

Historic moment for Siempelkamp:

Material inspection for the Soyuz creates that astronaut feeling

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Museum of Military History of the German Federal Armed Forces at Dresden, Germany



The background was as follows: In the summer of 2011, Siempelkamp Prüf- und Gutachter-Gesellschaft (SPG) in Dresden received an order to perform ultrasonic testing and wall-thickness measurements on the “Geschosshagel” installation (Geschosshagel = hail of bullets) in the Dresden Museum of Military History. The job was to perform non-destructive materials testing on 23 different rockets and shells.

This project was expanded during the work relating to the material inspection on the Soyuz 29 space capsule. It was to be suspended from the ceiling of the museum as an eye-catcher. Initially the TÜV (technical inspection association) refused its approval, as there was no certification of strength and integrity.

For this reason, Siempelkamp was brought on board (or actually the capsule) to perform the material inspection over the course of 14 days. This narrow timeframe represented a special challenge, as the material being examined was unknown – a consequence of the secrecy previously surrounding this project.

For the materials testers, this then became a highly unusual order, bringing back childhood memories of space travel and distant galaxies!

Soyuz 29 landing capsule hanging on its suspension at the ceiling in the Museum of Military History



29 landing capsule

Sometimes the stars are within reach, even for inspectors and expert consultants. The order to perform a material inspection on the famous Soyuz 29 capsule fulfills a childhood dream for the team at Siempelkamp Prüf- und Gutachter-Gesellschaft in Dresden, Germany: getting a taste of that cosmonaut feeling!

By Dr. Peter Seliger and Johannes Seichter

Safe with SPG: a space capsule as a museum exhibit

Exhibition pieces in museums are subject to specific safety regulations – just like other structures, stages, or mechanical facilities in theaters and other public venues. The requirements for such facilities in terms of quality and safety are governed by regulation BGV C1 “Event and production facilities for scenic presentations”.

Our task was to produce a survey of the integrity of the Soyuz 29 space capsule, and of its proposed “hanging” suspension in the museum.

The presentation concept created by a Berlin architects’ office proposed hanging the capsule from a ceiling crane using ropes, and displaying it in suspension. The suspension structure would involve using bolts to attach welded angle brackets (load-bearing points) to the existing flanged threaded holes in the Soyuz capsule.

In advance, the architects’ office had prepared a static concept for the museum’s Soyuz capsule suspension system (i.e. the crane system and gross load coefficients for the static design). The SPG survey was particularly required in terms of the strength of the space capsule’s flanges, which would be used for receiving the load fastening devices.



Creating a scene of rocket and grenade volley on the ground floor of the museum



Ten years after their historical flight into space the cosmonauts Sigmund Jähn and Valery Bykovsky immortalized on the Soyuz capsule

Two boundary conditions significantly limited the SPG experts' freedom. On the one hand, there was no documentation available on the design, material selection and material loading – on the other hand, only non-destructive testing processes could be used, as it was not permitted to take material samples.

Due to the complexity of the task, this job required the interdisciplinary expertise of inspection services and strength calculations: a decisive competitive advantage for SPG!

Inspection + calculation = safety

In detail, there were many individual tasks that had to be solved: visual inspection of the interior and exterior, spectral analysis to determine the material of the attachment flanges, ultrasound wall thickness measurements, hardness testing for purposes of estimating hardness, and load-bearing tests on the flanges and the threads provided.

The pull-out testing was intended to ensure that the screw-holes in the flanges made of an unknown metallic material were capable of bearing the necessary forces. On the basis of these test results, the SPG team also derived design alterations for the suspension system.

It was then possible to continue with the newly drafted static design calculations for the improved design. The final result was that through a combination of calculational and experimental measures, it was possible to demonstrate that adequate safety precautions were present to prevent the failure of the capsule attachment points and the suspension structure fixed to it.

Mission accomplished, and with a great deal of enthusiasm! Since the middle of January 2012, the space capsule has been marvelled at by visitors to the museum, without their safety being compromised.

Pulling test at stud bolts for fixing the suspension construction



Ultrasonic wall thickness gauging





Top:
Dr. Peter Seliger during visual inspection inside of the landing capsule
Bottom:
Inspection under rather confined space conditions

Soyuz 29: Historical flight into space

On August 26, 1978 Sigmund Jähn, the first German in space, and the Russian Commander Valery Bykovsky flew the spaceship Soyuz 31 to the Soviet orbital space station Salyut 6. The cosmonauts orbited the Earth for nine days, seven of them filled with scientific experiments. On September 3, the crew returned to Earth in the 6.8 t Soyuz 29 capsule, landing safely in the steppes of Kazakhstan even if the landing was a little bumpy.

After the flight, the Soviet Union presented the landing capsule to East Germany. There it was placed in what was then the Army Museum in Dresden. As a result of the Unification Treaty of 1990, the exhibit became the property of the German armed forces, and was for many years on loan to the German Museum in Munich. Since 2011, it has been a highlight of the permanent exhibition at the Dresden Museum of Military History.

Even today, the ingenious design and robustness of the Soyuz spaceship are being used intensively. Since the end of the American shuttle program in July 2011 it has been the only means of supplying the ISS international space station, and replacing its crew members.

While his American colleague Neil Armstrong recently passed away, Sigmund Jähn is still active. Since 1990 he has been working at the Russian cosmonaut training center as an independent consultant from the DLR German Aerospace Center, and since 1993 has also been working for the ESA (European Space Agency).

