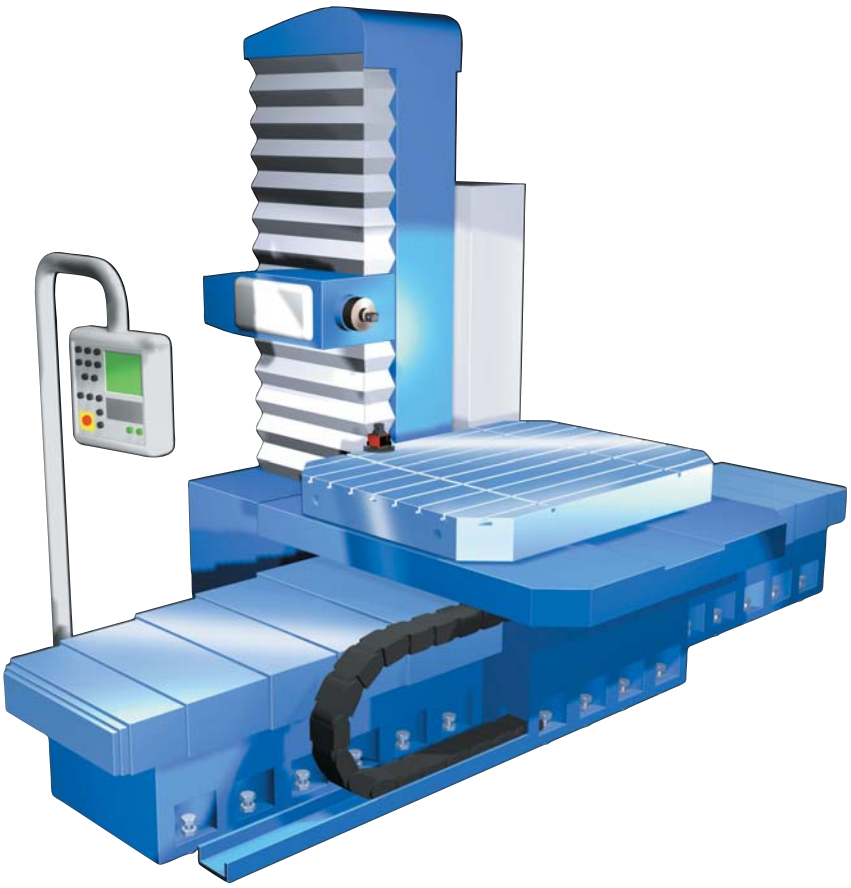

Machine tools guide

Lathes and milling machines

EASY-LASER®

05-0432 Rev 2

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Content

Machine tools

In order to meet quality requirements and minimise the number of waste workpieces, the checking and alignment of machine tools is essential. The most important thing to check is the geometry of the machine; not even a precisely calibrated linear motion can compensate for a crooked movement or uneven surface. The correct machine geometry is the basis for being able to produce parts that remain within the tolerances.

Our geometry measurement systems can handle most tasks in this field, despite the fact that there is considerable variation as regards to machine design: boring machines, vertical, horizontal and portal milling machines, lathes, vertical lathes, drilling machines, automatic drills, water cutting machines, presses, etc.

Easy-Laser® makes work much faster

Compared to conventional methods, such as dial gauges together with stones and shafts, work can be carried out much more quickly with the use of a laser measurement system. There are many reasons why:

Laser measurement system

- Easy to learn and use
- Light and handy equipment = shorter time for preparations and measurements
- Possible to measure and align at long distances = greater accuracy
- Possible to measure both X and Y (Z) directions at the same time = saves time
- The reference (laser beam) is always 100% straight
- Live adjustment
- Possible to create documentation of the measurement results via printer and to PC

Conventional methods

- Often heavy and ungainly equipment like stone and shaft
- Require more skill
- The equipment can be difficult to set up = prolongs measurement time
- Possible changes or wear on fixtures = the reference is not straight
- Handwritten documentation only

Manufacture more and at higher quality

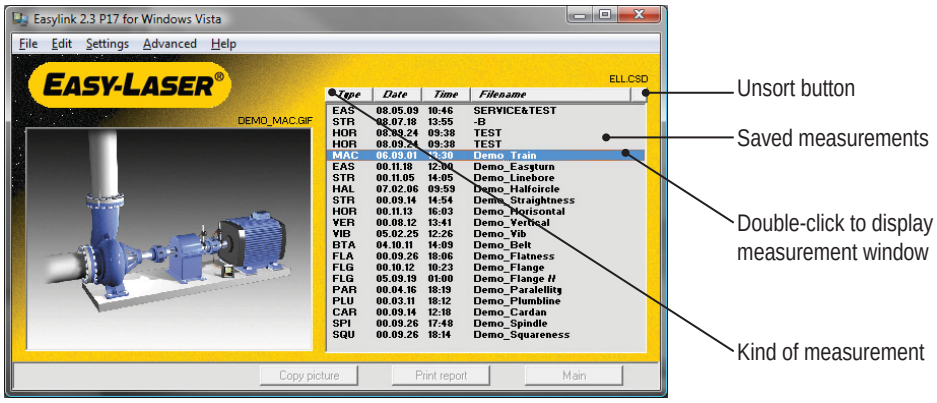
Being in full control of your machine has many advantages:

- Less downtime
- Better use of machine time
- Higher quality of manufactured parts
- Fewer waste workpieces
- Better material use
- Faster deliveries
- Longer service life for the machine tools

EasyLink™

EasyLink™ is a data transfer and database software for Windows. The export function supports Excel, Works and Lotus. 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 by the program.

Main window is displayed when you start the program. It is possible to add your own photo here.



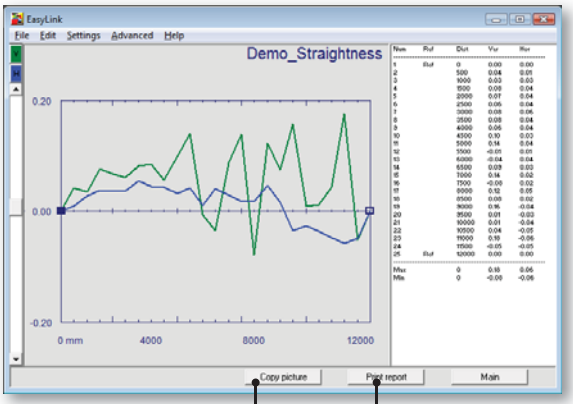
Measurement programs supported

The Display unit has many programs. For machine tools the programs you use the most are:

- Flatness (FLA)
- Straightness (STR)
- Vibration (VIB)
- Spindle (SPI)
- Squareness (SQU)
- Easy-Turn™ (EAS)
- Horizontal (HOR)

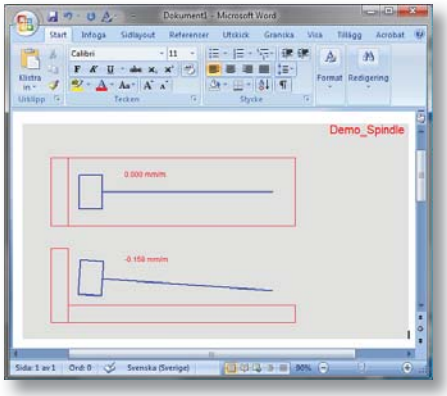
Copy to other programs

Make a screen dump of the result and copy the graph to Word for example.



Make screendumps

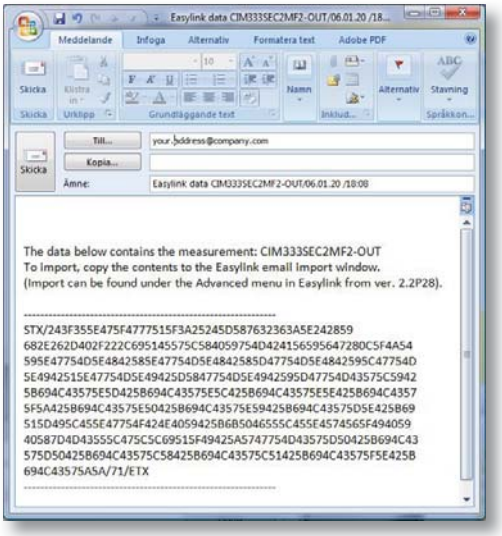
Print reports



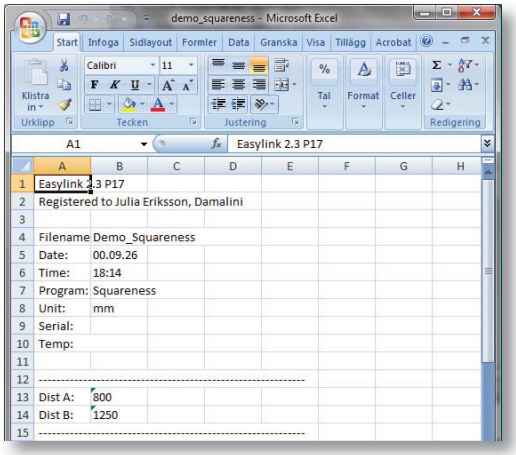
Copy to other programs

Send and export

It is possible to send the measurement results via e-mail. You can also export the data to for example Excel to make a custom designed report.



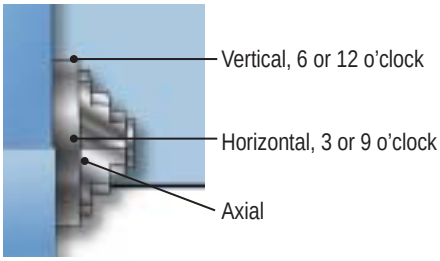
Send results via e-mail



Export to Excel

Spindle bearing condition

Measurement of bearing condition on the spindle bearings.



Equipment to use

Vibrometer probe

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. Do not change bearings before this is done.

Measure

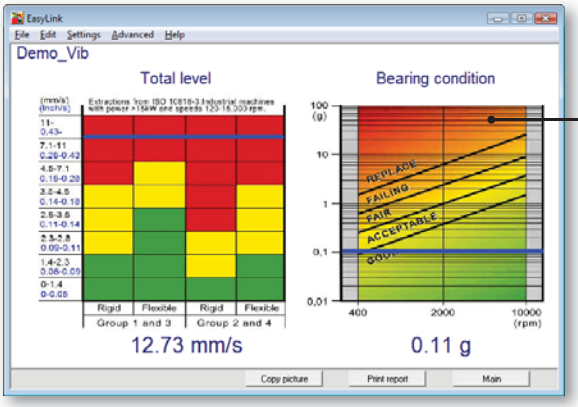
1. Place the probe firmly against the measurement point.
2. Make measurements on a vertical, horizontal and axial measurement point. Try to hold the probe as vertical, horizontal or axial as possible.
3. Use the M6 stud for high frequency measurements, and mount the probe directly to the machine.

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 probe more 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. **For most spindle bearing, your “g” value should be lower than 0.7 g**.

Vibrometer report

Transfer the data to a PC via EasyLink™. The result can be presented both digitally and graphically.

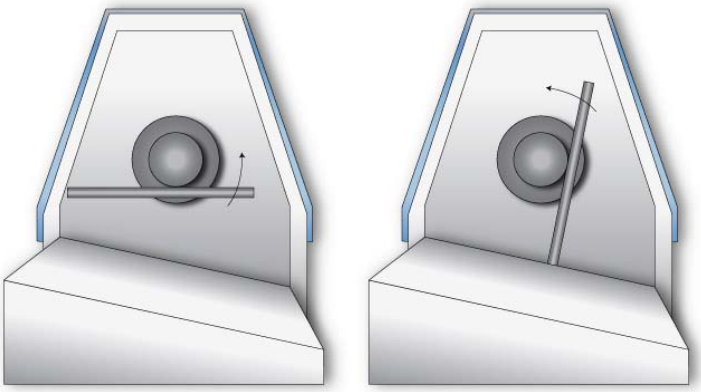


An important guide to interpret the bearing condition value.

Spindle bearing movement

To measure the vertical and horizontal play you check the spindle bearing movement.

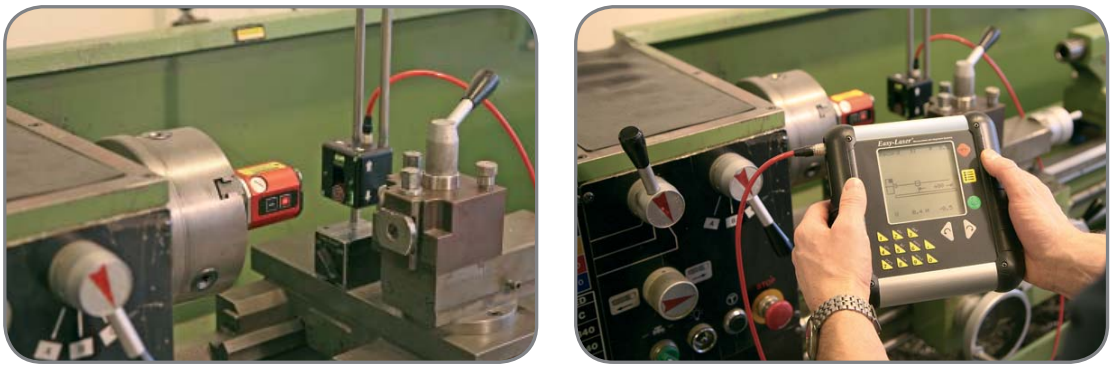
1. Press 0.
2. Push the bearing in vertical or horizontal direction.
3. Read value.



Lathe with tool support

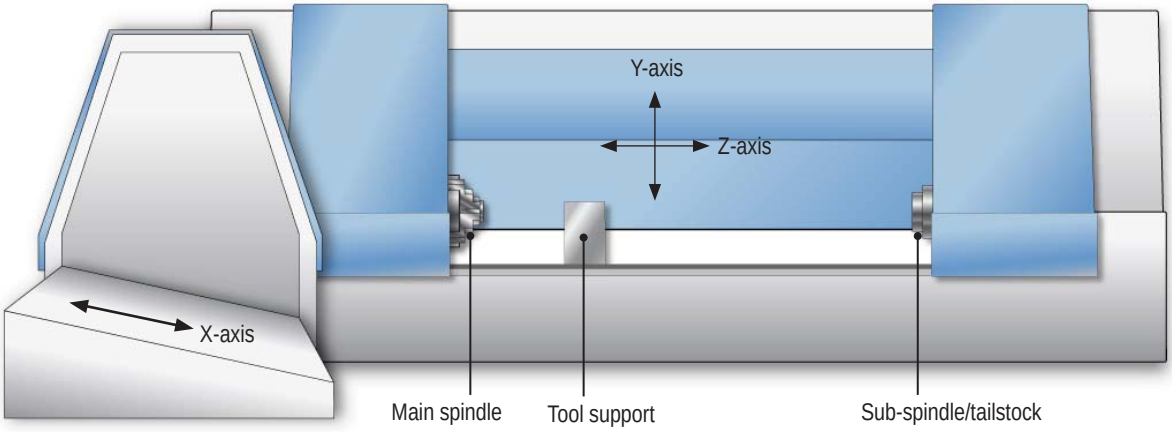
What to check

Check straightness, spindle direction, spindle to spindle, squareness and flatness. All of these can be measured with Easy-Laser®. Resolution of 0.001 mm and a maximum measuring distance of up to 40 m. Using our software EasyLink™, the results are presented both digitally and graphically.



Easy-Laser® equipment mounted on a lathe with tool support.

In this chapter we describe methods for measuring a traditional lathe with tool support. *See also chapter Lathe with turret.*



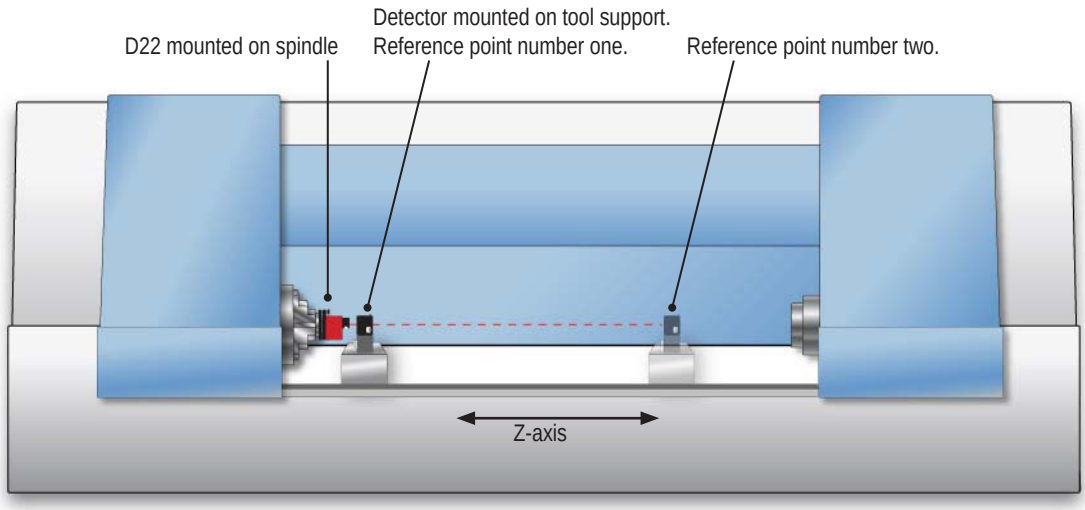
What to do first

For best result, measure and adjust the machine in the following order.

1. Straightness of all machine axis.
2. Main spindle direction.
3. Main spindle towards sub-spindle/tailstock.
4. Squareness of Z- and X-axis.
5. Spindle bearing condition.

