# Creeping and stress relaxation behaviour of epoxy resins

Jacob Bertsch

Polymer Lab meeting

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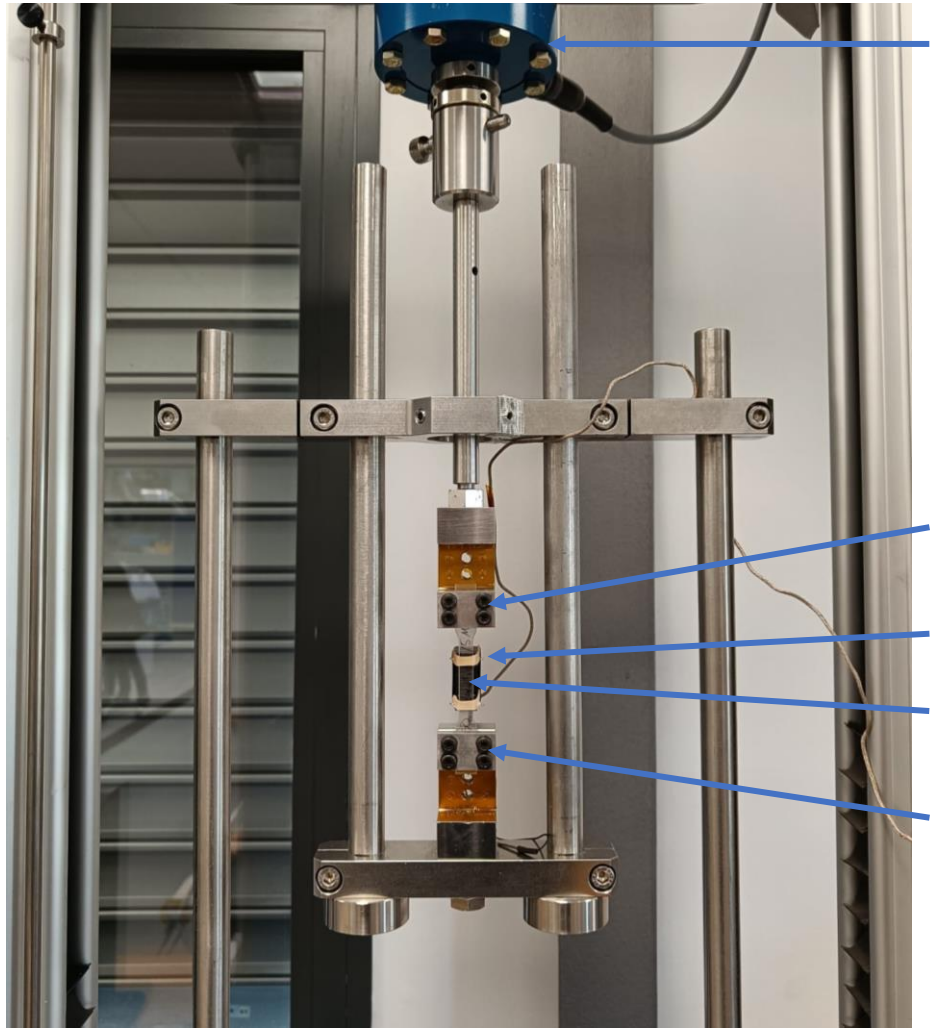
# Test configuration

- H&P Universal test machine with tensile test configuration
- Tensile DIN 50125-E3 4x8 mm samples
- Force measured by 5kN load cell
- Strain measured by “MTS 632.27F-21” clip-on extensometer
- Temperature monitored by “Sensirion SHT31 Smart Gadget”
- Samples get subjected to a tensile load, force and strain get recorded over a time span of 48h



# Creeping behaviour of epoxy resins

**Procedure:**

1. Samples get pre-stressed to 35 MPa or 15 MPa (depending on tensile strength of the material)
2. Load is held for 48h
3. Strain over time is recorded

