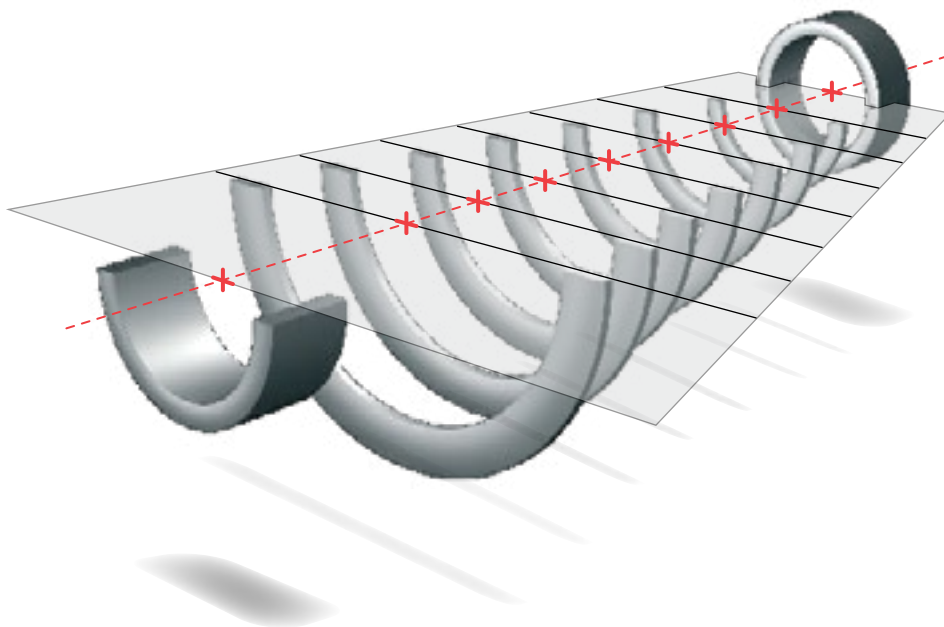


E960



TURBINE GUIDE
English

EASY-LASER®

CONTENT

INTRODUCTION	1
Service and calibration	2
IP code and classification	3
E960 TURBINE	5
System Easy-Laser® E960-A	5
System Easy-Laser® E960-B	5
Prepare the work	5
Assemble Laser transmitter	6
Using support beam	6
Using vertical support beam	7
Using arms	7
Assemble Detector	8
Using short stroke bracket	8
Using long stroke bracket	9
Beam extensions	10
Using sliding bracket	10
Preparations	11
Check the environment	11
Mount the laser transmitter	11
Rough align laser beam	12
Align the laser beam	13
Reference target	13
Adjust the measuring probe	14
Measure	15
Enter distance	16
Register values	16
Result	17
Result table view	17
Result 3D view	17
Result graph view	18
Tolerance	19

INTRODUCTION

Easy-Laser AB

Easy-Laser AB develops, manufactures and markets Easy-Laser® measurement and alignment equipment based on laser technology.

Intended use for the equipment is described in the technical data for each system.

You find the technical data in the end of the manual. Do not hesitate to contact us about your measurement problems. Our expertise will help you solve it in an easy way.

QUALITY CERTIFICATE

Equipment: Easy-Laser® product range

Quality statement

Easy-Laser AB is ISO 9001:2015 certified. Certificate number: 900958.

Easy-Laser AB confirms that our products are produced according to applicable national and international regulations and standards.

Warranty commitment

Easy-Laser AB develops and manufactures the Easy-Laser® product range. The products are manufactured under our stringent quality controls, and each Easy-Laser® system undergoes a Factory Acceptance Test and is visually inspected prior to delivery. If the product is malfunctioning or stops working within three (3) years of purchase, the warranty applies with free repair or replacement of defective parts or products.

Warranty does not apply:

- If the product is handled carelessly or incorrectly.
- If the product is subjected to environment factors that exceed the product specification limits, such as temperature, moisture, shock or high voltages.
- If the product is modified, repaired or dismantled by nonapproved personnel.

Compensation for any secondary damage caused by an Easy-Laser® product fault does not apply. Easy-Laser AB is not responsible for any transport costs for equipment sent back to Easy-Laser AB for repair.

Lithium Ion battery limited warranty

A Lithium ion battery inevitably loses power during its lifetime, depending on usage temperature and the number of charging cycles. Therefore, internal rechargeable batteries in the Easy-Laser® product range are not included in our general 3-year warranty. A 1-year warranty applies for the battery capacity to stay above 70 % (after 300 charging cycles, the battery should have more than 70 % of its nominal capacity left). A 3-year warranty applies if the battery becomes unusable because of a manufacturing fault or factors that Easy-Laser AB could be expected to have control of, or if the battery displays abnormal degradation of capacity in relation to use.

ECOM Tablet Computer limited warranty

The warranty of ECOM Tablet Computer (part no. 12-1086 / 12-1196 / 12-1327) is one (1) year.

Measurement data

It is the responsibility of the customer to make a backup of all saved data before the product is sent for repair. Resetting of saved measurement data is not covered by the warranty. Easy-Laser AB takes no responsibility for saved data that is damaged or lost during transportation or repair.

Safety precautions

Easy-Laser® is a laser instrument in laser class 2 with an output power normally less than 1 mW, which requires the following safety precautions:

- Never stare directly into the laser beam
- Never aim the laser beam at anyone else's eyes.

Note!

Opening the laser units can result in hazardous radiation, and will invalidate the manufacturer warranty.

If starting the machine to be measured would result in injuries, the possibility to unintentionally start it must be disabled before mounting the equipment, for example by locking the switch in the off position or removing the fuses. These safety precautions should remain in place until the measurement equipment has been removed from the machine.

Note!

The system should not be used in explosive risk areas.

Service and calibration

Easy-Laser products should only be repaired or calibrated by a certified service centre. Our main Service centre is located in Sweden. There are several local Service centres that are certified to carry out limited service and repair. Contact your local Service centre first before sending your equipment for service or repair. All Service centres are listed on our web site under Service and Calibration.

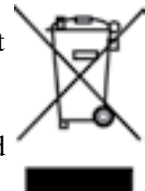
Before sending your measuring system to our main Service centre, please fill in the online Service and Repair report.

Disposal of old electrical and electronic equipment

(Applicable throughout the European Union and other European countries with separate collection programs)

This symbol, found on product or on its packing, indicates that this product should not be treated as household waste when disposed of.

It should be handed over to an applicable collection point for the recycling of electrical and electronic equipment. By ensuring this product is disposed correctly, you will help to prevent potential negative consequences to the environment and human health. For more detailed information about the recycling of this product, please contact your local city office, household waste disposal service or the retail store where you purchased this product.



Manuals as PDF

You can download our manuals in pdf format from our website. The pdf's are also available on the USB memory stick that is delivered with most systems.

EasyLink

The new version of our database program EasyLink is available on the USB memory stick that is delivered with most systems. You can always download the latest version from easylaser.com>download>software.

IP code and classification

How do I read the protection ratings?

