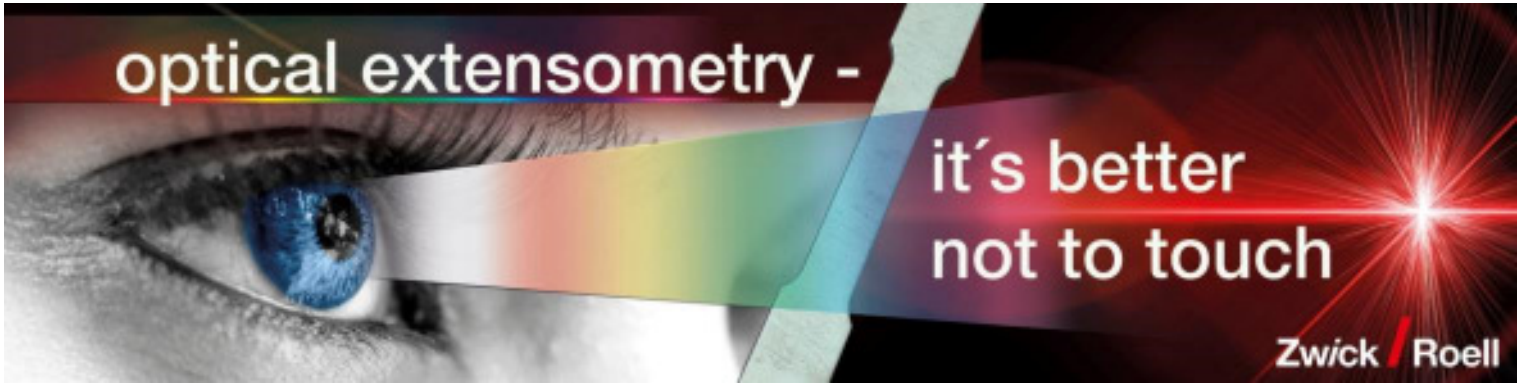
Zwick / Roell

Intelligent testing



examples of application in optical extensometry

videoXtens - laserXtens - lightXtens

Dr. Erhard Reimann, ZwickRoell GmbH & Co. KG, Ulm

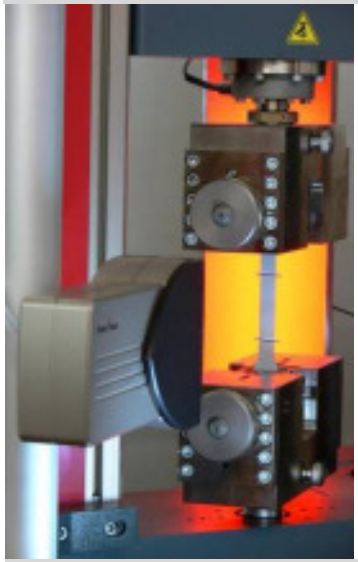
Overview

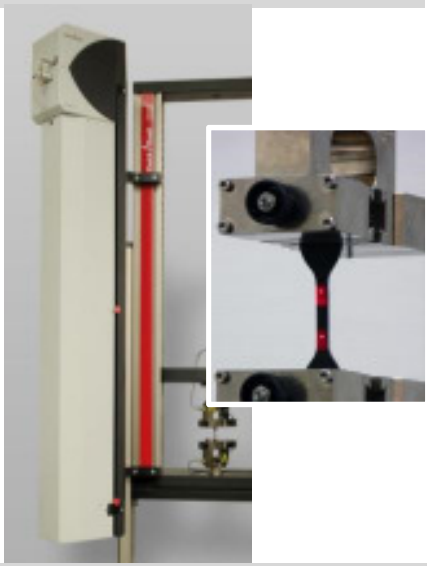
Our optical measurement systems

- videoXtens
- laserXtens
- lightXtens

Working principle:

videoXtens	laserXtens	lightXtens
camera-based detection of measuring marks	Laser speckle correlation	Light diodes





Application range:

videoXtens	laserXtens	lightXtens
All marked materials	All laser reflecting materials	Materials with high strain or fracture energy

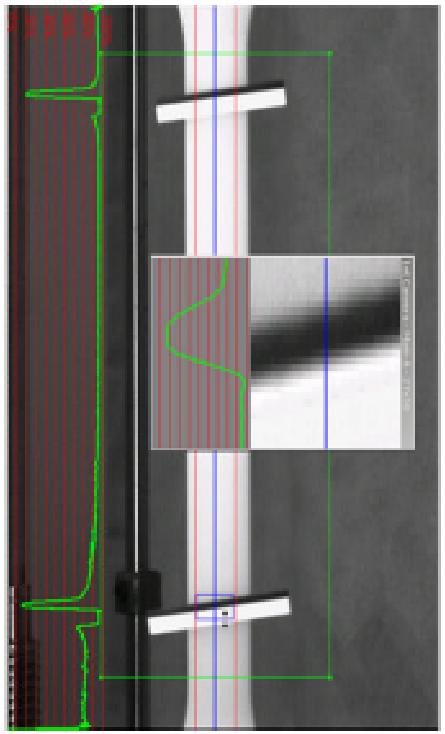
Agenda

videoXtens – working principle & applications

laserXtens – working principle & applications

lightXtens – working principle & applications

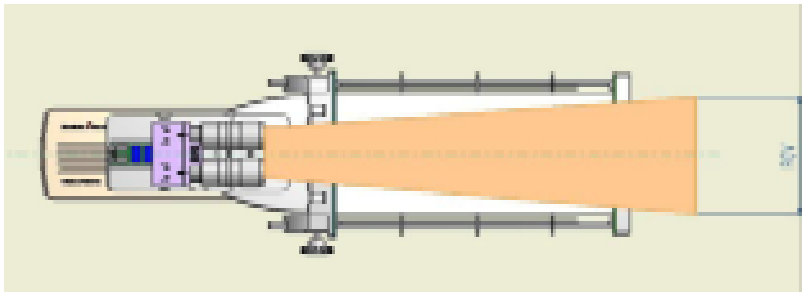
videoXtens – camera-based detection of gauge marks

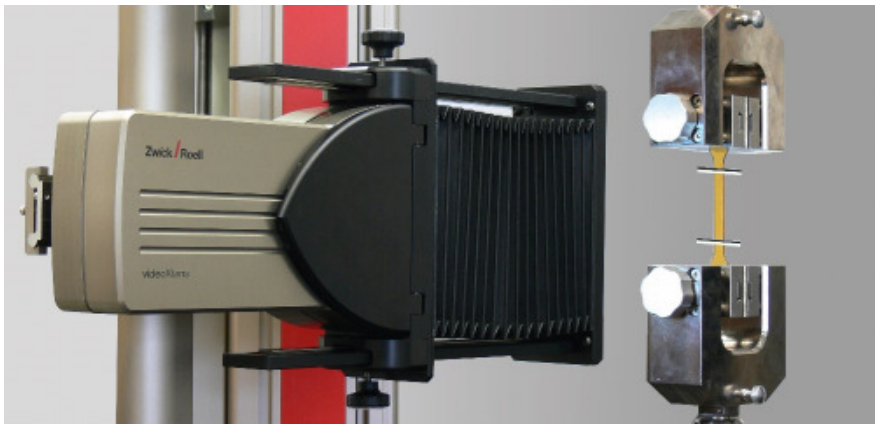


- Possible gauge marks: line marks, dot-shaped marks, clamped needles, manual or sprayed pattern or:
  natural pattern of specimen
- Higher measurement accuracy by tilted line marks due to the grayscale gradient
- Gauge marks are automatically detected and
  at the same time the initial gage length is taken over

videoXtens 2-120 HP fulfills the high requirements for testing plastics acc. to ISO 527-1 especially for tensile modulus

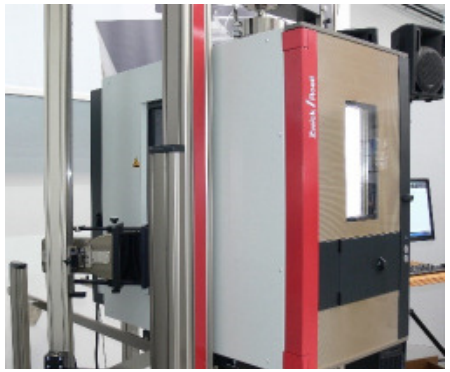
- Complete system for testing of plastics and CFK acc. to ISO 527-1, -2, -4, -5
- Suitable for all measurement lengths acc. ISO 527-1
- Accuracy grade 0.5 to ISO 9513
- Including 2 cameras with lenses f=35 mm
- Including tunneling of optical axis for reduction of signal noise, tunnel adaptable to grips and test environment