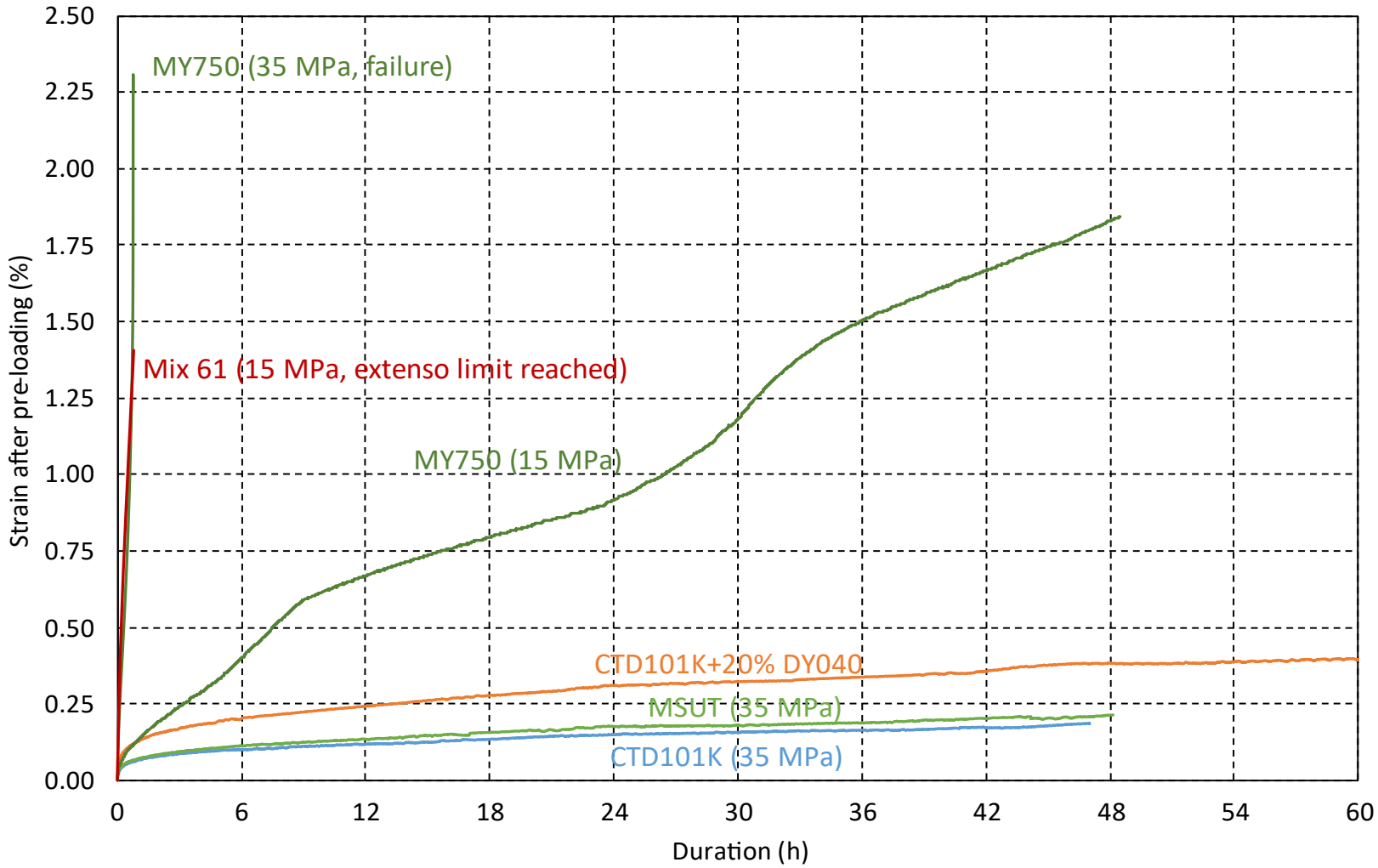
**Tested materials can be separated into two groups**

Low creep materials:

- CTD101K
- CTD101K 10% & 20% DY040
- MSUT Twente

High creep materials:

- MY750
- Mix 61



# Stress relaxation behaviour of epoxy resins

**Procedure:**

1. Samples get pre-stressed to 35 MPa or 15 MPa (depending on tensile strength of the material)
2. Tensile strain when reaching pre-stress is held for 48h
3. Stress over time is recorded