Straightness of Z-axis

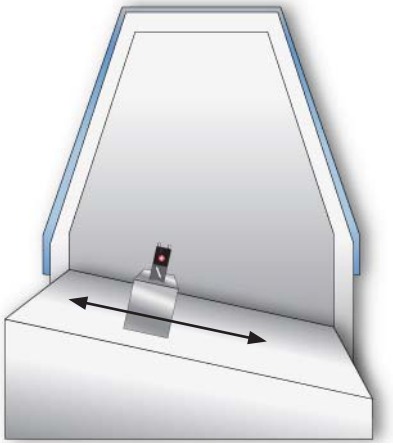
Straightness measurement of the tool support's Z-axis.



Equipment to use

Laser transmitter D22 or D146.

Detector D5 (or M-unit) mounted on a magnet base.



Detector correspond to the side movement

Preparations

1. Mount the laser transmitter in the chuck or on the spindle.
2. Mount the detector on the tool support. Make sure that the detector corresponds with the side movement of the tool support, see image.
3. Start the program Values (17).
4. Place the detector close to the transmitter. Press 0 to make this a reference point number one.
5. Move the tool support with detector furthest away from the transmitter, to reference point number two.
6. Adjust laser beam to zero (0.00), both H and V values. Adjust by using the tilting screws.

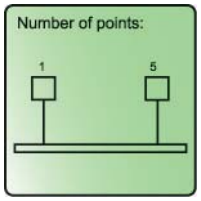
Note!

For this measurement the sideway result (H) is the most important, as you put a force on the bar from the tool.

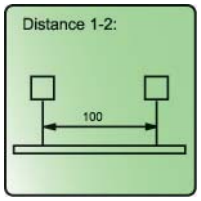
Measure

Make sure the reference points are still zero before measuring.

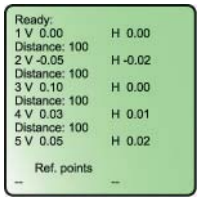
1. Start program Straightness (22).
2. Enter number of measurement points. Normally every 100 - 250 mm, or where there are adjustment points.
3. Place the detector on the first measurement point.
4. Press 0.
5. Move the detector to the next measurement point.
6. Press to record value.
7. Repeat until you have recorded all points on the machine bed.
8. Check from time to time that both reference points are still zero.
9. Adjust (if possible) by using the screws on the machine bed.
10. Save data and make a Straightness measurement report.



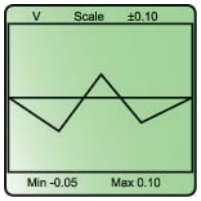
Number of measurement points.



Distance between points



Result displayed as table.

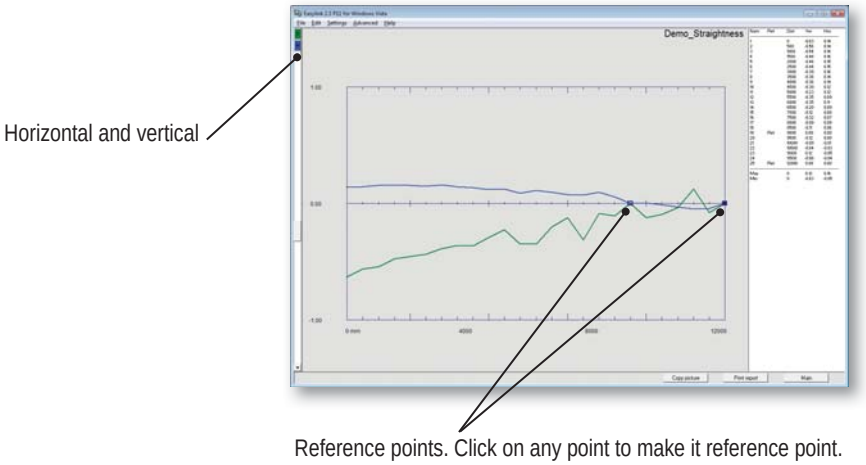


Result displayed as graph.

Straightness report

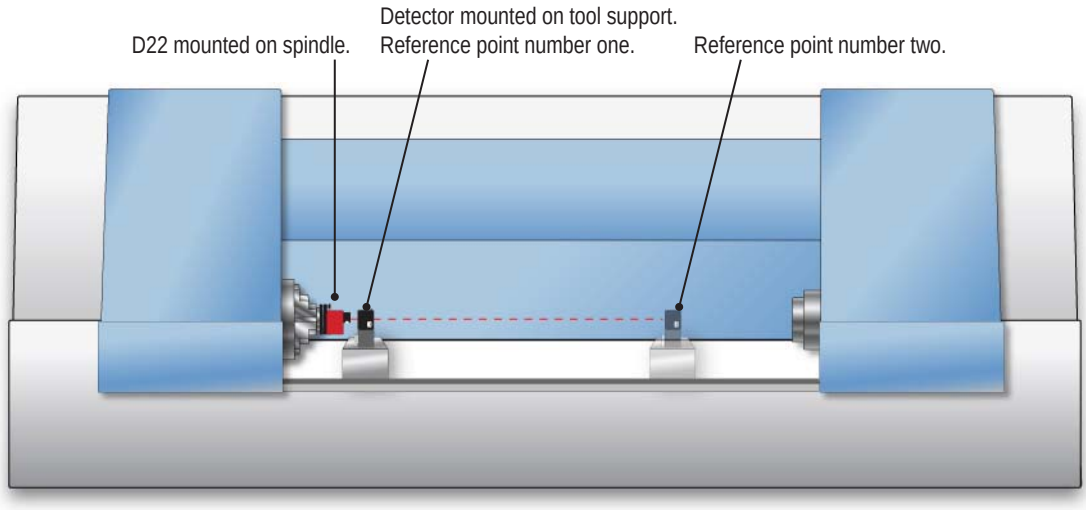
Transfer the data to a PC via EasyLink™. The result can be presented both digitally and graphically.

- Click the Horizontal and Vertical buttons to show or hide corresponding line.
- Click on any point in the graph to make it reference point.



Spindle direction Z-axis

Spindle direction measurement of the main spindle's Z-axis. Measurement on a lathe with tool support.

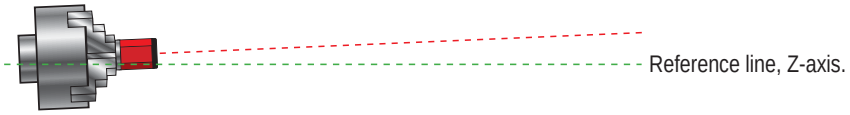


Equipment to use

Laser transmitter D146 or D22.

Detector D5 mounted on a magnet base.

In the image below the D146 laser transmitter is used. The D146 can also be used for straightness measurements and can be used in rotating spindle.



Note!

Before measuring spindle direction, make sure that the Z-movement is absolutely straight. Otherwise this measurement is useless.

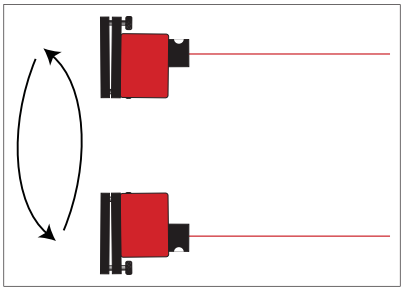
Preparations

1. Mount the laser transmitter in the chuck. For large machines you can mount it on the middle of the spindle.
2. Mount the detector on the tool support.

Measure

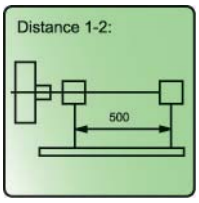
Start the program Spindle (21).

1. Enter distance between measurement point one and two. Use a distance of 500-1000 mm.
2. Place the detector on position one. Press to record value.
3. Rotate spindle 180° and press to record second value on position one.

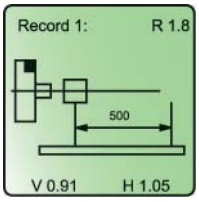


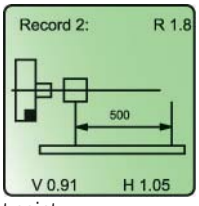
Rotate spindle

4. Move detector to position two. Press to record value.
5. Rotate spindle 180° and press to record second value on position two.
6. Save data and make a Spindle measurement report.

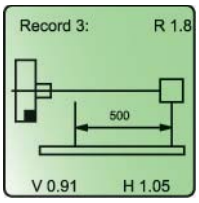


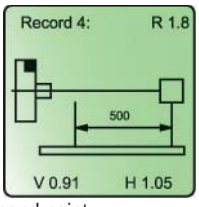
Distance between measurement points.



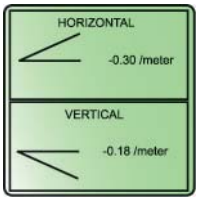


Two measurements on first point.





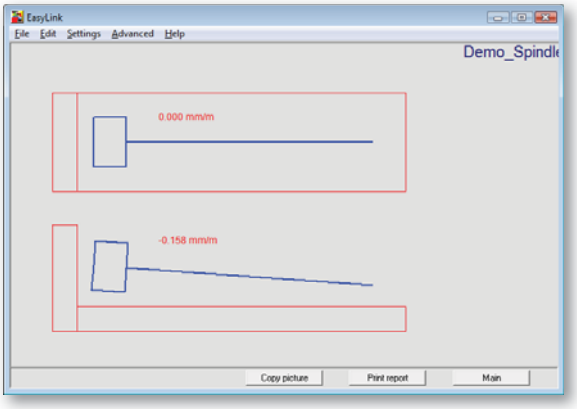
Two measurements on second point.



Result displayed as graph.

Spindle report

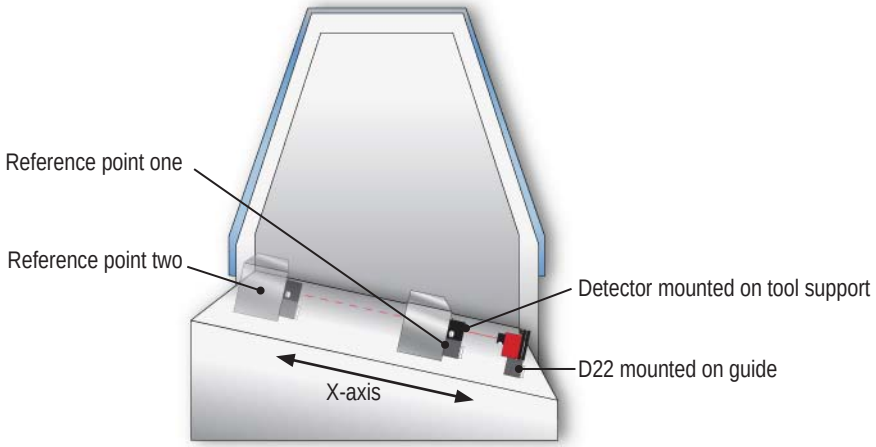
Transfer the data to a PC via EasyLink™. The result can be presented both digitally and graphically.



Red object is reference.

Straightness of X-axis

Straightness measurement of X-axis of the tool support.



Equipment to use

Laser transmitter D22.

Detector D5 (or M-unit) mounted on a magnet base.

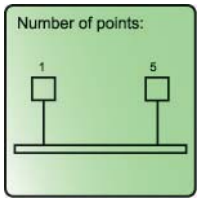
Preparations

1. Mount the laser transmitter on the guide.
2. Mount the detector on the tool support.
3. Place the detector close to the transmitter.
4. Reset the X scale on the machine to zero.
5. Press 0 to make this a reference point number one.
6. Move the tool support with detector 100-500 mm, to reference point number two. Move as far away from the transmitter as possible.

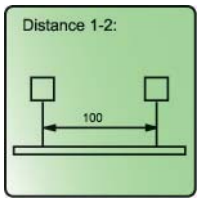
Measure

Make sure the reference points are still zero before measuring.

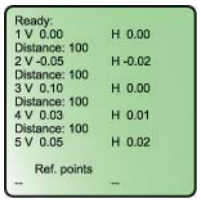
1. Start program Straightness (22).
2. Enter number of measurement points. Normally every 100 - 250 mm, or where there are adjustment points.
3. Place the detector on the first measurement point.
4. Press 0.
5. Move the detector to the next measurement point.
6. Press to record value.
7. Repeat until you have recorded all points of the X-axis.
8. Check from time to time that both reference points are still zero.
9. Adjust (if possible) by using the screws on the machine bed.
10. Save data and make a Straightness measurement report.



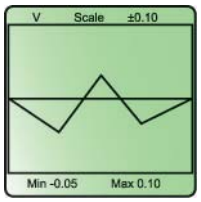
Number of measurement points.



Distance between points.



Result displayed as table.

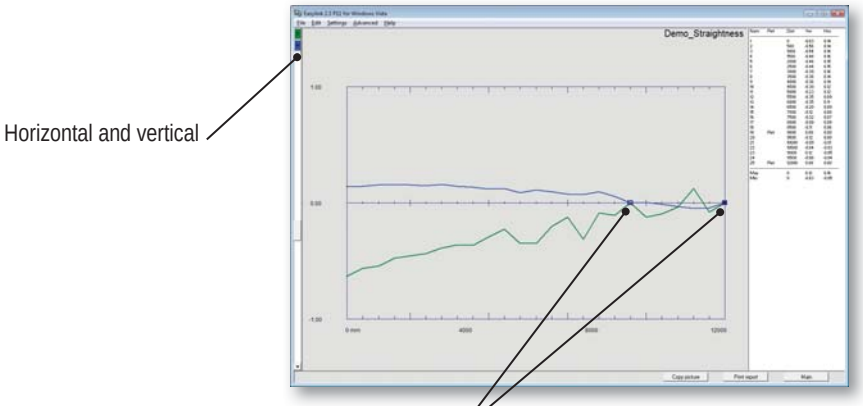


Result displayed as graph.

Straightness report

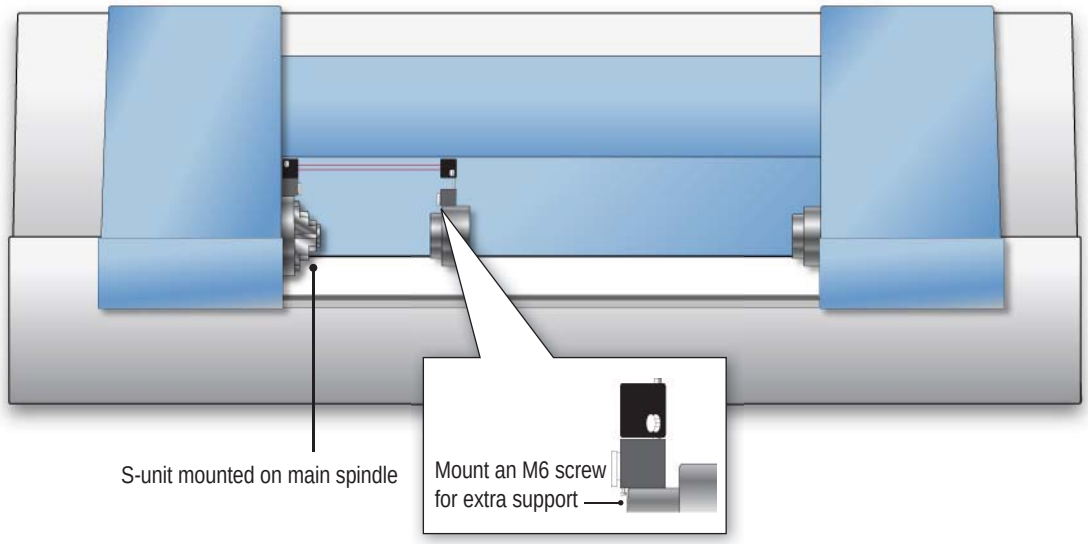
Transfer the data to a PC via EasyLink™. The result can be presented both digitally and graphically.

- Click the Horizontal and Vertical buttons to show or hide corresponding line.
- Click on any point in the graph to make it reference point.



Main spindle towards sub-spindle/tailstock

Measurement of main spindle towards the sub-spindle or tailstock.



Equipment to use

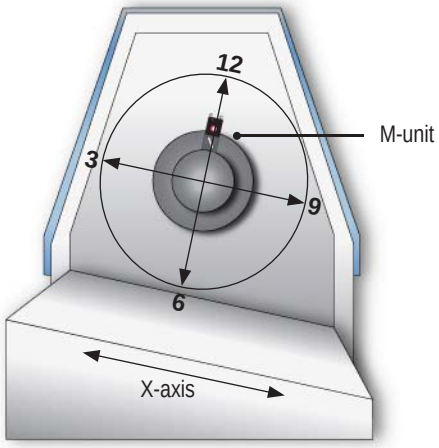
S- and M-units mounted on magnet bases.

Preparations

1. Mount an M6 screw for extra support on each unit.
2. Mount the S-unit with magnet base on the main spindle.
3. Mount the M-unit with magnet base on the sub-spindle.
4. Place the sub-spindle close to the main spindle, approx. 500 mm.

9, 3, 12 position

The positions 9, 3 and 12 corresponds to the X-axis, the side movement of the tool support.

