

USER REPORT



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SPECIAL SOLUTION FOR TEMPERATURE SIMULATION IN E-MOBILITY

The CO₂ limits in major automotive markets will be further tightened in the coming decade. Since not only the legal requirements but also the customer preferences differ from country to country, the new e-mobility division of automotive supplier Schaeffler relies on a variety of different drive solutions. In the meantime, Schaeffler has achieved great market success with twin-clutch transmissions and hybrid modules for hybrid vehicles, in which the electric drive is positioned between the combustion engine and the transmission. To the greater susceptibility of electric drives to failure compared to internal combustion engines, the automotive supplier responds increasingly with testing under extreme temperature conditions.

To ensure a perfect and long-lasting function of separating clutches, for example, the components must be exposed to as real as possible environmental conditions and changing extreme temperatures in endurance tests. At the same time, the tests include temperature measurements, drag torque measurements at different temperatures, and functional measurements.

TEMPERATURE CONTROL REQUIREMENTS OF SCHAEFFLER:

Schaeffler requires a test chamber that enables the precise simulation of ambient temperatures for quality-testing the separating clutch. The requirement is that the specimens should be exposed to ambient temperatures of $-40\text{ }^{\circ}\text{C}$ to $+120\text{ }^{\circ}\text{C}$ during endurance tests. To avoid long downtimes or waiting times for given temperature changes, a rapid temperature change from $+30\text{ }^{\circ}\text{C}$ to $-30\text{ }^{\circ}\text{C}$ within 1 ½ hours is required. A space-saving compact solution is needed for tempering the air inside the test chamber.

JULABO'S SOLUTION APPROACH:

An air-cooled PRESTO A85 is used in combination with a heat transfer device. A specially adapted powerful fan with adjustable speed provides the necessary air circulation. Thus, the speed can be increased, and thereby the airflow improved for larger test specimens. Fans and heat transfer devices are installed inside a stainless steel chamber. The PRESTO connected to the heat transfer device is placed outside the chamber. Tests are conducted in a temperature range from $-40\text{ }^{\circ}\text{C}$ to $+140\text{ }^{\circ}\text{C}$. With a cooling time of approx. 50 minutes from $+140\text{ }^{\circ}\text{C}$ to $-30\text{ }^{\circ}\text{C}$, the PRESTO allows a faster temperature change than specified by Schaeffler.

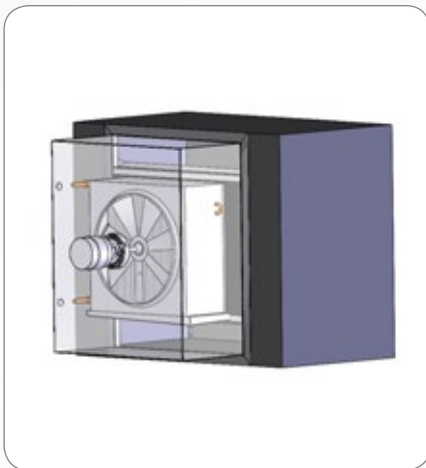


Fig. 1: Fans and heat transfer devices are installed inside a stainless steel chamber



Fig. 2: PRESTO A85

Initial preliminary tests are being carried out in a temporary test setup at JULABO (Fig. 3). Next, the heat transfer device with fan is attached to a stainless steel test chamber (Fig. 4). The fan draws in the air above and below the heat transfer device from the front of the chamber and then presses it back through the heat transfer device fins tempered by the PRESTO A85. Thus, the cooled or heated air is continuously discharged into the chamber part with the test specimen.



Fig. 3: Temporary test setup

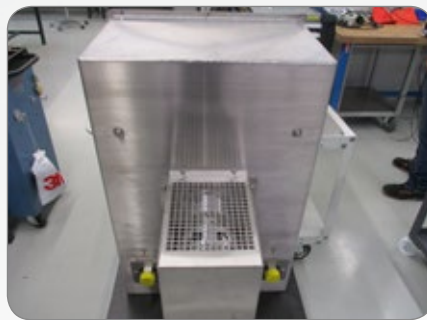


Fig. 4: Heat transfer device

By working with extreme temperatures in the minus and plus ranges, the following challenges arise during the tests: The electromechanical parts of the standard fan are not designed for the required extreme temperatures of $-40\text{ }^{\circ}\text{C}$ to $+140\text{ }^{\circ}\text{C}$. To avoid operation of the temperature-sensitive parts of the fan inside the test chamber, JULABO's temperature specialists modify the fan according to the requirements and bring the actual drive motor outside the chamber (Fig. 5).

