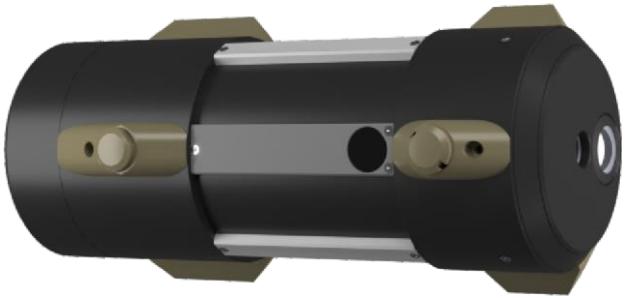
## TECHNICAL SPECIFICATION

# COMPLETE PIPE MEASURING AND VIDEOINSPECTION SYSTEM WITH LASER ALIGNMENT*, ROTATING LASER SCANNER, FRONT VIDEO AND RANGE FINDER

## FEATURES

- video inspection (frontal)
- non-contact laser measurement
- laser alignment (option)



### Measurable parameters

The system allows for measurement of :

- Inner diameter
- Ovality
- Out-of-roundness
- Non-straightness
- Barrel threading measurement
- Length measurement

The system scans profile of inner surface and performs:

- Surface anomalies detection
- Calculation of the deviation from the shape
- Calculation of the geometric dimensions of the profile of the inner surface

The system performs laser-alignments using integrated PSD sensor and external laser emitter.

## APPLICATION

Quality and geometric dimensions check during production as well as periodic inspection of components and assemblies.

- Smooth, Profiled and Rifled pipes
- Barrels
- Stators
- Extruders
- Precise Cylinders

## DESCRIPTION

The Complete Pipe Measuring and Inspection system (Probius™ Ultimate) is the most advanced unit available. It measures a range of parameters (inner diameter, ovality, out-of-roundness, non-straightness, barrel threading, rifling/profiling width/height and rifling angle), using five different measurement channels (rotating laser 2D scanner, frontal video inspection channel, distance gauge and PSD sensor) and combines this data to calculate the full 360˚cross-sectional profile of the pipe. Based on the exceptional number of precisely measured points, diameters and profiling parameters (width, height, irregularity, angle) are calculated.

Integrated HD cameras detect visual defects of the bore. The frontal video inspection channel houses a 5 Mpix camera with panamorph lens and 3 channel LED lighting system especially designed for hi-res video inspection of pipe interiors.

The laser distance gauge measures the distance from the probe to the pipe end to bind measured results to the probe position. The probe is moved along the barrel manually using a telescopic rod, gooseneck tube.

Non-straightness measurement is performed with an integrated module that measures deviation from a determined axis.

Measurement results and video are displayed on a PC in real time. The shots of the defects can be saved in a file. Measurement data can be displayed, protocoled and archived according to user requirements.

# COMPLETE PIPE MEASURING AND VIDEOINSPECTION SYSTEM WITH LASER ALIGNMENT, ROTATING LASER SCANNER, FRONT VIDEO AND RANGE FINDER