The IP protection rating system is a standard defined in international standard IEC 60529. This rating system classifies the degree of protection provided by an electrical equipment enclosure against solid objects (such as dust) and liquids (water, oil, etc.). The degree of protection provided by an enclosure is indicated with a two-digit (IPXX) system as described below:

The first number corresponds to the degree of protection provided against solid objects. The second number corresponds to the degree of protection provided against liquids. The rating IP66 thus corresponds to a product that is completely dust-tight and protected against powerful water jetting.

Note: if the criterion has not been tested for, the number will be replaced by the letter "X" (for example, the rating IPX6 indicates that the enclosure was not tested for protection against the ingress of solid objects).

Up to and including second characteristic numeral 6, the designation implies compliance also with the requirements for all lower characteristic numerals. Equipment with an IP65 certification is thus authorized for applications requiring an IP55 or IP64 certification.

IEC 60529 standard (article 6) considers that an enclosure designated with second characteristic numeral 7 or 8 is unsuitable for exposure to water jets (designated by second characteristic numeral 5 or 6) unless it is dual coded (ex: IPX5/IPX7 or IPX6/IPX7). Hence, IP classification IP66/67 found on some Easy-Laser units means that they are dust-tight (first characteristic numeral) and protected against powerful jetting and protected against temporary immersion up to 1 m for 30 min (second characteristic numerals 6 and 7). Ingress of water in harmful quantity shall not be possible.

The first number indicates the degree of protection against solid objects	The second number indicates the degree of protection against liquids
X: Not measured	X: Not measured
0: Non-protected	0: Non-protected
1 = protected against ingress of solid foreign objects ≥ 50 mm in diameter	1 = Protected against vertical dripping
2 = protected against ingress of solid foreign objects ≥ 12.5 mm in diameter	2 = Protected against dripping (15% tilt)
3 = protected against ingress of solid foreign objects ≥ 2.5 mm in diameter	3 = Protected against spraying (60% tilt)
4 = protected against ingress of solid foreign objects ≥ 1 mm in diameter	4 = Protected against splashing
5 = protected against dust (limited entry, no harmful deposits)	5 = Protected against jetting
6 = dust-tight	6 = Protected against powerful jetting
	7 = Protected against temporary immersion (up to 1 meter for 30 minutes) - ingress of water in harmful quantity shall not be possible.
	8 = Protected against continuous immersion (depth of more than 1 meter for period of time specified by the manufacturer). The equipment is suitable for continuous immersion in water. However, this can mean that water can enter but only in such a manner that it produces no harmful effects.

Travelling with your measurement system

When travelling by airplane with your measurement system we strongly recommend that you check which rules apply for each airline company. Some companies/countries have limitations for checked baggage when it comes to items including batteries. For information about Easy-Laser® batteries, please see system unit details in the end of this manual. If not using a laser for a long period of time, remove the battery.

Specifications for built-in rechargeable batteries

Easy-Laser Part No.	Type	Nominal Voltage	Nominal Capacity	Energy	Included in Part No.
12-1100	Li-Ion	3.65 V	11400 mAh	41.61 Wh	12-0418, 12-0700, 12-0748, 12-1062, 12-1077
03-0765	Li-Ion	3.7 V	660 mAh	2.5 Wh	12-0433, 12-0434, 12-0509, 12-0688, 12-0702, 12-0738, 12-0752, 12-0758, 12-0759, 12-0789, 12-0790, 12-0799, 12-0824, 12-1067, 12-1068, 12-1069, 12-0846
03-0971	Li-Ion	3.6 V	2600 mAh	9.36 Wh	12-0617, 12-0618, 12-0823, 12-0845
03-1052	Li-Ion	3.7 V	330 mAh	1.22 Wh	12-0746, 12-0747, 12-0776, 12-0777, 12-0791, 12-1054
12-0953	Li-Ion	3.7 V	2000 mAh	7.4 Wh	12-0943, 12-0944, 12-1028, 12-1029, 12-1045, 12-1046, 12-1241
12-1307	Li-Ion	3.7 V	1960 mAh	7.25 Wh	12-1026, 12-1027
N/A	Li-Ion	3.8 V	4450 mAh	16.91 Wh	12-1086, 12-1196
12-1099	Li-Ion	7.3 V	5700 mAh	41.64 Wh	12-0961 (2 pcs)
12-1328	Li-Ion	3.6 V	18900 mAh	68.04 Wh	12-1291, 12-1292
N/A	Li-Ion	3.85 V	4900 mAh	18.87 Wh	12-1327

Compatibility

The E-series is not compatible with previous analogue units from the D-series. You can however continue to use previous brackets.

The unit for wireless communication, Part No. 12-0436, is replaced by a new product in November 2022 with new Part No. 12-1336. The new product has been updated with new electronics which affects backwards compatibility. The new unit has also got a new UKCA (UK Conformity Assessed) marking on the label. The unit for wireless communication is used with detectors and measuring units in the E-series, namely 12-0509 (E5)/12-0702 (E4)/12-0752 (E7)/12-0434 (EM)/12-0433 (ES)/12-0790 (EMH)/ 12-0789 (ESH), 12-0824 (E7H).

NOTE! The new wireless unit 12-1336 which has the UKCA mark on the label only works with above mentioned detectors and measuring units which also have the UKCA mark, except for the 12-0509 (E5) detector with which the new wireless unit 12-1336 is compatible. If replacing an old wireless unit to use with other products than E5 detector, you must make sure to order a 12-0436 unit (available as spare part). If, for some reason, you need to use the new wireless unit 12-1336 with an existing detector or measurement unit delivered before November 2022 (except for E5), you may also need to upgrade the measuring unit/detector. In such an event, please contact your local distributor for advice before ordering a new wireless unit.

Disclaimer

Easy-Laser AB and our authorized dealers will take no responsibility for damage to machines and plant as a result of the use of Easy-Laser® measurement and alignment systems. If the system is not used as explained in this manual, the protection provided by the equipment may be impaired.

Copyright

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We might change and correct the manual in later issues without further information. Changes to the Easy-Laser® equipment may also affect the accuracy of the information.

October 2022



Elisabeth Gårdbäck

Quality Manager, Easy-Laser AB

Easy-Laser AB, PO Box 149, SE-431 22 Mölndal, Sweden

Phone: +46 31 708 63 00, E-mail: info@easylaser.com

Web: www.easylaser.com Org. No: 556474-3705

E960 TURBINE

System Easy-Laser® E960-A

Part no. 12-0710

This system is suitable for gas turbines and smaller steam turbines. Measures diameters 150–1700 mm [5.9"–67"]. The detector bracket comes with a slidable tube, making it possible to measure several positions in a row without moving the bracket.



System Easy-Laser® E960-B

Part no. 12-0711

System suitable for larger turbines. Measures diameters 200–1700 mm [7.8"–67"] as standard, and up to 4500 mm [177"] with accessory brackets. The detector bracket has a probe stroke of 60 mm [2.4"], which is convenient when nearby bore diameters vary a lot.



Note!

For a complete technical data, please see Manual.