Another challenge when working with minus temperatures is the formation of condensation and the resulting ice crystals. The air in the test chamber contains a low percentage of humidity only due to the small chamber volume. To avoid the introduction of any additional humidity by fresh air, the chamber must be hermetically sealed. The low formation of condensation or ice crystals from the existing air humidity does not influence on the temperature and is negligible.



Fig. 5: On the outside of the case mounted fan drive motor



Fig. 6: Heat transfer device

Due to the material, the housing of the heat transfer device can deform due to extreme temperature changes. With increasing temperatures, tested from a room temperature of +20 °C, the material of the housing slowly expands. With decreasing temperatures, the material contracts again. Although the deformation does not influence the temperature control process, it can affect the position and fit of the connections. Deformation due to temperature changes is prevented by a corresponding reinforcement of the housing walls.

A heating or cooling of the outer walls due to contact between stainless steel and heat transfer device is prevented through appropriate design measures. The use of special materials prevents points of contact between heat transfer device and stainless steel. This thermal decoupling, together with the insulation, ensures that there are no burns when the housing is touched and that no condensation forms as a result of heavy cooling (Fig. 7).



Fig. 7: Insulated housing of the heat transfer device.



Fig. 8: Universal test chamber, where test specimens are exposed to simulated ambient and extreme temperatures

CONCLUSION:

For the designers of the automotive supplier, cooperation with a reliable and competent partner was an important prerequisite for the successful realization of the project.

Therefore, various temperature control specialists were contacted regarding the specific Schaeffler requirements. Only the JULABO consulting team signaled immediate readiness to develop the desired special solution. In addition to many years of experience and competence, this flexibility was crucial for Schaeffler to choose JULABO.

With a development time of two months only, JULABO built a heat transfer device unit that meets all requirements, in some cases far beyond the specifications. Intensive cooperation with Schaeffler resulted in a temperature control solution for a universal test chamber, in which various test specimens can be exposed to precisely simulated ambient and extreme temperatures in continuous and functional tests (Fig. 8).



Picture: Stefan Serrer, Development Engineer
Mechanical Engineer at Schaeffler in Bühl

„The coordination phases of the project were characterized by uncomplicated and competent support through JULABO.“

Stefan Serrer

INFO ABOUT SCHAEFFLER:

The Schaeffler Group is a globally active automotive and industrial supplier. In 1965, the Schaeffler brothers co-founded LuK Lamellen und Kupplungsbau GmbH in Bühl. The first innovative product - a diaphragm spring clutch - put the company at the technological forefront of this market. As one of the world's largest clutch manufacturers and specialists for the drive train, LuK has been wholly owned by Schaeffler since 1999. With precision components and systems in engines, transmissions, and chassis as well as rolling bearing and plain bearing solutions for a large number of industrial applications, the Schaeffler Group is already making a decisive contribution today to the "mobility for tomorrow." Since its beginnings, the company has been characterized by groundbreaking innovations and global customer orientation. The Schaeffler Group's main development locations in Germany are Herzogenaurach, Schweinfurt, and Bühl, which are networked with other design centers in Europe, Asia, and North and South America.

SHORT INFO ABOUT JULABO:

JULABO GmbH, founded in 1967 in Germany, develops sophisticated temperature control technology and stands for innovation and competence in this area. Our units equipped with state-of-the-art control technology are used when highest temperature accuracy or fastest response to temperature changes is important. More than 600,000 JULABO units installed worldwide demonstrate the high acceptance among users in research and industry. With proven quality "Made in Germany" and fast and competent service by local contact partners, JULABO has developed to a leading company for temperature control solutions.