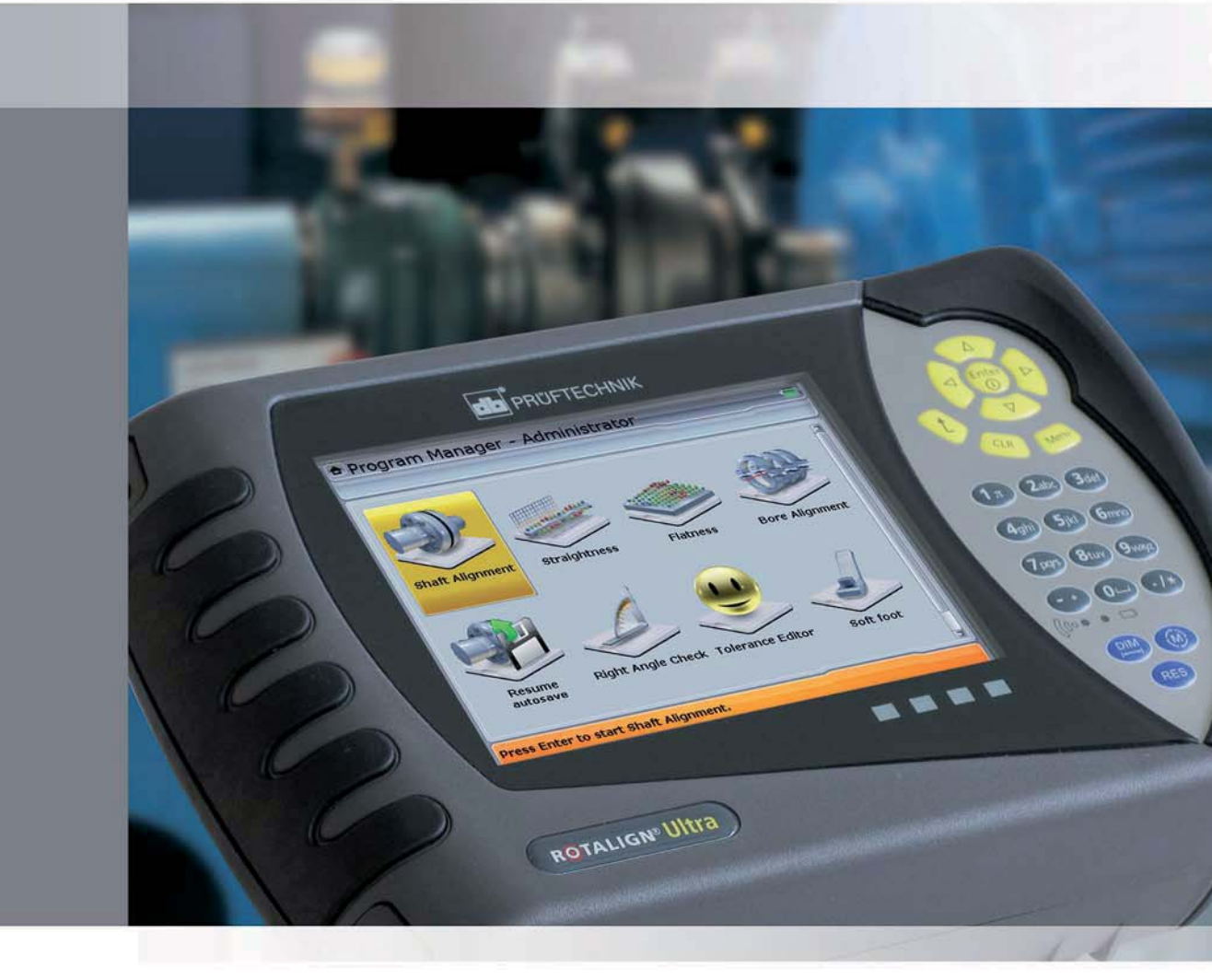
PRÜFTECHNIK

ROTALIGN® Ultra

Operating handbook - Shaft alignment



A user's handbook

Dear Customer,

Welcome to the world of laser-optical shaft alignment using ROTALIGN Ultra, another innovative product from PRÜFTECHNIK, the inventors of laser shaft alignment.
This handbook sets out to help the instrument user work through the instrument with the required ease. It is the standard work for both ROTALIGN Ultra "Advanced" and "Lite" versions, and meant to be a quick learning tool that hopefully should make compelling reading.

PRÜFTECHNIK Alignment Systems GmbH
Freisinger Str. 34
85737 Ismaning
Germany
Tel +49.89.99616-0
Fax +49.89.99616-100
Email info@pruftechnik.com

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Foreword

ROTALIGN Ultra is a user-friendly measurement system, thanks to its intuitive operation, ergonomic design and its many beneficial features. The result of continued development, the system has a new 5.7-inch colour TFT sunlight readable full VGA screen and a faster processor. It also features an alphanumeric keyboard with strategically placed navigation keys that handles all data entry functions, a long lasting rechargeable battery, handy on-screen context menu, a remarkable file storage capacity and computer LEDs that give the instant status of the alignment condition and laser beam adjustment.

The system is extremely customizable, has a comprehensive set of features and straightforward operation. The features are based on a tier system resulting in the versions "Lite" and "Advanced". The difference between the two versions is a slight adjustment in feature level. This difference is easily overcome by upgrading from "Lite" to "Advanced". This handbook uses the "Lite" and "Advanced" icons to differentiate between features available in the two versions. As most of the description in the handbook is based on the "Lite" version, the "Advanced" icon will be used to highlight features not available in the "Lite" version.

ROTALIGN Ultra "Advanced" handles the alignment of drive trains comprising up to 14 machines, while the "Lite" version is used for machine trains of up to 6 machines. The 'Dimensions' screen is so structured that machine and coupling properties can be entered directly. ROTALIGN Ultra "Advanced" incorporates standard deviation, a function that evaluates the reliability of the measurement results. The quality of the measurement may be evaluated using the measurement ellipse which shows the points measured and the angle of rotation.

The system is delivered together with ALIGNMENT REPORTER, a PRÜFTECHNIK Alignment Systems freeware used for generating and printing measurement reports, as well as creating backup files.

If you have any suggestions for improvement or corrections (not just to this manual, but also for hardware), please drop us a line. We would be glad to make improvements wherever possible.
We look forward to hearing from you.

PRÜFTECHNIK Alignment Systems
Ismaning, Germany

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Chapter 1: ROTALIGN Ultra package

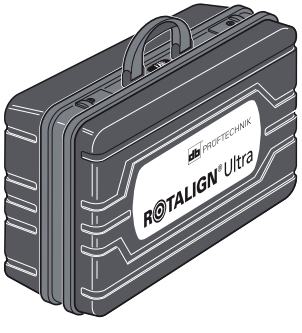
The hardware components for both ROTALIGN Ultra Advanced and ROTALIGN Ultra Lite remain identical.

To upgrade from ROTALIGN Ultra Lite to ROTALIGN Ultra Advanced, simply purchase the firmware registration certificate ALI 4.741.

Note

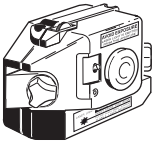
ROTALIGN Ultra Lite Shaft package ALI 4.000/2-L

ALI 4.800	**ROTALIGN Ultra case**
ALI 4.202	**ROTALIGN Ultra computer** including: ROTALIGN Ultra rechargeable battery **ALI 4.603** ROTALIGN Ultra stand **ALI 4.201**
ALI 3.610	**Laser emitter** including dust cap **ALI 3.607**
ALI 3.600	**Sensor** including dust cap **ALI 3.606**



ALI 4.800

ALI 4.202

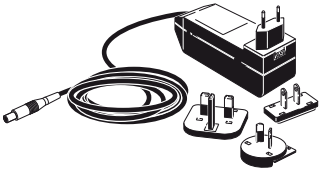


ALI 3.610

ALI 3.600

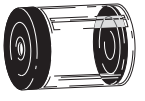
ALI 3.581-2	**Sensor cable**
ALI 3.608	**Adjustment tube**
ALI 12.502-2	**PC/USB cable**
ALI 12.503	**USB/peripheral devices cable**
ALI 12.651.I	**AC power supply/charger** (region-dependent)

ALI 12.502-2



ALI 12.651.I

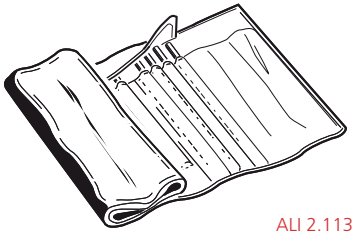
ALI 3.581-2



ALI 3.608

ALI 12.503

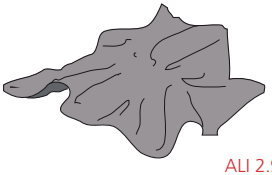
ALI 2.113 SET	**Compact chain-type bracket set** includes: ALI 2.114, ALI 2.115, ALI 2.170, ALI 2.171, ALI 2.172, ALI 2.173 and ALI 2.174
ALI 2.905	**Lens cleaning cloth**
ALI 3.588	**Tape measure mm/inch**
ALI 9.844.G	**ROTALIGN Ultra Shaft pocket guide**
ALI 9.855.G	**ROTALIGN Ultra Shaft operating instructions**



ALI 2.113 SET

ALI 3.588

ALI 9.855.G



ALI 2.905

ALI 9.844.G

DOC 4.900.de/en	**ROTALIGN Ultra product catalog**
ALI 9.638.G	**Shims mailing insert**
ALI 13.701 CD	**ALIGNMENT REPORTER CD**
ALI 13.700 CDS	**ALIGNMENT CENTER CD/Resources CD**

DOC 4.900.de/en

ALI 9.638.G

ALI 13.701 CD

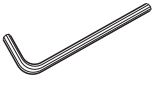
ALI 13.700 CDS

ALI 4.741-L	**Shaft Alignment Lite firmware registration certificate** (not shown)
ALI 4.451	**USB memory stick**
0 0739 1055	**Allen key** (2.5 mm)

ROTALIGN Ultra Shaft package ALI 4.000/2

The items included in this package are identical to those of the ROTALIGN Ultra Lite Shaft package ALI 4.000/2-L except for the firmware certificate. This package is delivered with the Shaft Alignment firmware certificate ALI 4.741.

