Easy-Laser®

Measurement and Alignment Systems

SHAFT ALIGNMENT
QUICK START GUIDE
Program Horizontal, EasyTurn™, Softfoot

CAUTION
LASER RADIATION
DO NOT STARE INTO BEAM
DIODE LASER
1 mW MAX OUTPUT AT 670 nm
CLASS II LASER PRODUCT

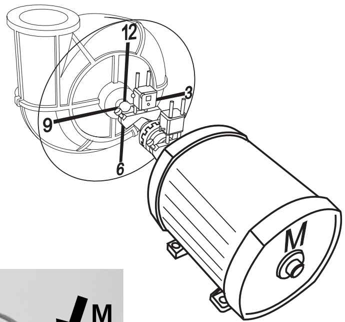
IMPORTANT! ALWAYS READ THE SAFETY INSTRUCTIONS IN THE MAIN MANUAL (PART.NR.05-0100) BEFORE USING THE MEASUREMENT SYSTEM.

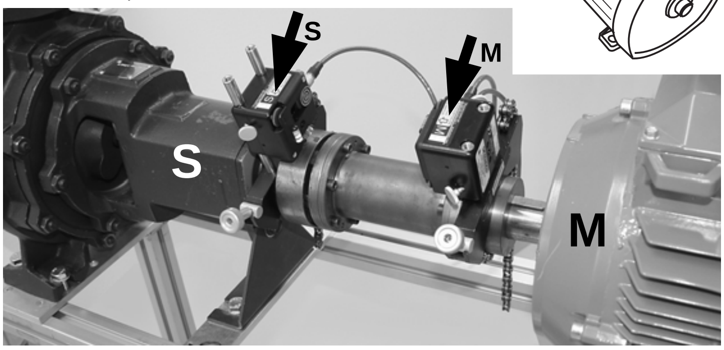
1. MOUNTING THE MEASURING UNITS

Important!
S-unit on stationary machine.
M-unit on movable machine.

Face the stationary machine (S) from the movable machine (M).

Then 9 o'clock is to the left as shown on the picture.



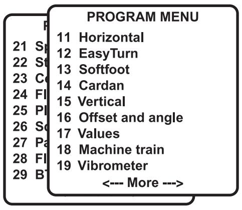


The units are mounted with standard shaft brackets. Labels facing away from coupling.

2. START THE MEASUREMENT SYSTEM

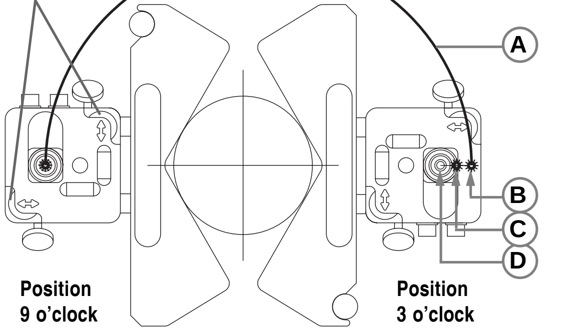
Press [ON / OFF] to start the measurement system.

The Program list is displayed. Go to page two with [→].
Choose appropriate program for your application.
Recommended is to start program 13, Softfoot.
(A program must be started to light up the laser beam.)
Then make a rough alignment if needed (step 3),
or go to step 4, Entering the distances, before continuing with step 5.

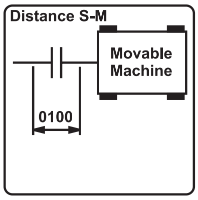


3. ROUGH ALIGNMENT

1. Turn shafts with measuring units to the 9 o'clock position. Aim the laserbeams at the centre of the closed targets.
2. Turn shafts with measuring units to the 3 o'clock position. (A=The arc described by the laserbeam from the M-unit during turning. B=The laser hits outside the detector area.)
3. Check where the laser hits, then adjust the beam half the distance towards the centre of the target (C).
4. Adjust the movable machine so that the laserbeam hits the centres of both the targets (D).
5. Open the targets before the measurement. Done.



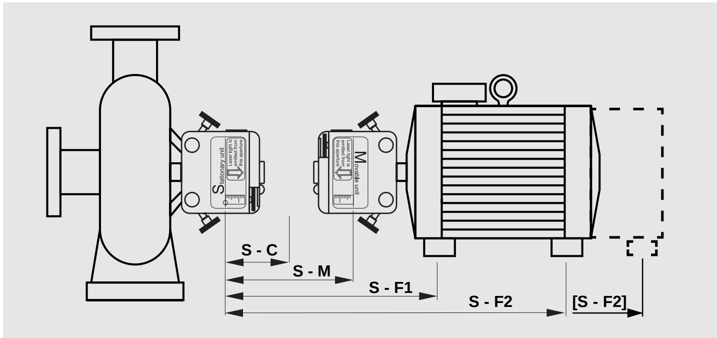
4. ENTERING THE DISTANCES



Type the distances in by using the numerical keys.

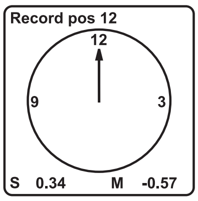
Confirm each distance with [👍]

[Redo with [↶]]



5. SOFT FOOT CHECK

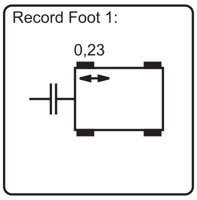
The result from this measurement program displays the difference between tightened and loosened bolt. You can go from softfoot check directly to the Horizontal or EasyTurn™ shaft alignment program and keep the entered machine distances.



1. Turn to position 12.
Adjust the beams.
Open the targets.

Confirm [👍]

[Back [↶]]



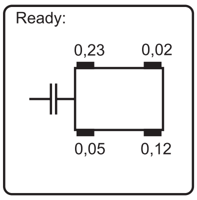
2. Release and tighten first bolt.

Confirm [👍]

Redo step 2 for each of the other feet (foot 2-4).

[If desired, zero set with [0]]

[Back [↶]]



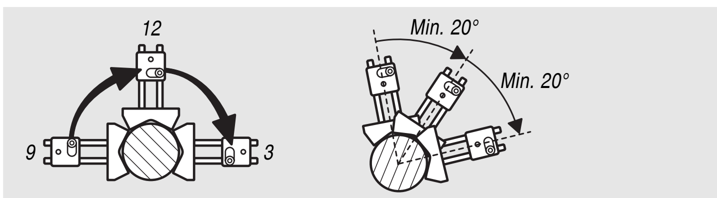
3. The result for all feet are displayed.
Shim the foot/feet with the highest value.

[Remeasure [9]]

[To go directly to alignment, and keep the entered distances, press [👍]]

6. MEASUREMENT PROCEDURE

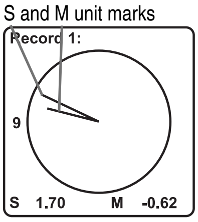
With Program Horizontal (11) the measuring units with shafts are positioned 9, 12 and 3 o'clock. This means that you turn the shafts a total of 180°.
With Program EasyTurn™ (12) you can start with the measuring units anywhere on the revolution. The smallest angle possible between the measurement positions is 20°.
NOTE! Check in each position (9, 12, 3) that the laser beam hits the detector area.



Program Horizontal (11) *Program EasyTurn™ (12)*

Continue! ➥

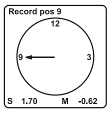
6. MEASUREMENT PROCEDURE (continued)



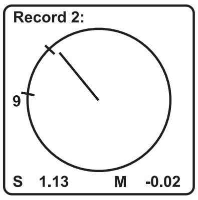
1. First reading (EasyTurn™: arbitrary position. Alt. Horizontal: 9 o'clock). *Place the measuring units so that the marks are on top of each other (or almost on top). Adjust the laserbeams to the closed targets. Open the targets.*

Confirm value

[Back]



9 o'clock

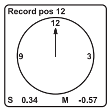


2. Second reading. *Turn the shafts at least 20° in any direction (displayed as small marks on the circle). Alt. Horizontal: 12 o'clock.*

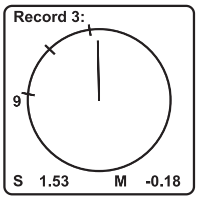
Confirm

[Show/hide M-angle mark with 6]

[Redo first value]

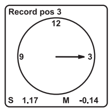


12 o'clock



3. Third reading. *Similar to second reading. Turn shafts beyond the 20° mark. Alt. Horizontal: 3 o'clock.*

Confirm

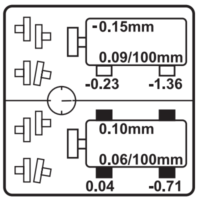


3 o'clock

7. MEASUREMENT RESULT

Recommended procedure: first position the measuring units with shafts 12 o'clock and shim according to the feet values (live). Then position the units 3 o'clock (or 9) and adjust sideways (live values).

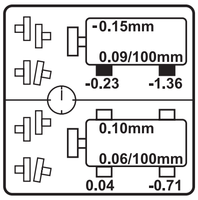
*Horizontal values updates continuously.



4. The result is displayed. *Horizontal and vertical positions for the movable machine are shown both digitally and graphically.*

[By pressing when the measurement values are displayed, a new S-F2 distance can be entered for a third pair of feet. New F2-values (adjustment and shimming) will be calculated for this pair of feet and displayed.]

*Vertical values updates continuously.

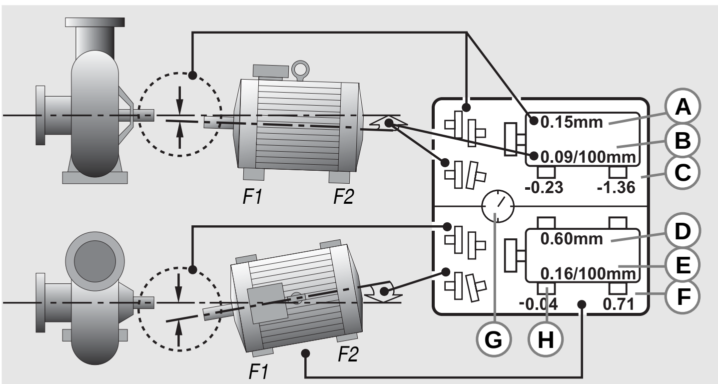


[Press 9 to do a new measurement from the **9 o'clock position**]

[Press 4 to select tolerance to check against the measured result.]

[Press 6 to set values for thermal growth compensation.]

[Press 5 for Live values in Horizontal program (see **G** below).]



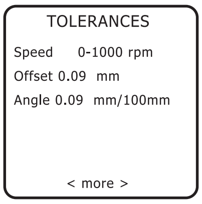
Vertical:
A. *Offset value*
B. *Angular value*
C. *Adjustment values (Shim values)*

Horizontal:
D. *Offset value*
E. *Angular value*
F. *Adjustment values*

G*. Indicator for measurement direction, that in the* ***EasyTurn™ program*** *shows the real position of the units.*
Note! *In the* ***Horizontal program*** *the indicator shows how the units* ***have to be*** *positioned for live values. This is because the Horizontal program doesn't use the electronic inclinometers to detect the position of the units.*
H*. *The foot symbols are filled for that direction (horizontal or vertical) in which the measurement values are updated live.*
Note! Be sure that the units are positioned in the right direction (3 or 12 o'clock).

(8. TOLERANCE CHECK)

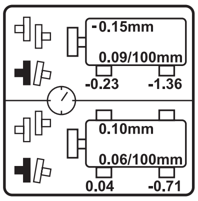
The measurement result can be checked towards tolerance value table. *This is based on the speed of the machine. When the alignment is within tolerance, the left part of the coupling symbol is filled. This also works live.*



1. Select Speed range.
No tolerance values are displayed from the start (the function is disabled every time the measurement system is started).

Press or to select speed range. The tolerances are displayed at the same time.

Confirm Speed range



2. The result is displayed with filled coupling for values which are within tolerance.

(In the example above the angular values are within tolerance, but the offset is too large.)

(9. SAVE)

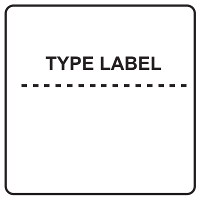
1*. The measurement result is displayed (see above).*

2*. Press the Menu button*

3*. Press 0 (Store)*

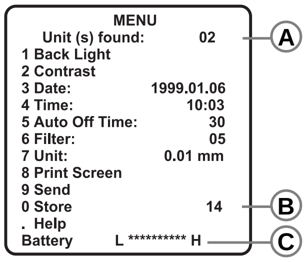
4*. Type your description (Max. 20 characters).*

5*. Finish and save*



MAIN MENU

Press corresponding numeric key to change or execute settings. Only available choices are shown.
A*. Shows the number of measuring units/ detectors connected.*
B*. Number of measurements stored.*
C*. Battery condition is shown as a series of *, Max. at H and Min. at L.*



1 *Toggle the Backlight of the display between On and Off.*
2 *Each touch changes the Contrast of the display to one of ten steps.*
3 *Set the current Date in the system clock.*
4 *Set the current Time in the system clock.*
5 *Set the time until Auto-Off between 10 and 99 minutes. 00 disables Auto-Off.*
6 *Set Measurement Filter Value between 0 and 30.*
7 *Toggle the units of measurement: 0.1, 0.01, 0.001 mm: 5, 0.5, 0.05 mils: 5, 0.5, 0.05 thou.*
8 *Print the previous screen on a connected printer.*
9 *Send the measurement result to a connected printer or PC.*
0 *Store and Restore measurement results.*
. *Help: Shows available program choices at each step.*
Return.

PROBLEM SOLVER, MAINTENANCE

Cleaning – For the best measurement result, always keep the equipment clean and the optics at the detector and laser very clean from dirt and fingerprints. Use a dry rag for cleaning.

Batteries – The system is powered by four R14 (C) batteries. Most types of batteries can be used, even rechargeable, but alcaline will give the longest operating time. If the system will not be used for a long time, the batteries must be taken out.

A. The system will not start:
1 Do not let go of the On-button too quickly.
2 Check that the battery poles are facing the correct side according to the labels.
3 Change batteries.

B. The laser does not light up:
1 Check the connectors.
2 Change batteries.

C. No measurement values are displayed:
1 See B
2 Open the target.
3 Adjust the laser to the detector.

D. Unstable measurement values:
1 Tighten the screws at the fixtures etc.
2 Adjust the laser away from the PSD edge.
3 Increase the filter setting (function 6 in the Main menu).

Easy-Laser®

Measurement and Alignment Systems

Manual

05-0100 Rev6

Display unit D279

D200 Sheave/Pulley Alignment
D450 Shaft Alignment
D505 Shaft Alignment
D525 Shaft Alignment
D600 Machine
D630 Extruder
D650 Linebore
D660 Turbine
D670 Parallelism
D800 Machine SpinLaserTechnology™

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APPLICATION EXAMPLES FOR EASY-LASER®

TABLE OF CONTENTS

Declaration of Conformity

Equipment: EASY-LASER® PRODUCT RANGE

Damalini AB declares that the Easy-Laser® product range is manufactured in conformity with national and international regulations.

The system complies with, and has been tested according to the following requirements:

EMC Directive:	**89/336/EEC**	
Low Voltage Directive:	**73/23/EEC**	
	including amendments by Directive 93/68/EEC.	
Laser Classification:	**EUROPE**	**SS-EN-608 25-1-1994**
	USA	**CFR 1040.10/11 - 1993**

Year 2000 compliance:
The manufacturer declares that the equipment mentioned above including all software and firmware delivered with the equipment complies with the Swedish IT Commissions Year 2000 definition.

Damalini
Measurement And Alignment Technology

1 February 2000, Damalini AB

Leif Törngren, Development

SAFETY PRECAUTIONS

Easy-Laser® is a laser instrument in laser class II with an output power less than 1 mW, which only 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 in validate the manufacturer warranty.

Warning!
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.

DISCLAIMER

Damalini 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.
Even though great efforts are made to make the information in this manual free from errors, and to make the information complete for the user, there could be things we have missed, because of the large amount of information. As a result of this, we might change and correct these things in later issues without further information. Changes to the Easy-Laser® equipment may also affect the accuracy of the information.

Easy-Laser®: measurement equipment for your needs

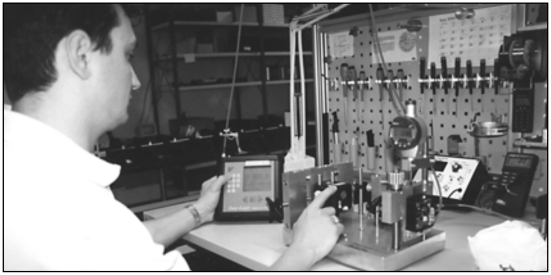
Damalini develops and manufactures Easy-Laser® for measurement and alignment of machinery and plant. We have more than 20 years of experience from measurement tasks in the field and product development. We also provide measurement service, which means that we ourselves use the equipment we develop, and continuously improve it. Because of this we dare to call ourselves measurement specialists.

Measurement service and training

Don not hesitate to contact us about your measurement problems. Our expertise will help you solve it in an easy way. For specific customer applications we develop customized systems. For the latest information, you are welcome to visit our web site.

Easy-Laser® around the world

Damalini products are used in more than 40 countries around the world. This means that as a user of Easy-Laser®, you have a lot of companions. For us this is the best source for improvements to the equipment. Wherever you are, we look forward to helping you with your measurement and alignment tasks!



Development department.

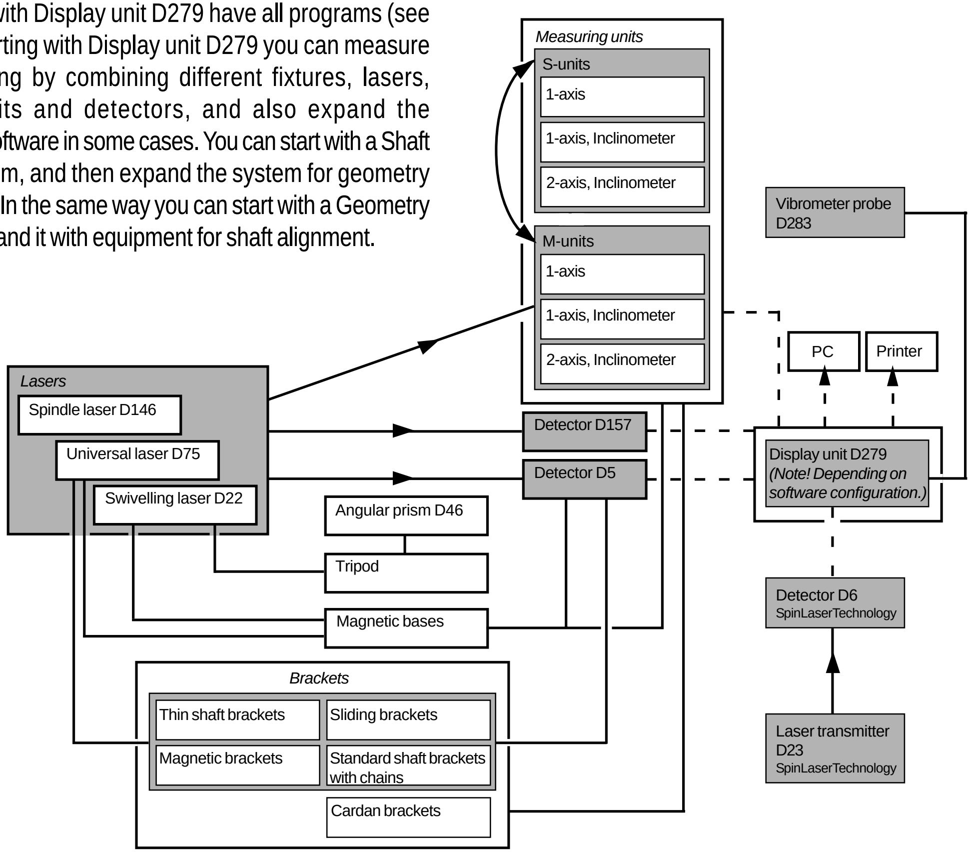
Measurement training.

Our products are used all around the world.

Systems and parts

The Easy-Laser® systems are designed to grow as the needs increase. Measurement systems D450 and D505 have as standard when delivered only programs for shaft alignment, and all other systems with Display unit D279 have all programs (see next page). Starting with Display unit D279 you can measure virtually anything by combining different fixtures, lasers, measuring units and detectors, and also expand the measurement software in some cases. You can start with a Shaft alignment system, and then expand the system for geometry measurements. In the same way you can start with a Geometry system and expand it with equipment for shaft alignment.

Schematic picture of the parts included in the Easy-Laser® measurement product range.



Measurement programs configurations

These pages describe which programs and functions the Display unit D279 has for the different measurement systems. There is also a brief description of each program.

	D450	D505	D525 D600 D630 D650 D660 D670 D800
Horizontal - For shaft alignment of horizontal machines with the 9-12-3 method.	X	X	X
Softfoot - With this program you can check that the machine is standing on all feet. Displays which foot to correct.	X	X	X
EasyTurn™ - For shaft alignment of horizontal machines. Requires only 20° between measurement points.		X	X
Cardan - Shows the angular misalignment and the adjustment value for offset mounted machines.		X	X
Vertical - For measurement of vertical and flange mounted machines.		X	X
Machine train - For the alignment of two to ten machines in a row (nine couplings). Shows the measurement values live during the alignment.		X	X
RefLock™ - Any two feet can be selected as references (locked). Works as a sub function in the Machine train program.		X	X
Thermal growth compensation - Compensates for difference in thermal growth between the machines. Works as a sub function in the Horizontal, EasyTurn™ and Machine train program.	X	X	X
Tolerance check - Checks the offset and angle values towards selected tolerance. Shows graphically when the alignment is within tolerance. Sub function.	X	X	X
Measurement Value Filter - Air with varying temperature may influence the direction of the laser beam. The filter function produces stable readings also for these conditions. Sub function in all programs except BTA Digital and Vibrometer.	X	X	X
Offset and Angle - This program displays the offset and the angular misalignment between e.g. two shafts. Shows values from both 1-axis and 2-axis measurement units. Also suitable for dynamic measurements.		X	X
	A	B	C

Values - This program displays the values from the detector in live mode, similar to measurement with dial indicators. The values can be zeroed and halved. Up to four units can be connected in series and can be zeroed individually.		X	X
Vibrometer - Shows vibration level in ”mm/s” or ”inch/s” and bearing condition value in ”g”. The measurement complies with vibrations standard ISO10816-3.		X	X
Straightness - For measurement of straightness on machine foundations, shafts, bearing journals etc. Handles up to 150 measurement points with two arbitrary zero points.			X
Flatness - Program for measurement of flatness/twist, for example on machine foundations, machine tables etc. Handles up to 300 measurement points with three zero points.			X
Squareness - For measurement of squareness in machinery and plant.			X
Parallelism - For measuring between rolls, machine sides etc. Handles up to 150 rolls or other objects. Baseline or roll can be chosen as reference. Each measurement object is given a specific name.			X
Spindle - For measurement of centerline direction of machine spindles on machine tools, drilling machines etc.			X
Center of circle - This program is used when measuring the straightness of bearing journals. Allows varying diameters.			X
Half-Circle - Measurement values are taken in the 9, 6 and 3 o’clock positions. Allows varying diameters. To be used with the Turbine system.			X
PlumbLine - With this program you measure plumbline and straightness on turbine and generator shafts, for example.			X
Flange - For measurement of flatness on flanges and circular planes, for example axial bearings. Up to 150 measurement points can be handled. Three zero points with 120° in between are calculated by the system.			X
BTA digital - For measurement and alignment of pulleys.			X
Note! Display unit D279 can be upgraded and expanded with new software. This means that above configurations is for standard systems.	X	X	X
	A	B	C

Manual

This manual describes in order:

The hardware parts:

Technical specifications and functions.

Handling the display unit:

Settings, button choices and measurement data handling.

Handling the measurement programs:

Measurement procedures step-by-step.

Measurement applications:

More examples of applications.

The basics of measurement and aligning:

The basics, technical terms etc.

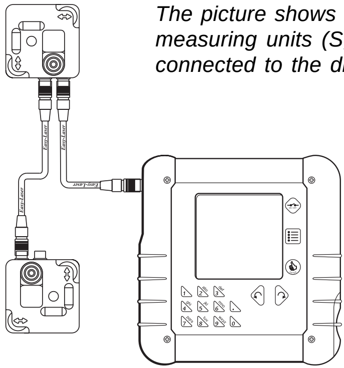
Appendix:

Tolerances, Conversion tables, Problem solver.

If you are unfamiliar with measurement and alignment, we suggest that you first read the chapter *E- Measurement basics...* before you start using the system, and then go on from chapter *A*.

NOTE! In chapter *C-Measurement programs* each step describes which button to press to continue the measurement. Also there are optional choices between brackets, for example:

[Backstep ]



The picture shows two measuring units (S, M) connected to the display unit.

The measurement system

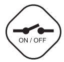
In the following way you connect the system to learn how to handle it. For the description of each laser, measuring unit etc, see chapter *A*.

1. Mount/place the equipment with suitable fixtures on the measurement object.

2. Connect the cable to the display unit.

3. Connect the other end of the cable to any measuring unit or detector. NOTE! You can use any of the two connections on the units.

4. If you are using a shaft alignment system, connect the other cable between the measuring units S and M.

5. Start the display unit by pressing 

. The first thing displayed is the program menu. Start the desired program by keying in the program number.

Shift to Program-menu page 2 by pressing

To get to the Main menu, press
Return to previous page by pressing the Menu-button once again.
(Possible in any situation, also during measurement.)

The first line of the Main menu says *"Units found:"* shows whether the display unit is in contact with all of the connected measuring units.

NOTE! If you connect two measuring units S and M the laser lights up when a program is started. If you have a detector and a separate laser transmitter you start the transmitter by pressing its On-button.

Rough alignment before measuring
6. Now aim the laser at the detector.
Start by aiming the laser at the closed target. (For detailed description, see chapter *C, "Rough alignment"* for shaft alignment, and each program for other measurements.)
7. Open the target.
8. Enter the required distances as prompted by the system.
9. Continue the measurement as described on the display.

10. After the measurement is finished you can do the following; save the result in the display unit, if you have a printer; connect this and make a printout (see chapter *B*) or connect the display unit to a PC and transmit the data (in this case you first have to install the EasyLink™ software, see chapter *B*.)

These are the basics for getting started with the system. Easy-Laser® is easy to use, but as with most things, practical training and experience are needed to correctly and effectively carry out the measurements.

Good luck, and thanks for chosing Easy-Laser® measurement and alignment systems!

System A

A. System

COMPLETE SYSTEMS

All systems:

All systems are delivered in aluminium framed carrying case with contoured foam insert. Size and design depending on system. Always included:

1 Protective case for display unit
1 Measuring tape
1 Manual
1 EasyLink™ PC program+cable

D450 Shaft Alignment system

1 Display unit D279 with 5 programs/functions
2 Cables with push-pull connectors
2 Measuring units (S, M); PSD 10x10 mm
2 Shaft brackets with chains
2 Sets of extension rods

Note! The Laser transmitter plus Detector unit can be added separately as accessories to all systems using the D279 Display unit with BTA Digital software.

D200 Sheave/Pulley alignment system

1 Display unit D279 with 23 programs/functions
1 Cable with push-pull connectors
1 Detector unit D162
1 Laser transmitter D164

D505 Shaft Alignment system

1 Display unit D279 with 13 programs/functions
2 Cables with push-pull connectors
2 Measuring units (S, M), PSD 18x18 mm
2 Shaft brackets with chains
2 Sets of extension rods
2 Extension chains
2 Offset brackets
2 Magnetic bases

D525 Shaft Alignment system

1 Display unit D279 with 23 programs/functions
2 Cables with push-pull connectors
2 Measuring units (S, M), PSD 18x18 mm
2 Shaft brackets with chains
2 Sets of extension rods
2 Extension chains
2 Offset brackets
2 Magnetic bases

D600 Machine *(Basic)*

1 Display unit D279 with 23 programs/functions
2 Cables with push-pull connectors (2m, 5m)
1 Detector D5
1 Magnetic base with turnable head
2 Sets of extension rods

For complete system add appropriate laser (D22, D146, D75), angular prism D46 and other accessories.

D630 Extruder system

1 Display unit D279 with 23 programs/functions
2 Cables with push-pull connectors
1 Laser transmitter D75 with fixture
1 Detector D157 with adapter plates
1 Large target Extruder

D650 Linebore system

1 Display unit D279 with 23 programs/functions
2 Cables withpush-pull connectors (2m, 5m)
1 Laser D75 with coordinate hub
1 Detector Linebore with offsethub
Arms for diameters 100–500 mm [4–20”].
1 Printer with cable and charger
1 Set of attachment items

D660 Turbine system

1 Display unit D279 with 23 programs/functions
2 Cables with push-pull connectors
1 Laser transmitter D75 with offset hub
1 Detector unit D5
1 Detector fixture with magnet bases and extension arms for diameters 150–1700 mm [5.90”–66.9”]
1 Set of probe extensions
1 Self centering target
1 Printer with cable and charger

D800 Machine system

1 Display unit D279 with 23 programs/functions
1 Laser transmitter D23
2 Cables with push-pull connectors (2m, 5m)
1 Detector D6
1 Magnet base for laser transmitter
1 Magnetic base D45 with turnable head
2 Sets of extension rods

D670 Parallelism system

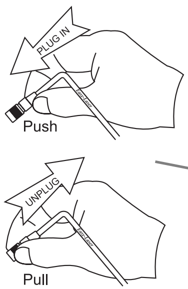
1 Display unit D279 with 23 programs/functions
2 Cables with push-pull connectors
1 Detector D5
1 Magnet base D45 with turnable head
2 Sets of extension rods
1 Swiveling laser D22
1 Sliding table
2 Large targets Base line
1 Sliding bracket with turnable head
1 Angular prism D46
2 Carrying cases
2 Tripods

A

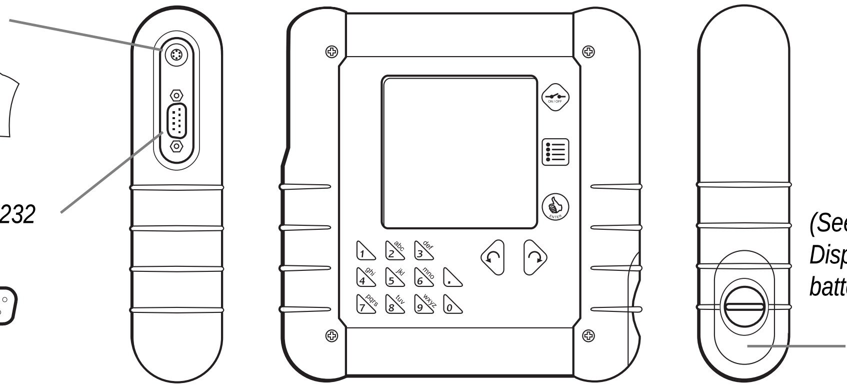
Display unit D279: Different number of measurement programs depending on which system the display unit is included in *(the software can be expanded and upgraded through the RS232 interface)*.
Battery operated unit that reads one to four measuring units/detectors. Membrane keyboard with 16 buttons and backlit LCD display.
Measurement data storage. Serial port for printer and PC communication. With protective case for rough environment.

TECHNICAL SPECIFICATIONS

Housing material	Aluminum / ABS
Keyboard	16 membrane buttons
Display	Backlit 4.5" LCD
Battery type	4 x 1.5 V R14 (C)
Operating time	48 hrs continuously 24 hours with two measuring units connected.
Displayed resolution	Changeable, down to 0.001 mm (0.05 mil)
Memory	Stores up to 1000 shaft alignments or 7000 measurement points
Connections	Measuring units/Detectors/ Vibrometer probe and serial port RS232, 9P
Dimensions	180x175x40 mm [7"x6 7/8"x1 9/16"]
Weight	1100 g [2.4 lbs]



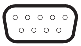
The connectors between display unit and detectors should be connected as on the picture.



Serial port RS232

Db9 Male

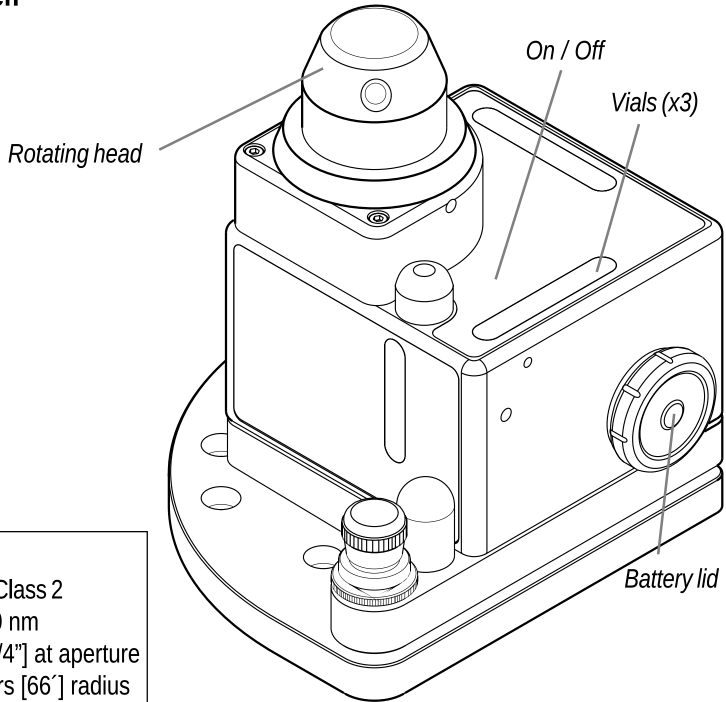
2 RxD
3 Txd
5 GND
7 RTS
8 CTS



(See back of Display unit for battery direction.)

Battery lid

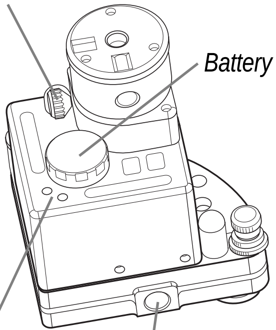
Laser transmitter with motor-driven rotating head (360°).

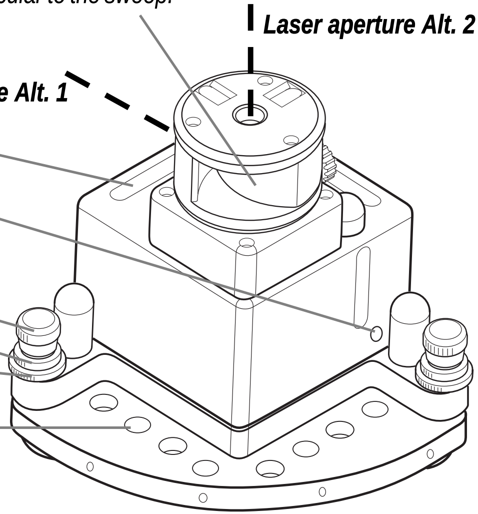


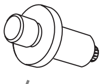
TECHNICAL SPECIFICATIONS	
Laser diode	< 1 mW Class 2
Laser wavelength	635–670 nm
Laser beam diameter	6 mm [1/4”] at aperture
Range of measurement	40 meters [66´] radius
Battery type	2 x R14 (C)
Operating time / battery	appr. 15 hrs
Leveling range	± 1.7° [± 30 mm/m]
Vials scaling	4 arc sec. [0.02 mm/m]
Flatness of sweep	0.02 mm [20µ]
Housing material	Aluminum
Weight	5.8 lbs [2650 g]

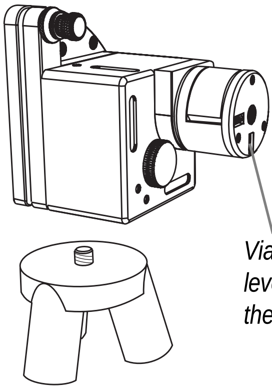
A

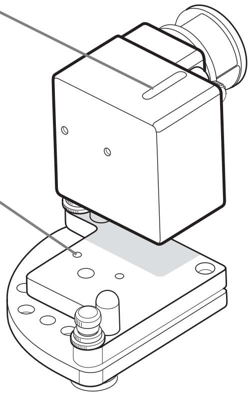
Laser transmitter with swivelling head for 360º sweep of the laser beam *(Alt. 1)*. The sweep can be leveled to a horizontal or vertical plane.
The beam can be deflected 90° to the sweep *(Alt. 2)*.

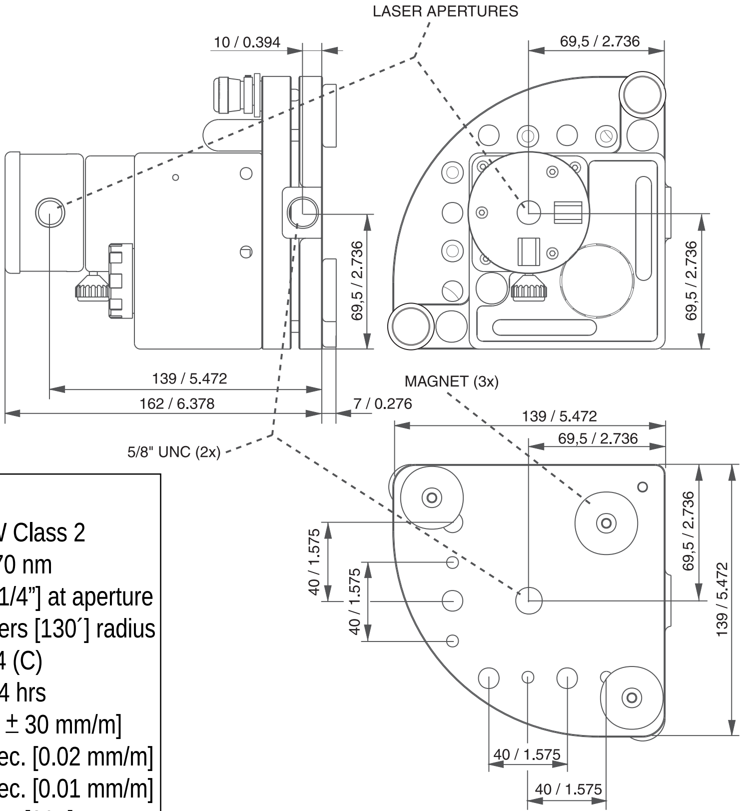










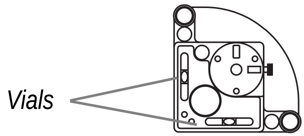


TECHNICAL SPECIFICATIONS

Laser diode	< 1 mW Class 2
Laser wavelength	635–670 nm
Laser beam diameter	6 mm [1/4”] at aperture
Range of measurement	40 meters [130´] radius
Battery type	1 x R14 (C)
Operating time / battery	appr. 24 hrs
Levelling range	$\pm$ 1.7^{o} [$\pm$ 30 mm/m]
Vial scaling	4 arc sec. [0.02 mm/m]
Perpendicularity	2 arc sec. [0.01 mm/m]
Flatness of sweep	0.02 mm [20µ]
Fine turning	20 arc sec. [0.1 mm/m]
Vial on head scaling	0.3^{o} [5 mm/m]
Housing material	Aluminum
Weight	5.8 lbs [2650 g]

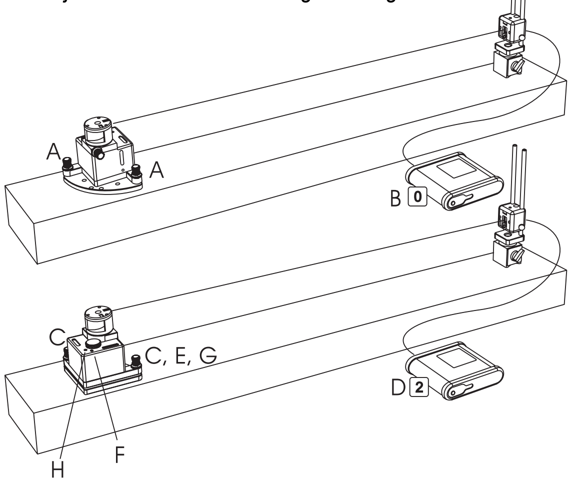
CAUTION
LASER RADIATION
DO NOT STARE INTO BEAM
DIODE LASER
1 mW MAX OUTPUT AT 670 nm
CLASS II LASER PRODUCT

Here we describe how you calibrate the vials on the D22 and D23. This is normally done at delivery, but can be redone when necessary. The vials are scaled to 0.02 mm/m [4 arc sec.].
Accurate levelling to the vials will achieve a repeated levelling better than the scaling of the vials, approximately 0.005 mm/m [1 arc sec.].
If the laser is to be used as a levelled reference the vials must be calibrated to the laser beam. That means that the vials are calibrated to the laser beam, and not to the bottom of the laser transmitter. Principle:
Let the laser beam pass through two fixed points, at least 1 meter apart. Turn the laser transmitter 180° and tilt the beam to pass through the two points again. Adjust the vials to half the travel. One of the fixed points is the laser transmitter, because the beam aperture is at the same height the whole turn around. The other fixed point is a detector with fixed position of the laser beam.