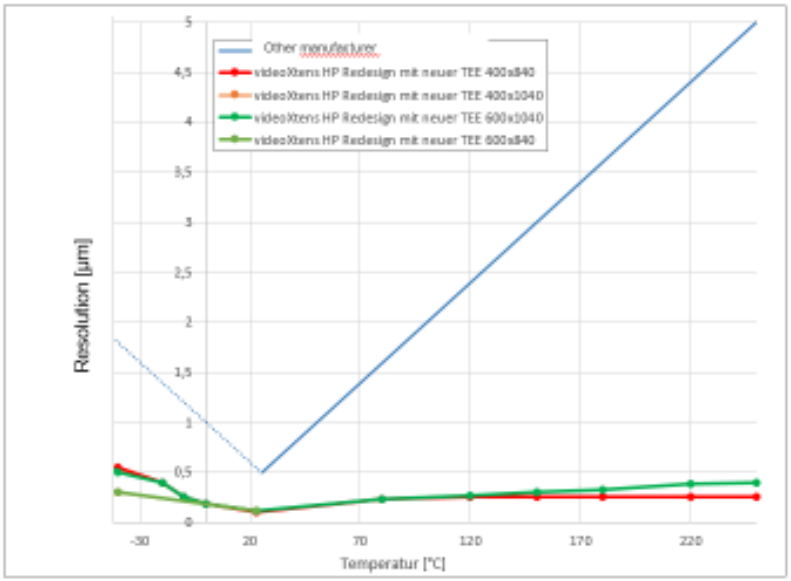


Application: ISO 527 under temperature

High-accuracy testing in the Zwick temperature chamber with videoXtens 2-120 HP

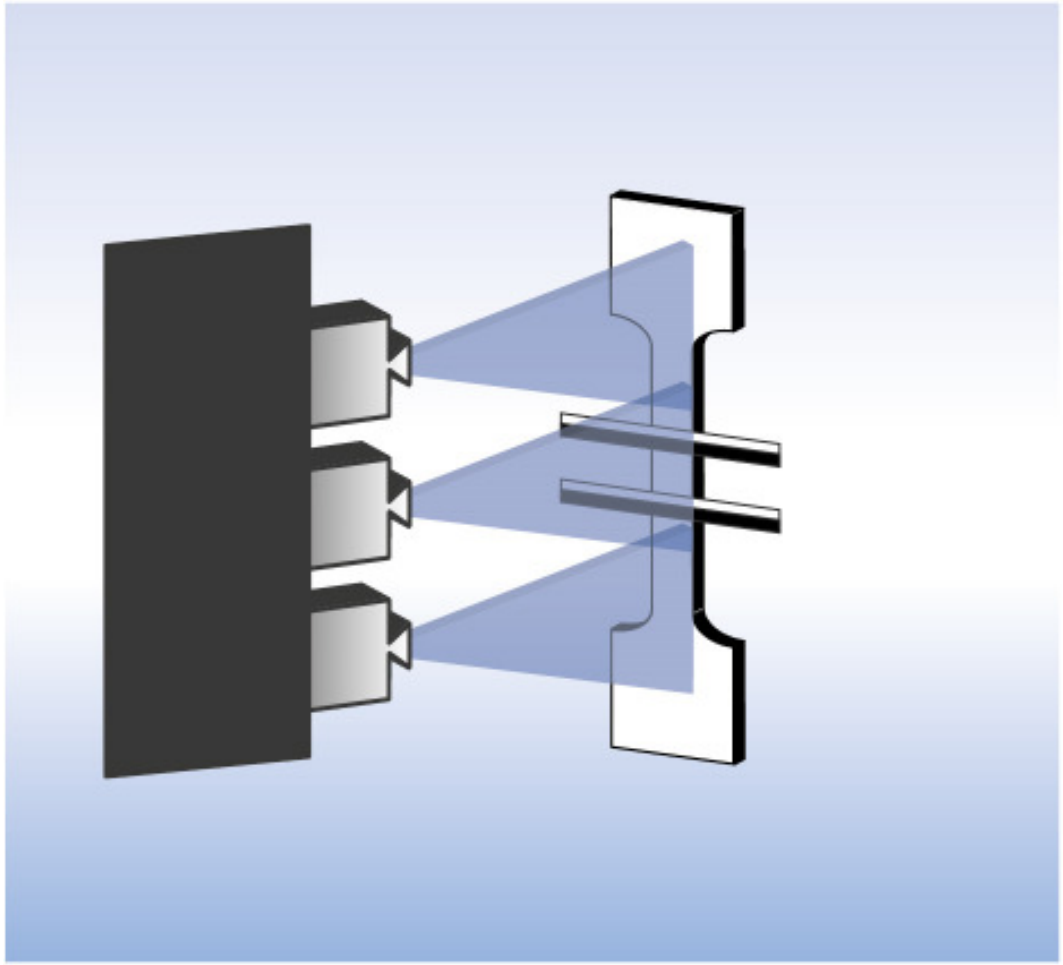


- videoXtens 2-120 HP satisfies the exacting requirements of ISO 527-1 for determination of tensile modulus in Zwick temperature chambers.
- The optical extensometers and the Zwick temperature chamber have been ideally matched to each other. Temperature control and air distribution in the temperature chamber are optimized so that extensometer resolution is only minimally affected, even at temperature.



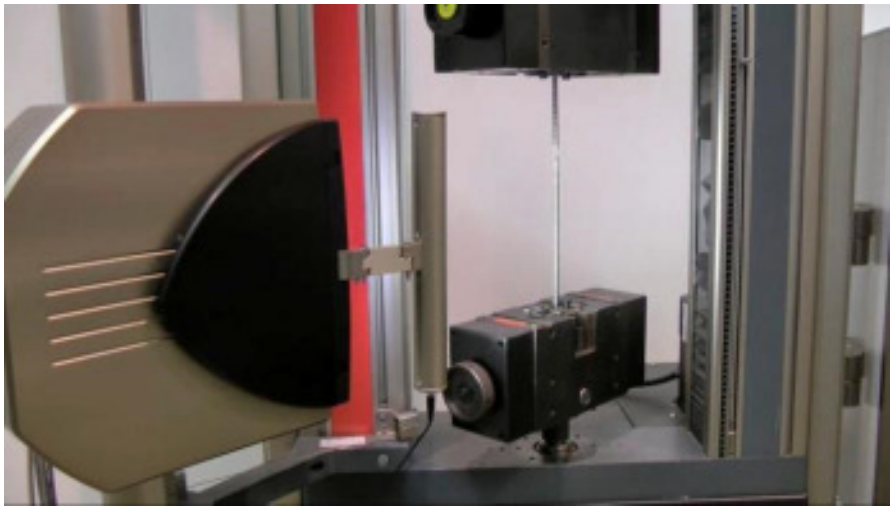
- Even the comparatively slight influence of the side panel on the measuring system scaling is compensated for. Compensation can be switched on when in temperature chamber mode by simply clicking in the software.
- The entire system is closed: videoXtens is applied to the temperature chamber via a tunnel, thereby minimizing the effect of air currents from outside the chamber.

