



## SSRT Autoclaves

*Cormet's stainless-steel loading units have been designed for autoclave applications. The PC controlled step-motor driven loading unit offers various loading modes and combinations. One can select the most suitable device from the wide product range. Due to the compact size of the actuators, Cormet can offer multi-head units as well as loading actuators for retrofitting to existing autoclaves and flow cells.*

### **Electromechanical loading devices**

Because the loading units are step-motor driven actuators, they provide a very small displacement resolution and good accuracy. The instruments have been designed specially for the slow displacement rate required in slow strain rate (SSRT) and rising-load tests. The PC controlled instruments provide slow strain rate (SSRT / CERT), constant-load and cyclic fatigue loading modes.

Due to the nature of the electromechanical actuators, their highest cyclic loading frequency is limited to less than 1 Hz. Servohydraulic actuators can be used in applications where higher frequency movement is needed. The electromechanical actuators are available in 10 kN,

25 kN, 50 kN, 100 kN and 200 kN versions. Various accessories such as recirculation loops, DC PD, LVDT, electrochemical tools and scratching devices can be combined with the loading units and autoclaves.

### Autoclaves

Cormet manufactures autoclaves for corrosion-testing purposes. The autoclaves can be adapted for various kinds of corrosion-testing applications, but most of Cormet's autoclaves are equipped with Cormet's PC-controlled electromechanical loading devices.

The most important autoclave design parameters are:

- operating temperature
- operating pressure
- construction material
- chemical environment
- volume
- number of ports required

### Autoclave pressure and temperature:

- autoclave temperature between  $-40^{\circ}\text{C}$  and  $700^{\circ}\text{C}$
- autoclave pressure from vacuum up to 100 MPa
- typical operating temperature and pressure for medium-size autoclaves  $360^{\circ}\text{C}/20\text{ MPa}$
- supercritical water autoclave typically operates at  $650^{\circ}\text{C}$  and 30 MPa with a size that is normally below 2 litres
- maximum operating temperature and pressure may be limited by the autoclave construction material

### Autoclave materials

The most common autoclave material is austenitic AISI 316L stainless steel, which has sufficient corrosion resistance in most clean-water applications. The maximum operating temperature of this material is  $500^{\circ}\text{C}$ .

Alloy C-276 (Hastelloy) is a nickel-based alloy with perhaps the widest corrosion resistance of commonly used nickel alloys. Alloy C-276 is frequently used in oil and



gas industry-related applications. The price of an alloy C-276 autoclave is higher due to the high material and machining costs.

Titanium is used in applications where pitting-corrosion resistance is needed due to a high chloride concentration. The highest operating temperature of a titanium autoclave is limited to about  $300^{\circ}\text{C}$ .

Autoclaves for a super-critical water environment are manufactured from Nimonic and Inconel nickel alloys.

### Autoclave instrumentation

An autoclave is typically equipped with a heating band, temperature sensor, PID temperature controller, pressure sensor and safety valve or a rupture disc. There are normally valves for water inlet and outlet, drain and gas inlet in the bottom of the autoclave. The venting valve is attached to the autoclave lid.

### Small autoclaves

- volume typically less than 1 litre
- 10 kN and 25 kN loading units
- limited space for accessories

### Medium size autoclaves:

- typically 2-litre/3-litre/5-litre and 7-litre auto  
claves
- up to four 10 kN or 25 kN loading units in an  
autoclave
- single 50 kN, 100 kN and 200 kN loading units  
in an autoclave
- electrical lid lifting system
- plenty of space for accessories