Use the progam Values during calibration. Long distance to detector will get you a better result (at least 1 m). Turn the laser 180° with the laser head at the centre and aim the beam backwards within 1 mm in side direction (H-value).

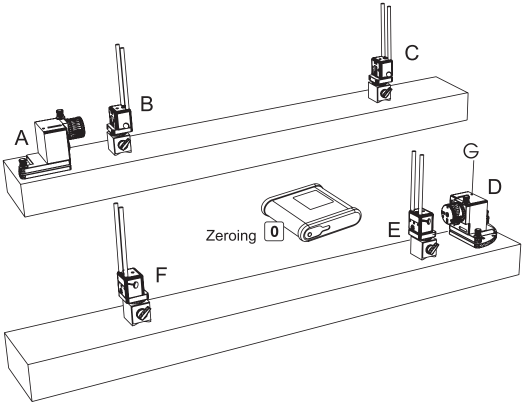
***A.** Level according to vials.*
***B.** Zero set on the display unit (press 0).*
***C.** Turn laser 180°.*
***C.** Level according to vials.*
***D.** Halve the displayed value (press 2).*
***E.** Level the V-value to zero.*
***F.** Adjust the vial using a hexagon wrench.*
***G.** Turn laser transmitter 90°.*
***G.** Level the V-value to zero.*
***F.** Adjust the second vial using a hexagon wrench.*



When calibrating the single vial on laser-transmitter D22, the sweep of the laser can be used. Place the detector in two positions, at least 1 m apart, and let the laser beam pass through this from two directions.

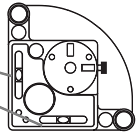
Use the three point washers placed on the magnets for proper elevation, and mount the laser as shown on picture below.

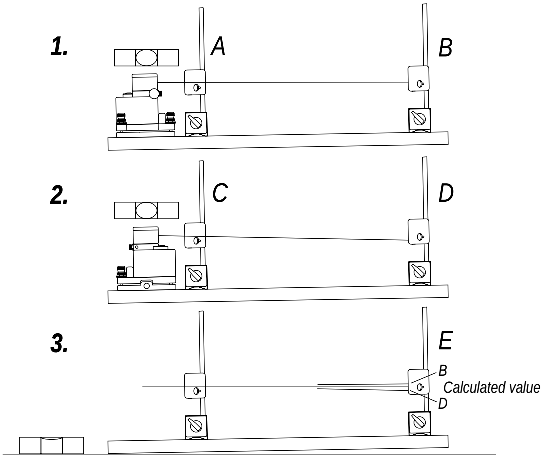
1. Level according to vial at A.
2. Zero set display at B.
3. Note the value at C.
4. Move the laser to D and level according to vial.
5. Zero set display at E.
6. Note the value at F.
7. Add C- and F-value and divide by 2.
8. Level the laser to the result from point 7.
9. Adjust the vial using a hexagon wrench.



Self calibration of vials when high demands of horizontal plane. The vials on laser D22 and D23 are normally calibrated to the laser beam. Measurements that need an absolute horizontal plane to be the reference will put great demands on the calibration. Therefore any errors in the calibration are measured and compensated for. The principle is the same as for normal calibration, but can get you a better accuracy because it is done during measurement.

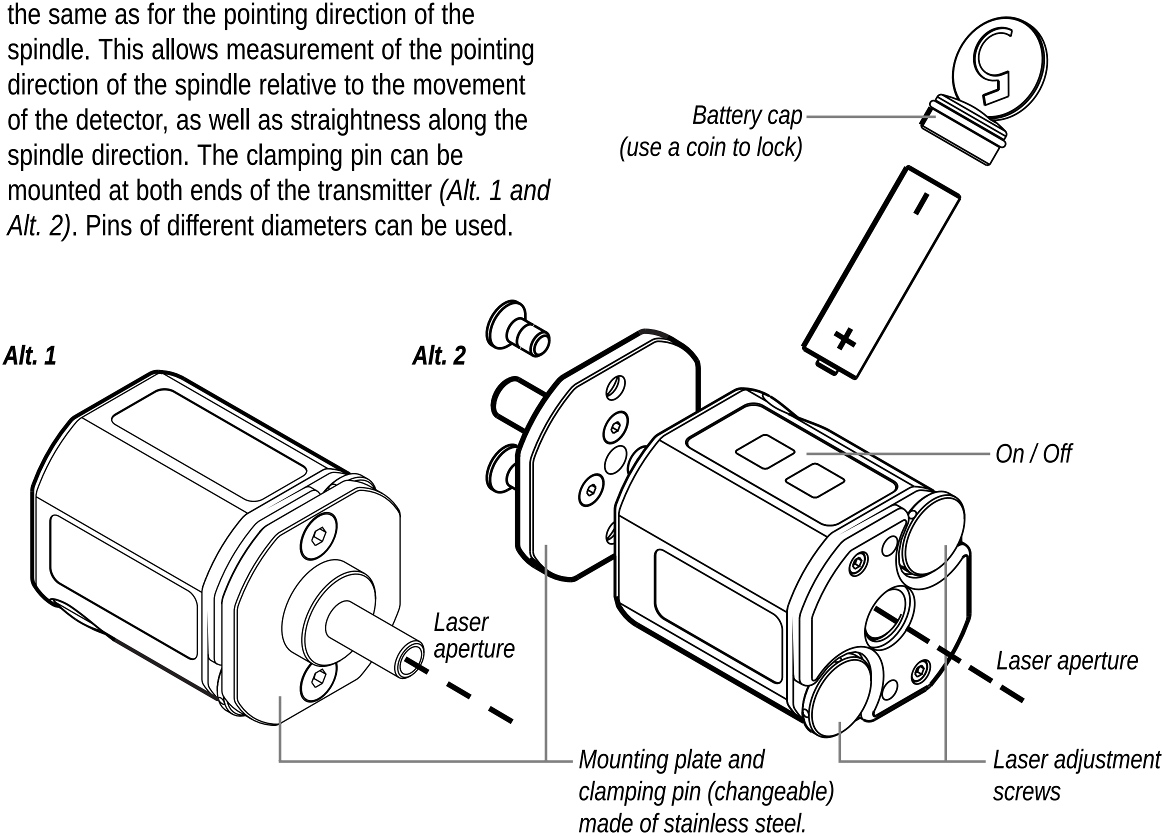
***1.** Level according to vials.*
A. Zero set value.
B. Read the value (for example 1.00)
***2.** Index the laser 180°, level according to vials.*
C. Zero set value.
D. Read the value(for example 2.00)
***3.** E. Calculate the middle of B and D (in this case 1.50)*
This shows the difference in level of the measurement points.



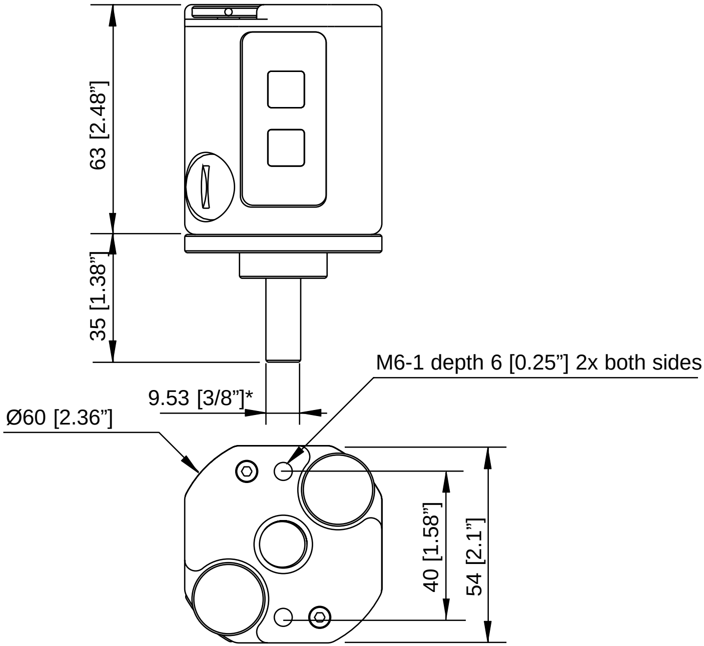


A

Laser transmitter D146 for measurement of spindle direction and straightness. Attached to a spindle it will project concentric circles when the spindle is rotated. The centres of those circles are the same as for the pointing direction of the spindle. This allows measurement of the pointing direction of the spindle relative to the movement of the detector, as well as straightness along the spindle direction. The clamping pin can be mounted at both ends of the transmitter *(Alt. 1 and Alt. 2)*. Pins of different diameters can be used.



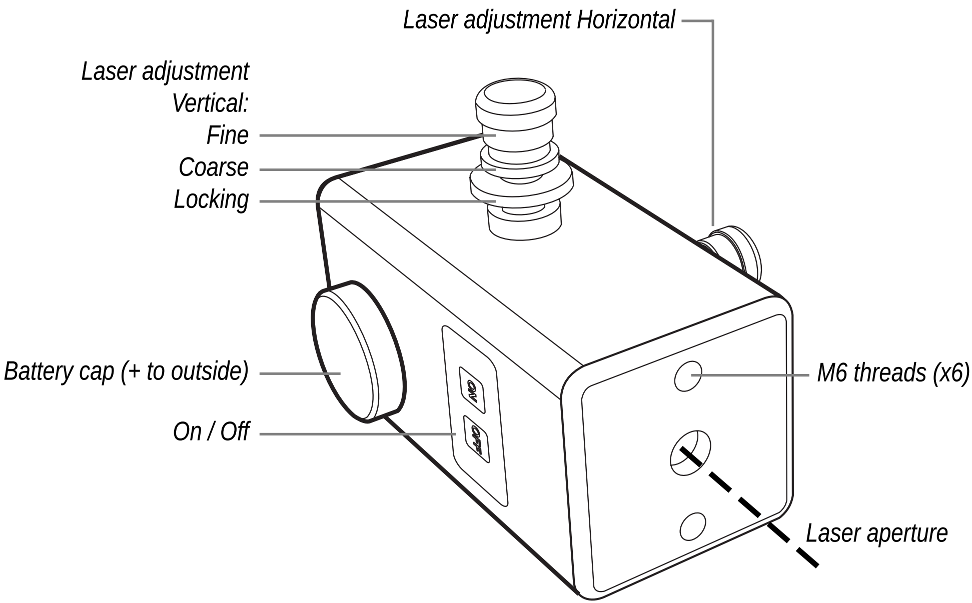
SPINDLE LASER D146: technical specifications



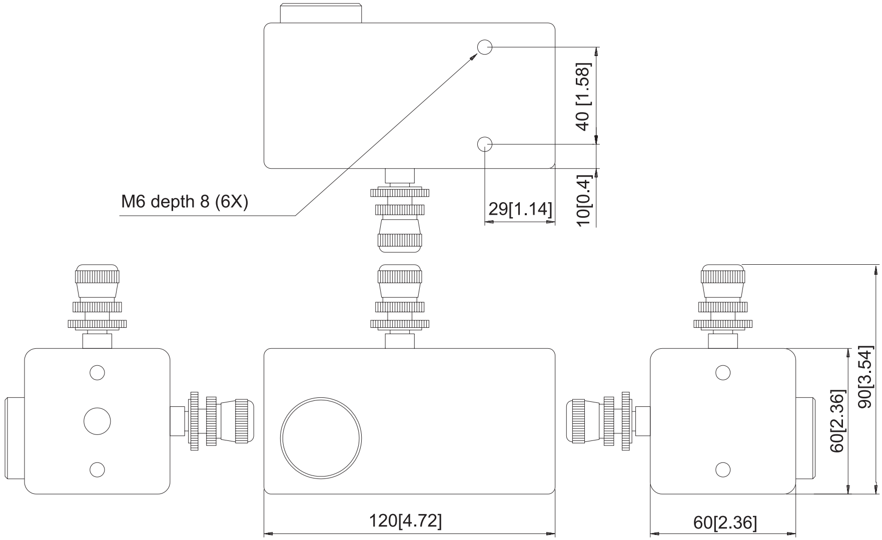
TECHNICAL SPECIFICATIONS

Housing material	Anodized aluminum
Laser diode	< 1mW, Class 2
Measurement distance	20 m [60´]
Battery type	1x R6 (AA)
Operating time	appr. 6 hours
Max. speed	2000 rpm
Clamping diameter*	Adapted with pin
Weight	300 g [10.5 oz]

The laser transmitter D75 is used for measurement of straightness and spindle direction. At the sides M6-threads allow alternative mounting possibilities. This transmitter comes as standard with the Extruder, Linebore and Turbine system.



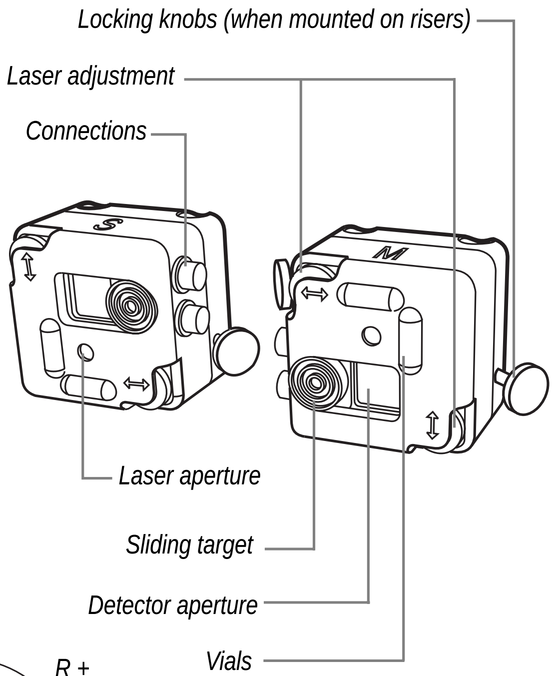
LASER TRANSMITTER D75: technical specifications

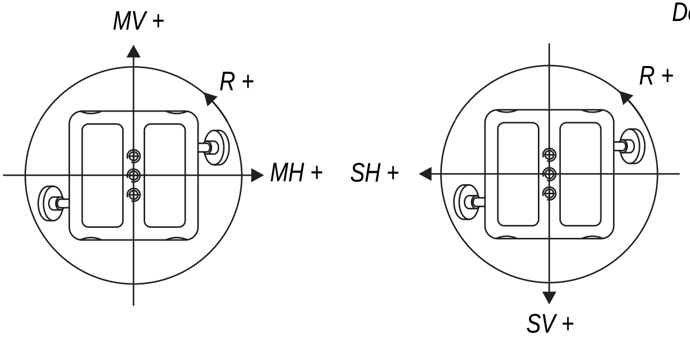


TECHNICAL SPECIFICATIONS

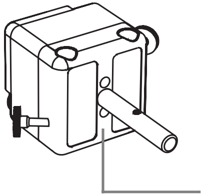
Laser diode	< 1 mW Class 2
Laser wavelength	635–670 nm
Beam diameter	6 mm [1/4”] at aperture
Measurement distance	40 meter [130´]
Battery type	1 x 1.5 V R14 (C)
Operating time / battery	>15 hrs
Laser adjustment	2 ways ± 2° (± 35 mm/m)
Housing material	Anodized aluminum
Dimensions	60x60x120 mm [2 3/8”x2 3/8”x4 3/4”]
Weight	700 g [1.5 lb]

Measuring units with PSD detector (18x18 mm), thermal sensor, electronic 360° inclinometer and laser diode in one housing. The housing has a number of threads and mounting holes, two vials and target. Two alternative connections for display unit and other measuring units. There are versions with 2-axis detectors available (optional). Delivered as a pair with S-unit and M-unit (for **S**tationary and **M**ovable machine).

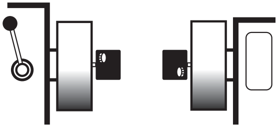


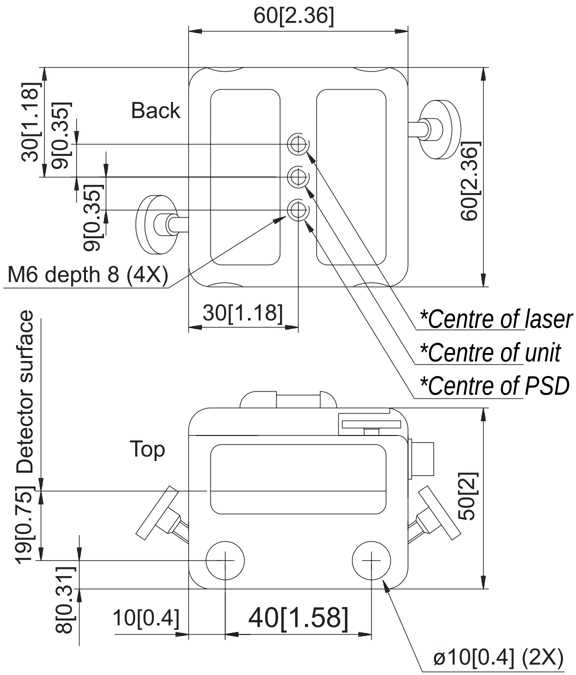


Measurement values when moved according to arrows.



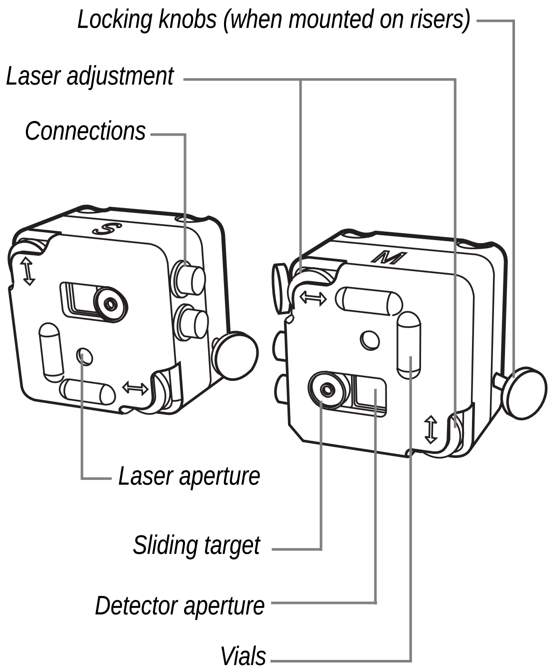
**Three threads on the back allow a lot of varying attachments for other machines and new applications.*

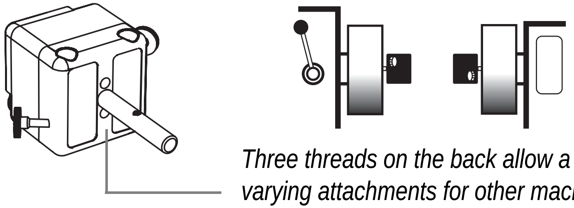




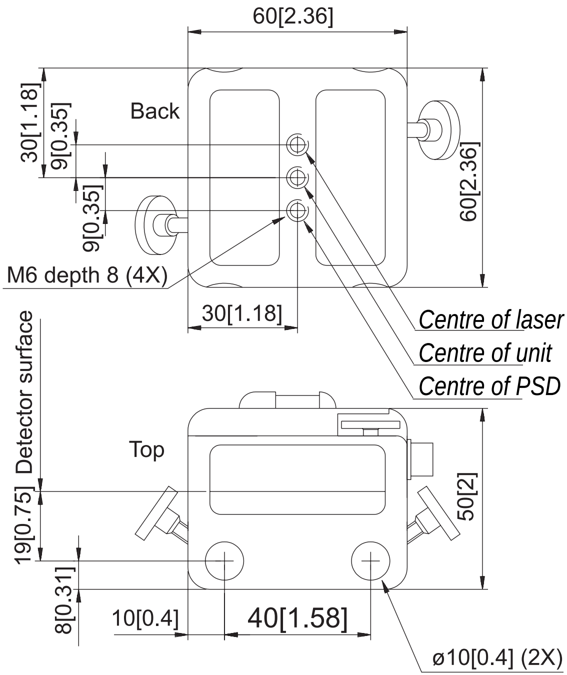
TECHNICAL SPECIFICATIONS	
Detector type	1-axis alt. 2-axis PSD
Detector size	18x18 mm [3/4”x3/4”]
Linearity	Better than 1%
Laser diode	< 1 mW Class 2
Laser wavelength	635-670 nm
Beam diameter	3 mm [1/8”] at aperture
Vial scaling	5 mm/m [0.3°]
Inclinometer resolution	0.1°
Thermal sensors	± 1° accuracy
Dimensions	60x60x50 mm [2 3/8”x2 3/8”x2”]
Housing material	Aluminum
Weight	198 g [7oz]

Measuring units with PSD detector (10x10 mm), and laser diode in one housing. The housing has a number of threads and mounting holes, two vials and target. Two alternative connections for display unit and the other measuring unit. Delivered as a pair with S-unit and M-unit (for **S**tationary and **M**ovable machine).
These are standard with the D450 system.





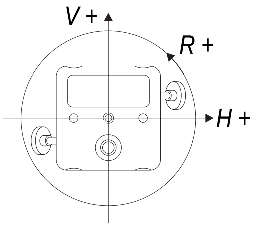
Three threads on the back allow a lot of varying attachments for other machines and new applications.



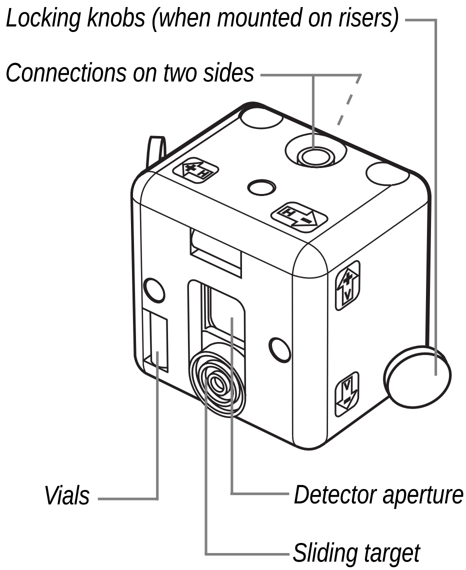
TECHNICAL SPECIFICATIONS

Detector type	1-axis PSD
Detector size	10x10 mm [3/8”x3/8”]
Linearity	Better than 1%
Laser diode	< 1 mW Class 2
Laser wavelength	635–670 nm
Beam diameter	3 mm [1/8”] at aperture
Vial scaling	5 mm/m [0.3º]
Dimensions	60x60x50 mm [2 3/8”x2 3/8”x2”]
Housing material	Aluminum
Weight	198 g [7oz]

Detector that can read the position of a laserbeam. Built-in electronic 360° inclinometer and thermal sensor. A number of threads and mounting holes allow varying attachment possibilities. Vials and target for rough alignment. Two alternative connections for display unit and other detectors. Markings for measurement directions.

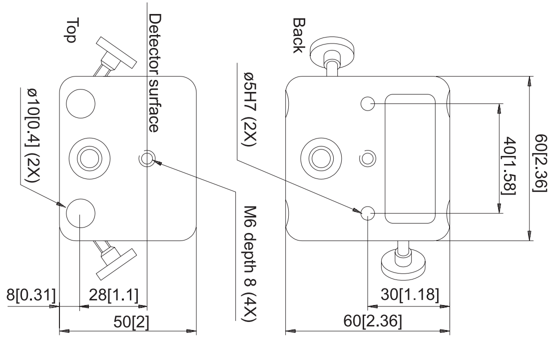


Facing towards the laser, movements of the detector to the right will give positive H-values and moving upwards will give positive V-values. Rotation anticlockwise around a horizontal axis will give positive angle values.

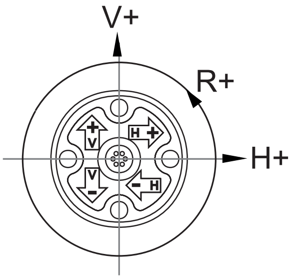


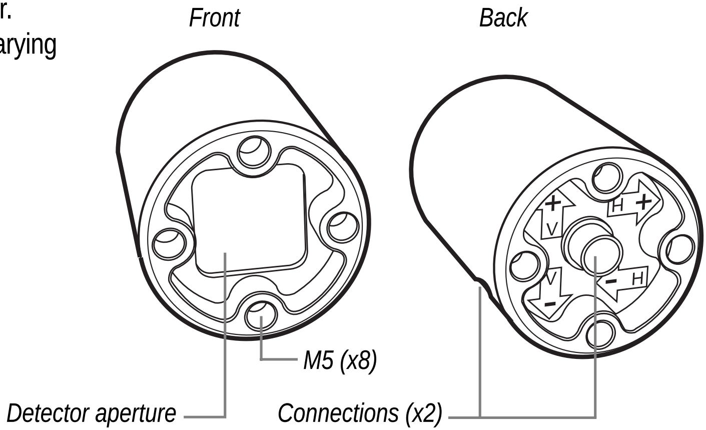
TECHNICAL SPECIFICATIONS

Detector type	2-axis PSD
Detector size	18x18 mm [3/4”x3/4”]
Linearity	Better than 1%
Vials scaling	5 mm/m [0.3º]
Inclinometer resolution	0.1°
Thermal sensors	± 1° accuracy
Dimensions	60x60x50 mm[2 3/8”x2 3/8”x2”]
Housing material	Aluminum
Weight	198 g [7oz]



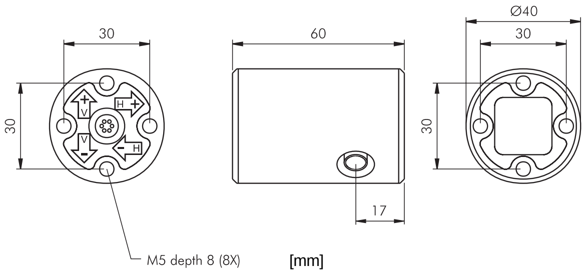
Detector that can read the position of a laser beam. Built-in electronic 360º inclinometer. Housing with eight threads (M5) allow a varying attachment possibilities. Two alternative connections for display unit. Markings for measurement directions.





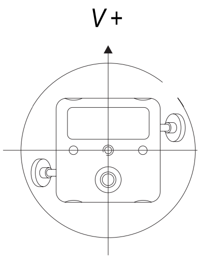
Facing towards the laser, movements of the detector to the right will give positive H-values and moving upwards will give positive V-values. Rotation anticlockwise around a horizontal axis will give positive angle values.

TECHNICAL SPECIFICATIONS	
Detector type	2-axis PSD
Detector size	20x20 mm [0.79”x0.79”]
Linearity	Better than 1%
Inclinometer res.	0.1°
Dimensions	Ø40[1.58”], length 60 mm [2 3/8”]
Housing material	Brass, stainless steel
Weight	198 g [7 oz]

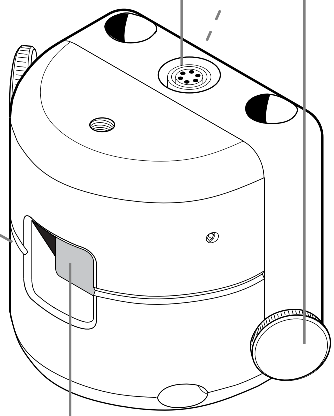


A

With SpinLaserTechnology™. Detector that can read the position of a rotating laser beam from the D23 laser transmitters. Two alternative connections for display unit and other detectors.

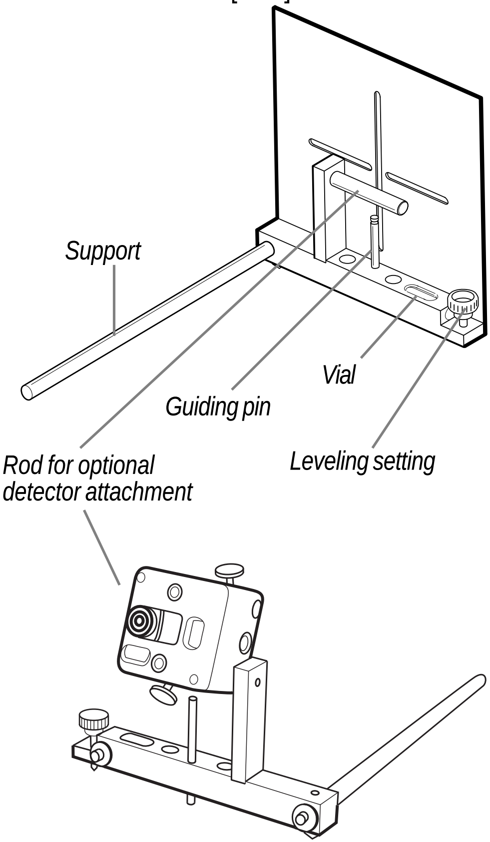


Facing towards the laser, moving upwards will give positive V-values.

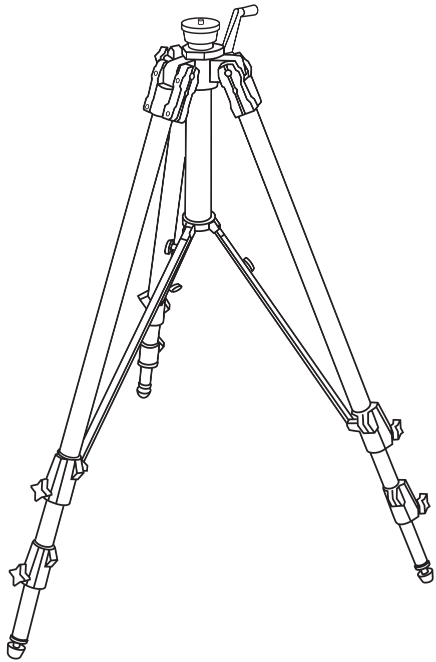


TECHNICAL SPECIFICATIONS	
Detector type	1-axis PSD
Detector size	18x18 mm [3/4"x3/4"]
Linearity	Better than 1%
Dimensions	60x60x50 mm[2 3/8"x2 3/8"x2"]
Housing material	Aluminum
Weight	190 g [7oz]

Target for datum line finding/setting. For use on floor or at magnet base with rods. Instead of a target, a detector can be mounted. Target area: 200x200 mm [8x8”].



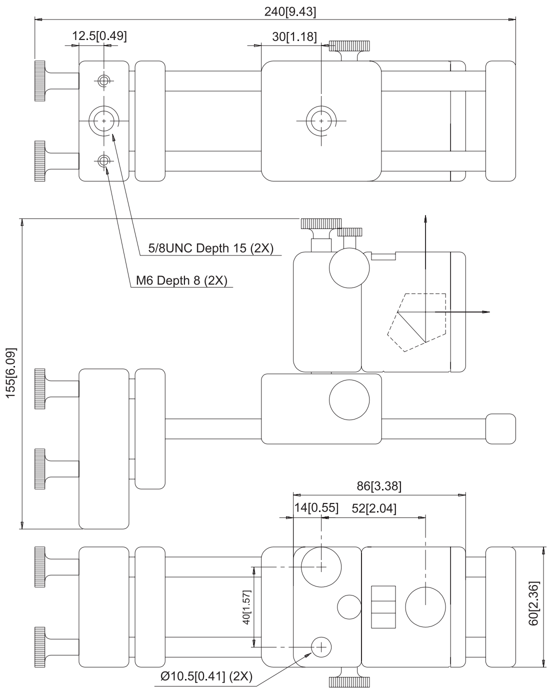
Tripod for laser transmitter and angular prism. Usable for example when measuring rolls for parallel.

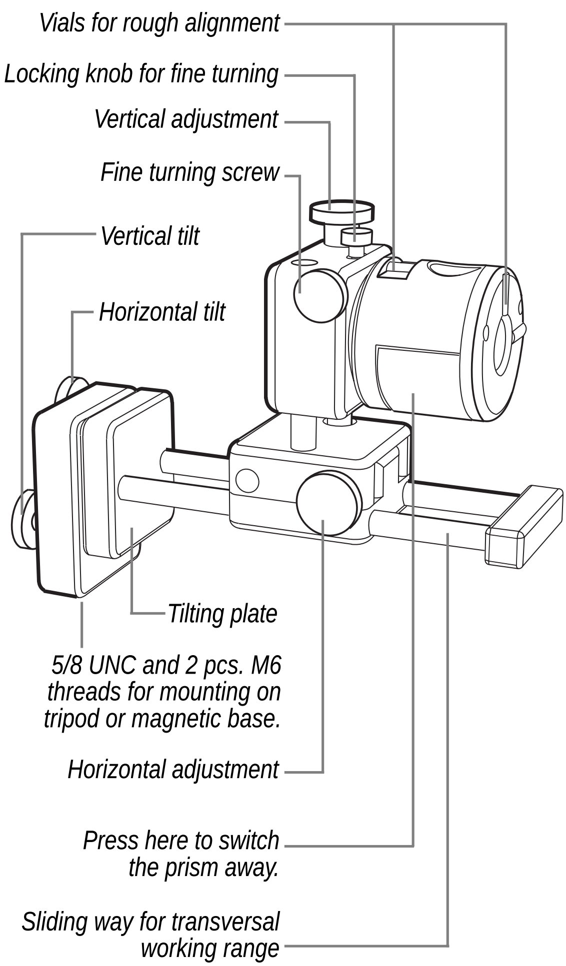


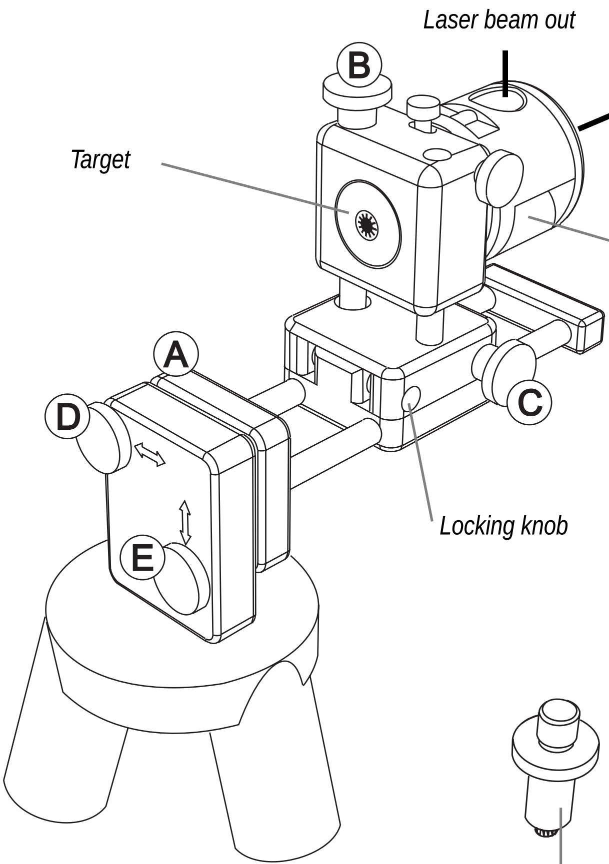
TECHNICAL SPECIFICATIONS

Transport dim.	1110 mm [44”]
Weight	7,9 kg [17.4 lbs]
Min. – Max. height	500–2730 mm [19”–107”]
Mounting thread	5/8 UNC

For measurement of squareness and parallelism. A built-in penta prism deflects the laserbeam 90°. To keep the accuracy of the prism when measuring, the prism should be aligned to the center of and parallel to the laser beam. The prism can be switched away to let the laser beam hit a target that is used for alignment of the unit.







Parallel alignment

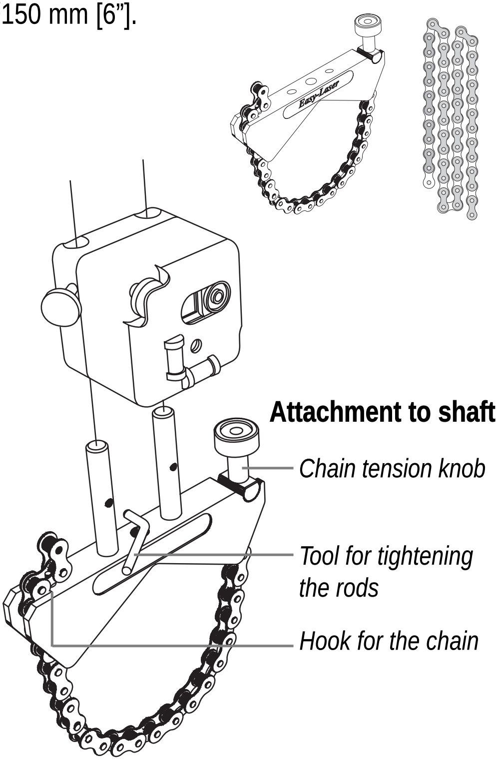
1. Switch the prism away to let the beam hit the target.
2. Slide the prism toward A and adjust with B and C until the target is concentric to the laser beam.
3. Slide the prism away from A and adjust with D and E until the target is concentric to the laser beam.
4. Repeat 2 and 3.
5.Switch the prism in, tighten the locking knob and measure.
Now the angular prism can be moved to a new position on the sliding way to aim the laser beam to the detector.

(The 90° unit is shown mounted on tripod.)

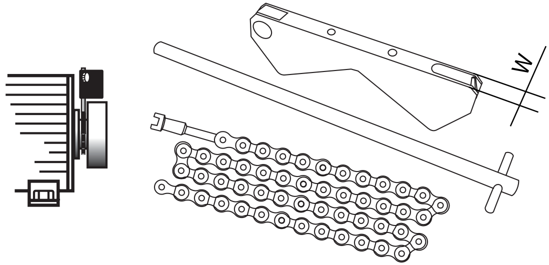
5/8 UNC - M6 spindle for mounting on magnetic base

TECHNICAL DATA	
Deflection	2 arc sec. (± 0,01 mm/m)
Turning range	360°
Fine turning	0.1 mm/m [20 arc sec.]
Sliding range	± 2” [± 50 mm]
Horizontal range	± 3/16” [± 5 mm]
Vertical range	± 3/16” [± 5 mm]
Tilting range	± 2°
Aperture size	Ø 3/4” [Ø 20 mm]
Vials scaling	0.3° [5 mm/m]
Threads	5/8 UNC and M6
Housing material	Aluminum/steel
Weight	4 lbs [1800 g]

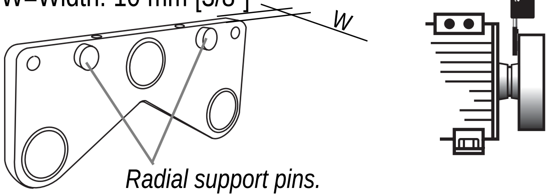
Standard Shaft brackets with chains.
For shafts Ø20–450 mm [3/4”–18”], width 20 mm [3/4”]. Extension chain for shafts larger than Ø150 mm [6”].



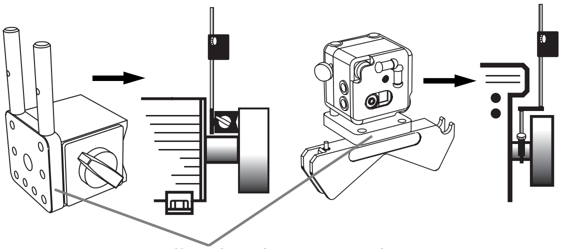
Thin shaft brackets.
W=Width: 12 mm [1/2”]. With chain and thin tool for chain tensioning.



Magnetic brackets for axial mounting.
W=Width: 10 mm [3/8”]

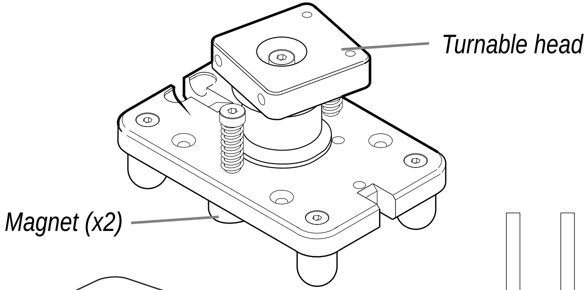


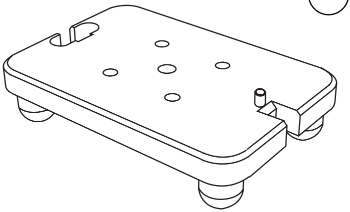
Offset brackets
Allows axial offset on brackets.

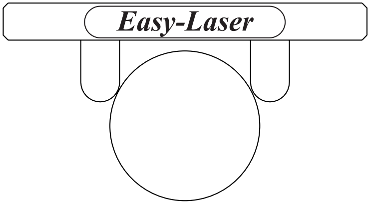


Offset bracket mounted to magnetic base and shaft brackets.

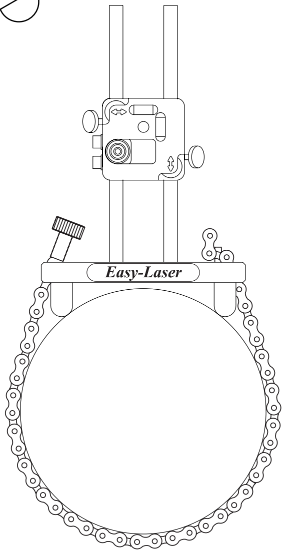
Brackets for use when turning of shafts is not possible.
To be used with standard chains or magnets and with or without turnable head depending on measurement application.

