An installation of technological importance at INCAS: – The air conditioning plant and its annexes

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The air conditioning plant, the water recycling station, the water-cooling tower and the air storage tanks together with the trisonic wind tunnel form a whole complex technological assembly intended for aerodynamic experiments on different types of models in order to establish the optimal configurations, the drag and other aerodynamic parameters of importance for the aircraft designing.

Building this complex technological installation was possible after many thorough technical-economic studies performed by Romanian and foreign specialists during 4 to 5 years of research and documentation, between the years 1967 and 1972 respectively and its construction lasted until 1978, when the first blowdowns were run in the trisonic wind tunnel, on April 17.

Description of the plant components

1. The air conditioning plant consisting of two distinct parts, namely:
   A. The compressed - air plant
   B. The compressed - air drying plant

   A. The compressed - air plant consists of two centrifugal compressors of 5- pressure steps CENTAC C70 type, with a rate of 12,000 Nm³/h at a max. pressure of 21.1 ATA. The compressors are driven by three phase induction motors with direct power start. A drive motor has a power of 1840 kW, 205 A rated current and 1480 rpm. The supply voltage is of 6000 V and reaches the nominal speed in 4.5 sec. absorbing 4.5 times the rated current. The compressor driving is made through a coupling to the compressor central pinion, on which other 5 differential spider pinions are located, corresponding to the 5- pressure steps of the compressor. The air is absorbed by the first stage of the compressor from a filter battery and is compressed from stage to stage until the exit of the 5th step at 21 ATA, step which is
connected to the after cooler whose destination is to cool the air temperature acquired by compression up to 40°C. From here it is transferred to B.
B. The compressed – air drying plant which consists of:

- a drops separator
- a buffer tank
- two silica gel dryers
- two final filters
- a heating battery of 324 kW

The drops separator is intended to retain any drops of water from condensation and eliminate them from the container through its bottom using a special designated system.

The buffer tank is designed to reduce the air turbulence created by the circuit configuration and to limit the air speed before entering the silica gel dryers.

The silica gel dryers consist of 2 tanks of 12 m³ each, within which there are 3.5 tons of 5.7 mm granulation silica (silica gel) placed between two reinforcing layers made of almost spherical-shaped river stones with a diameter of about 50-60 mm.

The driers role is to retain all the moisture in the air due to the hygroscopic properties of silica gel.

The final filters are two tanks with filter elements designed to retain the last fine particles that eventually reached the storage tanks and from there, through the blowdown, the model installed in the wind tunnel. This prevents the possibility to degrade the model, to
pervert data within the data acquisition system or to disturb the Schlieren visualizations when they used in experiments.

The role of the heating battery is to regenerate the silica gel from the driers after its saturation by the direct circuit air flow passage.

2. The water recycling plant
The plant operates in open circuit with recycled water, being designed to provide IR C70 centrifugal compressors cooling during running. The water flow needed for compressors cooling is of 240 m$^3$/h achieved by 3 electro pumps of LOTRU type (flow rate of 80 m$^3$/h, Ø 80) driven by three-phase motor having a power of 18 kW. The recycling water plant is a half buried construction with pumps installed at the level of - 2 m operating in drowned regime.

3. The water cooling tower
The cooling tower is of forced draft type, built of reinforced concrete with a drainage basin of 150 m$^2$ at the level of - 2.5 m. The cooling tower structure of resistance is made up of prop pillars and prefab reinforced concrete plates with a height of 15 m.

The tower cooling plant consists of:
- a OL Ø419 mm main pipeline
- 16 OL Ø114 mm pipelines perpendicular to the main pipeline
- 64 jet breakers mounted on the 114 mm diameter pipes.
- vaporizing grids on the entire surface of the tower.
- an electro- fan of 50 kW with a flow rate of 180 m$^3$/h.
- 2500 asbestos cement boards of 2 m$^2$ each vertically positioned to achieve the draft.

The cooling circuit in the above mentioned configuration (compressor coolers, pumping plant, connected by turn - return pipes) is able to accomplish the compressors cooling during operation so that the difference between the input water temperature and the cooling water does not exceed 15° C.

4. The air storage tanks
They are made of steel with a wall thickness of 40 mm, and a diameter of about 4 m and a length of about. 210 m.

The tanks capacity is of 2000 m$^3$ they are equipped to the final part with a 9 m thermal array.
The tanks communicate to the wind tunnel through a butterfly-type valve with a diameter of 1.2 m electrically operated from the control room of the Trisonic Wind Tunnel, where there is also the data acquisition system upgraded several times.

The whole plant assembly proper operation within the regular parameters is due to a careful operation and maintenance and also to a good collaboration with COMOTI which actually participates to INCAS efforts to maintain into operation, to repair and extend the scope of work, which far surpasses the performance range for which it has been designed.

Therefore, in the last year the connection of the Subsonic Wind Tunnel to the air conditioning plant was possible which led to experiments that formerly were not possible

Also, through a collaboration with the Institute COMOTI, the air conditioning and drying plant was connected to the testing stand of the combustion chamber of the above mentioned institute; thus an international collaboration with European partners (especially German) aiming to carry out research programs became possible.

We mention that over time experiments on important models such as IAR 93, IAR 99 and others. were performed in the INCAS Trisonic Wind Tunnel. Also, experiments were made for ILOT Warsaw (over 250 blowdowns) and together with the ELBIT company of ISRAEL we worked to improve the performances of the 21 MIG aircraft.

At present the entire complex of installations operates at the designed parameters thus being able to respond to any challenge. Also, by extending the INCAS participation in European research programs, its proper operation and maintenance become an absolutely indispensable condition for the development of the main testing base of our institute:- the Trisonic Wind Tunnel.

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Responsible for operation and maintenance of the whole complex technological assembly consisting in the air conditioning plant, the water recycling station, the water – cooling tower, the air storage tanks and the trisonic wind tunnel. Al. Scarlat has specialized in the centrifugal compressor maintenance after taking a specialized training at INGERSSOL-RAND in Italy.

He plays an important role in the maintenance and revitalization of all the facilities needed for the air pressuring, together with specialists from COMOTI such as PhD. Eng Valentin SILIVESTRU, PhD. Eng. Cristian CĂRLĂNESCU, Eng. Liviu ADAM and other specialists from INCAS such as Eng. Anton IVANOVICI, Eng. Teodor DEMETRESCU and also the entire operating team led by Gheorghe GOLOGAN.