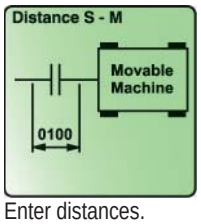


Positions corresponds to the X-axis

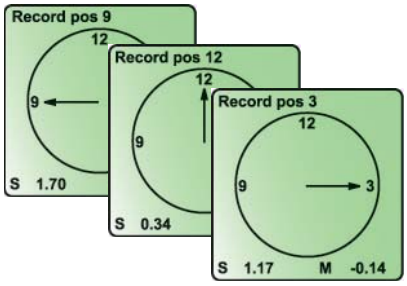
Measure

Before measuring the sub spindle/tailstock position you must make sure that the main spindle is pointing correctly.

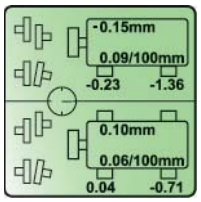
1. Start program Horizontal (11).
2. Enter distance between the measuring units.
3. Turn the measurement units to position 9 o'clock.
   Press to record first measurement value.
4. Turn units to 12 o'clock.
5. Press to record second measurement value.
6. Turn units to 3 o'clock.
7. Press to record third measurement value.
8. Save data and make a Horizontal measurement report.



Enter distances.



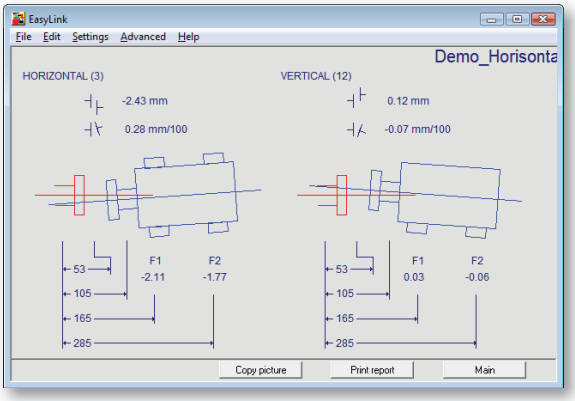
Record measurements on positions 9, 12 and 3.



Result displayed as graph.

Horizontal report

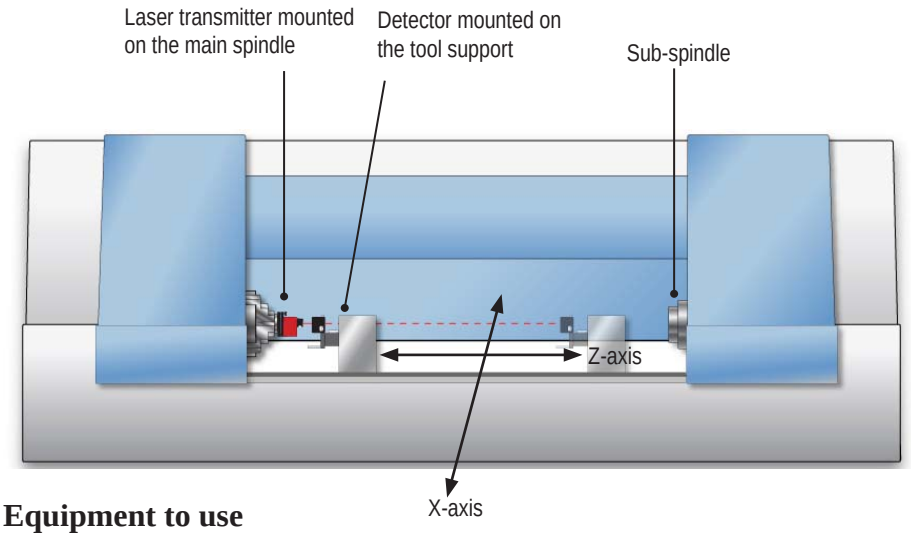
Transfer the data to a PC via EasyLink™. The result can be presented both digitally and graphically.



Red lines shows stationary machine.

Squareness of Z- and X-axis

The squareness measurements of the movements of the tool support. Before proceeding with this measurement, make sure both Z- and X- axis are straight by measuring straightness on both Z- and X-axis.



Equipment to use

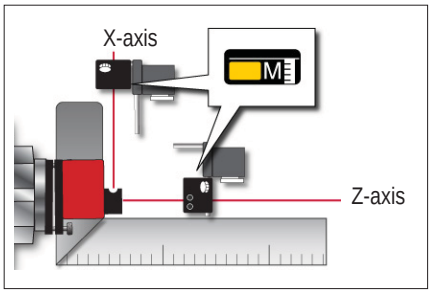
Laser transmitter D22

Detector D5 mounted on a D45 magnet base with turnable head.

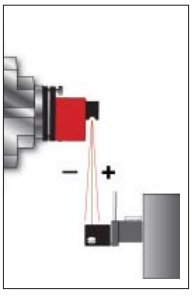
Preparations

Z-axis

1. Mount the laser transmitter D22 in the chuck of the main spindle.
2. Mount the detector on the tool support. Note the direction, see image.
3. Start program Values (17).
4. Place the detector close to the transmitter and press 0 to make this a reference point number one.
5. Move the tool support with detector furthest away from the transmitter.
6. Adjust the laser beam by using the tilting screws. Adjust both V and H values to 0.00 mm. This is reference point number two.



Imagine the two axis as a set square. Mount the detector with the label (M) facing into the angle.



A plus or minus value is displayed

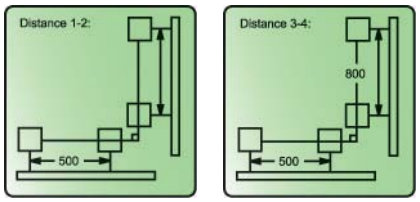
X-axis

1. Switch the prism 90° to show the X-axis.
2. Move the detector to the X-axis position on the rods.
3. Place the detector close to the transmitter and press 0.
4. Move 100-300mm.
5. Read value. The displayed value is the angular error at that distance.

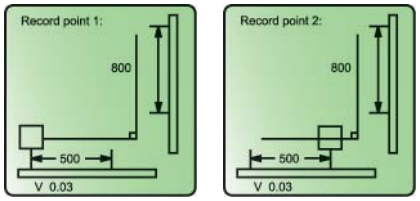
Measure

Make sure the reference points are still zero before measuring.

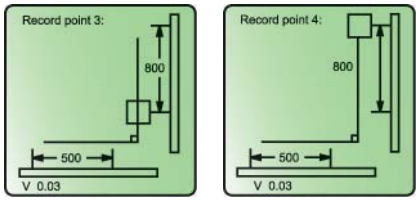
1. Mount the detector. The detector D5 or M-unit can be used.
2. Start the program Straightness (26).
3. Enter the distance between the measurement points 1–2, and then points 3–4.
4. Confirm with .
5. Place the detector at each point and record values 1 and 2 according to the display. This will create a reference for the angle
6. Confirm with
7. Switch the penta prism in laser transmitter and record two new measurement values on the second object.
8. Confirm with . The result is displayed graphically. The measurement values are converted into an angular value, showing any deviation from 90° in the second object.
9. Save data and make a Squareness measurement report.



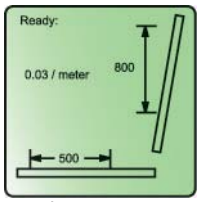
Enter distances



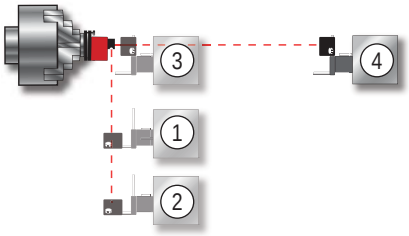
Record values



Second object



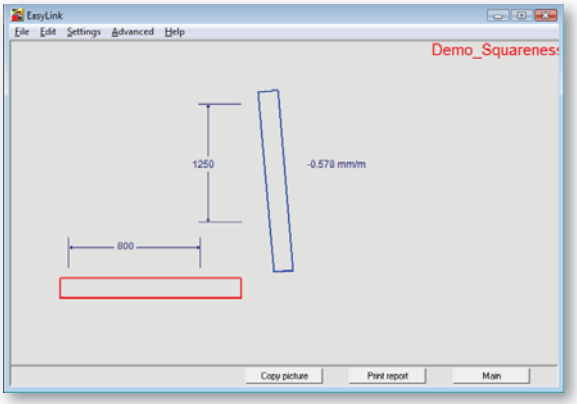
Result



Switch pentaprism 90°

Squareness report

Transfer the data to a PC via EasyLink™. The result can be presented both digitally and graphically.



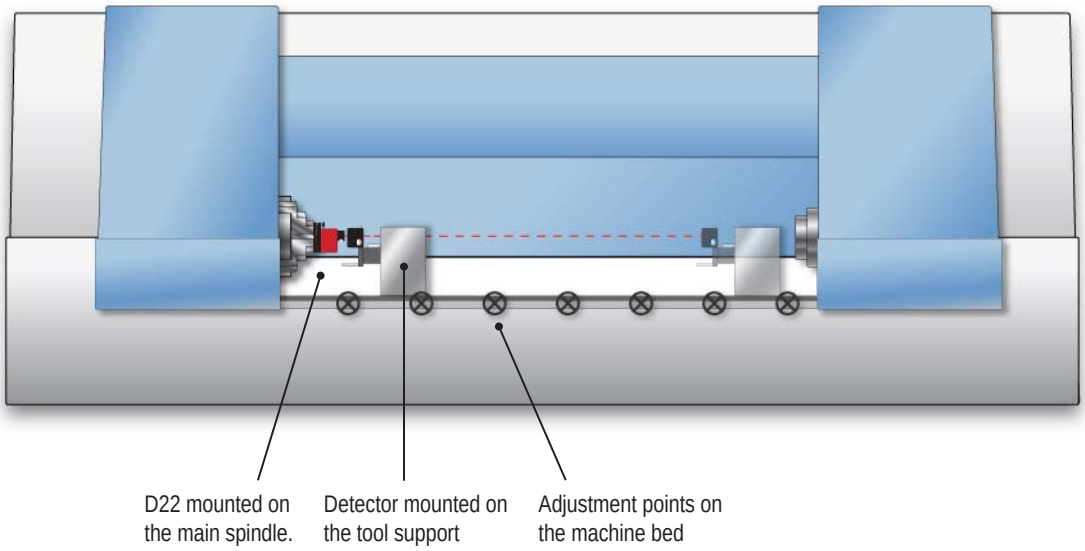
Red object is reference.

Machine bed

Adjustments of a machine bed on a lathe. Often needed on large machines.

Note!

This is only possible when the spindle foundation and machine bed are separate.



Equipment to use

Laser transmitter D22 or D146

Detector D5 (or M-unit) mounted on a magnet base.

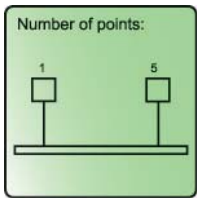
Preparations

1. Mount the laser transmitter in the chuck or just on the main spindle.
2. Mount the detector on the tool support.
3. Start program Values (17).
4. Place the detector close to the transmitter (10-20 mm) and press 0. This is now reference point number one. Make a mark to be able to place the detector exactly right every time.
5. Move the detector to the end of the machine bed or end of normal working area.
6. Adjust the laser beam to zero using the tilting screws. This is now reference point number two. Make a mark.
7. Check and repeat until both reference points are zero.

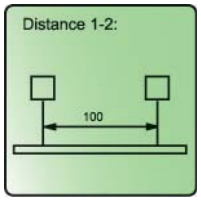
Measure

Make sure the reference points are still zero before measuring.

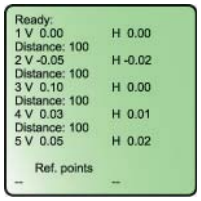
1. Start program Straightness (22).
2. Set your measurement points just over the adjustments points on the machine bed.
3. Place the detector on measurement point number one, close to the transmitter.
4. Press 0.
5. Move to measurement point two.
6. Check value and adjust both vertically and horizontally.
7. Press to record the value.
8. Repeat procedure for all measurement points.
9. Check from time to time that both reference points are still zero.
10. Save data and make a Straightness measurement report.



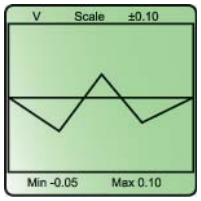
Number of measurement points.



Distance between points



Result displayed as table.

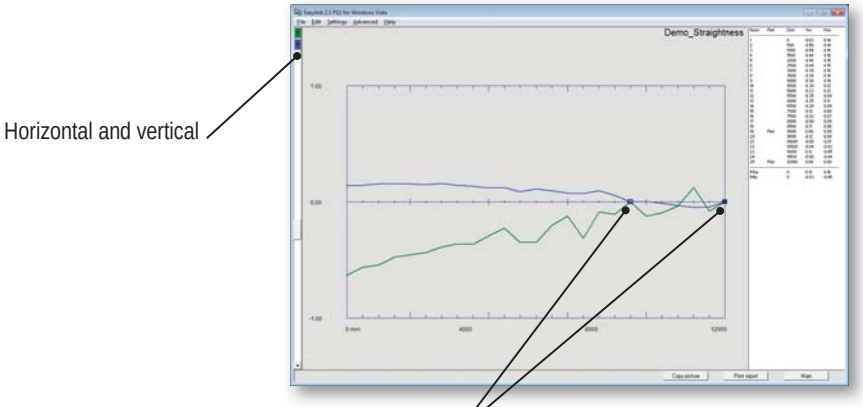


Result displayed as graph.

Straightness report

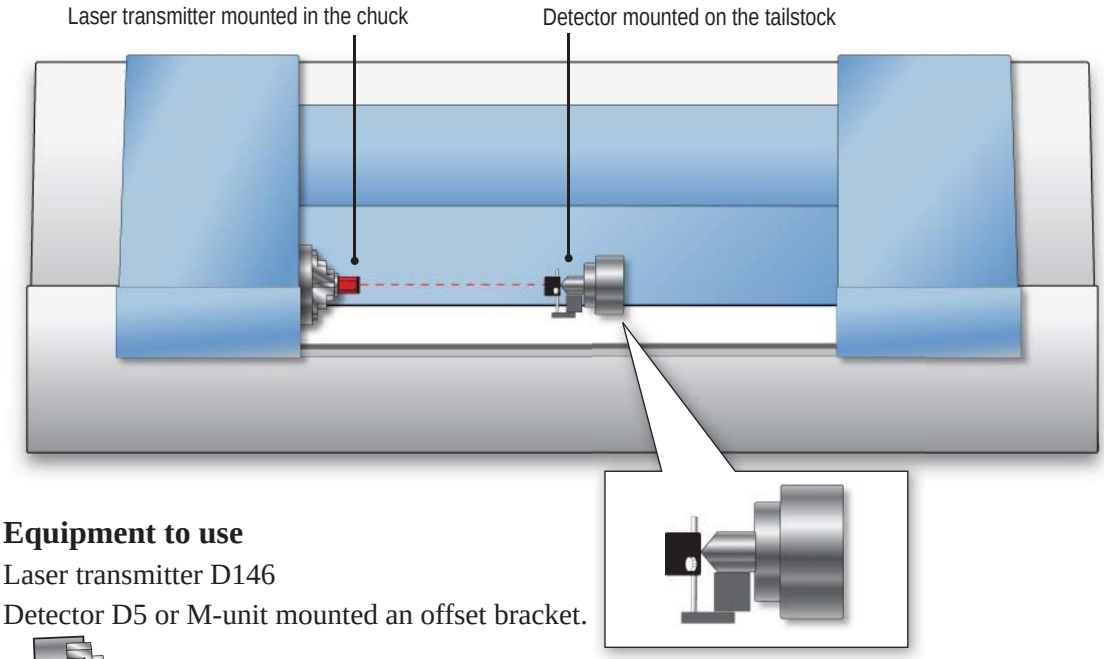
Transfer the data to a PC via EasyLink™. The result can be presented both digitally and graphically.

- Click the Horizontal and Vertical buttons to show or hide corresponding line.
- Click on any point in the graph to make it reference point.



Spindle to tailstock centre, fast check

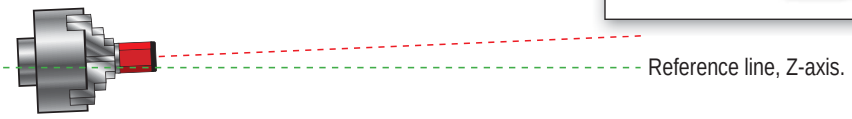
For checking that the main spindle and the tailstock are pointing straight towards each other.



Equipment to use

Laser transmitter D146

Detector D5 or M-unit mounted an offset bracket.



Laser transmitter D146

Preparations

1. Mount the D146 in the chuck of the main spindle.
2. Mount the detector on the tailstock.
3. Place and lock the tailstock approx. 500 mm from the spindle.

Measure

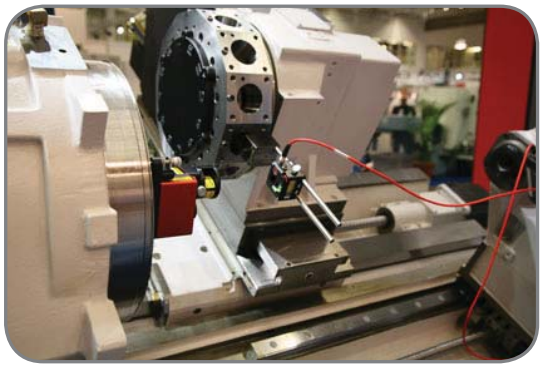
1. Start the program Values (17).
2. Point the laser towards the detector.
3. Press 0 to make this reference point number one.
4. Turn the main spindle 180º.
5. Press 2 to halve the value.
6. Adjust laser beam to zero.
7. Rotate tailstock with detector or slide the brackets with detector 180º.
8. Read value. The displayed value is the angular error at that distance.
9. Adjust the main spindle to ±0.00.
10. Repeat procedure.