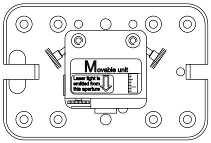


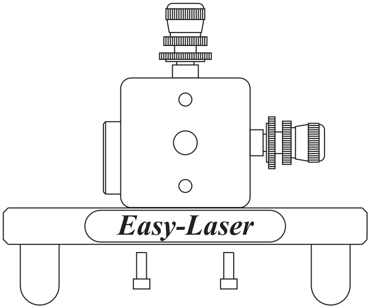




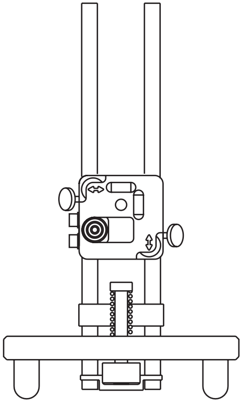
Move the four supports to the inner threads when measuring shafts Ø60–180 mm [2 3/8”–7”].







Laser D75 mounted to fixture for measurement of e.g. straightness of shaft.

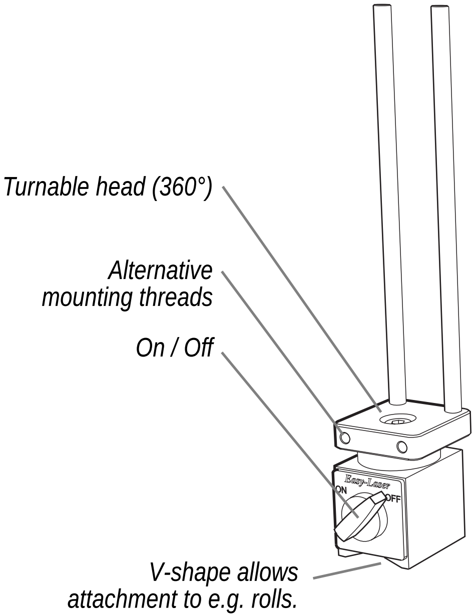


The bracket assembled for measurement of plumbline.

Bracket with standard chains.

MAGNET BASE D45

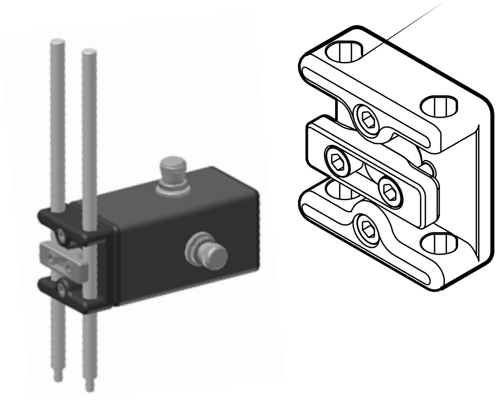
Magnet base with turnable head for detector mounting, 90° angular prism or laser. On the picture shown with risers mounted.



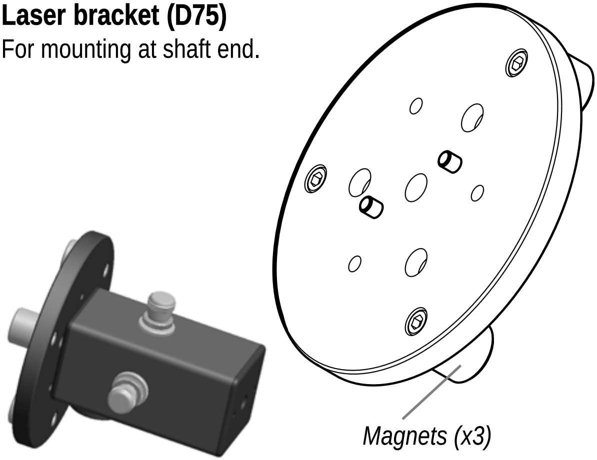
TECHNICAL SPECIFICATIONS

Dimensions WxHxD	50x80x60 mm [2”x3 1/8”x2 3/8”]
Weight	1200 g [2.8 lbs]
Holding power	800 N

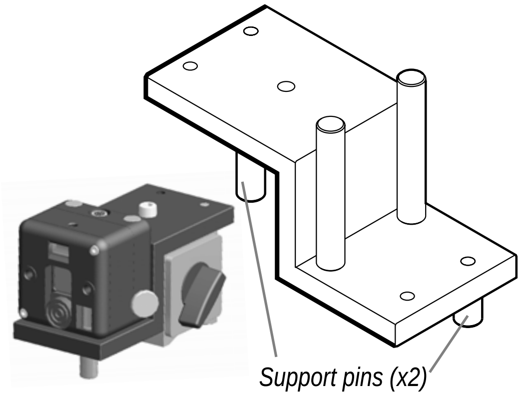
Laser bracket (D75)
For mounting on standard rods.



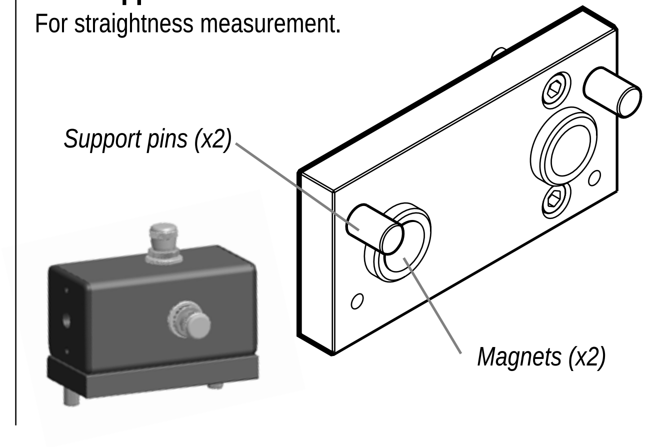
Laser bracket (D75)
For mounting at shaft end.



Side support for detector D5
For straightness measurement.

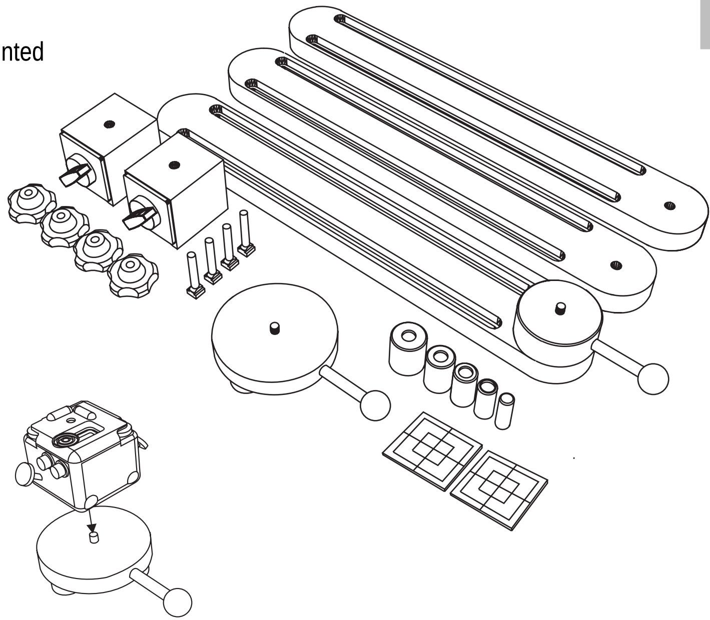


Side support for laser D75
For straightness measurement.

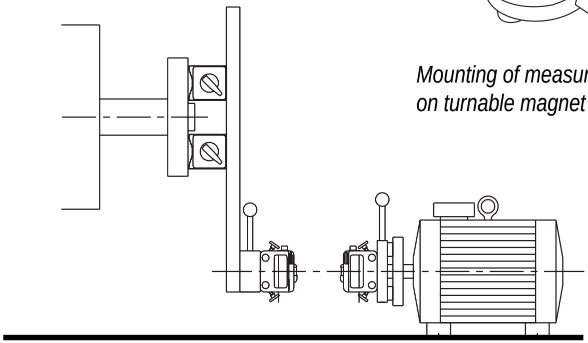


Cardan bracket set

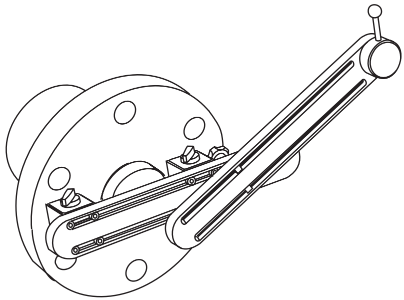
For measurement and alignment of offset mounted machines. Largest offset 900 mm [3´].
2 Magnetic bases
2 Bracket arms
1 Bracket arm with swivel head
1 Turnable magnet bracket
Guiding pins: M12, M16, M20, M24, M30
4 pcs. T-bolts
4 pcs. Knobs
5 pcs. M6x30 screw
4 pcs. M8x20 screw
2 pcs. M8x16 screw
Hexagon wrench 5 mm
Hexagon wrench 6 mm
2 pcs. Large targets



Mounting of measuring unit on turnable magnet bracket.

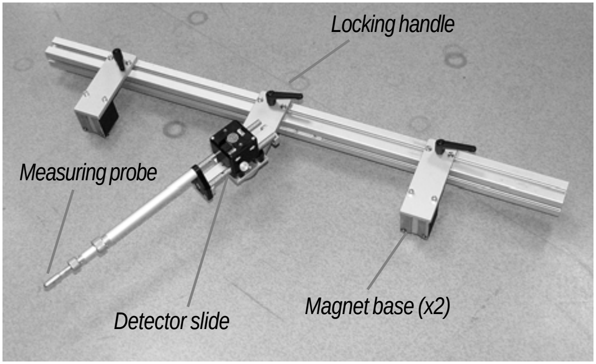


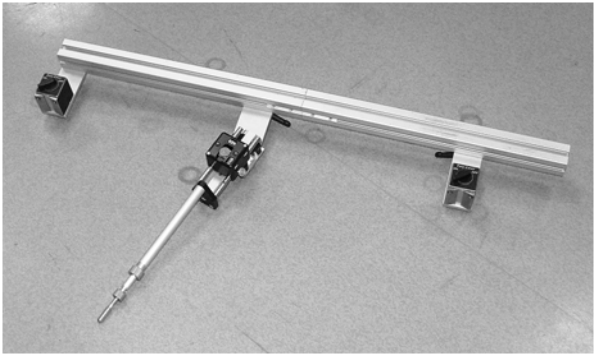
Picture of mounted equipment.



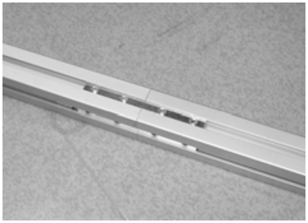
Bracket arms mounted on shaft flange.

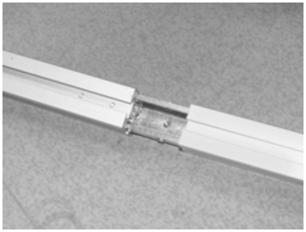
Detector fixture

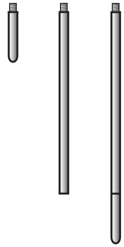




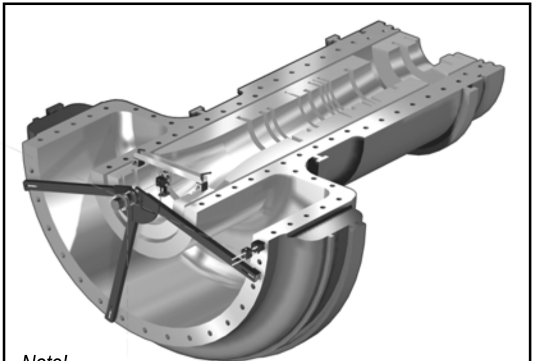
The design of the fixture allows for many different ways of mounting the magnet bases and detector slide.
The fixture can easily be extended if needed (see pictures up to the right).





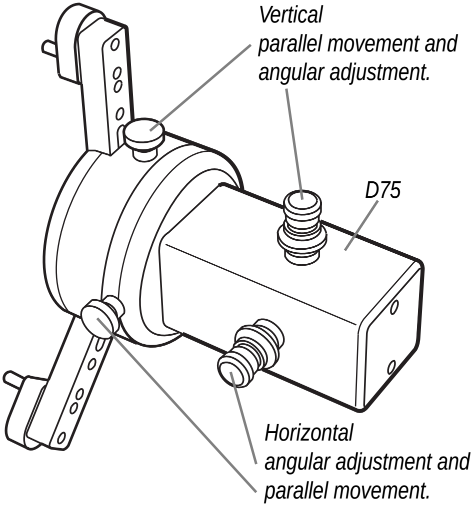


Instead of the pictured probe standard rods can be used to extend the measuring range.



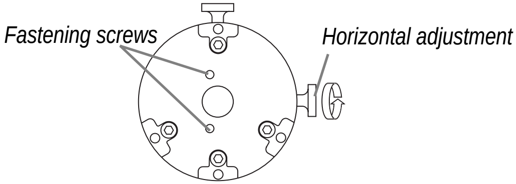
Note!
On special request we manufacture a measurement system for turbines where the axial flange and the center line of the turbine housing are the references to which the journals and diapraghms are adjusted.

Coordinate hub with three arms and magnets
for mounting and parallel movement (adjustment to centre) of the laser transmitter D75.

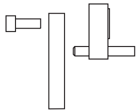


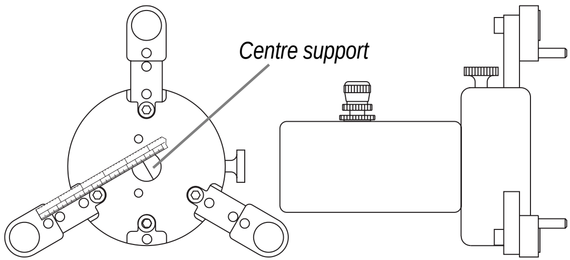
Coordinate hub with laser and arms mounted.

TECHNICAL SPECIFICATIONS	
Laser adjustment	±5 mm [3/16”] in 2 axis
Dimensions	Ø99x62 mm [3 7/8”x2 3/8”]
Housing material	Aluminum
Coordinate table weight	1 kg [2.2 lbs]
Arms for diameters	Ø100–500 mm [4–20”]
Weight	1.2 kg [2.6 lbs]



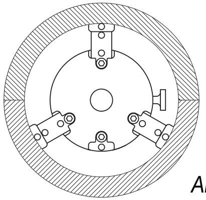
When mounting the laser on the coordinate hub, screw the horizontal adjustment as far out as possible so that the two fastening screws for the laser can be reached.



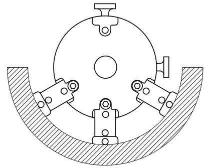


Measure and adjust the arms to the radius. Adjust the third arm when the unit is in position in the measuring object.

Placing the laser in a bearing journal:

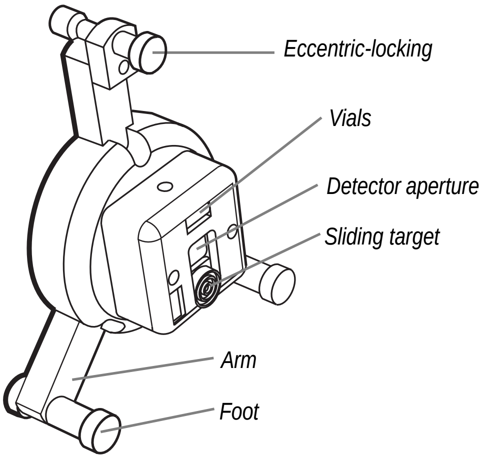


Alt. 1



Alt. 2. One of the arms mounted downwards when the upper bearing journal part is removed.

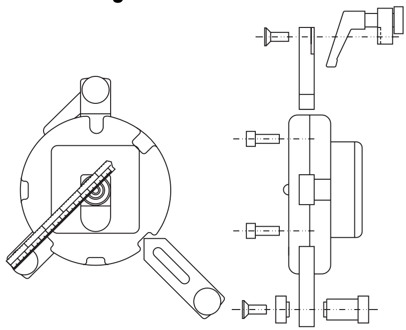
Detector with offset hub. Built-in electronic 360° inclinometer. Three adjustable arms for placing the detector in circular measurement places.



TECHNICAL SPECIFICATIONS

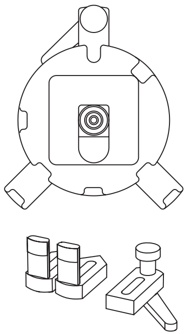
Detector type	2-axis PSD
Detector size	18x18 mm [3/4”x3/4”]
Linearity	Better than 1%
Vials scaling	5 mm/m [0.3°]
Inclinometer resolution	0.1°
Dimensions	Ø99x60 mm [3 7/8”x2 3/8”]
Housing material	Aluminum
Weight detector	400 g [14 oz]
Measuring diameters	Ø100–500 mm [4–20”]
Weight for set of arms	2.4 kg [5.3 lbs]

Detector mounting for Ø150–500 mm

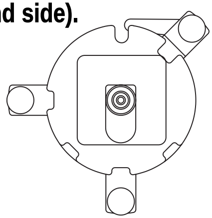


Measure and adjust the arms to the radius. The arm with eccentric-locking should be adjusted in the measured object.

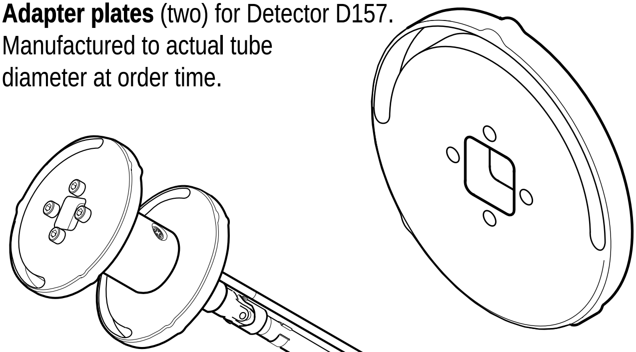
Alternative arms for Ø100–150 mm

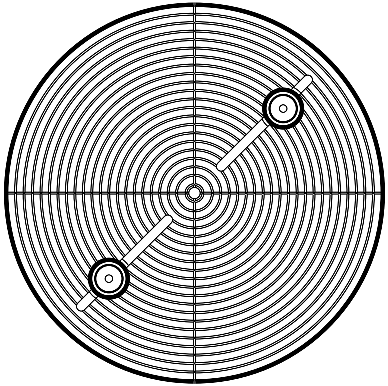


Arms in vertical and horizontal position (measurement at bottom and side).



Adapter plates (two) for Detector D157. Manufactured to actual tube diameter at order time.

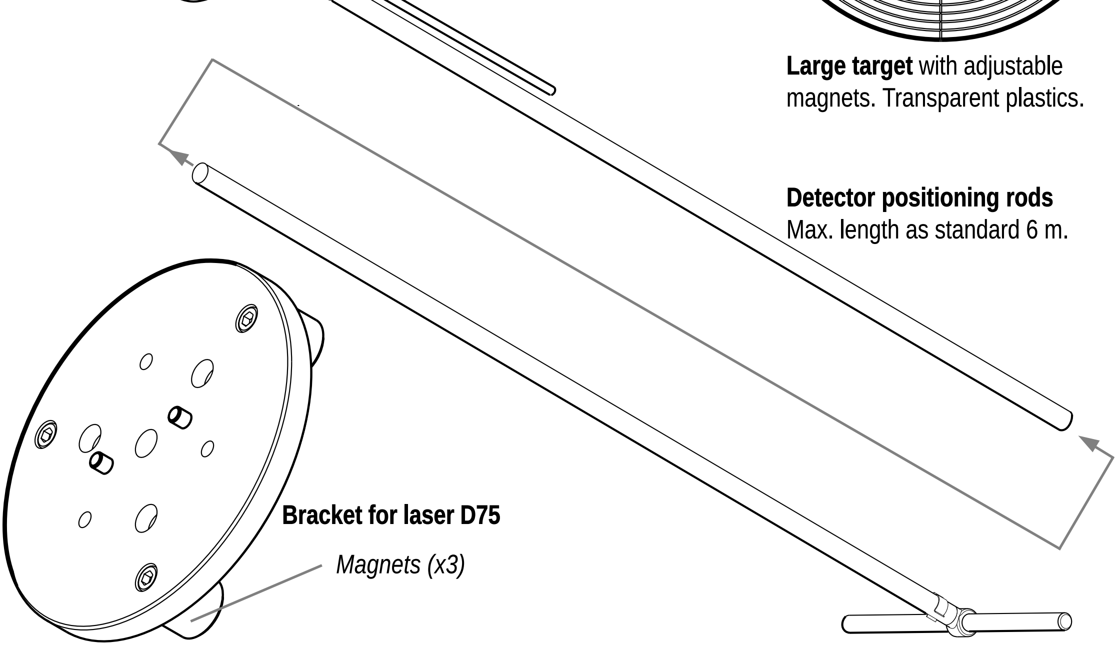




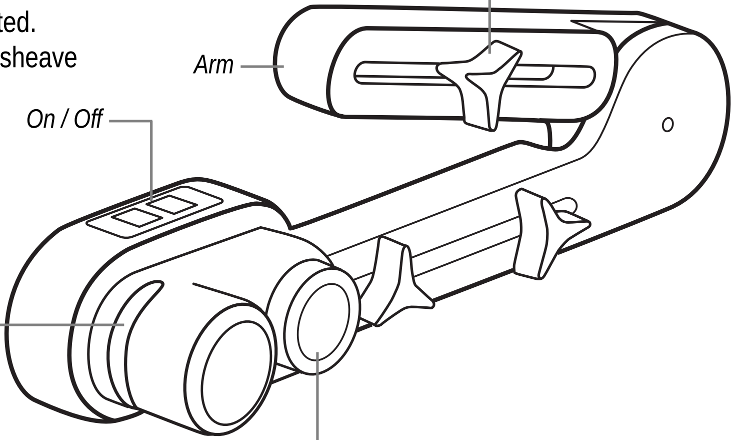
Large target with adjustable magnets. Transparent plastics.

Detector positioning rods
Max. length as standard 6 m.

Bracket for laser D75



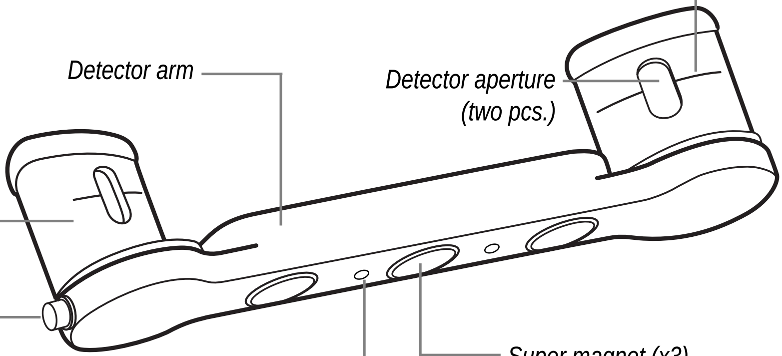
Laser transmitter with rotating beam (180° aperture). Turnable arm with movable attachment magnets. Battery operated. Mainly used together with D162 for sheave alignment.



TECHNICAL SPECIFICATIONS	
Sheave diameters	Ø 60 mm and larger
Sheave width	Not depending on width
Laser aperture	180°
Measurement range	10 m radially
Battery type	1xR14 (C)
Operating time	15 hrs. continuously
Laser class	2
Output power	<1 mW
Laser wave length	635–670 nm
Housing material	Anodized aluminum
Dimensions	WxHxD: 300x60x65 mm
Weight	1.3 kg [2.9 lbs]

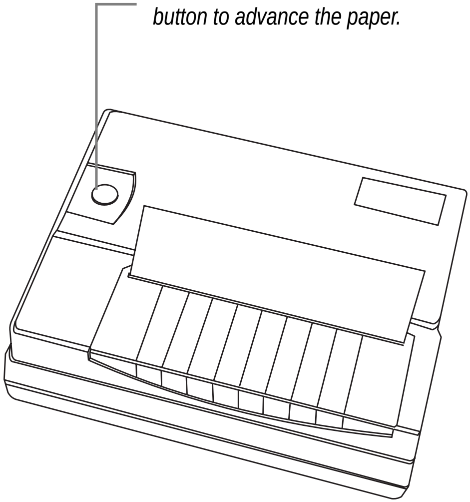
CAUTION
LASER RADIATION
DO NOT STARE INTO BEAM
DIODE LASER
1 mW MAX OUTPUT AT 670 nm
CLASS II LASER PRODUCT

Detector unit with two turnable PSD detector housings. Three attachment magnets, connection to display unit.



TECHNICAL SPECIFICATIONS	
Detectors	1 axis PSD (x2)
PSD range	±8 mm
Safety class	IP 65
Housing material	Anodized aluminum
Dimensions	WxHxD: 250x50x65 mm
Weight	600 g [21 oz]

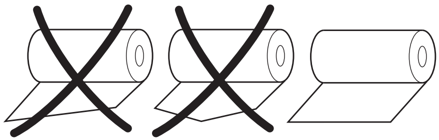
Thermal printer for Easy-Laser® systems.
When the power is turned on, the printer performs many internal tests and initializations. When the tests are completed, the printing head moves. The indicator lights up, and the printer is then ready for use.



The red indicator shows the state of the printer:
Constant light – printer ready
Flashing slow, short lighting – memory full, wait to launch the next printing
Flashing slow, short extinction – Battery charging in progress
Flashing fast – printing head jammed; turn the printer off, remove the paper and replace it correctly.
No light – printer needs to be charged. (First check that the printer is turned on.)

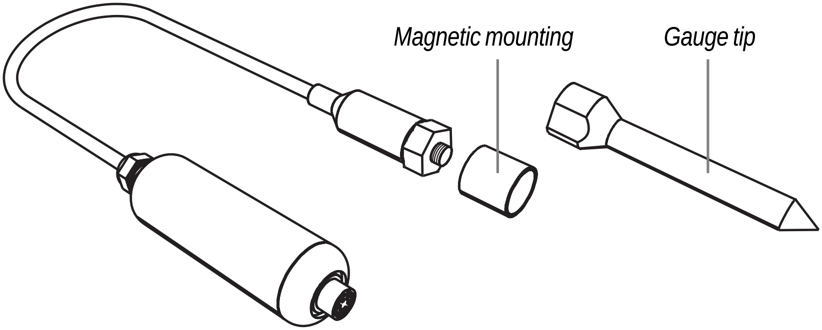
TECHNICAL SPECIFICATIONS

Interface	Serial RS232C, 9600 bauds
Power supply	Battery.
Operating conditions	5–35° C, 20–70% humidity
Dimensions	165x135x50 mm
Weight	560g [19 oz], with a 20 m paper roll
Roll paper	Thermal black printing, Part No.03-0041 width 112 mm, length 20 m diameter 42 mm.
Spare printer cable	Part No. 03-0241



When replacing the paper roll, cut the paper straight.

Vibrometer probe D283: To use together with the Vibrometer program in display unit D279.



TECHNICAL SPECIFICATIONS

(Instrument/Software)	
Measurement range	0–50 mm/s [0–2 inch/s] RMS
Resolution	0.1 mm/s [0.01 inch/s]
Frequency range	Total level: 2–3200 Hz (Lp), 10–3200 Hz (Hp) Bearing condition: 3200–20000 Hz
(Probe)	
Sensitivity	100 mV/g +/-10%
Dimensions	Magnet: L=20 mm [4/5”], Ø=15 mm [19/32”] Gauge tip: L=65 mm [2 1/2”9

Handling B

B. Handling the display unit

```
              MENU
   Unit (s) found:          02
1 Back Light
2 Contrast
3 Date:             1999.01.06
4 Time:                  10:03
5 Auto Off Time:            30
6 Filter:                   05
7 Unit:                0.01 mm
8 Print Screen
9 Send
0 Store                     14
. Help
Battery       L ********** H
```

Shows the number of measuring units/ detectors connected.

Number of measurements stored.

The menu for main settings, print and store is shown when pressing . This can of course be done during measurement. When the display unit is shut off, all the settings will remain *(except measurement filter value and tolerance checked display of measurement result)*.

Press corresponding numeric key to change or execute settings. Only available choices are shown.

*Battery condition is shown as a series of *, Max. at H and Min. at L.*

> ***NOTE!***
> *6: Program BTA DIGITAL; no filter available.*
> *7: Program BTA DIGITAL only uses the resolution level 0.1 mm, 5 mils, 5 thou. Therefore only the unit will be affected when you toggle between the choices, not the resolution.*

1 *Toggle the Backlight of the display between On and Off.*

2 *Each touch changes the Contrast of the display to one of ten steps.*

3 *Set the current Date in the system clock.*

4 *Set the current Time in the system clock.*

5 *Set the time until Auto-Off between 10 and 99 minutes. 00 disables Auto-Off.*

6 *Set Measurement Filter Value between 0 and 30. (see page B19)*

7 *Toggle the units of measurement between 0.1, 0.01, 0.001 mm: 5, 0.5, 0.05 mils: 5, 0.5, 0.05 thou.*

8 *Print the previous screen on a connected printer.*

9 *Send the measurement result to a connected printer or PC.*

0 *Store and Restore measurement results.*

. *Help: Shows available program choices at each step of the measurement program procedure.*

Return.

Help menus are available at most steps in the measurement program procedure. “Help menu” is a display page that shows available button choices (direct commands). This is for example usable when the printed manual is not available.

***1**. To show current Help menu, first press*

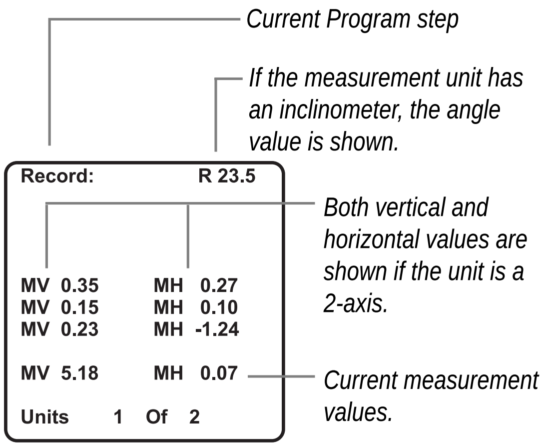
***2**. Then press , and the current help menu is shown.*

***3**. NOTE! The shown button choices are **only active in the measurement procedure**, and not when the Help menu is shown. Therefore, return to the Main menu and the measurement procedure by pressing Menu-button twice. Then press appropriate numeric key.*

<	***Prev. Page***
>	***Next Page***
0	***Set ref. points***
1	***Clear ref. points***
4	***Graph***
9	***Remeasure***

Example from Straightness program when the measurement result is shown digitally. Press 4 and the result will be shown graphically instead.

What the display shows in most programs:



Current measurement values becomes +++++ when loss of signal, for example if the laserbeam is interrupted.
When connection failure, for example if cable isn’t connected, measurement values become --------

STORE MEASUREMENT RESULT

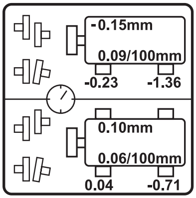
The measurement result with date, time and description can be stored in the internal memory, and will be kept even when the display unit is shut off. The stored result can later on be reviewed on the display, printed or transferred to a PC.
Date and time are stored automatically. When you type the letters and figures in, the cursor jumps to the next position after 1 second. Repeated pressings will give the next letter or figure.
The memory is very large. 1000 shaft alignments or 7000 measurement points can be stored. Occassionally, if the memory is full the oldest measurement stored will be erased and a new result is stored.

Characters

1	*blank _ - 1*
2	*A B C 2*
3	*D E F 3*
4	*G H I 4*
5	*J K L 5*
6	*M N O 6*
7	*P Q R S 7*
8	*T U V 8*
9	*W X Y Z 9*
0	*/ 0*
.	*& ( ) .*

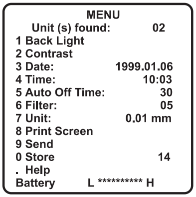
Example: press 9 three times and you have entered Y.

(Example from shaft alignment.)

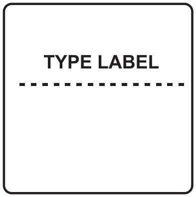


1. The measurement result is displayed...

2. Press the Menu-button



3. Press 0 (Store)



4. Enter a label (Max. 20 characters).

5. Finish and store

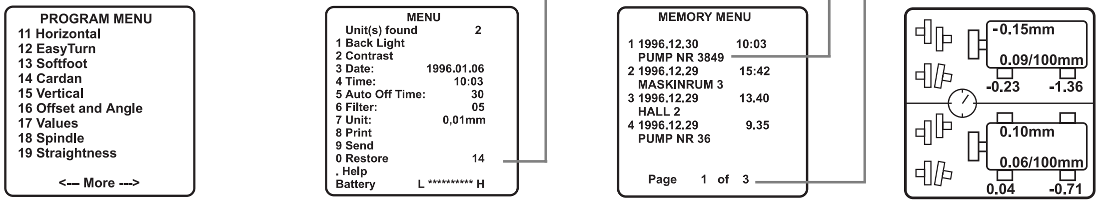
Restore a measurement by turning the system on and then press the Menu-button *before* starting any program. Choose *Restore* and each stored measurement is displayed with Date, Time and Label. The measurements are sorted in chronological order with the latest at the first position (number 1). Up to five measurements can be displayed at each time. Show desired measurement by pressing the corresponding number. When the data is displayed it can be printed or transferred to a PC. This is done as usual via the Main menu by pressing Print or Send. To return to the list of stored measurements when displaying a measurement, press [9]

Your label

Number of stored measurements.

Page number and total amount of pages.

1. Start the system ON / OFF



2. Press Menu-button

3. Press [0] *(Restore)*

4. Press corresponding figure to display desired measurement.
[Toggle between pages with]

5. The measurement result is displayed.
[Return to Memory Menu by pressing [9]]

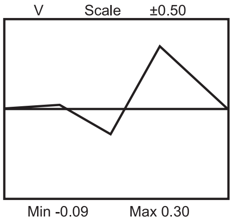
Two options are available for measurement data transfers. These are carried out from the Main menu. The *Print Screen* command transfers a copy of what is shown on the display. Actually a screen-dump.
The *Send* command transfers a complete set of information, in text mode. Transferring a previously stored measurement also includes description if available.
When using the programs *Offset and Angle* and *Values,* measurement values can be sent directly from the detector to the serial port. The EasyLink™ software (or other similar terminal program) can recieve the data sent.

1. Press

2. Press 8 *(print) or* 9 *(send)*

(For installation of EasyLink™, see next page.)

> **Easy-Laser®** is equipped with an *RS 232 C, 9 pin D-sub* connector for printer or PC. The printer must be Epson compatible to achieve a proper graphic printout.
>
> Port settings:
> *9600 Baud, no parity check, 8 data bits,1 stopbit*



---------EASY LASER ALIGNMENT TOOLS----------------

COMPANY : ....

MACHINE : ....

OPERATOR : ....

Date : 1999.02.15 20:01
Filename :
Program : Straightness
Unit : mm
Serial No : 13636, 13633
Temp : 21.4

No	Ref	Distance	V-Values	H-values
1	Ref	0	0.00	0.00
2		100	0.01	0.00
3		100	-0.09	-0.15
4		100	0.30	0.69
5	Ref	100	0.00	0.00
Max			0.30	0.69
Min			-0.09	-0.15

Example: printout from Straightness-program.

Print Screen *performs a graphic screen dump.*

Send *transfers a complete set of information about current measurement in text mode. The serial number of the equipment used and the measurement temperature will also be specified.*

EasyLink™ is a data transfer and database software for Windows. The export function supports the Excel, Works and Lotus programs.
The import function supports, besides Easy-Laser®, also measurement systems from some other manufacturers. Up to 16000 measurements per database can (at the time of publication of this manual) be handled/stored by the program.

For the best functionality the EasyLink™ program should be upgraded continuously. The latest version is always available for download at our web site: *www.damalini.com*
Because of this some of the functions in the program might differ from what is described on the following pages. When necessary, please check the internal Help files of the program.

Installing the program

1. Place the Easy-Laser® CD in the CD drive of your PC. The presentation program that also includes the installation files for EasyLink™ will normally autostart. Choose language. Then the image according to Fig. 1 will appear. Click on the image (at the arrow), then choose type of installation (”full installation” if this is the first time the program is installed).

If the CD doesn’t start automatically, do like this:
Under the [Start]-menu, choose [Run]. Then type the path ”D:\ Software \ Easylink \ Install.exe”. Press [OK].)

EasyLink™ requires; DOS: Windows® 95, 98, NT, 2000 eller XP. RAM: 32 MB
Available hard disk space for program files: 5 MB.
Serial cable – nullmodem type (i.e. serial LapLink cable).

B

Fig.1

2. The program will be installed with preset alternatives if you don't choose otherwise (Fig. 2–3). Press [Next] in the following dialogs until the program installation starts (Fig. 4).

3. Press [Finish] to finish the installation.

4. Remove the CD from the CD drive.

When installation is complete the program icon appears at the desktop. You can also find the program in the [Start]-menu.

Fig.2

Fig.3

Fig.4

B

The first time you start EasyLink™ the program asks for registration data (Fig. 5). You should e-mail this to get information on program updatings.

Update EasyLink™ via the internet

If you want to update an older version of EasyLink™ for Windows, do as follows :

1. Under “Help” in EasyLink™, choose “Update via internet”
2. The dialog in Fig. 6 will appear.
3. Press “OK” and your internet browser starts and locates the address assigned in the dialog.*
4. In the next dialog, choose “Save to disc”
5. Download the file to C:\Program\Well (which is the EasyLink™ folder)
6. Under the “Start” menu, choose “Run” and browse for the file (C:\Program\Well \Update.EXE) where x is the update version)
**Some browsers doesn’t support this function. Then you have to download the file manually from www.damalini.com instead.*

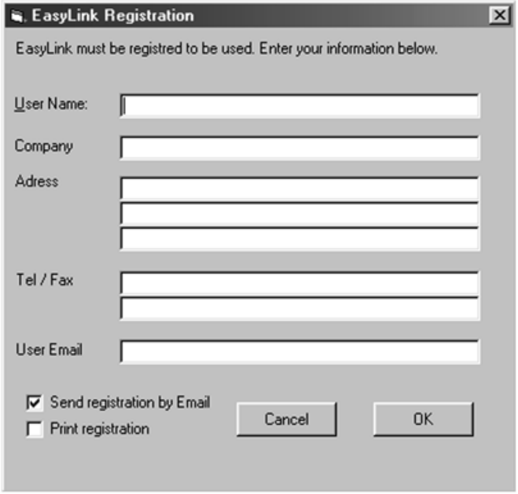


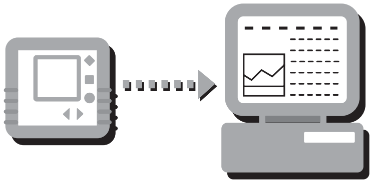
Fig.5

Fig.6

Continued

Communication setup

Start the EasyLink™ program.
Under ”Settings”, choose the Com-port to which the serial cable is connected. Only available ports can be selected. Note that a port that appear to be available sometimes can be assigned to camera or phone programs in your PC, which makes it necessary to reconfigure these.



Transferring data from the Display unit.

Connect the Display unit to the PC with the serial cable that came with the measurement system.

In the Display unit, display the measurement you want to transfer to EasyLink™ by pressing ,

then 0 *(restore)*,

and finally choose your measurement file.

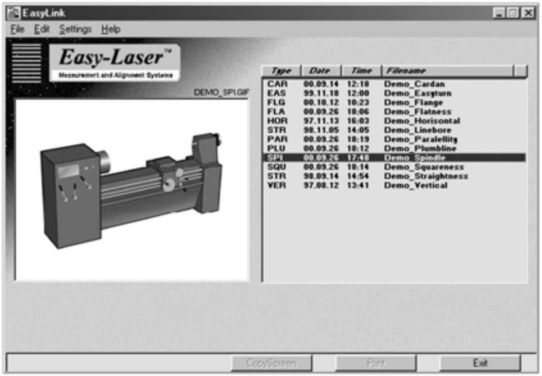
Press the menu button again, and then 9 to transfer the data to the PC.

When the transfer is finished the current measurement will appear in the data window in the EasyLink™ program.

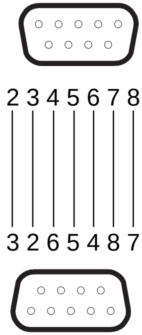
B

Note that it is only from the Start page of EasyLink™ communication with the Display unit can be established. The program automatically assigns a suitable picture, but you can change this picture later to one of your own.

A serial cable for EasyLink™ can usually be bought from any computer store. The cable is a “null modem” cable (also known as Laplink). The connections of the cable must be configured as in the picture to the right.
Note! The length of the cable should not exceed 3 meters.



Start page for EasyLink™ with saved measurements to the right (image can vary).