## SPECIFICATION

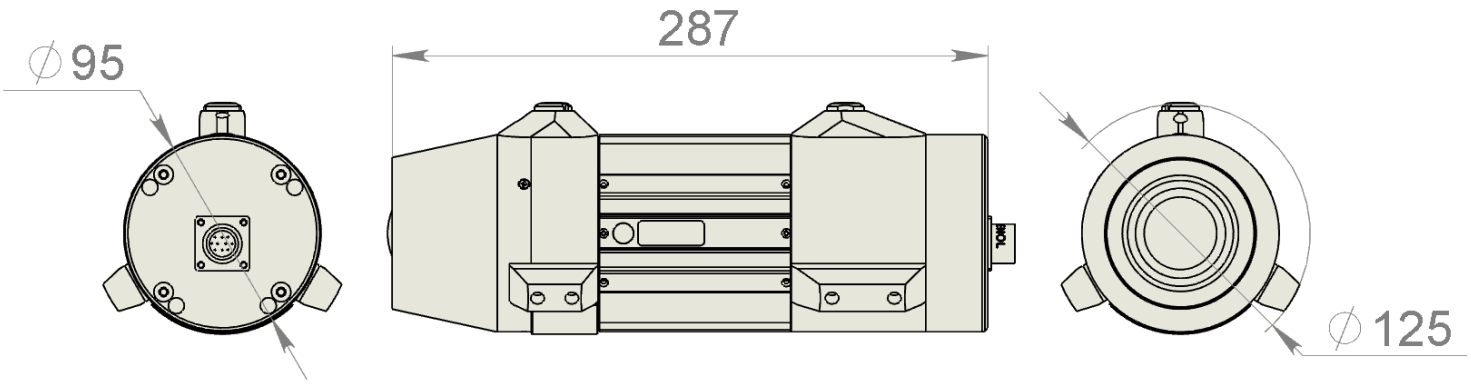
| | |
|---|---|
| **Profile measurement accuracy, mm** | +/- 0.01 |
| **Non-straightness measurement accuracy, mm** | +/- 0.01 |
| **Diameter Range, mm** | 105-155 |
| **Probe position, mm** | +/- 1 |
| **Movement method** | Manual by rod |
| **Video inspection channel** | Front: panamorph lens, 5 Mpix |
| **Camera angle (frontal)** | 180° with distortion elimination |
| **Connection "probe"-"computer"** | Wired |
| **Power** | 220 V 50 Hz 200 W via power supply |

## OPTIONS

- Self-centering probe | Manual moving
- Non-straightness measurement
- Temperature measurement
- 3D model

## OVERALL DIMENSIONS

***Base configuration D95***



## CONTENTS OF DELIVERY

| Name | Quantity, pcs. |
|---|---|
| **Measuring probe** | 1 |
| **Rod (set)** | 1 |
| **Communication unit** | 1 |
| **Power cable** | 1 |
| **Connecting cables (set)** | 1 |
| **Set of bearings or rollers or legs (set)** | 2 sets per diameter |
| **Case** | 1 |
| **Software** | 1 |
| **User manual** | 1 |
| **Quality Certificate** | 1 |
| **Calibration Certificate** | 1 |

| Optional addons (if applicable) | Option | Quantity, PCs. |
|---|---|---|
| **Measuring probe with video module** | FVI and/or SVI | 1 |
| **Built-in rangefinder** | LD | 1 |
| **Rangefinder beam reflector** | LD | 1 |
| **External rangefinder & tripod (set)** | LDO | 1 |
| **Pipe extender** | PE | 1 |
| **Laser module** | NS | 1 |
| **Power supply for laser module** | NS | 1 |
| **Laser module adaptors for different diameters** | NS | set per diameter |
| **Calibration module for laser scanner** | CAL1 | 1 |
| **Calibration module for laser scanner&Straightness channel** | CAL2 | 1 |

## DESIGNATION WHEN ORDERING

PS– /pipe type / D1-D2 /measuring channels/ /movement method/ /accessories/ /data transfer/

| /pipe type / | /measuring channels/ | /movement method/ | /accessories/ | /data transfer/ |
|---|---|---|---|---|
| SP smooth pipes | LRS rotating laser scanner | MM manual | PE pipe extender | W0 data transfer and power supply via cable (Basic) |
| RT profile | FVI frontal video | | WE balancing weight | W1 wireless data transmission (Wi-Fi). Powered by cable. |
| ST stator | | | GTK rugged PC | |
| DF(x) another form | NS straightness | PSV for vertical pipes | HST hoist | |
| | LD built-in rangefinder | | T build in thermometer | |
| | LDO external rangefinder | | | |