### SSRT Autoclaves

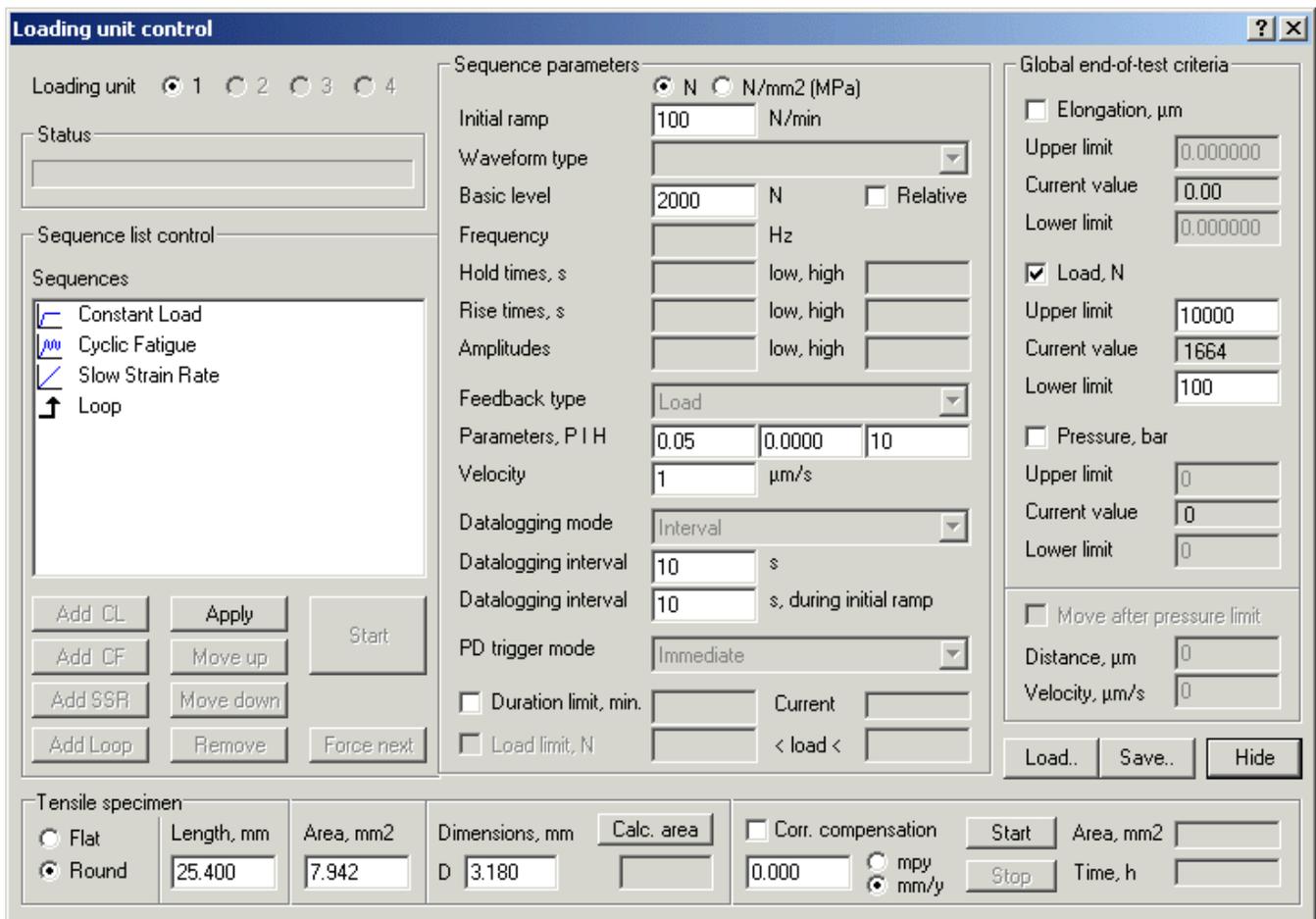
Cormet's electromechanical loading units have been designed for autoclave applications. The PC-controlled step-motor-driven loading unit offers various loading

modes and combinations. The PC-controlled instruments provide slow strain rate (SSRT/CERT), constant-load and cyclic fatigue loading modes. There are specimen holders available for various kinds of specimens.

Due to the compact size of the actuators, Cormet can offer multi-head units as well as loading actuators for retrofitting to existing autoclaves and flow cells. Because the loading units are step-motor-driven actuators, they provide a very small displacement resolution and good accuracy.

Due to the nature of the electromechanical actuators, their highest cyclic loading frequency is limited to less than 1 Hz. Servohydraulic actuators can be used in applications where higher frequency movement is needed.

The electromechanical actuators are available in 10 kN, 25 kN, 50 kN, 100 kN and 200 kN versions. Various accessories such as recirculation loops, DC PD, LVDT, electrochemical tools and scratching devices can be combined with the loading units and autoclaves.



Cormet's Windows 7-based software controls the loading devices. Thanks to the sequence-based approach, various loading patterns can be combined in series and even in loops. The software is continuously evolving, largely based on customer feedback.

### Accessories

The autoclaves can be equipped with various kinds of accessories.

There is continuous convection in an autoclave due to the hot autoclave walls. The solution can also be mixed using a stirrer. In most cases, stirrers are operated with magnetic drives. Various kinds of propellers are available.

Recirculation loops feed clean water or steam into the autoclave. They monitor and regenerate the water chemistry.

Electrochemical tools are used for corrosion-potential monitoring and also for various kinds of dynamic DC and AC tests. A Contact Electric Resistance instrument is used for surface-film monitoring.

A polymer lining (PTFE, PFA) improves the corrosion resistance of an autoclave because it separates the metallic autoclave wall from the corrosive environment. A polymer lining is typically used at temperatures less than 200°C.

Rotating electrodes and jet impingement tools are used for flow-accelerated corrosion studies and for corrosion inhibitor selection.

Autoclaves can be equipped with sapphire windows for the monitoring of specimen surfaces using optical tools.



An autoclave can be equipped with a data acquisition system that monitors, displays and saves the data from all the sensors.



Cormet manufactures material- and corrosion-testing instruments for the laboratory and field environments. We specialise in high-temperature high-pressure applications. Cormet delivers instruments to university and industrial laboratories including the power-generation, chemical, transportation and oil & gas industries. Nearly all the products are tailored according to customers' needs.