Prepare the work

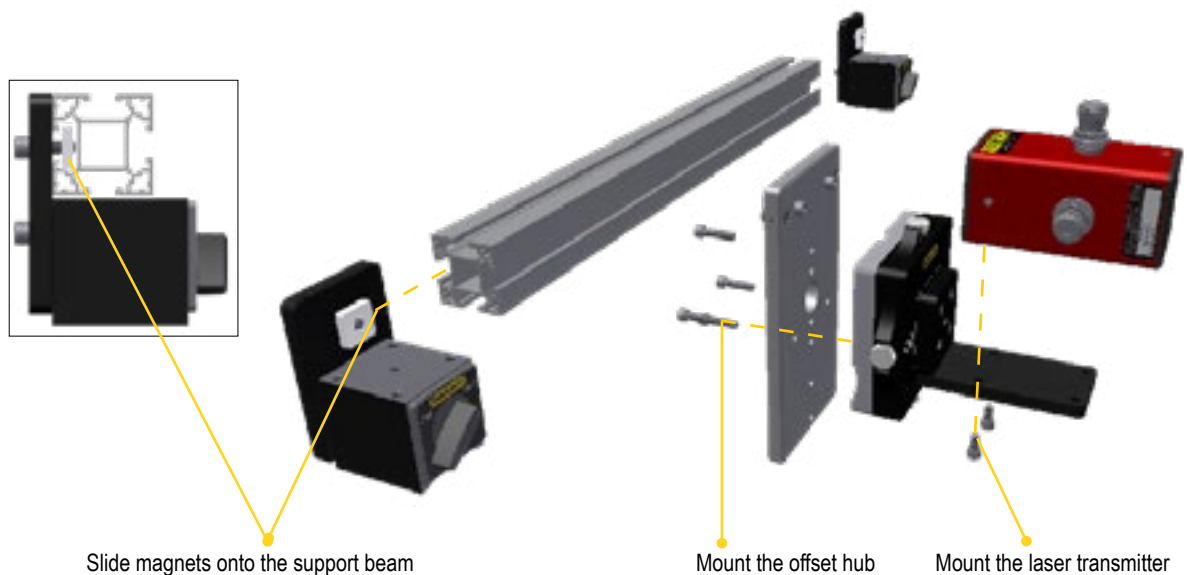
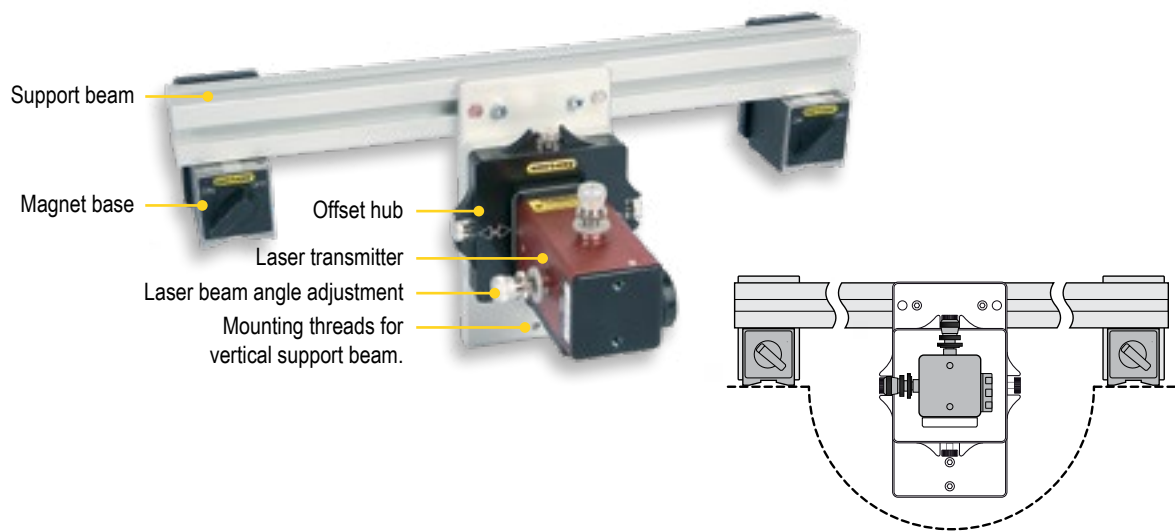
- Get hard copies of drawings with distances and diameters.
- Determine tolerances according to drawings, specification or standards.
- Assemble all brackets (as far as possible) in advance according to drawings.
- Check battery status of laser and display. Extra AA batteries for laser and display (Note! Alkaline type only)
- Chalk for marking



Assemble Laser transmitter

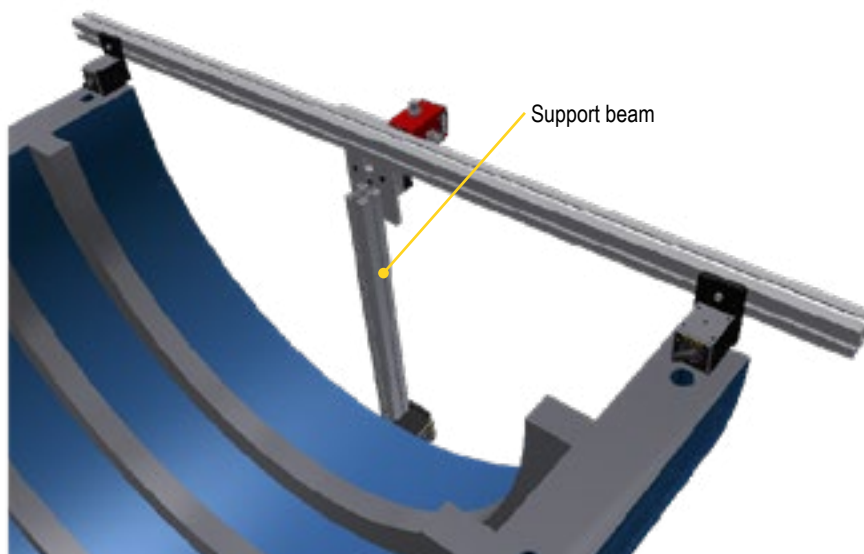
Using support beam

1. Select a horizontal support beam, long enough to rest on both sides with good margin.
2. Use as short bracket as possible to maintain stability.
3. Mount the laser transmitter approximately at the middle of the support beam using the square nuts.
4. Slide the magnets onto the support beam.



Using vertical support beam

Use the third vertical beam to increase stability if the horizontal beam is extended with one or more sections.

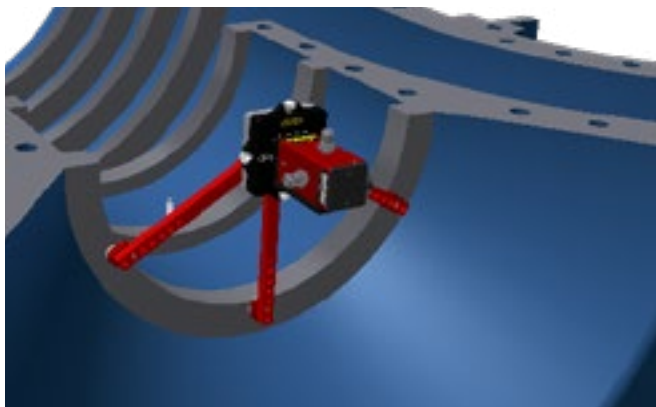
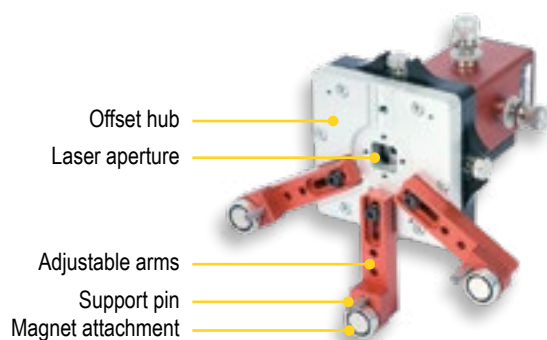


Using arms

If needed, you can use extension arms to mount the laser transmitter. The arms are 100–500 mm.