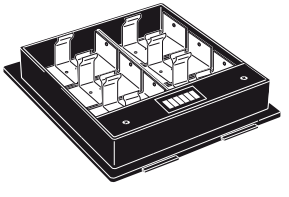
ALI 4.451



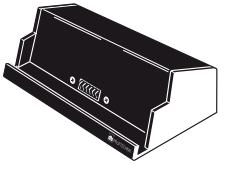
0 0739 1055

Optional ROTALIGN Ultra components

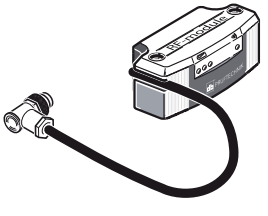
ALI 4.620 SET	**Wireless data transmission module package**
ALI 4.605	**ROTALIGN Ultra disposable battery housing**
ALI 4.615	**Desktop charging station for ROTALIGN Ultra rechargeable battery**
ALI 4.410	**Dust cap for computer sensor socket**



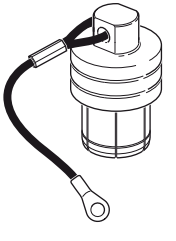
ALI 4.605



ALI 4.615



ALI 4.620 SET



ALI 4.410

Safety notes

ROTALIGN Ultra is to be used in industrial environments only for alignment of turbine components, shafts, bores, measurement of straightness and flatness of different surfaces. Although shockproof to the IP 65 standard, care must be taken to ensure that the instrument is not subjected to mechanical knocks. ROTALIGN Ultra must be operated only by properly trained personnel. No liability will be assumed when components or operating procedures as described in this manual are altered without permission of the manufacturer.

Symbols used in this handbook

The following symbols are used in this manual in order to draw the reader's attention to especially important text, such as that regarding possible sources of danger or useful operating tips.

Note

This symbol denotes general information and tips regarding operation of ROTALIGN Ultra.

CAUTION

This symbol denotes information which must be followed in order to avoid damage to equipment.

WARNING

This symbol denotes information which must be followed in order to avoid personal injury.

1

Numbers in red circles indicate the corresponding operating step described in these instructions and must be performed exactly.

CE compliance and EMC

ROTALIGN Ultra fulfills the EC Guidelines for electric devices (73/23/EWG) and electromagnetic compatibility (EMC) (89/336/EWG). ROTALIGN Ultra has been tested to the scope of:

- EN 61326 Edition 2004-05
- EN 61000-4-2 Edition 2001-12
- EN 61000-4-3 Edition 2003-11
- EN 61000-4-4 Edition 2002-07
- EN 61000-4-5 Edition 2001-12
- EN 61000-4-6 Edition 2001-12
- EN 61000-4-11 Edition 2001-12
- EN 55022 Edition 2003-09

Laser safety

The ROTALIGN Ultra system uses a class II laser beam. Class II lasers comply with the requirements outlined in the USA's FDA specification 21 CFR Ch. 1, Parts 1040.10 and 1040.11 as well as the ANSI standard. It also fulfills British standard BS 4803 (Part 1 to Part 3) and European Industrial Standard IEC825.

The class II laser operates at a wavelength of 675 nm, with a maximum pulse duration of 128µs, maximum radiant power of 0.8mW and maximum radiant energy per pulse of 0.1µJ. No maintenance is necessary to keep this product in compliance with the specifications referred to.

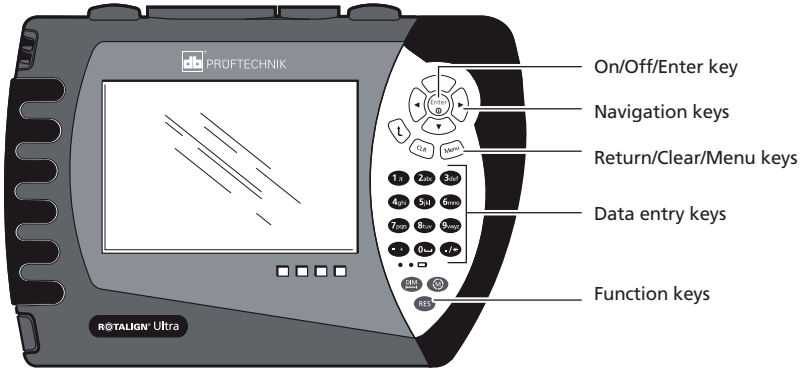
- Do not look directly into the laser beam at any time. (Since FDA specifications allow maximum exposure of 0.25 seconds, the natural blink reaction of the human eye is normally sufficient to avert any danger, provided that no optical instruments other than ordinary eye glasses/contact lenses are used. But as natural blink reaction may fail to occur, care should be taken to avoid staring into the beam.)
- Do not insert any optical devices into the beam path.
- The red LED on the front of the laser illuminates whenever the laser beam is emitted.

WARNING

Getting to know the ROTALIGN Ultra computer

The ROTALIGN Ultra computer has been developed to effectively handle both simple and complex shaft, bore and turbine diaphragm applications. The computer is also used to carry out straightness and flatness measurements. ROTALIGN Ultra has a customer-oriented user interface. It uses easy-to-follow icons and comprehensive on-screen menus and hint texts, that enable even first-time users to operate the computer without difficulty.
ROTALIGN Ultra is built to rugged industrial standards of shock and water resistance. It contains a complete computer with a 5.7 inch color TFT full VGA display, oval-shaped function and data entry keys, 4-way navigation keys, an On/Off/Enter key, an up key, a clear key and a menu key.

Operating keys



- The navigation keys are used to navigate through the menu and display items. The 'Enter' key in the center is used to access any selected item or confirm an action.

- The 'On/Off/Enter' key is used to perform the dual function of switching on ROTALIGN Ultra, and accessing any selected item. To switch on, press and hold Enter, the 'On/Off/Enter' key, for approximately 5 seconds.

- The 'Up' key is used as a back/return key, taking user to previously selected function, or to exit current screen.

- The 'CLR' (Clear) key is used to delete information entered inadvertently.

- The 'Menu' key is used to callup menu options related to the selected display screen. Pressing it twice brings up the global menu.

- The data entry keys are used to enter relevant data.

ROTALIGN Ultra possesses 3 function keys.

- The 'Dimension' key is used to access machine set-up where machine dimensions and properties are defined.

- The 'Measurement' key is used to access the measurement screen.

- The 'Result' key is used to call alignment results into the display.

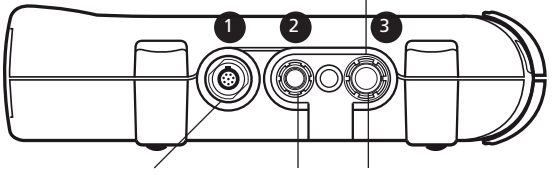
Power supply

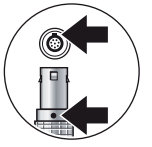
ROTALIGN Ultra is powered using a 7.2 V 6.0 Ah Lithium-ion rechargeable battery ALI 4.603, which is to be charged only using the battery charger ALI 12.651. This can be done with the battery inside the computer. The computer may continue to be used if the battery is charged inside it.
Alternatively, use 6 standard 'C' size batteries contained in the optional battery compartment ALI 4.605.

If the ROTALIGN Ultra computer is not in use for extended periods of time, a month or more, the rechargeable battery or the standard batteries should be removed from the unit.

CAUTION

ROTALIGN Ultra top panel connectors





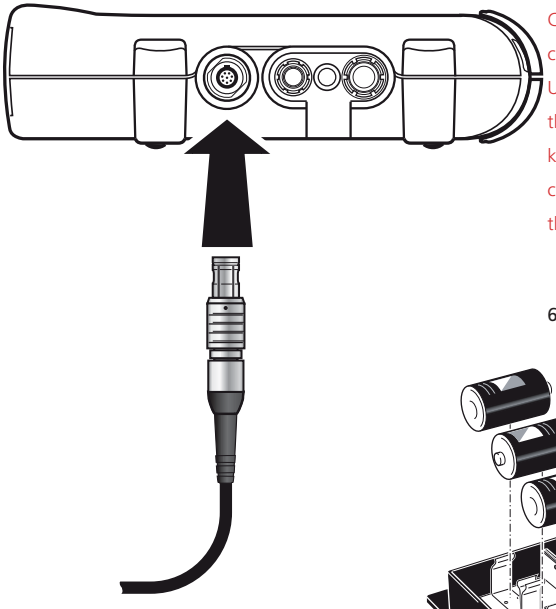
USB host/slave port
The red dot on the USB cable plug must match the red dot on the USB port

Sensor / RS232 socket
Ensure correct ROTALIGN sensor cable plug orientation to avoid damaging pins

Charger socket
The red dot on the charger plug must match the red dot on the battery socket

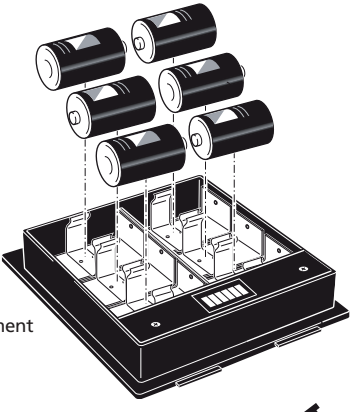
Note that available cables may be connected to the corresponding numbered sockets as follows:

1. ALI 3.581-2 / ALI 3.581-5 (sensor cable)
2. ALI 12.503 (short USB cable), ALI 12.651 (charger)
3. ALI 12.502 (long USB cable), ALI 12.503, ALI 12.651



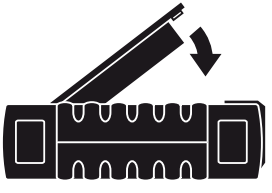
Connecting the battery charger to ROTALIGN Ultra – The LED next to the battery symbol on the keypad lights up when charging takes place with the system turned on

6 'C' size batteries

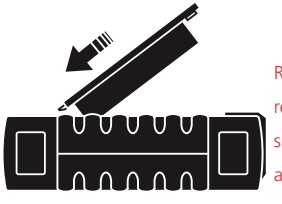


If you are using the standard 'C' size batteries, it is recommended to replace all of them at once. Note the battery polarity when inserting them in the compartment ALI 4.605. The battery compartment is removed and replaced in the same manner as the rechargeable battery ALI 4.603

Battery compartment
ALI 4.605



Lift compartment or rechargeable battery after undoing the screws



Replace compartment or rechargeable battery by sliding it into the groove appropriately

Replacing batteries

The rechargeable battery ALI 4.603 and the battery compartment ALI 4.605 have identical shapes and are therefore replaceable. If batteries require removal, turn over the computer taking care not to damage the display and the hard keys. Undo the two screws by turning them at least a quarter of a turn. With the screws loosened, lift and pull the rechargeable battery or the battery compartment (depending on power supply source) out. The reverse procedure is used to mount back the rechargeable battery or the battery compartment.

Laser and sensor

Laser ALI 3.610

The semiconductor laser diode emits a ray of red light (wavelength 675nm) which is visible where it strikes a surface. The beam is emitted with a diameter of approx. 5mm (3/16”). Because the laser is operated in short pulses and not as a continuous beam, its power is low enough to qualify for Class II safety rating.

