

Machines & Automation

# Alleima – Super Duplex Hydro-Test Machine

To design and manufacture a production line for conducting leak-tests on super duplex tubes

Enabling Cabling

Case study

[sea-reelgood.com](http://sea-reelgood.com)



Customer  
Alleima

Location  
Chomutov,  
Czech Republic

Delivery schedule  
November 2023

Total quantity  
1 Production Line

### Summary

## Using the full range of SEA design and engineering skills

Alleima contacted SEA Enterprises a.s. about designing and manufacturing a production line to conduct leak tests of super duplex hollow tubes. The project scope required the machine to accommodate a range of tube length and tube wall thickness. Through a series of design iterations SEA engineers developed a unique design with a solution that satisfied all customer requirements.

### Objective

## To design and manufacturing an automated production line

The key goal of the automated machine was to perform tube feeding then carry out hydro-pressure tests on stainless steel super duplex tubes up to 40m length covering the full range of tube outside diameters produced by Alleima. The production line was required to be delivered to the customer 6.5 months after PO placement.

The project scope required SEA to design the control panel, write software, and develop the operating system and production line to conduct leak-testing of super duplex stainless steel tubes.

The following key project challenges were identified:

- Tube sealed for pressures up to 500 bar (according to tube dimensions)
- Pipe sealing with zero pressure to ensure no pressure drop during testing
- Automatic operation of tube clamping heads
- Automatic adjustment of the position of the tubes based on diameter
- Securing the position of the test heads during the operating cycle
- Holding the tubes being tested during the pressure cycle
- A closed water circuit required for the pressure tests
- Automatic sorting of tubes based on after testing
- Automatic transfer of tested tubes

The hydro-test production line had to be installed in the customer location and FAT conducted before commencement of production operations.

## Solution

The tubes are first visually inspected on a horizontal inspection table and then manually rolled into an inclined loading section. They roll by gravity to an adjustable stop determined by the tube diameter. The last tube is then lifted and rolled into the test station.

Because the tube head would be subjected to a force of up to 63 kN at a pressure of 500 bar, it was necessary to ensure very secure locking of both the pipe and the compression head. The design specification required that the clamping heads must not damage the super duplex tubes; in other words, the design was not permitted to use jaws that clamp directly onto the tube surface.

The clamping heads were designed without jaws and their fixation at the tube ends was secured by a robust clamping system for both the heads and the tested tube. Due to varying tube lengths, a rack system was implemented to mechanically lock the position of the pressurization head at any required location.

The machine was designed to test one tube at a time; however the loading section could hold up to 30 tubes depending on the tube diameter. Tubes had to be automatically fed from this section into the test station.

The high-pressure section of the production line was designed and manufactured together with Maximator, a proven supplier of high-pressure components.

The hydro-test circuit was designed with a minimum number of fittings to reduce the risk of fluid leakage and pressure drop. For sealing the test circuit, tested and reliable valves were used to ensure perfect closure of the tube under test.

This method of perfectly sealing the system had to be developed by the design engineers because all valves and pressure heads had to be perfectly tight when subjected to pressure - no pressure drop was permitted when checking the tightness of the tube.