Note!

The arms are not included in the E960 system, but delivered as an option.



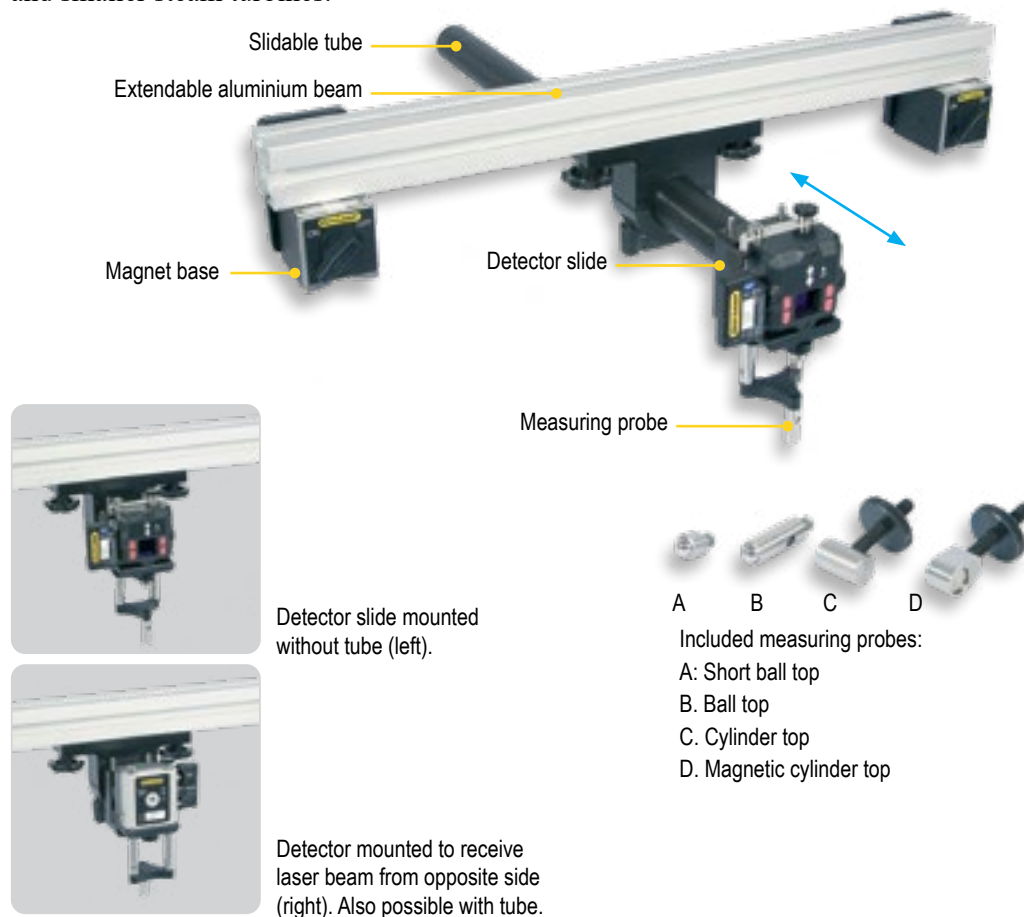
Assemble Detector

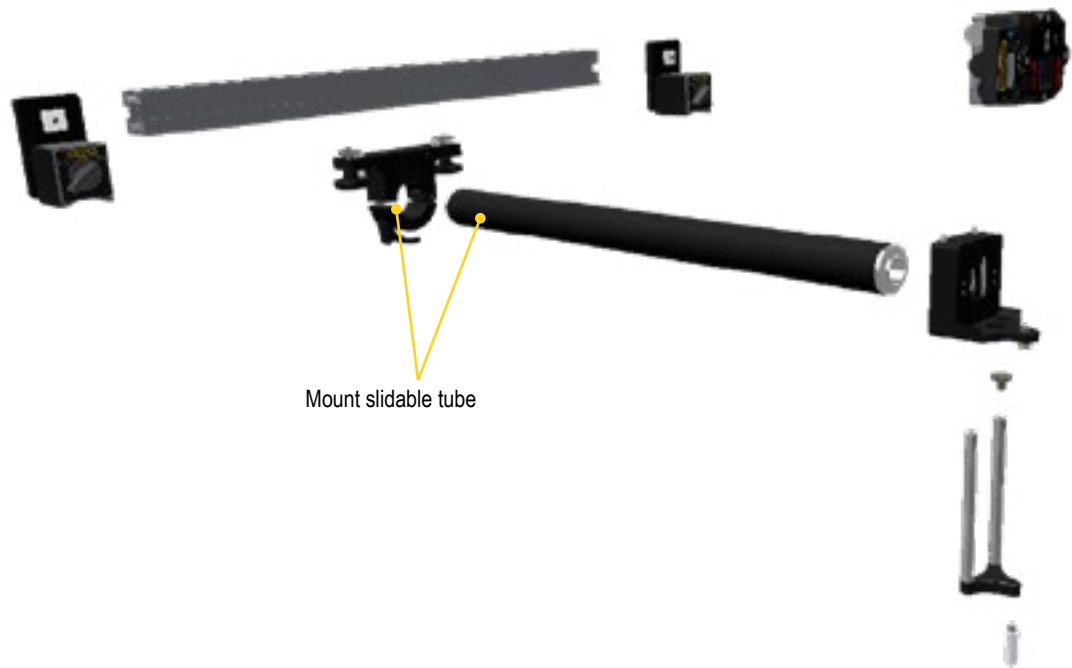
1. Select a horizontal support beam and extensions, long enough to rest on both sides with good margin.
2. Mount the detector with bracket in the middle of the support beam (± 25 mm).
3. Attach probe with extension rods (approximately measuring radius – 120mm).
4. Slide the magnets in place. When using long support beams (>2.5m) it may be necessary to readjust the magnet fixation screws in order to maintain the laser beam vertically in center.
5. Place the detector in the middle of the rods of the movable slide.

Using short stroke bracket

Part no. 12-0438

Measuring probe with a stroke of 10 mm. The slidable tube makes it possible to measure several positions in a row without moving the bracket. Suitable for gas turbines and smaller steam turbines.