Program Values

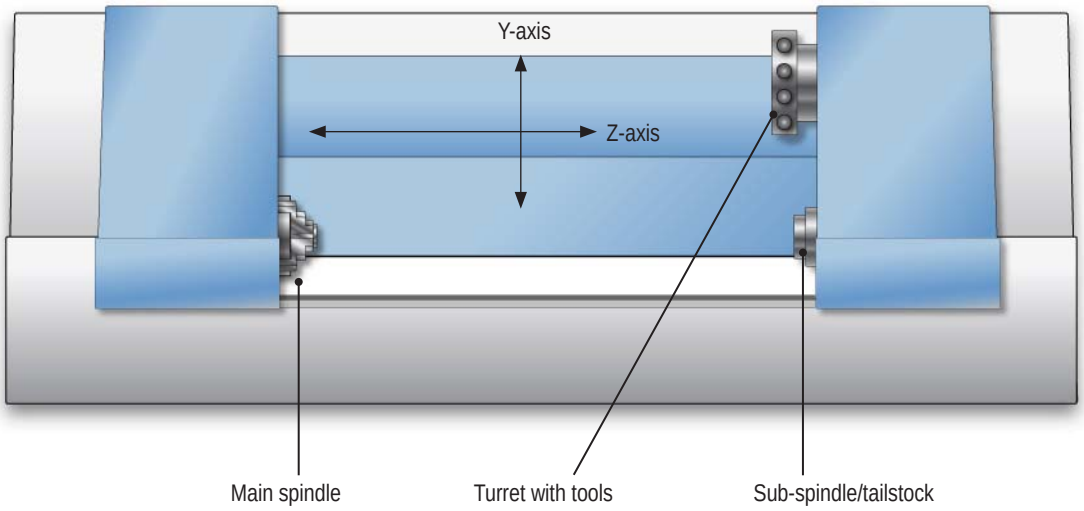
Lathe with turret

What to check

Check straightness, spindle direction, spindle to spindle, squareness and flatness. All of these can be measured with Easy-Laser®. Resolution of 0.001 mm and a maximum measuring distance of up to 40 m. Using our software EasyLink™, the results are presented both digitally and graphically.



Easy-Laser® equipment mounted on a lathe with turret.



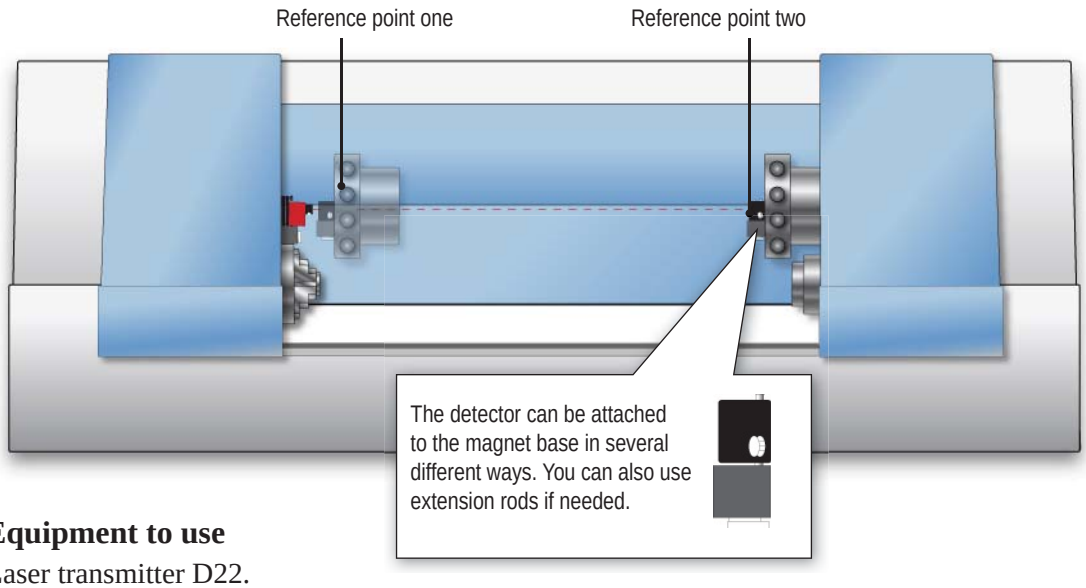
What to do first

For best result, measure and adjust the machine in the following order.

1. Straightness of all machine axis.
2. Main spindle direction.
3. Main spindle towards turret.
4. Main spindle towards sub-spindle/tailstock.
5. Squareness of Z- and X-axis.
6. Spindle bearing condition.

Straightness of Z-axis

Straightness of the turret movement in Z-axis.



Equipment to use

Laser transmitter D22.

Detector D5 (or M-unit) mounted on a magnet base.

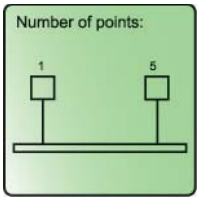
Preparations

1. Mount the laser transmitter on the main spindle.
2. Mount the detector on the turret.
3. Start the program Values (17).
4. Place the turret with detector close to the transmitter. Press  to make this reference point number one.
5. Move the turret with detector furthest away from the transmitter, to reference point number two.
6. Adjust laser beam to zero (0.00), both H and V values.

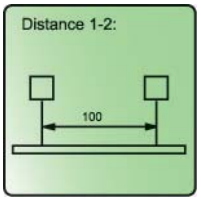
Measure

Make sure the reference points are still zero before measuring.

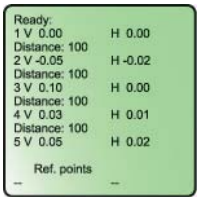
1. Start program Straightness (22).
2. Enter number of measurement points. Normally every 100 - 250 mm.
3. Place the turret with detector on the first measurement point.
4. Press 0.
5. Move the detector to the next measurement point.
6. Press to record value.
7. Repeat until you have recorded all points.
8. Check from time to time that both reference points are still zero.
9. Save data and make a Straightness measurement report.



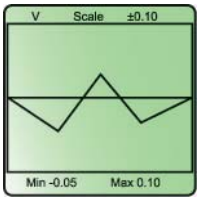
Number of measurement points.



Distance between points



Result displayed as table.

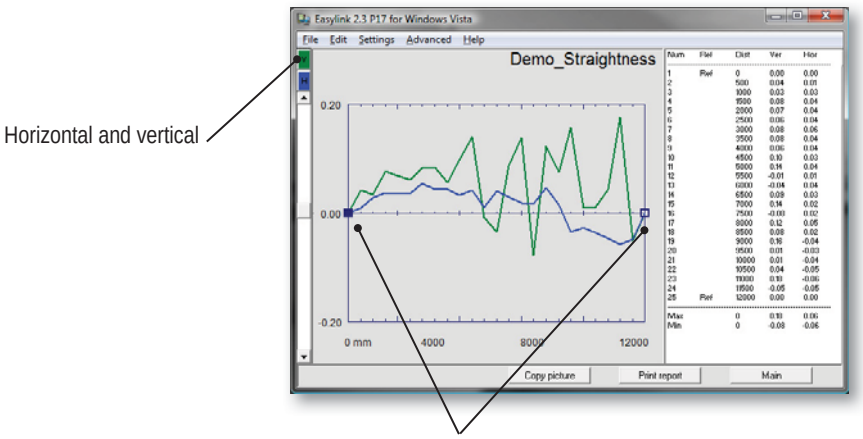


Result displayed as graph.

Straightness report

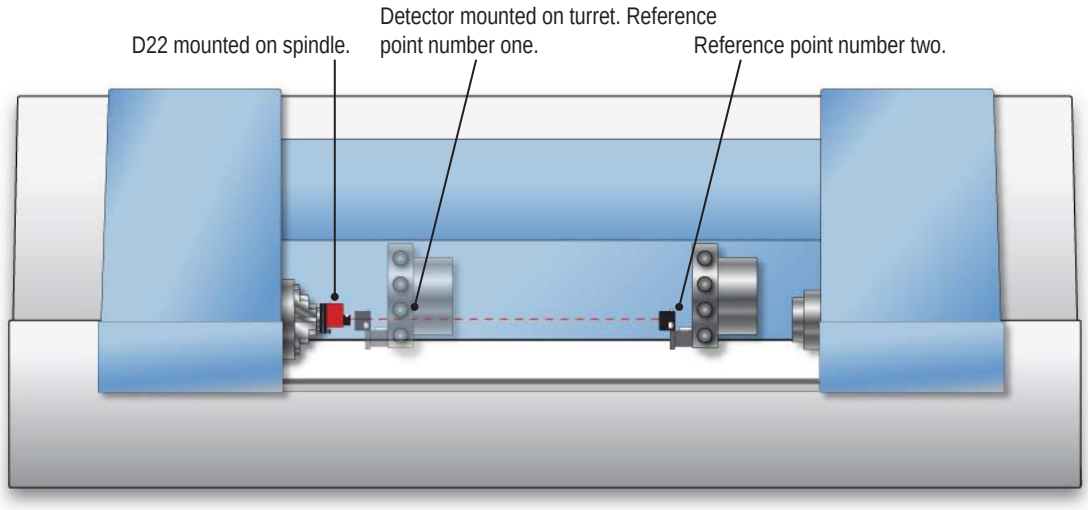
Transfer the data to a PC via EasyLink™. The result can be presented both digitally and graphically.

- Click the Horizontal and Vertical buttons to show or hide corresponding line.
- Click on any point in the graph to make it reference point.



Spindle direction Z-axis

Spindle direction measurement of the main spindle's Z-axis. Measurement on a lathe with turret.

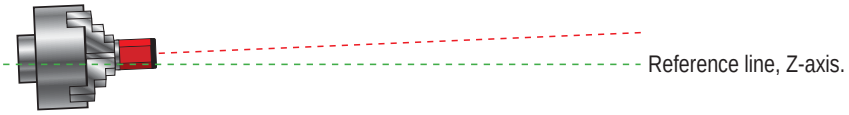


Equipment to use

Laser transmitter D146 or D22.

Detector D5 (or M-unit) mounted on a magnet base.

In the image below the D146 laser transmitter is used. The D146 can also be used for straightness measurements and can be used in rotating spindle.



Note!

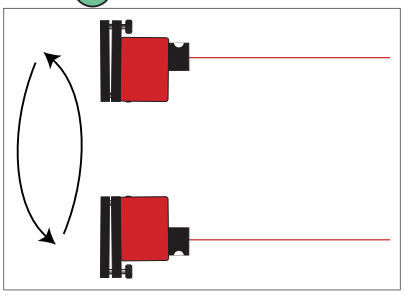
Before measuring spindle direction, make sure that the Z-movement is absolutely straight. Otherwise this measurement is useless.

Preparations

1. Mount the laser transmitter in the chuck. For large machines you can mount it on the middle of the spindle.
2. Mount the detector on the tool support.

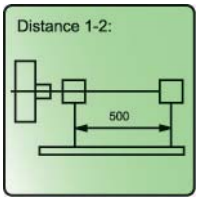
Measure

1. Start the program Spindle (21).
2. Enter distance between measurement point one and two. Use a distance of 500-1000 mm.
3. Place the detector on position one.
4. Press to record value.
5. Rotate spindle 180°.
6. Press to record second value on position one.

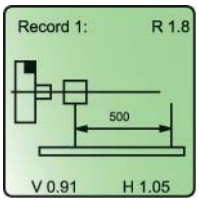


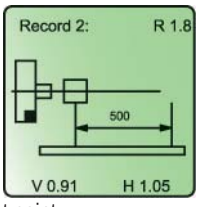
Rotate spindle

7. Move detector to position two.
8. Press to record value.
9. Rotate spindle 180°.
10. Press to record second value on position two.
11. Save data and make a Spindle measurement report.

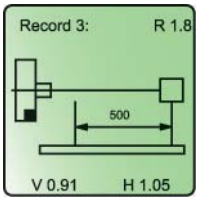


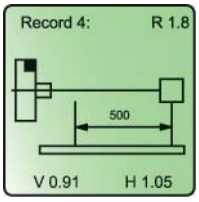
Distance between measurement points



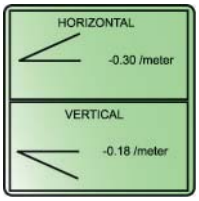


Two measurements on first point.





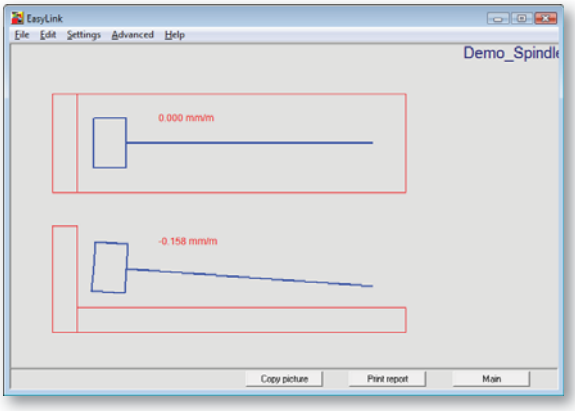
Two measurements on second point.



Result displayed as graph.

Spindle report

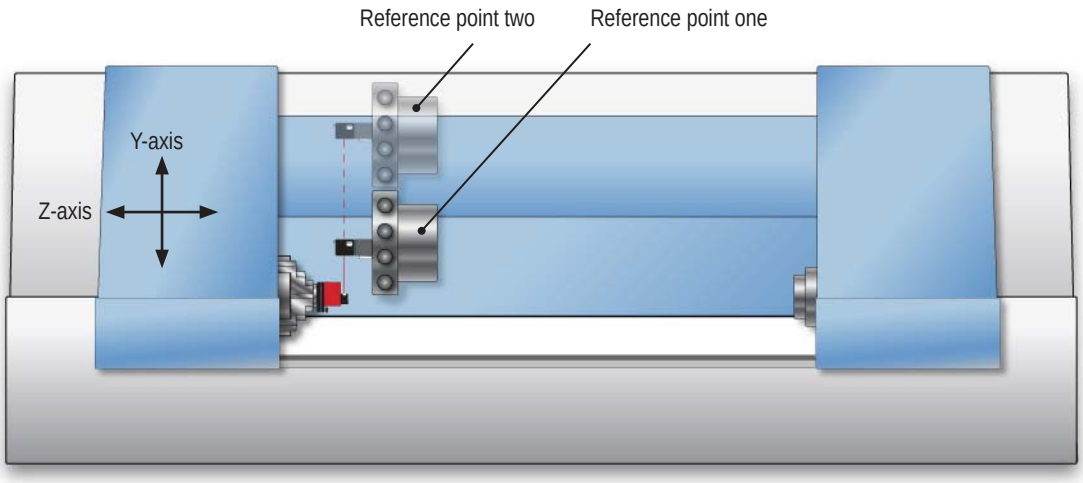
Transfer the data to a PC via EasyLink™. The result can be presented both digitally and graphically.



Red object is reference.

Straightness of turret Y-axis

Straightness of the turret movement in Y-axis.



Equipment to use

Laser transmitter D22.

Detector D5 (or M-unit) mounted on a magnet base.

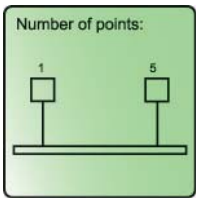
Preparations

1. Mount the laser transmitter D22 in the chuck of the main spindle.
2. Mount the detector on the turret.
3. Start the program Values (17).
4. Place the turret with detector close to the transmitter. Press 0 to make this reference point number one.
5. Move the turret with detector furthest away from the transmitter, to reference point number two.
6. Adjust laser beam to zero (0.00), both H and V values.

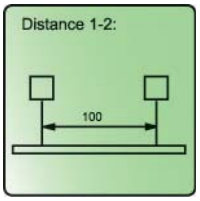
Measure

Make sure the reference points are still zero before measuring.

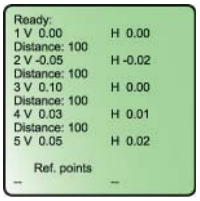
1. Start program Straightness (22).
2. Enter number of measurement points. Normally every 100 - 250 mm.
3. Place the turret with detector on the first measurement point.
4. Press 0.
5. Move the detector to the next measurement point.
6. Press to record value.
7. Repeat until you have recorded all points.
8. Check from time to time that both reference points are still zero.
9. Save data and make a Straightness measurement report.



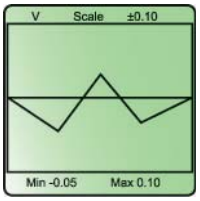
Number of measurement points.



Distance between points.



Result displayed as table.

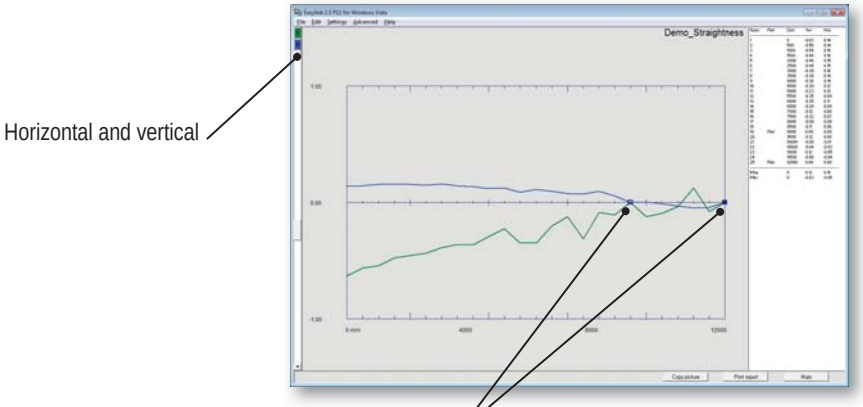


Result displayed as graph.