Do not stare into the laser beam!

WARNING

The beam is adjusted during set-up by changing its vertical and horizontal angles with thumbwheels so that the beam strikes the sensor lens straight on.
The laser is water and dust resistant. The internal optics and electronics are internally sealed, preventing possible contamination, e.g. via the two thumbwheel slots.

The battery compartment is not watertight. If water enters this compartment, open it and dry it out. The battery should then be replaced.

CAUTION

Laser battery

The laser is powered by a single 9 V battery (type IEC6LR61) which, depending on battery make and operating patterns, provides a typical operating duration of 80 hours. A lithium battery of this size can also be used, increasing operation up to 150 hours. NiCad rechargeables may also be used.

As the battery becomes depleted, the color of the ‘laser active’ indicator LED changes from red to yellow. When this occurs, the battery should be replaced.

CAUTION

The battery is replaced by removing both screws from the battery compartment cover of the laser housing.

- Under no circumstances may the four smaller housing screws be removed, as that would result in misadjustment and would void all warranty coverage.
- Be aware that when NiCad rechargeable batteries are used as replacements, their voltage tends to drop quite rapidly as they become depleted. This may limit the effective warning time (see note above), so a fully-charged spare should be held in reserve.
- Used batteries should be disposed of in an environmentally-sound manner!

Sensor ALI 3.600

The sensor contains two position detectors, which measure the exact position of the laser beam as the shafts are rotated. The sensor also contains an electronic inclinometer for shaft rotation measurements.

The sensor has two indicator LEDs on its front side, one green and the other red, to indicate beam adjustment.

The sensor is powered by the ROTALIGN Ultra computer via a cable (ALI 3.581-2) through which measurement data also pass.

If using wireless data transmission, the sensor is powered through the optional RF module which is also used to pass measurement to the sensor.

Note

The optional RF module is described in chapter 3.

Cable connection

Insert the angled plug into the sensor socket as shown; note the keyway indicating proper plug orientation. Screw down the cable fitting to tighten the connection. The angled plug should be left permanently connected to the sensor, even when storing the system in its case, as this will help avoid damage to cable pins, plugs and sockets.

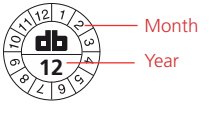
Never turn the plug itself, as that can damage the cable pins!
Note correct plug orientation indicated by the markings on the plug and the socket.

CAUTION

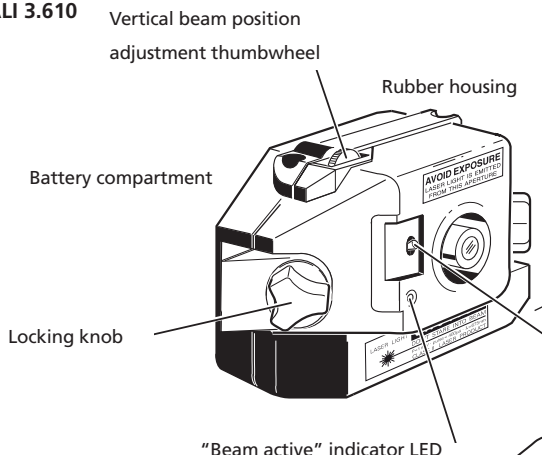
Service and care

The calibration accuracy of the system should be checked every two years as indicated by the date wheel label (shown at right) located on the back of the sensor housing.
Please return the system to your authorized PRÜFTECHNIK service centre for calibration checking by the date indicated.

Note

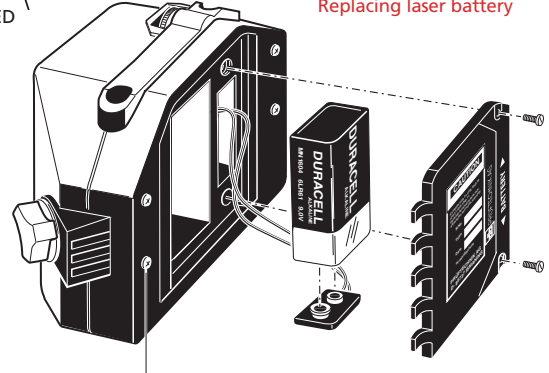


Laser ALI 3.610



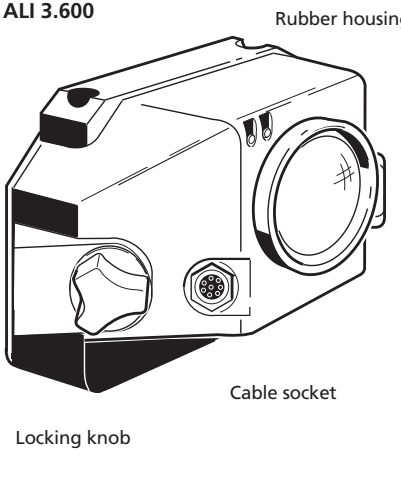
Laser complies with 21 CFR 1040.10 and 21 CFR 1040.11

Replacing laser battery

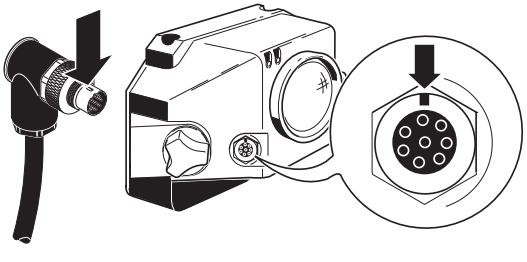


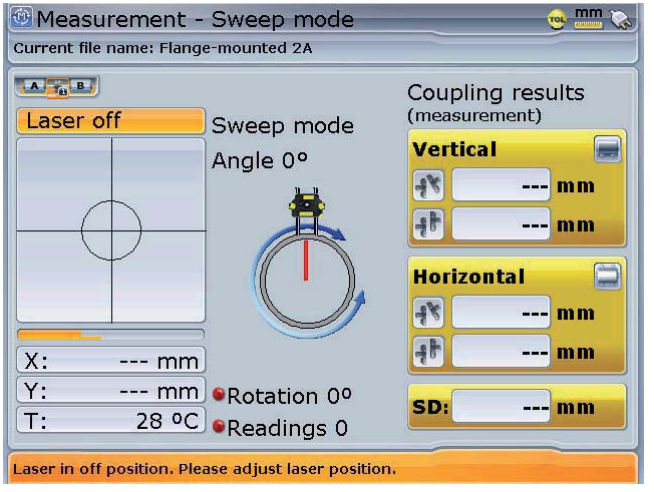
Under no circumstances may the four smaller housing screws be removed, as that would result in misadjustment and would void all warranty coverage.

Sensor ALI 3.600



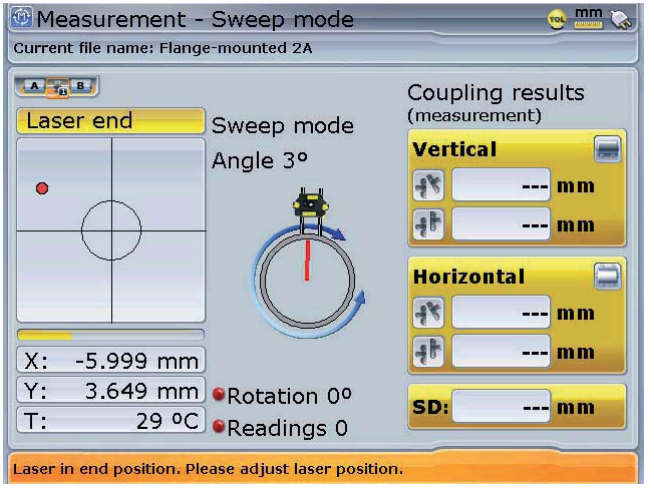
Scratch-resistant lens





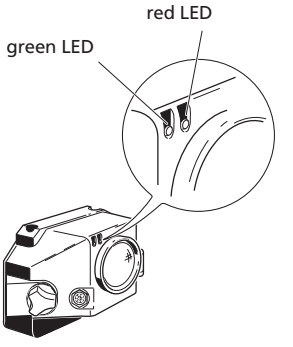
The laser beam is out of the position detector range and the red LED is on and steady

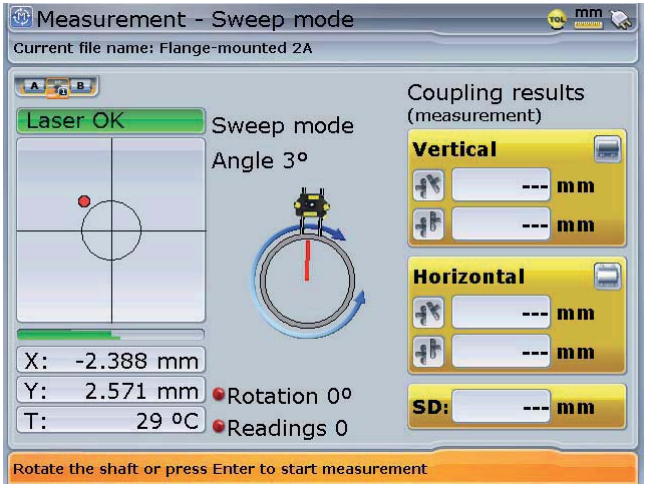
The red computer LED is on and steady



The laser beam is at the edge of the the position detector and both the red and green LEDs are blinking fast

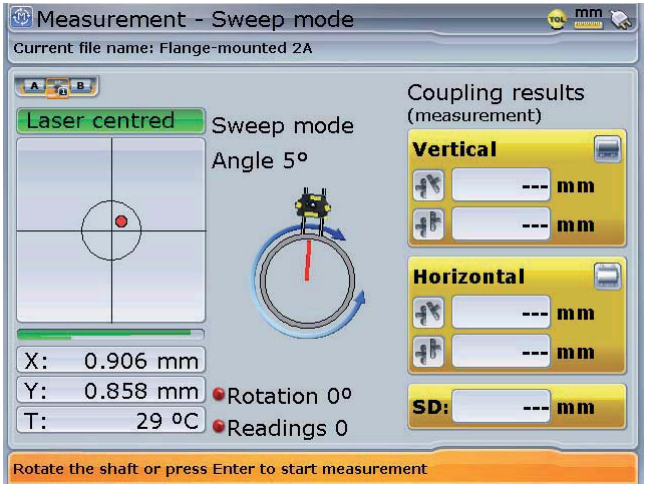
The amber computer LED is on and steady





The laser beam lies in the position detector measurement range. The red LED is off while the green one blinks slowly

The green computer LED is on and steady



The laser beam lies at the center of the position detector measurement range. The red LED is off while the green one blinks slowly

The blue computer LED is on and steady

Any waste electrical and electronic parts of the ROTALIGN Ultra system including memory sticks must be disposed off in accordance with the WEEE (Waste Electrical and Electronic Equipment) Directive. Such parts must be taken to the nearest collection facility.