| The type of checked object (pipe) | |
|---|---|
| SP (basic) | Device for measurement of smooth pipes |
| RT | Device for measurement of profiled pipes, rifled tubes, siphons. Profile height does not exceed 5 mm |
| ST | Device for measurement of stators, screw pumps and pipes.<br>Profile height does not exceed 25 mm |
| DF(x) | Device for measurement of pipes with a cross-section shape different from circle, where (x): H-hexagonal S-square and rectangular tubes T-triangle tubes C - free-form<br>*) customer should provide drawings of the pipe |
| Diameter Range | |
| D1-D2 | Diameter range of the pipe<br>D1 - Minimum<br>D2 - Maximum |
| Measuring channels | |
| LRS (base) | Rotating laser scanner<br>* It is possible to combine with SVI |
| FVI | Front camera with high-resolution HDR (high dynamic range) and panamorphic wide-angle lens. (basic)<br><br>* It is possible to combine FVI with NS(x). In this case, fish-eye HiRes lens is integrated instead of panamorphic wide-angle lens.<br>** Panamorphic wide-angle lens is not available for D1<90 mm |
| NS(x) | Straightness measurement channel, where (x) the range of measurement of NS(5) +/-5 mm, NS(20) 20 mm.<br><br>The system with “Straightness measurement channel” is supplied with an external laser module. The probe is equipped with a PSD sensor and rangefinder. |

| | |
|---|---|
| | *) 45 mm PSD sensor is also available for some systems. Contacts us to find out more. |
| LD xxx | Built-in rangefinder (accuracy ±1 mm). xxx is the pipe length range.<br>Pipe length - up to 30 m.<br>*) For pipe length more than 30 m, contact us. |
| LDO xxx | External rangefinder (accuracy ±0.5 mm). xxx is the pipe length range.<br>Pipe length - up to 30 m.<br>*) For pipe length more than 30 m, contact us. |
| Movement method | |
| MM (basic) | Manually: movement by hand using a telescopic rod (similar to tentpole) with 500 mm sections |
| Accessories | |
| PE | The extension tube allows you to measure the pipe from its very edge. Without this option, there are uncheckable areas on both sides of the pipe (up to 200 mm, depends on the probe modification). |
| WE | Balancing weight to keep the probe balance when checking conical surfaces.<br>Very special option for narrow application. |
| GTK(x) | Operator console based on Getac (or similar) laptops, where x:<br>sr, br – semi-rugged, fr - rugged notebooks<br>*according to ruggedness class |
| T | Thermometer |

| | |
|---|---|
| Data transfer | |
| W0 (Basic) | Data transfer and power supply via cable (option) |
| W1 | Wireless data transfer from device to operator console, powered by cable. |
| Calibration | |
| CAL1 | Calibration module for laser scanner calibrating |
| CAL2 | Calibration module for straightness channel calibrating |

**Example of product code**: **PS-RT/105-152/ LRS – FVI/SVI–NS(5)-LD(15)-SMAC/W0**

The device for profiled pipes from 100 to 150 mm in diameter equipped with laser rotating scanner, frontal and side video camera, built-in range finder with the range 15 meters, straightness measurement channel with the range of +/-5 mm, self-moving with precise centering, data and powered by cable.

## THE ROD

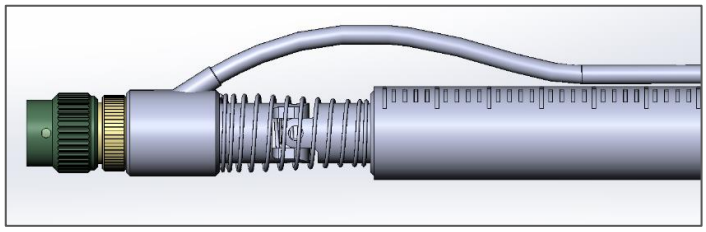


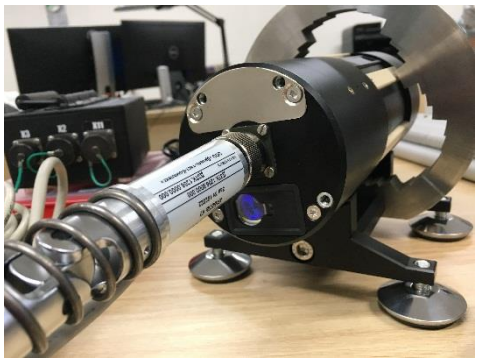
Fig. The first rod section for probe movement

For manual movement and distance orientation.

The basic system is supplied with a rod. It consists of sections 500 mm long. The first section has a joint and connector which is screwed into the connector on the back side of the probe. Thus, the probe is provided with power and network connections and can be moved by hand along the pipe.

All rods are numbered and have a marking with increment of 5 mm. If a rangefinder or encoder is not ordered this marking allows to monitoring the distance between the probe and the edge of the pipe.