Straightness report

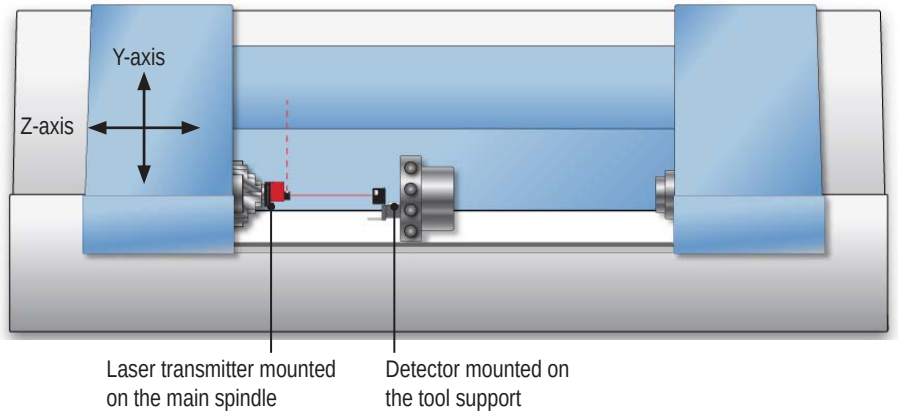
Transfer the data to a PC via EasyLink™. The result can be presented both digitally and graphically.

- Click the Horizontal and Vertical buttons to show or hide corresponding line.
- Click on any point in the graph to make it reference point.



Squareness of Z- and Y-axis

The squareness measurements of the movements of the turret. Before proceeding with this measurement, make sure both Z- and Y- axis are straight by measuring straightness on both Z- and Y-axis.

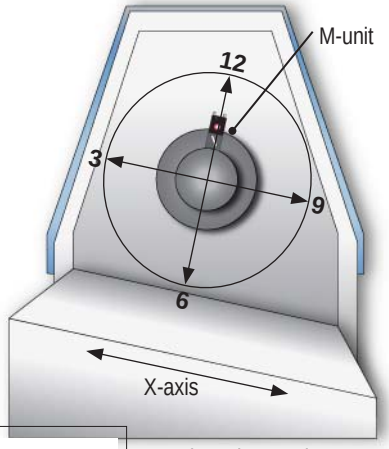


Equipment to use

Laser transmitter D22

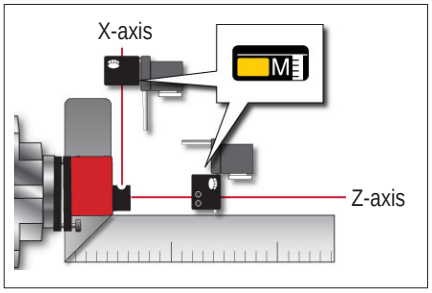
Detector D5 mounted on a D45 magnet base with turnable head.

Preparations

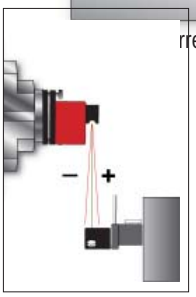


Z-axis

1. Mount the laser transmitter D22 in the chuck of the main spindle.
2. Mount the detector on the turret. Note the direction, see image.
3. Start program Values (17).
4. Place the detector close to the transmitter and press 0 to make this a reference point number one.
5. Move the turret with detector furthest away from the transmitter.
6. Adjust the laser beam by using the tilting screws. Adjust both V and H values to 0.00 mm. This is reference point number two.



Imagine the two axis as a set square. Mount the detector with the label (M) facing into the angle.



A plus or minus value is displayed

rresponds to the X-axis

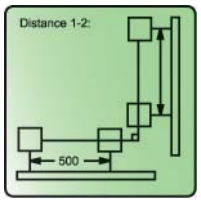
X-axis

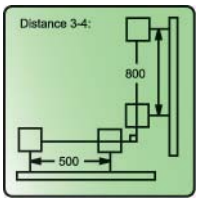
1. Switch the prism 90° to show the X-axis.
2. Move the detector to the X-axis position on the rods.
3. Place the detector close to the transmitter and press 0.
4. Move 100-300mm.
5. Read value. The displayed value is the angular error at that distance.

Measure

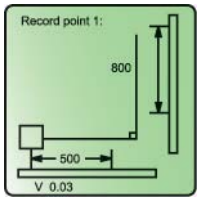
Make sure the reference points are still zero before measuring.

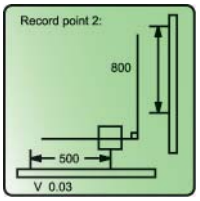
1. Mount the detector. The detector D5 or M-unit can be used.
2. Start the program Straightness (26).
3. Enter the distance between the measurement points 1–2, and then points 3–4.
4. Confirm with .
5. Place the detector at each point and record values 1 and 2 according to the display. This will create a reference for the angle
6. Confirm with
7. Switch the penta prism in laser transmitter and record two new measurement values on the second object.
8. Confirm with . The result is displayed graphically. The measurement values are converted into an angular value, showing any deviation from 90° in the second object.
9. Save data and make a Squareness measurement report.



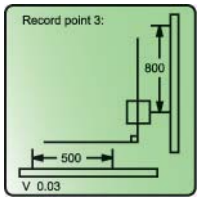


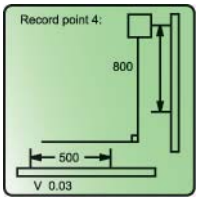
Enter distances



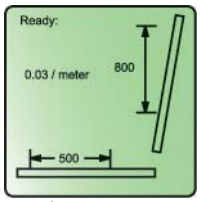


Record values

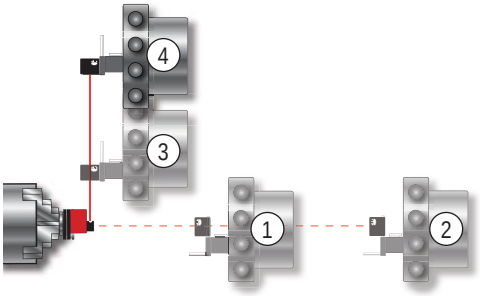




Second object



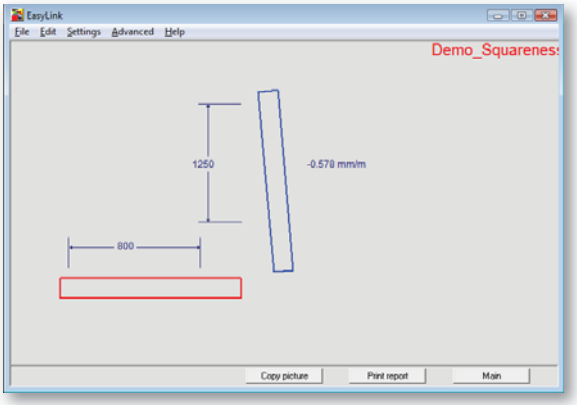
Result



Switch pentaprism 90°

Squareness report

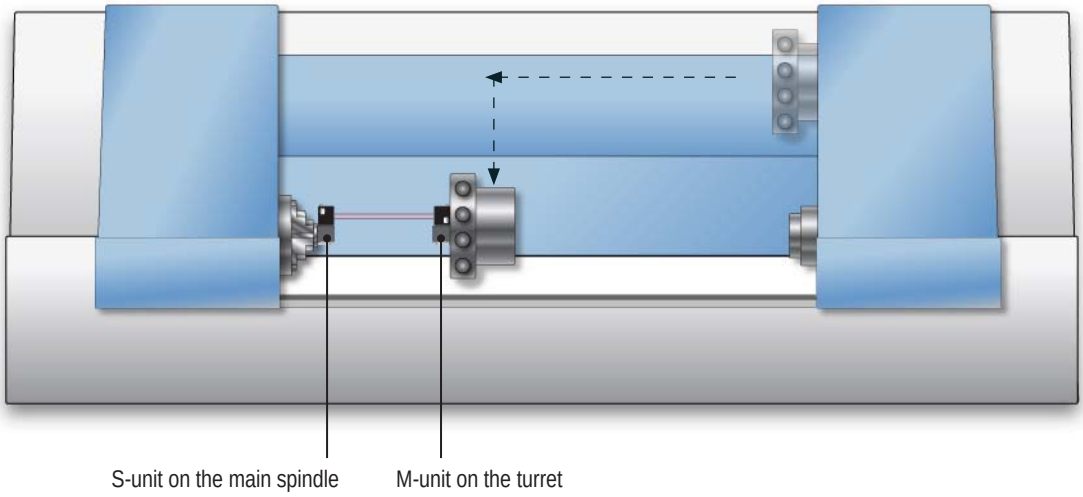
Transfer the data to a PC via EasyLink™. The result can be presented both digitally and graphically.



Red object is reference.

Main spindle to turret

Measurement of CNC lathe with turret towards main spindle.



Equipment to use

S- and M-units mounted on D45 magnet base with turnable head.

Method one

This method is preferable, but if it impossible, try method two.

Preparations

1. Move the turret to in front of the main spindle.
2. Mount the S-unit on the main spindle.
3. Mount the M-unit roughly in the centre of the turret.
4. Place the turret close to the main spindle, approx. 500 mm.

Measure

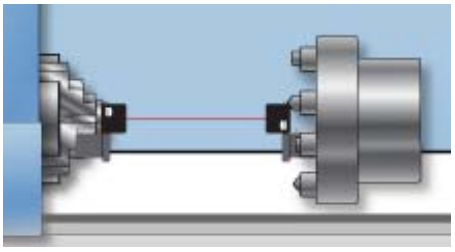
The positions 9, 3 and 12 corresponds to the X-axis, the side movement of the tool support.

1. Start program Horizontal (11).
2. Enter distance between the measuring units.
3. Turn the measurement units to position 9 o'clock. Press to record first measurement value.
4. Turn units to 12 o'clock. Press to record second measurement value.
5. Turn units to 3 o'clock. Press to record third measurement value.
6. Save data and make a Horizontal measurement report.

Note!

You are just interested in the angle, not the offset.

If the tools on the turret are turned towards the main spindle, you can check each tool against the main spindle.



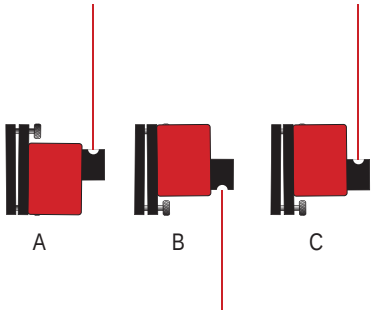
Tools turned towards the main spindle.

Method two

Use this method if it is not possible to position main spindle and turret centre to centre.

Preparations

1. Place the turret above the main spindle.
2. Place the detector on the turret on position 6 o'clock.
3. Press 0.
4. Turn the spindle 180°.
5. Turn the laser beam back towards the detector again.
6. Press 2 to halve the value.
7. Adjust laser to zero (0.00) by using the tilting screws.



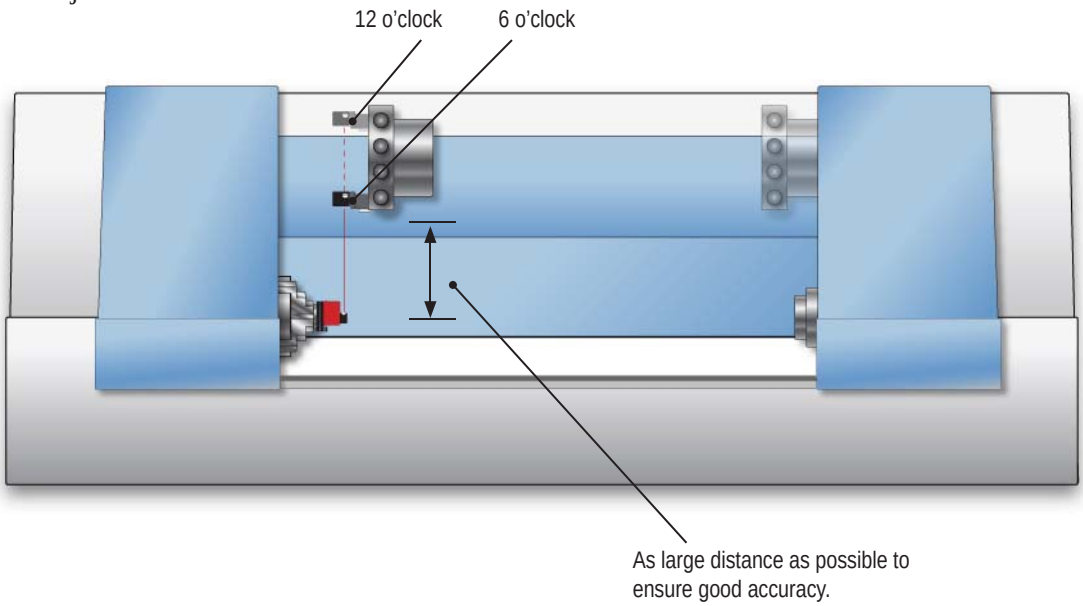
Turn spindle 180° and turn laser beam back

Measure 6 and 12 o'clock

1. Start program Values (17).
2. Press 0 with the detector at 6 o'clock.
3. Turn the turret 180°. The detector is now in position 12 o'clock.
4. Turn detector towards the laser beam.
5. Check value.
6. Adjust turret if needed.

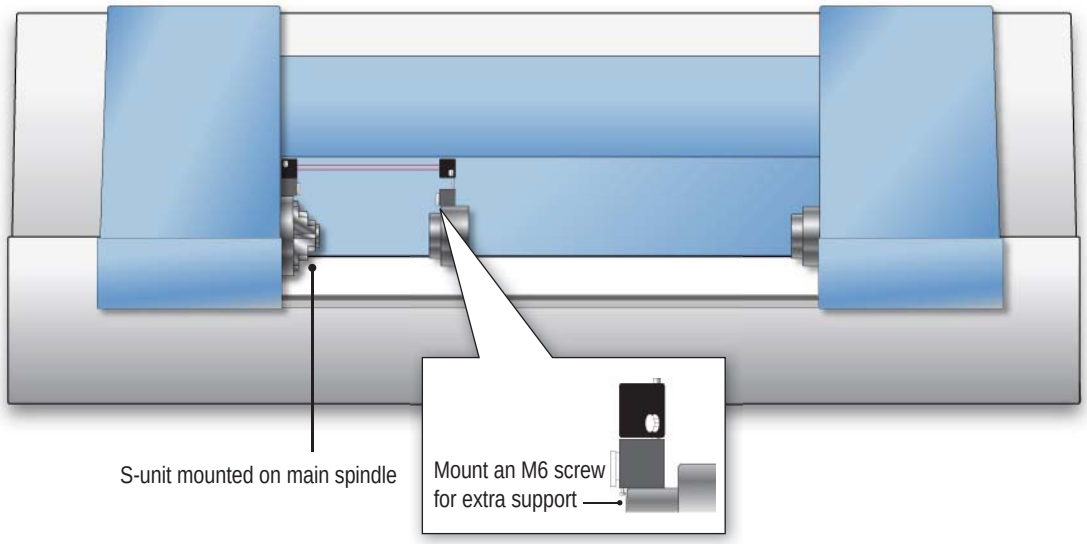
Measure 3 and 9 o'clock

1. Make same preparations as before.
2. Press 0 with the detector at 9 o'clock.
3. Turn the turret 180°. The detector is now in position 3 o'clock.
4. Turn detector towards the laser beam.
5. Check value.
6. Adjust turret if needed.



Main spindle towards sub-spindle/tailstock

Measurement of main spindle towards the sub-spindle or tailstock.



Equipment to use

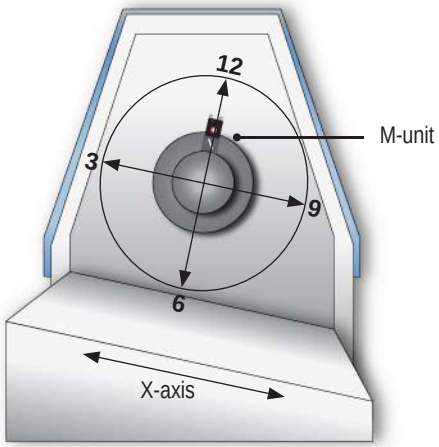
S- and M-units mounted on magnet bases.

Preparations

1. Mount an M6 screw for extra support on each unit.
2. Mount the S-unit with magnet base on the main spindle.
3. Mount the M-unit with magnet base on the sub-spindle.
4. Place the sub-spindle close to the main spindle, approx. 500 mm.

9, 3, 12 position

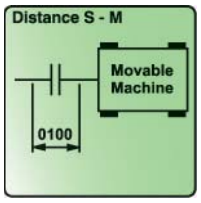
The positions 9, 3 and 12 corresponds to the X-axis, the side movement of the tool support.