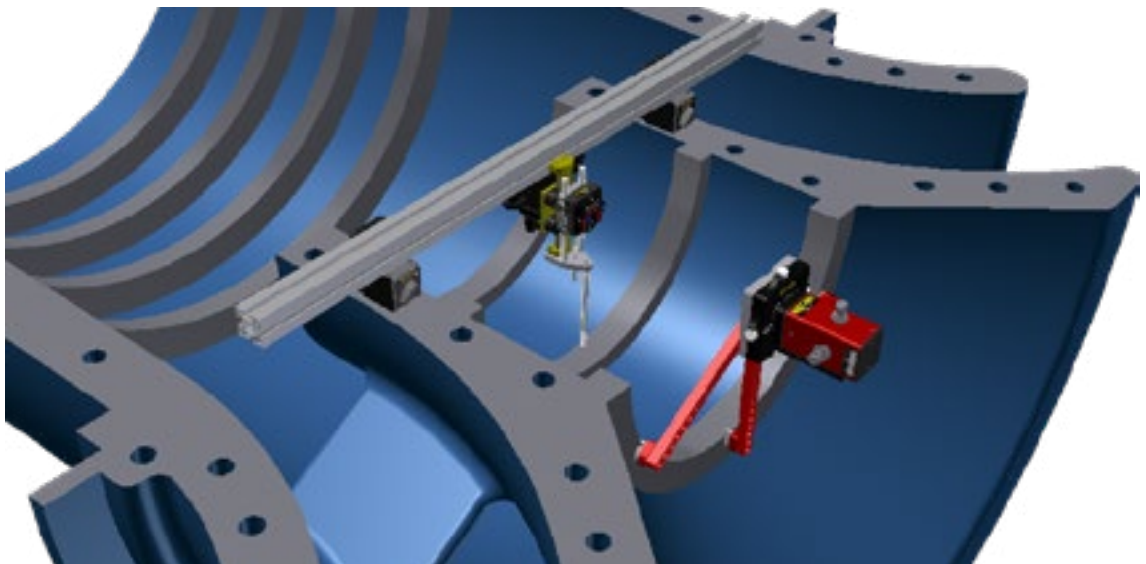
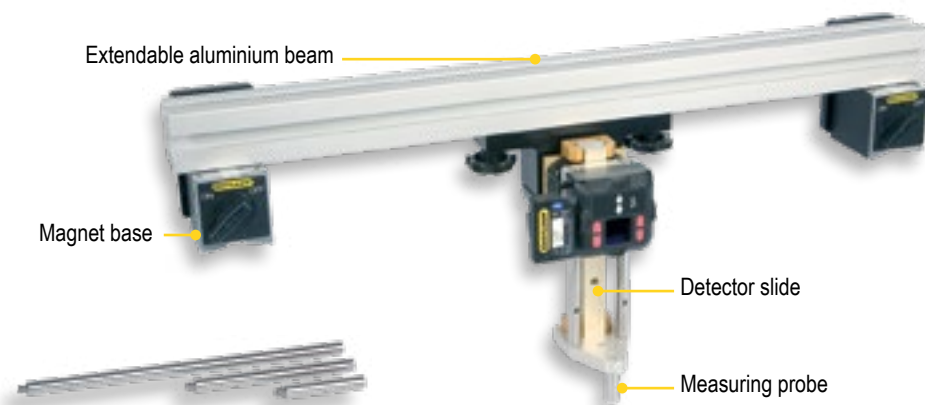




Using long stroke bracket

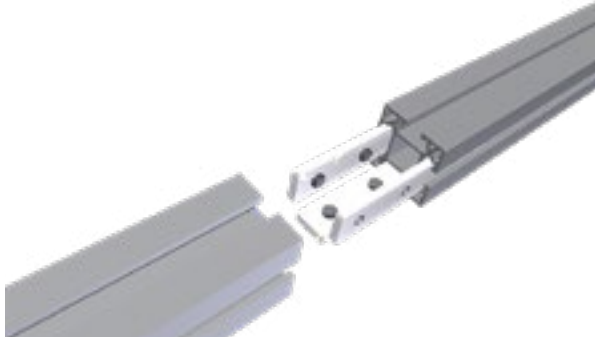
Part no. 12-0715

Measuring probe with a stroke of 60 mm. Suitable for larger turbines.



Beam extensions

It is possible to extend the support beams. Mount three extension plates on one of the aluminum beams. Slide the second beam onto the extension plates. See image below.



Using sliding bracket

It is not possible to slide in a turbine segment. Sliding brackets can only be used in support bearings.

When measuring in tops-on condition, the self-center bracket is replaced with light weight slide bracket. The slide bracket is useful in diameters up to 3m.



Slide bracket min. Ø120 mm [4.72"]

Part No: 12-0455

For bores Ø120–250 mm [4.72"–9.84"], width Min. 60 mm [2.36"].



Slide bracket min. Ø200 [7.87"]

Part No: 12-0543

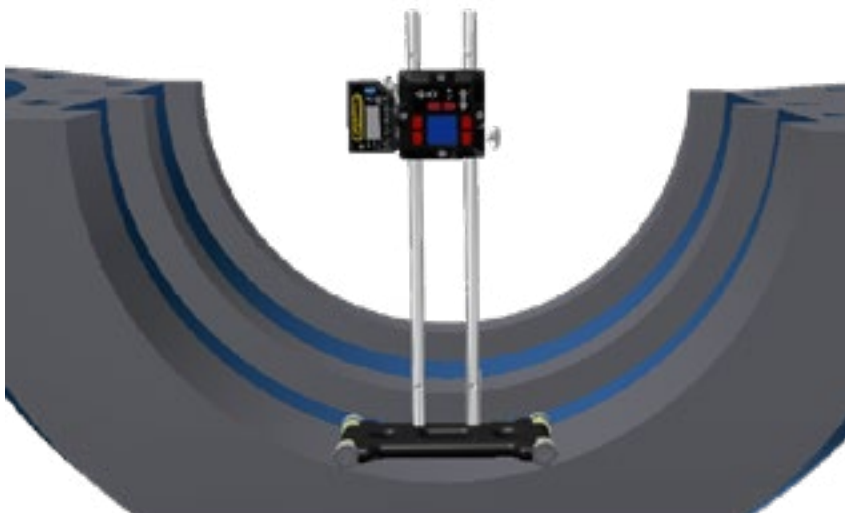
For bores Ø200–350 mm [7.87"–13.78"], width Min. 80 mm [3.15"].



Slide bracket min. Ø300 mm [11.81"]

Part No: 12-0510

For bores Ø300–500 mm [11.81"–19.68"], width Min. 100 mm [3.94"].



Preparations

Check the environment

- Check that the turbine has a uniform temperature. Mainly important if the turbine partly has been exposed to direct sunshine.
- Check that the laser, detector and brackets are covered from direct sunlight from roof windows or other sources. Direct light (sun, strong lights or welding) into the sensor may result in fluctuating measurements and has to be prevented.
- Check that the ambient temperature is within the operating range of the EasyLaser: 0 to 50 degrees.
- Check that airflow or wind does not enter the measurement area, especially not close to the laser source. To further reduce influence, use appropriate filter settings.
- Check for vibrations, low and mid frequencies, that may interfere with the measurement. If found, identify the source and take actions to reduce the vibrations. In case vibrations re-mains, use measurement filter (see the user manual).
- Check that rain can not enter into the measurement area
- Refrain from using mobile phone or communication radio while taking a reading.
- Clean all measurement points for oil, grease and other substances using grease cleaner
- Remove any burr, welding spatter etc. Ensure that no original material is removed during cleaning.