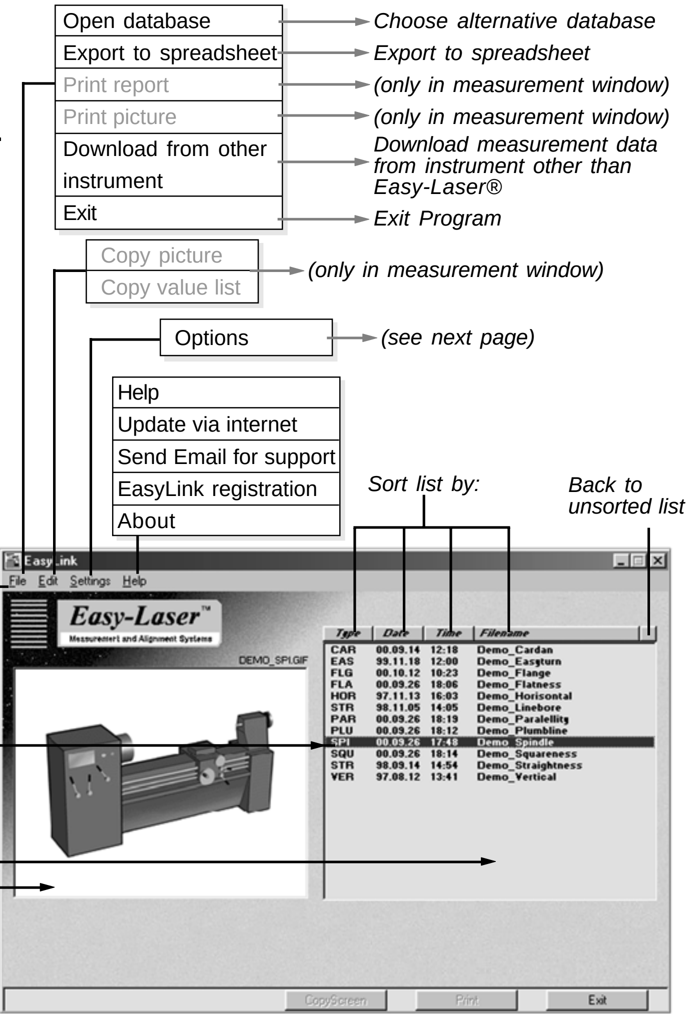
Null modem cable

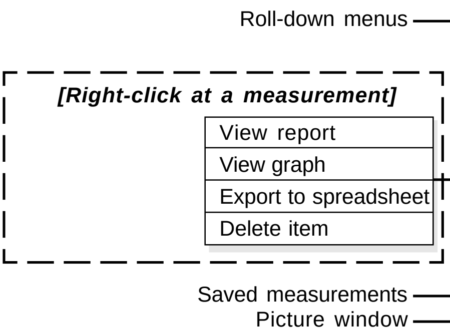
Continued ➡

When you start the EasyLink™-program the START WINDOW appears with all saved measurements listed to the right. You can sort these by *type of measurement*, *date*, *time* or *file name* by clicking at the buttons right above the list.

Open a saved measurement by double clicking on it in the list.

To right-click at a measurement in the list gives you more options (see below).





The Start Window

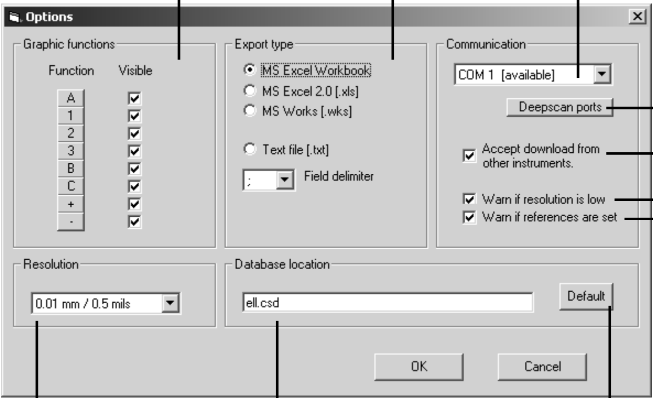
In the Options dialog you can make settings suitable for you.

Choose to which format you want to export your measurement data.

Settings for graphic functions for some geometry programs.

Set Com-port. Only available ports can be selected.

When having problem finding a Com port that is available a Deepscan can be made. This means that the program tries to release Com-ports.



Allows for downloading of measurement data from instruments other than Easy-Laser®.

Warn if the measurement data being transmitted is at a low resolution. (The measurement data will be transmitted with the resolution set in the main menu of the Display unit. This resolution is necessarily not the highest possible.)

Set displayed resolution.

The data base that is displayed when the program is started (default).

Set database to default (ell.csd).

Warn if references are set on the measurement data being transmitted, i.e. if there are points set to 0.00. Then the EasyLink™ program cannot calculate absolute values.

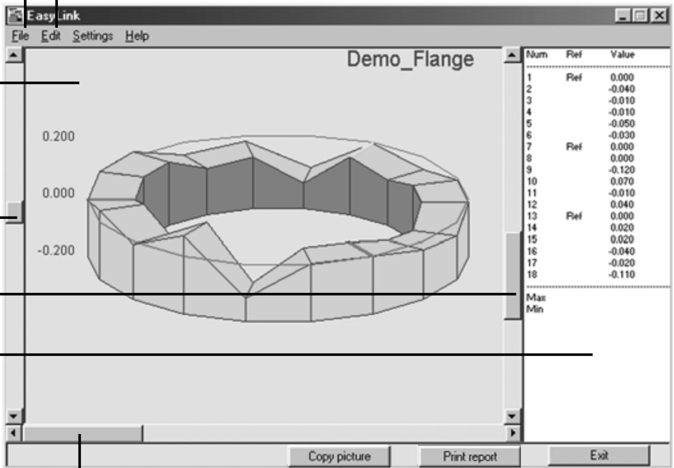
Continued ➡

The different MEASUREMENT WINDOWS are all handled similarly to each other, but in some of them some functions are not possible, such as “Rotate object”.

File menu	
Open database	
Export to spreadsheet	*Export to spreadsheet*
Print report	*Print Data window*
Print picture	*Print Picture window*
Download from other instrument	
Exit	

Edit menu	
Copy picture	*Copy picture window*
Copy value list	*Copy Data window as picture*

Example of a Measurement Window



Picture window

Change visible scale

Change picture angle (possible for 3D-graph)

Data window

(Active measurement data; updates when reference points are moved)

Rotate object (possible for 3D-graph)

Copy Picture window

Print Picture window and Data window

Return to Start window

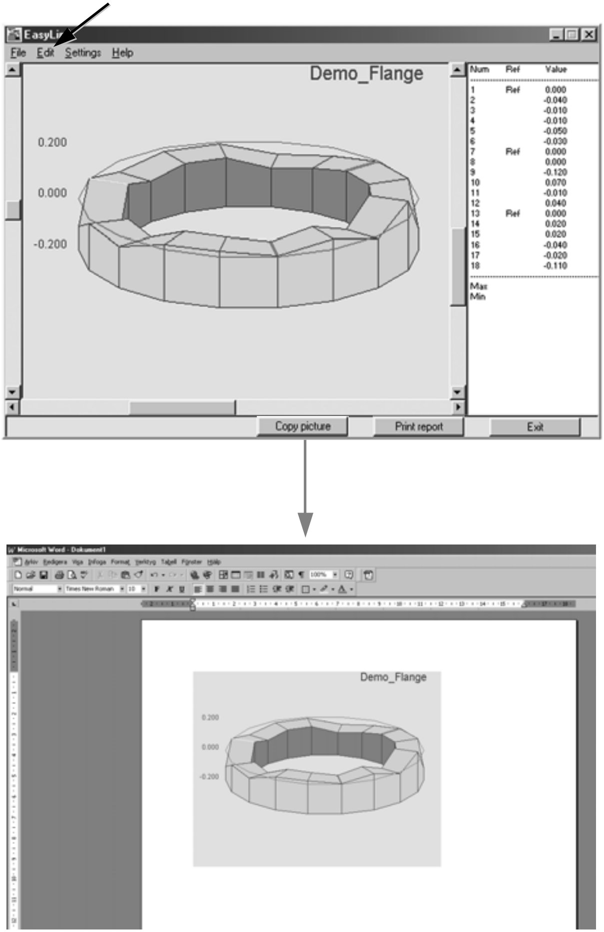
B

Copy the DATA WINDOW to other programs
In the Data window to the right the current data is shown. This window can be copied as a picture, and then pasted in to another document, e.g. Word or Excel documents.

Do like this:
1. Under "Edit", choose "Copy value list"
2. Open your document
3. Paste the picture in [Ctrl+V]

Copy the PICTURE WINDOW to other programs
"Copy Picture" copies the picture in the Picture window, which you then can paste in to another document.

Do like this:
1. Press Copy picture *, or under "Edit",*
choose "Copy picture"
2. Open your document
3. Paste the picture in [Ctrl+V]



Example: Word document with the Picture window pasted

Continued ➡

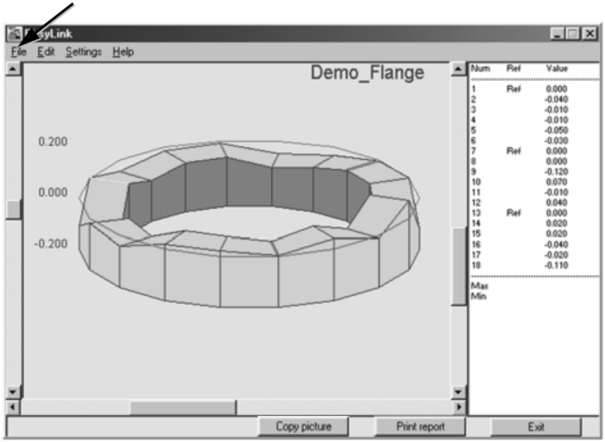
Print the DATA WINDOW and the PICTURE WINDOW

You can make a printout of both the picture and the measurement data at the same time.

Do this:

1. Under “File”, choose “Print report”,
or press Print report

2. Printout is done on your default printer.

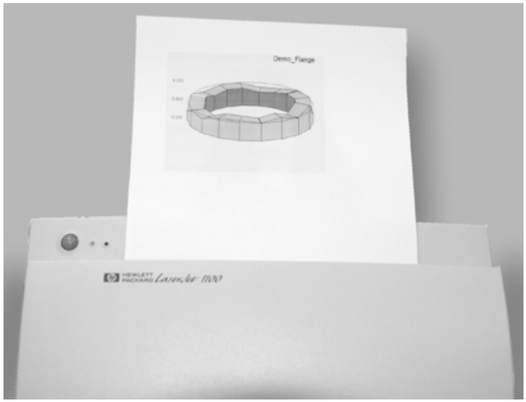


Print the PICTURE WINDOW

Do this:

1. Under “File”, choose “Print picture”

2. Printout is done on your default printer.



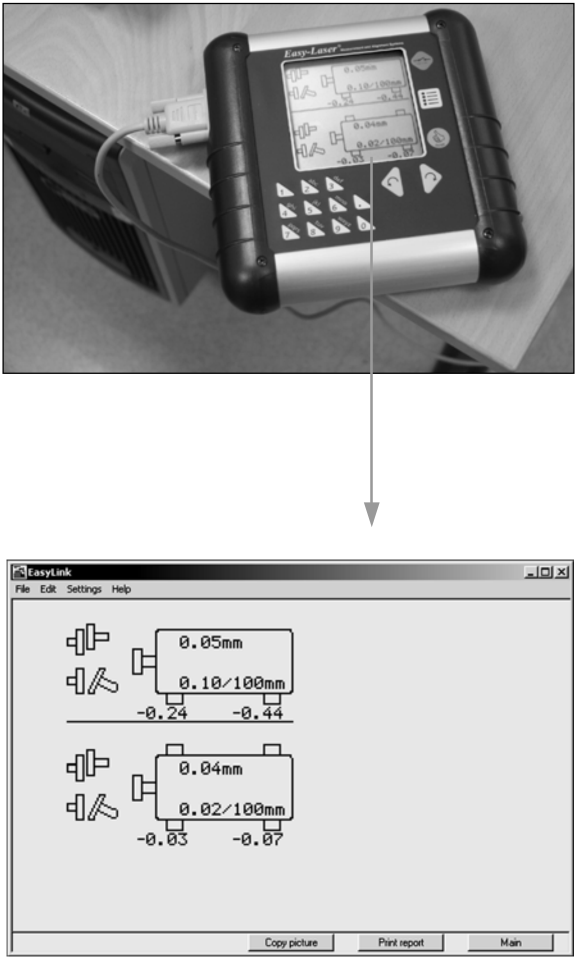
Example: Printout of the Picture Window

B

Copy the screen of the Display unit directly to the EasyLink™ program

Do this:

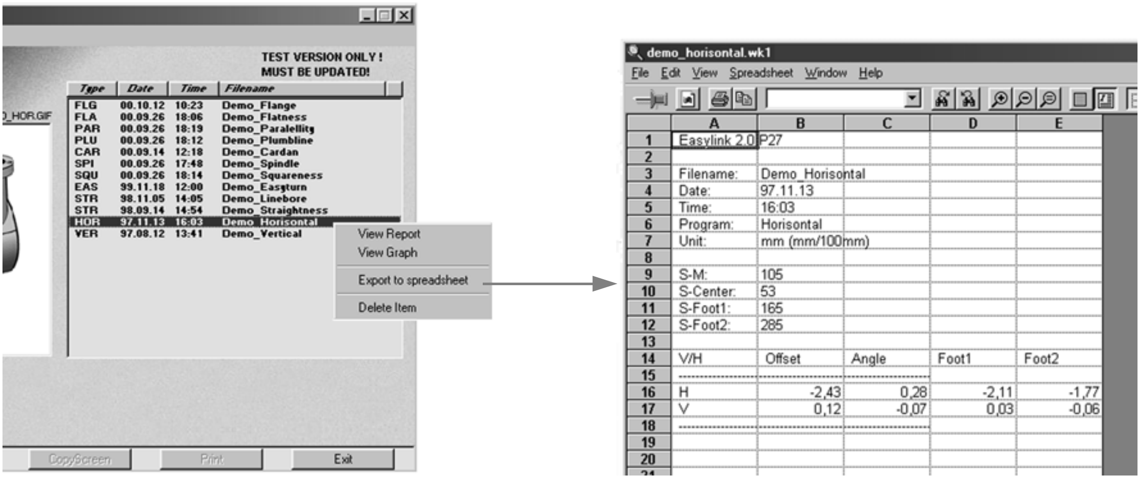
1. Connect the Display unit to the PC.
2. Start the EasyLink™ program.
3. Show the display you want to copy from the Display unit.
4. Press to go to the Main menu.
5. Press 8 and the display is directly copied into the EasyLink™ program, and opened in a new window.

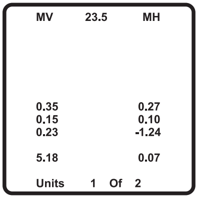


Continued

Exporting measurement data to spreadsheet

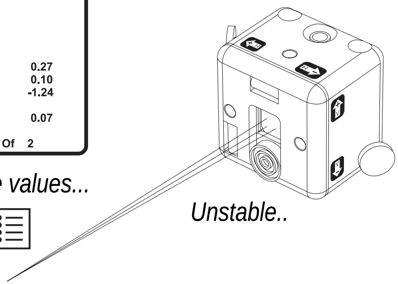
When exporting to ***MS Excel****, do this (the Excel program must be installed on your computer):*
1. In the Start window, first left-click once on the measurement, then right-click it to see the pop-up menu.
2. Choose "Export to spreadsheet" in the pop-up menu.
3. Excel automatically starts and the data is exported to a new spreadsheet.

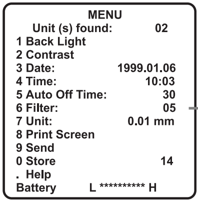




1. Unstable values...

2. Press ☰





3. Press [6] *(filter).*

4. Select suitable value.

5. Press ☰ *to return to measurement.*

When measurement values are registering, “WAIT 5” is displayed, where the number corresponds to chosen filter value and counts down to 0. *NOTE!* Do not interrupt the laserbeam or move the detector before countdown is complete.

If the laser beam passes through air with varying temperature, this may influence the direction of the laser beam. If measurement values fluctuate, this could mean unstable readings. Try to reduce air movements between laser and detector by, for instance, moving heat sources, closing doors etc. If the readings remain unstable, increase the filter time (more samples will become available to the statistical filter). In the Main menu, choose a filter value between 1 and 30. Use as short a time as possible that still produces acceptable stability during the measurement.

Filter value 0=filter not active.

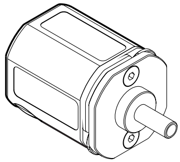
Note! Settings for filter value are not saved when the Display unit is turned off.

Note! Filter is not available for program BTA digital.

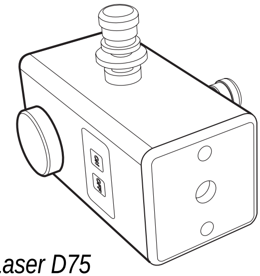
Always ensure a good measurement environment.

B

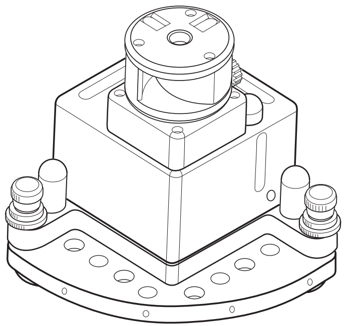
The laser transmitters D22, D75 and D146 can be programmed to minimize the consumption of electricity, and you can choose between two modulation frequencies to fit other systems than Easy-Laser®.
When the laser lights up, current modulation is shown with four blinks for 32 kHz and five blinks for 5 kHz.
Default settings for Easy-Laser® are 32 kHz modulation and no Auto-Off.



Spindle laser D146



Laser D75



Swivelling laser D22

Programming

A. Turn the laser on by pressing the ON-button.

B. Press and hold the ON-button at the same time as you press the OFF-button the number of times corresponding to the list below:

0 (just press ON) Restarts Auto-Off (if enabled)
1 Disables Auto-Off
2 Auto-Off after 30 minutes
3 Auto-Off after 60 minutes
4 Sets the modulation frequency to 32 kHz
5 Sets the modulation frequency to 5 kHz
6 Disables modulation

C. When you release the ON-button the laser transmitter confirms selected function with one to six blinks according to the list above.

Programs C

C. The measurement programs

Misaligned machines cause:
Bearing failure, shaft failure, seal failure, coupling wear, overheating, energy loss, high vibration etc.

Shaft alignment means adjustment of the relative position of two coupled machines, e.g. a motor and pump, so that the centre line of the axis will be concentric when the machines are running during normal working conditions.

Measuring with Easy-Laser® shaft alignment systems means that the system registers measurement values in three positions via measuring units mounted on each shaft. The system calculates and displays the offset value at the coupling, the angular value and the adjustment values for the machine feet on the movable (M) machine.

Procedure

- Safety precautions. Be sure that the machines you are working at cannot be started unintentionally.

- Mount the measurement equipment.

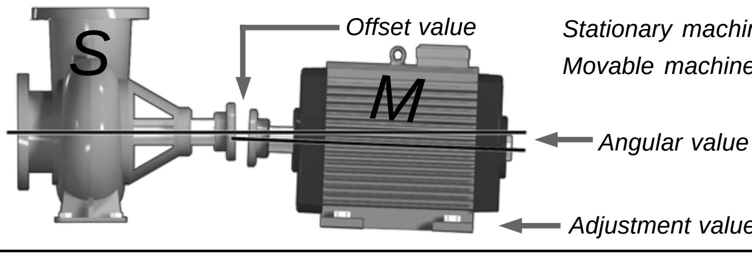
- Select the desired program, then follow the instructions.

- Measure and specify the distances between measuring units, machine feet and coupling.

- Do the measurement.

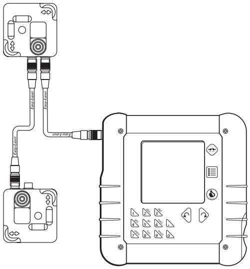
- If neccessary, adjust the machines.

- Document the measurement result.

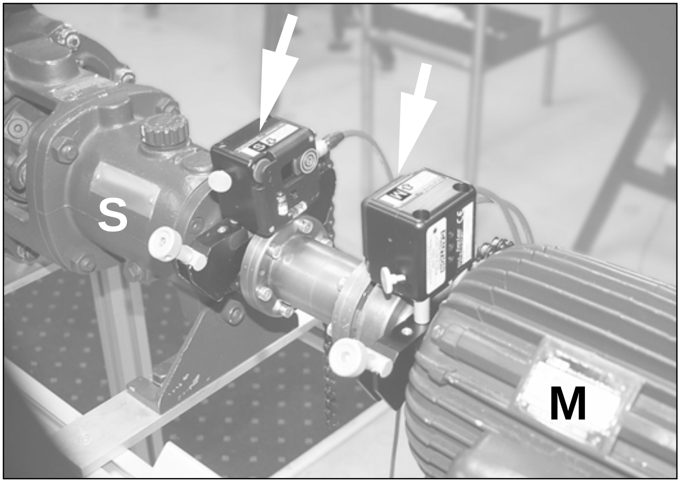


Stationary machine (S)
Movable machine (M)

When you are doing a shaft alignment the measuring units can be mounted with a lot of different brackets. For more examples, see the page “shaft brackets”.



The cables can be connected to any of the two connectors on the measuring unit/detector.



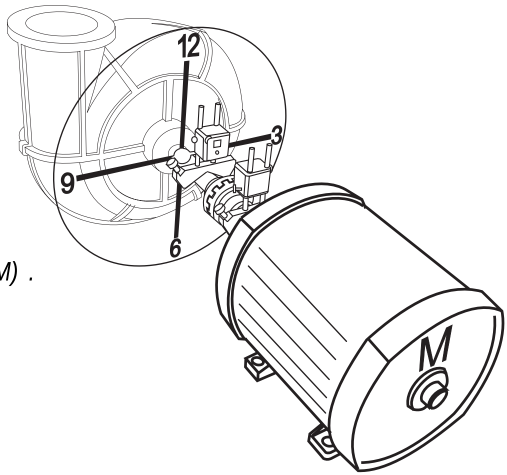
The units mounted with standard shaft brackets. Labels facing away from coupling.

Important!

S-unit on stationary machine.
M-unit on movable machine.

Face the stationary machine (S) from the movable machine (M) .

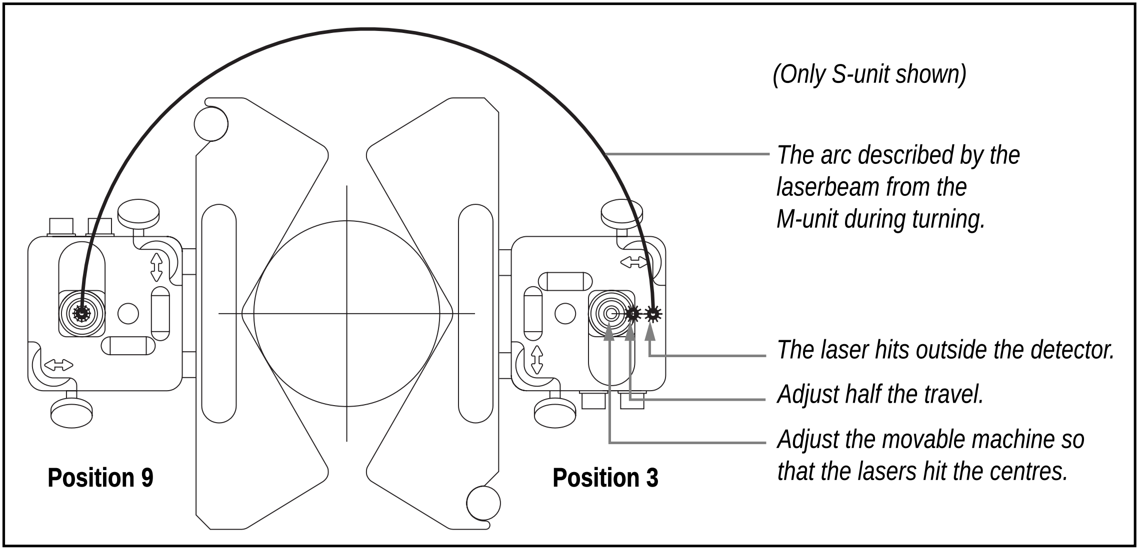
Then 9 o’clock is to the left as shown on the picture.



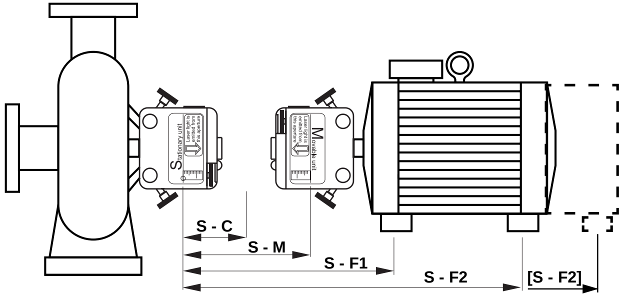
When turning the shafts with measuring units mounted, the laserbeams will project arcs, where the centres will coincide with the centres of the shafts. During the turning the laser beams will move on the detector surfaces. When the alignment is poor the beams may travel outside the detectors. If this happens you will have to do a rough alignment first.
Preparation: mount the equipment, specify the distances.

Rough alignment procedure

1. Turn shafts with measuring units to the 9 o'clock position. Aim the laserbeams at the centre of the closed targets.
2. Turn shafts with measuring units to the 3 o'clock position.
3. Check where the laser hits, then adjust the beam half the travel in direction to the centre of the target (see picture below).
4. Adjust the movable machine so that the laserbeam hits the centres of both the targets.
5. Open the targets before the measurement. Done.

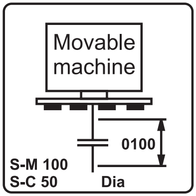


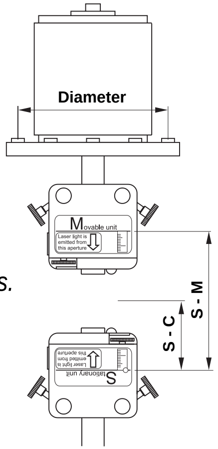
When you select a shaft alignment program the system asks for the distances between measuring units, coupling and feet. Enter the distances according to the pictures below. The system can handle distances between 1 and 32000 mm (1260 Inch).



__S-M__=distance between measuring units.
__S-F1__=distance between stationary detector (S) and feetpair 1 (F1).
__S-C__=distance between S and Center of coupling (if the coupling is in the middle between the measuring units, just press “Enter”. If not, enter the right value).
__S-F2__=distance between S and F2 (must be longer than S-F1).
__[S-F2]__=if the machine has three pairs of feet, you can add this distance after finished measurement, and let the system calculate a new shimming and adjustment value for this pair of feet (see page C7).

Vertical program:



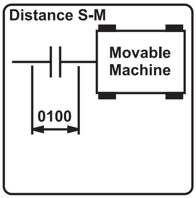


Type the distances in with the numerical keys.

Confirm each distance with 

[Redo ]

Horizontal program:



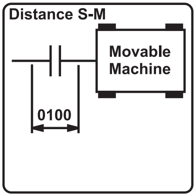
Type the distances in by using the numerical keys.

Confirm each distance with 

[Redo with ]

(11) HORIZONTAL: shaft alignment with positions 9, 12, 3

With the Horizontal program you read values at the 9, 12 and 3 o'clock positions. That is, you turn the shafts a total of 180°. Measurement procedure: mount the equipment, start the Horizontal program, enter the distances, if neccessary make a rough alignment, start the measurement.
NOTE! Check in each position (9, 12, 3) that the laser beams hit the detectors.

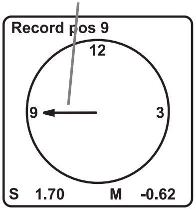


***1. Enter the distances**, as prompted by the system.*

Confirm each distance with

[Redo with]

The mark blinks to show where the measuring units are to be positioned.

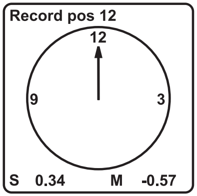


S- and M-unit value

***2. 9 o'clock**. Turn the measuring units/shafts according to the vials into the 9 o'clock position. Adjust the lasers. Open the targets. Record the first measurement value.*

Confirm

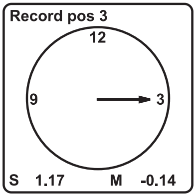
[Redo]



3. Turn shafts to the 12 o'clock position.
Record second value.

Confirm

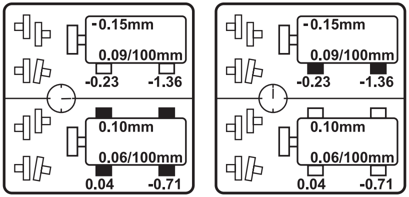
[Redo]



4. Turn shafts to the 3 o'clock position.
Record last value.

Confirm

Horizontal values updates continuously. Vertical values updates continuously.



5. The result is displayed. *Horizontal and vertical positions for the movable machine are shown both digitally and graphically.*

See page C8, "Result for Horizontal machine" for detailed information of the result display.

[By pressing when the measurement values are displayed, a new S-F2 distance can be entered for a third pair of feet. New F2-*values* (adjustment and shimming) will be calculated for this pair of feet and displayed.]

[Press 9 to do a new measurement from the **9 o'clock position**]

[Press 4 to select tolerance checked displaying of the measurement result. *See page C9.*]

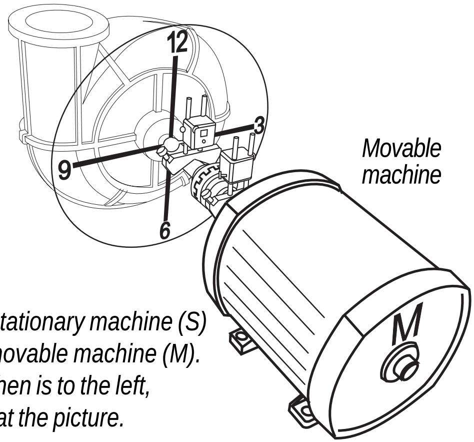
[Press 6 to set values for Thermal growth compensation. *See page C10.*]

An indicator for measurement direction ( ) in the middle of the display shows that the measuring units now have to be in the 3 o'clock position. The horizontal values now updates continuously (live), indicated by filled foot symbols.
Button 5 changes between Horizontal and Vertical live values. The indicator for measurement direction shows in which position the measuring units have to be placed (3 or 12 o'clock) and filled foot symbols shows which direction is displaying live values.

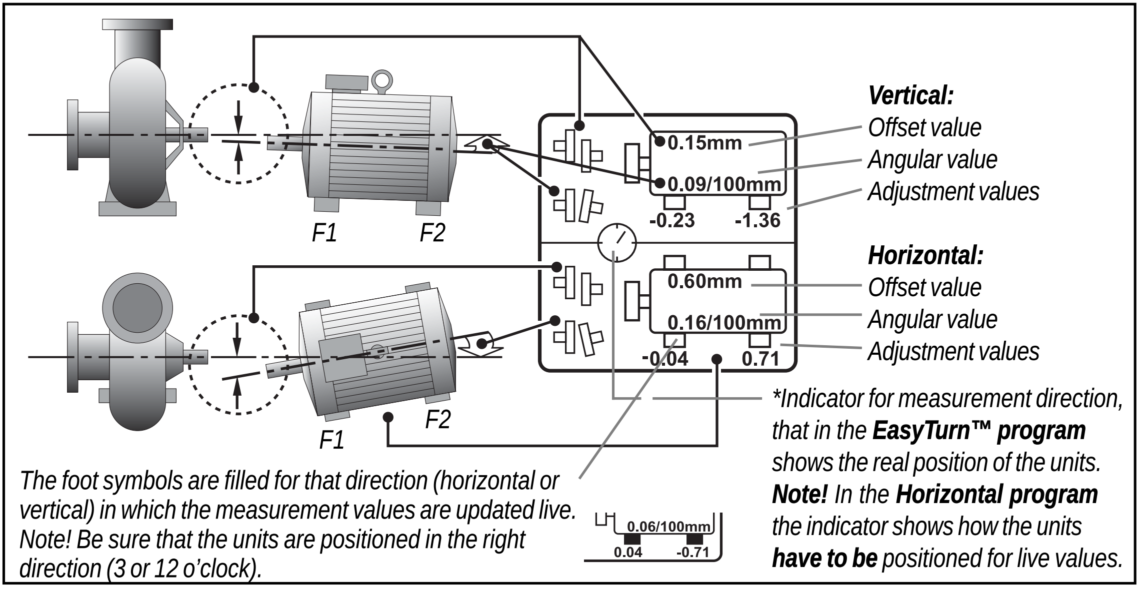
Continued

The result from a measurement of a horizontal machine displays the position of the movable machine, and how to shim and adjust to align the machine. (Note! The indicator for measurement direction works differently for the Horizontal and the EasyTurn™ program. See below*.)

1. Read the values and decide if the machine needs to be aligned. If so:
2. Shim according to the vertical adjustment values.
3. Adjust sideways according to the horizontal values.



Face the stationary machine (S) from the movable machine (M). 9 o'clock then is to the left, as shown at the picture.

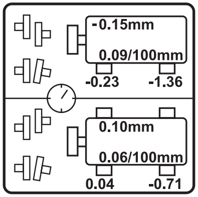


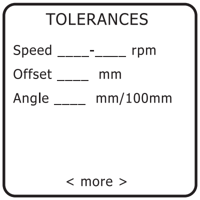
The measurement result can be checked towards tolerance value table. This is based on the speed of the machine. When the alignment is within tolerance, the left part of the coupling symbol is filled. This also works live. The coupling symbols for horizontal and vertical offset and angle is filled independently of each other. This clearly displays which values are within tolerance, making it easy to adjust the others.

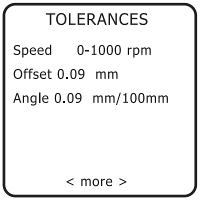
Note! There is a Speed Range "User". Here you can define your own setting. This setting will only remain during this measurement, and will be cleared if you start a new measurement, or turn the Display unit off.

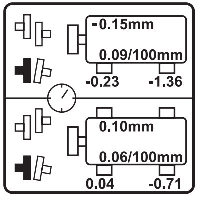
Speed	0–1000	1000–2000	2000–3000	3000–4000	4000–	rpm
Offset	3,5	2,8	2,0	1,2	0,4	mils
	0,09	0,07	0,05	0,03	0,01	mm
Angular error	0,9	0,7	0,5	0,3	0,1	mils/ inch
	0,09	0,07	0,05	0,03	0,01	mm/ 100mm

Tolerance table with maximum values for offset and angle, towards which the actual values are checked.









1. The result is displayed.

Press 4 to select tolerance checked displaying.

2. Select Speed range.

No tolerance values are displayed from the start (the function is disabled every time the measurement system is started).

Press  or  to select speed range. The tolerances is displayed at the same time.

Confirm Speed range 

3. The result is displayed with filled coupling for values which are within tolerance.

(In the example above the angular values are within tolerance, but the offset is too large.)

Compensation for thermal growth

You enter specified values (from the manufacturer of the machines) for offset and and angular deviation caused by thermal growth. The system compensates for these and recalculates the foot values to true adjustment values. This function works with programs Horizontal, EasyTurn™ and Machine Train. Read more about thermal growth at page E9.

Procedure for setting thermal growth values:

1. *At the display, show the result* for the coupling you want to set compensation value for.
2. First enter the direction for the *Horizontal offset*, then the value.
3. *Horizontal angle*; direction and value.
4. *Vertical offset*; direction and value.
5. *Vertical angle*; direction and value.
6. Go back to result display, now it is compensated for thermal growth.

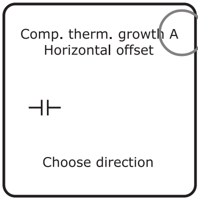
Special notes for Machine Train Program:

NOTE1! When using the Machine Train Program, note that it is the machine "to the right" at each coupling you enter values for. Select coupling by pressing and .

Go to the next coupling you want to set compensation values for and repeat steps 2–6 above.

NOTE2! Works both at graph and digital display.

NOTE3! You can also enter the values directly after the measurement of each coupling.



Example:
Entering compensation values for coupling **A**. *(If you are working with Machine Train Program it will indicate B, C etc here.)*

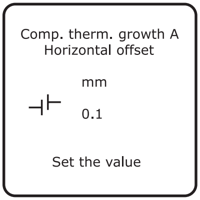
1. Enter the direction for the horizontal offset:

Press [6] *to go to the first question.*

Toggle Between ⊣⊢ ⊣⊢ ⊣⊢ *with*

Confirm choice with

[Redo]

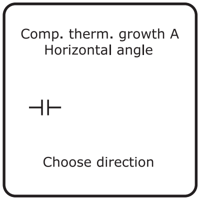


2. Enter the value for horizontal offset:

Type the value with the numerical buttons.

Confirm value with

[Back to step 1]

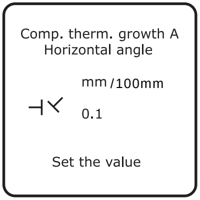


3. Enter the direction for horizontal angle:

Toggle between with

Confirm choice with

[Back to step 1]

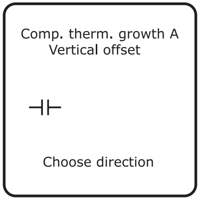


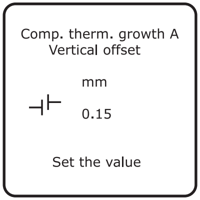
4. Enter value for horizontal angle:

Type the value with the number buttons.

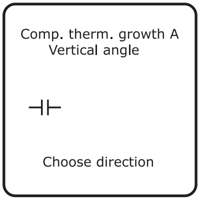
Confirm value with

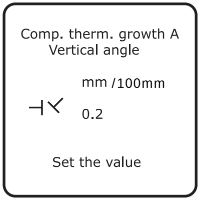
[Back to step 1]





5. Enter the direction and value for vertical offset according to steps 1 and 2.





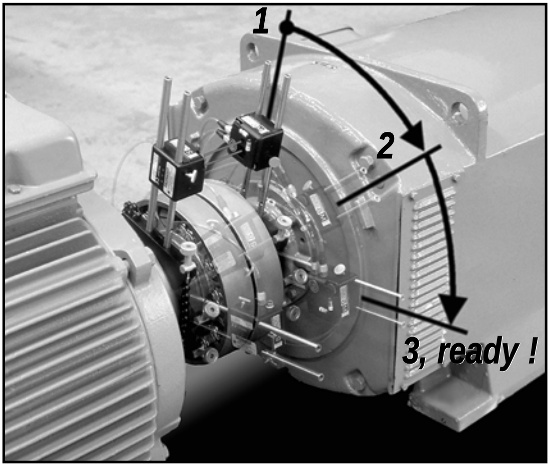
6. Enter direction and value for vertical angle according to steps 3 and 4.

7. The program returns to measurement value display, now with compensation for thermal growth.
If wanted, go to the next coupling (display the result for the coupling) and enter compensation values for this according to steps 1–6.
(The compensation values are shown at the print out.)

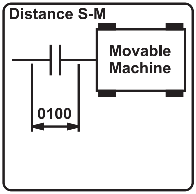
[At a compensated coupling, press 6 to change values. By confirming no value the compensation will be reset.]

With the EasyTurn™ program shaft alignment is possible even if machine parts or piping interfere with 180° of shaft rotation. The smallest angle needed between measurement points is 20°.
Note! For this program the measuring units S, M must have built-in inclinometers.
Procedure: mount the measurement equipment, start the EasyTurn™ program, enter the distances, if necessary do a rough alignment, start the measurement.

Built-in electronic inclinometers detect the angular position of the units. The angles are displayed as hands on a clock (angular marks). If machines are severely misaligned, the beam from the M-unit may not strike the S-unit detector surface. The second and third positions of the M-unit are therefore dependent on the laserbeam from the S-unit.



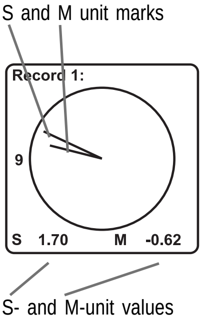
The EasyTurn™ program permits shaft alignment even when you cannot turn the shafts with measuring units to the 9, 12 and 3 o'clock positions.



***1. Enter the distances**, as prompted by the system.*

Confirm each distance with

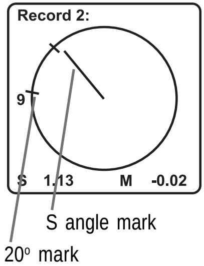
[Redo with]



***2. Place the measuring units** so that the marks are on top of each other (or almost on top). Adjust the laserbeams to the closed targets.*
Open the targets.
Record the first measurement value.

Confirm

[Back]

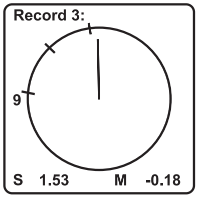


***3. Second reading.** Turn the shafts at least 20° in any direction (displayed as small marks on the circle). If the shafts are uncoupled; first turn the shaft with the S-unit, then close the target at the M-unit, turn the shaft with the M-unit so that the S-laser hits the target.*
Open the target.

