



## Airplane wing test stand for simulating the airstream

Airbus Deutschland GmbH



**HANCHEN**<sup>®</sup>



1 | Airplane wing test stand for simulating the airstream



## Hänschen ist standard

**In test stands at Airbus in Bremen, Hänschen cylinders have proven themselves in system tests.** Airbus – this name stands for the highest safety standards, and for an association of European locations that share research, development and production. To guarantee such a high level of safety, extensive simulations and tests are being performed. System tests that also simulate loads and environmental conditions during different flight phases are especially demanding. As this involves rapidly changing forces with very irregular parameters, the actuators that simulate the airstream must fulfil the highest demands. In different test sectors, the hydraulic cylinders by Hänschen have proven themselves in many generations of the Airbus test stand technology.

### The high lift divide system

This positive experience has also been made in the High-Lift-Test-Centre at the Bremen location. Here is where high lift divide systems for the wings of all Airbus series, including the A380 series, are developed designed and produced. The best known elements of the high lift divide system are called landing flaps and slats. During the different flight phases, they adjust the aerodynamic properties of the wings and optimise these, whereby the corresponding drive systems are especially strained. They move the so-called 'slats' in the front and the 'flaps' on the rear edge of the wings. Many hydraulic and electric drive components position the slats and flaps during starting, cruising and landing. Extensive tests simulate the occurring environmental conditions, forces and other strains. This ensures and proves the necessary system safety





2 | Monitoring and controlling of the wing tests  
 3 | Dipl.-Ing. Michael Johst, Head of High Lift Rig Operations & Maintenance at Airbus Deutschland in Bremen

for the first flight and the airworthiness certificate – even for extreme situations.

### **An absolutely thorough test**

In Bremen, normal flights and extreme situations are investigated in order to prove the required functionality especially of the complex high lift divide system. The A350 XWB system test is decisive for the airworthiness certificate for this airplane. It differs from previous tests with its much higher complexity: "We concentrate on every single detail in the system in the tests in Bremen," is how Dipl.-Ing. Michael Johst, who is in charge of operating the test facilities in the high lift sector, describes the task. "We have completely installed the original drive motors, the safety features and equipment and the sensor technology to thoroughly check the individual system. In doing so, we do not only investigate various 'normal operation cases' but also possible extreme situations. These are simulated on the original system to verify that the system stability is guaranteed under all circumstances. In addition to the tests on the real test stands, we use virtual test platforms.

### **Hydraulics simulate air loads**

System tests check redundancies and the function of the control computer in interaction with all relevant system and structure components, which is partially quite complex. In these tests, the air loads as well as high and low temperatures of at least  $-56^{\circ}\text{C}$  respectively of at most  $+90^{\circ}\text{C}$  are simulated. For Airbus in Bremen, an additional focus during the test of the high lift divide system is on the qualification of novel high lift components. Wherever linear forces act in these test stands, hydraulic cylinders by Herbert Hänchen GmbH & Co. KG from Ostfildern near Stuttgart are generally used, especially in the simulation of air loads.

### **A350 XWB – the latest project**

When testing the slats and landing flaps of the A350 XWB 26 cylinders made exclusively by Hänchen are being used. Due to the size of the drives, the power density, the control quality and the dynamic, hydraulics are especially suited to optimally simulate the flight conditions. The admissible deviation of 1% with static load is maintained thanks to the cylinders by Hänchen. With dynamic tests, the admissible deviation is 4%. The test stand is designed for a service life of 15 to 20 years. Exceptions are special tools for investigating extreme situations that are designed for limited load changes under ultimate load conditions.





4| Hydraulic cylinder series 300 with position measuring system



5| Servocop® cover type

### Cover type Servocop®

These specifications can be effortlessly fulfilled in series by the hydraulic cylinders by Hänchen: The Hänchen series 300 cylinders applied in Bremen are all designed in the Servocop® cover type due to the high requirements on performance and dynamics. The maximum applied supply pressure is 250 bar with the flap cylinders and 300 bar with the slat cylinders. In the test field, the supply pressure is reduced to 180 bar due to the pressure loss required for controlling. The bore is between 40 and 160 mm, the rod diameter between 30 and 110 mm with a stroke of 300 to 1670 mm. Important characteristics are high accuracy and minimum clearance between cover and piston rod. The sliding surface guarantees optimised friction properties. A long service life is guaranteed by the high production accuracy and the minimal guide clearance. In addition, the Servocop® design features a practically stick-slip-free movement even at very low (up to 0.02 m/s) and very high (up to 1 m/s) piston speed.

For this reason, the Servocop® cover type is especially suited for the test and inspection sector such as that at Airbus. In Bremen, safety aspects for the protection of the operating staff and the test stand itself are also important, because damages may set back a test for many months. Electric drives turn out to be quite unsuccessful for this application field in testing, especially with load simulations.

All cylinders of the new test field generation are equipped with an EtherCAT-capable integrated position measuring device, because the realtime-capable field bus has become standard in Bremen. Controlling of the actuators supplied centrally with hydraulics from basement takes place via load and position. The load control of the air load simulation is done in dependence on the respective position in the original system. With smaller test setups, the cylinder manufacturer also supplies complete actuators with accumulator, valve and other elements.

### The design of the high lift test stands

With the high lift test stand for the A350 XWB, Airbus has reconstructed the systems of the left wing true to scale; the right side is displayed shortened. The slat stations are charged by an arrangement of 14 cylinders and are directly connected to the system components via gear rods. On the inner and outer landing flaps of the rear wing edge, the load simulation is supported by hexapods. Actuators are 6 hydraulic cylinders each. Pneumatic linear drives are attached on the hydraulic cylinders to support fast motions with low mass.





6 | Slat station with 14 hydraulic cylinders by Hänchen  
7 | Hydraulic cylinder of the hexapod with flanged Ratio-Clamp®

### Ratio-Clamp®

To fix the hexapods securely even without applied pressure for an unlimited period of time, all hydraulic cylinders feature a flanged Ratio-Clamp® on the flaps. This patented clamping is designed for a holding load of between 140 and 300 kN, depending on the cylinder. The force is stored in screw plate springs and fixes the rod via a conic clamping element through frictional contact in case of pressure loss. The applied spring sets and the length of the cone exactly define clamping force and trigger pressure here. This clamping procedure can be triggered by direct cut-off, reduction of pressure or a power failure as well as system damages. This clamping force is then preserved for any amount of time without energy supply until the releasing pressure is applied again and the piston rod thus released. In case of applied pressure, the rod can be turned in both directions with low friction. The use of Ratio-Clamp® also provides the typical advantages of a hydraulic system: high power density and precise reaction due to the minimal compressibility of the fluid. This practically rules out damage on the expensive Airbus test stands, for example in case of a failure of the hydraulic supply.



8 | Cross section of a Ratio-Clamp® clamping device with a Servocop® sealing system

### Hänchen is a must in Bremen

"We like to work with Hänchen cylinders and clamps, because they have proven themselves well and maintain the promised quality," summarised the leading test engineer Johst. "We have gathered this experience since our first high lift tests in 1980. Even though we work in many sectors with several partners: Hänchen products are a standard in our company."

Jörg Beyer – mediaword



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