It is highly recommended that final measurement is done during the night time when there is less interfering work ongoing and the temperature has become stable (around midnight).

Mount the laser transmitter

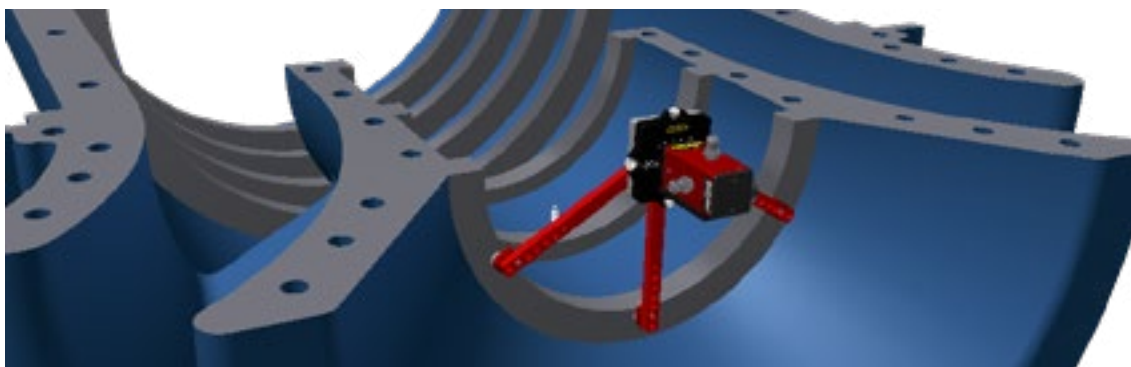
The laser should be placed on a stable and rigid place, free from air flow, vibrations and sunshine. A welded structure fixed to the ground or the turning gear bearing may be suitable locations.

Check the following:

- Magnets are seated a machined surface, without tension.
- All magnets have full contact with the surface. If not, release and tighten screws.
- All screws on the bracket are properly tightened (but do not overtighten).
- Make sure that the laser transmitter battery is replaced to avoid interrupting the measurement.

Note!

The fine adjustment screw on the tilting table must not exceed its maximum position. That might damage the threads of the screw. See also Techdata in Manual.



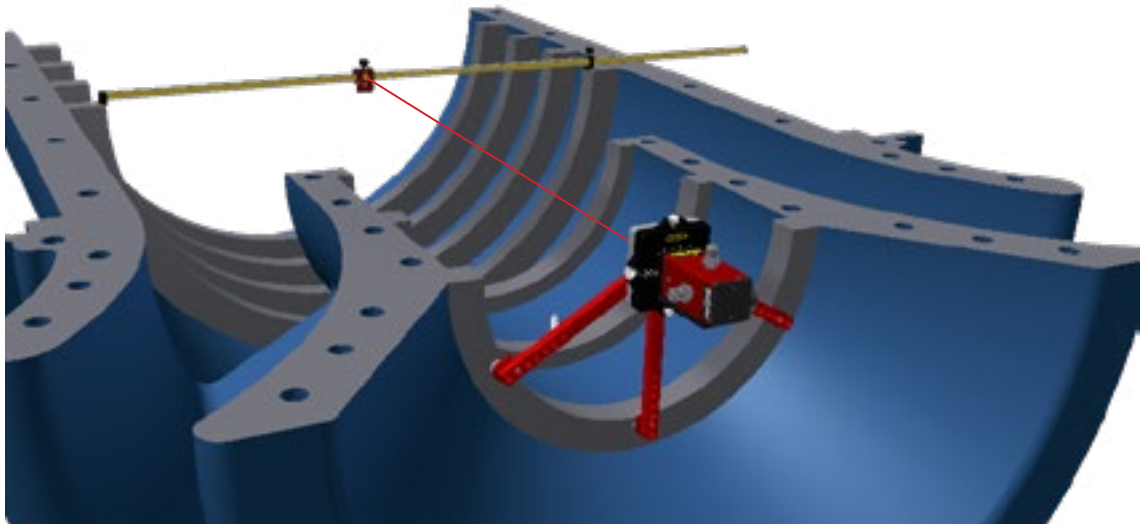
Rough align laser beam

The visual targets are used for laser beam prealignment and should be placed at the first and last bearing seating.



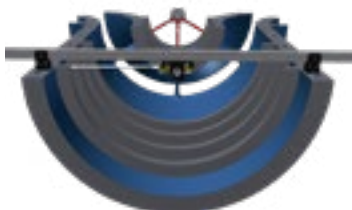
Part no. 12-0443

1. Place the ruler at the bearing pocket and move the adjustable side to fit the diameter.
2. Read the diameter and divide by two.
3. Switch on the laser.
4. Adjust the laser beam to the far target center. Use the angular adjustment screws on the laser transmitter.
5. Adjust the laser beam to the target close to the laser. Adjust beam using the offset adjustments.
6. Repeat until beam passes both target centers as accurate as possible. The laser bracket may have to be moved if the parallel offset adjustment screws reach the limit.
7. Remove targets.



Align the laser beam

If extra high accuracy is required, for example during a final inspection, the beam may be precisely aligned to the reference surfaces. Note, this is not necessary during normal corrective adjustment work.



1. Place the detector at the reference point furthest away from the laser transmitter.
2. Turn the detector to position 9 o'clock position and select **0**.

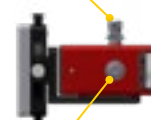


3. Turn detector to 3 o'clock and select **1/2**.
4. Adjust horizontal error to zero with the angular adjustment screw.



5. Turn detector to 6 o'clock and adjust vertical error to zero.

Angular adjustment screw



Vertical adjustment screw

6. Move the detector close to the laser transmitter and repeat step 2-5 to adjust the offset.

Offset adjustment screws



Repeat until both reference points are zero.

Reference target

The purpose of a reference target is to monitor that the laser beam remain in its original position during the measurement within the specified tolerance. Reasons for deviation may be temperature changes, sun light or someone touching the laser.

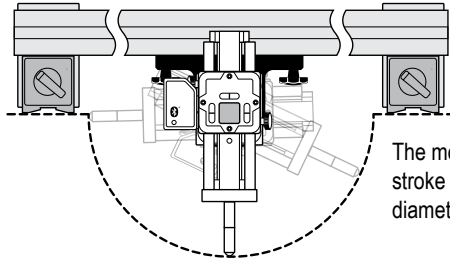
1. Place the reference target at the far end of the turbine.
2. Select **2** and **2** to display the reference target.
3. The first time you select the command, a window is displayed. Select which detector you want to use as reference detector and press **OK**.