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Chapter 2: Using ROTALIGN Ultra

Press (Enter) to switch on the computer

Press and hold (Enter) the 'On/Off/Enter' key for about 5 seconds. The opening screen below appears.

Use the navigation keys to access available applications and options. The navigation direction is either upwards/downwards or sideways.

Available applications and options

The following applications and options can be selected via the program manager start screen.

i) Resume – Depending on the set customization option, the resume option loads a default template or the most recent job.
ii) Shaft alignment – used to position the centerlines of rotation of two (or more) machinery shafts in line with each other.
iii) Straightness – used to measure straightness.
iv) Flatness – used to determine levelness and flatness of surfaces.
v) BORALIGN –used for bore and turbine alignment.
vi) Right angle check – used to measure perpendicularity.
vii) Tolerance editor – used to define individual alignment tolerace levels in terms of any desired coupling alignment parameters such as offset and angularity.

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viii) Soft foot – starts the soft foot wizard [the wizard is available in Advanced Shaft only] which assists in correcting soft foot.

ix) Templates – used to select a specified template for a new measurement job.

x) Device configuration – used to configure the ROTALIGN Ultra computer settings. When this option is selected, the following computer settings can be configured: date and time, language, units, power management, printer set-up, device info, display, owner info and users' list. The option is also used to open the licence manager, start the word completion function, customization, change users, backup and restore files.

xi) Turn off – is used to turn ROTALIGN Ultra off.

Applications and options that have not been licenced will appear in program manager grayed out.

Note

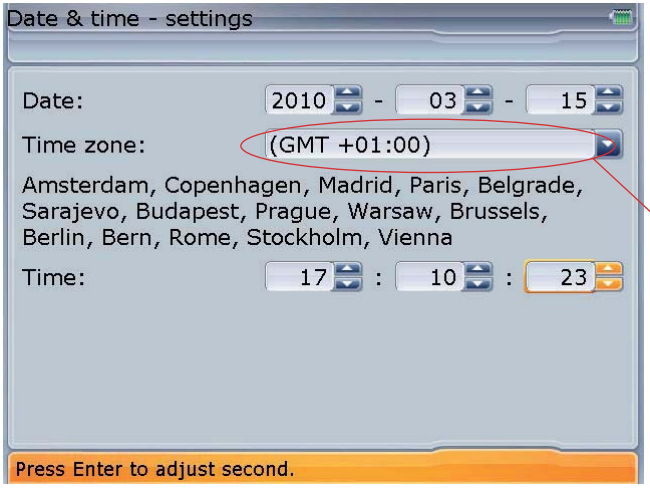
ROTALIGN Ultra configuration

From the 'Program Manager' screen use the navigation keys to highlight 'Configuration'.

Press Enter to reveal the items used to configure the ROTALIGN Ultra computer.

Setting date and time

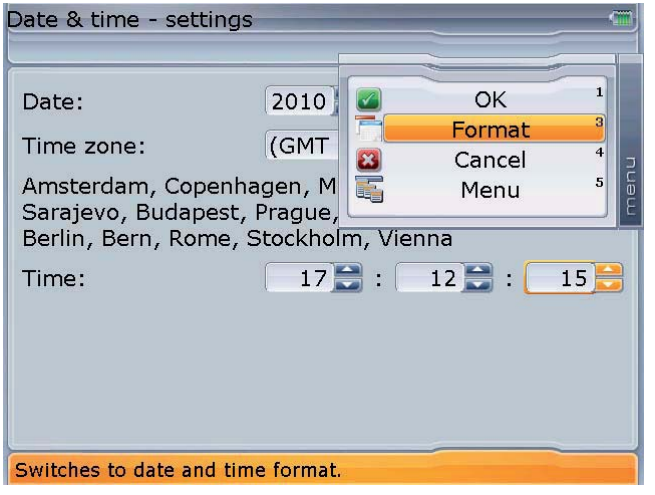
Accessing this section allows you to set the current date and time, choose the proper time zone, and change the date and time presentation formats.



Use the navigation keys to select item to be changed. To change digit values press Enter followed by △ to increase value or ▽ to decrease value.

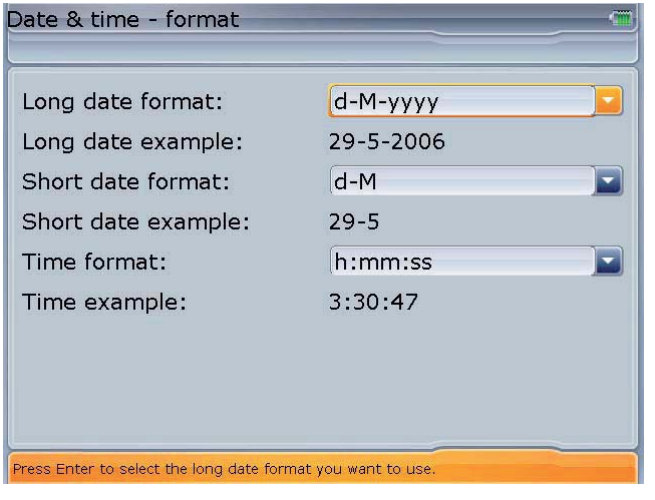
A drop down menu is available for the selection of time zones.

To change the presentation format, press Menu. The context menu appears.



Alternatively, access 'Format' by pressing 3def.

Use ▵/▿ to highlight 'Format' and press Enter to confirm selection. The 'Date & time format' screen appears.



Use the navigation keys to move from one dropdown menu to the next. When a dropdown menu box is highlighted, press Enter to display the available formats. Use ▵/▿ to highlight the desired format, confirming selection by pressing either Enter or t.

Language selection

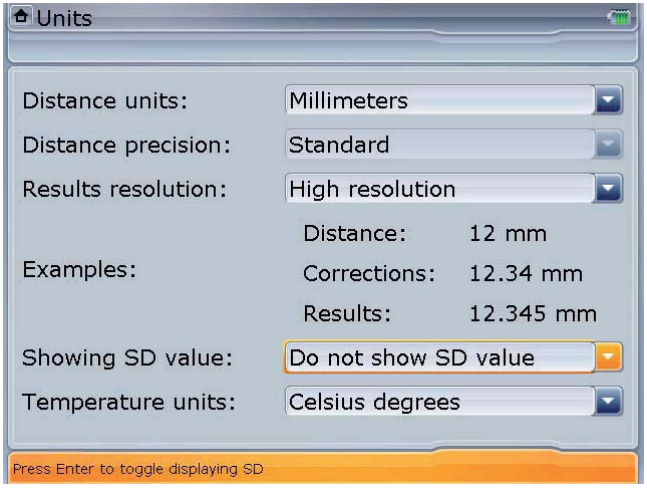
Accessing this section allows you to select preferred country language.

The green checkmark indicates the currently set language.

Use ▵/▿ to highlight preferred language. Press Enter to confirm selection.

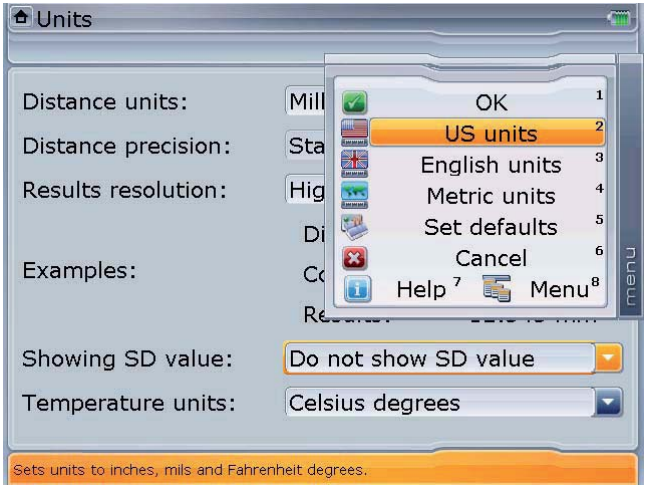
Setting units

Accessing this section allows you to change the units and resolution of physical quantities used in ROTALIGN Ultra. In this case, resolution is defined as the measurement precision in two or three decimal places



Use the navigation keys to move from one dropdown menu to the next. When a dropdown menu box is highlighted, press Enter to display the available options. Use ▵/▿ to highlight the desired option, confirming selection by pressing either Enter or t.

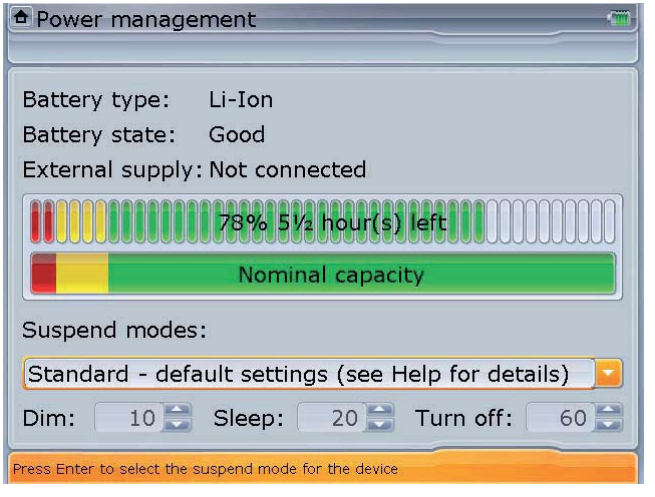
Different system units can be configured by pressing (Menu) while in the unit screen. The context menu appears.



Use (△)/(▽) to highlight the preferred system of units. Confirm selection by pressing either (Enter) or (t). Alternatively, the system of units may be selected by pressing the corresponding data entry key. Pressing (4ghi) selects the metric system.

Power management

This section displays the current battery status, allows you to control the power management features of shutdown, hibernate (sleep mode), and standby.

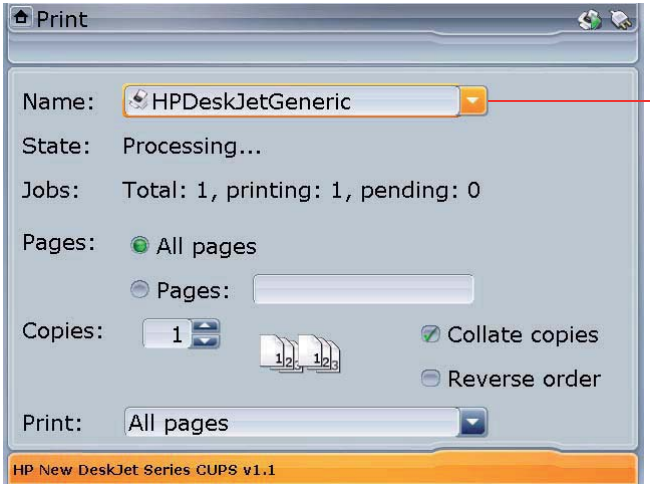


To set standby and hibernate modes, press (Enter). Highlight required mode from the drop down menu that appears using (△)/(▽). Confirm selection by pressing (Enter) or (t).