Confirm

[Show/hide M-angle mark with 6

[Redo first value]



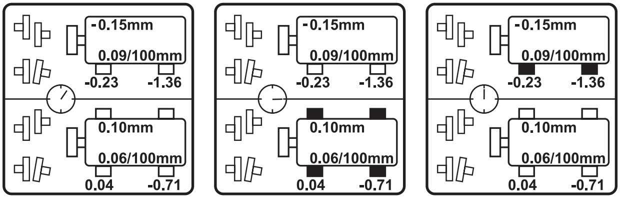
***4. Third reading.** Similar to second reading. Turn shafts beyond the 20° mark.*

Confirm

Continued

Horizontal values updates continuously.

Vertical values updates continuously.



The foot symbols are filled for the horizontal or vertical values when the measuring units are positioned 3, 6, 9 or 12 o'clock (±2º). Then the values are updated continuously in each direction. The indicator for measurement direction ( ) in the middle of the display shows the actual position of the units.

5. The measurement result is displayed. *The Horizontal and vertical positions for the movable machine are displayed both digitally and graphically.*

See page C8, "Result for Horizontal machine" for detailed information of the result display.

[By pressing a new S-F2 distance can be typed in. A new F2-*value* will then be calculated and dislayed.]

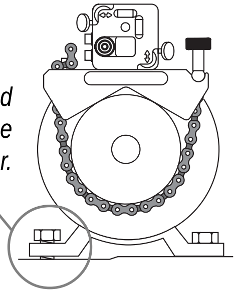
[Press 9 to do a new measurement from **first position "9"**]

[Press 4 to select tolerance checked displaying of the measurement result. *See page C9.*]

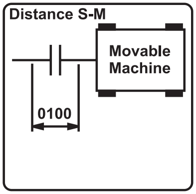
[Press 6 to set values for Thermal growth compensation. *See page C10.*]

Before you begin a shaft alignment you should do a *softfoot* check. Previous shimming or a twisted machine bed may cause the machine to rest unevenly on the feet (=softfoot). The result from this measurement program displays the difference between tightened and loosened bolt. You can go from softfoot check directly to the Horizontal or EasyTurn™ shaft alignment program and keep the entered machine distances.
Procedure: Tighten all bolts, mount the measure-ment equipment, start the softfoot program, enter the distances, start the measurement.
Note! the "Store" function can not be used in this program.

Shimming is required where large variations appear.



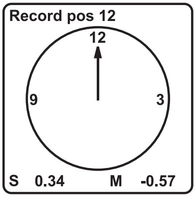
C



1. Enter the distances when prompted on the display.

Confirm

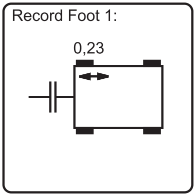
[Redo]



2. Turn to position 12.
Adjust the beams.
Open the targets.

Confirm

[Back]



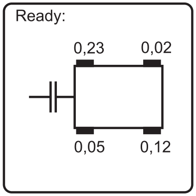
3. Release and tighten first bolt.

Confirm

Redo step 3 for each of the other feet (foot 2-4).

[If desired, zero set with 0]

[Back]



4. The result for all feet are displayed.
Shim the foot/feet with the highest value.

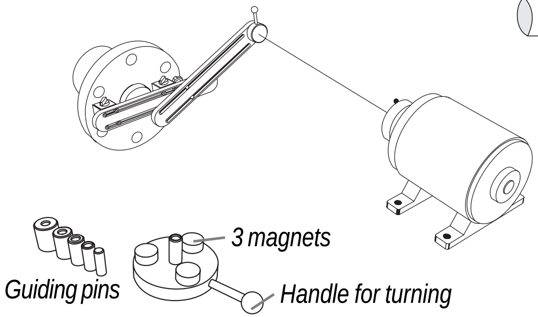
[Remeasure 9]

[To go directly to alignment, and keep the entered distances, press]

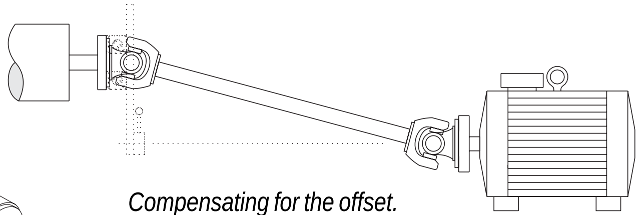
PROGRAM MENU

11 Horizontal
12 EasyTurn

The Cardan program is used when aligning offset mounted machines. The procedure is shown step-by-step.

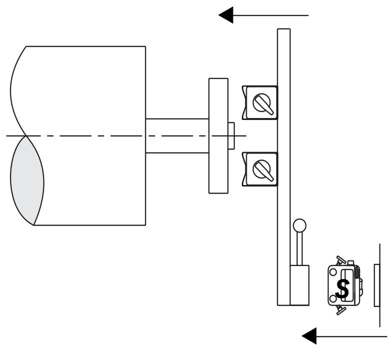


When there are threads at the end of the “movable” shaft, mount guiding pins on the turnable magnet bracket. The guiding pin centres the bracket and permits turning when indexing. Attach the measuring units to the fixtures using the central M6-threads.
NOTE! When the distance between movable (M) and stationary (S) fixture/unit is short (<300 mm), it might happen that the adjustment range in the measuring units will not get the beam to hit within the detector. Then use the M6-thread back at the unit that centres with the laser beam aperture instead.

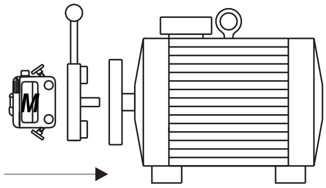


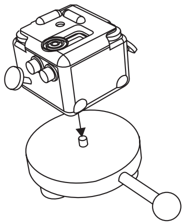
Compensating for the offset.

***1. Mount the fixture arm** with magnets on the shaft end of the stationary machine (if needed, use extension arm to compensate for the whole offset).*



***2. Mount the measuring unit S** on the fixture arm. Attach the large target to the measuring unit.*





3. Mount the turnable magnet fixture *on the end of the shaft of the movable machine. Mount the measuring unit M on the fixture.*

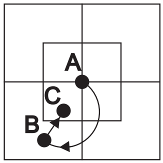
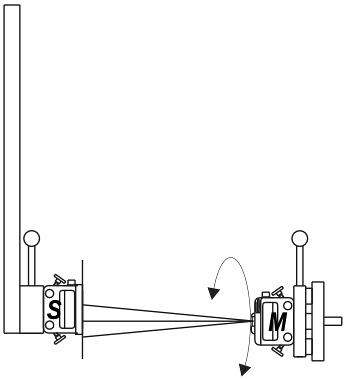
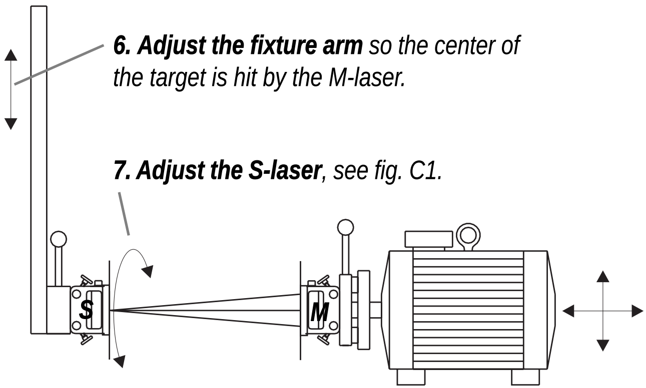


Fig C1*. Turn the unit so one of the vials is levelled.*
Adjust the beam to the centre of the opposite target (A).
Turn the unit half a turn (beam hits B).
Adjust the beam to the centre of rotation (C).

4. Connect the S- and M-unit *to the display unit and start the Cardan program.*



5. Adjust the M-laser beam*, see fig. C1 to the right. Attach a large target on the unit.*



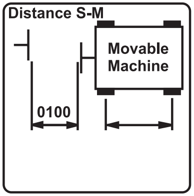
6. Adjust the fixture arm *so the center of the target is hit by the M-laser.*

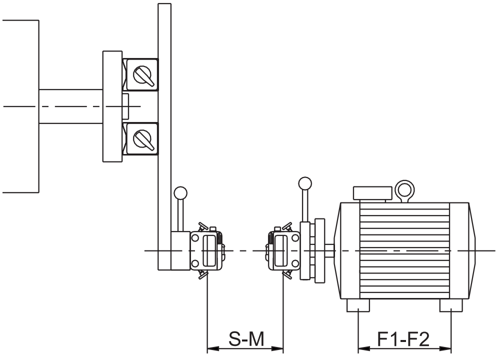
7. Adjust the S-laser*, see fig. C1.*

8. Roughly align the movable machine. *NOTE! Final adjustment of the fixture arm may be needed. Remove the large targets.*

Continued ➡

C

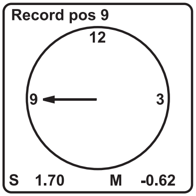




9. Measure and enter the distances.

Confirm each distance with

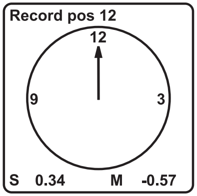
[Redo]



10. Face the stationary machine *from the movable machine. Turn both measuring units to position 9 (S and M-labels to the left). Adjust the beam to the centre of the closed targets. Open the targets. Record the first value.*

Confirm

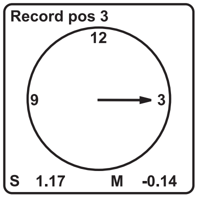
[Redo]



11. Record the second value in position 12. *(Labels upwards.)*

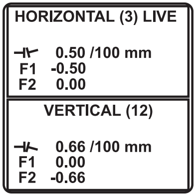
Confirm

[Redo]



12. Record the third value in position 3. *(Labels to the right.)*

Confirm



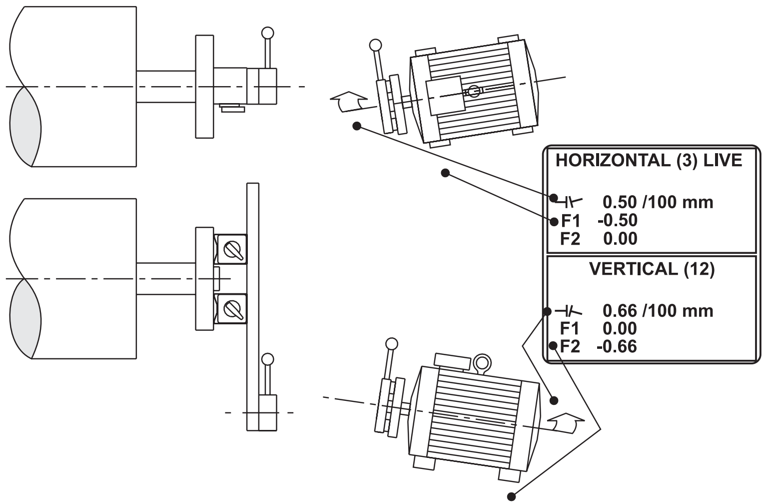
13. The result is displayed.

When parallel adjustment is not needed, only one end of the machine should be adjusted, therefore the other pair of feet is set to zero.

[Pressing 5 will toggle the LIVE display between the horizontal and vertical direction (Measuring units must be in position 3 or 12).]

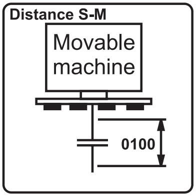
[Press 9 to restart a measurement from position 9.]

Explanation of the measurement result



The Vertical program is used for the measurement of vertical and flange mounted machines. Position the measuring units and record the values at positions 9, 12 and 3. The 9 o'clock position is selected at any bolt. Rotate the measuring units a total of 180°.

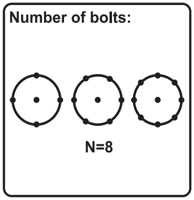
Procedure: mount the measurement equipment, start the Vertical program, enter the distances, number of bolts and the diameter, start the measurement.



***1. Enter the distances**, as prompted by the system.*

Confirm each distance

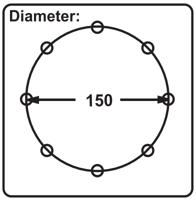
[Redo with]



***2. Enter the number of bolts.** (4, 6 or 8)*

Confirm

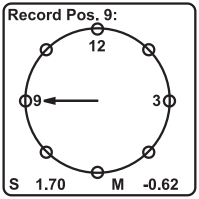
[Back]



***3. Enter the diameter** between the bolts.*

Confirm

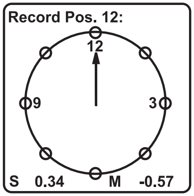
[Back]



***4. Place the units in position 9** (Bolt 1), record the value.*

Confirm

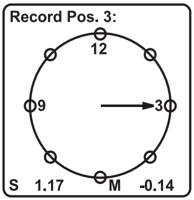
[Back]



***5. Place the units in position 12.** Record the value.*

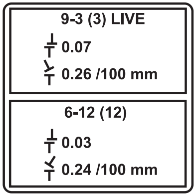
Confirm

[Back]



***6. Place the units in position 3.** Record the value.*

Confirm



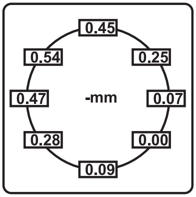
7. The result is displayed.
Offset and angular error in two directions (9-3 or 6-12) for the movable machine are shown both digitally and graphically. If the machine is adjusted, a new measurement is needed to get all the values updated.

Adjust sideways according to the offset value (continuously updated).
The direction depends on the position of the measuring units; 3 or 12.

[Toggle LIVE with [5]]

[To enter new distances, press]

[Press [9] to restart measurement from **position 9**]

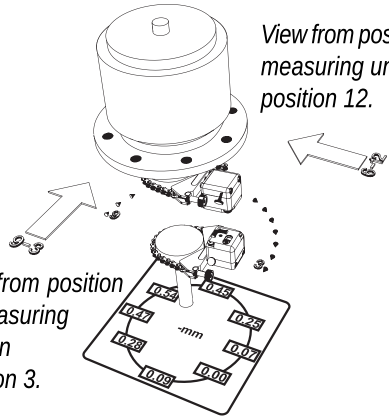


***8. The shim values are shown** by pressing .*
The “highest” bolt is displayed as 0.00.

Shim according to the shim values.

[Press [9] to restart measurement from **position 9**]

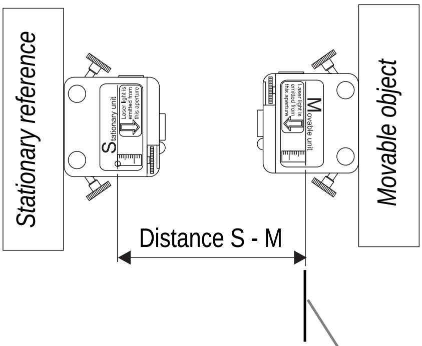
[Back to offset and angular error (step 7)]



View from position 3, measuring units in position 12.

View from position 6, measuring units in position 3.

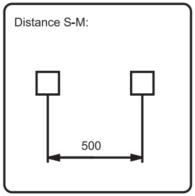
The Offset And Angle program continuously displays measurement values from two measuring units S and M. The measurement values can be zeroed and any offset and angular changes between the units that may occur are displayed. If you are using two-axis measuring units you will get both horizontal and vertical values at the same time. The program is intended for dynamic measurements.



Section to which the offset value relates.

1. Mount the measuring units.

Close the targets.

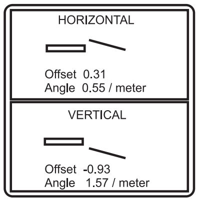


2. Enter the distance S - M.

Confirm 

Adjust the beams.

Open the targets.



(This example shows both horizontal and vertical values, which means that a two-axis measuring unit is used.)

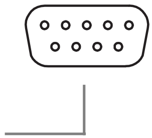
3. The measurement values are shown.

Zero the values by pressing [0]

Absolute values [1]

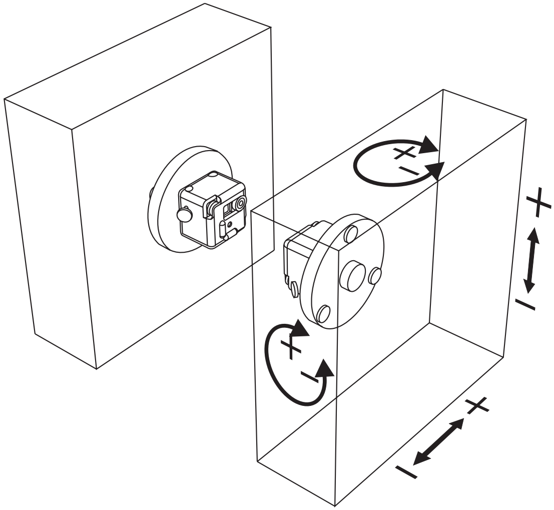
Halve the values [2]

Send to serial port (continuously) [3]

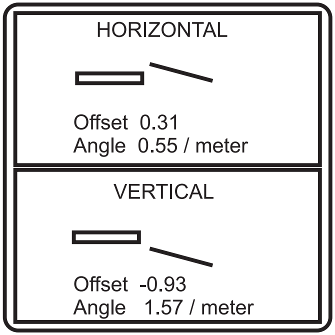


Explanation of movements

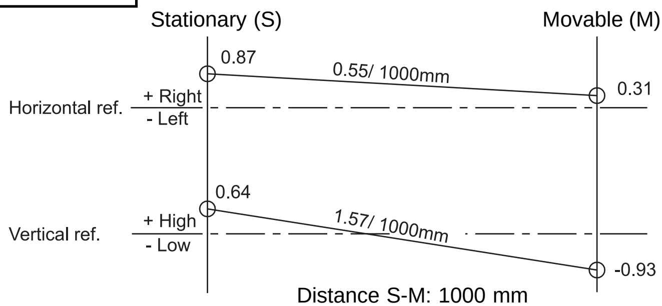
Horizontal and vertical angle changes and offset for the movable object.



Example of measurement values



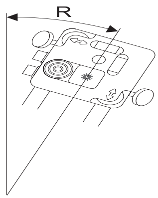
	+ angle	*- angle*
+ offset		
- offset		



The Values program continuously displays measurement values from one detector (of up to four connected). The detector can be the D5, D6, D157 or measuring unit S or M. The laser transmitter can be another measuring unit or a laser transmitter from the Easy-Laser® assortment. With series connection of detectors/measuring units these will be numbered by the system software so that the one with the lowest serial number (counted on the three last figures) will be 1, the next higher serial number will be 2, and so on. Therefore you should connect the units in this order to avoid misunderstanding of which unit you are reading.

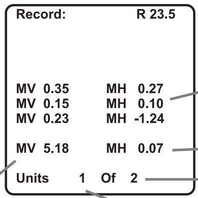
Procedure: mount the measurement equipment, start the Values program, start the measurement.

NOTE! The "Store" function cannot be used with this program.



Angle

The angle of the unit with 0º in the start position.



Registered measurement values

***M**-unit **H**orizontal*

The number of connected units

***M**-unit **V**ertical*

Actual unit

1. The measurement values are displayed immediately when starting the program.

The example shows both vertical and horizontal values from the M-unit. This can be done with two-axis units.

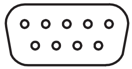
Zero actual [0]

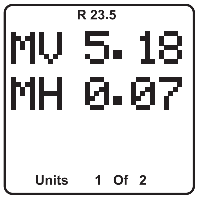
Absolute values [1]

Halve [2]

Send to serial port (continuously) [3]

Large figures / small figures [.]





Last unit

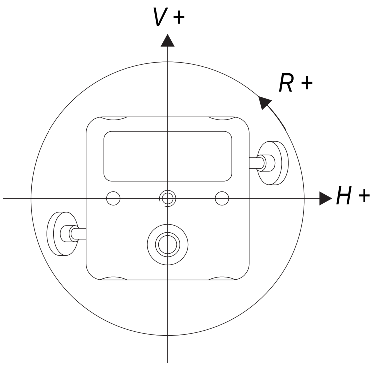
Next unit

Confirm

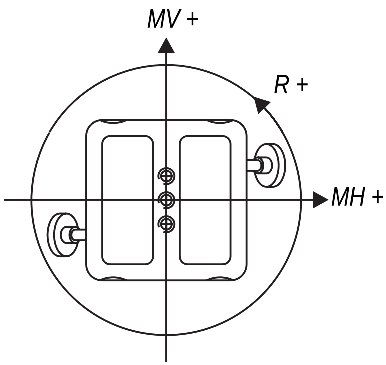
Clear display [9]

H-value on/off [5]

Explanation of the measurement values (+ , -)

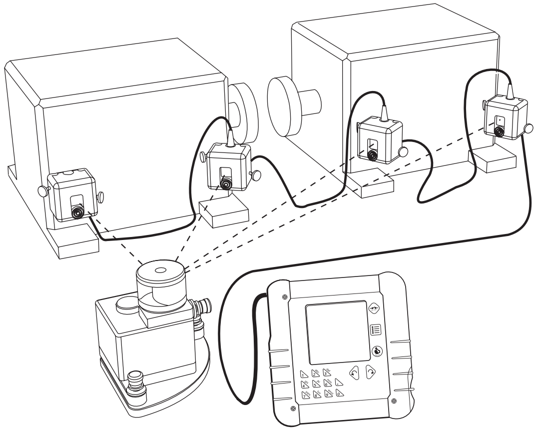


Detector D5 (seen from behind)



Measuring unit M (seen from behind)

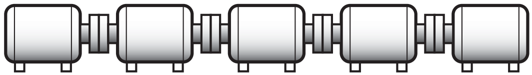
Dynamic measurement



The example shows how four detectors are series connected and placed (shown without fixtures on the picture) to detect how e.g. a motor and a gearbox move relative to each other, for example depending on thermal growth. Each detector can be zeroed individually.

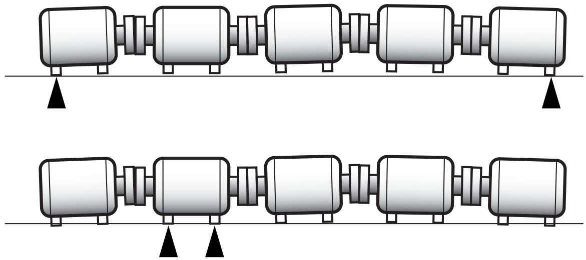
C

With the Machine train program up to ten coupled or uncoupled machines in a row (nine couplings) can be measured. The EasyTurn™ function is used, which allows for a complete measurement with only 40° turn of the shafts. The display shows live values both digitally and graphically, which makes the alignment easy. Note! The measuring units S, M must have built-in inclinometers.



Feetlock

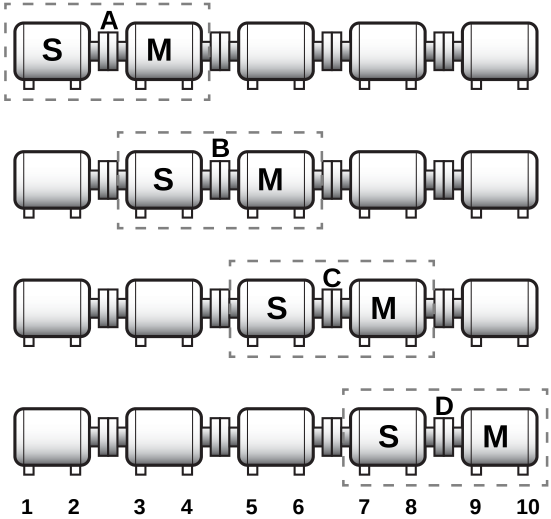
The program has Reflock function which means that any two pairs of feet in the machine train can be used as stationary reference, e.g. pair 1 and 10 or 3 and 4 (see fig.). The program is also suitable for measurement of two machines, e.g. a motor and a pump. You can choose which machine you want to use as stationary by changing references in the program.



Compensation for thermal growth

You enter specified values (from the manufacturer of the machines) for offset and and angular deviation caused by thermal growth. The system compensates for these and recalculates the foot values to true adjustment values.

Note
During the measurement, the S-unit must always be mounted on the left machine (see fig).

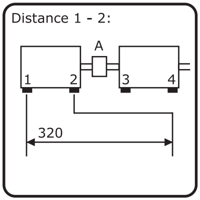


Explanation of signs
On the display these signs are displayed:
A, B, C, ...=the order and name of the couplings.
H=horizontally
V=vertically
S=stationary
M=movable
L=live
Ref.=reference
Ang.=angle
Off.=offset
1, 2, 3, ...=the order of the feet pair.

Measurement procedure (briefly)
1. Mount the measuring units at the first coupling (A).
2. Enter the distances according to the display.
3. Record the values at the first coupling.
4. Move the measuring units to the following couplings (B, C and D if four couplings are to be aligned), enter the distances and record the values.
5. If wanted, enter values for thermal growth compensation.
6. Enter which pair of feet that are to be references (by default the feet of the first machine, 1 and 2, are set to reference).
7. Document the measurement result.

Continued ➡

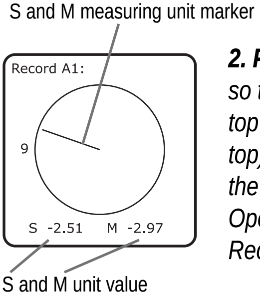
C



***1. Enter the distances**, as prompted by the program.*

Confirm each distance with

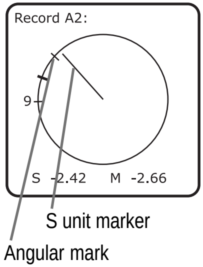
[Back]



***2. Place the measuring units** so that the unit markers are on top of each other (or almost on top). Adjust the laser beams to the targets.*
Open the targets.
Record the first value.

Confirm value with

[Back]

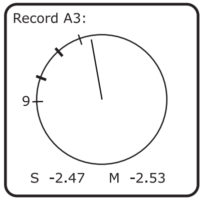


***3. Second value.** Turn shafts a minimum of 20° in any direction (shown as small angular marks at the circle). For uncoupled shafts; first turn the shaft with the S-unit, close the target on the M-unit, then turn the shaft with the M-unit so that the S-laser hits the target. Open the target.*

Confirm with

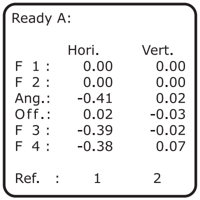
[Show/hide M-angular marker 6]

[Redo first value]



***4. Third value.** As second value. Turn units beyond 20° markings.*

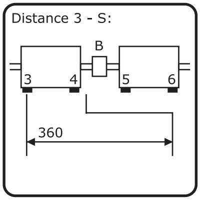
Confirm with



5. The result for coupling A is shown. *Horizontal and vertical position, and angle and offset for the machines are displayed digitally. As default pair of feet 1 and 2 are set as stationary references.*

Press to continue the measurement at coupling B.

(See step 11 for graph display.)
(See step 12 for reference setting.)
(See page C10 for thermal growth compensation.)
(See page “Measurement result” for adjustment of the machine.)

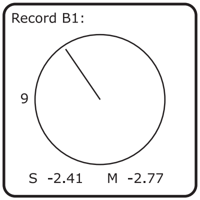


6. Enter the distances for coupling B*, as prompted by the program.*

Confirm each distance with

[Back]

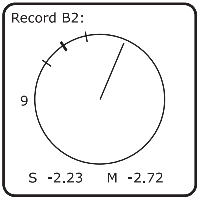
(Note! The program already knows the distance 3–4.)



7. Place the units *so that the markers are on top of each other (or almost on top). Adjust the laser beams to the targets.*
Open the targets.
Record the first value.

Confirm with

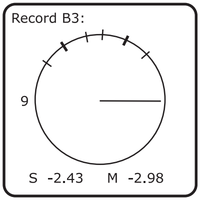
[Back]



8. Second value.

Confirm with

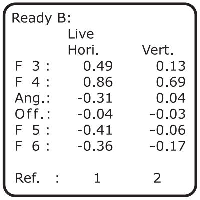
[Redo first value]



9. Third value. *As second value. Turn units beyond 20° markings.*

Confirm with

Continued ➡



The result is displayed. Horizontal values are shown in “Live”. This means that the measuring units are in position 9 or 3.

10. The result for coupling B is displayed. *Horizontal and vertical position, and angle and offset for the machines are displayed digitally.*

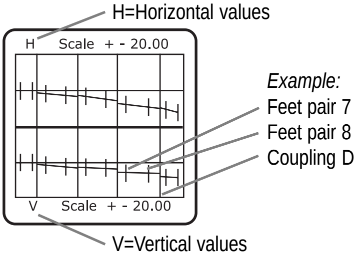
Press to continue the measurement at coupling C (and after that D when the result for C is displayed), then follow the procedure according to steps 6–9.

[It says “LIVE” at either the horizontal or the vertical values when you turn the shafts with measuring units to positions according to 3, 6, 9 or 12 o’clock (±2°). Then the value updates continuously in each direction.]

[Change which coupling result is displayed by pressing

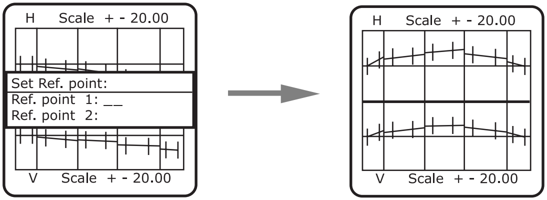
or]

[Press 6 to set values for Thermal growth compensation. *See page C10.*]



11. Graph display of the result:

Toggle between graph/digital display of the values 4



Window for reference setting.

Feet pair 1 and 10 as references.

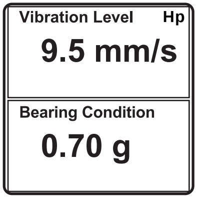
12. Change references:

Press 0 *to set new references. Enter the figures of the feet that are to be references. Confirm each with*

(NOTE! Works both at graph and digital display.)

General

Easy-Laser® Vibrometer can be used in preventive as well as active maintenance work on rotating machinery. Easy-Laser® Vibrometer is measuring the effective velocity (mm/s or inch/s RMS) in the frequency range between 10 and 3200 Hz (alt. 2–3200). This range covers most of the frequencies that will occur for the majority of mechanical malfunctions and imperfections, for example unbalance and misalignment. The judgement of the measured levels is greatly supported by several vibration standards. A comparison between vibration levels and actual wear being performed on the machinery will quickly build up a knowledge of the machine, and which type of action is required when higher vibrations are found. A common standard for judgement of vibrations is ISO 10816-3. This standard is an upgrade of older standards that has been in use for several decades and has a world wide acceptance as a good judgement for continuos and long lasting operation of machinery.



1. The display shows Vibration Level (mm/s [inch/s]) and Bearing condition value (g) at the same time. *(For interpretation of the values, see the following pages.)*

The current frequency range is indicated.

Press to toggle frequency range between 10–3200 Hz (Hp) and 2–3200 Hz (Lp).

Pressing will exit the program back to Program Menu.

[Store measurement value: see page B4]

Continued ➡

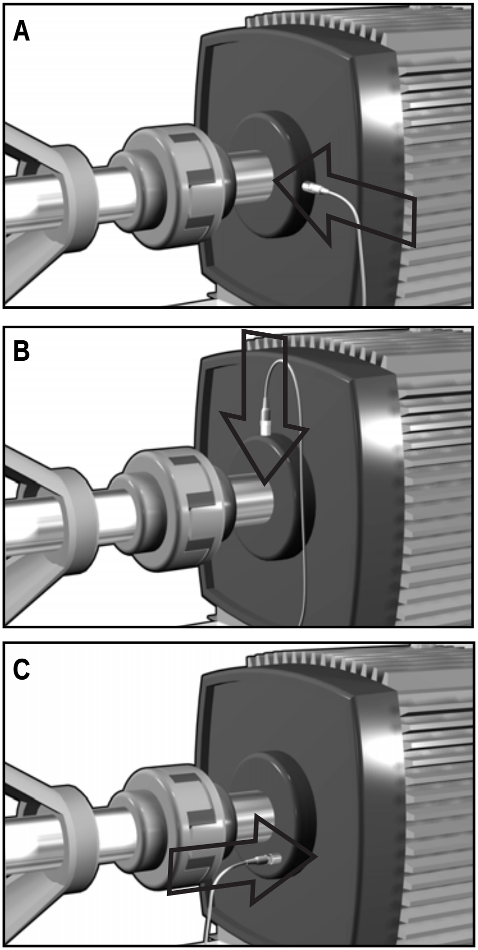
How to make good measurements.

Place the transducer (the probe) firmly against the measurement point. The sensitivity direction of the transducer coincides with the centre axis of the transducer. The main purpose is to make the complete transducer to fully participate in the motion of the measurement point. Try to hold the probe as vertical, horizontal or axial as possible, even if the machine surface does not have these directions.

Note! When using the magnet or the measuring tip the *bearing condition value* can be substantially changed. Use the M6 stud on the transducer for high frequency measurements, and mount the probe directly to the machine.

When the transducer is mounted with the magnet the frequency range of the measurement is reduced to about 2000 to 3000Hz depending on the flatness of the measuring surface.
When the measuring tip is used the frequency range is reduced to about 800 to 1500Hz.
Vibrations at high frequencies can sometimes cause measurement problems. Pressing the transducer mora firmly should not change the reading. If in doubt, always try to adjust the contact point first. Secondly, if shown to be necessary, mount the transducer with the M6 stud.

All normal measurements on vertical or horizontal machinery should follow the three perpendicular axis of true vertical, horizontal and axial directions. The reason is that you should keep to the main stiffness directions caused by normal non symmetrical properties of the foundation, piping, supports etc. It will result in better understanding if the basic measurements are made in this way.



Placing the measuring points. The measurements should be made as close as possible to the bearing and only horizontal (A), vertical (B) or axial (C).

Recommended vibration levels in mm/s and common findings.
This simplified list can be used, as a first consideration, when you approach a machine newly commissioned or after some time in operation. Take as a good housekeeping rule to investigate the reason for any machine that vibrates above 3 mm/s [0.12 inch/s] RMS. Do not leave them above 7mm/s [0.27 inch/s] without being assured that they will sustain long term operation without increased wear.

0 – 3 mm/s 0 – 0.12inch/s	Small vibrations. None or very small bearing wear. Rather low noise level.
3 – 7 mm/s 0.12 – 0.27 inch/s	Noticeable vibration levels often concentrated to some specific part as well as direction of the machine. Noticeable bearing wear. Seal problems occur in pumps etc. Increased noise level. Try to investigate the reason. Plan action during next regular stop. Keep the machine under observation and measure at smaller time intervals than before to detect a deterioration trend if any. Compare vibrations to other operating variables.
7 – 18 mm/s 0.27 – 0.71 inch/s	Large vibrations. Bearings running hot. Bearing wear-out cause frequent replacements. Seals wear out, leakage of all kinds evident. Cracks in weldings and concrete foundations. Screws and bolts are loosening. High noise level. Plan action soonest. Do your best to reveal the reason.
> 18 mm/s > 0.71 inch/s	Very large vibrations and high noise levels. This is detrimental to the safe operation of the machine. Stop operation if technically or economically possible considering the plant stop cost. No known machine will withstand this level without internal or external damage.

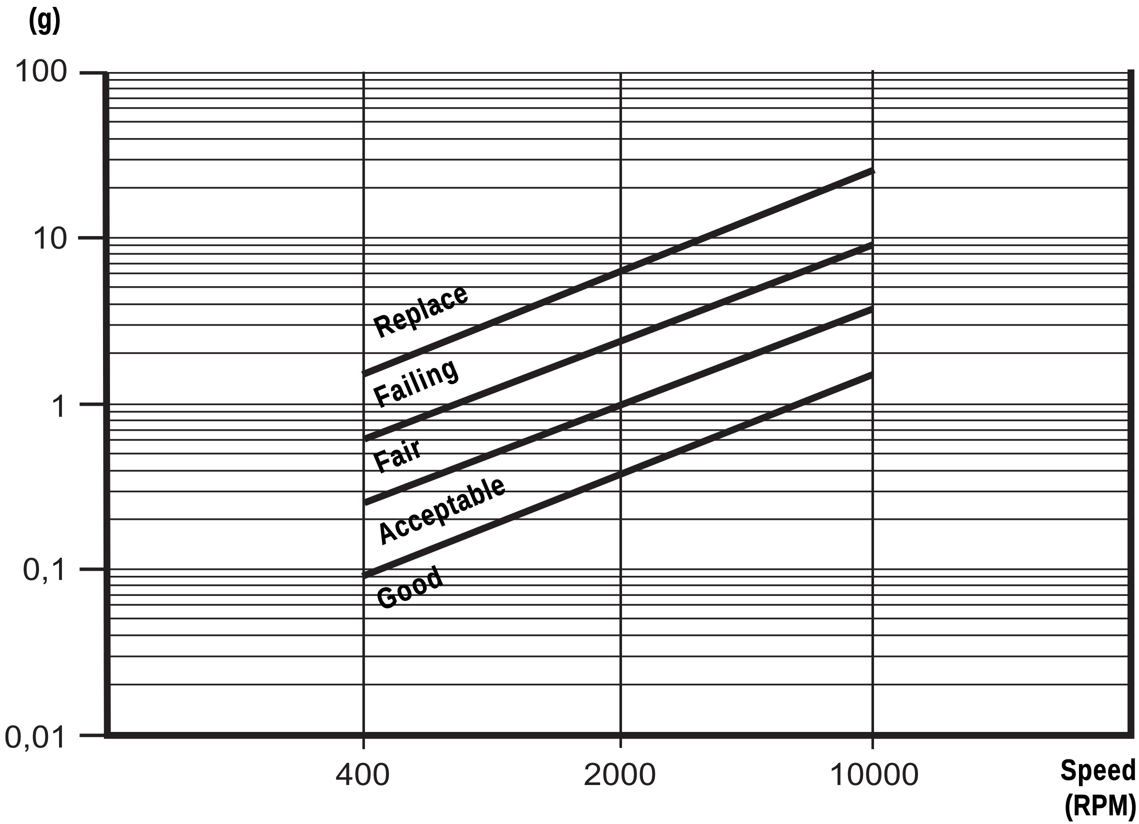
Continued ➡

What is a bearing condition value?
The bearing condition value is the sum average value, RMS value, of all high frequency vibrations between 3200 Hz to 20000 Hz. This value is an acceleration average with the unit “g” because high frequencies give a large signal if it is measured in acceleration. When the balls or rollers rotate inside the bearing a wide-band noise and vibration arises. This noise and vibration are increased if the bearing is poorly lubricated, overloaded due to misalignment or has a damaged surface.
Because this is a wide-band noise and vibration it is possible to select any frequency or frequency band as a measurement of bearing condition.
If the selected frequency band includes low frequencies the bearing condition value would also include vibrations from unbalances, misalignment, etc., and not purely from bearing vibrations and would therefor be difficult to interpret.
If the selected frequency band only includes very high frequency noise and vibrations we would need special vibration transducers that are very rigidly and closely mounted to the bearing because the machine structure works as a mechanical filter for high frequencies.
High bearing condition values can appear at gear boxes, converting machines with cutters and similar machines without any bearing faults because they “naturally” produce frequencies above 3200 Hz.

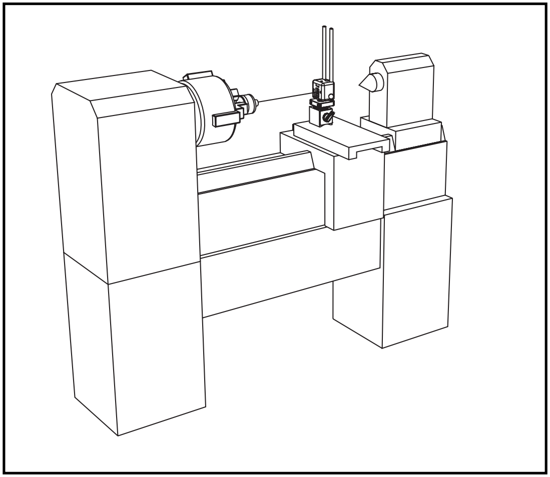
NOTE! *A high bearing condition value should always be used as a request to make frequency analysis, for example with Easy-Viber™. Do not change bearings before this is done.*

The bearing condition value is RMS value of all high frequency vibrations in the range of 3.200 Hz to 20.000 Hz. This average has the unit “g” (=acceleration due to gravity).

Note! The diagram below is only a guide to interpret the bearing condition value.



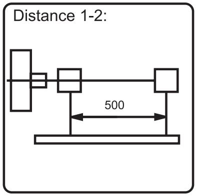
For spindle alignment you can use the D146, the D22 or S-unit as transmitter mounted in the spindle. The detector is placed at the part of the machine that can be moved along the working area of the machine. It can be a D5 detector or a M-unit.
Procedure: mount the laser in the spindle and the detector on a magnet base, start the Spindle program, enter the distances between first and second position, if neccessary rough align the laser, start the measurement.



Laser D146 can be used during rotating spindle measurement. This eliminates eventual static hang down of the spindle. You run the machine at 500–2000 rpm. When the Spindle program prompts you, record value 1 and 2 at each question. Then move the *detector* to pos. 2 and register measurement values 3 and 4.

