

Executive Summary

The general objective of the Clean Sky Eco-Design ITD is to make a significant step towards the concept of the all-electric vehicle systems aircraft. Thus the feasibility of such an aircraft has to be investigated through the study of innovative energy management architectures while reducing ground and flight tests with innovative concepts and technologies.

To develop, validate and finally demonstrate these energy management architectures in the frame of Clean Sky programme, a modular test rig has been developed, based on Hispano-Suiza's COPPER Bird® bench (Characterization & Optimization of Power Plant and Equipment Rig).

The ELTESTSYS project has been started in August 2011 in order to design, manufacture, commission and validate of four complete and identical driving systems intended to be used for aircraft starters/generators testing inside the modular test rig above mentioned. The project, funded by the European Community's Seventh Framework Program (Clean Sky / Eco-Design) under the grant agreement n° 270584, involved two Romanian organisations: Institute for Theoretical & Experimental Analysis of Aeronautical Structures STRAERO S.A & National Research and Development Institute for Gas Turbines COMOTI. The ELTESTSYS consortium was coordinated by STRAERO and the specific project requirements were provided by Hispano Suiza as Topic Manager and end user of the ELTESTSYS Test Bench. The main project final result is the ELTESTSYS Test Bench, which is actually installed and used at Hispano-Suiza's COPPER Bird® bench in Colombes, France. The project was successfully completed in November 2013.

The ELTESTSYS Test Bench consists in four identical Driving Systems, associated control and power cabinets and a control and storage computer. Each system drives one single generator or starter/generator and is able to simulate electrical start of the aircraft engine, as well as electrical generation. Any two of the four drive systems have the possibility to be synchronized in speed and position. The four drives function simultaneously or not, independently and/or interdependently, can be locally or remote controlled and are integrated with ancillaries and central control system available at Hispano-Suiza's COPPER Bird® bench. A complete measurement channel deserves the entire test bench. Innovative aspects of the ELTESTSYS Test Bench are: mechanical transmissions with high efficiency by using recess gear system; bidirectional and birotational speed multiplier (23000 RPM); non-contacting measuring of torques and speeds; custom software for complete system configuration and management.

The ELTESTSYS Test Bench will be used at Hispano-Suiza's COPPER Bird® bench in Colombes, France, in the frame of Clean Sky programme, for testing generators and/or starter-generators in order to validate the integration of electrical systems and equipment, the quality of the energy produced, as well as demonstrating the maturity of technologies and systems for more electric aircraft.

Summary description of project context and objectives

Clean Sky is the most ambitious aeronautical research programme ever launched in Europe. Its mission is to develop breakthrough technologies to significantly increase the environmental performances of airplanes and air transport, resulting in less noisy and more fuel efficient aircraft.

The general objective of the Clean Sky Eco-Design ITD is to make a significant step towards the concept of the more/all-electric vehicle systems aircraft. Thus the feasibility of such an aircraft has to be investigated through the study of innovative energy management architectures while reducing ground and flight tests with innovative concepts and technologies.

To develop, validate and finally demonstrate these energy management architectures in the frame of Clean Sky programme, a modular test rig has been developed, based on Hispano-Suiza's COPPER Bird® bench (Characterization & Optimization of Power Plant and Equipment Rig). One component of the COPPER Bird® bench which had to be developed is a test bench dedicated to aircraft starters/generators testing

In line with Clean Sky mission, Eco-Design general objective and COPPER Bird® bench needs, the ELTESTSYS project aims to design, manufacture, commission and validate of four complete and identical driving systems intended to be used for aircraft starters/generators testing. These driving systems, with their control and power cabinets, have to be integrated into a single product: ELTESTSYS Test Bench. The test bench, which will be used at COPPER Bird® bench, must be integrated with ancillaries and a central control system. Being used in conjunction with other equipment developed in the Clean Sky programme, a high compatibility is needed: mechanical interfaces with the new developed generators and starter/generators, torque and speed characteristics, control and measurement, dimensions/compactness.

Description of main S & T results/foregrounds

The main project final result is the ELTESTSYS Test Bench which is actually installed and used at Hispano-Suiza's COPPER Bird® bench in Colombes, France.

The test bench consists of four complete and identical Driving Systems which can function simultaneously or not, independently and/or interdependently, locally or remote controlled. Each Driving System drives one single generator or starter/generator and is able to simulate electrical start of the aircraft engine, as well as electrical generation. Any two of the four Driving Systems have the possibility to be synchronized in speed and position. The maximum torque is 100 Nm and the maximum speed is 22000 RPM, in four quadrants functioning.

Each Driving System consists of one Control Cabinet (CC), one Power Electronics Cabinet (PEC) and one Drive (DRV). The Driving Systems are assisted by one Control and Storage Computer (CSC).