The exhibit at the depot of the museum



Front ceiling suspension at the entry flange



Interview:

The Soyuz project – a high-flying engineering achievement with its feet on the ground



(left to right) Johannes Seichter and Dr. Peter Seliger have experienced cosmonaut feeling

Dr. Seliger, Mr Seichter – How did it feel to investigate a historic space capsule?

Dr. Peter Seliger: When we inspected this technically fascinating development, we were given the opportunity to be a part of an exciting and unique project. Now the capsule is hanging from the ceiling of the museum, and no one is going to get it down again anytime soon.

Johannes Seichter: After seeing the capsule, the idea that Sigmund Jähn and Valery Bykovsky had to endure two days in that tiny space, without being able to move, was rather spooky and nightmarish. But overall the project was a brilliant experience!

Did you use to wish – like so many young men in East Germany after the historic space-flight of Sigmund Jähn – you could become a cosmonaut?

Johannes Seichter: It certainly was tempting. Particularly as I saw Sigmund Jähn personally in 1978, during a speech after his historic flight into space. Back then, I was just finishing my national service in the military. I was already too old to choose the “cosmonaut” career path, but I very much admired it.

Dr. Peter Seliger: It was much the same for me. I found this task unimaginably interesting, but my personal aim had always been to become an engineer. Three weeks after Jähn’s space flight, I started my engineering studies.

How did the space capsule really feel?

Dr. Peter Seliger: You really come to respect what Sigmund Jähn did, entrusting himself to this capsule and taking that massive risk. I was excited at all they managed to achieve with the technology they had back then. All of the controls were analog. You truly felt the long development time that went into this capsule.

What made it so technically challenging for Siempelkamp Prüf- und Gutachter-Gesellschaft?

Johannes Seichter: The challenge was the material ...

Dr. Peter Seliger: ... we mean, our lack of knowledge about the material used ...

Johannes Seichter: ... and of course the fact that we did not know the details of the design. “How much strain can we put on the unknown material?” was a key question. This was because it was important not to endanger the visitors to the museum. On the one hand, we have the load; on the other hand, the material needs to be able to take this load. To answer the question reliably, we used almost the entire range of non-destructive tests.

How many SPG employees took part in the project?

Dr. Peter Seliger: In total, four of us were involved. It was an exceptional event for all of us, even though the famous Soyuz space flight took place 33 years ago.



SPG in Dresden – the specialist for extraordinary inspections

Dresden Museum of Military History

After seven years of restoration and rebuilding work, the Dresden Museum of Military History was ceremonially reopened on October 14, 2011 by the Minister of Defence, Dr. Thomas de Maizière. With over 10,500 exhibits in the permanent exhibition, over a total area of 19,000 m², the museum is one of the largest and most modern military history museums in Europe.

Of particular note is the newly designed façade of the museum, created by star architect Daniel Libeskind. A giant, V-shaped wedge made from reinforced concrete and stainless steel cuts through the symmetrical old structure of the Royal Saxon Army's arsenal, which was built in the classical style between 1873 and 1877. A successful union of history and the modern era.

Amongst the top exhibits, also much sought-after by other museums, is without a doubt the Soyuz 29 landing capsule. Since 2011 it has been on display in the Libeskind wedge, at a height of about 10 m. It hangs there at precisely the same angle as it re-entered the Earth's atmosphere.

Has SPG done any other exceptional tests?

Dr. Peter Seliger: We have dedicated ourselves to a whole series of similarly illustrious projects. Particularly impressive, for example, was the endoscopic investigation of the sarcophagus of King John of Saxony (1801–1873). The X-ray examination of gold found in archaeological digs in Central Asia was also an exciting task.

Johannes Seichter: Another exceptional job was attaching resistance strain gauges to the teeth and tooth implants of military pilots, to measure the involuntary biting forces, e.g. during nose dives.

Dr. Peter Seliger: Not forgetting the non-destructive material testing on the wheel steamer “Diesbar,” which went on its virgin voyage down the Elbe in 1884. The Saxon Elbe wheel steamer fleet is the oldest and largest still in service anywhere in the world!

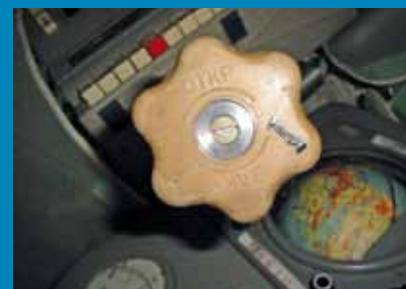
So there is no shortage of extravagant projects for you to work on. Do you still have a “dream investigation” you would like to add to this collection?

Dr. Peter Seliger: Absolutely! Right at the top of my list is the “Blue Wonder” of Dresden, one of the oldest riveted, self-supporting bridges. It was built between 1891 and 1893, so in terms of age, it is hard on the heels of the Eiffel Tower (Paris), which started construction in 1887.

What would the challenge be there?

Dr. Peter Seliger: The steel grades used in this bridge come from the tail end of the 19th century. From an engineering perspective, the interesting thing is that the entire bridge is riveted, and supports itself over the entire breadth of the Elbe river. It certainly would be exciting to test the materials ...

Then we hope you get commissioned to do so, and thank you very much for the interview!



In the cockpit of the Soyuz: steering units of the capsule, breathing air system etc – in most confined space, operated analogically