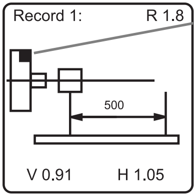
***NOTE!** It is only the D146 that can be used to measure during rotation.*

The symbol indicates that the spindle+laser must be rotated 180° before recording the value.



1. Enter the distances *between position 1 and 2.*

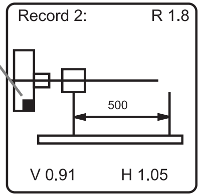
Confirm



2. Record the first value *at position 1.*

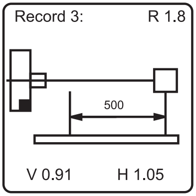
Confirm

[2-axis detector:
H-value on/off with 5]
[Back]



3. Rotate the spindle 180°. *Record the second value at position 1.*

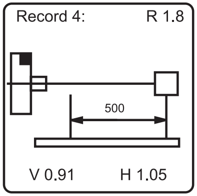
Confirm



4. Move the detector *the entered distance, then record the third measurement value at the second position of the detector.*

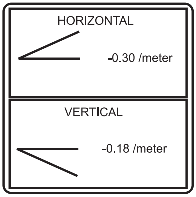
Confirm

[2-axis detector:
H-value on/off with 5]
[Back]



5. Rotate the spindle 180°. *Record the fourth measurement value at position 2 of the detector.*

Confirm

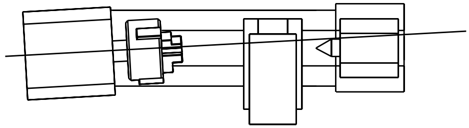


6. The measurement result is displayed.

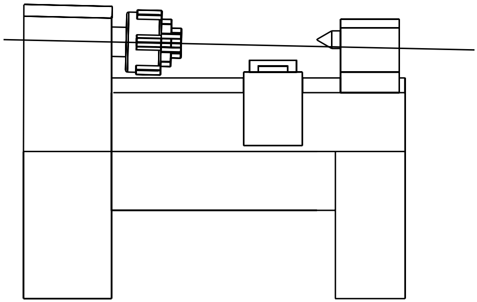
[Back]
[Remeasure from position 1 9]

Continued

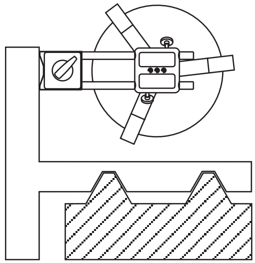
Horizontal pointing direction



Vertical pointing direction



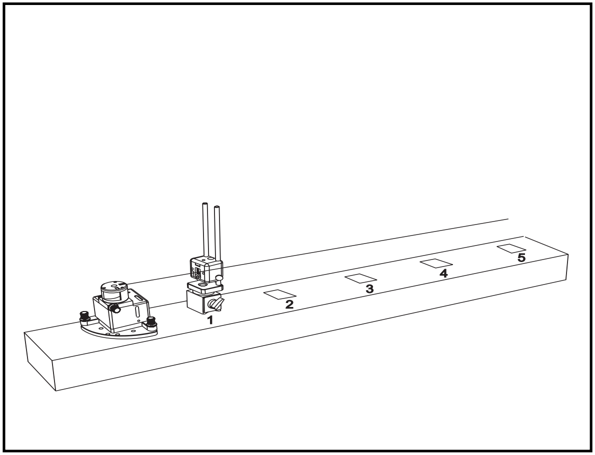
The result displays the pointing direction and a value in mm/meter (mils/inch). Horizontal value only when the H-value has been displayed when registering the fourth value.

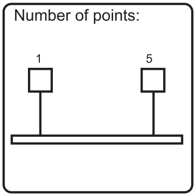


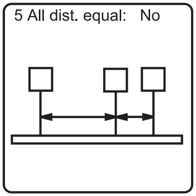
Horizontal value with 1-axis detector will need this to be placed in the 90° position with the label to the right.

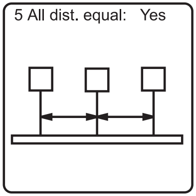
Straightness program. Prepare for the measurement by marking the desired measurement points. The program can handle up to 150 measurement points with two zero points. Aim the laser according to measurement principle on page E15.

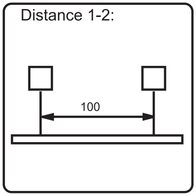
Use laser transmitter D22, D23 or D75 and detector D5, D6 or D157 with suitable fixtures depending on application.
For straightness measurement you can also use S- and M-unit (see page D5).











1. Enter the number of measurement points (2–150).

Confirm

[Redo]

2. Are the points evenly placed on the object? Yes or No?

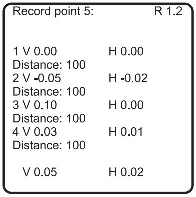
*Toggle between **No / Yes** with* 5

Confirm choice with

3. Enter the distances.
*If **evenly placed** points, just enter this distance and confirm*

*If **different** distances, enter each distance and confirm each*

Continued



4. Place the detector at the assigned point, then record the value.

Confirm

[Zero value 0]
(only at measurement point 1)

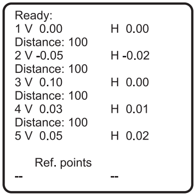
[Show / Hide H-value with 5]
NOTE! If the H-value is not displayed when registering the last measurement value this cannot be displayed again.

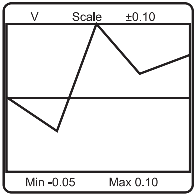
[Show absolute value 1]

[Half the value 2]

[Back]

Next: move the detector to the following points and register the values.





***5. The result can be displayed** as a graph or as a table.*
The graph can display vertical (V) or horizontal (H) measurement values. Measurement point 1 is at the left. The biggest deviation from zero sets the scale to one of three possible. The smallest and largest measurement values are displayed as Min. and Max.

[Back to registration of the last point]
(only possible *before* pressing another button).

[Shift to previous page]
(only possible *after* pressing another button).

[Shift to next page]

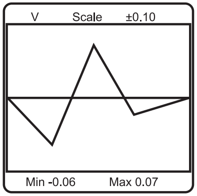
[Toggle between table and graph 4]

[Toggle V / H at graph display 5]

[New measurement from point 1 9]

Set Ref. point 1:	
1 V 0.00	H 0.00
Distance: 100	
2 V -0.05	H -0.02
Distance: 100	
3 V 0.10	H 0.00
Distance: 100	
4 V 0.03	H 0.01
Distance: 100	
5 V 0.05	H 0.02
Ref. points	
1	--

Ready:	
1 V 0.00	H 0.00
Distance: 100	
2 V -0.06	H -0.01
Distance: 100	
3 V 0.07	H 0.00
Distance: 100	
4 V -0.01	H -0.01
Distance: 100	
5 V 0.00	H 0.00
Ref. points	
1	5



---------EASY LASER ALIGNMENT TOOLS----------------

COMPANY : ....

MACHINE : ....

OPERATOR : ....

Date : 1999.02.15 20:01
Filename : BEAM01
Program : Straightness
Unit : mm
Serial No : 13636, 13633
Temp : 21.4

No	Ref	Distance	V-Values	H-values
1	Ref	0	0.00	0.00
2		100	0.01	0.00
3		100	-0.09	-0.15
4		100	0.30	0.69
5	Ref	100	0.00	0.00
Max			0.30	0.69
Min			-0.09	-0.15

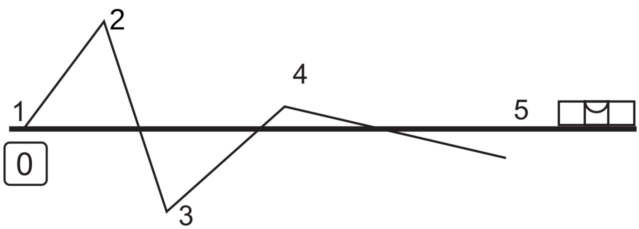
Printout from Straightness program.

Selecting reference points.
Two of the measurement points can be selected as reference points, which will set them to zero. The values of the rest of the measurement points will then be recalculated. Selecting the same measurement point as ref.1 and ref.2 will give one zero point. New reference points can be set on a previously stored measurement.

[Select ref. points 0]

[Restore ref. points 1]

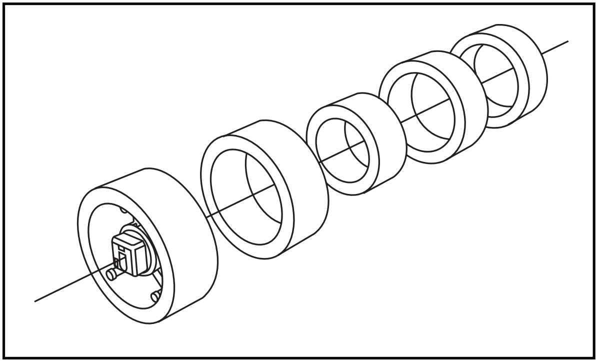
Straightness measurement with the horizontal plane as reference.



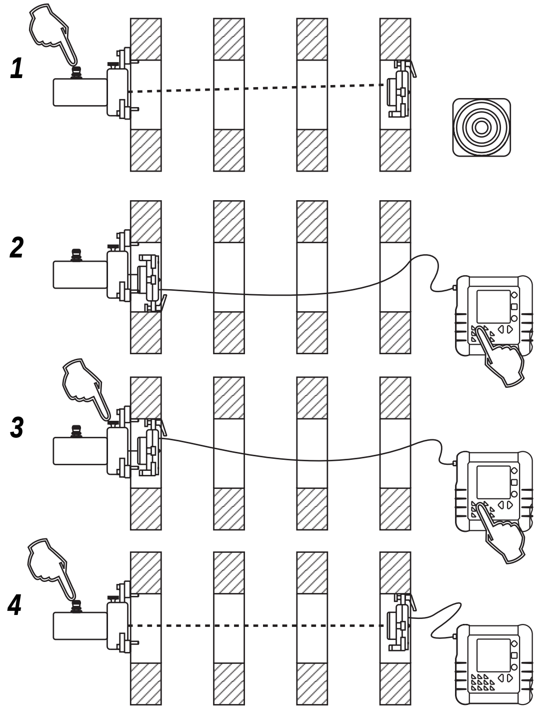
If the laser is levelled according to its vials and only one reference point is selected, then the graph will display the points of the object relative to the horizontal plane.

(23) CENTER OF CIRCLE

The Center of circle program is used for straightness measurement of bores e.g. bearing journals when the diameters vary.
Best performance when using the Linebore system, but lasers D75/D22 and detectors D5/D157 can also be used with suitable fixtures.



Note!
Adjustment of the center point and pointing direction of the laserbeam before measurement.



*1. **Adjust the angle** of the laserbeam to closed target in bearing journal with the detector in the furthest position.*

*2. Place the detector in pos.6 in the bearing journal closest to the laser and **zero the value** at the display unit.*

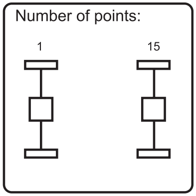
*3. Turn the detector to pos.12 and halve the value at the display unit. **Move the laser parallel** within 0.5 mm [20 mils] in the vertical and horizontal direction.*

*4. Move the detector to the bearing journal furthest away from the laser and **adjust the angle** of the laser within 0.5 mm [20 mils] in the vertical and horizontal direction.*

C

Continued ➡

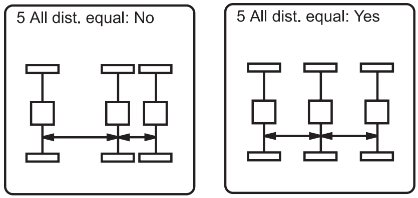
(23) CENTER OF CIRCLE



1. Enter the number of measurement points (2–150).

Confirm

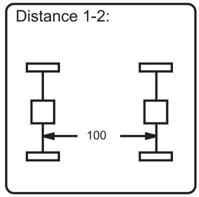
[Redo]



2. Are the points evenly placed on the object? Yes or No?

*Toggle between **No / Yes** with* 5

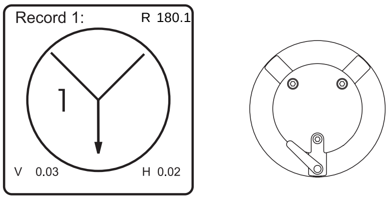
Confirm choice with



3. Enter the distances.

*If **evenly placed** points, just enter this distance and confirm*

*If **different** distances, enter each distance and confirm each*

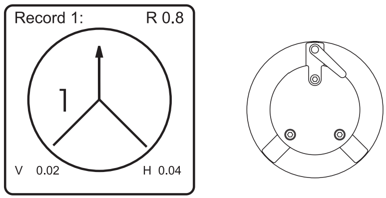


4. Place the detector on the assigned point, record first measurement value in position 6.

Confirm value

[Show / Hide H-value with 5]
NOTE! If the H-value is not displayed when registering the last value it cannot be displayed again.

[Back]

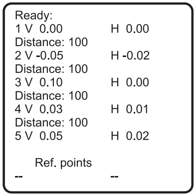


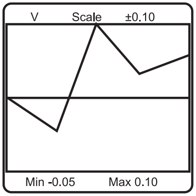
5. Turn the detector 180º.
Record second value in position 12.

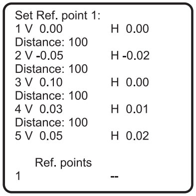
Confirm

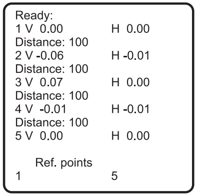
Move the detector to the following measurement points and record the values similar to steps 4 and 5 again.

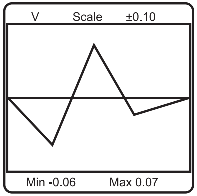
[Back]











C

6. The result can be displayed *either as a table or as a graph.*
The graph can display vertical (V) or horizontal (H) measurement values. Measurement point 1 is to the left. The biggest deviation from zero sets the scale to one of three possible. The smallest and largest measurement values are displayed as Min and Max.

[Back to registration of the last point]
(only possible *before* pressing another button)

[Shift to previous page]
(only possible *after* pressing another button)

[Shift to next page]

[Toggle between table and graph 4]

[Toggle V / H at graph display 5]

[New measurement from point 1 9]

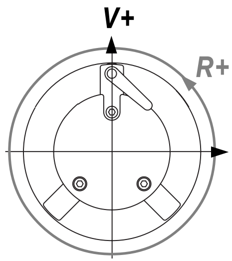
Selecting reference points.
Two of the measurement points can be selected as reference points, which will set them to zero. The values of the rest of the measurement points will then be recalculated. Selecting the same measurement point as ref.1 and ref.2 will give one zero point. New reference points can be set on a previous stored measurement.

[Select ref. points 0]

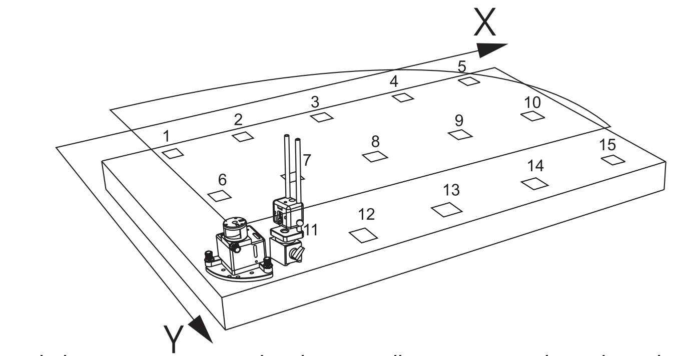
[Restore ref. points 1]

Values

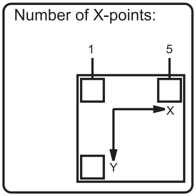
When the detector is pointing at the laser, movement of the detector to the right will give positive H-values and lifting upwards positive V-values. Rotation anticlockwise around a horizontal axis will give positive angle values.

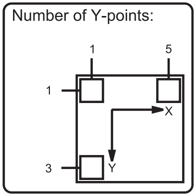


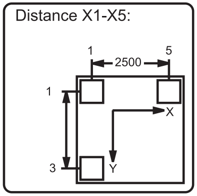
Program for flatness measurement, where the measurement points are to be placed in a coordinate system. Up to 300 measurement points can be handled. The measurement values can be recalculated so that three of them become zero references.
Procedure: Plan the measurement and mark the points where the detector will be placed. Level the laser within 0.5 mm [20 mils] in both X- and Y-direction. Start the Flatness program.
Use laser D22 with detector D5 or M-unit, or use laser D23 with D6 detector.

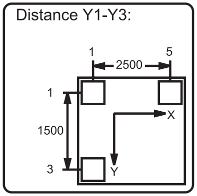


Mark the measurement points in a coordinate system where the points are numbered in columns according to the picture in x- and y-direction. NOTE! The distances between the points must be equal for all points in each direction.









1. Enter the number of measurement points in X-direction (2–99) and Y-direction (2–99).

Confirm 

[Redo ]

2. Enter the distance between first and last measurement point in X-direction and Y-direction.

Confirm 

[Redo ]

Record X 5, Y 1

X 1, Y 1	V -0.18
X 2, Y 1	V -0.21
X 3, Y 1	V -0.11
X 4, Y 1	V -0.12
X 5, Y 1	V -0.10

3. Place the detector on the assigned point, record the value.

Repeat for each point in the coordinate system (the display assigns which point in the coordinate system to place the detector at).

Confirm each

[Zero the value 0
(only on measurement point 1,1)]

[Back to absolute value 1]

[Back to previous measurement point]

Ready:

X1 ,Y2	V 0.13
X2 ,Y2	V 0.39
X3 ,Y2	V 0.73
X4 ,Y2	V 0.42
X5 ,Y2	V 0.13
X1 ,Y3	V -0.07
X2 ,Y3	V -0.32
X3 ,Y3	V -0.55
X4 ,Y3	V -0.68
X5 ,Y3	V -0.47

Ref. points
-- ,-- -- , -- -- , --

4. The result is displayed.

Up to 10 measurement values can be displayed on each page.

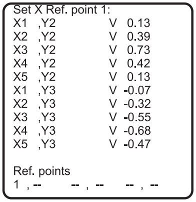
[Back to registration of the last measurement point
(can only be done *before* pressing another button)]

[Shift to previous page
(can only be done *after* pressing another button)]

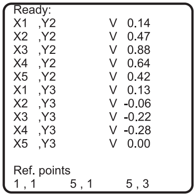
[Shift to next page]

[New measurement from point 1,1 9]

Continued



Without ref. points



With ref. points

Selecting reference points.

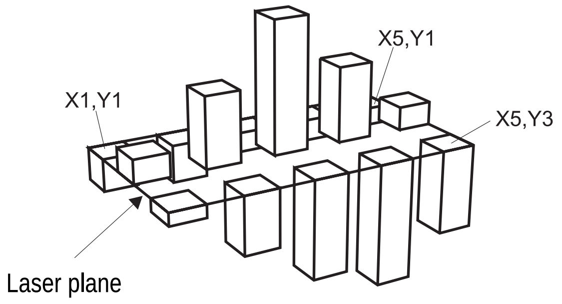
Three of the measurement points can be selected as reference points, which will set them to zero. The measurement value of the rest of the points will then be recalculated. New reference points can be set on a previous stored measurement.

[Select reference points $\boxed{0}$]

[Values without reference points $\boxed{1}$]

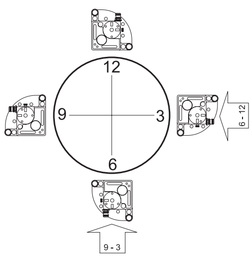
[Remeasure $\boxed{9}$]

NOTE! The measurement result can be displayed as a graph after transmitting the data to a PC via EasyLink™.



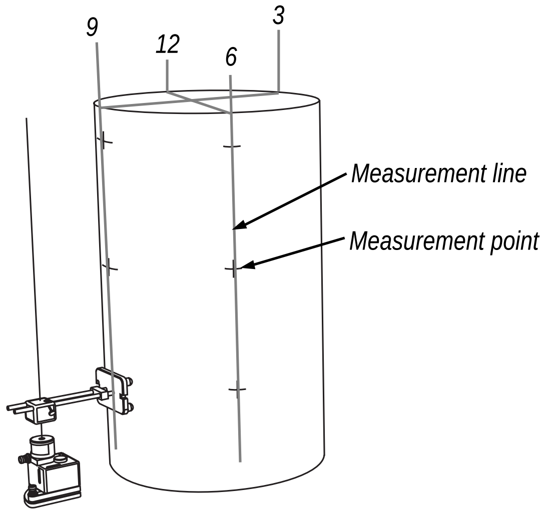
Example: The size of the values displayed as columns.

Plumbline program. For measurement of the straightness of shafts and their centre line relative to an absolute plumbline. The program uses the self-calibrating function of the laser when it is indexed 180°. Plan the measurement by placing the laser at the first “side” (9) of the shaft. Mark the measurement points. Register all measurement values on this side of the shaft, then move the laser to the opposite side (indexing) and register the points on this side at the same heights as before.
Use laser D22 and detector D5+sliding bracket.



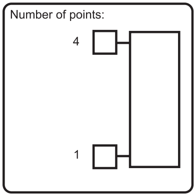
The lasertransmitter is placed at four sides of the shaft (9, 3, 6 and 12) with the same side of the transmitter towards the shaft. By doing a very careful levelling according to the vials you will get an accurate plumbline when indexing the laser 180°.

Turbine shaft.



Use the laser beam to mark the points at the shaft. Measure a quarter of the circumference to get the four “measurement lines”. Take extra care on shafts that deviate a lot from the plumbline.

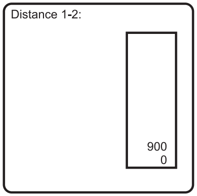
Continued ➡



1. Enter the number of measurement points (2–10) at each measurement line.

Confirm

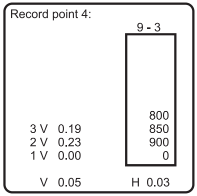
[Redo]



2. Enter the vertical distance between measurement points 1–2, 2–3 and further on.

Confirm each

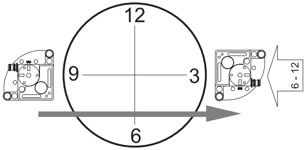
[Redo]

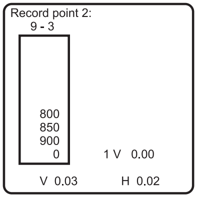


3. Place the detector on the lowest measurement point *on measurement line "9" and record the value. (The H-value is used for positioning the detector sideways.) Move the detector to the other points on the same measurement line and record the values.*

Record the value

[Redo]

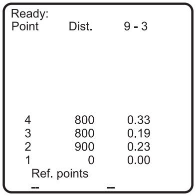


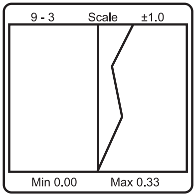


4. Measurement line "3".
When you have finished recording values on measurement line "9", move the detector and laser to the opposite side and continue with the recording.

Record the value

[Redo]





5. The result for the first direction (9–3) is displayed.
If no or only one reference point is set, the values relate to the plumbline with optional point through zero.

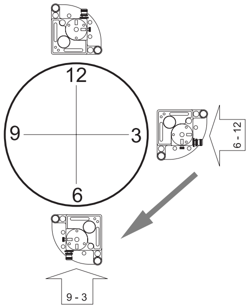
[Back to registration of the previous point (only *before* pressing another button)]

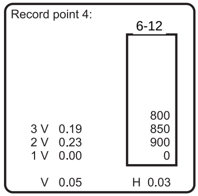
[Toggle between table and graph [4]]

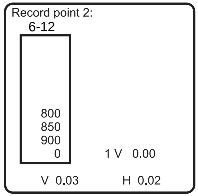
[Toggle displayed direction; 9–3 or 6–12. (after completed measurement of both directions) [5]]

[New measurement from measurement line “9”, point 1 [9]]

Continue the measurement at measurement line “6”



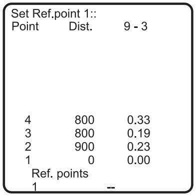




6. The measurement in the other direction (6–12) *is done in the same way as the first one. Move the detector and laser to measurement line “6” and record the values. Then move the detector to measurement line “12” and complete the measurement. When finished, the measurement result for the “6–12” direction is displayed according to step 5.*

The values can be displayed as a graph for one direction at a time.

Continued ➡

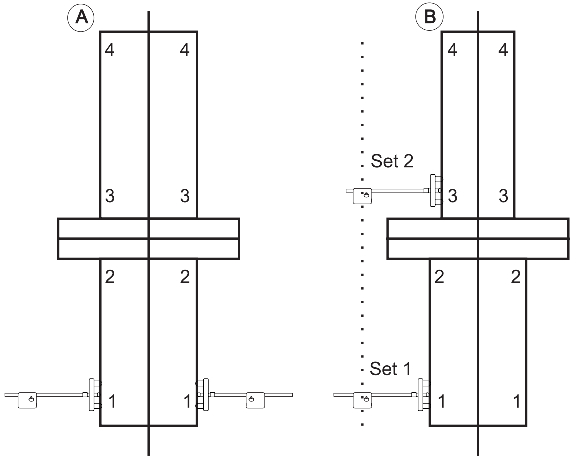


Selecting reference points.
Two of the measurement points can be selected as reference point. Doing this will set them to zero. The other points will then be recalculated. Selecting the same measurement point as ref. 1 and ref. 2 will give one zero point. New reference points can be set on a previous stored measurement.

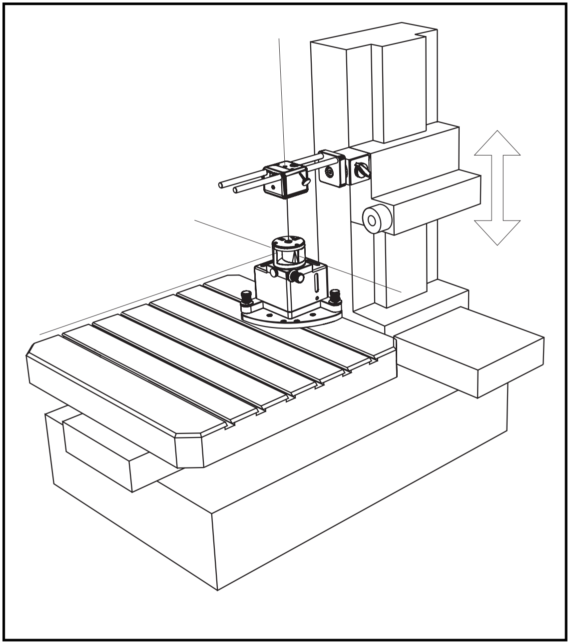
[Select ref. points $\boxed{0}$]

[Values without ref. points $\boxed{1}$]

NOTE! If two ref. points are set, the measurement values will not correspond to the plumbline, but can be used as a guide to the straightness of the shaft.

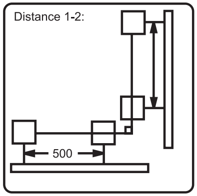


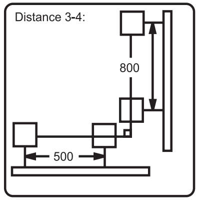
Important!
When moving the units to the opposite side, the length from shaft to detector can be altered *only* if *all* measurements is done on the same shaft diameter (A). Measurement on a shaft with different diameters (B), can only be done at point 3 and 4 with another complete set of detector, risers and magnet base. These two sets must not be changed and must be used again on the opposite side of the shaft.



For measurement of squareness. This program uses the perpendicularity in the D22 prism. Two of the measurement values on one of the surfaces are compared to the measurement values on the other surface. The values are recalculated to an angular value that shows any deviation from 90° that may occur. Mark where the detector shall be placed. The laser transmitter D22 is placed according to the picture and levelled to the table in both directions (x and y). As detector the D5 or M-unit can be used.

C



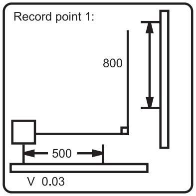


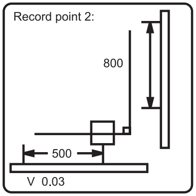
1. Enter the distance between the measurement points 1–2, and then points 3–4.

Confirm each

[Redo]

Continued

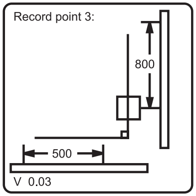


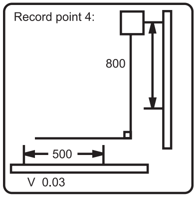


2. Record the first two measurement points.
Place the detector at each point and record values 1 and 2 according to the display.

Confirm each 

[Redo ]

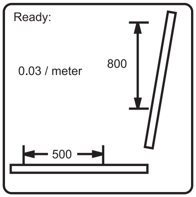




3. Record the following two measurement values.
Place the detector at each point and record values 3 and 4 according to the display.

Confirm each 

[Redo ]

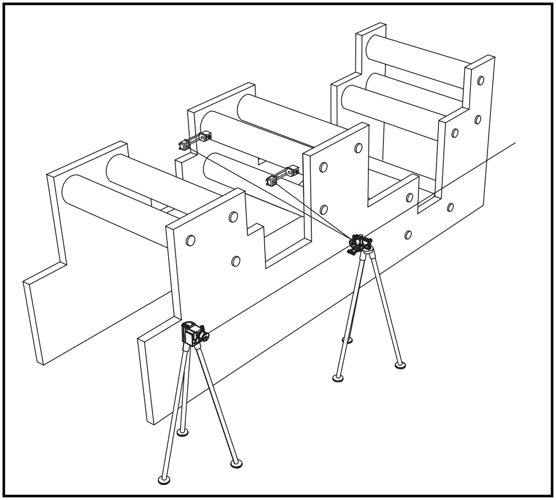


4. The result is displayed graphically
to explain the direction and a value for the angle in mm/m or mils/inch.

[Back to registration of previous point ]

[New measurement from point 1 $\boxed{9}$]

Parallelism program. For the measurement of parallelism between e.g. rolls. The program uses the 90° deviation in the angular prism D46 to create a number of parallel laser beams. Up to 150 rolls or other objects can be handled by the program. The result is displayed graphically with the angular value for an eventual deviation from parallelity. Any object or the base line can be selected as the reference afterwards.
The most common setup for parallelism measurement is laser D22 and prism D46 mounted on tripods, detector D5 on magnet base or sliding bracket. Large target base line may also be used.

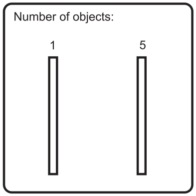


Example of a parallelism measurement :

1. Level the vertical swivel of the laser according to the vial.
2. Rough align the vertical turning according to the vial on the laser head.
3. Aim the laser perpendicular to the measurement objects (e.g. rolls). If the line made out by the laser beam is to be the reference, you now fine adjust to the detector on the machine sides.
4. Place the Angular prism D46 with free sight to both two positions of the detector on the roll to be measured. Calibrate the prism according to its instructions (see page “D46” in chapter *A*).
5. Adjust the beam on to the detector at one end of the roll and record the first value.
6. Move the detector to the other end, adjust the beam and record the second value.
7. Move the Angular prism to the next roll, calibrate and then record according to step 5 and 6.

NOTE! Measurement shall only be done with the detector levelled according to its vials, or according to the angular value on the display, supported by the electronic inclinometers.

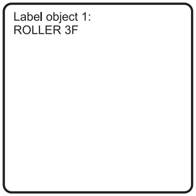
Continued ➡



1. Enter the number of measurement objects (2–150).

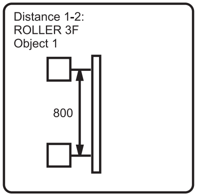
Confirm

[Redo]



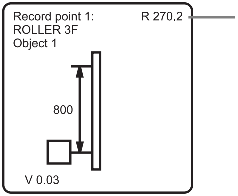
2. Name the (first) object.
(See page “Store measurement result” for information)

Confirm



3. Enter the distances between the measurement points 1–2.

Confirm



Place the detector in horizontal position (90° or 270°).

4. Enter the position of the first measurement point (left / right and front / rear).

Move the detector mark on the display with

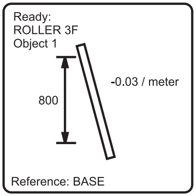
4. (continued) Place the detector at the measurement point assigned on the display and record the first value.

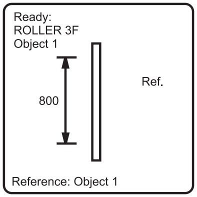
Confirm value

The measurement value is automatically zeroed after registration. Then move the detector to the next point as assigned on the display. Record measurement value two.

[Redo]

5. The following measurement objects.
Follow the procedure in steps 2–4 for the rest of the objects.





6. The result display *with graphics displaying the angle direction and a value for the angle in mm/m or mils/Inch.*
As standard the reference is set to the laser beam direction (Base), but optionally a measurement object can be set as the reference instead. The reference object is set to zero.

[Set displayed object as reference [0]]

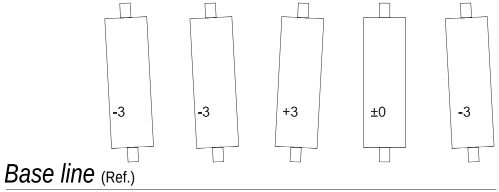
[Set “Base” as the reference [1]]

[Remeasure from object 1 [9]]

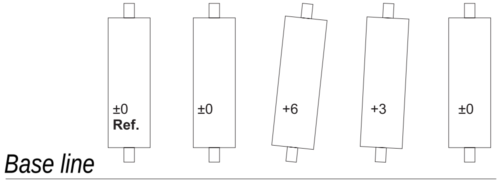
[Toggle between measurement objects]

Selecting reference for the measurement

Example 1. Base line as reference



Example 2. First roll as reference



These two examples shows the same set of rolls but with different references, and how that affects the measurement values.

––––––EASY LASER ALIGNMENT TOOLS––––––––––

COMPANY : ....

MACHINE : ....

OPERATOR : ....

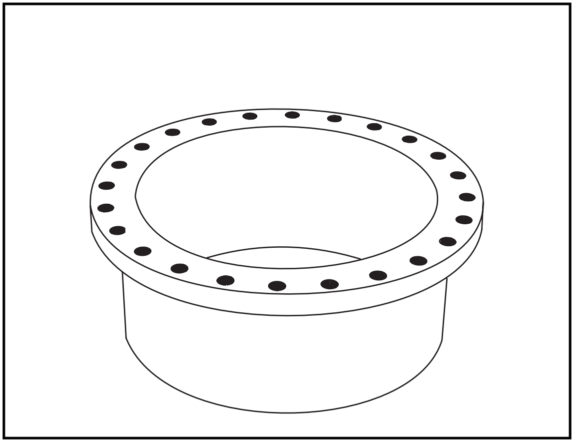
Date : 1999.02.15 20:01
Filename : MACHINE 3
Program : Parallism
Unit : mm/meter
Serial No : 13636, 13633
Temp : 18.5 C

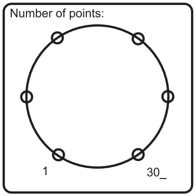
No	Ref	Length	Angle	Label
1	Ref	1500	0.00	First
2		1500	0.00	2
3		1500	0.06	3
4		1500	0.03	4
5		1500	0.00	Last
Max			0.06	
Min			0.00	

Printout from the Parallelism program.

C

The Flange program is used for flatness measurement of circular planes such as slewing bearings and flanges. The laser is placed at or near the measurement object and levelled within 0.5 mm [20 mils] to three points evenly placed on the circle. The program handles up to 150 points. Mark all the measurement points before the measurement. After completed measurement you can recalculate the measurement values so that three of them are zeroed as the reference. The program calculates these three points with 120° split.
Use laser D22 with D5 detector, or laser D23 with D6 detector.

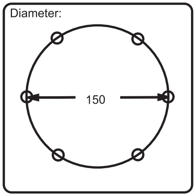




__1. Enter the number of measurement points (6–150).__

Confirm

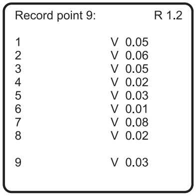
[Redo]



__2. Enter the diameter for the measurement points__
(only for documentation).

Confirm

[Back]

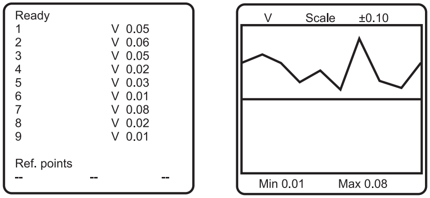


__3. Place the detector on the first measurement point and record the value__
(zeroing can be made at the first point). Then continue with the rest of the points.

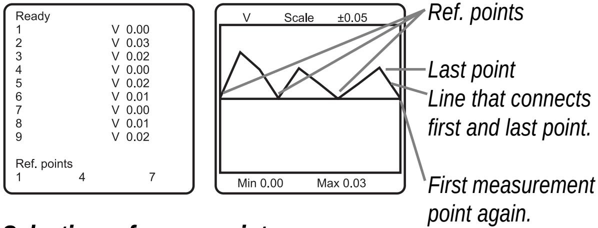
Confirm

[Zero set the value 0]

[Back]



With reference points.



4. The result can be displayed as a table or a graph. *The largest deviation from zero sets the scale on the display to one of three possible. Smallest and largest measurement values are displayed as Min. and Max. Up to 10 measurement points can be displayed at each page.*

[Back to registration of the last point (can only be done before pressing another button).]

[Shift to previous page]

[Shift to next page]

[Toggle between table and graph 4]

[New measurement from point 1 9]

Selecting reference points.
Three of the measurement points can be set as reference by setting ***one*** *point as reference. The program calculates the two others, evenly placed on the circle. The reference points are set to zero. The other points will be recalculated. New reference points can be set on a previous stored measurement.*

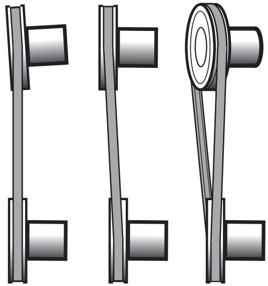
[Set reference points 0]

[Restore reference points 1]

Flatness measurement of slewing bearing.

Errors for belt transmissions

The two sheaves/shafts are not parallel .... Unparallelity (A)
The two sheaves are parallel but not in line .... Parallel offset (B)
The machines are neither parallel or in line .... Unparallelity (C)



(A) (B) (C)

Causes:

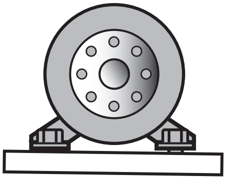
Abnormal wear on sheaves, belts, sealings and bearings.
Decreased efficiency.
Increased vibration and noise.

Check before alignment:

Check the sheaves for radial runout. Uncentered sheaves or bent shafts will make it impossible to perform an accurate alignment.

Check the sheaves for axial runout. If possible, adjust with the mounting screws of the bushings.

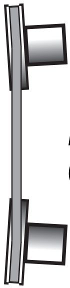
Check that the machine is resting evenly on the feet (e.g no *softfoot*).



Softfoot

Recommendations for alignment:

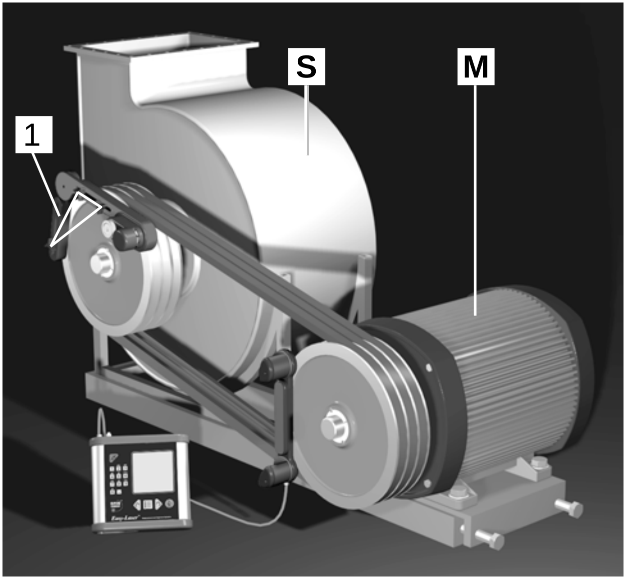
When the right belt tension is achieved, the shafts, and maybe the foundation, will be bent a little. When you start the machine the shafts will straighten again. Therefore it is recommended that the sheaves/shafts point a little bit negative (see picture to the right).



Negative alignment (much exaggerated)

This page describes the measurement in summary. On the following pages the measurement is described in greater detail.
NOTE! Also read the "Safety precautions" page.

Mounting the equipment on the machines
The magnets are super magnets with great force which means you have to be careful not to get your fingers caught. Also try to soften the touch to the sheaves by putting just one magnet to sheave first, then turning the other ones in.