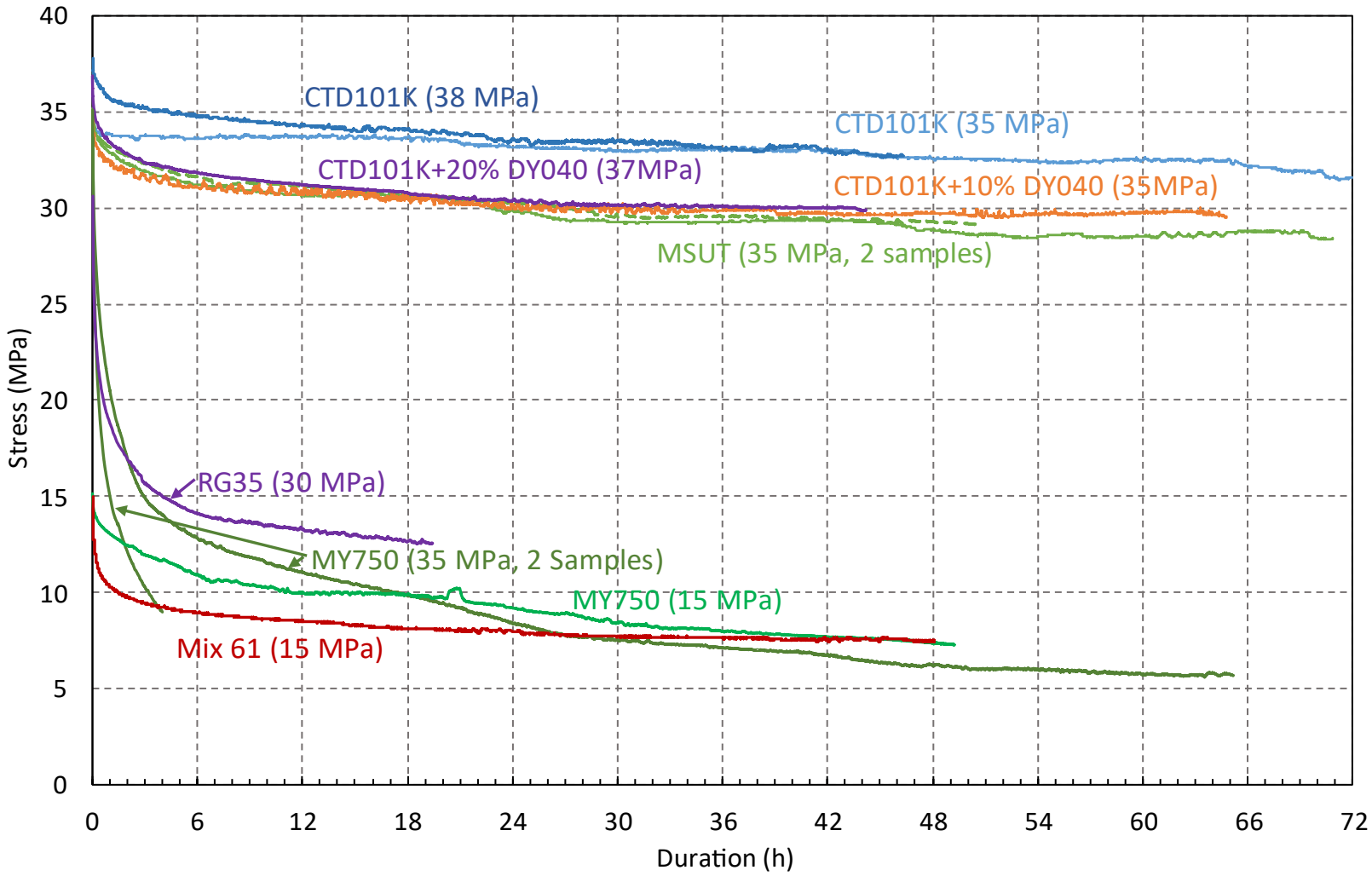
**Stress relaxation behaviour correlates with creeping behaviour**

Low creep materials:

- CTD101K
- CTD101K 10% & 20% DY040
- MSUT Twente

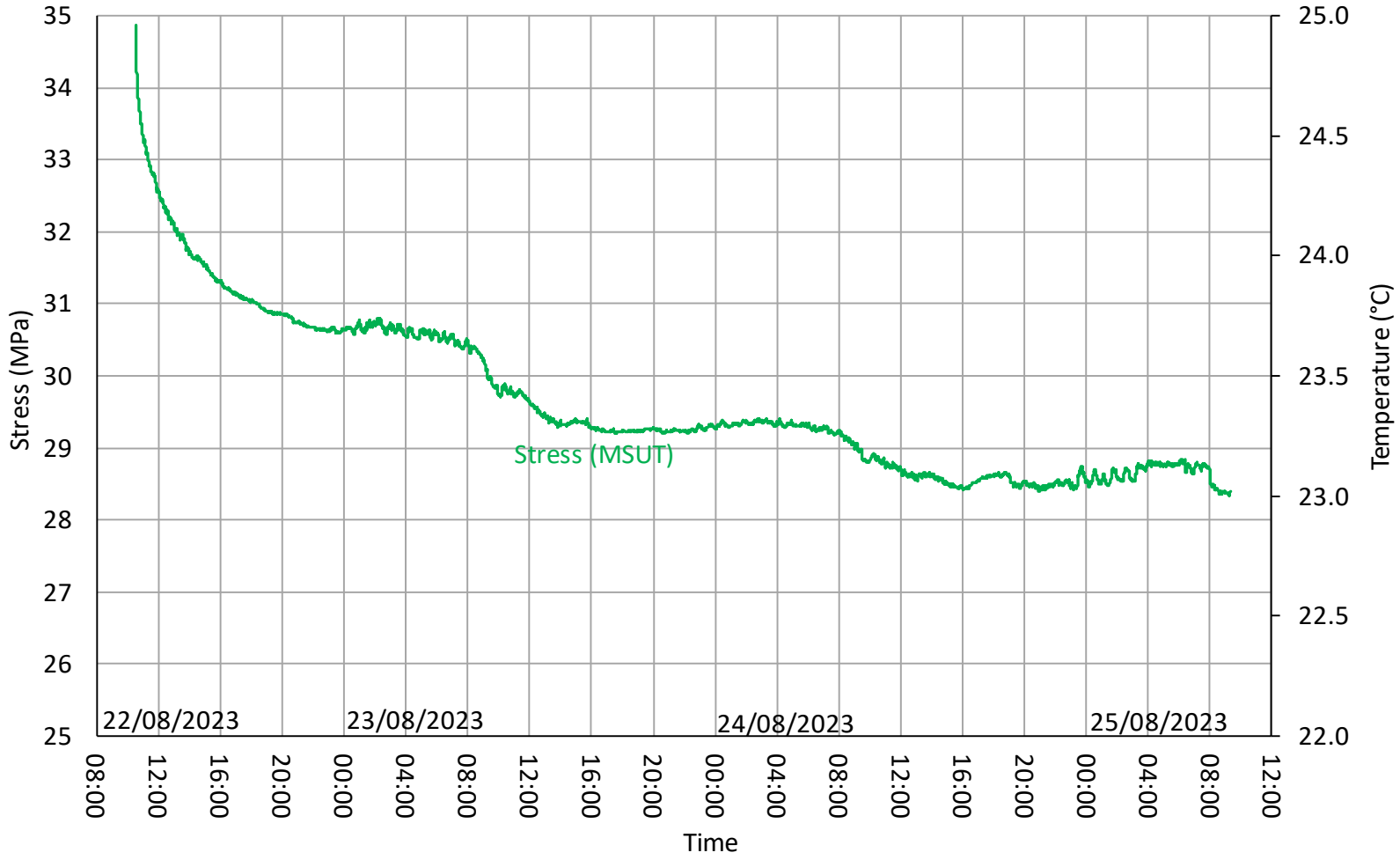
High creep materials:

- MY750
- Mix 61
- BASF RG35



# Temperature effect on tensile stress relaxation measurements

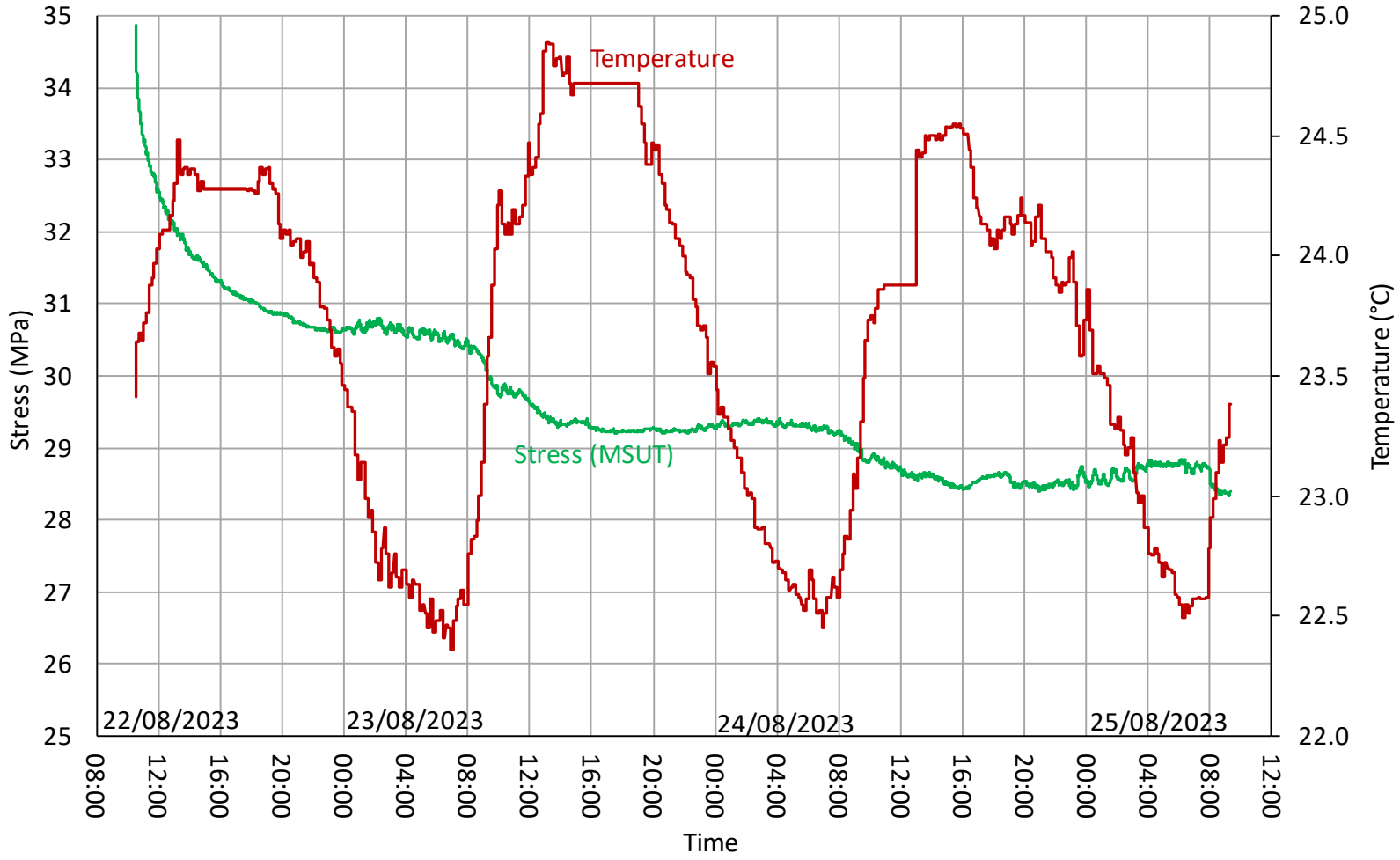
**Tensile stress in the stress relaxation measurements of MSUT decreases in 24h intervals**