## PROBE 95 OVERALL DIMENSIONS

***Straightness configuration D95***

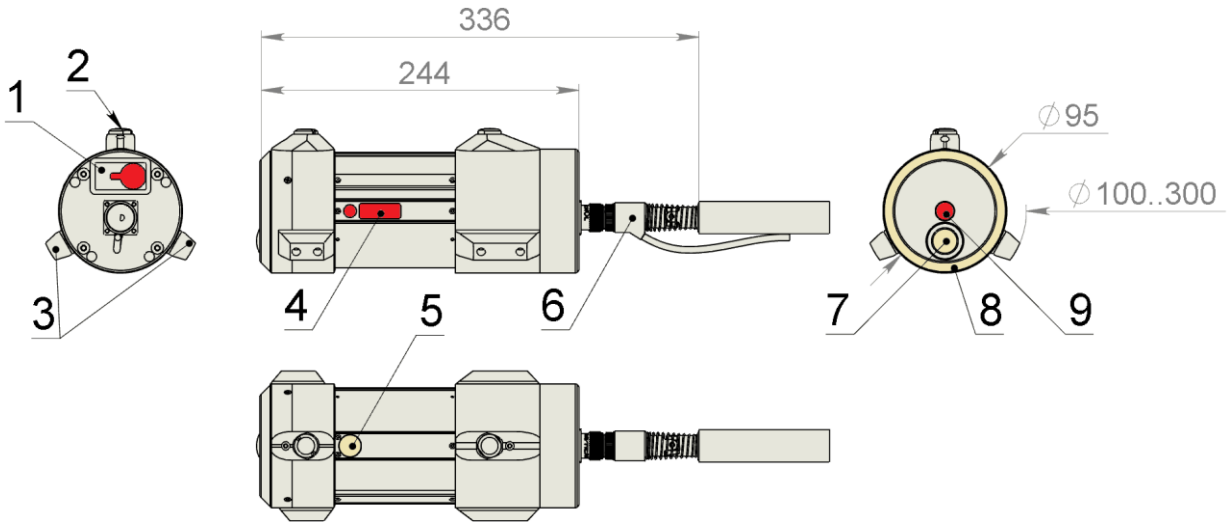


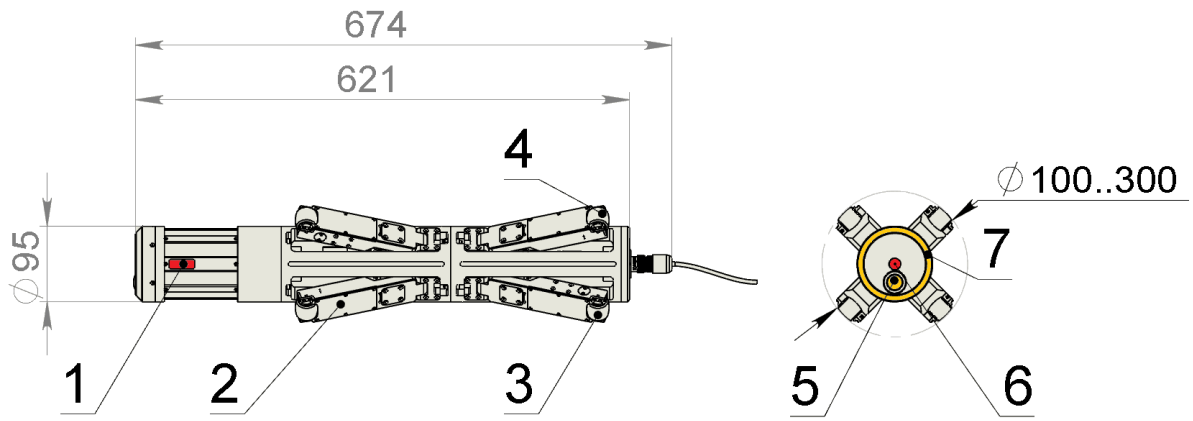

Fig. Dimensions and composition of the probe in the modification of FVI-SVI-NS-LD (x):
1-built-in rangefinder; 2-the spring-loaded spacers; 3-supports; 4-laser measuring head; 5-side camera; 6-rod; 7-front facing camera; 8-frontal illumination system; 9-position sensitive detector.





