Optimization of the flueric actuators testing system

Tiberiu Adrian SALAORU*,[1], Marina ANDREI[1], Dragos Daniel ION GUTA[1], Minodor ARGHIR[1], Cristiana DONCIU[1], Ioana POPESCU[1], Silviu UNGUREANU[1]

*Corresponding author
*,[1] INCAS – National Institute for Aerospace Research "Elie Carafoli"
B-dul Iuliu Maniu 220, Bucharest 061126, Romania
salaoru.tiberiu@incas.ro

DOI: 10.13111/2066-8201.2013.5.4.6

Abstract: *A supplying system for air with precisely controlled temperature, pressure, flow and speed has been designed in order to test the flueric actuator. All these parameters are monitored and the acquired data are stored on a PC hard drive and used for warning the operator in case of exceeding the normal operating range and for later processing and analysis.*

Key Words*: flueric actuators, testing system*

1. INTRODUCTION

Flueric actuators are experimental devices used for improving the air adhesion to the flaps surface. For testing these devices air supplying is required with pressure, flow speed and temperature parameters similar to those provided from the aircraft engines. Changing these parameters value is needed during tests to check if the actuators work in normal operating regime and to determine any limitation and/or other problems that may occur.

2. SYSTEM DESCRIPTION

The air supply system has three main parts: the air compression unit which is placed in different building, followed by a buffer tank which is outside of the testing area and the conditioning air unit placed within the flueric actuators testing area, according to [1], [3].

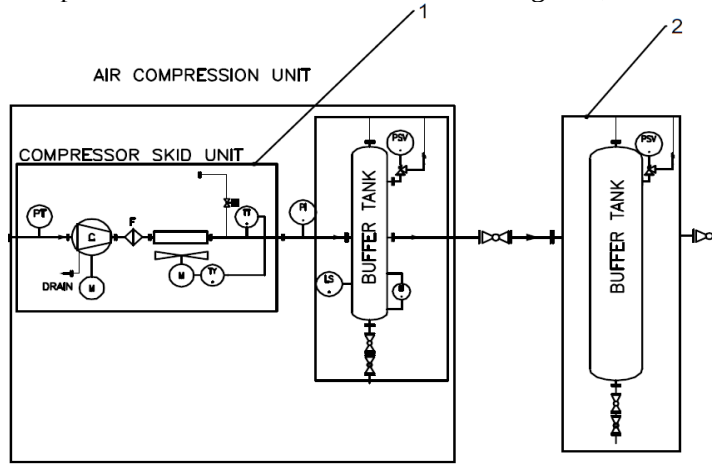

Figure 1. Air compression unit and buffer tank

Air compression unit is built in accordance with the regulations in force [2], [3] and the instructions of the normative [4], and it consists of two parts: the compressor skid unit (1) and the buffer tank (2) (Figure 1).

The air from the output of this unit is going into a buffer tank for storage. The compressed air from the buffer tank is brought thru a 100mm diameter pipe to the air conditioning unit (Figure 2).

