

# Advanced Creep Testing System with Non-Contact Extensometry Measurement Technology

*Customized testing solution for research*

**Customer:** Texas A&M University at Qatar

**Country:** Qatar

**Sector:** Research / University / Education / Oil & Gas Industry



**TEXAS A&M**  
UNIVERSITY at QATAR

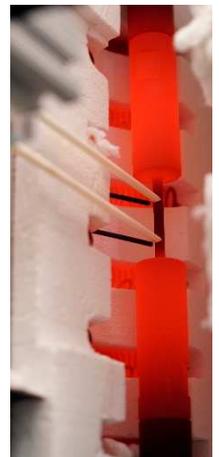
## 1. Introduction

The mechanical properties characterization at high temperatures is generally done with information taken from the specimen under test, with conventional techniques which are currently very standardized. Strain is typically measured with some special versions of contact extensometry solutions which are available in the market for temperatures over 1000°C, but this technology has some drawbacks and limitations in spacial resolution and is affected by thermally-induced errors to some extent.

In addition, the traditional method requires a uniform temperature distribution; therefore, the characterization of one material at different temperatures requires several specimens and test runs, which can be expensive and time-consuming, given that creep testing can involve durations of thousands of hours.

In contrast to these classical test methods, non-contact extensometry, based on Digital Image Correlation (DIC) is an advanced measurement technology capable of tracking the deformation of a speckle pattern applied to the surface of the specimen. The data is collected in a full-field manner, resulting in a deformation map from which a strain map can be derived. This way the measurement is at a distance (non-contact) through a window in the furnace. By using this technology, is possible to measure tensile properties of materials at several high temperatures from a single sample.

To apply DIC to high-temperature tests is challenging as the specimen shall be marked and the speckle must be resistant to high temperature and must retain its contrast during the test. In addition, oxidation of material at high temperatures causes changes in the surface of the specimen. These difficulties, among many others, were overcome with IBERTEST testing solution which combines the IB-CREEP machine (50 kN version) with a customized furnace and a special videoextensometer for high-temperature creep testing.



## 2. Description of the testing system

Texas A&M University at Qatar has purchased our IB-CREEP-based testing solution with non-contact extensometry. Our IB-CREEP 50 (50 kN capacity) is an electromechanical machine, which gives all the set a reliable and robust frame for tests and a high accuracy load and

position measurement. Our IB-CREEP allows high precision in the control of the test parameters, and is specially designed for high-temperature tensile tests, relaxation, low fatigue, long-term tests...

The furnace supplied with the machine is a customized model with a quartz glass window specifically designed for the high-temperature extensometer IBXS-HT. This extensometer is capable of measuring strain in tests up to 1400°C, within a field of view of 47 x 41 mm. It provides high-precision measurement during uniaxial or biaxial tensile, compression and shear testing. This non-contact extensometer is capable of axial and radial neck detection and uses Digital Image Correlation (DIC) for precise analysis of thermomechanical and thermophysical properties. Specific software for this device records the complete test and allows post-processing of the frames obtained by the videoextensometer to do DIC area analysis.

The complete testing solution has been configured in cooperation with Texas A&M University at Qatar and was discussed with end user in order to do creep testing at relatively low temperatures (in the range from 800°C to 1100°C) on metallic specimens with 40 mm of gauge length and M12 threads. The testing system included the IBXS-HT videoextensometer, specific for high temperatures.

### *Testing system specifications*

- **Testing machine:** Capacity of 50 kN, accuracy in class 0.5 from 1% up to 100% of the machine capacity. Displacement resolution 0.0025 µm.
- **Specimens under test:** Metallic threaded specimens (M12). Specimens to be marked with Al<sub>2</sub>O<sub>3</sub> mixed with water; this substance is applied to the surface of the specimen with a brush or stamp.
- **High temperature furnace:** Customized split vertical furnace with casing in AISI304 stainless steel (its design ensures the external surface is at a safe temperature for the operator). The furnace is fixed to the machine frame with a hinged support to quickly and easily position and remove the furnace from the testing area. Maximum operating temperature: 1200°C. Equipped with a quartz window with hinge, lock and tempered glass in the front of furnace. Heating elements are Kanthal APM spiral wire embedded in grooves opened in the internal cylindrical wall. Insulation is made with rigid ceramic fibre boards grade 1400°C.
- **Videoextensometer:** Optical extensometer suitable for temperatures from ambient up to 1400°C, based on DIC technology and capable of DIC area analysis in the post-processing of frames.