Fig. Inspection PROBE manual movement + FVI+W0

## INSPECTION PROBE - SMAC




Dimensions and composition of the probe in the modification of SMAC-FVI- NS-LD (x):
1- laser measuring head; 2-the legs; 3- rollers; 4-; 5- position sensitive detector;
6 - front facing camera; 7-frontal illumination system.

Centering module is included in SMAC specification of the device. It is a system of folding legs with rollers, which automatically adapts to the diameter of the pipe and maintains a constant unclamping pressure. This mechanism allows the instrument to measure pipes with a variable diameter, measure the conical tube parts. Probe movement is carried out by means of a drive mounted in one of the centering legs on command via software in manual mode or automatic sections positioning mode set by the operator

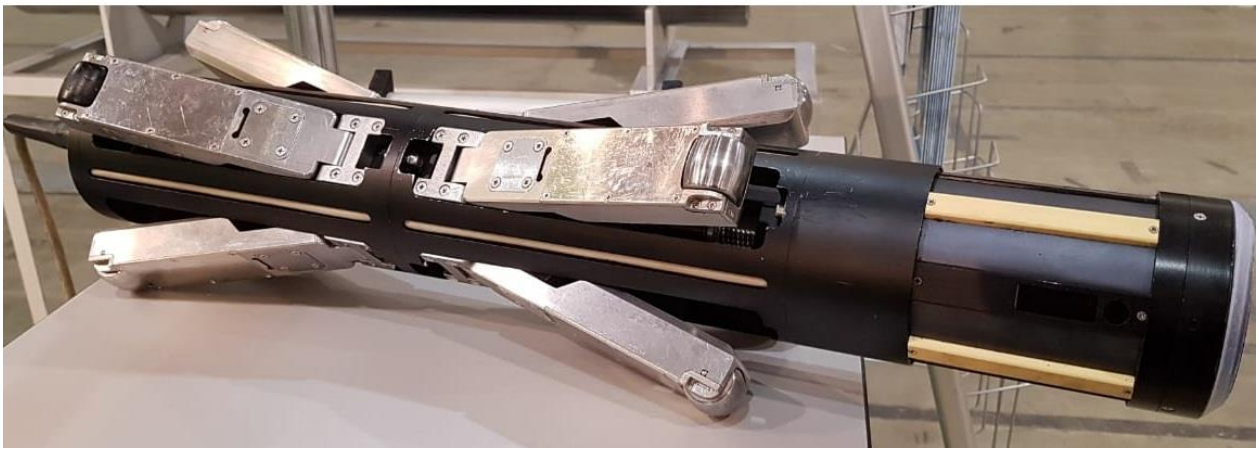


Fig. Inspection PROBE SMAC-FVI- NS-LD (x)-W0

## PROFILE SCANNING

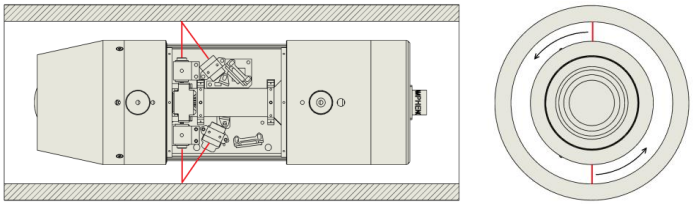


Fig. Location of triangulation sensors inside the measuring head.

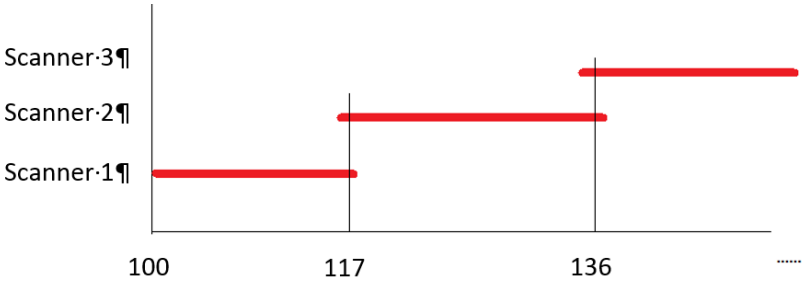



Fig. Overlapping measurement ranges

The main module of the probe is a rotating measurement head. Each one contains few (depends on chosen configuration) radially arranged laser triangulation sensors (see. Figure). To obtain a profile of a scanned cross-section, rotating laser scanner makes a few complete revolutions, thereby getting a full information of the cross-section.