Function buttons

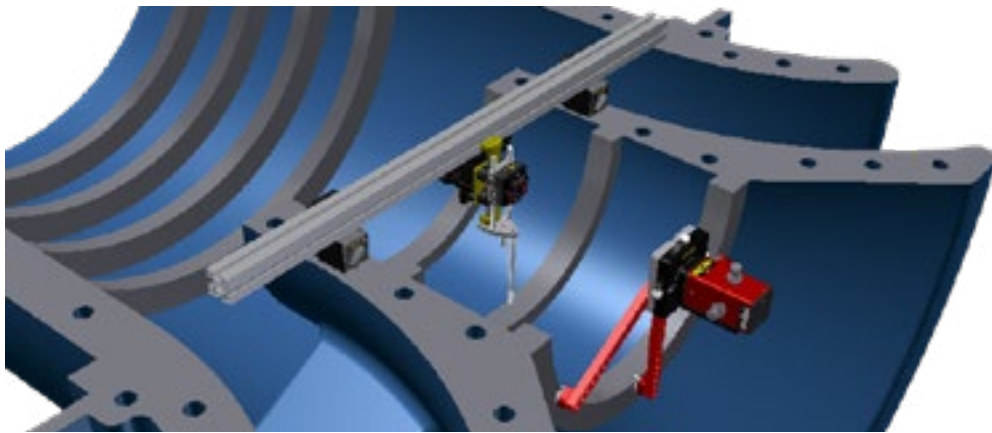
	Zero set displayed value.
	Return to the absolute value.
	Close target. You can also close by pressing OK .

Adjust the measuring probe

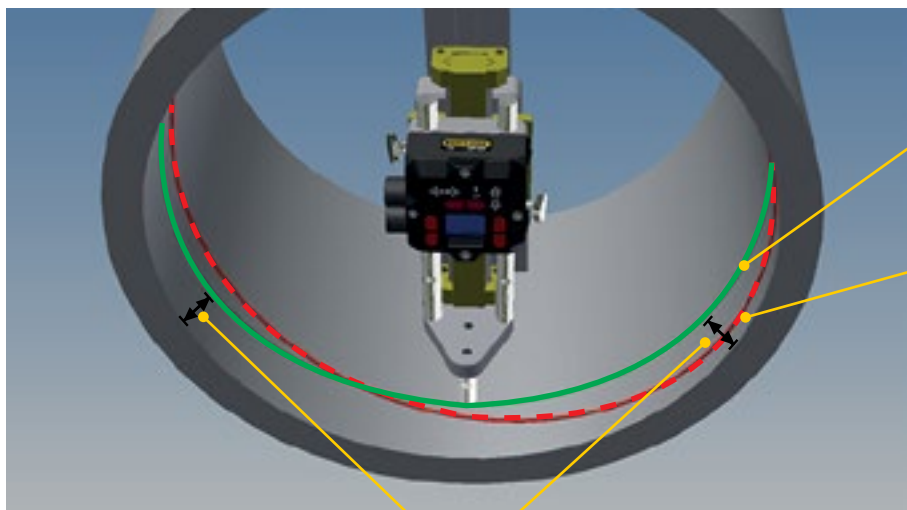
1. Place the detector in the measurement position.
2. Adjust the probe length to the radius.
3. Turn the probe to position 6.
4. Adjust the detector vertically and horizontally to the centre of the laser beam.
5. Adjust the detector fixture so that the probe runs parallel to the surface to be measured.



The measuring principle is the same for both long and short stroke bracket. The probe rod is very easily adapted to each diameter with extensions of different length.



Before measuring, please check that you have mounted the bracket and probe correctly. If the bracket has been mounted skewed, the values will be incorrect. Image below show a linebore measurement, but the same principle apply to turbines.



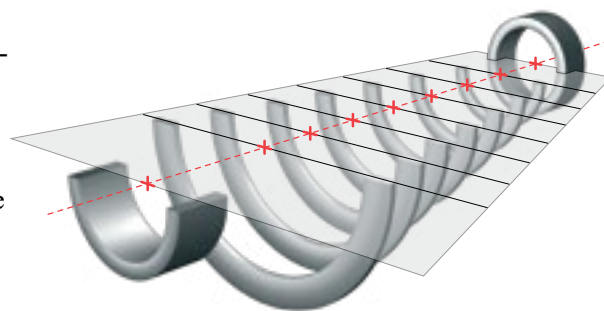
Green line = correct

Red dotted line = incorrect

Make sure it is the same distance

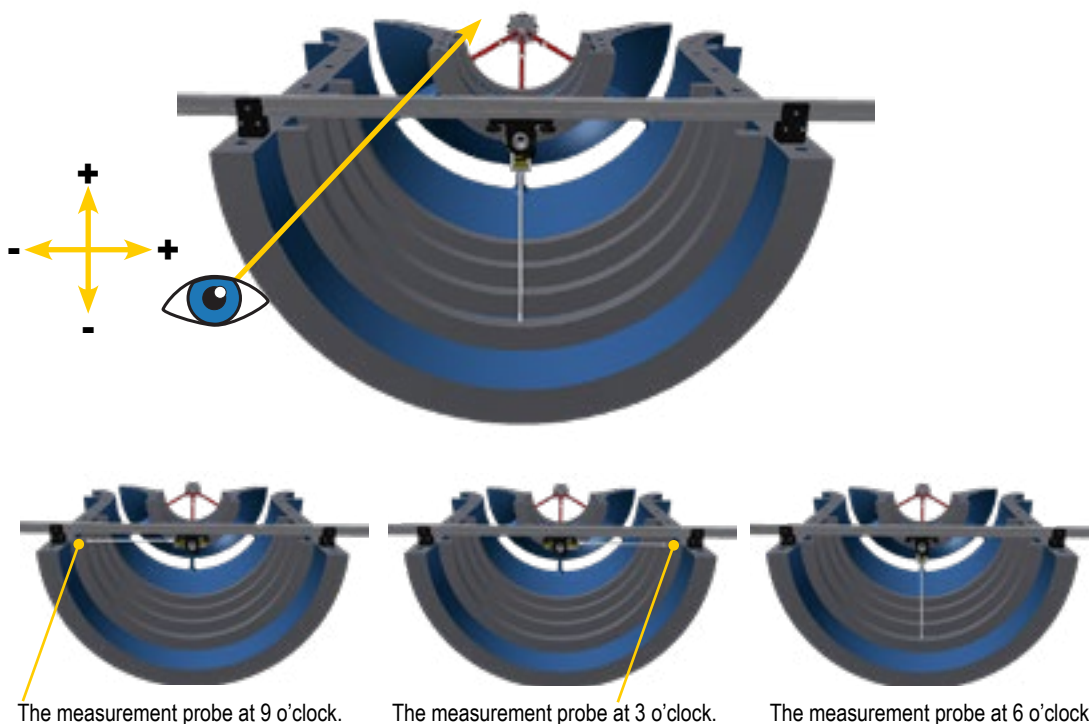
Measure

You can use the program Half circle or Multi-points. Here the program Half circle is used. Please note that the order of measurement or distances is not dependent on laser position. First measurement point may therefore be the most distant from the laser.



Note!

