

Glass-shaft setup

A test rig to measure contact width and percolation threshold of radial lip seals

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Working principle and schematic

This specialized rig with a hollow glass shaft was developed to examine the contact width and potential leakage points of seals, mimicking the static conditions of a stern tube seal. It employs two pressure regulators for independent control of the seal's pressure environment. The inspection of the contact area is facilitated through a calibrated USB camera, enabling precise measurements via image processing. To analyze the contact area along the shaft, the setup utilizes the Frustrated Total Internal Reflection technique, which employs a laser beam that reflects within the glass. This technique reveals the contact width and seal compression state, which is crucial for understanding seal behavior under various pressure conditions.

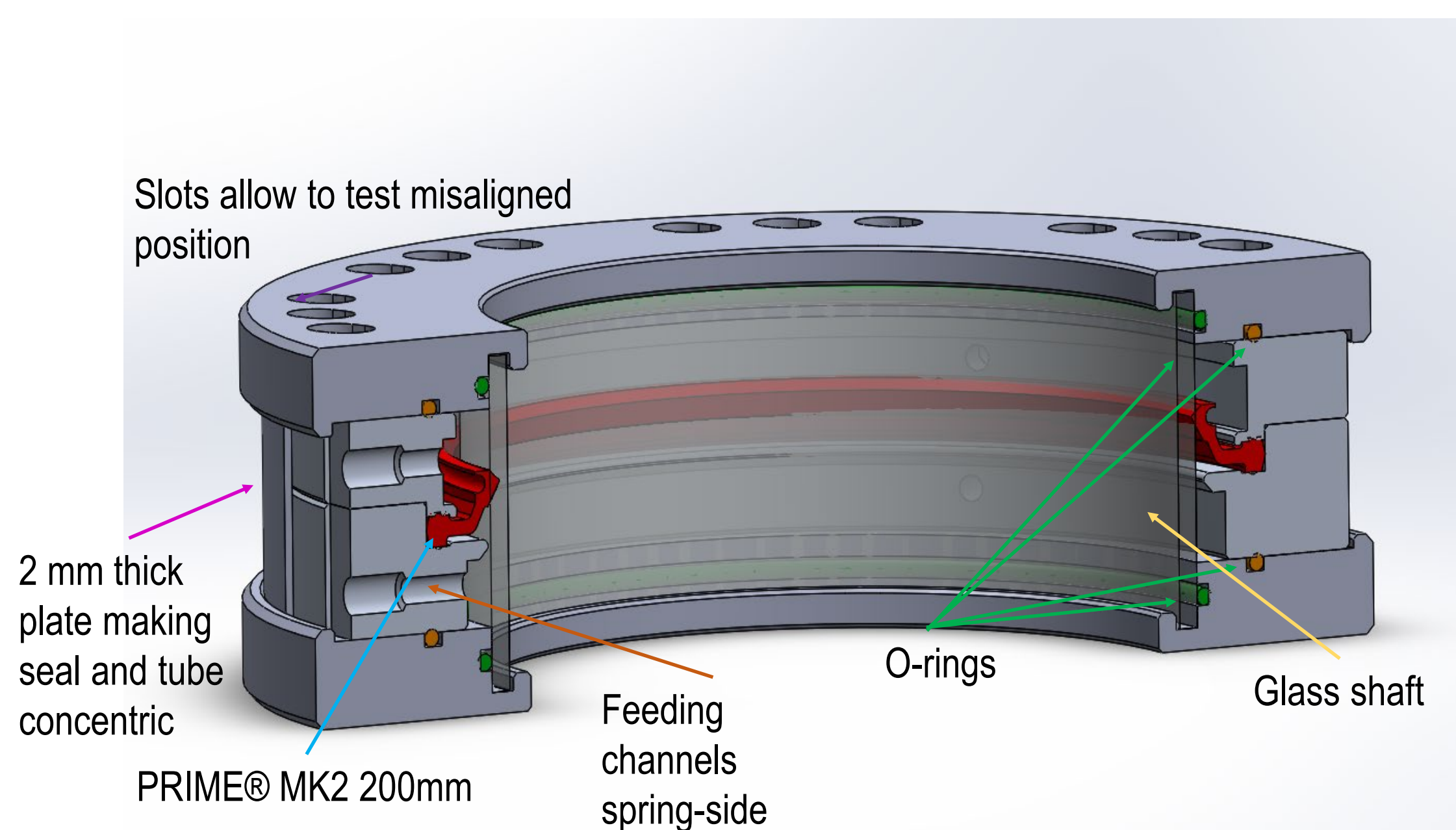


Figure 1. Glass shaft setup depicting an MK2 seal mounted

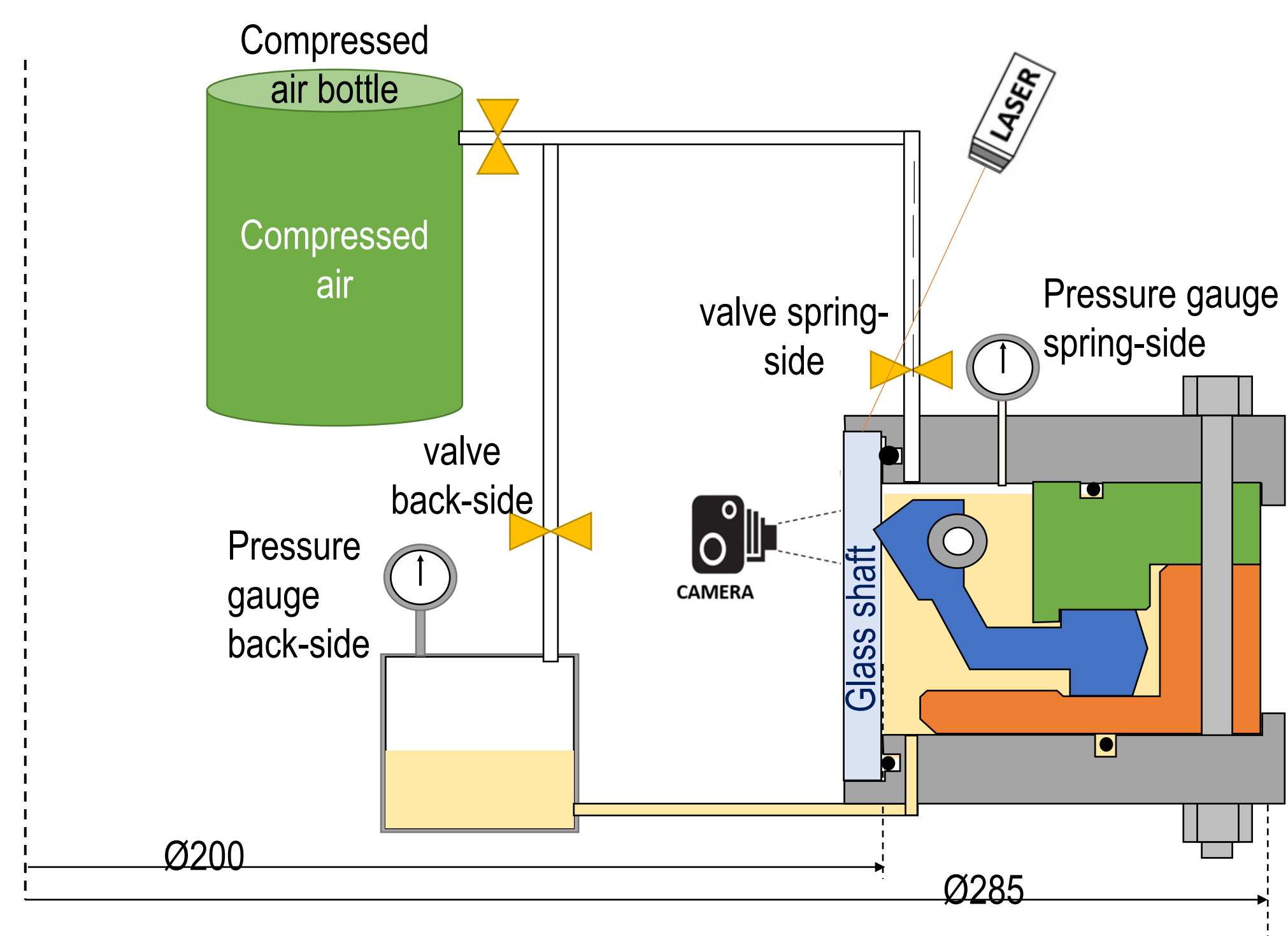


Figure 2. Working principle for observing seal tip contact using the frustrated total internal reflection technique