Depending on a controlled diameter and accuracy, rotating measurement head may contain from 1 to 4 sensors in order to cover a full measurement range. In this case, each sensor has a measurement range which overlaps the range of adjacent sensors.

The magnetic ring encoder placed inside the laser scanner provides the value of the rotation angle. As a result of the scanning system has a point cloud of the cross-section.

## RANGEFINDER

Laser rangefinder determines the position of the probe relative to the pipe end what allows you to automatically bind results of the scan to the pipe length. Depending on required accuracy it comes with built-in or external rangefinder.



Fig. A built-in rangefinder
Accuracy 1.5 mm up to 30 m length



Fig. An external rangefinder and a tripod
Accuracy 0.5 mm up to 30 m length or 0.3 mm up to 2m

## STRAIGHTNESS

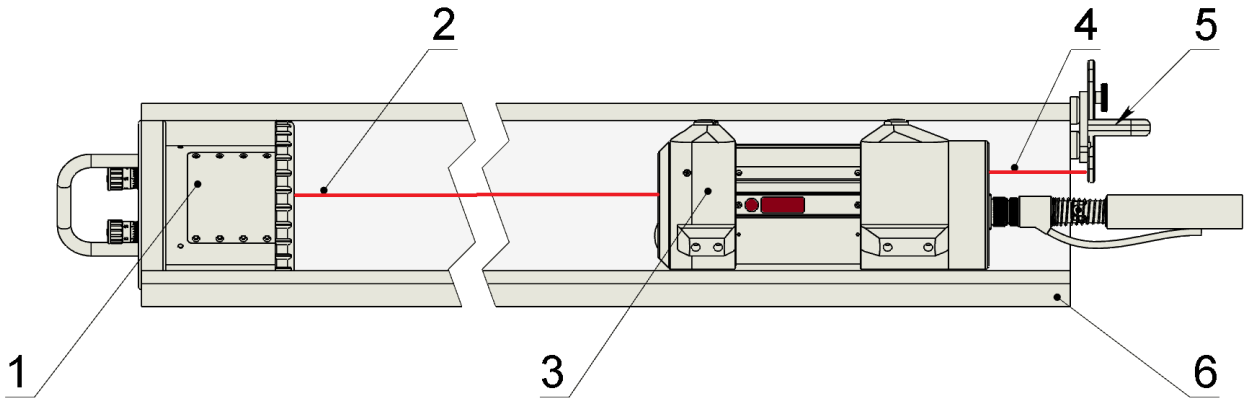



Fig. The arrangement of the elements of the device for the alignment control:
1-laser module; 2-baseline beam; 3-probe with built-in rangefinder;
4-rangefinder beam; 5- rangefinder reflector; 6-pipe.

Measurement of deviation between the longitudinal axis of a pipe from straightness is performed by a basic laser beam, which is formed by the laser module.

The laser module is installed on the edge of the pipe. It can be supplied with a set of interchangeable spacer-caps for installation in pipes of different diameters. The direction of the laser beam changes on two axes using handles of vertical and horizontal adjustment. Laser module is connected to the main (220 V 50 Hz) power supply via the laser module power module.