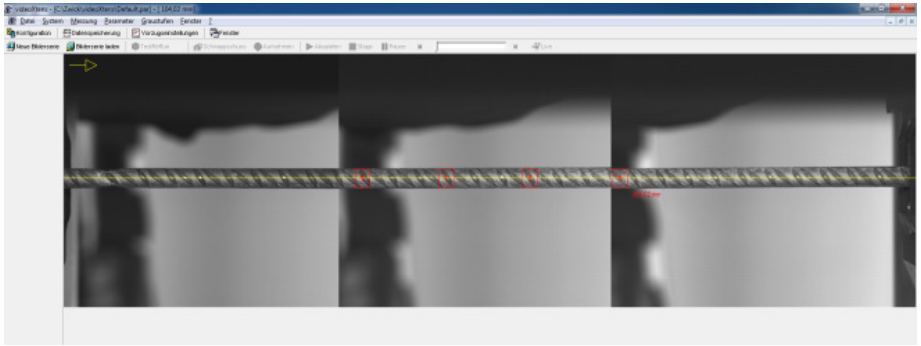
videoXtens 3-300: Extension of measurement travel by Zwick Roell Array Technology



videoXtens 3-300 - rebar testing with pattern recognition

- Three cameras with identical, overlapping fields of view (FOVs) in a big housing
- FOVs are combined to one big FOV
- Enlargement of measuring range without loss of resolution
- Perfect for applications needing a high resolution over the total gauge length or a high measurement range
- Connection to crosshead
- Option strain distribution: Rebars → expensive specimen material → no specimens are wasted due to break outside Le

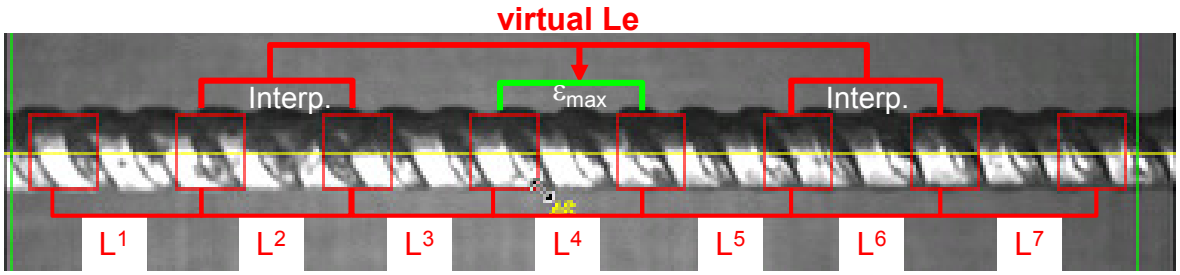


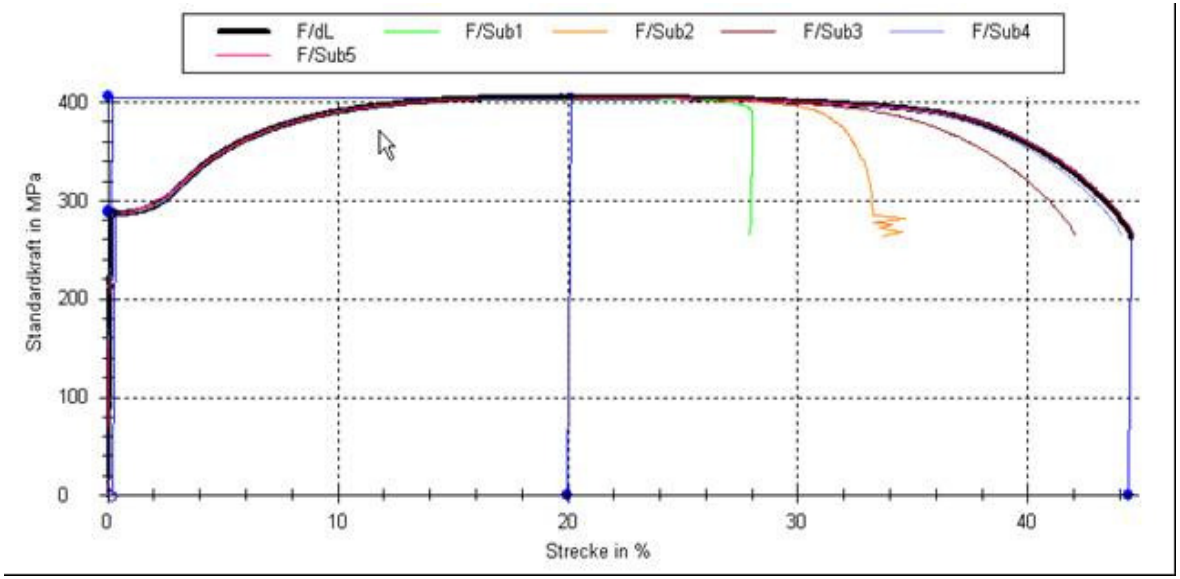


Software option strain distribution

Strain distribution – reliable determination of elongation at fracture

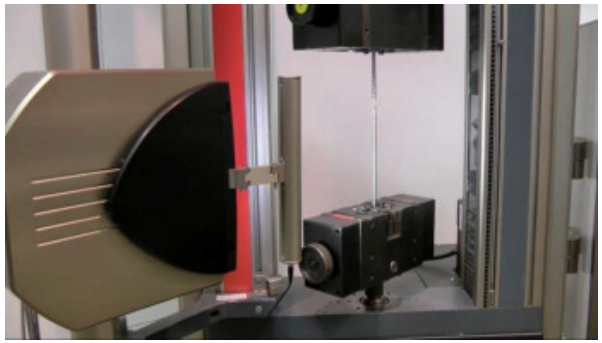
- Simultaneous capture of up to 15 local strains
- Determination of local strains and balancing of Le around break
- Virtual gage length is centered automatically around the sector of highest strain



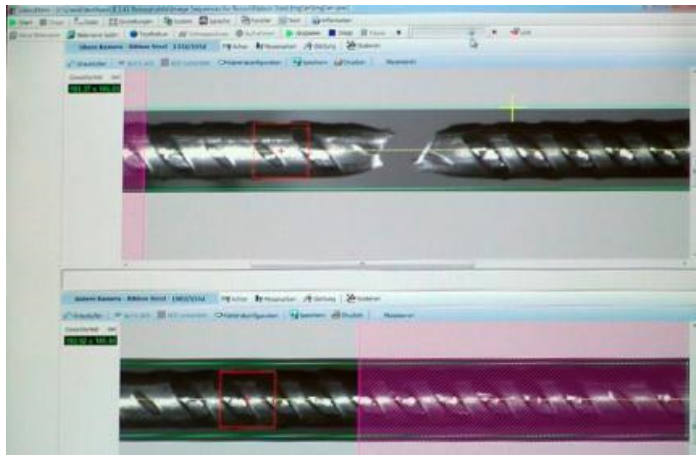


Software option Test Re-Run

- Test re-run:
  - If break happens outside L_e: subsequent recalculation of the strain with a different initial gauge length
  - or just for analysation of test



- Strain distribution:
  determination of local strains and balancing of Le around break