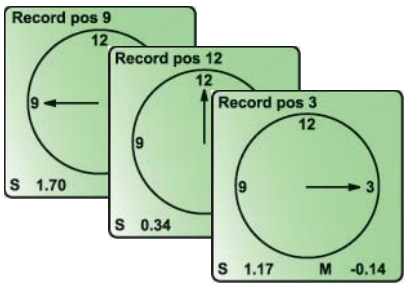
Positions corresponds to the X-axis

Measure

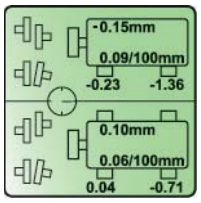
1. Start program Horizontal (11).
2. Enter distance between the measuring units.
3. Turn the measurement units to position 9 o'clock. Press to record first measurement value.
4. Turn units to 12 o'clock. Press to record second measurement value.
5. Turn units to 3 o'clock. Press to record third measurement value.
6. Save data and make a Horizontal measurement report.



Enter distances.



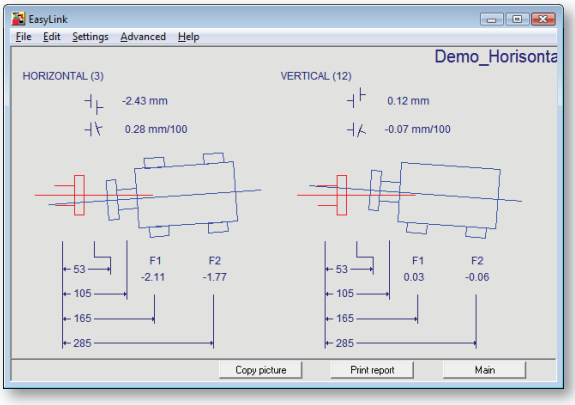
Record measurements on positions 9, 12 and 3.



Result displayed as graph.

Horizontal report

Transfer the data to a PC via EasyLink™. The result can be presented both digitally and graphically.

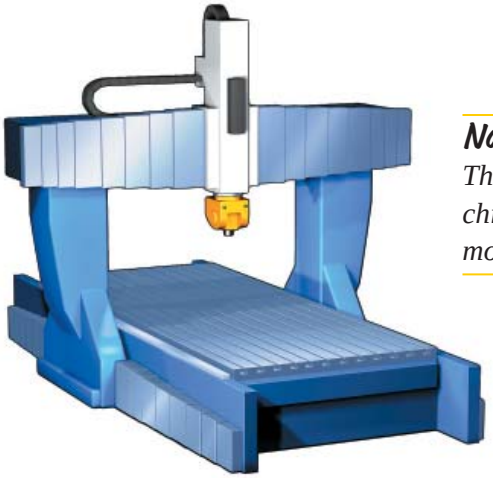


Red lines shows stationary machine.

Milling machine

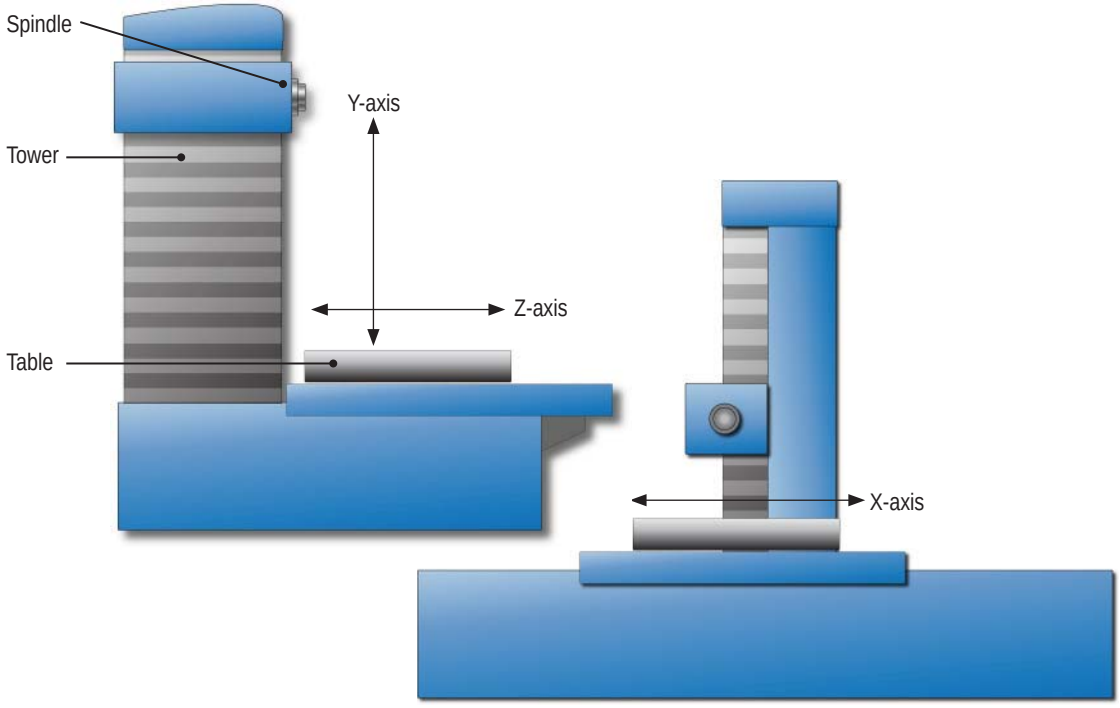
What to check

Check straightness, spindle direction, squareness and flatness. All of these can be measured with Easy-Laser®. Resolution of 0.001 mm and a maximum measuring distance of up to 40 m. Using our software EasyLink™, the results are presented both digitally and graphically.



Note!

There are many different kinds of milling machines, but the principles described here are most often applicable.



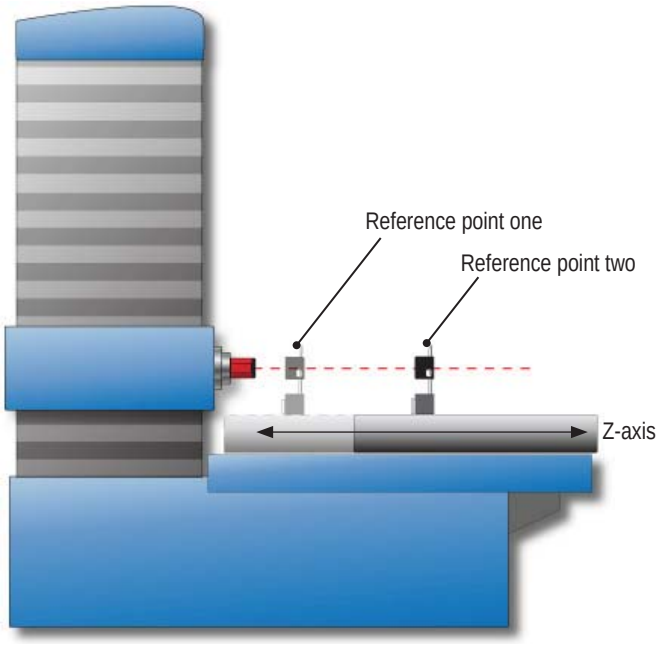
What to do first

For best result, measure and adjust the machine in the following order.

1. Straightness of all moving axis.
2. Spindle direction.
3. Flatness of the machine table.
4. Squareness measurement.
5. Spindle bearing condition.

Straightness Z-axis

Measurement of the Z-axis of the machine table.



Equipment to use

Laser transmitter D146

Detector D5 (or M-unit) mounted on a magnet base.

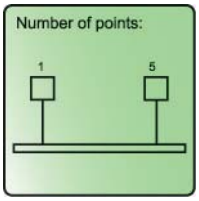
Preparations

1. Position the spindle low on the tower.
2. Mount the laser transmitter on the spindle.
3. Mount the detector on the table.
4. Start the program Values (17).
5. Place the detector close to the transmitter. Press 0 to make this reference point number one.
6. Move the table with detector furthest away from the transmitter, to reference point number two.
7. Adjust laser beam to zero (0.00), both H and V values.

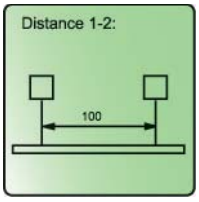
Measure

Make sure the reference points are still zero before measuring.

1. Start program Straightness (22).
2. Enter number of measurement points. Normally every 100 - 250 mm.
3. Place the table with detector on the first measurement point.
4. Press 0.
5. Move the table with detector to the next measurement point.
6. Press to record value.
7. Continue until you have recorded all points.
8. Save data and make a Straightness measurement report.

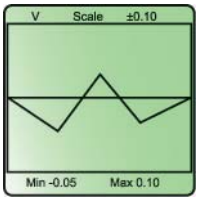


Number of measurement points.



Distance between points.

Result displayed as table.

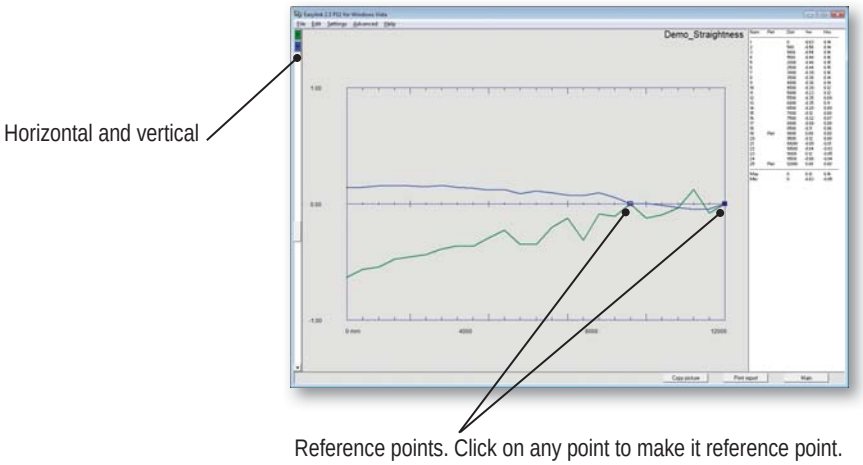


Result displayed as graph.

Straightness report

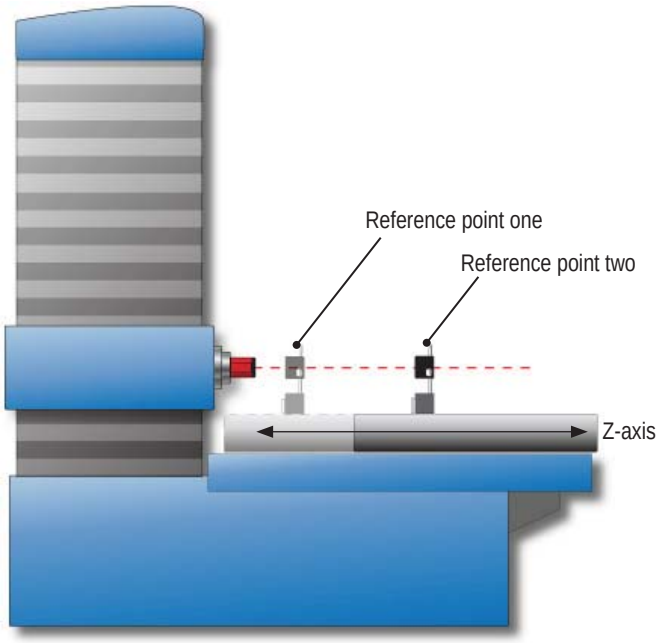
Transfer the data to a PC via EasyLink™. The result can be presented both digitally and graphically.

- Click the Horizontal and Vertical buttons to show or hide corresponding line.
- Click on any point in the graph to make it reference point.



Spindle direction Z-axis

Measurement of the spindle direction.

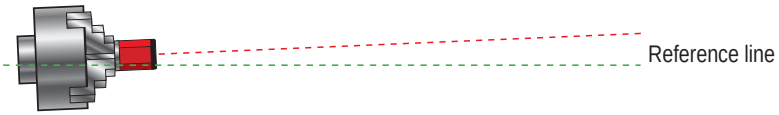


Equipment to use

Laser transmitter D146

Detector D5 (or M-unit) mounted on a magnet base.

In the image below the D146 laser transmitter is used. The D146 can also be used for straightness measurements and can be used in rotating spindle.



Note!

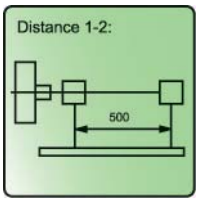
Before measuring spindle direction, make sure that the Z-movement is absolutely straight. Otherwise this measurement is useless.

Preparations

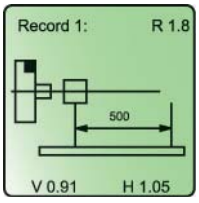
1. Mount the laser transmitter in the chuck. For large machines you can mount it on the middle of the spindle.
2. Mount the detector on the table.

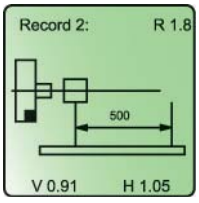
Measurement

1. Start the program Spindle (21).
2. Enter distance between measurement point one and two. Use a distance of 500 mm.
3. Place the detector on position one.
4. Press to record value.
5. Rotate spindle 180° and press to record second value on position one.
6. Move the table with detector to position two.
7. Press to record value.
8. Rotate spindle 180°.
9. Press to record second value on position two.
10. Save data and make a Spindle measurement report.

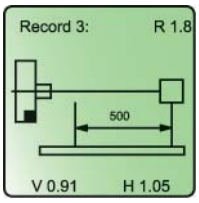


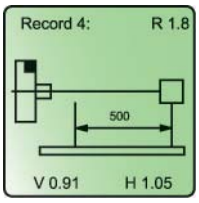
Distance between measurement points



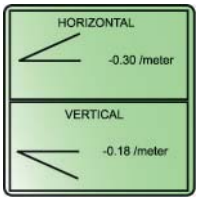


Two measurements on first point.





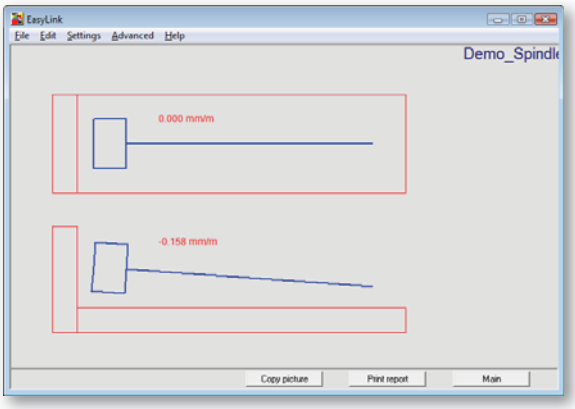
Two measurements on second point.



Result displayed as graph.

Spindle report

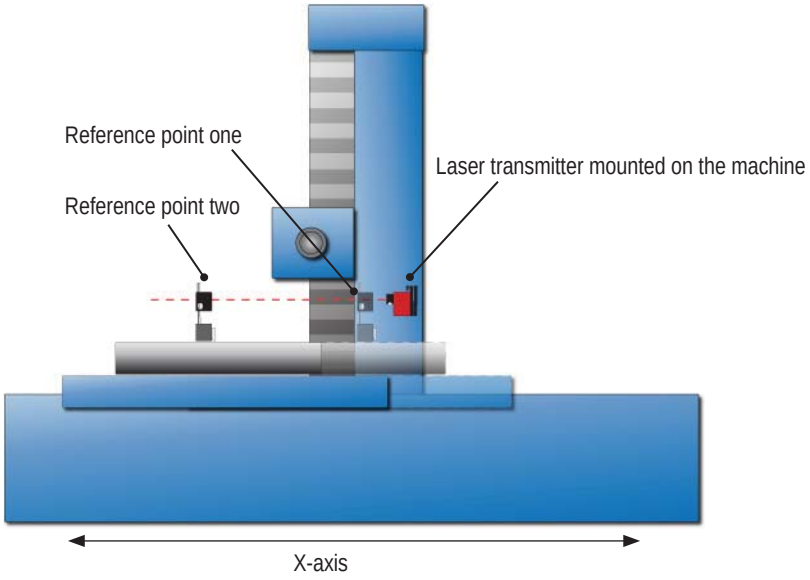
The result can be presented both digitally and graphically.



Red object is reference.

Straightness X-axis

Straightness measurements of the machine table's movement in X-axis.



Equipment to use

Laser transmitter D22 or D146

Detector D5 (or M-unit) mounted on a magnet base.

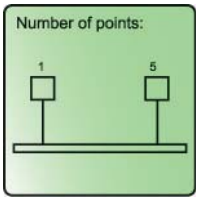
Preparations

1. Mount the laser transmitter on the tower or on a tripod.
2. Mount the detector on the table.
3. Start the program Values (17).
4. Place the detector close to the transmitter. Press  to make this reference point number one.
5. Move the table with detector furthest away from the transmitter, to reference point number two.
6. Adjust laser beam to zero (0.00), both H and V values.

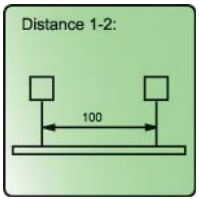
Measure

Make sure the reference points are still zero before measuring.

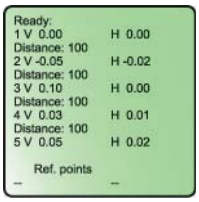
1. Start program Straightness (22).
2. Enter number of measurement points. Normally every 100 - 250 mm.
3. Place the table with detector on the first measurement point.
4. Press  .
5. Move the table with detector to the next measurement point.
6. Press  to record value.
7. Continue until you have recorded all points.
8. Save data and make a Straightness measurement report.



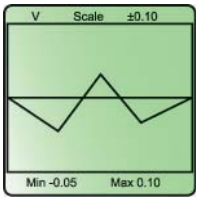
Number of measurement points.