***Mount** the Laser transmitter on the sheaves of the (**S**) machine with the laser aperture towards the sheaves of the (**M**) machine. Let the magnets attach to a flat, tooled surface and spread them to make up a triangle as large as possible (1).*

***Mount** the detector unit.*
***Aim** the laser scan at the detector unit.*
***Start** program "BTA DIGITAL"*

***First** perform an alignment check according to steps 3–8 without aligning the machine ("CHECK"). (You can also align the machine directly during the "check" if you are not going to document how the machine was standing before the alignment or if you know that the machine is out of alignment.)*

***Document** the measurement result for misaligned machine.*

***Perform the alignment** according to steps 6–7 ("ALIGNMENT") for the measurement values shown.(Text on grey bottom.)*

***Document** the measurement result for the aligned machine.*

Continued ➥

C

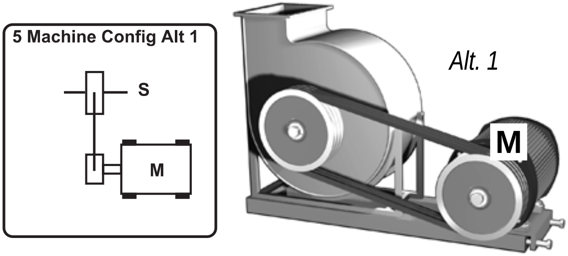
Menu
1 BTA DIGITAL
2 CALIBRATION

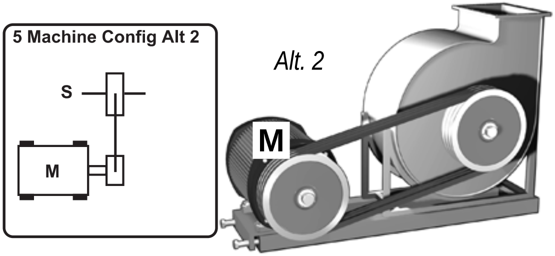
1. Start program BTA DIGITAL

2. Choose 1, BTA DIGITAL.

Press [1] *or*

[See page F4 for “Calibration”.]

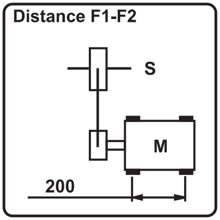




3. Face the side of the sheave *on which the BTAd shall be attached to and is to choose with* [5] *between the above shown settings; movable (M) machine to the right or to the left of the stationary machine.*

Confirm with

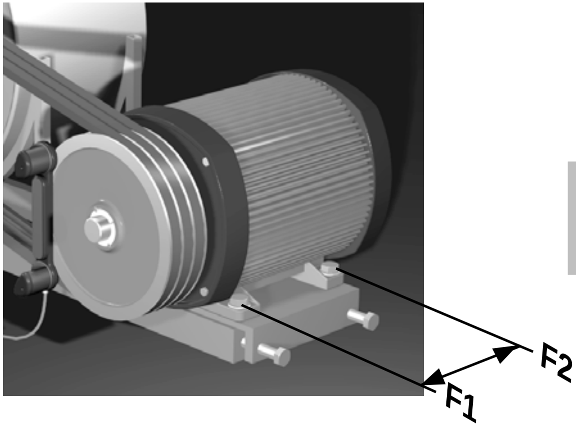
NOTE! From here on, the manual only describes setting Alt. 1 with movable machine to the right, since the procedure is the same as for Alt. 2.

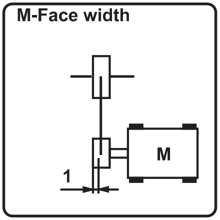


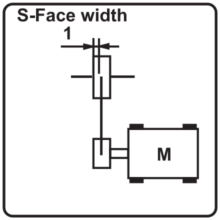
***4. Measure and enter the distance** between the feet pair F1 and F2 on the movable machine.*

Confirm distance with

[Back]





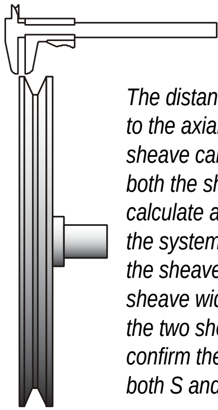


5. Enter the sheave face width

*If **equal** widths on both the sheaves, accept "width" 1 with for both S and M sheave.*

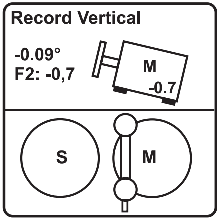
*If **different** widths, enter each width S and M. Confirm each width with*

[Back]



The distance from the belt to the axial face of the sheave can be different for both the sheaves. To calculate a possible offset the system requires both the sheave widths. If the sheave widths are equal for the two sheaves you just confirm the pre set (1) for both S and M.

Continued



6. [CHECK]
***Mount the detector unit** as described at the picture to the right.*

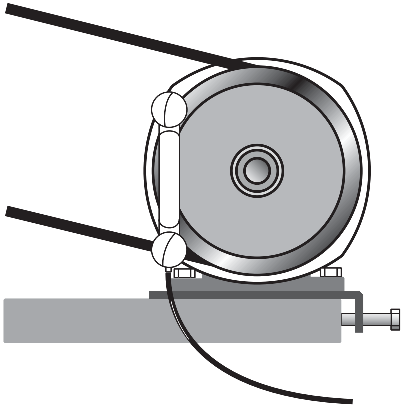
Register the Vertical measurement value

[Back]

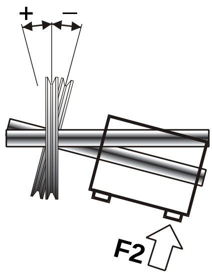
6. [ALIGNMENT]
***Adjust the machine** according to the shim value (the display shows the shim value for the feet F1 or F2 that are lowest). The value is updated in live.*

Confirm adjustment with

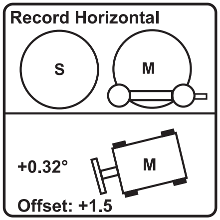
[Back]



Mount the detector unit on the sheave of the movable (M) machine, with the detector arm perpendicular to the machine foundation and the connection downwards. Turn the detector housings so the apertures faces the laser. A clear view is necessary between laser and detector, therefore it is best to place the detector between the sheave shafts as shown on the display.



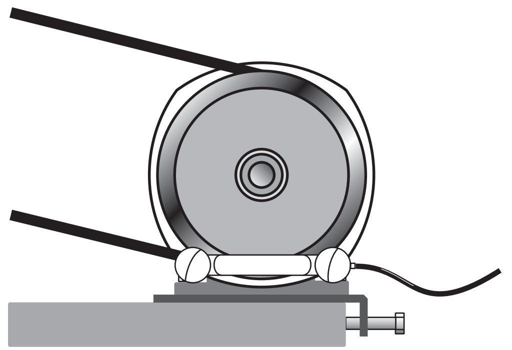
With the detector unit mounted vertically, any difference of the measurement values from the detectors will give a vertical angle (top–bottom). With the help of the feet distance the correction value is calculated (F1 or F2).



7. [CHECK]
Mount the detector unit *as described at the picture to the right.*

Register the Horizontal measurement value

[Back]

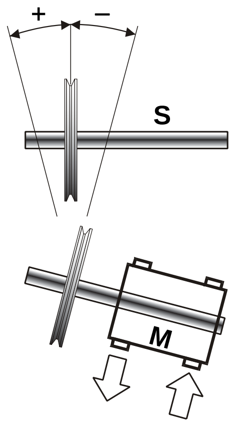


Place the detector unit in position as shown on the display so the detector arm is parallel with the machine foundation and with the connection pointing away from S. Turn the detector housings so that the apertures faces the laser.

7. [ALIGNMENT]
Adjust the machine in horizontal way according to the value on the display. The value is updated in live.
First adjust possible angular value, then the offset **(for explanation of offset, see next page)**.

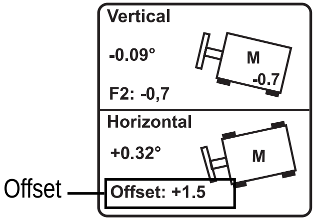
Confirm adjustment with

[Back]



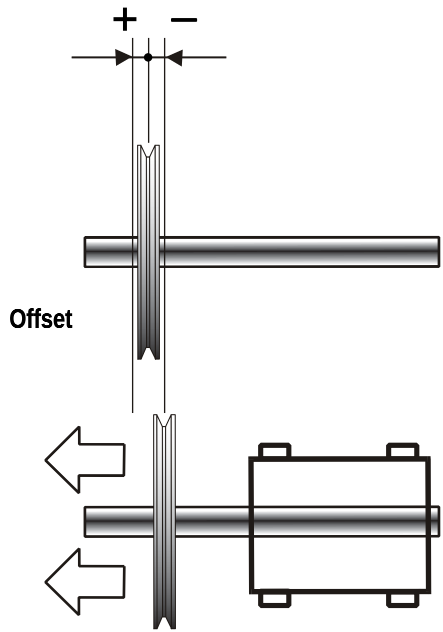
With the detector unit mounted horizontally, any difference of the measurement values from the detectors will give a horizontal angle (side–side). Angle and offset are shown.

Continued



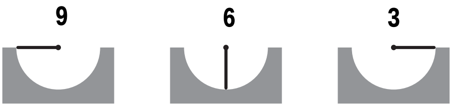
8. [CHECK and ALIGNMENT]
The result for the whole measurement is shown.
The values are frozen (No longer live).
Save or Print out the measurement result if wanted.

To begin the actual alignment according to step 6 and 7 [ALIGNMENT], press 9

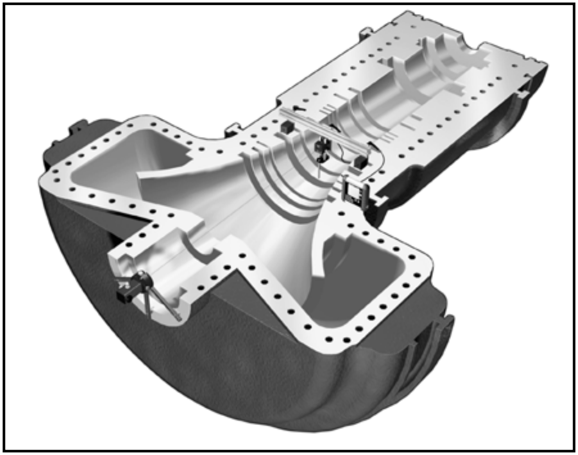


Offset: The measurement value at a calculated point between the detectors will give a measure of the axial offset. By compensating for possible difference in sheave face width, the value is calculated and displayed. Take care of the axial offset by, if possible, loosing and moving the sheave on the shaft, otherwise by parallel adjusting the whole movable machine. Check so that the axial runout does not exceed the limit value.

The Half-Circle program is used mostly for the measurement and alignment of bearing journals and diapraghms in turbines together with the turbine fixtures.



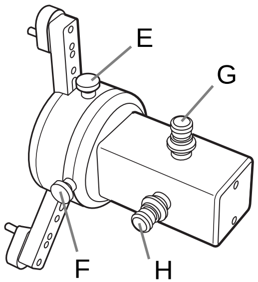
Measurement positions with program Half Circle

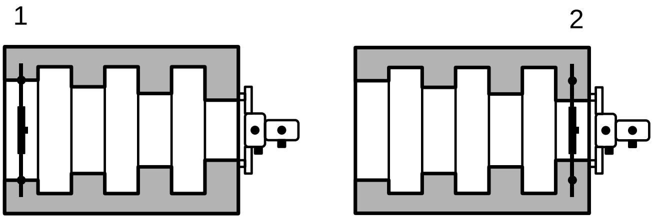


Rough adjustment of laser

Place the laser transmitter at the first journal.

E: *Vertical parallel adjustment*
F: *Horizontal parallel adjustment*
G: *Vertical angle adjustment*
H: *Horizontal angle adjustment*

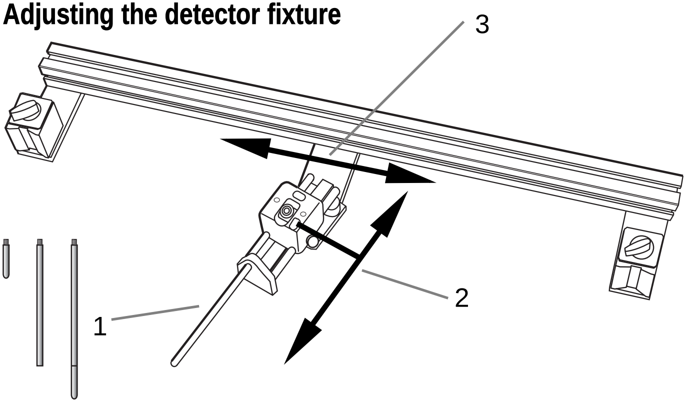




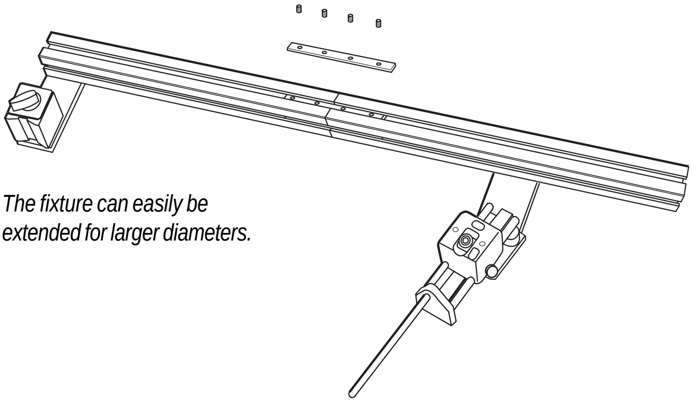
1. *Place Centring target at the measurement position* ***furthest away*** *from the laser transmitter. Adjust the angle of the laser beam on G and H until it hits the centre of target.*
2. *Place Centring target at the measurement position* ***nearest*** *the laser transmitter. Adjust the parallelity of the laser beam on E and F until it hits the centre of target.*
Redo step 1: *Place Centring target at the measurement position furthest away from the laser transmitter. Adjust the angle on G and H again until the laser beam hits the centre of target. Now the laser beam is roughly adjusted to the centre of journals.*

Continued ➡

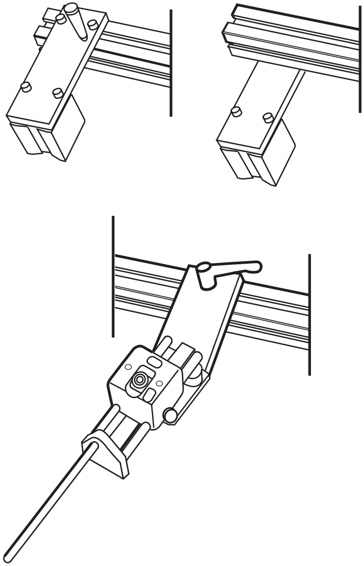
Adjusting the detector fixture



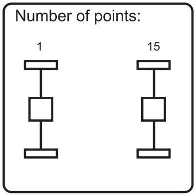
1. *Mount the right length of measurement probe.*
2. *Mount the detector on the fixture. In the 6 o'clock position, adjust the detector position on risers so that the laser hits at the same height as **closed** detector target.*
3. *Adjust fixture horizontally until the laser beam hits the centre of **closed** target. Lock the handles.*



The fixture can easily be extended for larger diameters.



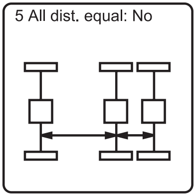
There are a lot of possibilities and combinations for mounting the magnet bases and detector slide.

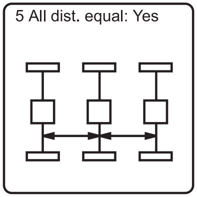


1. Enter the number of measurement points (2–150).

Confirm

[Redo]

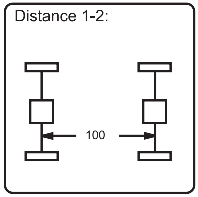




2. Are the distances between the measurement points equal? Yes or No?

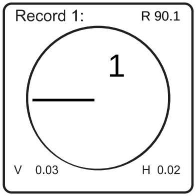
*Toggle between **No / Yes** with* 5

Confirm choice with



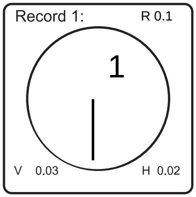
3. Enter the distances.
*If **evenly placed** points, just enter this distance and confirm*

*If **different** distances, enter each distance and confirm each*



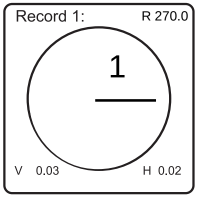
***4. Turn detector unit** to the 9 o'clock position.*

Record the value



***5. Turn detector unit** to the 6 o'clock position.*

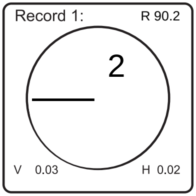
Record the value



***6. Turn detector unit** to the 3 o'clock position.*

Record the value

Continued



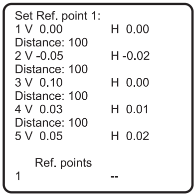
7. Move the fixture *to the next measurement point (2).*

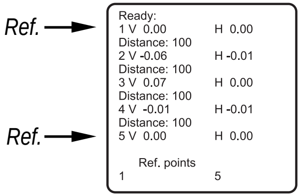
Adjust the fixture according to instructions at page C68 for this measurement position.

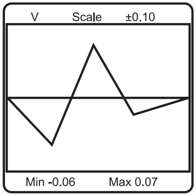
Turn the detector unit to the 9, 6 and 3 o'clock positions and record the values at each position as before.

8. Continue with the other measurement points *until the whole object has been measured.*

Without reference points







9. The result can be displayed *either as a table or as a graph. The graph can display vertical (V) or horizontal (H) measurement values. Measurement point 1 is to the left. The largest deviation from zero sets the scale to one of three possible. The smallest and largest measurement values are displayed as Min. and Max.*

Selecting reference points.
Two of the measurement points can be selected as reference points, which will set them to zero. Example:

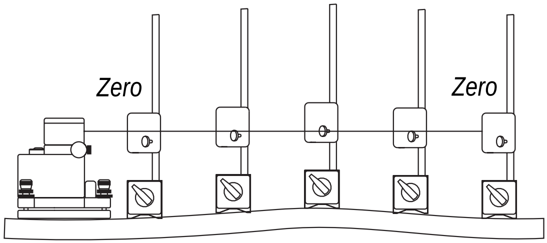
1. Press 0 to get to "set reference points"-mode.
2. Press 1 then  to set measurement point 1 to zero.
3. Press 5 then  to set measurement point 5 to zero.

Applications D

D. Measurement applications

Fundamental straightness measurement where the measurement value from the detector is read, for example, in the *Values* program.

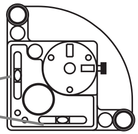
With two zero points as reference.
The laser beam is adjusted to pass through two selected reference points at the same distance from the measurement object. The measurement value is set to zero at the reference points. The measurement value at the other points will show the deviation from the straight line between the reference points.

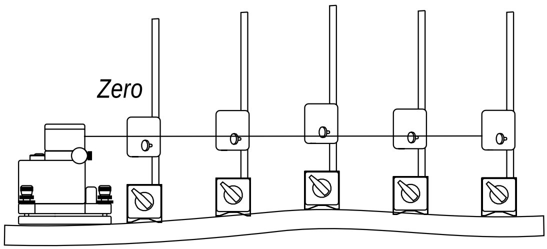


(One detector in five different positions.)

With the horizontal plane as reference.
The laserbeam is levelled according to the vials on the transmitter and the value on the first point is zeroed. The measurement values on the other points will show the deviation from the horizontal plane.

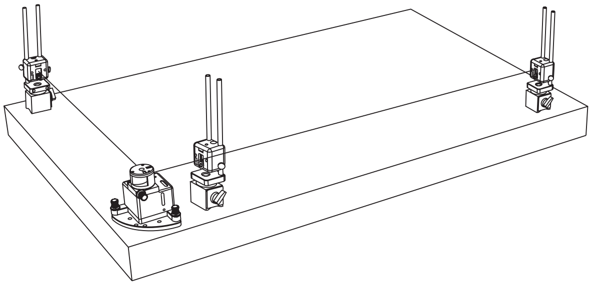
Level according to vials.





Fundamental flatness measurement. The same principle as for straightness measurement, but one dimension is added. Suitable program is *Values.*

(One detector in three different positions.)

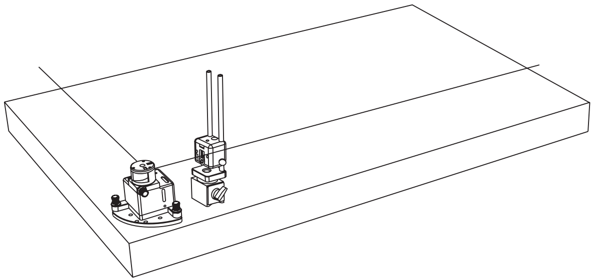


With one reference plane that “rests” on three ref.points.

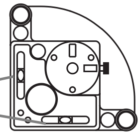
The laser beam is adjusted to pass through 3 selected ref.points at the same distance from the measurement object. The measurement values at the reference points are levelled to zero.
The measurement values at the other points will show the deviation from the laser plane.

With a reference plane parallel to the horizontal plane.

The laser beam is levelled according to the vials and the measurement value at the first point is set to zero. The measurement values at the other points will show the deviation from the horizontal plane.

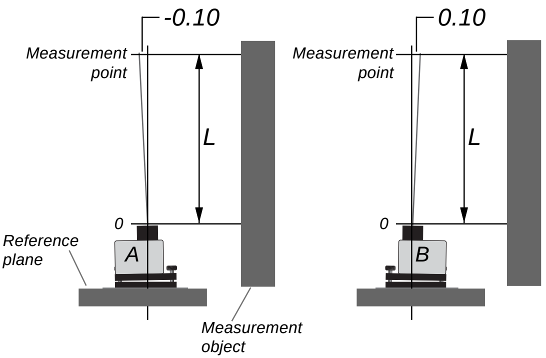


Level according to vials.



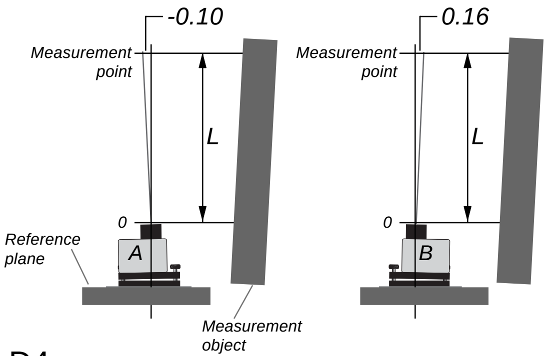
SQUARENESS MEASUREMENT WITH INDEXING

When a very high accuracy is wanted when measuring squareness, where we need to get an even higher accuracy than for the laser transmitter (D22 according to technical specifications 0.01 mm/m), we use a method where the laser transmitter is indexed 180°. The picture to the right shows the principle.
The method is suitable for measurement of straightness compared to two points on a reference plane, or for measuring plumb where we use the vials on the laser transmitter as reference.



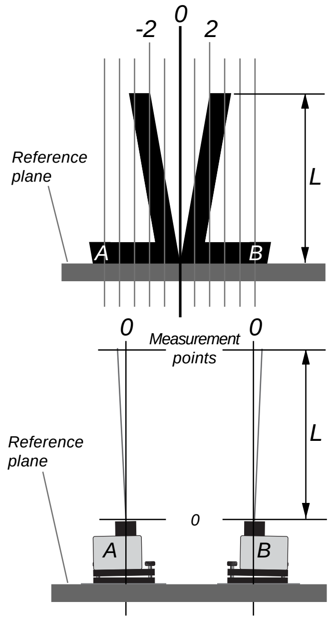
0.10
-0.10
0

This means that the object is perpendicular to the reference plane.



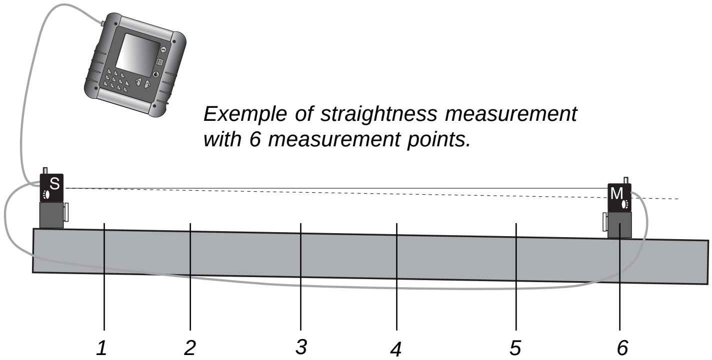
0.16
-0.10
0.06

0.06/2=0.03= The absolute angle for the measured object at a distance L.



We suppose a constant "angular error" for a set square. This angular error will be the same in absolute values if we rotate the set square 180° around an axis "0" perpendicular to the reference plane. It is the value between the measured positions A and B that represents a square angle.

You can perform a straightness measurement with the S- and M-unit (i.e. no separate laser transmitter is used). The S-unit is used as reference transmitter and the M-unit as detector. Follow the instructions below.



Exemple of straightness measurement with 6 measurement points.

1. Mount the S- and M-unit on magnet bases.

2. Adjust the laser beam from the S-unit visually to hit detector centre on the M-unit, placed on the measurement position furthest away. (The beam from the M-unit is not used.) Then the beam will be parallel to the measurement object.

3. Decide the number of measurement points and the distance between them.

4. Start the Straightness program and follow the instructions on the display.

5. Move the M-unit to the measurement points and register the values according to instructions on the display.

6. After the last measurement point, choose zero points in the program. Read the values and decide the straightness of the measured object. If you wish, make a printout of the graph and table on the display.

POINTING DIRECTION

Measuring pointing direction in an arbor or milling machine can be done with the table as reference or the movement of the table as reference. By doing this we are able to see if the table is parallel to the machine bed.

The measurement in Fig. 1 shows the pointing direction of the spindle relative to two points at the table. When measuring the pointing direction of the spindle relative to the machine bed/movement (Fig. 2), let us say we get a different measurement value. The difference between these two values is the deviation from parallelity for the table and the movement.

Fig. 1. The table as reference (the detector is moved).

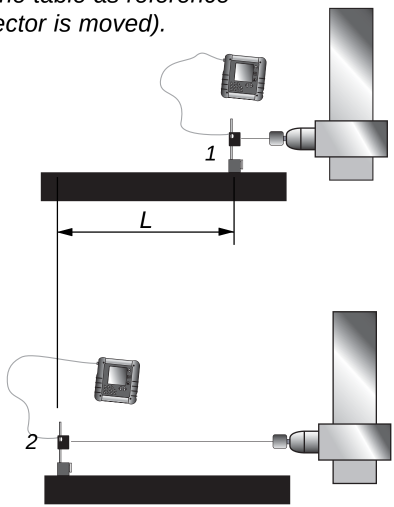
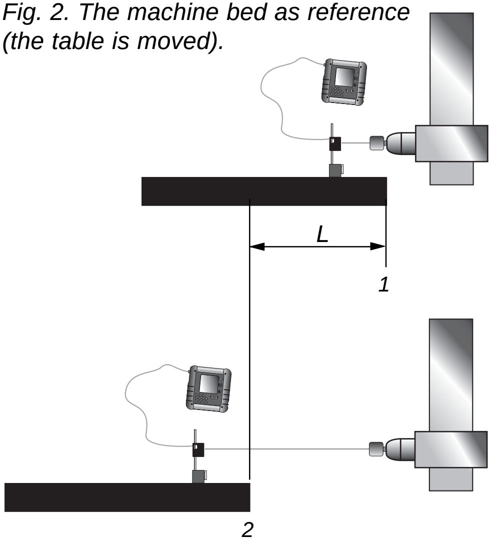
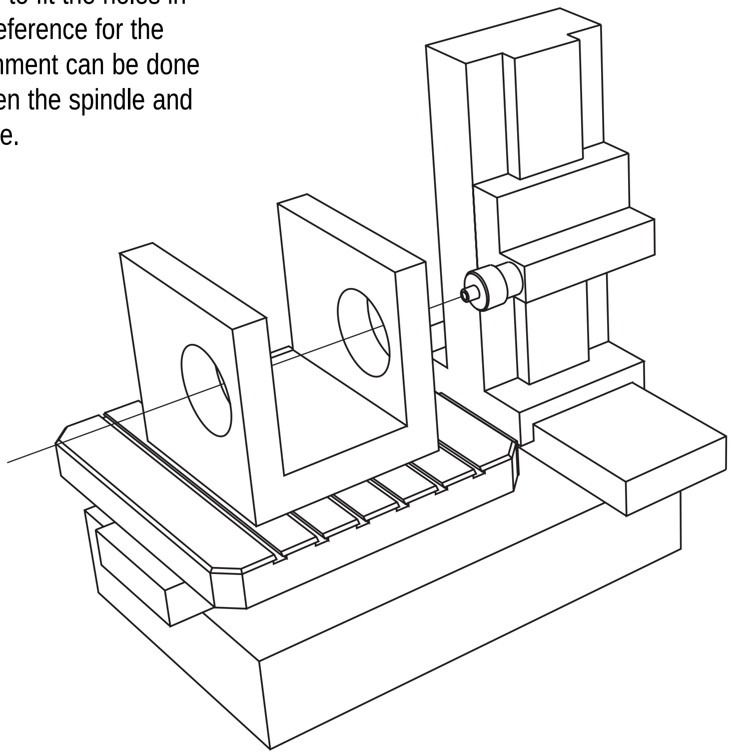


Fig. 2. The machine bed as reference (the table is moved).



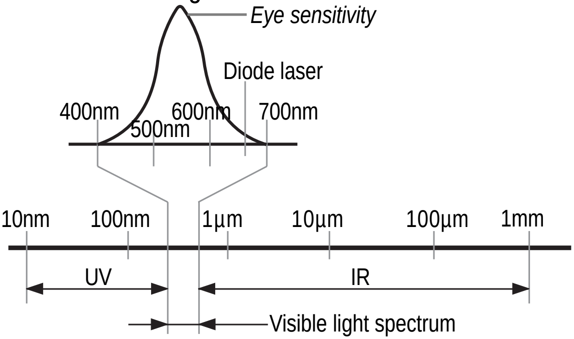
With the spindle laser D146 or the swivelling laser D22 mounted in the spindle of a machine tool. Place the Linebore detector D32 or the detector D5 in a suitable fixture to fit the holes in the workpiece that will be the reference for the alignment. Then a precise alignment can be done even when the distance between the spindle and the reference holes is very large.



Measurement basics E

E. Measurement basics

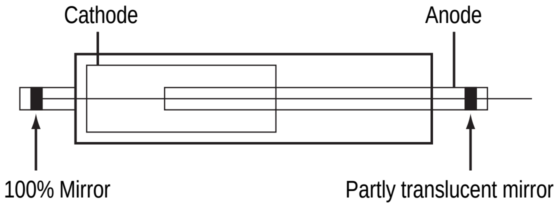
Light is a part of the electromagnetic spectrum, which also includes UV, IR, microwaves etc. Wavelengths between 400 nm and 780 nm are called visible light.



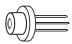
Electromagnetic spectrum

The word laser means: *Light Amplification by Stimulated Emission of Radiation*.
There are many applications for lasers and even more kinds of lasers to handle them. Instruments for length scale calibration (interferometers) of machine tools are most often equipped with gas lasers of helium-neon type. Within alignment instruments semiconductor lasers are the ones preferred. The benefits with this kind of lasers are the extremely compact design and very high directional stability of the beam.

To describe the laser principle we use a HeNe-laser because of its simplicity. The HeNe-laser consists of a glass tube with anode and cathode, filled with a mixture of helium and neon gas. At each end mirrors are placed, of which the one at the front is partially translucent.
The tube is powered from a high-voltage supply unit. The light is then generated by the electrical discharge in the gas (spontaneous emission), and begins to “bounce” between the mirrors. Only light that is moving exactly parallel to the length axis of the tube can go on bouncing and get so powerful (stimulated emission) that it can pass through the translucent mirror as a laser beam. In principle laser light is similar to normal light, but consists of light with only one wavelength.

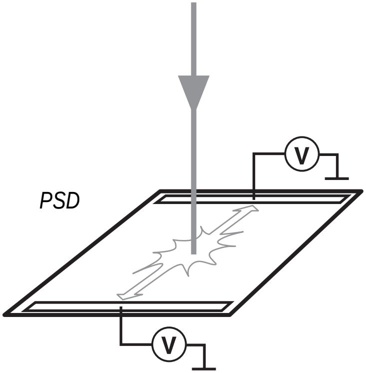


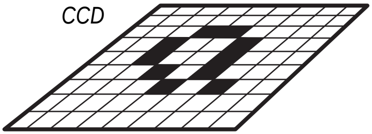
Simplified picture of a HeNe laser.



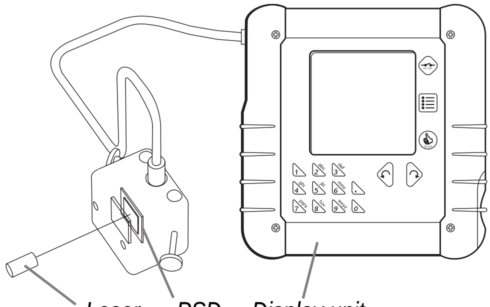
Laser diode (semiconductor type) as used in the Easy-Laser®.

PSD is short for *Position Sensitive Device.* The PSD detector consists of a light-sensitive silicon wafer. For comparision the PSD can be called an analogue component, with theoretically unlimited resolution, on the contrary to a CCD detector (camera device), which is digital and with a resolution limited by the design.
When the laserbeam hits the PSD, an electric current flows through the point hit by the beam. The electric currents at the two electrodes are proportional to the position of the beam. This makes it possible to determine the position of the beam center. The resolution possible is, quite literally, one in a million.



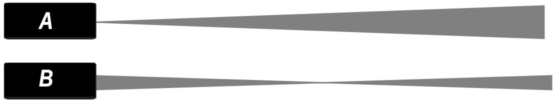


Easy-Laser® measurement systems uses a visible red laser beam as a measurement reference. The laser beam is directed to the PSD detector. Then the measurement programs in the Display unit calculate the values from the PSD and present the result according to which program is used.



Divergence

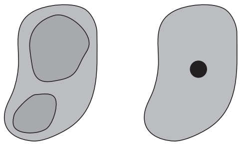
Every laser diverges i.e. the beam diameter increases with the distance depending on the type of laser. Normally lasers diverge with less than 1 mrad, i.e. the beam diameter increases with <1 mm/m. Due to their design, semiconductor lasers are always made with collimator optics. To reduce the divergence of the laser even more, telescopic optics can be used. The laser beam can then be focused at a specified distance, but the optics also enlarge the beam diameter at the aperture (see picture).
An example of a laser transmitter with telescopic optics is the Easy-Laser® D22.



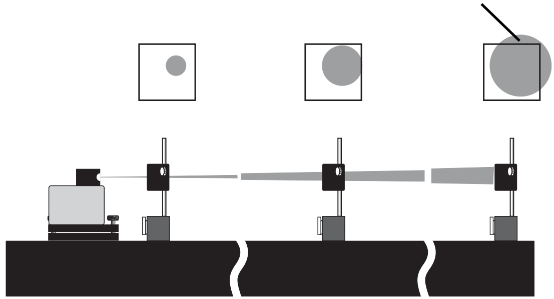
Laser divergence: A; plain. B; with telescopic optics

The centre of the laser beam

No laser beam is perfectly round. The energy from the beam is also somewhat different over the surface. But this is of no importance for the measurement result because the detector calculates/reads the energy centre for the beam, similar to how the centre of gravity of a body of any material can be calculated. Because of this it is however important that the whole of the beam hits inside the detector surface. It is the size of the detector surface in combination with the laser beam divergence that limits the possible measurement distance in each case.



The laser beam has an energy centre.

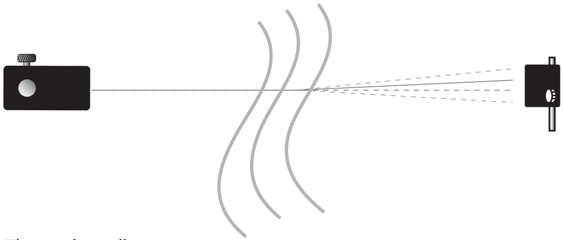


Be sure that the whole beam hits the detector for correct calculation of laser energy centre (i.e. correct measurement value).

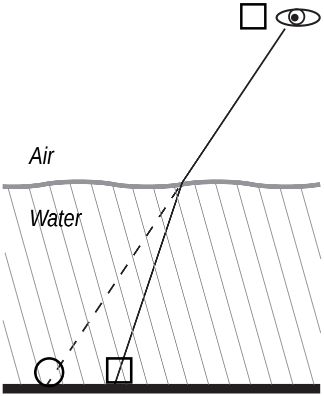
Thermal gradients

You can easily see the effects of thermal gradients when the air is moving above the asphalt a hot summer day. It is then not possible to focus what is on the other side of this area. If the laserbeam passes through air with varying temperature, that may influence the direction of the laserbeam in the same way. During continous measurement this could mean unstable readings. Try to reduce air movements between laser and detector by, for instance, moving heat sources, closing doors etc. If the readings remain unstable, you can use the measurement value filter feature in the Easy-Laser® systems.

Always ensure a good measurement environment.



Thermal gradients



When you look down into the water, the light reflected from what you see at the bottom will deflect similar to the light from a laser when it breaks through two media, or two different temperatures of the same medium.

Demands on quality and performance in the industry of today are increasing all the time. Down-time and maintenance need to be very well planned. When maintenance is done, there should be no doubt about the result. Using laser equipment is then a great advantage. With lasers the work is done very quickly, it can be done with very high precision and it can be documented. The measurement result will also be the same irrespective of who has done the work (unlike conventional methods).

In this chapter we describe the fundamentals within measurement and alignment, both laser and conventional methods. To get the most out of your Easy-Laser® measurement system it is important that you have fundamental knowledge about measurement. You will then do the measurements and alignments much faster and more accurately. In addition, you will doubtless see new possibilites to solve measurement problems you until then thought were hard, or even impossible to solve. Even if you have great experience in the field of alignment, you will probably get a better understanding of what to notice when doing the alignment work. At the same time you get an introduction to expressions and technical terms we use on other pages in this manual.

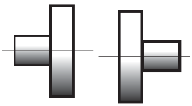
Shaft Alignment
Almost 50% of all down-time in rotating machines depends on misalignment. Misaligned shafts can cause:
Bearing failure
Shaft failure
Seal failure
Coupling wear
Overheating
Energy loss
High vibration

Carefully aligned machines will get you:
Increased production time
Less bearing and seal wear
Less coupling wear
Less vibration
Lower maintenance costs

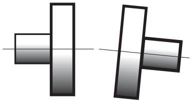
To be able to handle the measurement equipment in the right way is an important part of the alignment. Knowledge about tolerances, different types of couplings, machines and foundations etc. is also neccessary for a good result of the alignment work.

Technical terms within measurement and alignment
that is important to know:

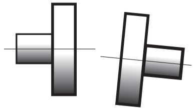
Offset	*The centre lines of the two shafts are not concentric but parallel.*
Angular deviation	*The centre lines of the two shafts are not parallel.*
M-machine	*Movable machine. The machine that is adjusted relative to the stationary machine.*
M-unit	*The measuring unit to be mounted on the movable machine.*
S-machine	*Stationary machine. Must not be moved.*
S-unit	*The measuring unit that shall be mounted on the stationary machine.*
Softfoot	*A condition where the machine stands on three feet instead of four. This of course means that the machine is standing unstably on the foundation. Should be adjusted before alignment.*



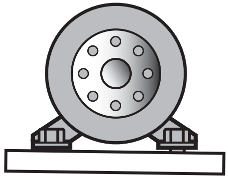
Offset



Angular deviation



Offset and angular deviation



Softfoot

E

The conditions for a good alignment

Before you start the alignment you have to know how the machines will react in normal working conditions. To align machines that are in bad shape, or will move from their position just a short moment after starting them is a waste of effort.

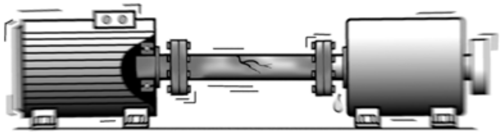
New machines

Make a rough alignment, followed by a more accurate alignment when the installation is finished. Before alignment, check how the machine is working. Check the mounting bolts, coupling, vibrations, temperature, pipes and other connections.

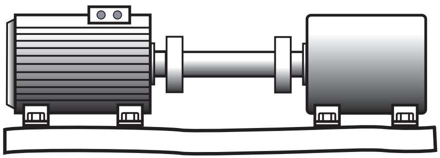
Machine foundations (new installation)

Check that the foundations of both the machines are stable and flat, and that the concrete foundation has hardened before placing the machines. Observe that the feet of the machines should not rest directly on to the foundation, instead you should use shims. Clean the machine feet from dirt and rust. In addition the stationary machine should be shimmed a little bit higher than the moveable one before alignment.

To begin with, place approximately 2 mm of shims under each machine foot. Then you will be well prepared for the following alignment.



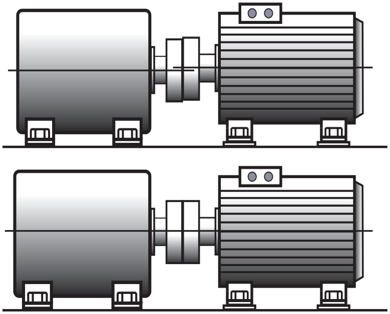
Misaligned shafts will always cause strains and stresses in bearings, shafts, couplings and the driving machine.