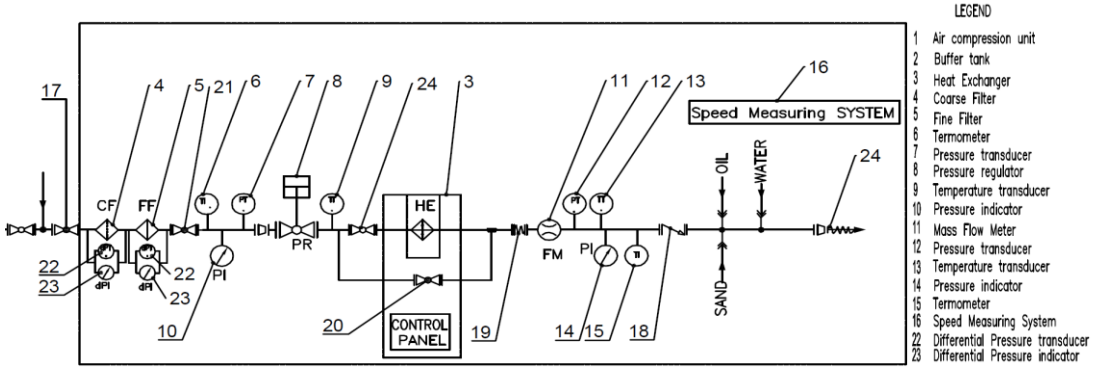

Figure 2. Air conditioning unit for flueric actuators testing

The First stages of this unit consist of two filters, a coarse one (160 μm) followed by a fine one (20 μm) provided with a differential pressure transducers (22) and a differential pressure indicators (23) having each of them 0-1 bar operating range for checking the dropping pressure on each filter in order to monitor their colmatation grade.

At this point the following parameters are checked: the air temperature (using a thermometer (6) of 0-100ºC operating range and a temperature transducer (9) of 0-250ºC operating range) and the pressure (by means of a pressure gauge (10) and a pressure transducer (7) of 0-7 bars operating range each).

Before heating, the air pressure is reduced to about 0.5 bars by the pressure regulator (8). In the following stage, the air is passed thru a 35kW heater (3) manufactured by Masterwatt Company. If necessary, the heater can be bypassed by means of two taps/valves, (20) and (24).

The air parameters are checked again after heating: the pressure, using a pressure indicator (14) having 0-1.6 bar operating range and a pressure transducer (12) having 0-2.5 bar operating range; the temperature, using a thermometer (15) and a temperature transducer (13) having each of them 0-250ºC operating range; and, finally, the air flow speed, using a mass flow meter (11).

Inlets for sand, oil and water were located to the output of the system to allow testing the actuators operating regime with contaminated air.

The output signals received from the differential pressure transducer and from the mass flow meter are electric currents in the range of 4-20mA while those received from all the others transducers are voltages in the 0-10V range.

These signals are applied to Adam 4117 data acquisition module which converts the analog input signals into digital signals transmitted thru a RS 485 interface to a PC where the data are analyzed in real time to warn the operator about the abnormal values.

Then they are stored on the PC hard drive [5], [6]. These components of the system are shown in Figure 3.

A Labview code has been written which displays the values numerically using graphic indicators for acquisition and processing of data. (Figure 4).

(a) (b)

Figure 3. General view of the system (a) and air filtering units and pressure regulator (b)

The data acquisition time can be set from the front panel in 0.1-1000s range allowing a maximum number of measurements of 10 per second.