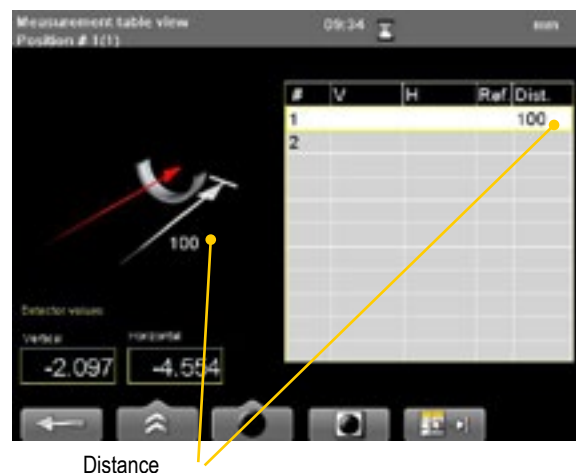
Face the laser transmitter from the detector. Then 9 o'clock is to the left, as in the measuring programs.



Enter distance

Press  and enter the distance to the first measurement object.

Or Select  to enter several distances.
For more information, see Manual.



Distance

Register values

Press  to register a value. The Measurement position view is displayed. Register values on three positions. You can register values with or without using inclinometer values.

With inclinometer values

The inclinometer values are displayed. It is possible to register points anywhere.

1. Press  to register first position. A red marking is displayed.
2. Turn outside of the red marking.
3. Press  to register second position.
4. Turn outside of the red markings.
5. Press  to register third position.
6. Select  to measure next position.



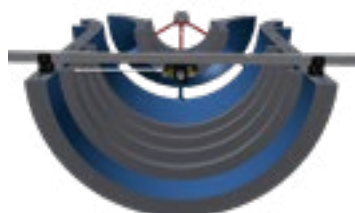
Inclinometer values on

Without inclinometer values

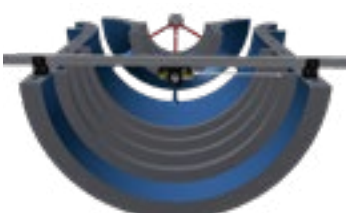
With the inclinometer values hidden, you are prompted to register points at three positions. Press  to register values.



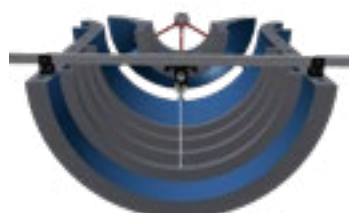
Inclinometer values off



The measurement probe at 9 o'clock.



The measurement probe at 3 o'clock.



The measurement probe at 6 o'clock.

Result

The result can be displayed as graph, table or a 3D view. By default the table view is displayed. The function buttons are almost the same for all three views. Zoom is only available in Graph view.

For more information regarding result views and different calculation settings, see Manual

Result table view

Navigate using the navigation buttons. To remeasure, select a point in the list and select .

Result table view
Point 184

Position #184/Cmpst: V: 2.0, H: 2.6
Reference points: 100, 184. Zoomed in

	V	H	Dist.
179	0.6	-1.2	1780
180	0.0	0.0	1790
181	-0.7	-0.9	1800
182	-1.3	-0.1	1810
183	-2.1	-1.1	1820
184	-2.0	-2.0	1830
185	-2.9	-10.2	1840
186	-3.7	-11.1	1850
187	-5.7	-12.8	1860
188	-6.4	-13.8	1870
189	-7.2	-14.7	1880
190	-7.9	-15.7	1890

	V	H
Max	134.4	165.2
Min	-243.4	-313.4
Peak-peak	377.8	478.7
Standard deviation	109.1	138.1
Straightness RMS	122.0	156.7
Max waviness(15)	11.4	5.1

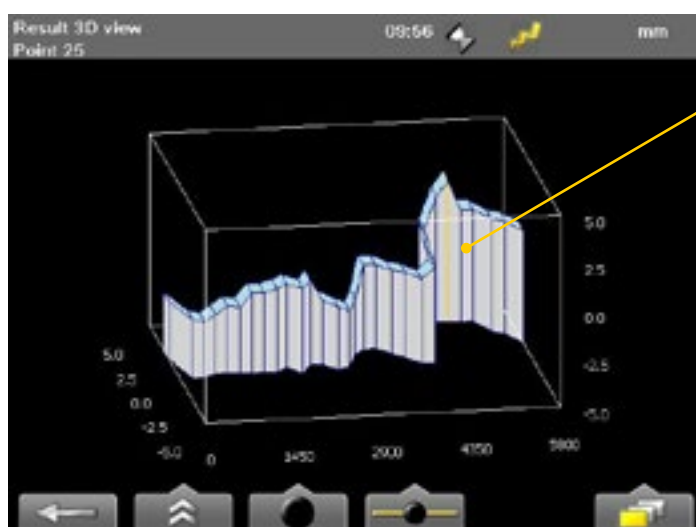
Reference point

Reference point with offset

Result 3D view

Navigate using the numeric buttons.

- Buttons 2, 4, 6 and 8 rotates the 3D view.
- Button 5 returns to the initial view.



Selected point



Navigate using the numeric buttons

Result graph view

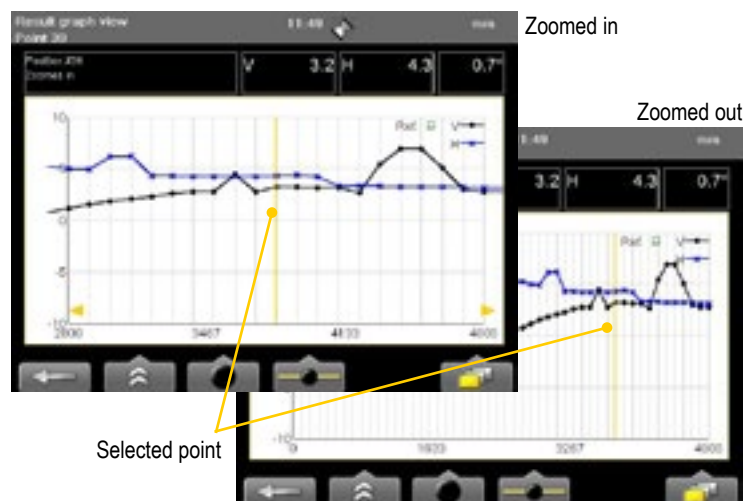
Navigate using the navigation buttons.



Zoom

It is possible to zoom in the graph view if you have registered more than 20 points.

Select a measurement point and select  and . The graph is zoomed in around the selected point.



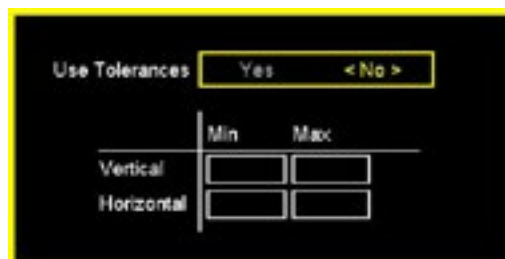
Scale using navigation buttons

Press navigation button "Up" and "Down" to scale the result graph view.



Tolerance

1. Select . A the tolerance window is displayed.
2. Set use tolerance to <YES>. Navigate using the navigation buttons. Press **OK**.
3. Set vertical and horizontal tolerance. Press **OK** to confirm each tolerance. The tolerance is shown in the result view.



Enter tolerance

Tolerance in graph and table view

- In the Table view, the values within tolerance are shown in black, values not within tolerance are red.
- In the Graph view, vertical and horizontal tolerances are colour coded.