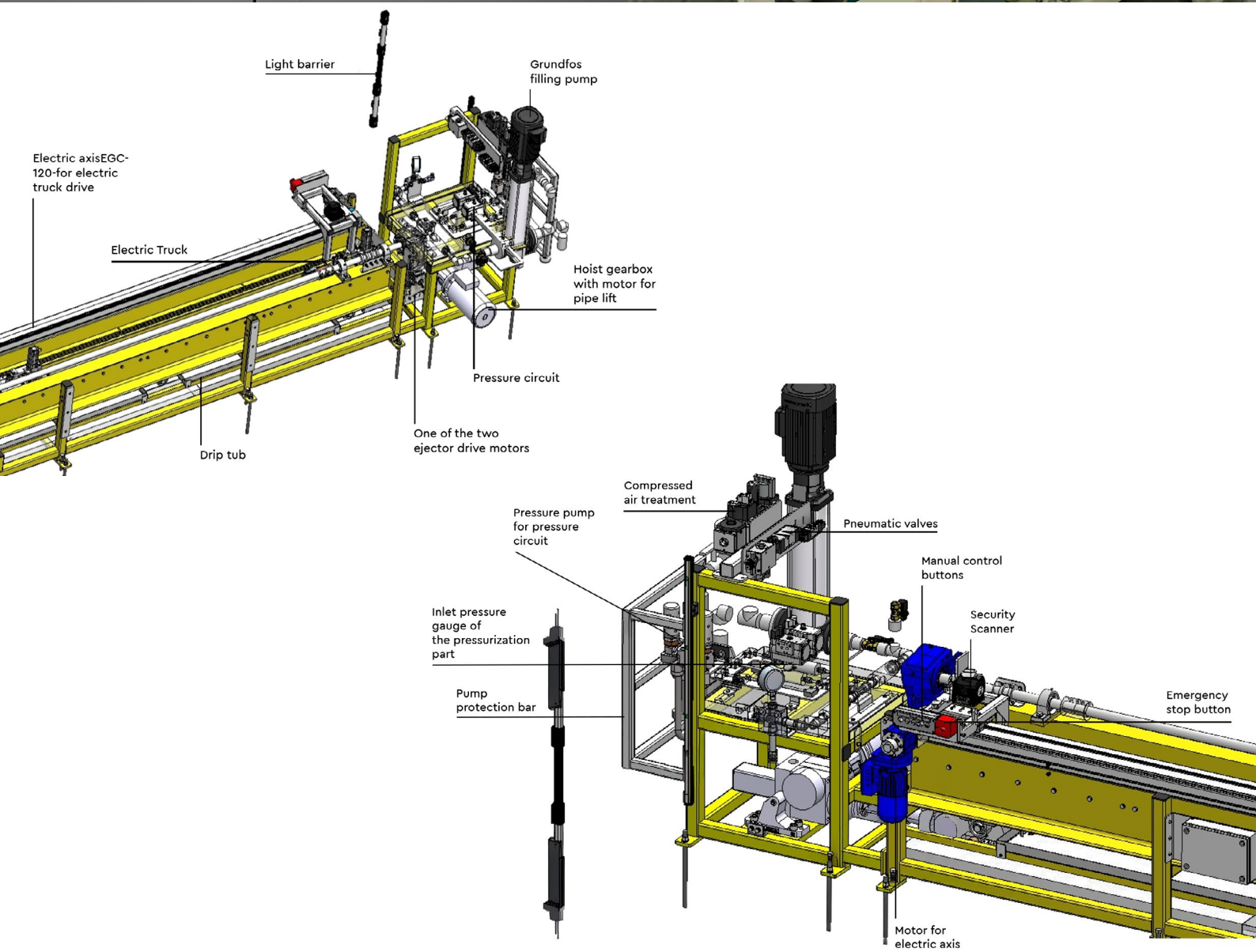
### The design team had to develop a pump system with multiple capabilities:

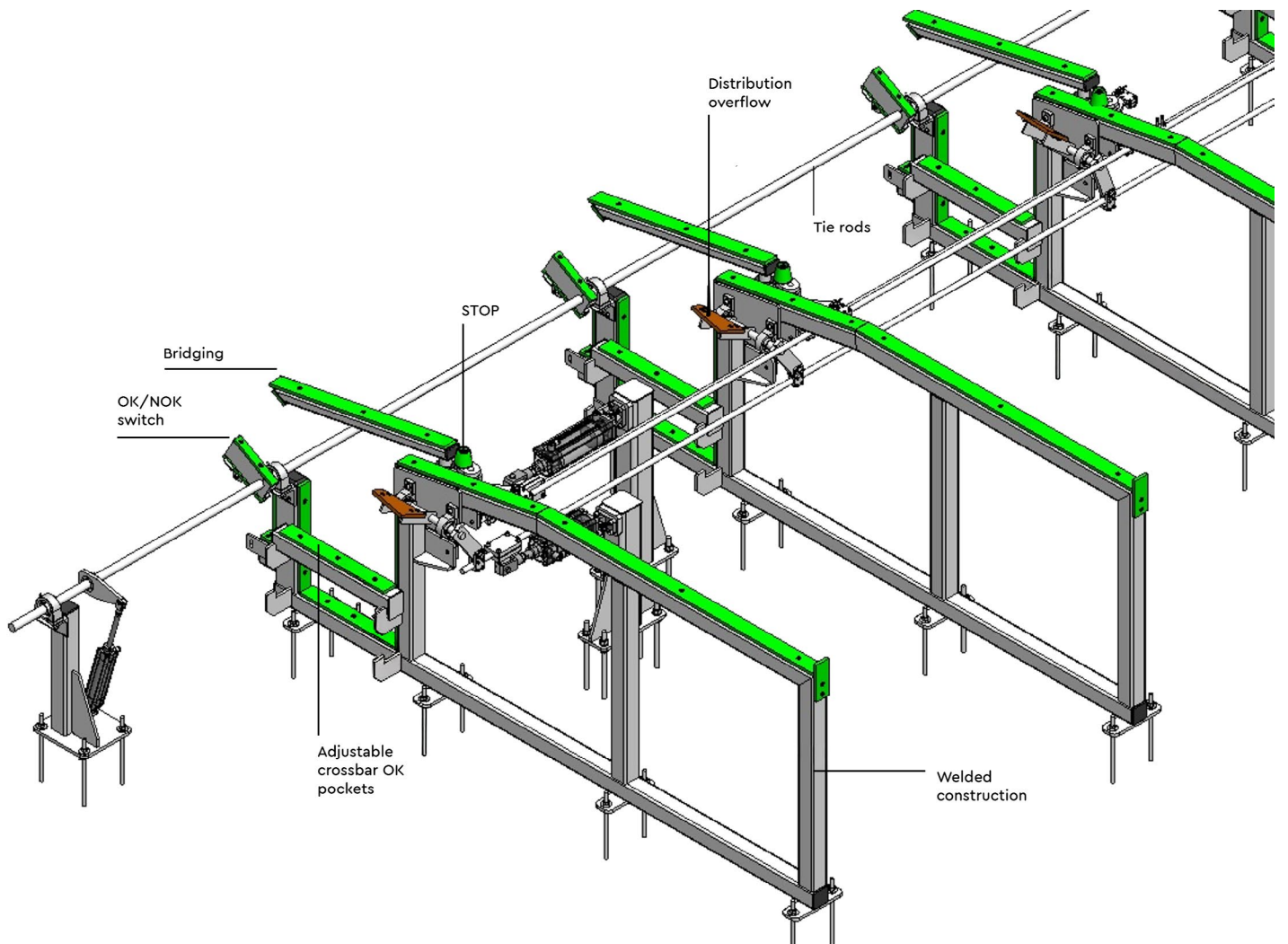
1. A tube had to be first filled with a high-flow pump (filling the circuit with water)
2. This had to then switch from the high-pressure valves to a high-pressure pump which had a limited flow rate to ensure an optimal ramp-up to the required test pressure.