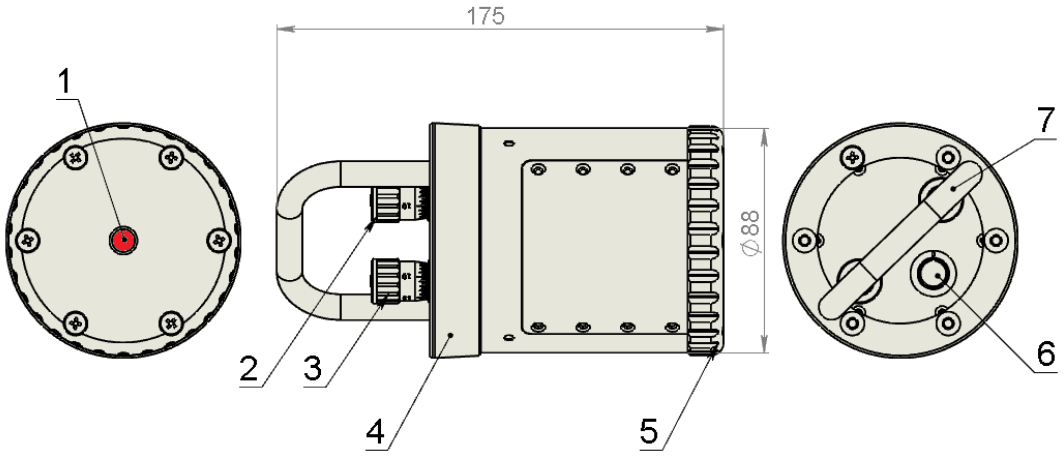



Fig. Dimensions and composition of the laser module:
1 – laser beam window; 2 – vertical adjustment handle; 3 – horizontal adjustment handle;
4, 5 – spacer-caps; 6 – power supply unit connector; 7 – handle.

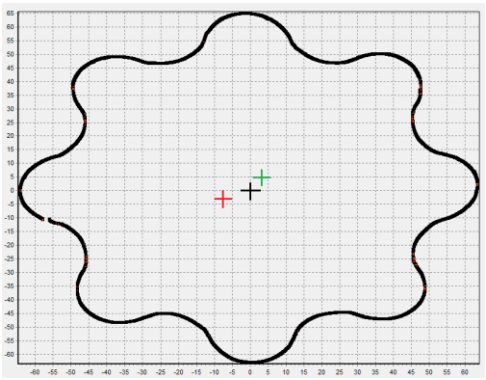


Fig. A principle of straightness measurement in cross-section:
red cross is reference beam position, black cross is cross-section center,
green one is the center of rotation.

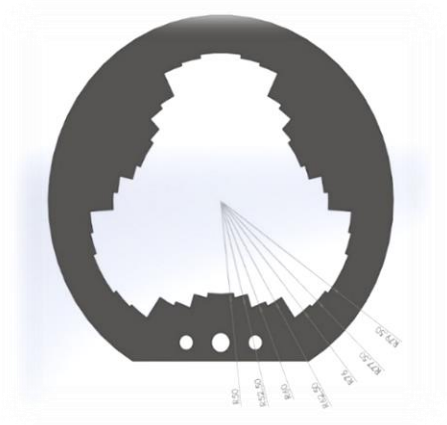
Measurement of straightness is performed by a position sensitive detector (PSD) placed on the front cap of the probe. The PSD determines a probe rotating axis deviation from the reference beam. Simultaneously, the laser rotating scanner defines the center of radial pipe cross-section. Thereby, a deviation of cross-section center from the reference beam is calculated.

Described measurement principle does not require precise centering of the probe inside the pipe. It allows measuring straightness of pipes which have a complicated form.

## CALIBRATION MODULE

Depend on the model of the probe the Probius could be equipped with **CAL1** or **CAL2**.

### CAL1 type



Module consists of:

- the stand
-the caliber ring.

The stand allows placing the probe the way the rotating laser position is inside the ring.

The ring diameter is changed stepwise (3 steps for each diameter) and cover the entire working range of the laser scanner.

The SW has a calibration menu for providing a periodic calibration measurement.

Fig. CAL 1: the ring.

The ring is supplied with a certificate of calibration.

### CAL2 type.

The **CAL2** module provides calibration for probes with straightness function. It consists of two parts



The first one contains a caliber-ring which imitates a profile of pipes of different form and diameters. Calibration method of the first part similar to CAL1 method.

The second - is intended for straightness sensor (PSD) calibration. It is a system of two motorized translation stages positioned orthogonally and reference laser source. The design of the module centers the probe what eliminates the risk of incorrect calibration.

During calibration the laser beam is directed into PSD and motorized translation stages provide its high precision movement in the plane of the PSD.

The method of calibration is based on the comparison of the trajectory of the laser beam given by linear translators and obtained from the PSD.

The system is supplied with calibration certificate.