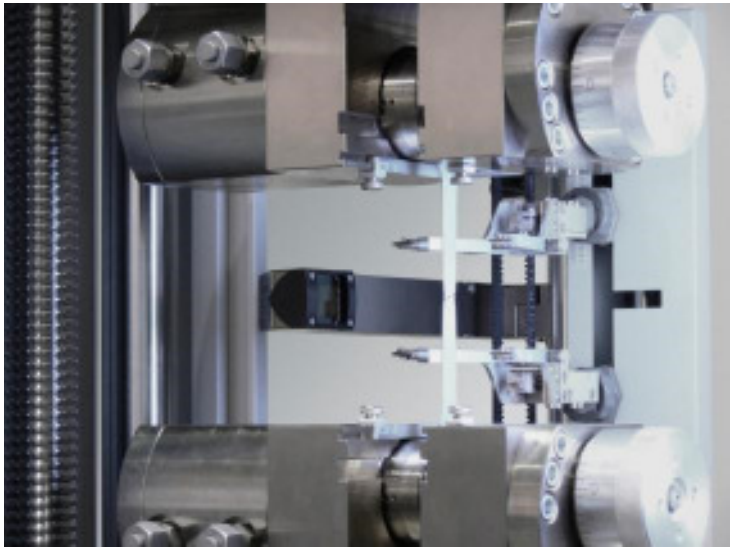


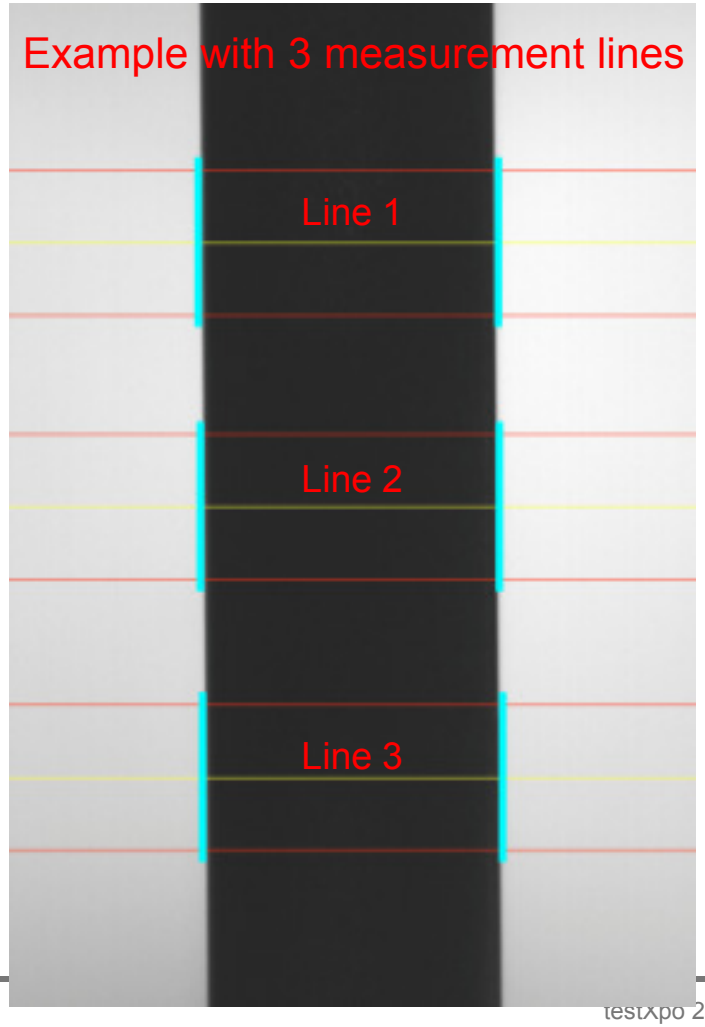
Test Re-Run: Analysation and recalculation of the strain

Strain distribution: the red squares mark the gauge marks

videoXtens transverse strain extensometer

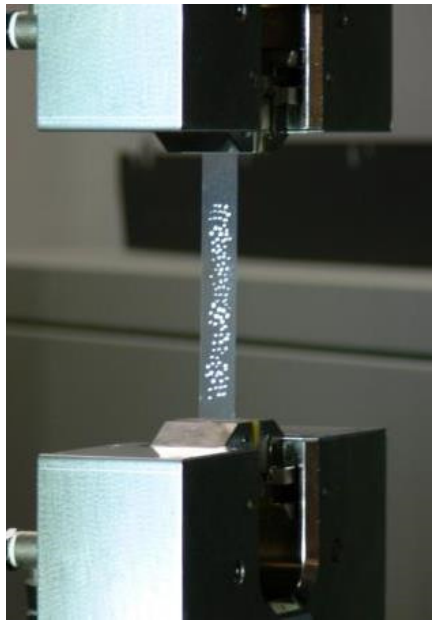
- Independing product for use together with makroXtens, multiXtens and laserXtens (not required for videoXtens)
- Determination of r value according to ISO 10113: Measurement at specimens edge with backlight
- Up to 10 measurement lines!

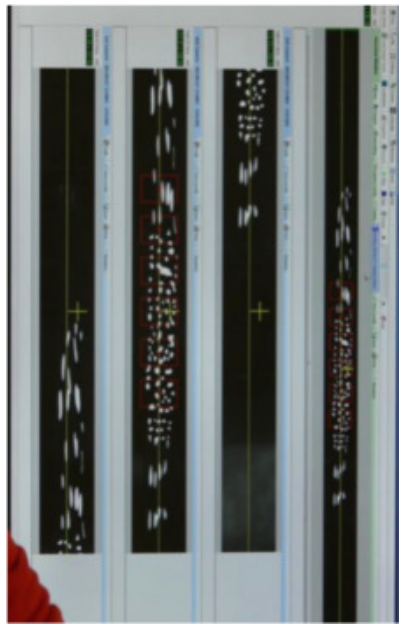




videoXtens: Testing plastic foils with pattern recognition

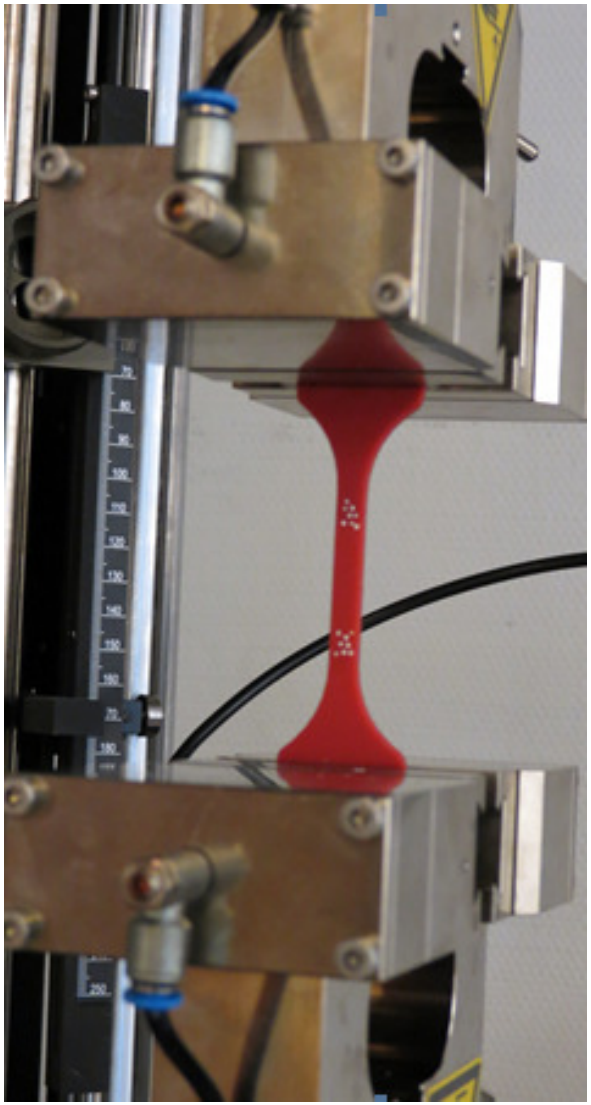
- Test requirements: Testing plastic foils acc. to ISO 527-3
  - L0: 50 mm → strains up to 500% possible
  - Test results: strain at yield, nominal strain at break
- videoXtens 3-300
- Marking: dotting an irregular pattern on the specimen with a white pen





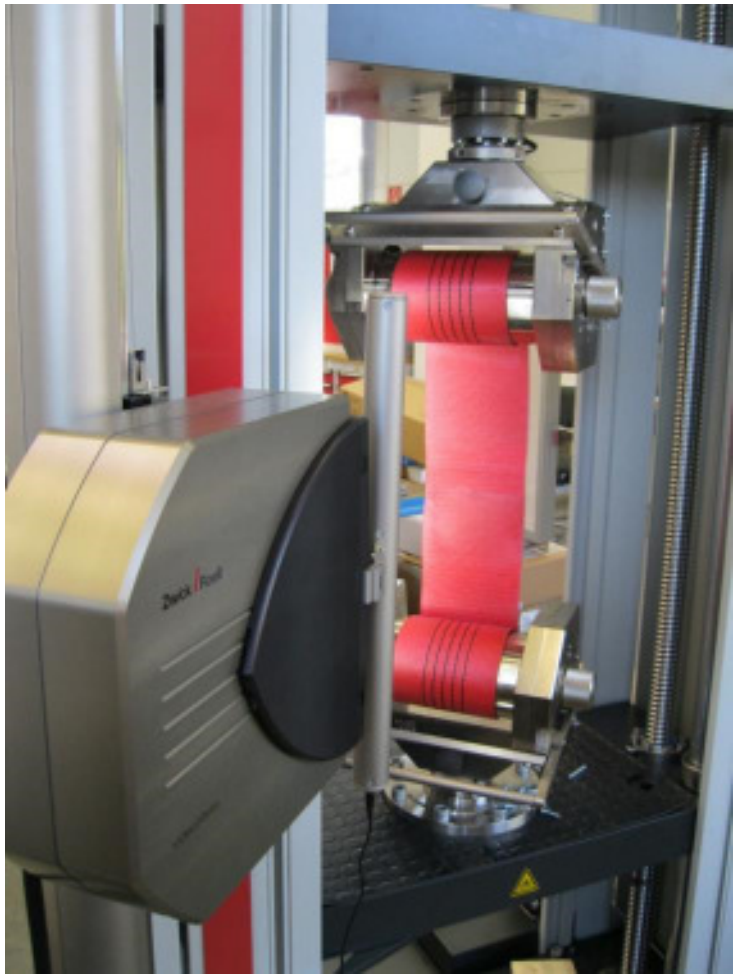
Testing of rubber to ISO 37

- Test requirement:
  L0: 10/20/25 mm
  Strain: 1000%
  Test results: strain at break, strain at reference value, strain at yield
- Simple specimen marking by white pen dots, measurement by pattern recognition
- Very smooth surface: self-adhesive markings would fall down during strain
- Contacting extensometer would influence the sensitive specimens