In hibernate, power is cut off completely while in standby it is not cut off completely.

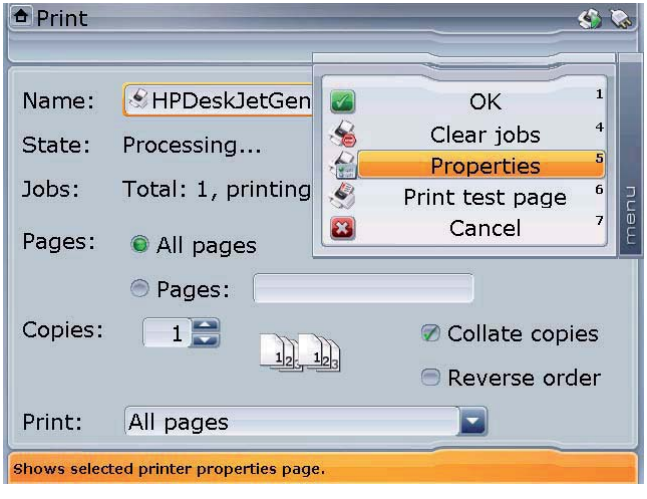
Printer set-up

Accessing this section allows you to set-up printers and the printing configuration on ROTALIGN Ultra.



Select printer by pressing Enter, and highlighting required printer from the drop down menu that appears using △/▽. Selection is confirmed by pressing any one of these keys – Enter or t or ◁ or ▷.

Use the navigation keys to scroll through the settings and print options. Press Enter to select or edit an option or setting.
More printing options can be accessed by pressing Menu while in the print screen. The context menu appears.

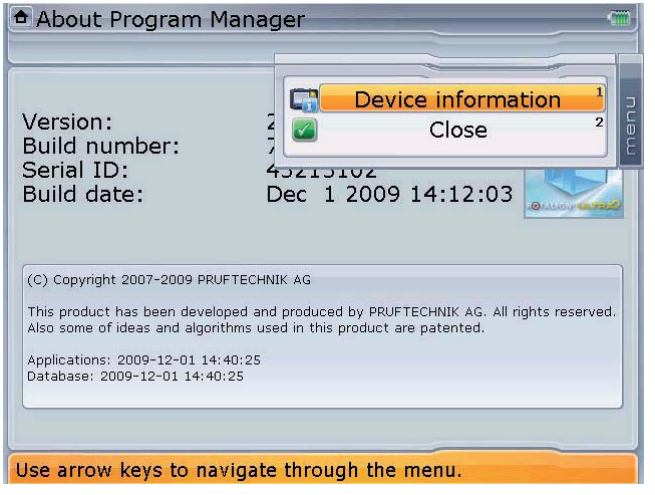


Scroll the context menu using △/▽. Press Enter to confirm selection. Alternatively access the menu item directly by pressing the corresponding data entry key.
Pressing 5jkl accesses the window where printing preferences such as page size, pages per sheet, page orientation, paper source or duplex printing may be set.

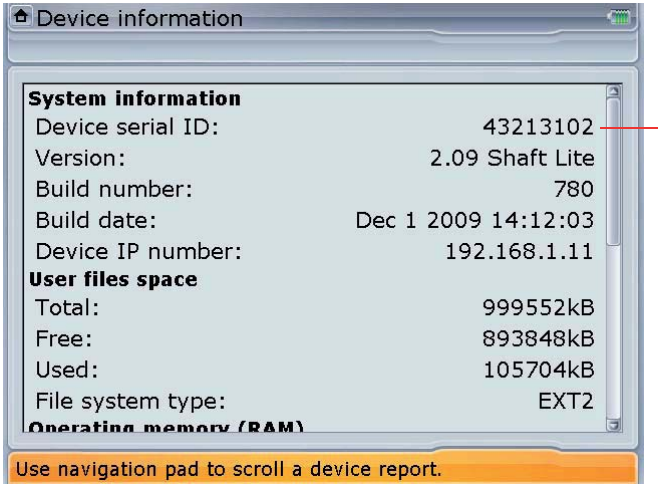
Device info

Accessing this section allows you to see the current file space and operating memory statistics, the CPU data, the ROTALIGN Ultra serial number, and information about the core software used in the device.

'Device information' is accessed via the 'Application information' icon in the 'Configuration' screen. When the 'About Program Manager' screen appears, press Menu. A context menu with the item 'Device information' appears.



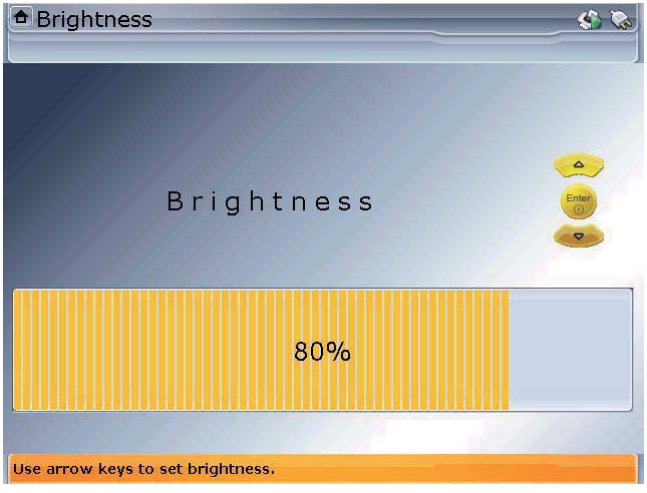
Use ▵/▿ to highlight 'Device information'. Press Enter to confirm selection and display device information.



ROTALIGN Ultra serial number

Display brightness

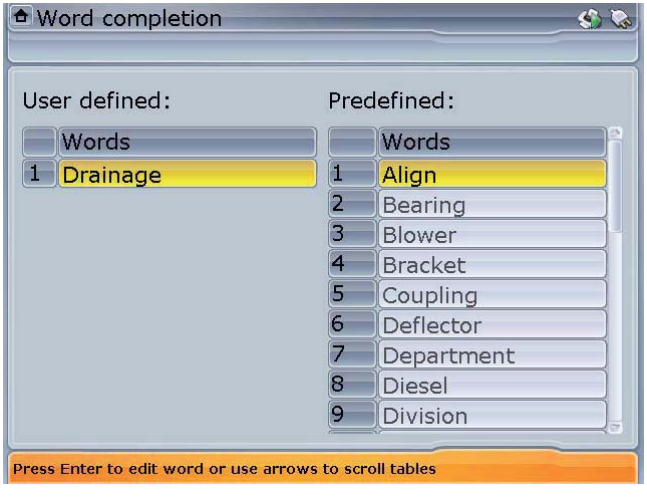
Accessing this section allows you to change the brightness of the display screen.



The display brightness is adjusted using (increases) or (decreases).

Word completion

The word completion mechanism helps save keystrokes and time while typing. It also helps you to make sure that the misspelling of words is avoided. When a user begins the entry of a word already listed in the system dictionary, the word is completed automatically, and may be adopted by pressing Enter.

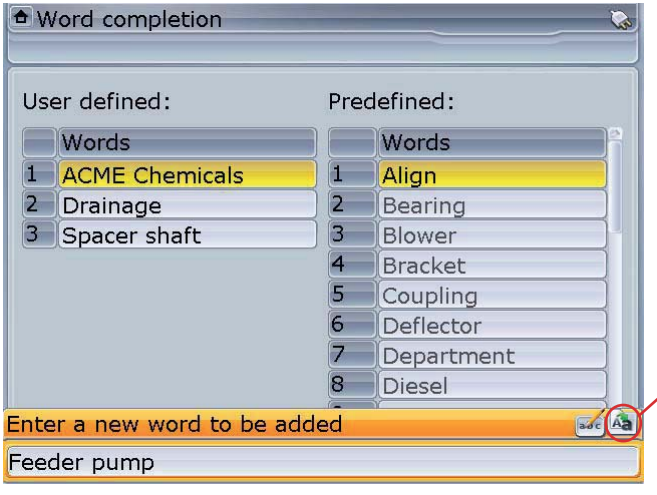


The 'Word completion' screen displays choice of words available for the automatic completion mechanism.

To add, delete or test the completion mechanism, press Menu. A context menu as shown below appears.

Use ▵/▿ to highlight action required from the context menu confirming selection by pressing Enter.

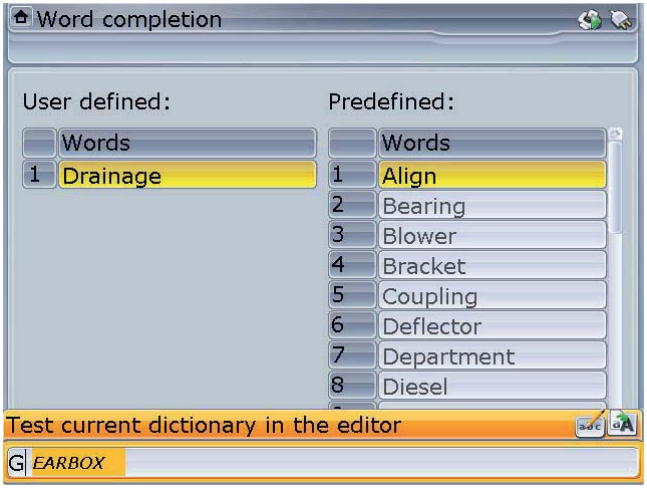
New additions can be made on the "User defined" column only. To do this, use ▵/▿ to highlight 'Add'. Press Enter to confirm selection. Use the data entry keys to enter the new word in the dialog box that appears.



When entering user defined words that contain both upper and lower case characters, as well as numerals, use ·/* to cycle through the three options. Press and hold down ·/* while observing the status indicator at the top right corner of the dialog box. This displays the character to be entered.
When entering letters, 0␣ is used to enter a blank space.