The operator can control the hydro-test machine via a touchscreen interface with a custom application for tube testing. The application allows saving test protocols for different tube types; the operator can pre-set the test pressure and required hold time. Once the process starts, the system automatically performs all steps according to the selected protocol.

At the end of each test, the tube must be blown through with compressed air to remove any residual water from the pressurization process.

Based on the test result, the tube is automatically lifted from the pressurization station and rolls by gravity into either the OK or Not-OK pocket. The tubes are then bundled in these pockets and transferred by crane for further processing.





# Design specification

## Hydro-test machine

Description	Specification
Pipe OD:	12-40mm
Pipe length:	6-40m
Pipe material:	Super Duplex
Working pressure:	500 Bar
Test medium:	Water

### Results

## Using the SEA Ecosystem to help deliver a complex design and manufacturing project

The machine was ordered by the customer on 8 February 2021, and delivered five months later on 9 July 2021.

The production line was developed with two separate zones. In the first a tube was brought to the pressure test equipment on rollers where the tube was pressurized and the leak-test performed. Once purged of pressure the tube was then automatically picked up from the rollers and placed on a rack, the location of placement on the rack depended on whether the tube had passed or failed the leak-test.

During the FAT at SEA, it was confirmed that the clamping system of the pressurization heads and tubes was sufficiently robust and the system did not loosen during pressurization. The first tubes tested had a small diameter and thin wall, and the tubes collapsed during the hydro-test.

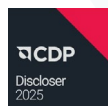
To prevent thin-walled tube collapse, modified clamping heads were needed that included jaws that bit into the surface of the tubes, leaving marks on the ends.

Thin-walled tubes with small diameters cannot withstand the test pressures without being clamped by jaws.

As a result, a second type of clamping head with jaws was added to the line. Although these jaws left marks on the tube ends, they made it possible to perform the hydro-test. The marked tube ends are later cut off by the customer.

The line was initially assembled at SEA in a shortened version (not the full 40m) to verify the principles and perform FAT. The complete line was then installed and commissioned at the customer's site.

After delivery to the customer, minor modifications to the complete production line were necessary based on initial operation. One modification involved the installation of stainless steel screens in the heads to prevent chips from entering and damaging the sealing valves. Even with the customer's advanced technical requirements, a REEL GOOD design solution was achieved by the SEA design and engineering team. All issues were ultimately resolved to the customer's satisfaction and the production line entered full production operations.



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ISO:

9001:2015, 14001:2015, 45001:2018, 17020:2012, 17025:2017, 3842-2:2005

1225-01