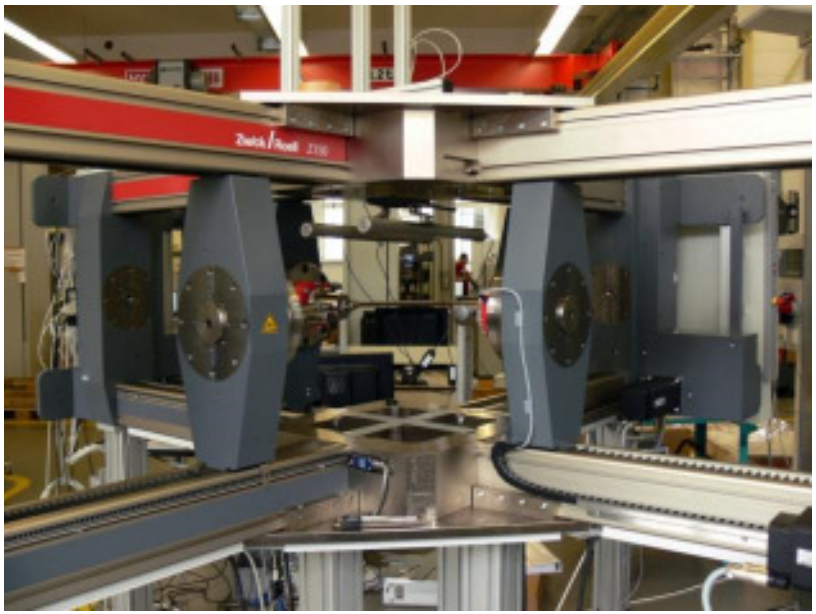
videoXtens 3-300: strain distribution & large field of view

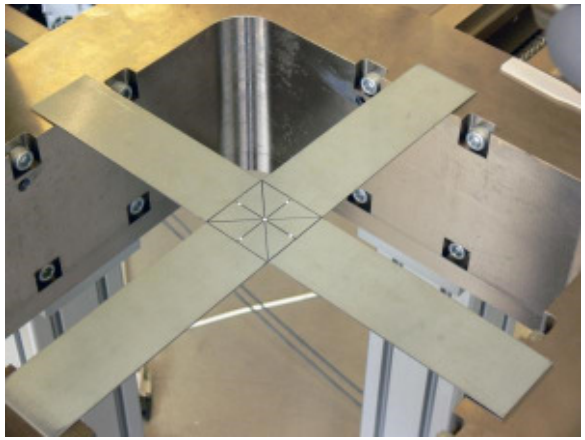
- Automotive supplier in India defines new specification for his tests with videoXtens 3-300 – for more and detailed information of material characteristics
- Belts and textiles: test of particular tear-strength properties
- videoXtens 3-300: system also prepared for future applications by enlarged field of view and option strain distribution
- Insensitive system in dusty production environment, free from wear
- Test requirements:
  L0: 100…300 mm, max. strain: 50%
  test results: strain at max. force, strain at break, strain at reference values (stress)



Test in 4 axis with videoXtens and 2D dot matrix

- Biaxial testing system with a videoXtens installed top-view, 2 incident light lamps
- Specimen is pulled in 4 directions
- Dot pattern marked on specimen by template, different channels defined to measure the change of their relation

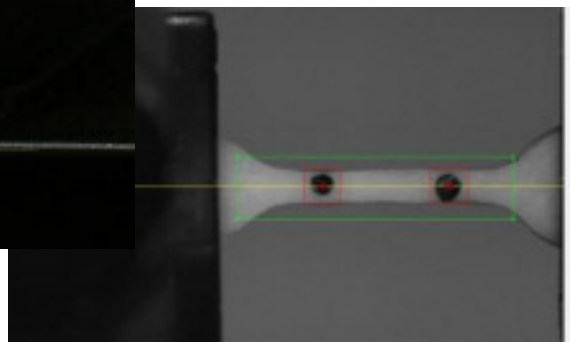




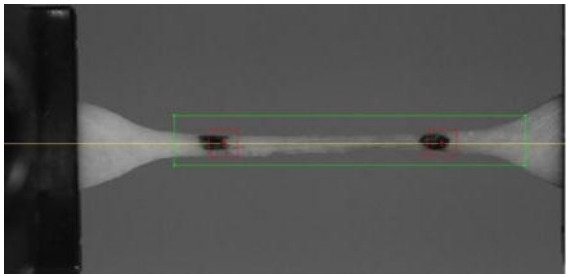
videoXtens: testing of sensitive biomaterial

- Sensitive biomaterial as used for valvular transplant or the like
- Simple marking of specimen with a felt marker, test via pattern recognition
- Test requirements:
  L0: 10 mm
  max strain: 100 %
  Test results: strain at break, strain at Fmax

Marking of specimen



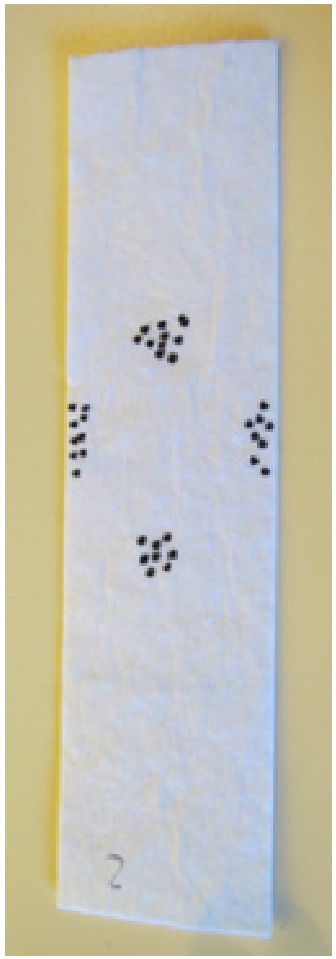
View before break



View after break

videoXtens: testing filter materials

- Test requirements:
  L0: 50 mm
  max. strain: 20%
  Test results: strain at break and transverse strain
- Simple specimen marking with black pen dots
- Testing of change in length and width via pattern recognition
- No clear edges -> width can´t be measured at edges
- No Standard, test parameters defined by customer



Agenda

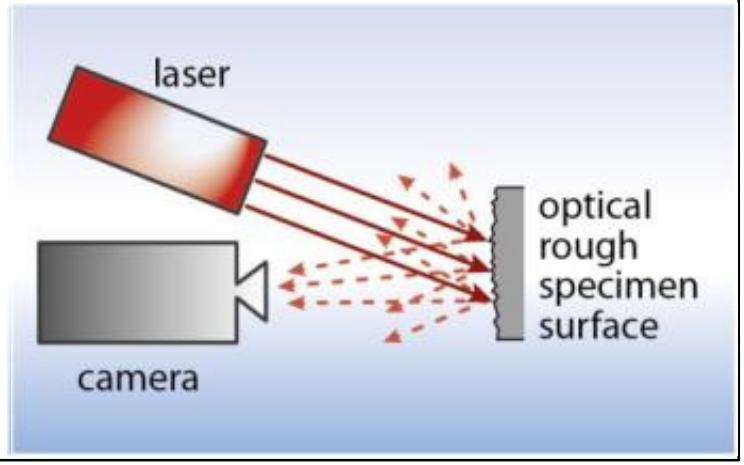
videoXtens – working principle & applications