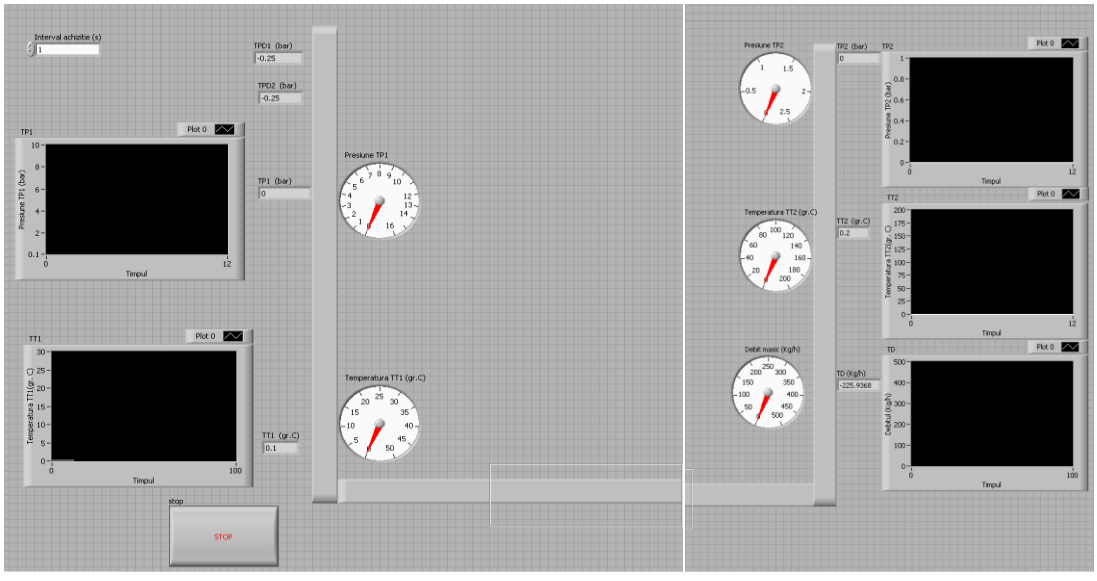

Figure 4. Main panel of Labview code

This system is provided with over temperature protection, assured by Masterwatt control panel. This cuts the power supply if the heater's sheath temperature exceeds a set temperature point which can be adjusted up to a maximal value of 500ºC degree. An additional protection system has been made, by applying the output signal from the mass flow meter to an electronic comparator, which cuts the power supply if the air flow is too low or if it is absent [7].

The electrical connections of the transducers utilized for this system are shown in Figures 5 (general connections), 6 (mass flow meter), 7 (pressure transducers).

3. FUTURE DIRECTIONS OF DEVELOPMENT

This system will be extended for testing other types of air actuators having a wider range of air parameters.

Data acquisition concerning the heating power variation and the remote control for the heater functions will be made by connecting the heater control panel via RS485 to PC.