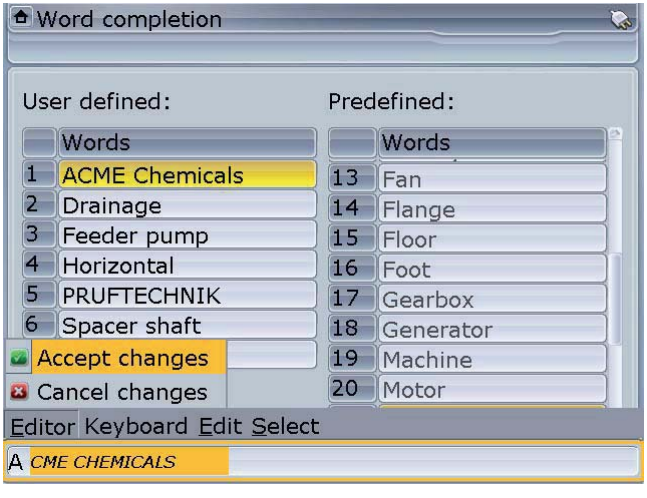
The new word is adopted within the user defined column by pressing either t/Enter or using the context menu item "Accept changes" (refer to screen on the next page).

To test if a word is available in the dictionary, use △/▽ to highlight 'Test dictionary'. Press Enter to confirm selection. Use the data entry keys to enter the first letter of the word required. The word high up in alphabetical order will appear in the dialog box. Test further by entering the second letter. If necessary enter the third and fourth letters to confirm whether the word is available in the dictionary.



In the screen opposite, entering 'G' as the first letter reveals that the word 'Gearbox' exists in the dictionary. If looking up the word 'Generator', we would be required to enter the first three letters ('gen') for results.

An additional editing facility is achieved using the dialog box menu bar items. The bar appears by pressing Menu when the dialog box is open.



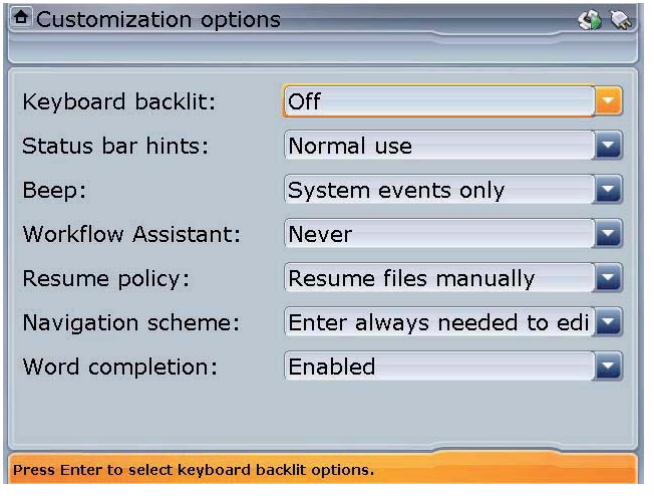
The additional menu bar is navigated using the navigation keys.

Addition and deletion of words is possible only with user defined words. Predefined words are not available for editing.

Note

Customization

Customization makes it possible to change the device settings such that the information displayed is suited to individual needs. These settings are carried out in the 'Customization options' screen which accessed by pressing Enter with 'Customization' highlighted.



Select item to be customized by highlighting the respective item box using the navigation keys. Press Enter and use ▲/▼ to select desired setting from the drop down menu that appears. Confirm setting by pressing Enter/t or any of the navigation keys.

Options available include:

Keyboard backlit

Two options are available – backlit is set either "off" or in "normal use"

Status bar hints

Four options are available – "normal use", "never in menu", "only in menu" and "never"

Beep

The internal beeper can emit sound signals when specific tasks take place. The drop down menu reveals the following options:

"Never" – beeper is permanently off

"System events only" – the sound signal is emitted only when a system event occurs

"Every key stroke" – the sound signal is emitted when a system event occurs and each time a button is pressed

Workflow assistant

This option is used to provide hints to the user on how to proceed with using the system. Options available include – "never", "always", and "only when important"

Resume policy

This option is useful for the resume functionality of ROTALIGN Ultra. The drop down menu reveals the following items:
"Resume files manually" – a new job is started by loading a default template
"Always resume last file" – the most recent job resumes automatically

Navigation scheme

Four options on how to navigate through the menu items are availabe – "Enter always needed to edit", "Quick editing with up/down", "Editing moves focus" and "All features listed above"

Note

This customization option is very important in that it determines how a user navigates through the system. It would be advisable to try out the different options to establish which option suits you best. In this operating instruction we will try to stay with the option "editing moves focus" and depending on the situation, try and explain the option "all features listed below".

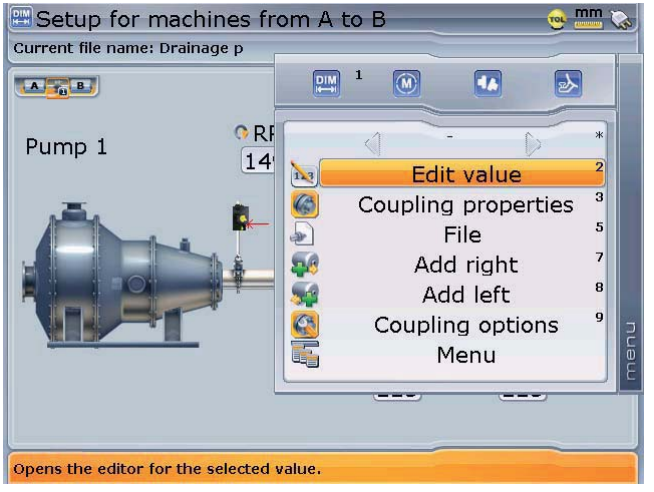
Word completion

Two options are available – "enabled" or "disenabled"

Context menu items

Useful menu items that include accessing the program manager, turning the computer off and configuring the instrument can be accessed via the context menu that appears when Menu is pressed at any time. The item 'Menu' is used to access the global menu.

Context menu items available from the program manager screen.



Context menu items available from the set-up screen.

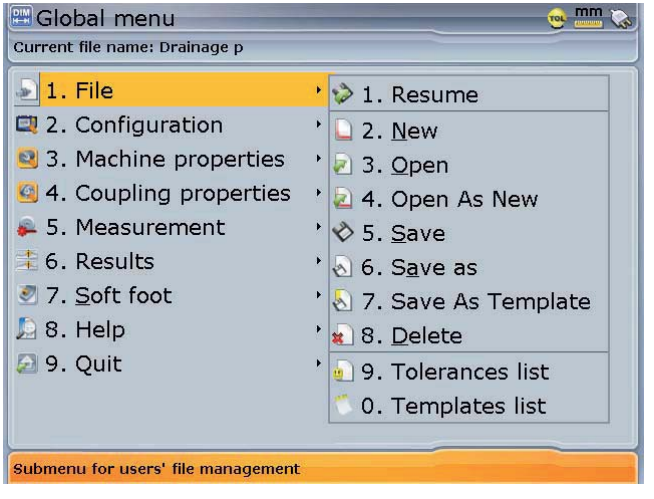
Tips and tricks

Program manager

- While in the program manager, the data entry keys are used to select the corresponding application icon in a numerically ascending order.

General

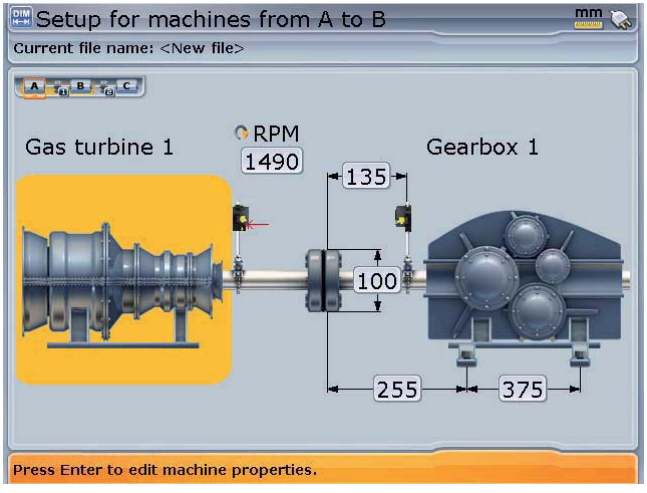
- Pressing Menu long enough opens the global menu.
- Pressing Menu twice opens the global menu. This is the quicker option.



Global menu from the Shaft application set-up screen.

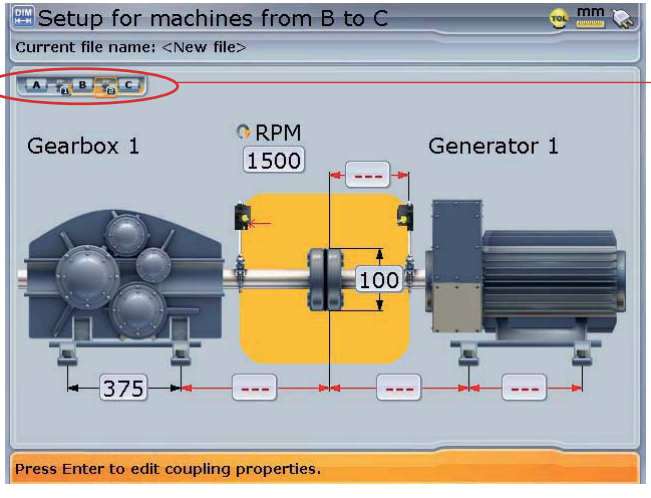
- Pressing Enter for approximately 3 seconds prompts the 'turn off system' dialog.

- Pressing Enter for approximately 7 seconds resets the system.
- Pressing either ◁ or ▷ long enough moves the view of the train to the left or right respectively.



The displayed view shows machines A and B with coupling 1

- Pressing the corresponding data entry key moves the view to the respective coupling position (observe inset in display).



The displayed view shows machines B and C with coupling 2

- Pressing either .-/* or -+ moves the view of the train to the right or left respectively.

Dimensions (set-up)

- When in set-up and units are set to Imperial system, entering a dimension as 11.3.8 corresponds to 11 3/8 in.
- Pressing CLR while in set-up prompts the deletion of the selected machine.
- When selecting type of machine the orientation of the machine can be altered by pressing either ◁ or ▷.
- Pressing DIM twice while in set-up zooms the machine train out and in again.
- When entering data (file and element names), pressing ·/* cycles through the characters that can be entered, and pressing '1' long enough enters the value π.
- Press △ to zoom out the image (any one of the train elements has to be highlighted).
- Press ▽ to zoom in the image (any one of the train elements has to be highlighted).

Measurement

- Pressing M twice activates auto measurement.

In auto measurement any of the three measurement modes – continuous sweep, multipoint or static measurement is started directly by the appropriate action.

- sweep mode is activated by rotating the shafts
- multipoint is started by pressing Enter
- static measurement is started by pressing either the data etry keys or any of the navigation keys

Note

Results

- Pressing ▽ and holding on, while in results, cycles the results between vertical (V), horizontal (H) and both H&V.