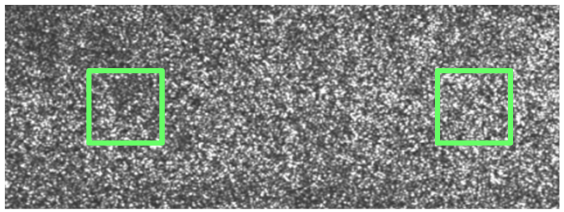
laserXtens – working principle & applications

lightXtens – working principle & applications

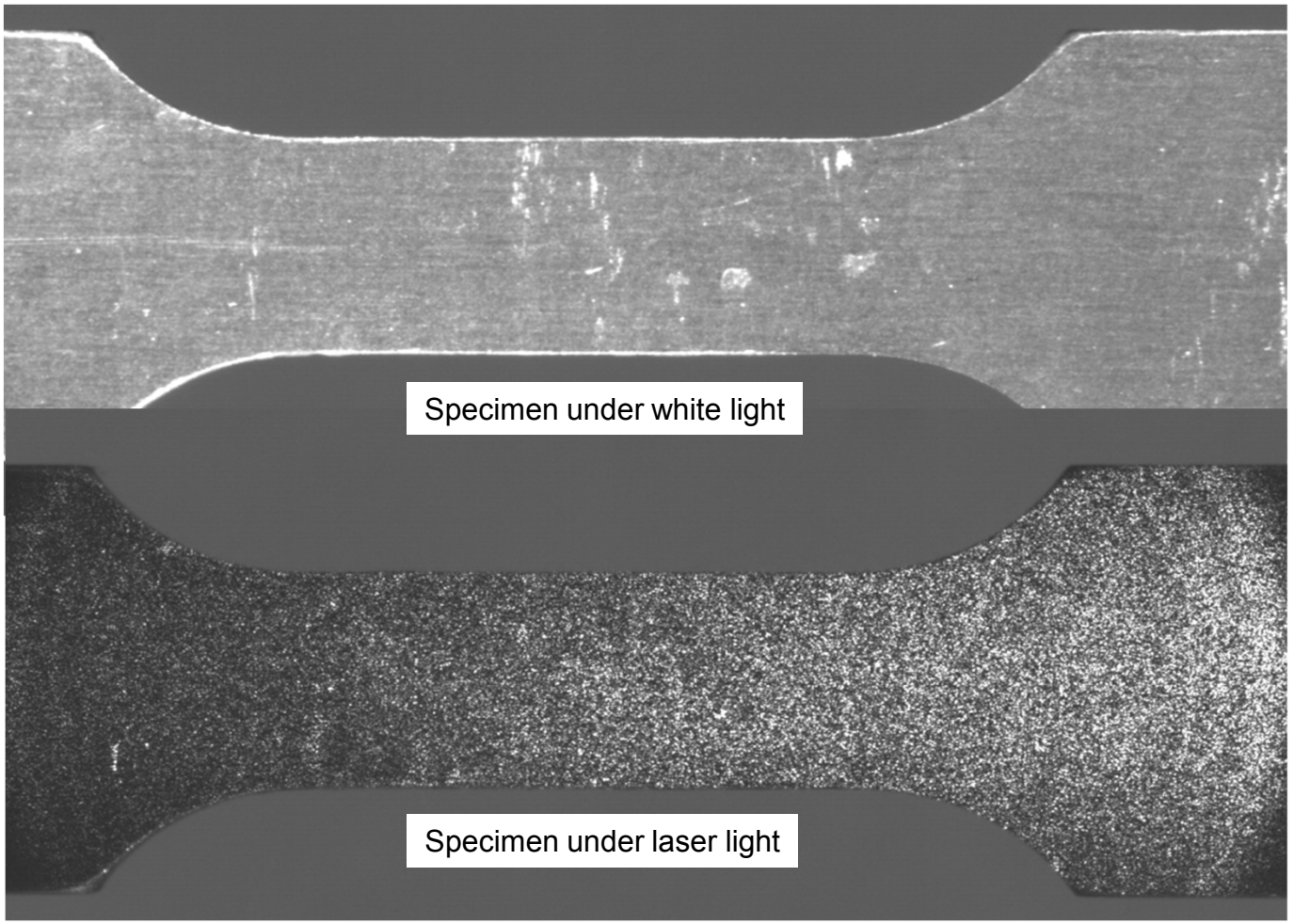
laserXtens – non-contact measurement without any marking of the specimen