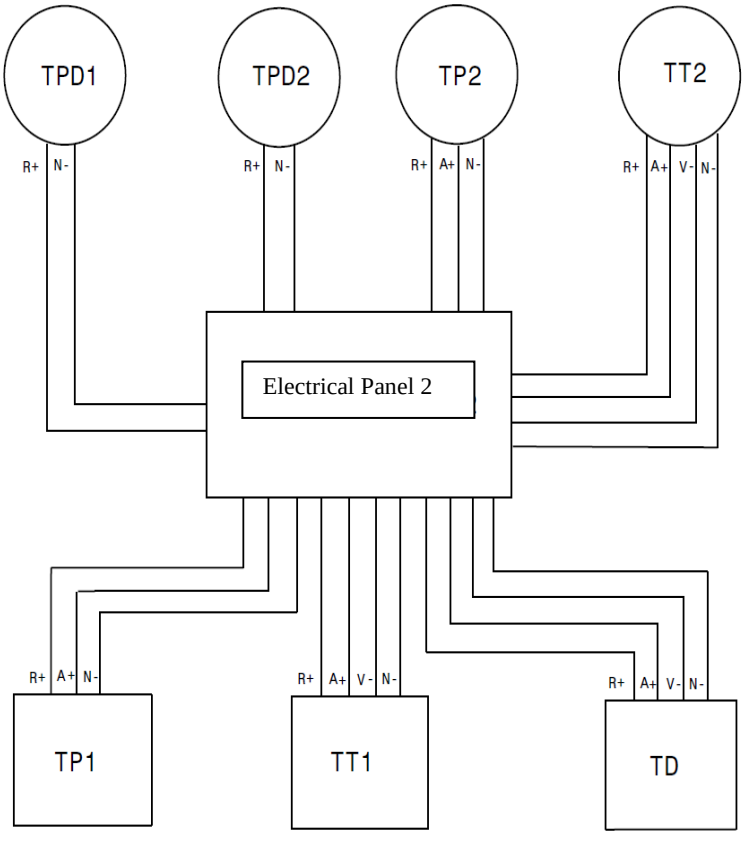

Figure 5. Schematic of general electrical connections of transducers

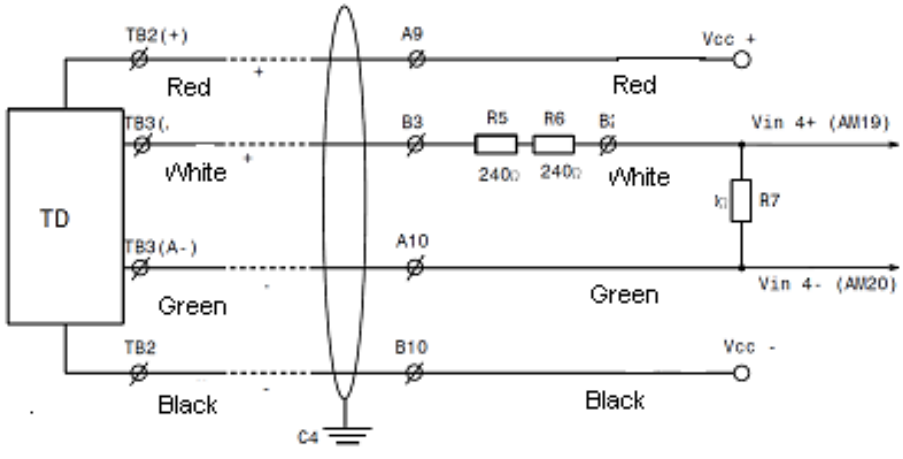

Figure 6. Schematic of electrical connections for mass flow meters

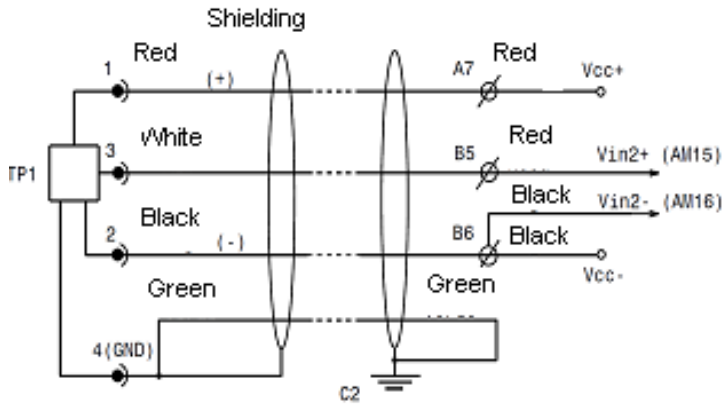

Figure 7. Schematic of electrical connections for pressure transducer

4. CONCLUSIONS

As expected, the testing system works in the normal range of operating parameters and its design is flexible and can be easily upgraded and adapted to any new test procedure, if necessary.

REFERENCES

[1] Gh. Duţă, *Ventilation and air conditioning installations*, Didactic Publishing House, Bucharest, 1982 (in Romanian: *Instalaţii de ventilare şi climatizare*. Ed. Didactică Bucureşti 1982).

[2] *** 137/1995 *Law-Environmental Law* (in Romanian: Legea 137/1995 — *Legea protectiei mediului*).

[3] *** 5.I 5-98 — *Standard for the design and execution of ventilation and air conditioning* (in Romanian: 5.I 5-98 *Normativ privind proiectarea si executarea instalatiilor de ventilare si climatizare*).

[4] *** NP 029-02 — *Normative for design, construction and operation of pre-insulated pipes for heating systems;* (in Romanian: NP 029-02- *Normativ de proiectare, executie si exploatare pentru retele termice cu conducte preizolate*).

[5] *** C. Nițu, *Electrical and electronic equipment automation*, Didactic and Pedagogical Publishing House, Bucharest, 1983 (in Romanian: C. Nițu, *Echipamente electrice şi electronice de automatizare*, Editura Didactică și Pedagogică, Bucureşti,1983).

[6] Șt. Popescu, *Actuations and automations*, Didactic and Pedagogical Publishing House, Bucharest, 1977 (in Romanian: *Acționări și automatizări*, Editura Didactică și Pedagogică, București, 1977).

[7] Șt. Gârlașu, *Electronics and industrial automation*, Didactic and Pedagogical Publishing House, Bucharest, 1982 (in Romanian: *Electronică şi automatizări industriale*: Editura Didactică și Pedagogică, București, 1982).