Distance between points



Result displayed as table.

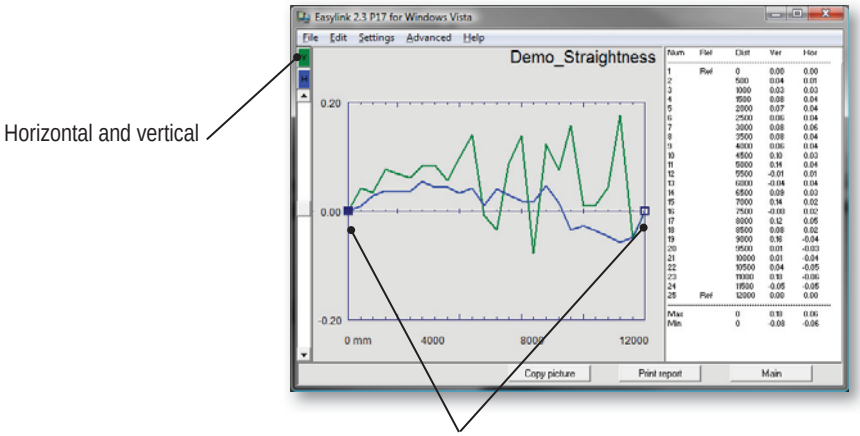


Result displayed as graph.

Straightness report

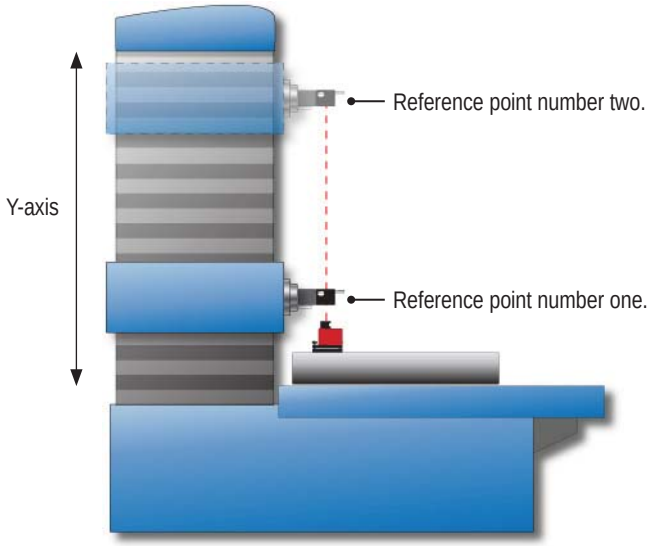
Transfer the data to a PC via EasyLink™. The result can be presented both digitally and graphically.

- Click the Horizontal and Vertical buttons to show or hide corresponding line.
- Click on any point in the graph to make it reference point.



Straightness Y-axis

Measurement of the Y-axis of the spindle.



Equipment to use

Laser transmitter D22

Detector D5 (or M-unit) mounted on a magnet base.

Preparations

1. Mount the laser transmitter on the table.
2. Mount the detector on the spindle.
3. Start the program Values (17).
4. Place the detector close to the transmitter. Press 0 to make this reference point number one.
5. Move the table with detector furthest away from the transmitter, to reference point number two.
6. Adjust laser beam to zero (0.00), both H and V values.

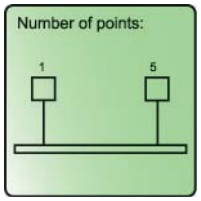
Note!

Which value that is H and V depends on how you mount the detector.

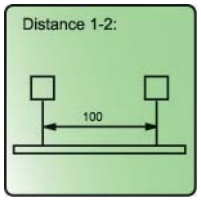
Measure

Make sure the reference points are still zero before measuring.

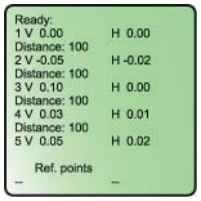
1. Start program Straightness (22).
2. Enter number of measurement points. Normally every 100 - 250 mm.
3. Position the spindle with detector on the first measurement point.
4. Press  .
5. Move the spindle with detector to the next measurement point.
6. Press  to record value.
7. Continue until you have recorded all points.
8. Save data and make a Straightness measurement report.



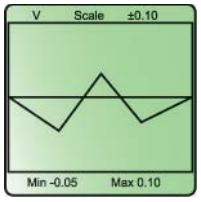
Number of measurement points.



Distance between points



Result displayed as table.

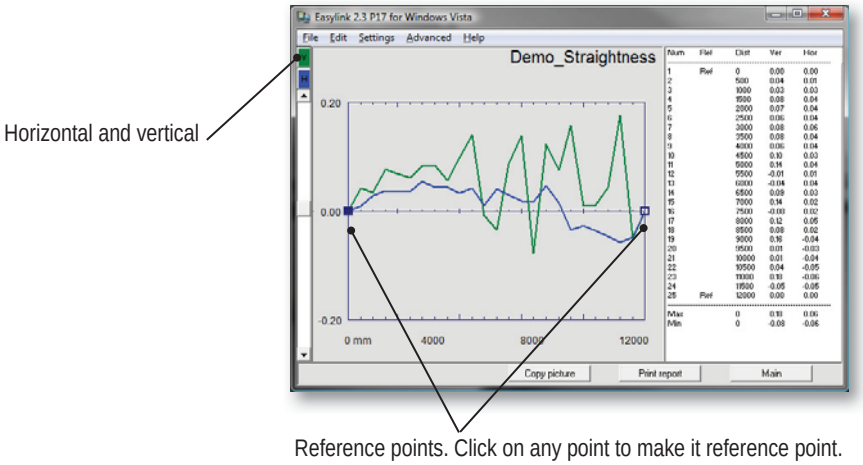


Result displayed as graph.

Straightness report

Transfer the data to a PC via EasyLink™. The result can be presented both digitally and graphically.

- Click the Horizontal and Vertical buttons to show or hide corresponding line.
- Click on any point in the graph to make it reference point.



Flatness of the machine table

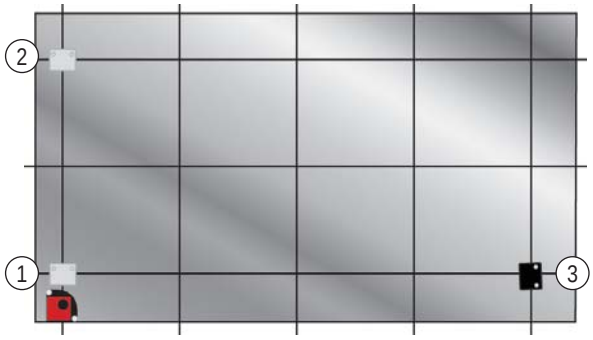
Equipment to use

Laser transmitter D22

Detector D5 (or M-unit) mounted on a magnet base.

Preparation

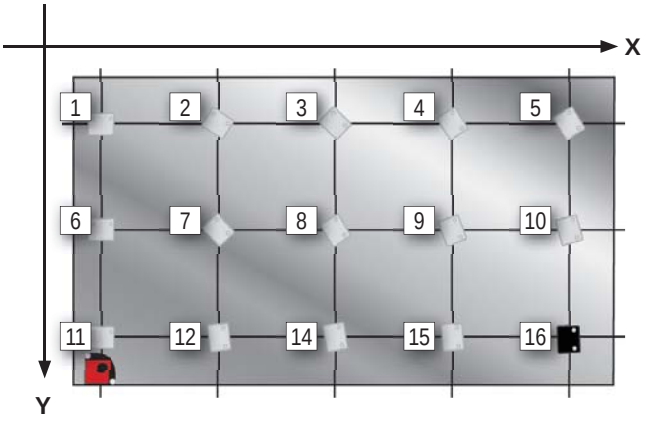
1. Mount the laser transmitter on the table.
2. Mount the detector close to the transmitter on the table.
3. Start program Values (17).
4. Press 0 to make this reference point number one.
5. Move the detector to the corner of the table, to reference point number two.
6. Adjust the laser beam to zero (0.00) in V-value.
7. Move the detector to the other corner, to reference point number three.
8. Adjust the laser beam to zero (0.00) in V-value.



Three reference points

Measure

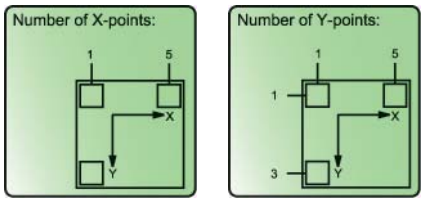
1. Mark the reference points in a coordinate system in X- and Y-direction.
   Up to 300 measurement points can be handled by the Easy-Laser® system. The distances between the points has to be equal for all points in each direction.



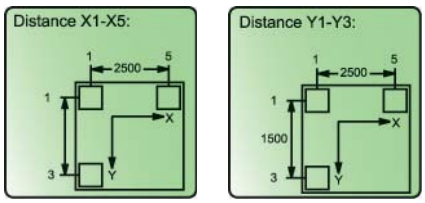
Measurement point coordinates:

1: X_1 Y_1 (1,1)
2: X_2 Y_1 (2,1)
3: X_3 Y_1 (3,1)
4: X_4 Y_1 (4,1)
5: X_5 Y_1 (5,1)
6: X_1 Y_2 (1,2)
7: X_2 Y_2 (2,2)
...

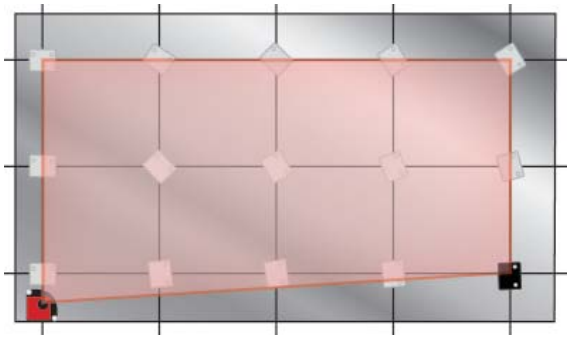
2. Start the program Flatness (24).
3. Enter the number of measurement points in X-direction (2-99) and Y-direction (2-99).
4. Enter the distance between the first and last measurement point in X-direction and Y-direction.
5. Place the detector on assigned point, register the value. Repeat for each point in the coordinate system (the display assign which point to place the detector at).
6. Set the three reference points to zero.
7. The remaining points are recalculated to the new reference plane formed. The values we get at each measurement position are compared to this plane. The measurement values can be recalculated so that any 3 of them become zero references, with the limitation that only 2 of them are in line horizontally, vertically or diagonally, in the coordinate system.



Number of measurement points



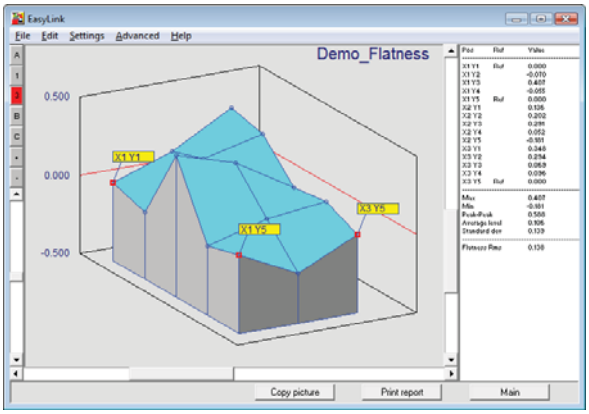
Distance between first and last



Reference plane

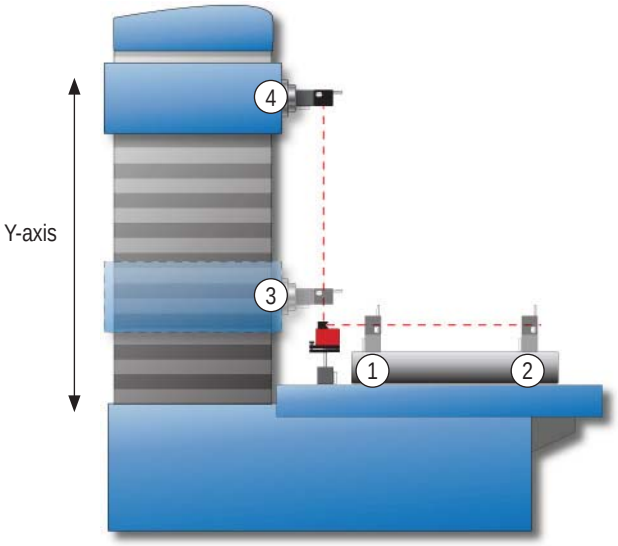
Flatness report

Transfer the data to a PC via EasyLink™. The result can be presented both digitally and graphically.



Squareness machine table vs Y-axis

Squareness measurement of the Y-axis movement and machine table.



Equipment to use

Laser transmitter D22

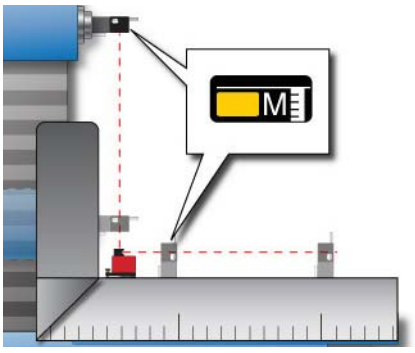
Detector D5 (or M-unit) mounted on a magnet base.

Note!

Before measuring squareness, make sure that the Y-axis is straight and that the machine table is flat.

Preparations

1. Mount the laser transmitter on the machine table, see image.
2. Mount the detector on the movable table.
3. Start the program Values (17).
4. Place the detector close to the transmitter. Press 0 to make this reference point number one. Make a mark to be able to place the detector exactly right every time.
5. Move the detector furthest away from the transmitter, to reference point number two. Make a mark to be able to place the detector exactly right every time.
6. Adjust laser beam to zero (0.00), both H and V values.
7. Mount the detector on the spindle and move it close to the laser transmitter.
8. Press 0 to make this reference point number three.
9. Move the spindle 500 mm to reference point number four.
10. Read value. The displayed value is the squareness error at that distance.

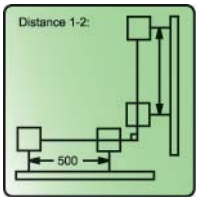


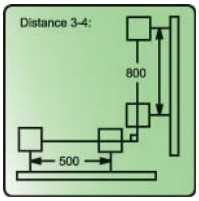
Imagine the two axis as a set square. Mount the detector with the label (M) facing into the angle.

Measure

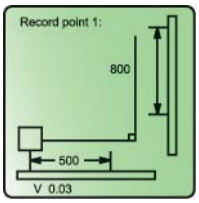
Make sure the reference points are still zero before measuring.

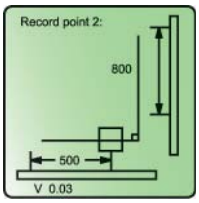
1. Mount the detector.
2. Start the program Squareness (26).
3. Enter the distance between the measurement points 1–2, and then points 3–4.
4. Confirm with .
5. Place the detector at each point and record values 1 and 2 according to the display. This will create a reference for the angle.
6. Confirm with .
7. Switch the penta prism in laser transmitter and record two new measurement values on the second object.
8. Confirm with . The result is displayed graphically. The measurement values are converted into an angular value, showing any deviation from 90° in the second object.
9. Save data and make a Squareness measurement report.



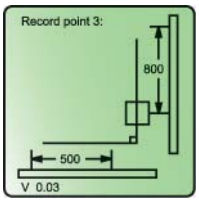


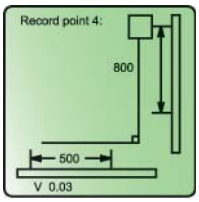
Enter distances



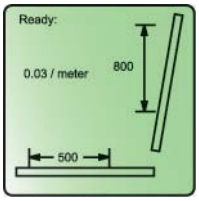


Record values





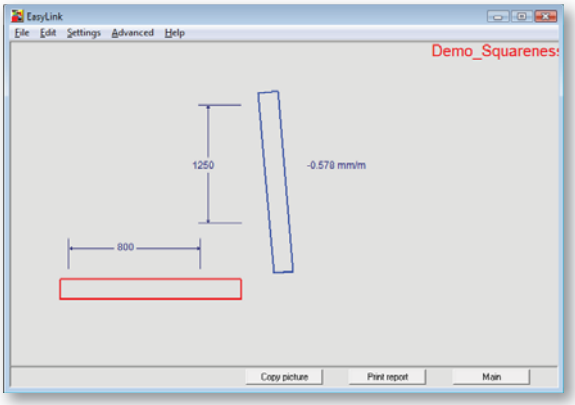
Second object



Result

Squareness report

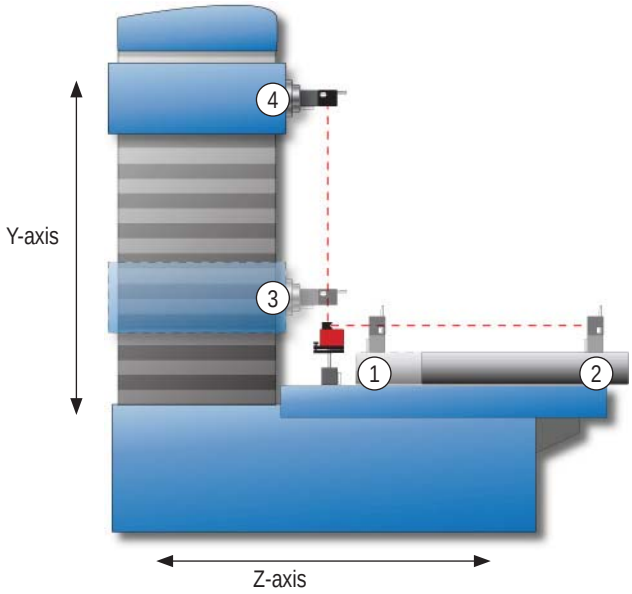
Transfer the data to a PC via EasyLink™. The result can be presented both digitally and graphically.