Laser Speckle effekt
by diffusion of laser light at specimens surface

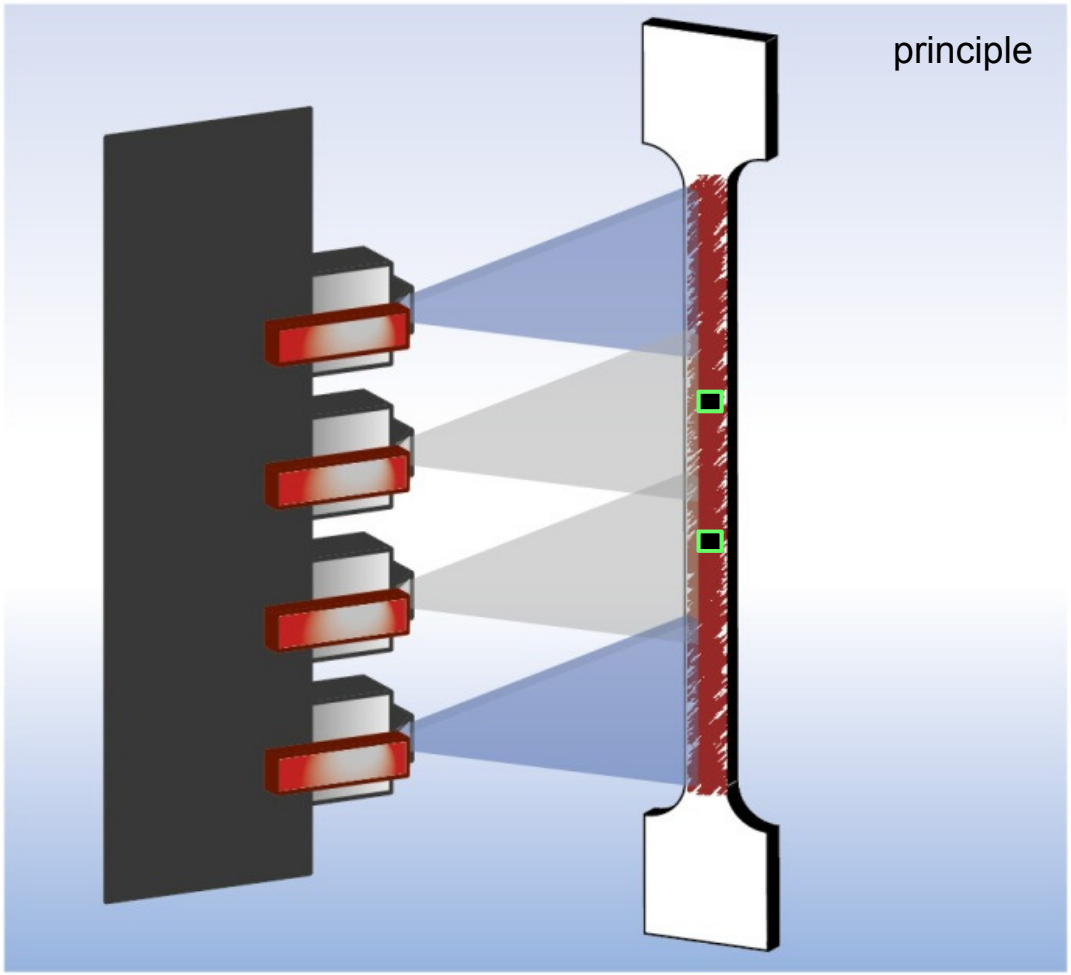




laserXtens– measurement principle

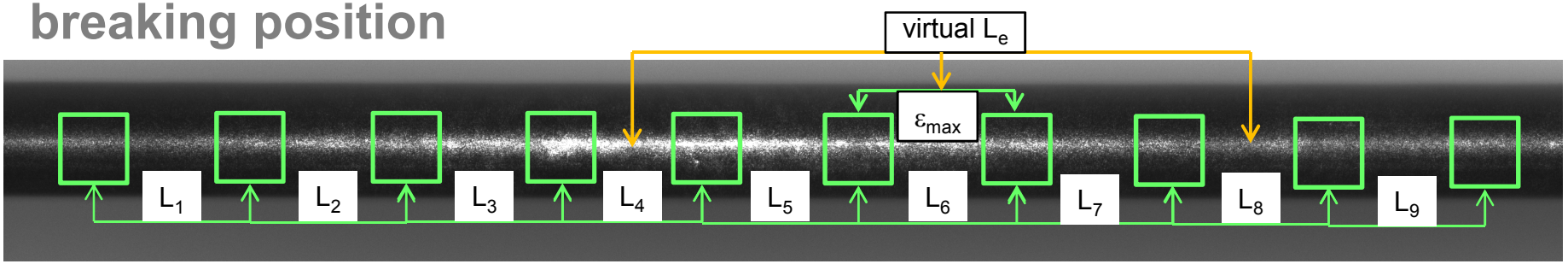


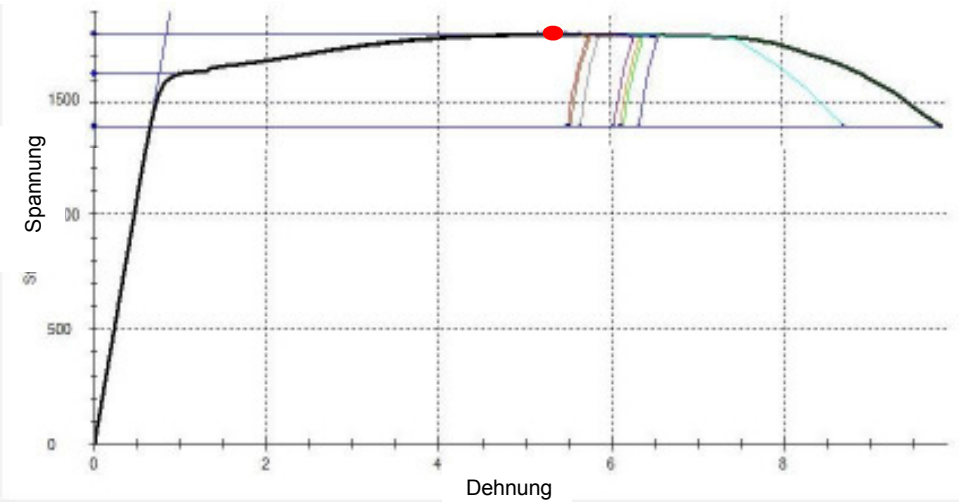
laserXtens 7-220 HP: Expansion of measurement travel by array configuration



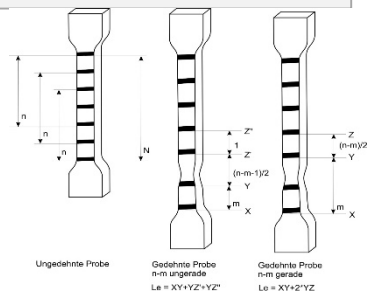
Strain distribution for laserXtens

Testing metals with automatic determination of specimens breaking position



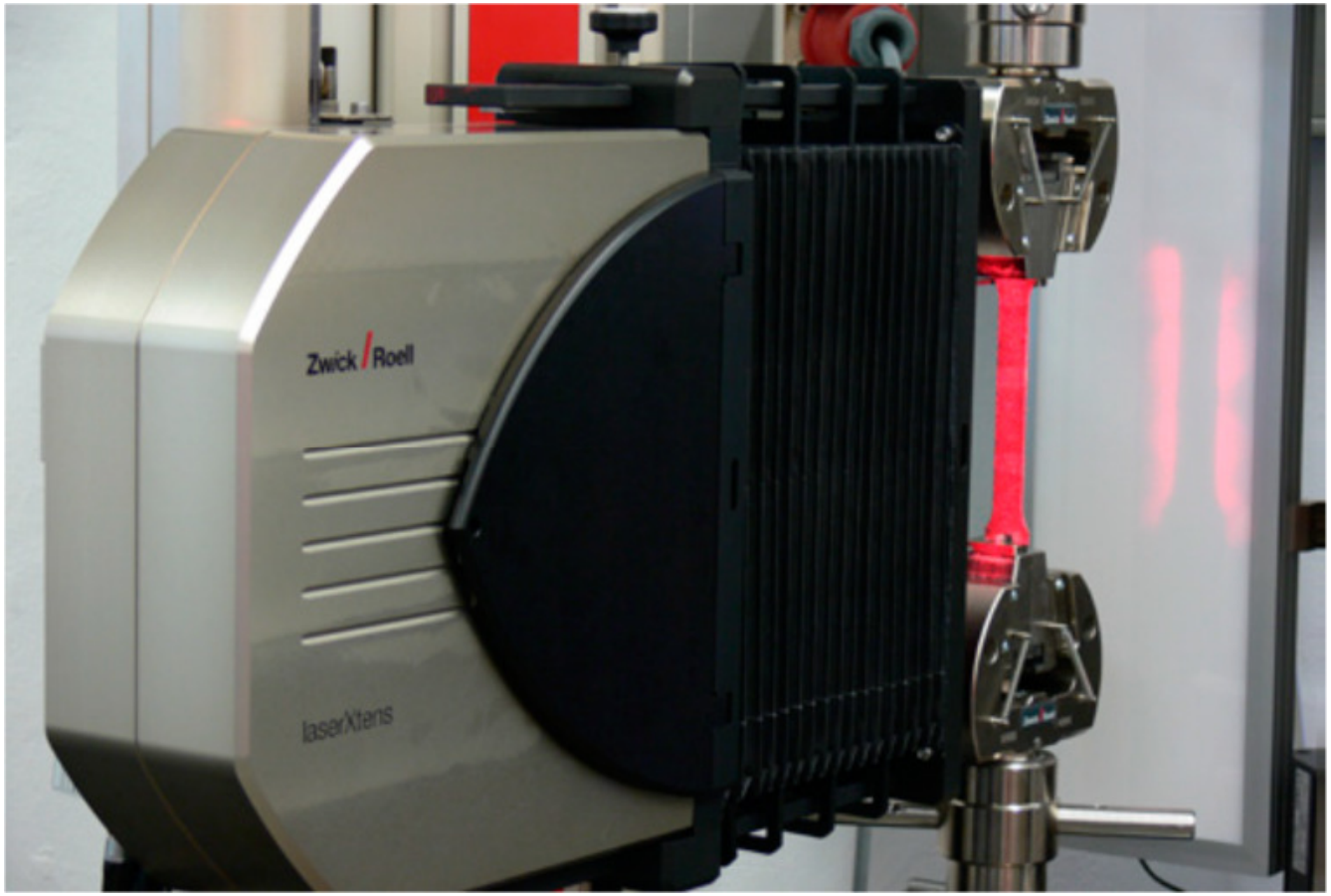


- no marking required
- up to 16 virtual measurement marks, (in-between automatically identical distances)
- during the test: simultaneous recording of up to 15 local strains
- Le is centered automatically around the sector of highest strain → automatic determination of specimens breaking position
- automatic balancing of the virtual Le around the constriction acc. to ISO 6892-1 annex I