Creating templates

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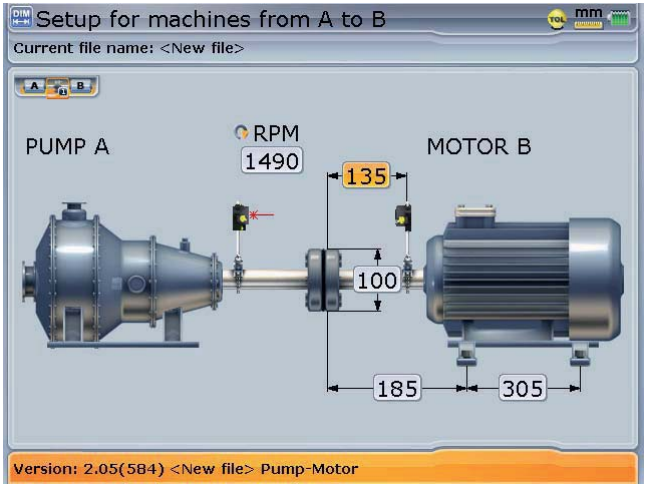
A template is a file that serves as a pattern for alignment set-ups that are repeated frequently. Their main purpose is to save you time by not having to reconfigure the same set-up many times. As such, it can contain all known dimensions, target specifications, thermal growth values, preferred measure mode, preferred machine icons and coupling types.

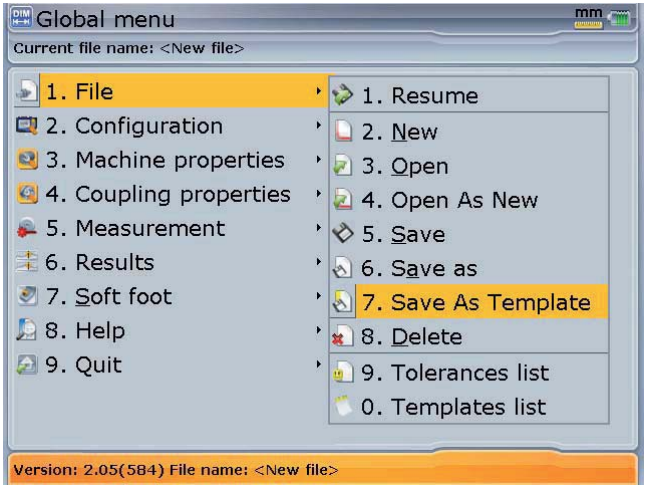
Any readings already taken and present in the measurement table will be flushed. Readings should only be saved in active job files and cannot be saved with a template.

Note

Start Shaft Alignment application and define template.



Press Menu twice to open the global menu.



Use the navigation keys to highlight 'File' / 'Save as template'. Confirm selection by pressing Enter.The "Save as template" window appears. Press Enter to edit the name of the template in the editing box that opens.

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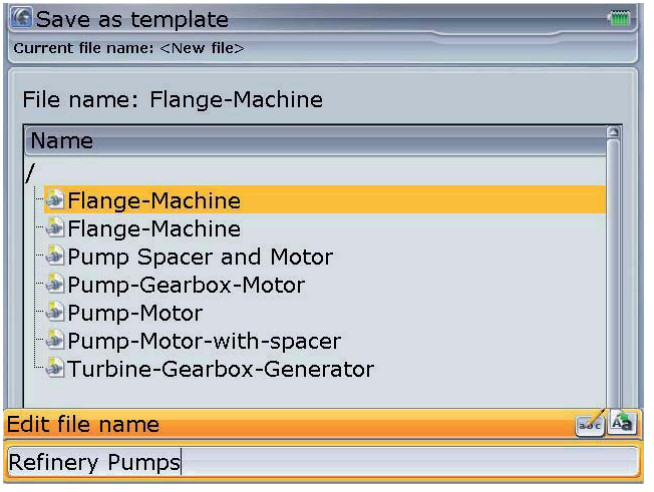
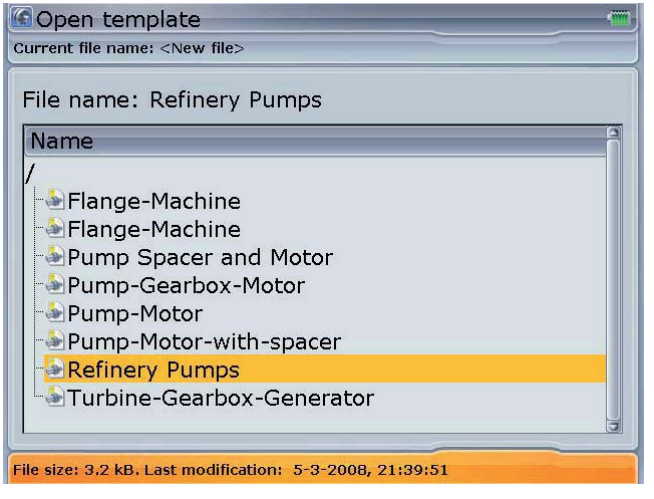


Press Enter to confirm template name and save template

The new template will now appear on the templates list.



Deleting created templates from the program manager

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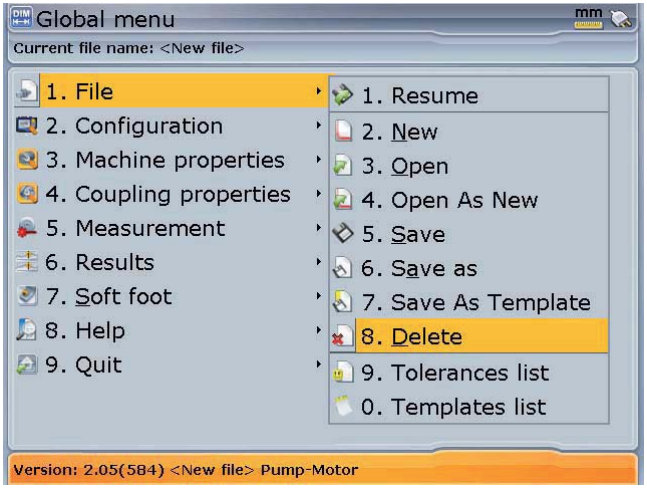
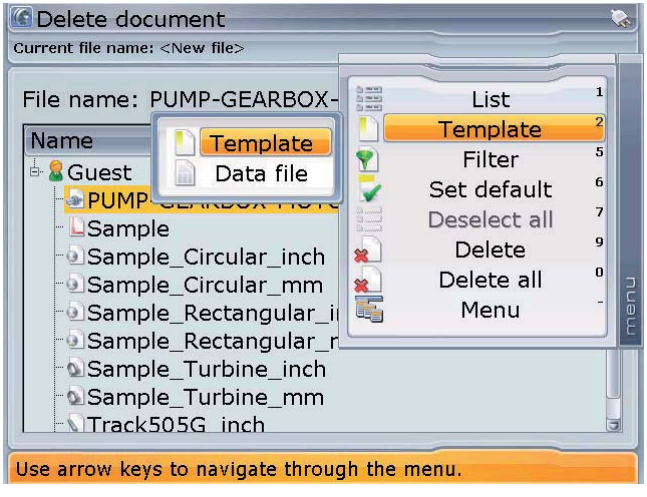
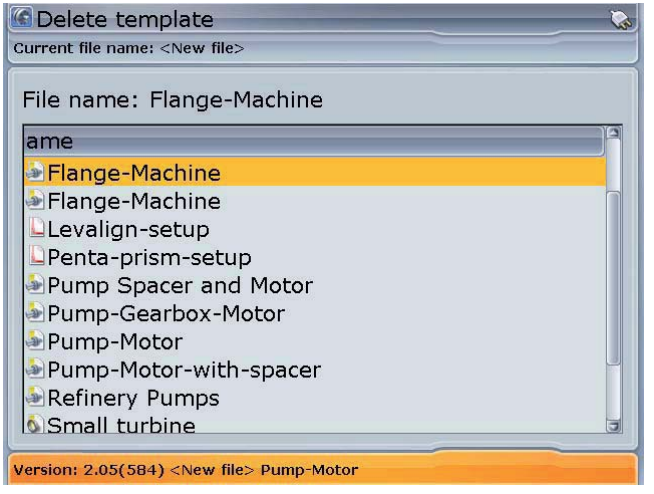
Press Menu twice to open the global menu while in the Shaft Alignment application.



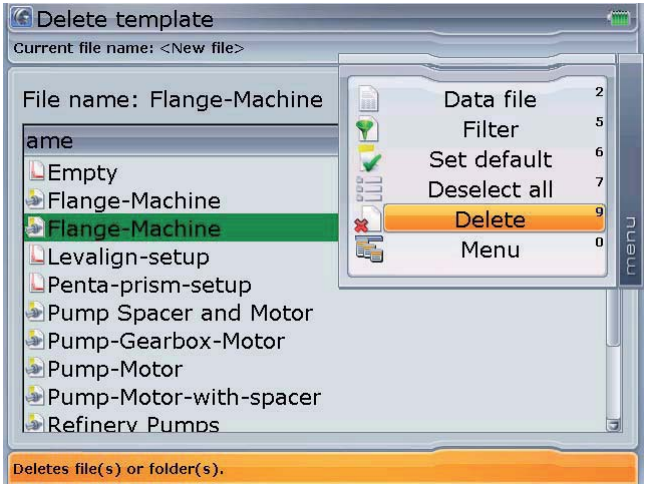
Use the navigation keys to highlight 'File'/'Delete'. Confirm by pressing Enter. The 'Delete document' window appears. Press Menu to open the context menu and use the navigation keys to highlight 'Template'/'Template'.



Confirm selection by pressing Enter. The 'Delete template' window opens with a complete list of all available templates.



Use the navigation keys to highlight the template to be deleted. With the template highlighted, press Menu. The context menu appears.



With the context menu displayed, press 9wxyz. A message pops up requesting confirmation if the file should actually be deleted. Use the navigation keys to highlight 'Yes' and confirm selection by pressing Enter. The template is deleted from the template list.

Alternatively, use △/▽ to highlight 'Delete', confirming selection by pressing Enter. The hint requesting confirmation to delete template then appears on the display.

If you select a template and set it as the 'default' template, a working file based on this template will be started every time you launch the Shaft Alignment application. If you do not designate a default template, a working file based on the factory default template will launch instead.

Chapter 3: Shaft alignment application

Starting the shaft alignment application

Before the application can be started, a licence code must be entered in the licence manager. In most cases the application is licenced at the factory and the system is delivered with the Shaft Alignment firmware registration certificate ALI 4.741 which contains the entered licence code.

