Project acronym: **ASE-TB**

Project full title: Design and development of an Adaptive Smart and Eco-efficient Test Bench for synchronized testing of linear actuators in the aeronautic sector

Grant agreement no.: **255730**

Publishable summary

The ASE-TB project has designed, manufactured and tuned an innovative test Bench for linear actuators that will be capable of conducting synchronized tests on two linear actuators of the same type while applying different loads on them. This test bench has been based on a modular and adaptive concept by integrating easily exchangeable hydraulic and mechanical components with sensors and control strategies that will allow automatic and autonomous safety controls during endurance tests.

One of the major challenges in the aeronautic sector is to conduct endurance tests on critical components and actuators in an automated, safe and sustainable way by means of appropriate test benches that include actuating, sensing, monitoring and supervising capabilities.

In this respect, there are several European Research Projects that have tackled this issue as a means for validating the developed components as well as for comparing and adjusting models of components as of their production processes.
Tecnalia, based on the experience of these mentioned two state-of-the-art test benches, has developed ASE-TB test bench, fulfilling the following objectives:

- The developed test bench (CLTB) validates the feasibility of an electrical synchronization of electrical actuators with high accuracy.

- This CLTB is capable of providing counter-loads for 2 actuators at the same time with the ability to apply different loads for each actuator. Additionally, the CLTB is able to be used with a single electrical actuator under test.

- This test bench assures a safe test running without an operator during endurance tests.

-The CLTB is designed to apply an adjustable load from –35.000 N to 35.000N on each actuator on the complete stroke. The load is adjustable independently on each actuator at every position.

The architecture of the CLTB is made up of two mechanically independent carriages, on which the actuators are tested.

The main components are listed below:

1. Fixed carriage/table
2. Movable carriage/table
3. Actuator mounting beds
4. Control interface (Does not need to be onboard. The CLTB can be remotely operated through a network connection)
5. Hydraulic cylinders
6. Hydraulic auxiliary elements
7. Electric cabinet

The CLTB is totally autonomous, except for an electrical power source. One of carriages, referred from now on as CLTB2, has all the electric and hydraulic servitudes mounted onboard.
Approximate dimensions of the carriage are 2400(+1050 of the cylinder) x 800 x 1400 mm.

The second carriage, referred as the moveable carriage ②, will be displaceable to accommodate different flex-shaft sizes. Approximate dimensions of the carriage are 2350(+1050) x 400 x 1400 mm. The width of the CLTB when fully retracted is shown below:

The distance between the carriages can be varied between 0 and 2 meters. The CLTB will be designed to be as compact as possible.

The counter load is applied through hydraulic cylinders. Both cylinders have internal mechanical stops and a position sensor.

A hydraulic system has been chosen for driving the actuator test bench. Hydraulic systems are capable of working with frequencies up to 200-400Hz, while other systems, as electromechanical solutions, can not reach these frequencies. Therefore, under dynamic precision and reaction time points of view a hydraulic system is the best solution. High loads application is another key factor to select a hydraulic system. High dynamic test benches are mainly hydraulic.

The hydraulic system of the test bench consists of the following main parts:

- Hydraulic power unit,
- Accumulators,
- Double rod Cylinders
- Servo valve.

The cylinders are sized to achieve the maximum loads specified in the requirements. Two identical cylinders are projected, each one able to apply the maximum load. This maximum load can be applied in tensile and compression working modes. The cylinders are designed in compliance with ISO 6020/1 standard. They are front round flange mounting double rod cylinders.

The servovalves (one per cylinder) permits to control the movement of the cylinders with the accuracy specified in the requirements. But, the hydraulic system comprises also some other secondary components as air-cooler, electrovalves, check valves, filters, etc.

The main process control unit of the CLTB is a MOOG® Controller and Data acquisition system. This acquisition system is capable to read the sensors inputs at a frequency of 1000Hz. It has been directly design to perform hydraulic control.

Two load cells will be installed, one for each cylinder. The accuracy of the load cells will be 0.1% of the measuring range (Full Scale, F.S.), an accuracy of 50N for a 50.000N maximum load cell.

Two position sensors will measure the cylinder stroke. These sensors will use digital electronics to adapt its output signal. The precision of the sensor will be of 0,1mm.

To prevent incidents related to the security, some safety systems will be implemented:

- Emergency stop button
- Enclosure with limit switch
- Oil temperature sensor
- Relief valve to avoid overpressures in the hydraulic circuit
- Minimum and maximum stroke limiter

All these safety systems will be connected to the main unit process. If some of them are activated the process will stop, will show and alarm to the user and will reduce the hydraulic pressure.


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