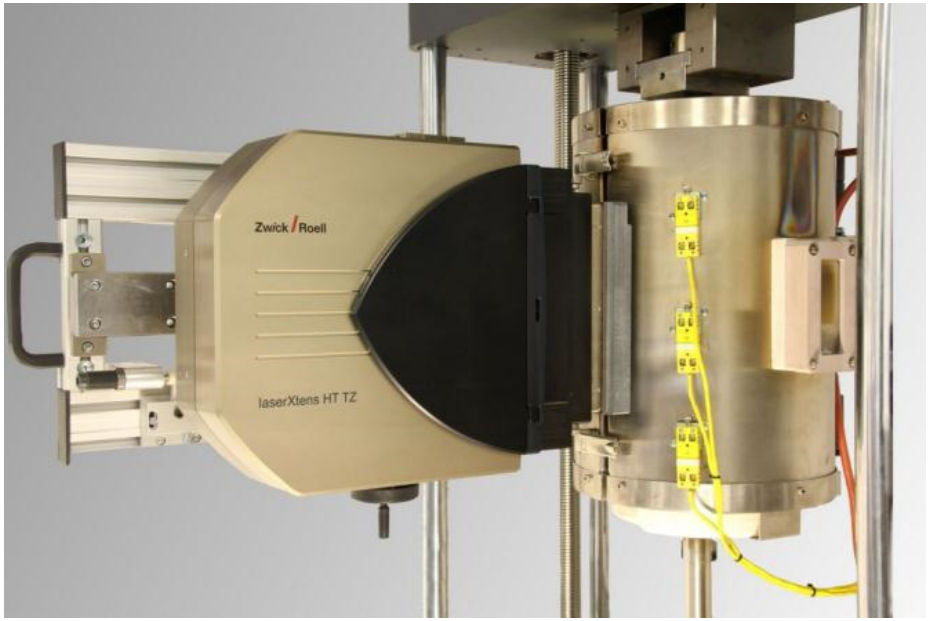
- reliable determination of strain at break
- „no“ specimen to reject

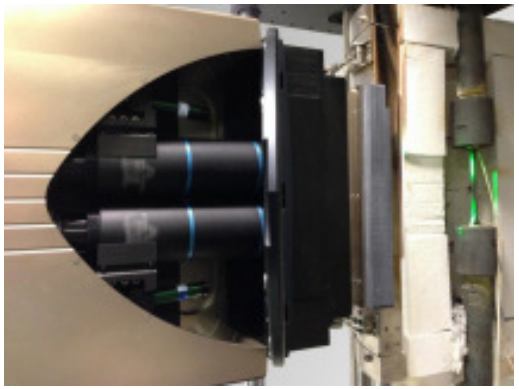
laserXtens 7-220 HP – perfect for metals testing acc. ISO 6892-1



laserXtens HT/TZ – ideal for high temperature testing

- Based on laserXtens 2-220 HP
- Telecentric lenses for compensation of the specimens lateral movement
- With green laser diodes
- L0: 3 mm ... 120 mm depending on furnace height (windows height)
- Measurement travel: 32 mm
- Accuracy grade 0,5 at AT / grade 1 at HT



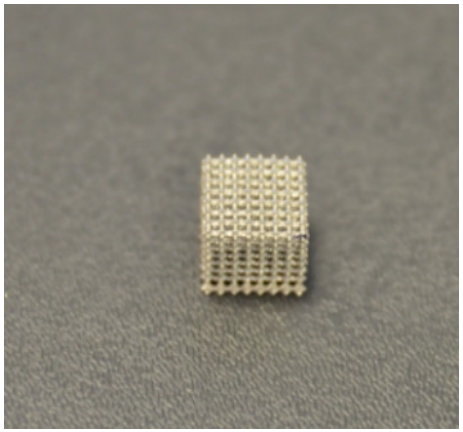


High temperature

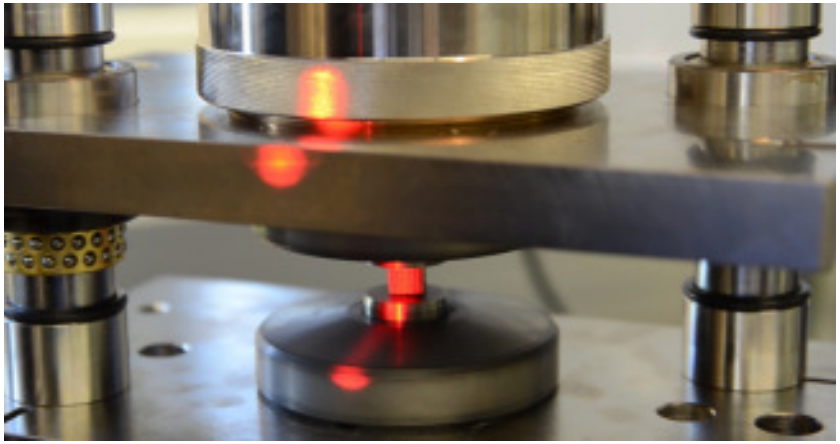
Sensitive, thin specimen: wires with laserXtens 1-15 HP

- Test to ISO 6892-1; determination of strain at break
- Wire too sensitive for contact systems
- Small extensions, low load, but highly accuracte extension measurement required
- Small specimens: telecentric objective is important to eliminate out-of-plane movements

Compression tests with laserXtens



- Bone void filling material – Alu Silicium compound in which the backbone cells can grow
- Size 10x10 mm
- Compression test to ensure ist stability / characteristics after implant (it´s constantly under pressure after implant in body)
- Measurement at the grid, not at compression platens



Agenda

videoXtens – working principle & applications

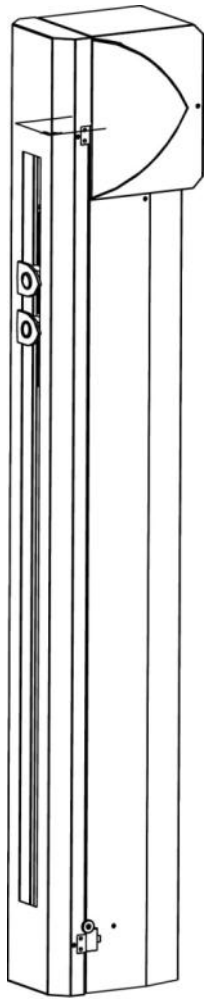
laserXtens – working principle & applications

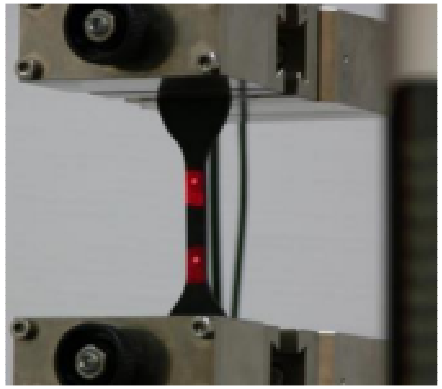
lightXtens – working principle & applications

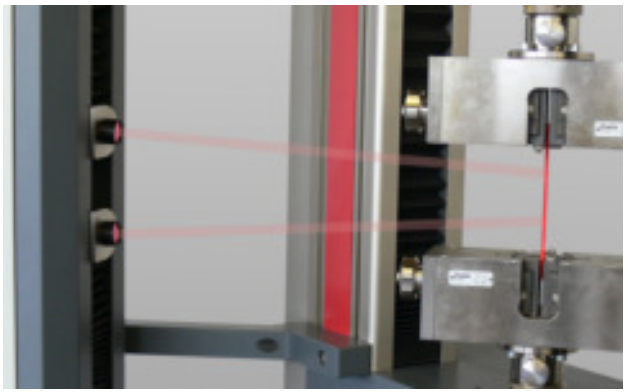
lightXtens - principle

Principle of lightXtens

- Measurement marks: specially coated reflective spots (or rings)
- Optical measurement carriages
- 1st measurement carriage drives to both marks & determines their distance (initial gage length)
- Both measurement carriage position themselves, then test runs automatically
- Tracking of the marks by movement of the carriages
- Marks detected by optical sensors







lightXtens - application range

lightXtens is used for specimens with high strain, high fracture energy or whipping specimens.

It is simple in operation and with fully automatic test sequence.

- Highly extensible / elastic, contact-sensitive specimens, as
  - Rubber and elastomers, latex
  - Films and foils
  - Textiles (Ropes, belts, technical/coated textiles e.g. for belt conveyors)
- Specimens with large L0 e.g. steel wires / wire strands
- Features:
  - max. measurement path 1000 mm – L0
  - Accuracy grade 1 to ISO 9513 from 3 mm
  - Also for use with temperature chamber in the temperature range -40°C bis +120°C

Thank you for your attention!