# Temperature effect on tensile stress relaxation measurements

**Tensile stress in the stress relaxation measurements of MSUT decreases in 24h intervals**

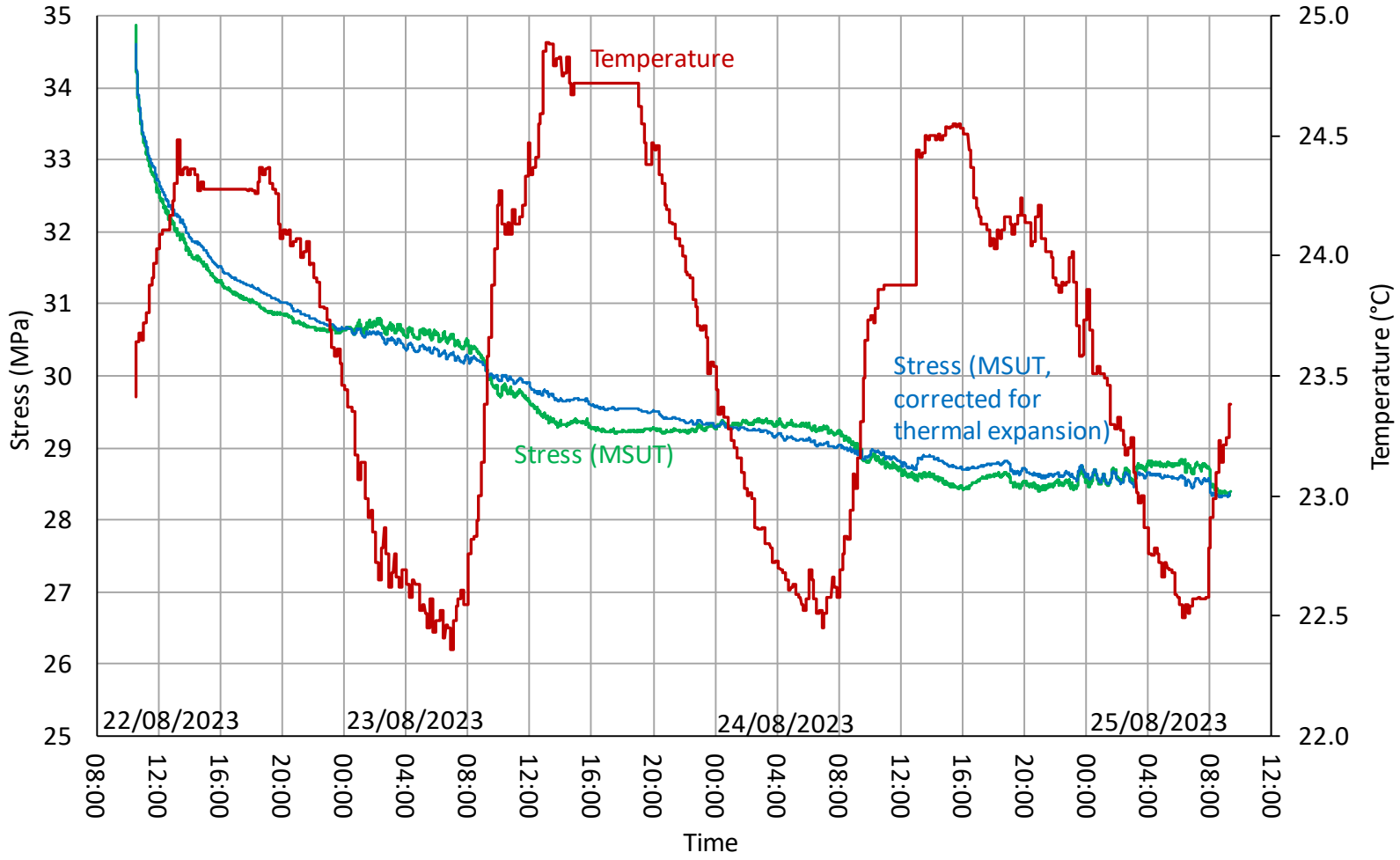
- Stress changes correlate with temperature changes
- Thermal expansion of the sample results in a decrease of stress. Thermal contraction results in an increase of stress.



# Temperature effect on tensile stress relaxation measurements

**Tensile stress in the stress relaxation measurements of MSUT decreases in 24h intervals**

- Stress changes correlate with temperature changes
- Thermal expansion of the sample results in a decrease of stress. Thermal contraction results in an increase of stress.
- Sample cannot expand, since the machine holds the strain at a fixed value. This results in a change in stress.
- **Measured stress, corrected for thermal expansion:**
  $\sigma_{te} = E * \Delta T * \alpha$ ([i], [ii])



# References

**[i]** J. Bertsch , “Strain rate dependence of the stress-strain behaviour of selected polymers", EDMS No. 2928311, (2023)

**[ii]** N.E. Martin, "Thermal expansion measurements with the Anton Paar MCR 702e Dynamic Mechanical Analyser of the Polymerlab", CERN Polymerlab test report, EDMS No. 2906914, (2023)