

## Profile LFR-9

### LIMETS3

### BELGIUM

#### GENERAL INFORMATION

NAME OF THE FACILITY Liquid METals Test Stand 3  
ACRONYM LIMETS3  
COOLANT(S) OF THE FACILITY Lead-Bismuth Eutectic (LBE)  
LOCATION (address): SCK•CEN, Boeretang 200, 2400, Mol, Belgium  
OPERATOR SCK•CEN  
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#### STATUS OF THE FACILITY

Start of operation (date):

In operation

#### MAIN RESEARCH FIELD(S)

- Zero power facility for V&V and licensing purposes
- Design Basis Accidents (DBA) and Design Extended Conditions (DEC)
- Thermal-hydraulics
- Coolant chemistry
- Materials
- Systems and components
- Instrumentation & ISI&R

#### TECHNICAL DESCRIPTION

##### Description of the facility

LIMETS3 is an experimental set-up designed for mechanical testing of materials in an LBE environment in order to investigate mechanisms and kinetics of material/liquid metal interactions that influence mechanical properties of the material. LIMETS 3 focusses on fatigue tests. The vessel consists of an autoclave in which the experiments are performed and a dump tank. Oxygen control is

done via a controlled gas flow of an adjustable argon Hydrogen mixture with an H<sub>2</sub> concentration of up to 20%. Oxygen control can be performed in both the autoclave and the dump tank. Each of these are equipped with two Bi/BiO<sub>2</sub> oxygen sensors. The autoclave houses a mechanical testing device that can be operated in a gas atmosphere or under stagnant LBE. Possible tests include fatigue tests in LBE with an extensometer on the sample and tensile/compression tests with an extensometer on the sample. The maximum load of the device is 15kN and the load frequency is about 0,3 Hz. The temperature ranges from 500°C down to room temperature. Obviously, below the melting point of the coolant only experiments in a gas atmosphere are possible.

**Acceptance of radioactive material**

No

**Scheme/diagram**

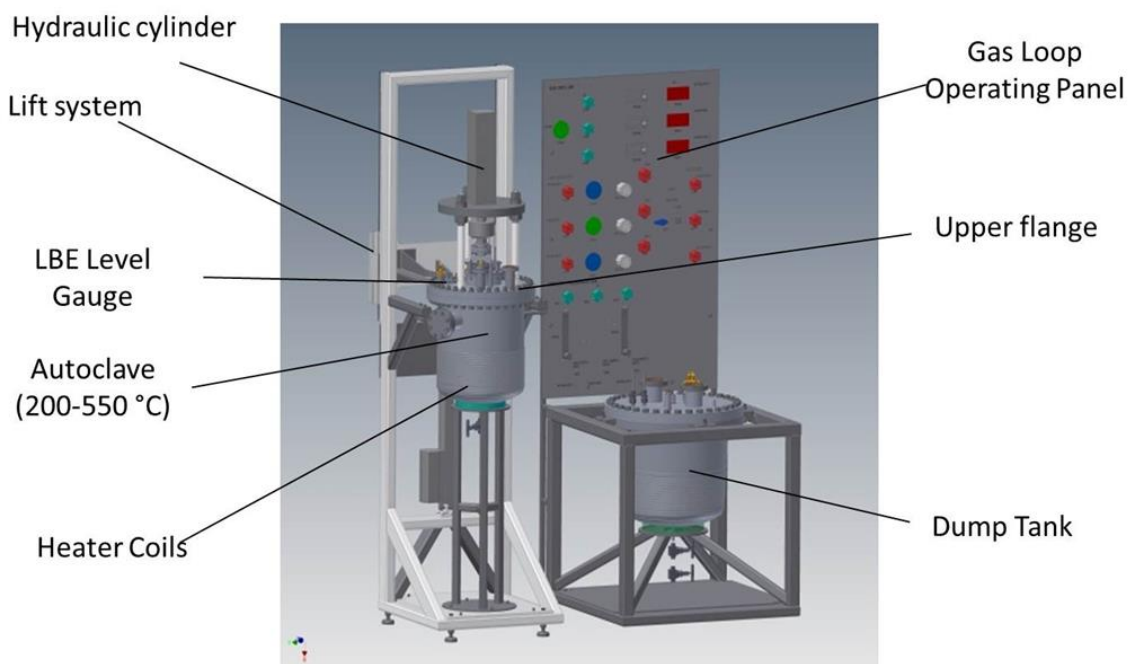


FIG. 1. Scheme of the LIMETS3 facility

**3D drawing/photo**

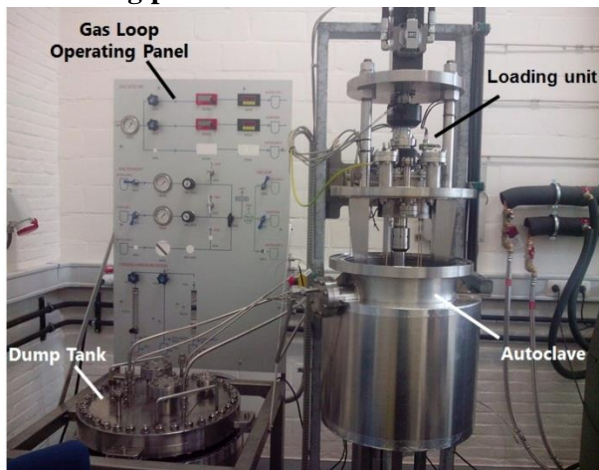


FIG. 2. View of the LIMETS3 facility

**Parameters table**

Coolant inventory	15 l
Power	3,5 kW
Test sections	
TS #1	<u>Characteristic dimensions</u> φ20 cm x 30 cm
	<u>Static/dynamic experiment</u> Static
	<u>Temperature range in the test section (Delta T)</u> 500°C
	<u>Operating pressure and design pressure</u> 1,1 bars (no pressure vessel)
	<u>Flow range (mass, velocity, etc.)</u> Stagnant LBE
Coolant chemistry measurement and control (active or not, measured parameters)	Oxygen control via controlled gas flow Ar, Ar+5% H <sub>2</sub> , Ar+20% H <sub>2</sub> . Double set of Bi/BiO <sub>2</sub> sensors installed in both tanks
Instrumentation	Level sensors, Thermocouples, Oxygen sensors, Direct measurement of displacement on specimens, strain rate, load and frequency

**COMPLETED EXPERIMENTAL CAMPAIGNS: MAIN RESULTS AND ACHIEVEMENTS**

LIMETS 3 was used in the MYRRHA materials qualification programme for the assessment of Liquid metal assisted fatigue of austenitic and ferritic martensitic steels. For T91 it was found that both the strain amplitudes as well as the chemical composition of the LBE play a role in the fatigue lifetime assessment of the steel, at least in comparison with its behavior in vacuum. The strain rate effect on the fatigue endurance of T91 steel in the presence of LBE is strain amplitude and oxygen concentration dependent. Low cycle fatigue experiments on 316L have also been performed.

**PLANNED EXPERIMENTS (including time schedule)**

LIMETS 3 will be used in the future for further fatigue experiments for the MYRRHA materials testing programme. In particular parametric studies regarding strain rate, amplitude, temperature and oxygen concentration in the LBE are envisaged.

**TRAINING ACTIVITIES**

Training activities are possible, availability allowing and after prior agreement under supervision of SCK•CEN Qualified staff.

**REFERENCES (specification of availability and language)**

1. MARMY P., GONG X., Journal of Nuclear Materials, 2014, 450(1-3): 256-261