Power Electronics Cabinets

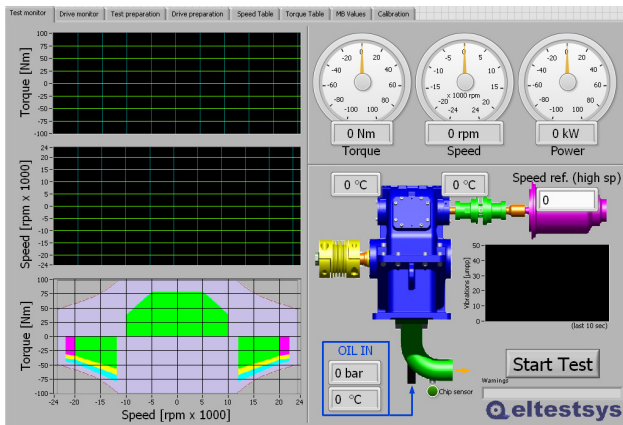


Drives and Control Cabinets

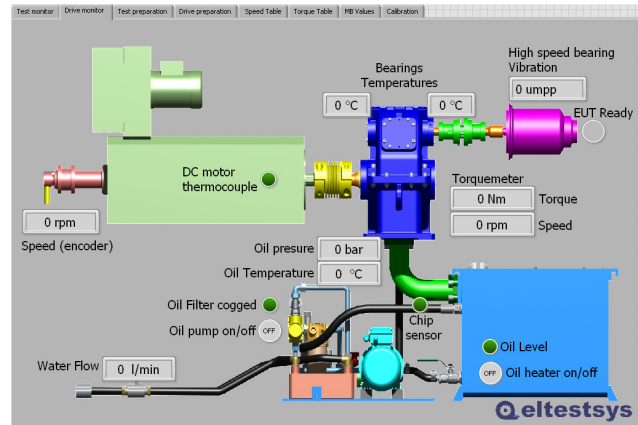
ELTESTSYS Test Bench installed at Copper Bird ®

The components of one Drive (DRV) are: Supporting Frame, DC Motor with compensating windings, cylindrical Gearbox (GB), Lubrication and Cooling Group (LCG), Low Speed Coupling (backlash-free torsionally stiff metal bellows coupling), High Speed Coupling (two hydraulic hub-shaft connections - ETP couplings) with Torque Meter, EUT Chair, Bursting Shield, power and signal cables.

For controlling the four systems, in a local and a remote manner, as well for data acquisition, each Control Cabinet has an industrial Panel PC equipped with a high-speed control and data acquisition board. Specialized control software has been developed in LabView.



HMI Application – Test monitor



HMI Application – Drive monitor

ELTESTSYS Test Bench Control Software

The Control System works with preloaded Torque(Speed) and Speed(Time) characteristics. These characteristics have to be provided, before any test, by the operator directly at the Panel PC or trough Ethernet. The synchronization in position of any two drives is done trough a special application board for the Converter (a board with dedicated function - Electric Line Shaft). For data storage purposes, one PC for all four drives is used.

The commissioning phase for the ELTESTSYS Test Bench has been closed on September 2013 and the consortium provided technical support to the end user up to end of the project and after that.

Potential impact and main dissemination activities and exploitation results

The expected final result of the ELTESTSYS project is one test bench consisting in four driving systems with the following features/performances:

- The four mechanical drives will permit testing of up to four generators and/or starter-generators, simultaneous, independently or interdependently, continuously and in conditions similar to their use on aircraft.
- Any two of the four mechanical driving systems can be synchronized in position at high-speed (up to 22000 rpm);
- The high-speed transmission (speed multiplier) will have high efficiency, low noise and vibration levels, low oil volume and a long life for it by using recess gear system;
- The high-speed transmission (speed multiplier) will be bidirectional and birotational;
- Non-Contacting Speed and Torque Measurement will be used;

The main dissemination activities performed are:

The project website has been developed: www.eltestsys-project.eu.

The project was promoted at Farnborough International Airshow 2012, in the Romanian pavilion.

The project was presented at X-NOISE EV workshop at ONERA, Chatillon, France on April 2012.

The project was promoted at Le Bourget International Airshow 2013, in the Romanian pavilion.

The Consortium organized a dissemination workshop in Bucharest, Romania.

Two papers have been published.

The ELTESTSYS Test Bench will be used, in the frame of Clean Sky programme, for testing generators and/or starter-generators in order to validate the integration of electrical systems and equipment, the quality of the energy produced, as well as demonstrating the maturity of technologies and systems for more/all-electric aircraft.

ELTESTSYS project had and will have significant impacts. With the project, a productive collaboration between STRAERO, COMOTI and HISPANO-SUIZA has started. Fruitful contacts between Romanian and French specialists have been made. In the international context, favourable to integrating national resources to EU capabilities, the ELTESTSYS project allowed the development of a stimulating and attractive environment for young researchers. The project not only provides work to them but also provides motivation, encourages communication and stimulates their inclusion in the European scientific environment.

Further to this, the ELTESTSYS project will contribute to increase the competitiveness of the industry, keeping European aeronautics in a leading global position by bringing up innovative solutions in the area of mechanical high speed transmissions and by improving the capabilities for electrical test benches. After the project ends, the test bench will be used near Paris, France, in the frame of Clean Sky programme, and will enable the European generators manufacturers to perform complex tests for new and existing units.

Address of project public website and relevant contact details

www.eltestsys-project.eu

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