Red object is reference.

Squareness Z-axis vs Y-axis

Squareness of the machine table movement and the Y-axis.



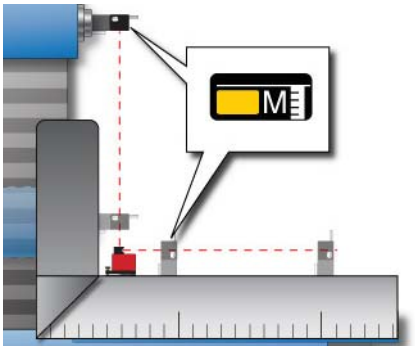
Equipment to use

Laser transmitter D22

Detector D5 (or M-unit) mounted on a magnet base.

Preparations

1. Mount the laser transmitter, see image.
2. Mount the detector on the movable table.
3. Start the program Values (17).
4. Place the detector close to the transmitter. Press 0 to make this reference point number one.
5. Move the table 1000 mm to reference point number two.
6. Adjust laser beam to zero (0.00).
7. Mount the detector on the spindle and move it close to the laser transmitter.
8. Press 0 to make this reference point number three.
9. Move the spindle housing 500 mm to reference point number four.
10. Read value. The displayed value is the angular error at that distance.

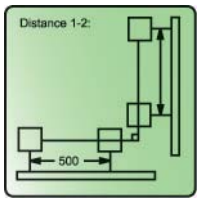


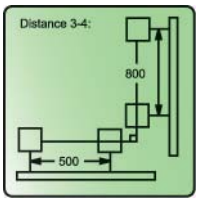
Imagine the two axis as a set square. Mount the detector with the label (M) facing into the angle.

Measure

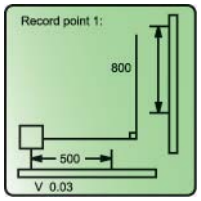
Make sure the reference points are still zero before measuring.

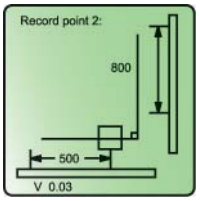
1. Mount the detector.
2. Start the program Squareness (26).
3. Enter the distance between the measurement points 1–2, and then points 3–4.
4. Confirm with .
5. Place the detector at each point and record values 1 and 2 according to the display. This will create a reference for the angle.
6. Confirm with .
7. Switch the penta prism in laser transmitter and record two new measurement values on the second object.
8. Confirm with . The result is displayed graphically. The measurement values are converted into an angular value, showing any deviation from 90° in the second object.
9. Save data and make a Squareness measurement report.



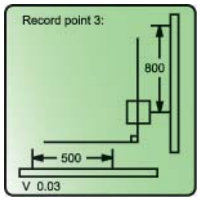


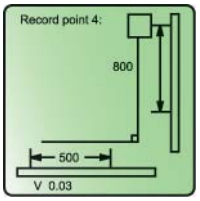
Enter distances



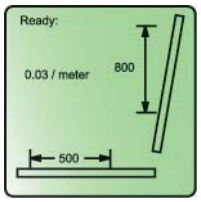


Record values





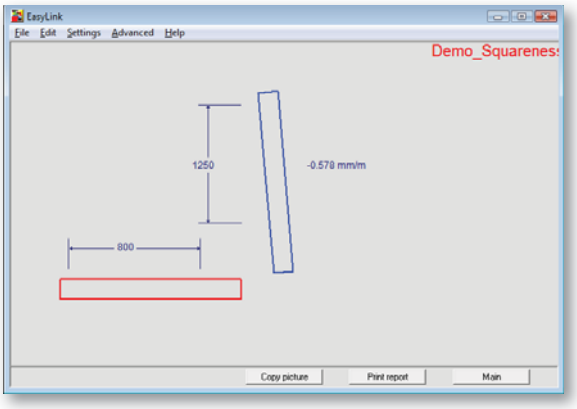
Second object



Result

Squareness report

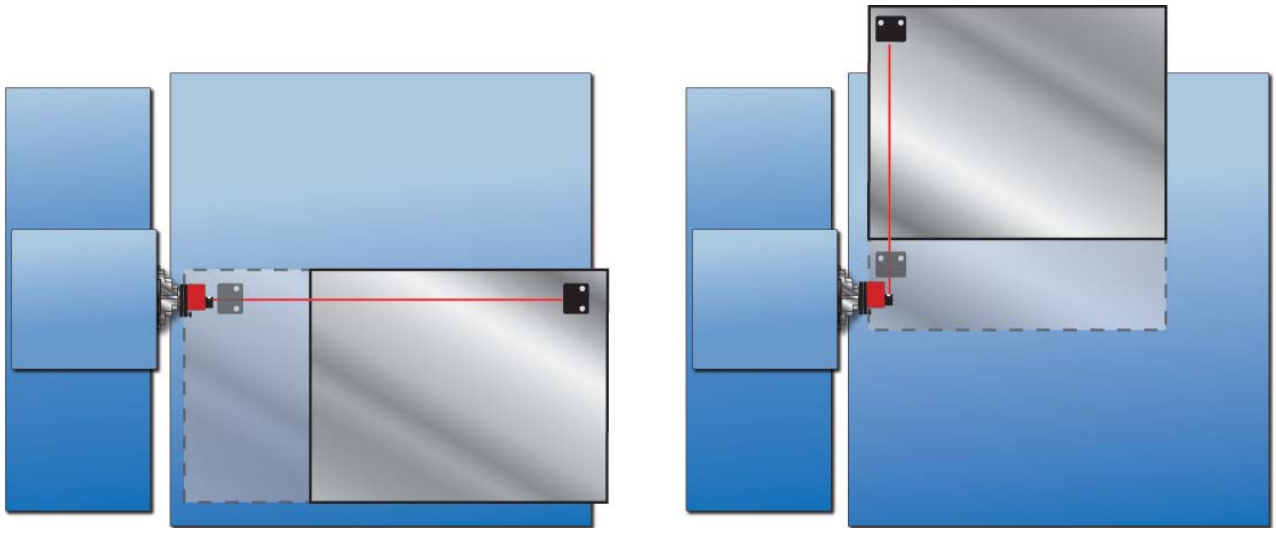
Transfer the data to a PC via EasyLink™. The result can be presented both digitally and graphically.



Red object is reference.

Squareness Z-axis vs X-axis

Squareness of the machine table in the X-axis movement.



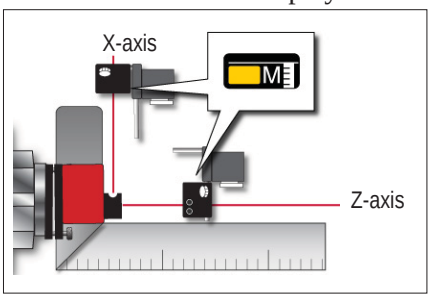
Equipment to use

Laser transmitter D22

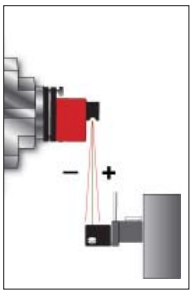
Detector D5 (or M-unit) mounted on a magnet base.

Preparations

1. Mount the laser transmitter on the tower.
2. Mount the detector on the table.
3. Start the program Values (17).
4. Place the detector close to the transmitter. Press 0 to make this reference point number one.
5. Move the table and adjust laser beam to zero (0.00), both H and V values.
6. Switch laser beam 90º.
7. Press 0 to make this reference point number three.
8. Move table.
9. Read value. The displayed value is the angular error at that distance.



Imagine the two axis as a set square. Mount the detector with the label (M) facing into the angle.

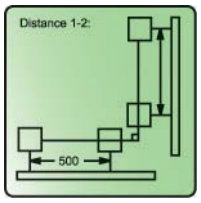


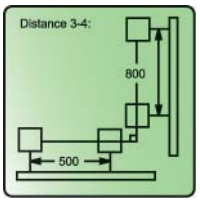
A plus or minus value is displayed

Measure

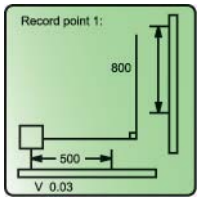
Make sure the reference points are still zero before measuring.

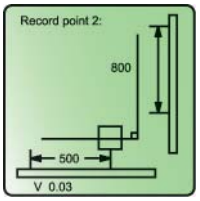
1. Mount the detector. The detector D5 or M-unit can be used.
2. Start the program Squareness (26).
3. Enter the distance between the measurement points 1–2, and then points 3–4.
4. Confirm with .
5. Place the detector at each point and record values 1 and 2 according to the display. This will create a reference for the angle.
6. Confirm with .
7. Switch the penta prism in laser transmitter and record two new measurement values on the second object.
8. Confirm with . The result is displayed graphically. The measurement values are converted into an angular value, showing any deviation from 90° in the second object.
9. Save data and make a Squareness measurement report.



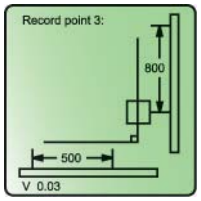


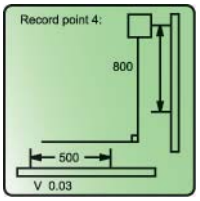
Enter distances



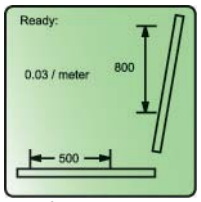


Record values





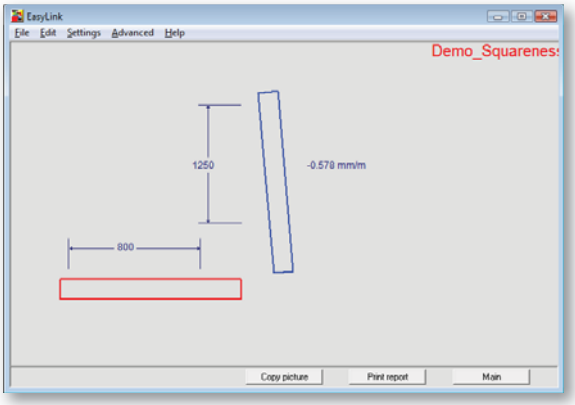
Second object



Result

Squareness report

Transfer the data to a PC via EasyLink™. The result can be presented both digitally and graphically.



Red object is reference.

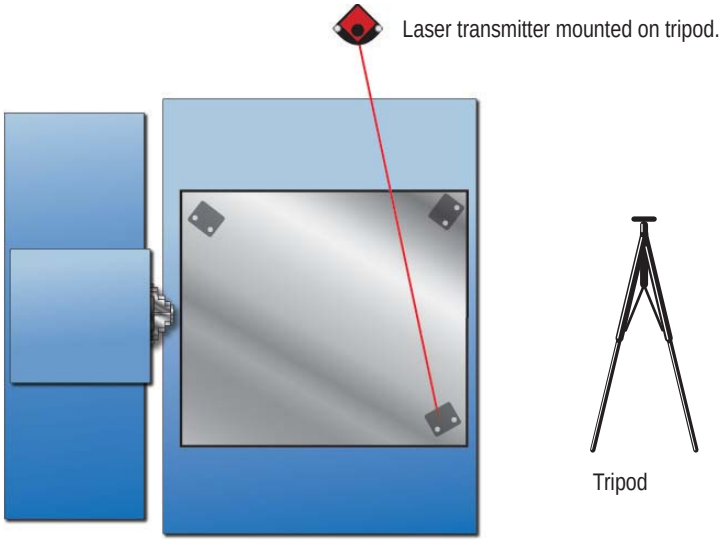
Indexing of machine table

Equipment to use

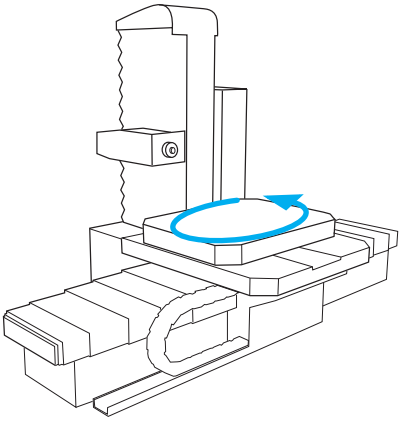
Laser transmitter D22

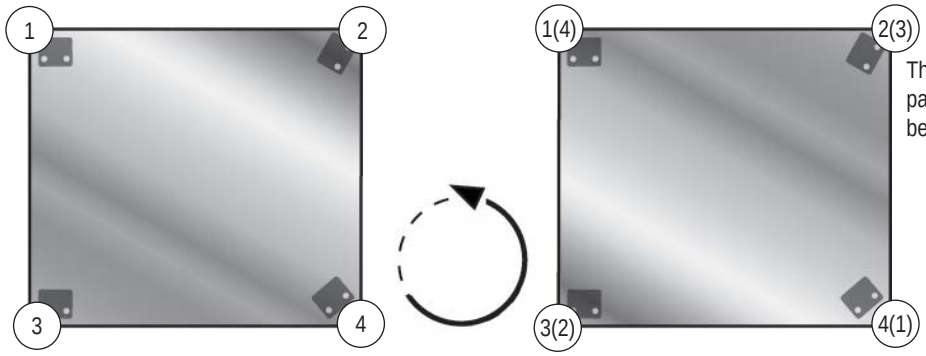
Detector D5 (or M-unit) mounted on a magnet base.

Method one, level the laser



1. Mount the laser transmitter on a tripod.
2. Start the program Values (17).
3. Place the detector on measurement point 1, see image below.
4. Press 0.
5. Place the detector on measurement point 2 and write down the value displayed.
6. Place the detector on measurement point 3 and write down the value displayed.
7. Turn the table 180º.



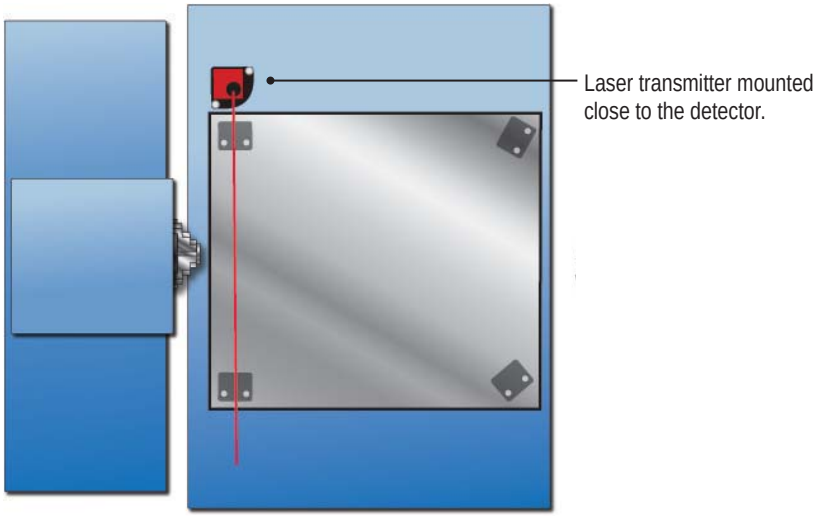


Turn the table 180º.

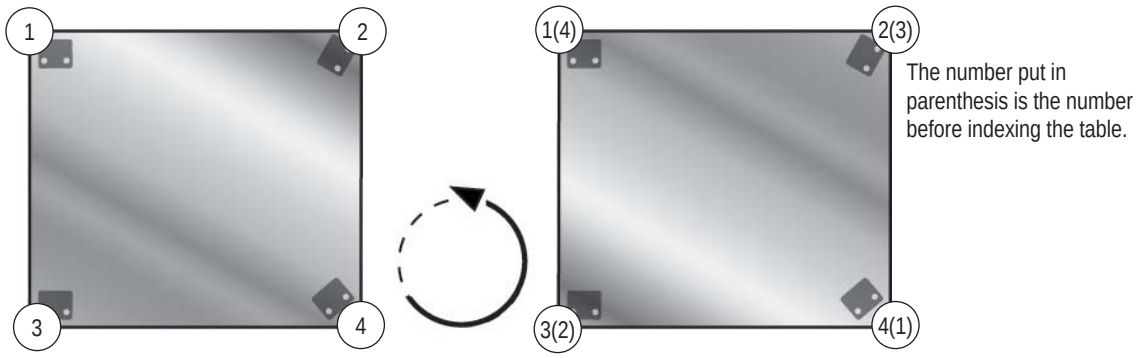
8. Position the detector on point 1(4) and press 0.
9. Compare the values on position 2 and 2(3).
10. Compare the values on position 4 and 4(1).

Method two

In this method the laser transmitter is placed on the machine.



1. Mount the laser transmitter close to the detector, see image above.
2. Start the program Values (17).
3. Place the detector on measurement point 1, see image below.
4. Press 0.
5. Place the detector on measurement point 2 and adjust laserbeam to 0.00mm.
6. Place the detector on measurement point 3 and adjust laserbeam to 0.00mm.
7. Read the value on measurement point 4.
8. Turn the table 180º.



Turn the table 180º.

9. Position the detector on point 1(4). The number put in parenthesis is the number before indexing the table.
10. Press 0.
11. Check value on position 2(3) and 4(1).