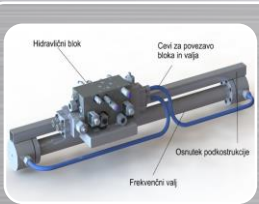
Function of analyzed **flow valve** *is dividing/combining hydraulic flow with 50:50 ratio, independent of pressure on respective port. The goal of optimization was to improve dividing/combining accuracy. At first, major causes were theoretic analyzed. According to theoretic analysis results, two improvements were realized. After that, valve before and after improvements was tested.*



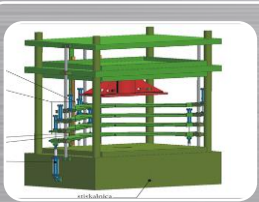
For development of **a new type of water hydraulic cylinder** *we tested different types of seals. Combination of the computer simulations and experimental part gave us the optimal solution. Further, we analysed the effect of seals on the operation of the hydraulic cylinder and the effect of seals on starting pressure under constant motion and under the water hammer effect.*

Design and case study of **a non standard hydraulic lift table** *for end user had to be done. With help of the finite element analysis software we determined maximal stress of the table and were able to optimize construction.*

On the basis of preliminary investigations, the conclusion made suggests the market is absent of **cartridge valves** *for usage in* **water hydraulics.** *The analysis of design solutions of cartridge valve for usage in oil hydraulics, is presented. The descriptions of hydraulic fluids properties and definitions of appropriate materials are followed by analytical and numerical calculations of the main working characteristics of the valve and solenoid.*



Test rig *was designed to* **measure dynamic and static characteristics of proportional and servo valves.** *For testing purposes a special hydraulic cylinder for measurement of the frequency response of tested valves had to be made.*



An **air spring vulcanization tool** *was reconstructed for a customer. Additionally we developed the lifting mechanism for moving separately vulcanization tool parts.*

At the end

I would like to point that we promote co-operation with industry. So far, we started a lot of different projects and also successfully finished them. If you have any new idea or need help with existing hydraulic systems and components, contact us and we will be happy to assist you in the final solution.

Why choose us?

Because we are a dynamic group of experts in various fields, who are not afraid of new challenges.

The strategic plan of the laboratory strives to direction that we become the leading laboratory in our field in this part of Europe.

Hoping for joint cooperation, wish you a nice welcome,

Head of the laboratory

Assist. Prof Dr. ing Franc Majdič

How to find us!

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