Reliable alignment is not possible if the machine foundation is not stable.

Dynamical movements

During operation, machinery will be influenced by different factors and forces. These factors may be thermal growth, twisting forces, aerodynamical forces and hydraulic forces to mention some. The sum of these factors will result in an offset deviation from the position of a “cold” machine. This new position of the shafts is normally called the “hot” condition. Depending on the kind of machinery, these changes can be of great importance.



Cold condition

Hot condition

Thermal growth

The result of the measurement can be influenced from different thermal growth factors for the S- and the M-machine. For example the thermal growth factor for steel is approxemately 0.01 mm/m for each degree of temperature rising.

Example:

Height from foundation to shaft	*1 m*
Temperature when aligning	*$+20\ ^{o}C$*
Working temperature	*$+50\ ^{o}C$*
Thermal growth:	1 x 0.01 x (50-20)=0.3 mm

There is no problem when the S-machine has the same characteristics as the M-machine. In other cases you have to do the alignment before the machine get cold, or you have to compensate for the difference.

Example:

If the S-machine rises with 0.25 mm more than the M-machine as a result of the thermal growth, the shims under the M-machine also have to be increased with 0.25 mm (under all feet).

The machine manufacturers normally provide information about the thermal characteristics of their machines. Always check the following when deciding the influences of thermal growth:

The working temperature for both the machines.

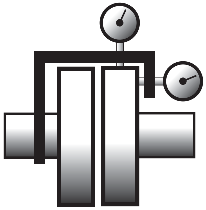
The temperature coefficient for both the machines.

The influence of the surrounding temperature such as machinery insulation, external heat sources, cooling systems etc.

Alignment methods

Rim and face method

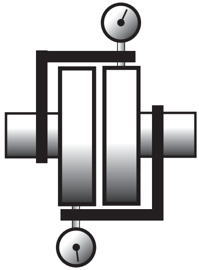
Two dial indicators mounted on a fixture indicate the offset (rim) and angular error (face) of the coupling. The readings are taken when the shafts are turned 180° between positions 6 - 12 - 9 - 3.



Rim and face method.

Reversed indicator method

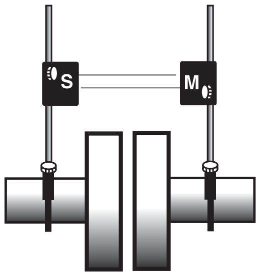
Two dial indicators, mounted on each half of the coupling shows the offset and angular error. Measurement values are read when the shafts are turned 180° between the measurement positions 6 - 12 - 9 - 3. One of the dials indicates the offset, and the difference between the dials gives the angular error.



Reversed indicator method.

Laser method

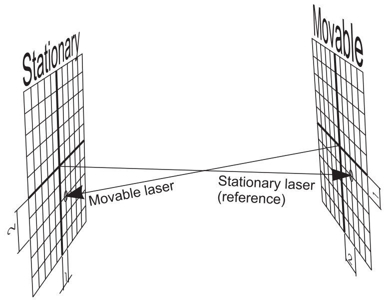
Works with the reversed method where, instead of dial indicators, two laser transmitters/detectors mounted on each part of the shaft/coupling are used. The measurement values are read when the shafts are turned to measurement positions 9 - 12 - 3, or with the program EasyTurn™ to three arbitrary positions with as little as 20° between the positions. The display unit calculates the offset and angular error, and also the position of front and rear feet pair. All values are displayed “live”.

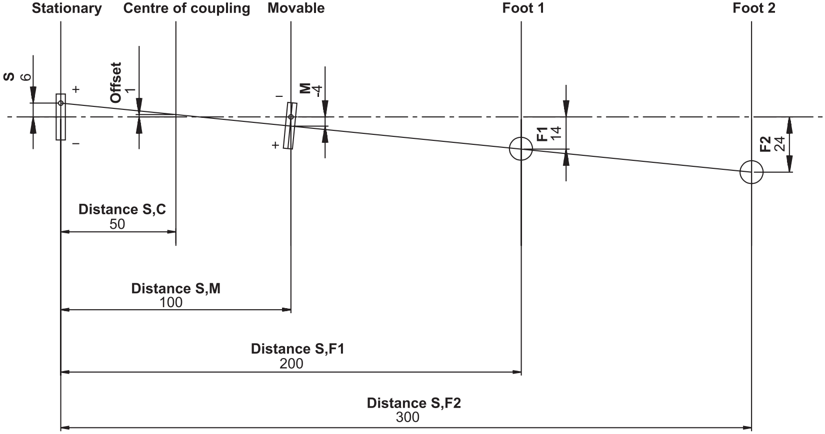


Laser method

Shaft alignment with laser is based on normal trigonometrics, where the values are calculated by the display unit. The diagram below describes the mathematics behind the calculations.

Example from a measurement where the laserbeams from the measuring units hit in an imagined coordinate system.



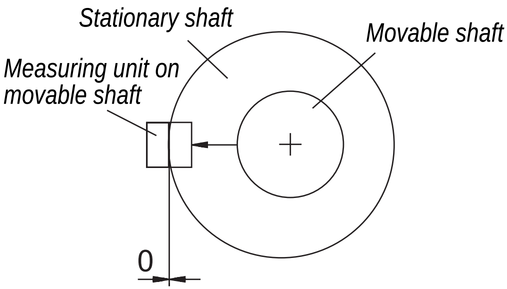


Foot position= $\left(\frac{\text{(M-S)}}{\text{Distance S,M}}\right.$ x Distance S,Fx)+S	F1=($\frac{-4-6}{100}$ x200)+6= 14 and F2=($\frac{-4-6}{100}$ x300)+6= 24
Angle= ($\frac{\text{(M-S)x100}}{\text{Distance S,M}}$	$\frac{-4-6}{100}$ x100= -10/100
Offset= ($\frac{\text{(M-S)}}{\text{Distance S,M}}$ x Distance S,C)+S	($\frac{-4-6}{100}$ x50)+6= 1

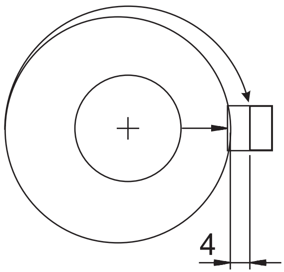
Basic method to find the centre of the shafts when doing *shaft alignment*.

Example (only “movable” measuring unit shown):

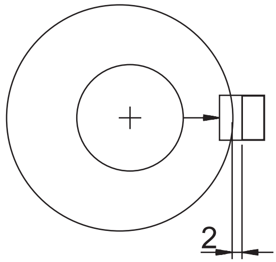
1. Zero set.



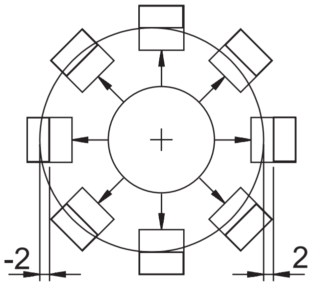
2. Turn 180º and read the value.



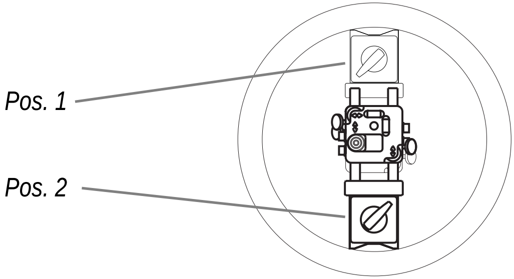
3. Halve the value.



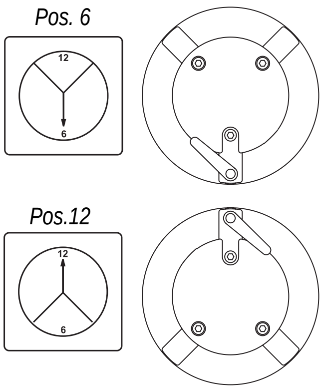
4. Turn and read absolute values over one full revolution.



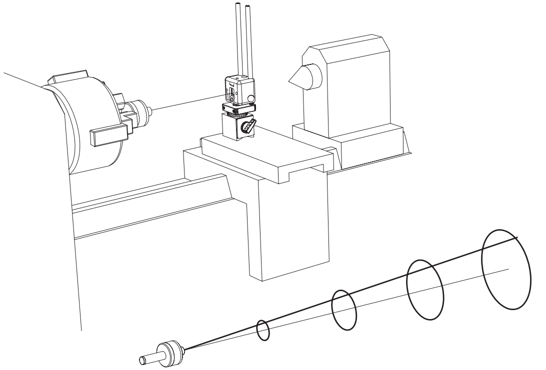
The centre of rotation for a detector when measuring centre of circle.



When indexing the detector its centre of rotation is calculated relative to the laserbeam.
Zero the measurement values in position 1, and halve the values in position 2.
Now any different diameters will not affect the measurement value from being a true value of the centre point.

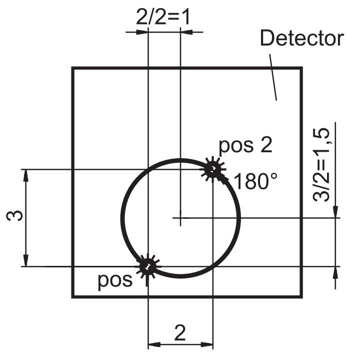


Centre of rotation for the laser when measuring pointing direction.

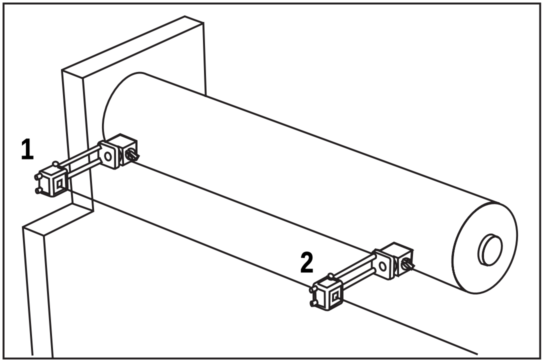


The laser beam projects concentric circles. A line through two centre points will show the pointing direction of the spindle.

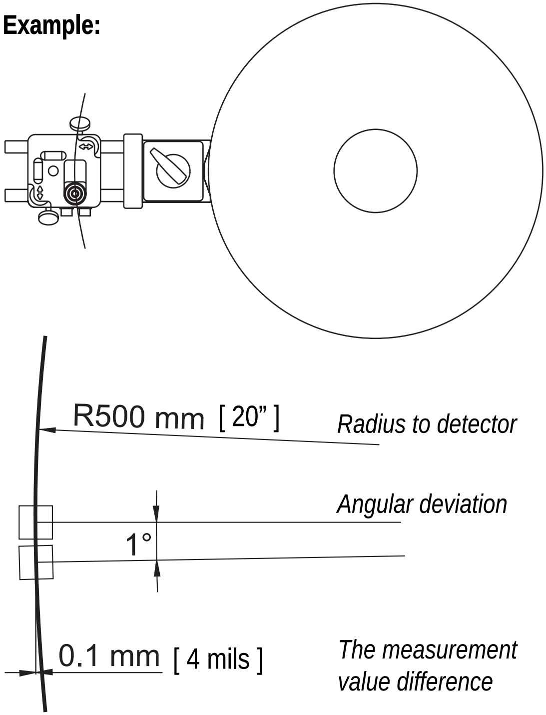
If the laser is indexed 180°, its centre of rotation will be calculated relative to the detector.



The position of the detector will influence the measurement value when measuring the parallelity between rolls. Therefore it is important to place the detector at the same angle at measurement positions 1 and 2 at each object.



Example:



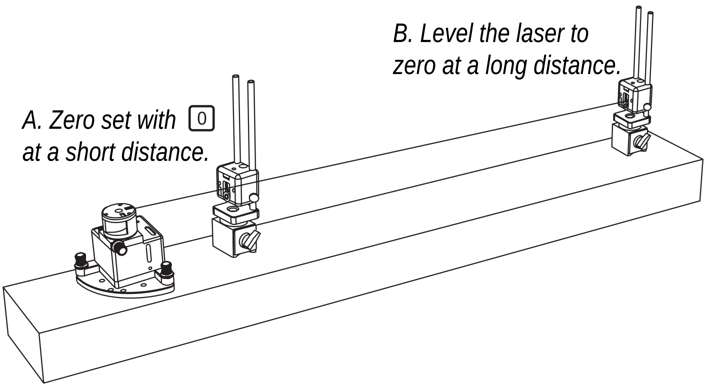
At a radius of 500 mm [20"] an angular deviation of 1° will give a difference of 0.1 mm [4 mils] in radial measurement value.

All measurement with Easy-Laser® such as straightness, flatness, parallelism and squareness is based upon the same principle. All measurement values will reflect the position of the detector relative the laser beam. To be able to use the measurement values for adjustment and documentation, you need to select absolute references/zero points. These can be either points on the measurement object or the horizontal plane.
When using a horizontal reference, the laser beam is levelled to the vials on the laser transmitter.
When the measurement object is to be the reference, the laser is levelled to the detectors placed at the reference points.
This levelling is always carried out in the same way: *zero setting of the laser.*

Zero setting of the laser
1. *Rough alignment to closed target.*
A- At a short distance, aim the detector at the laser beam by sliding the detector on the risers.
B- At a long distance, level the laser to the target.

2. *Fine adjustment to open target.*
A- At a short distance, zero set detector with $\boxed{0}$ *on the display unit.*
B- At a long distance, level the laser to zero on the detector.
C- Redo steps 2A and 2B until you get zero at both of the reference points.

Now a measurement of the object along the laserbeam can be made.

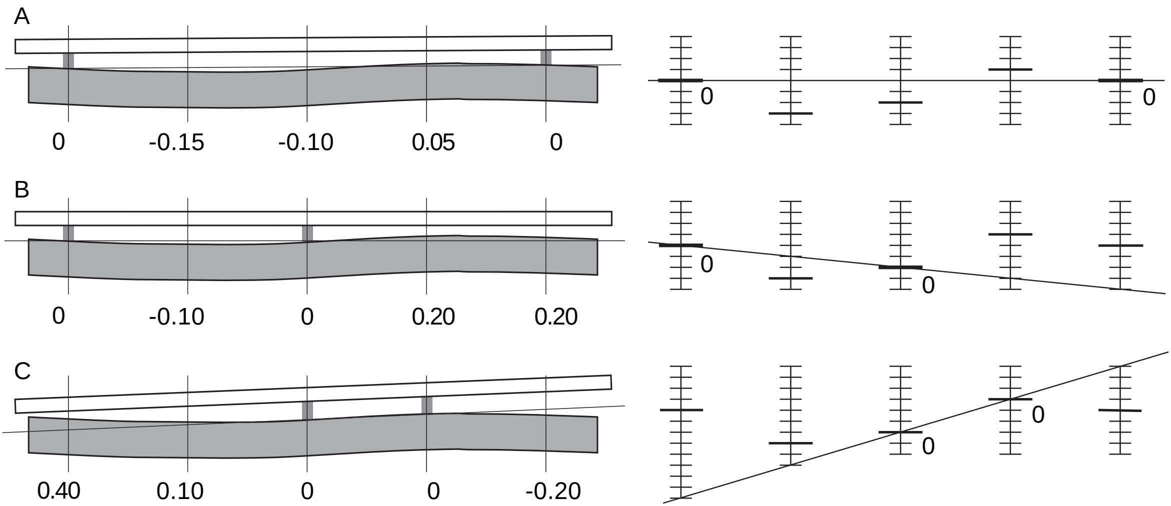


E

Example of a straightness measurement

Taking a girder as example, we place our “zero points” (the gauge blocks under the straight edge) at different positions. The straight edge will now act as the reference line to which the other measurement values will refer. The measurement values are assumed according to example (A).

NOTE! The measurement values have been compensated for the thickness of the gauge blocks (represented in the picture by the thin line). If we then move the zero points (examples B and C), the measurement values will also change, corresponding to the reference line. In the same way as for the straight edge, the measurement values will change for an object measured with a laser system when the reference points are moved.



Appendix F

F. Appendix

The rotation speed of the shafts will decide the demands on the alignment. The table on this side can be used as a guidance if no other tolerances is recommended by the manufacturer of the machines. The tolerances are set to the maximum allowed deviation from accurate values, with no consideration of whether that value should be zero or compensated for thermal growth.

	Excellent		Acceptable	
Offset				
rpm	***mils***	***mm***	***mils***	***mm***
0000-1000	*3.0*	*0.07*	*5.0*	*0.13*
1000-2000	*2.0*	*0.05*	*4.0*	*0.10*
2000-3000	*1.5*	*0.03*	*3.0*	*0.07*
3000-4000	*1.0*	*0.02*	*2.0*	*0.04*
4000-5000	*0.5*	*0.01*	*1.5*	*0.03*
5000-6000	*<0.5*	*<0.01*	*<1.5*	*<0.03*
Angular error				
rpm	***mils/”***	***mm/100***	***mils/”***	***mm/100***
0000-1000	*0.6*	*0.06*	*1.0*	*0.10*
1000-2000	*0.5*	*0.05*	*0.8*	*0.08*
2000-3000	*0.4*	*0.04*	*0.7*	*0.07*
3000-4000	*0.3*	*0.03*	*0.6*	*0.06*
4000-5000	*0.2*	*0.02*	*0.5*	*0.05*
5000-6000	*0.1*	*0.01*	*0.4*	*0.04*

Recommended maximum tolerances from manufacturers of belt transmissions are, depending on type of belt, 0.25–0.5°.

<°	mm/m mils/inch
0.1	1.75
0.2	3.49
0.3	5.24
0.4	6.98
0.5	8.73
0.6	10.47
0.7	1222
0.8	13.96
0.9	15.71
1.0	17.45

Recommended range

F

Calibrate the equipment

Now and then the BTA Digital equipment needs to be calibrated. This is done with the “Calibration” program according to the principle below.

***1. Place the detector and the transmitter** on a perfectly flat surface, e.g. a machine table. The purpose is to zero the measurement values when the magnet surfaces of the two units are truly parallel to each other, and not displaced.*

2. Start the BTA DIGITAL program

Menu

1 BTA DIGITAL

2 CALIBRATION

3. Select 2, CALIBRATION

Press [2]

Calibration

Serial No : 16997

-0.6 1.5

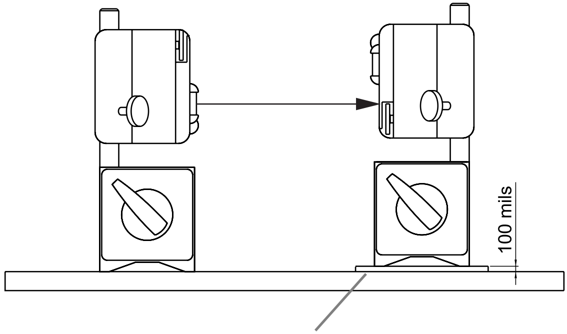
9 Exit

***4. Calibrate the detector** to 0 by first pressing [0], then press [8] “Save”.*

Now the detector unit is calibrated to the laser transmitter.

[To interrupt the calibration, press [9] “Exit”, or turn the display unit off with ON / OFF. If you choose Exit you will come to the measurement procedure step 3.]

A method to check if the Easy-Laser® measuring units are within the specified tolerances.



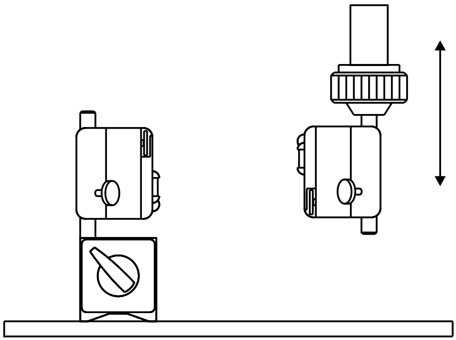
Parallel lift a known distance.

1. *Use program Values. Set the resolution to 0.5 mil [0.01 mm], display the M-values and set to zero by pressing the* [0] *button.*

2. *Put a shim under the magnet base to lift the M-unit 100 mils [1 mm] and the M-reading shall correspond to the movement within 1 % (1 mil ±1 digit) [0.01 mm ±1 digit).*

3. *Remove the shim, display the S-values, set to zero and put the shim under the magnet base to lift the S-unit. S-reading shall now correspond to the movement within 1 % (1 mil ±1 digit) [0.01 mm ±1 digit).*

Note!
It is only the lifted unit that can be measured each time.



An alternative way to move the units a known distance is to use the movement of a machine tool spindle.

F

Conversion tables to convert measurement values from one unit to another.

Mass

gram (g)	ounce (oz)	pound (lb)
1	0.035	
28.35	1	
453.59	16	1
1000		2.205

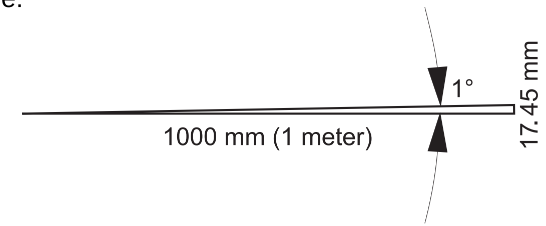
Length

mil	mm	Inch	Foot	meter
0.0394	0.001			
0.05	0.00127			
0.3937	0.01			
0.5	0.0127			
1	0.0254	0.001		
3.937	0.1	0.0039		
5	0.127	0.005		
39.37	1	0.0394		
100	2.54	0.1		
1000	25.4	1	0.0833	
	304.8	12	1	0.3048
	1000	39.37	3.28	1

Angle

arc sec.	mil/foot	mil/inch	mm/m	degree	inch/foot
1	0.06	0.005	0.005		
16.6	1	0.083	0.083		
	12	1	1	0.057°	0.012
	210	17.45	17.45	1°	0.21
	1000	83.3	83.3	4.75°	1

Example:



Temperature

°C	°F
-40	-40
-30	-22
-20	-4
-17.8	0
-10	14
0	32
10	50
20	68
30	86
37.8	100
40	104
50	122
60	140
70	158

A. The system will not start:
1 Don not let go of the *On*-button so quickly.
2 Check that the battery poles are facing the correct side according to the labels.
3 Change batteries.

B. The laser does not light up:
1 Check the connectors.
2 Change batteries.

C. No measurement values are displayed:
1 See B
2 Open the target.
3 Adjust the laser to the detector.

D. Unstable measurement values:
1 Tighten the screws at the fixtures etc.
2 Adjust the laser away from the PSD edge.
3 Increase the filter setting (not for BTA digital).

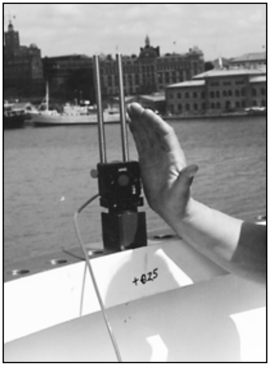
E. Wrong measurement values?
1 Study arrows and signs on the detector labels.
2. BTA digital; check mounting direction of detector unit.

F. There is no printout from the printer:
1 Check the printer cable.
2 If red diode on the printer goes out, charge the printer batteries.

Cleaning
For the best measurement result, always keep the equipment clean and the optics at the detector and laser very clean from dirt and fingerprints. Use a *dry* rag for cleaning.

Batteries
The system is powered by four R14 (C) batteries. Most types of batteries can be used, even rechargeable, but alcaline will give the longest operating time. If the system will not be used for a long time, the batteries must be taken out.

Avoid direct sunlight
If the measuring unit/detector has to be placed so that sunlight hits the PSD directly, there is a risk of unstable measurement values. Try to shade the detector, for example as shown in the picture.



DESCRIPTION OF FAULT

If the equipment is damaged or if any other fault occur that requires repair at Damalini, please copy this page, describe the fault and enclose it with the system.

Company: ....

....

....

System: ....

Fault description: ....

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Signature: ....

Date: ....

NOTES

NOTES

Easy-Laser®

Measurement and Alignment Systems

EasyLink™

MEASUREMENT DOCUMENTATION

Data base program for Windows®

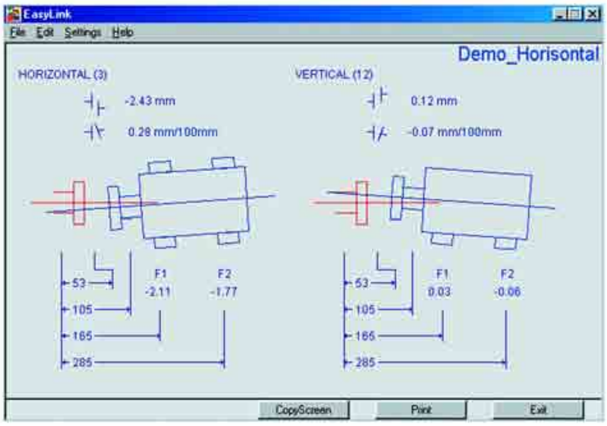
Receives and handles measurement data from the Easy-Laser® systems.

Make reports with screen dumps and/or editable measurement databases.

Measurement programs supported:

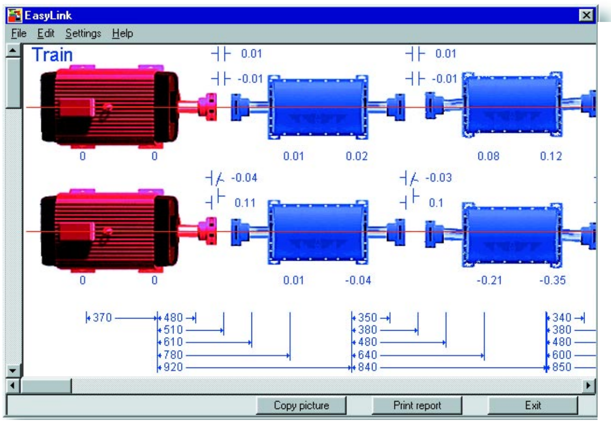
Horizontal, Vertical, Easy-Turn™, Cardan, Machine train, Straightness, Flatness, Squareness, Parallelism, Plumbline, Spindle, Center Of Circle, Flange, BTA Digital, Vibration.

HORIZONTAL & EASY-TURN™ — Shaft alignment

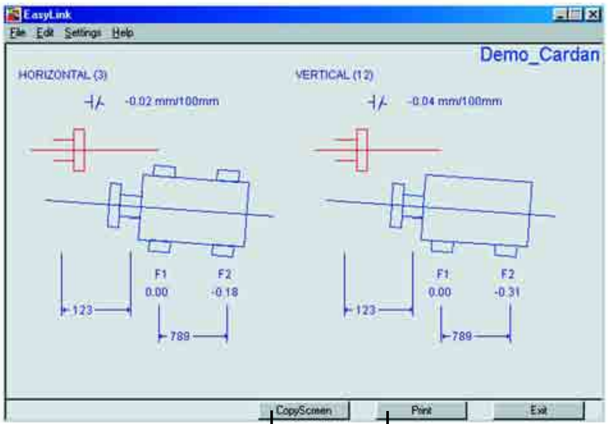


Red lines shows stationary machine.

MACHINE TRAIN — Shaft alignment



CARDAN — Shaft alignment

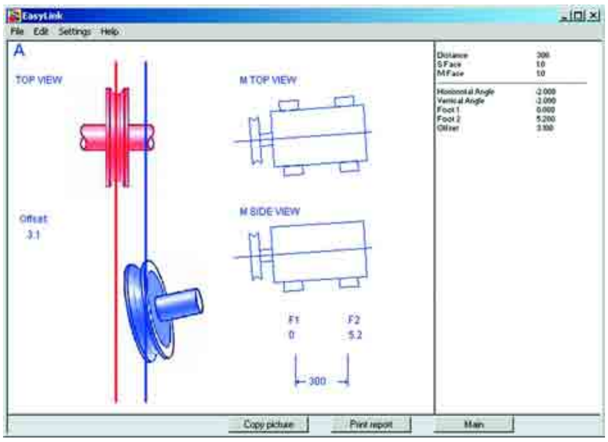


Screen Dump

Print screen

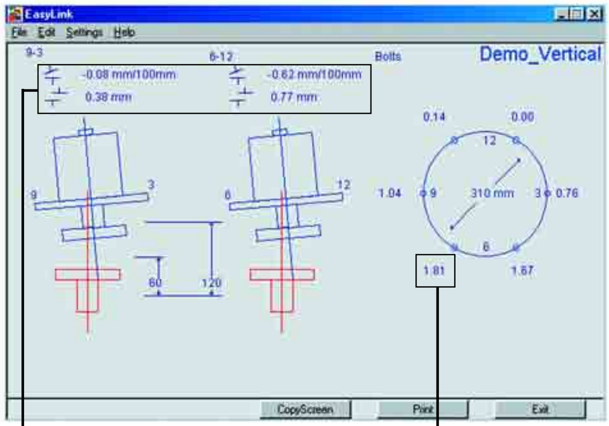
(Possible from all measurements.)

BTA DIGITAL — Sheave/Pulley alignment



Red line shows stationary machine.

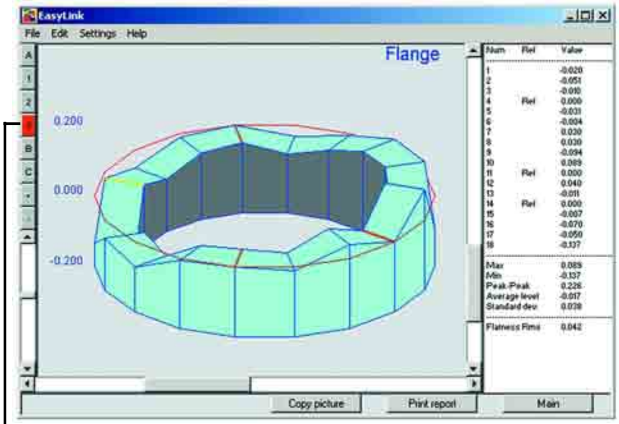
VERTICAL



Angular and parallel misalignment

Shim value for each bolt

FLANGE — Flatness measurement



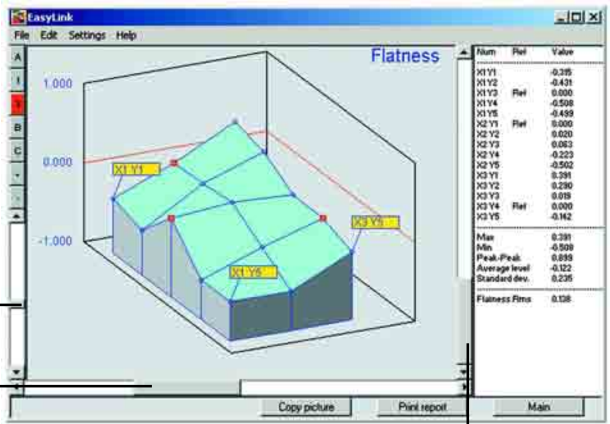
Three points are set to zero by choosing one point, the two other will be calculated by the program, evenly placed at the circle. Zero points marked with red. First point marked with yellow.

Calculation functions:
A: Absolute readings
1: Select one point offset. This function can be used if measurement is done with levelled laser.
3: Select three arbitrary reference points.
B: Best fit around zero. No reference points used.
C: Best fit around zero. Three reference points are calculated, placing plane as close as possible to zero.
+: Displays best plane with all measurement values positive compared to three reference points.
-: Displays best plane with all measurement values negative compared to three reference points.

FLATNESS

Rotate object

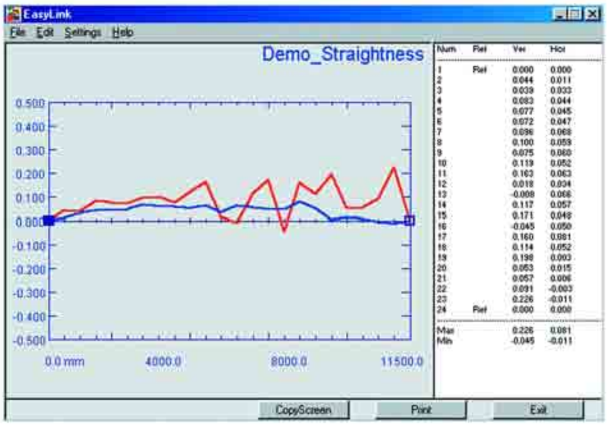
Change displayed resolution



Three points are set to zero.
Calculation functions: See *Flange* above.

Change picture angle

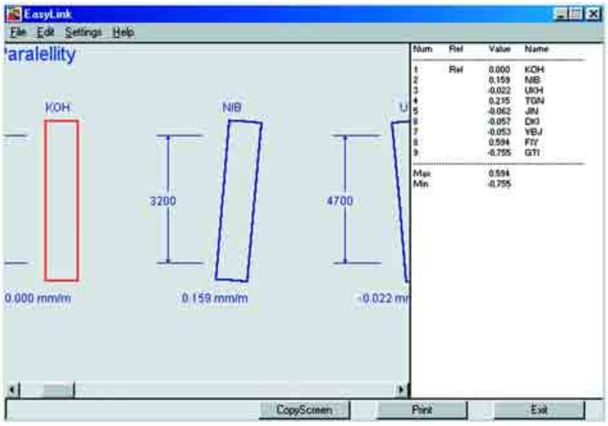
STRAIGHTNESS / CENTER OF CIRCLE



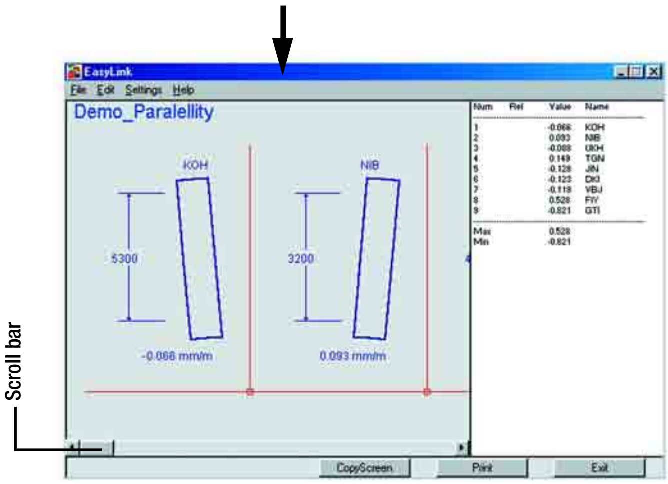
Red line shows Horizontal values. Blue shows Vertical. Click on any point to make it reference point.

■ □ = reference points

PARALLELISM

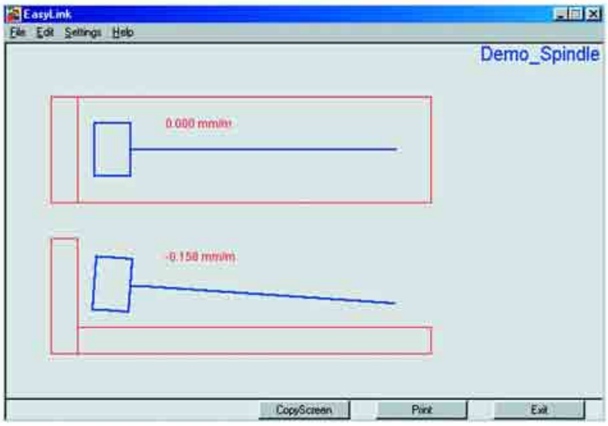


Red object is reference. Any of the objects can be choosen as reference. The values for the other objects will be recalculated.



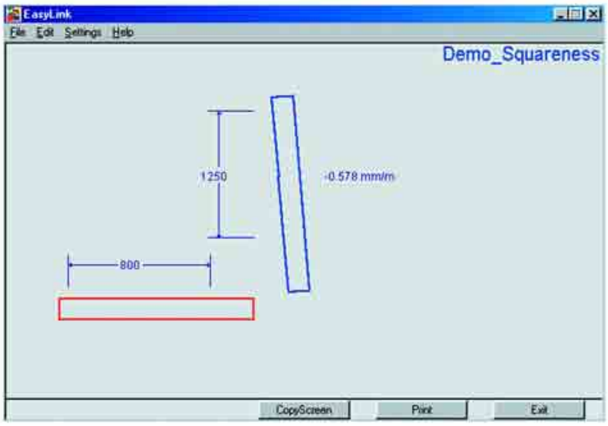
The same measurement with the base line as reference. Notice how the values have been recalculated.

SPINDLE



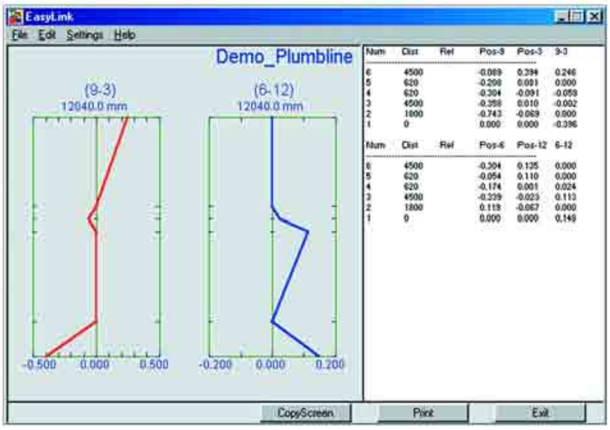
Red object is reference.

SQUARENESS



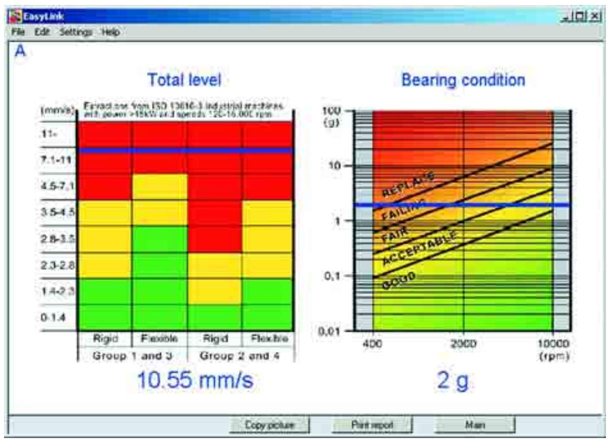
Red object is reference.

PLUMBLINE



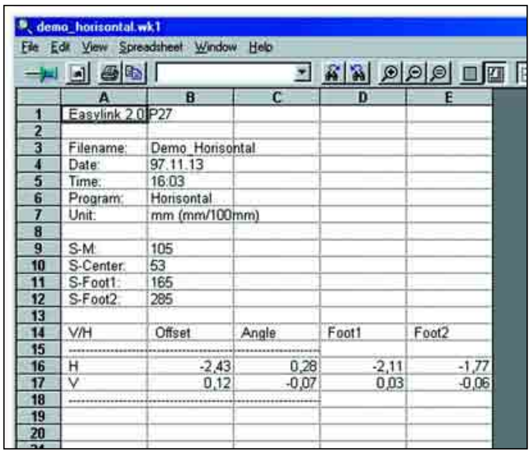
Turbine shaft measurement showing plumbline values.

VIBROMETER



EXPORT MEASUREMENT DATA

The measurement data can easily be exported to a spreadsheet, e.g. an Excel or Lotus sheet.

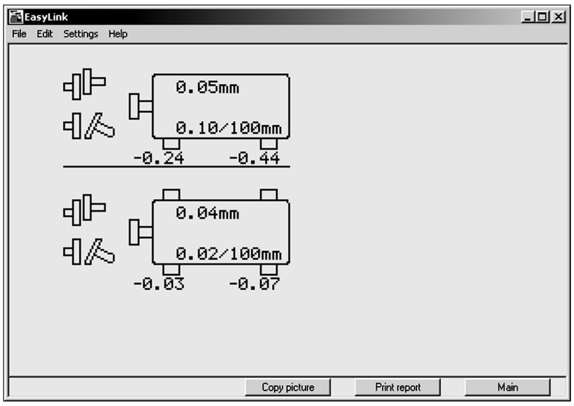

demo_horisontal.wk1

File Edit View Spreadsheet Window Help

	A	B	C	D	E
1	Easylink 2.0	P27			
2					
3	Filename:	Demo_Horisontal			
4	Date:	97.11.13			
5	Time:	16:03			
6	Program:	Horisontal			
7	Unit:	mm (mm/100mm)			
8					
9	S-M:	105			
10	S-Center:	53			
11	S-Foot1:	165			
12	S-Foot2:	285			
13					
14	V/H	Offset	Angle	Foot1	Foot2
15	----------	----------	----------	----------	----------
16	H	-2,43	0,28	-2,11	-1,77
17	V	0,12	-0,07	0,03	-0,06
18	----------	----------	----------	----------	----------
19					
20					

SCREEN DUMPS

A screen dump can be directly transferred from the Display unit to a PC to be used for documentation.



SYSTEM REQUIREMENTS

DOS: Windows 95 or later.
RAM: 16 MB, 32 preferred
Available hard disc space for program files: 5 MB
Every transferred measurement will need approximately 1 kB.
GIF and JPEG pictures shall be saved in low resolution for fastest possible access.

UPGRADING

The EasyLink™ software will continuously be upgraded for the best functionality. You can always download the latest version from our web site: www.damalini.com

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Measurement And Alignment Technology

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