Results and discussion

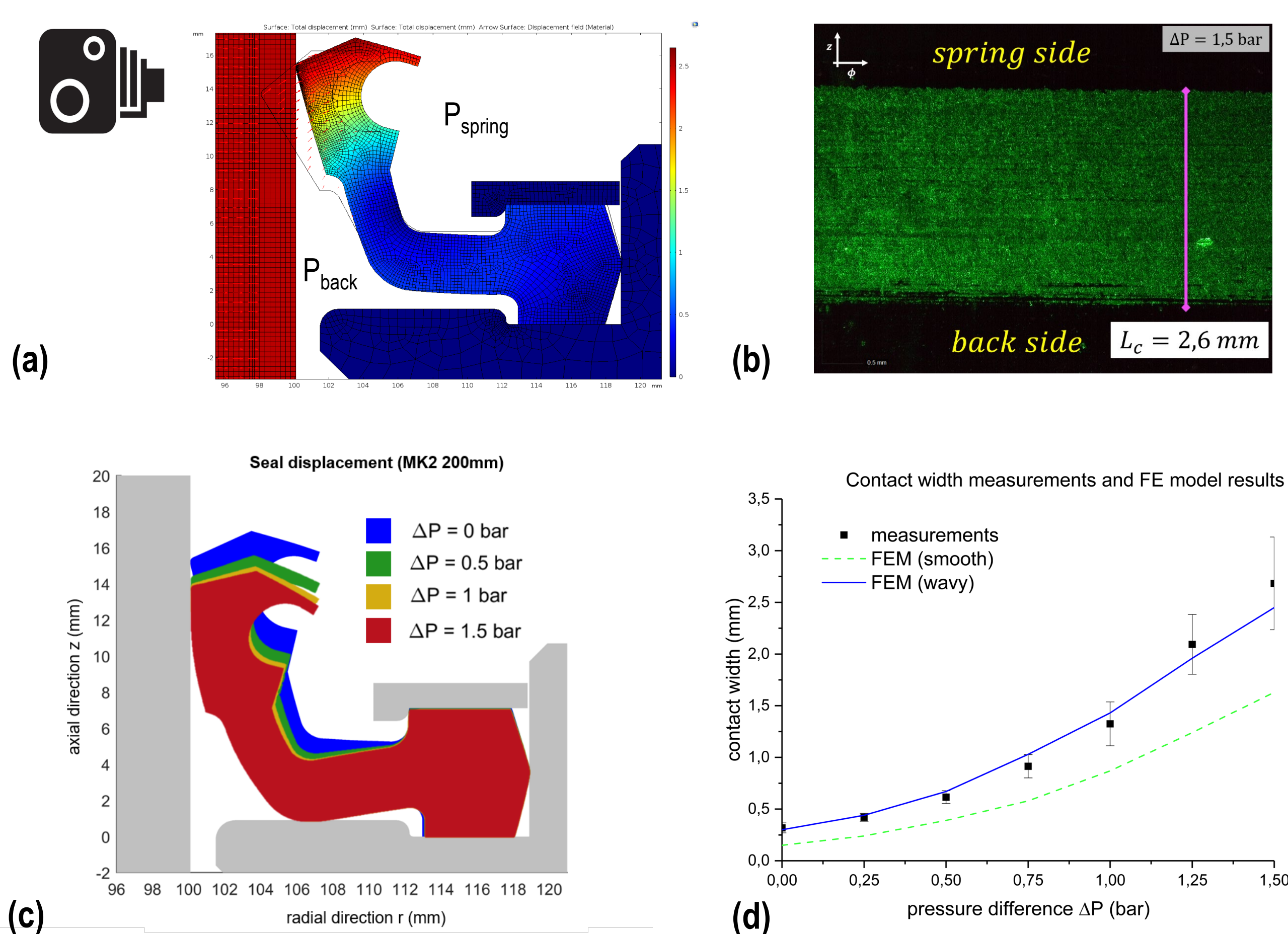


Figure 3. Contact width measurements to validate FEM computations.

- Figure 3a shows a visual representation of a FEM simulated lip seal with surface displacement and pressure analysis including a camera viewpoint indicator.
- Figure 3b represents the contact width measured at 1.5 bar pressure difference using the glass shaft setup.
- Figure 3c is a contour plot that quantifies the seal's deformation across different pressures, ranging from 0 to 1.5 bar, and demonstrates the axial displacement about the radial direction of the seal.
- Figure 3d displays a comparison between measured contact width and Finite Element (FE) model predictions. It illustrates two FE model variations—one assuming a smooth surface and the other incorporating a wavy surface texture.

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