Note

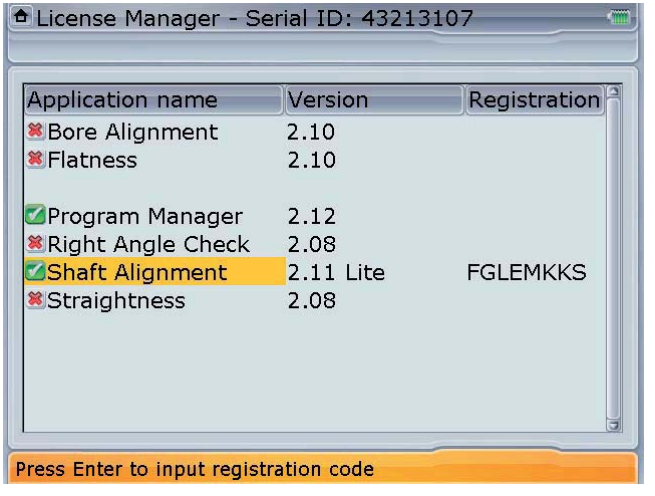
Starting the licence manager

After switching ROTALIGN Ultra on, use the navigation keys to highlight 'Configuration'.

Press Enter to access this option.

Use the navigation keys to highlight 'License Manager'. Press Enter to access 'License Manager'. Use ▲/▼ to highlight 'Shaft Alignment'. Press Enter and proceed to enter the application licence code (registration key) in the editing box.

After successful registration, a green tick appears next to the application and the suffix 'Lite' if registering the Lite Shaft version. The application shaft alignment can be started.



If registering the Advanced version, the suffix 'Advanced' appears after the version number.

Please refer to page 86 for a brief description on upgrading from Lite Shaft to Advanced Shaft version.

Horizontal machine alignment - preparation

1. Preparing for the alignment procedure

Before using the ROTALIGN Ultra shaft alignment application, prepare the machines as described below.

Switch off the machines before commencing work, and make sure that they cannot be started accidentally!

WARNING

a. Solid, flat foundation

A solid, rigid foundation is required to obtain correct, lasting shaft alignment that allows long-term uninterrupted machine service.

b. Machine mobility

If the machine to be moved stands directly on the foundations, it cannot be lowered for alignment correction. It is therefore advisable to start with about 2 mm (80 mils) of shims beneath the feet of both machines. Hydraulic or screw-type positioning aids are recommended for horizontal movement.

c. Rigid couplings

Rigid couplings must be loosened before measurement so that they do not distort the alignment condition.

d. Shaft play and coupling backlash

Axial shaft play of up to 3 mm (1/8") has no adverse effect on alignment results (but not necessarily for machine operation).

e. Soft foot

Soft foot causes the machine frame distortion every time the bolts are loosened or tightened, making proper alignment difficult or impossible.

f. Thermal growth, alignment targets, tolerances

These values can be obtained from the individual machine specifications, and then entered into the program. In addition, a built in thermal growth calculator can help you derive these values from the observed changes in temperature.

g. Measurement separation

Since ROTALIGN Ultra requires no mechanical connections (such as cantilevered dial indicator brackets) to span over the coupling during measurement, alignment may easily be performed over large laser – sensor separations.

Note that over very large distances the shafts and coupling may sag, and the machines may need to be aligned to take this into account. Refer to the machine manufacturer's specifications.

2. Check soft foot

Refer to section on soft foot on page 125.

3. Mount the brackets

Mount the brackets on either side of the coupling on either the shafts or on the solid coupling hubs, and both at the same rotational position.

Please note the following in order to obtain the highest possible measurement accuracy and to avoid damage to equipment:

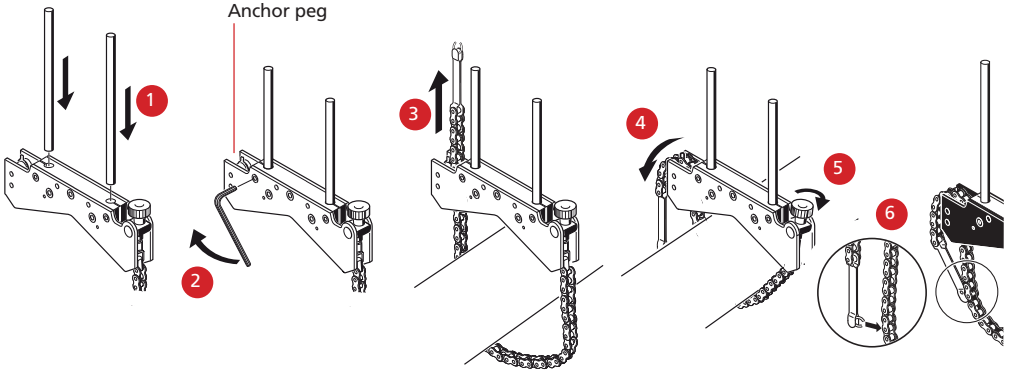
- Ensure that the brackets fit solidly onto their mounting surfaces!
- Do not use self-constructed mounting brackets, or modify the original bracket configuration supplied by PRÜFTECHNIK Alignment (for example, do not use support posts longer than those supplied with the bracket).

CAUTION

Bracket mounting procedure

To fit the compact chain brackets, refer to the diagram shown below and follow the instructions carefully.

1. Choose the shortest support posts which will still allow the laser beam to pass over or through the coupling. Insert the support posts into the bracket.
2. Fasten them in place by tightening the hex screws on the sides of the bracket frame.
3. Place the bracket on the shaft or coupling, wrap the chain around the shaft and feed it through the other side of the bracket: if the shaft is smaller than the width of the bracket frame, insert the chain from the inside of the bracket as shown in the diagram; if the shaft is larger than the bracket width, insert the chain into the frame from the outside.
4. Catch the chain loosely on the anchor peg.
5. Turn the bracket thumbscrew to tighten the assembly onto the shaft.
6. Clip the loose end of the chain back onto itself.



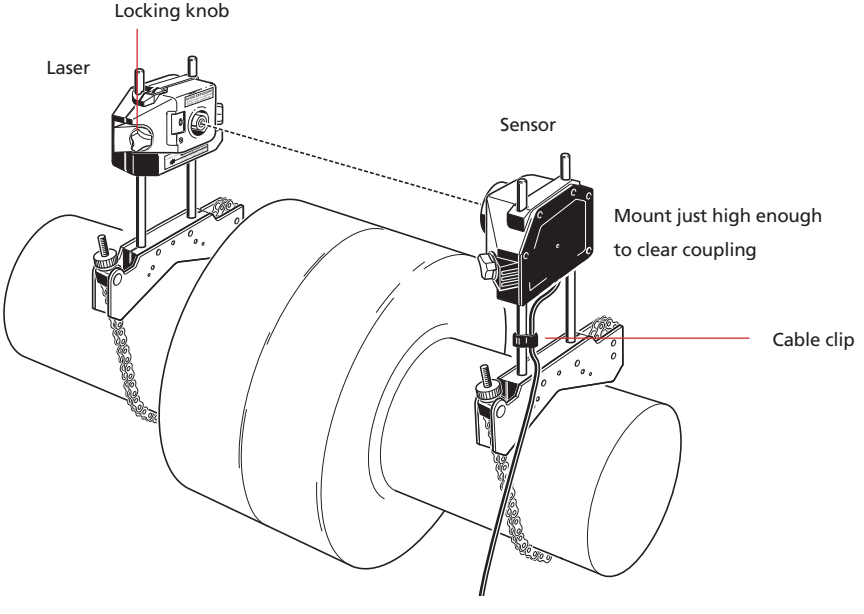
The bracket should now be tight upon the shaft. Do not push or pull on the bracket to check, since this could loosen its mounting.
To remove the brackets, loosen the thumbscrew, then remove the chain from its anchor peg.

The compact chain-type brackets cover most situations, but in cramped or special cases, other types of brackets may be required. Ask your PRÜFTECHNIK representative for details.

Note

4. Mount laser and sensor

Mount the laser on the support posts of the bracket fixed on the shaft of the left machine (usually reference machine), and the sensor on the support posts of the bracket fixed on the shaft of the right machine (usually moveable machine) – as viewed from normal working position. Ensure that the yellow knobs are loosened enough to let you slide the housing onto the support posts.
Clamp both the laser and the sensor onto the respective support posts by tightening the yellow knobs. Ensure that the laser can pass over or through the coupling and is not blocked. Fasten the sensor cable to one of the support posts using a cable clip.
Both the laser and sensor should be at the same height, as low as possible, yet just high enough for the beam to clear the coupling flange. They should also visually appear to be rotationally aligned to each other.
Make the final adjustments, loosening the brackets slightly if necessary, then rotating them and retightening.



5. Connect the sensor

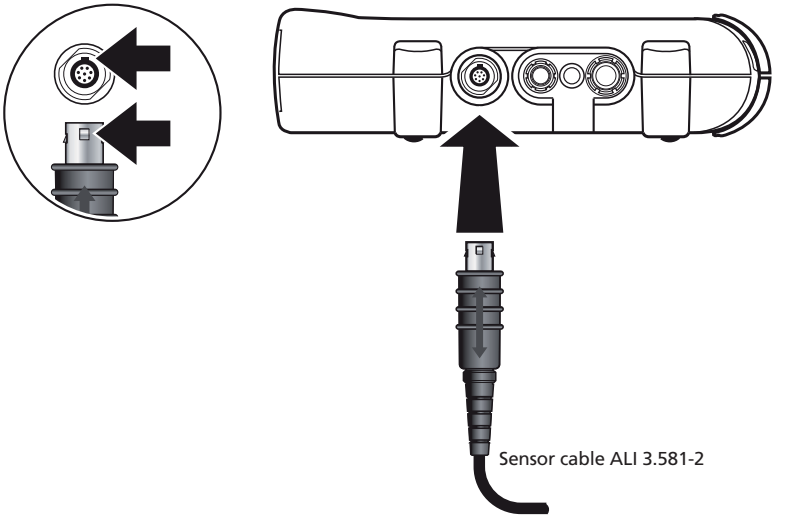
Insert the quick fit straight-ended sensor cable plug into the eight-pin socket on the top of the computer housing with the red dot at the front.

Match the double-sided arrow head on the plug to the red marking on the socket to ensure proper plug orientation; otherwise the pins inside the plug may be damaged.
To disconnect, grasp the ribbed collar of the plug on the sensor cable (ALI 3.581-2) and carefully pull it out of the ROTALIGN Ultra RS232/Sensor socket.

CAUTION

Wireless communication between the sensor and ROTALIGN Ultra computer is also possible. In this case, use is made of the optional wireless data transmission module package ALI 4.620 SET.

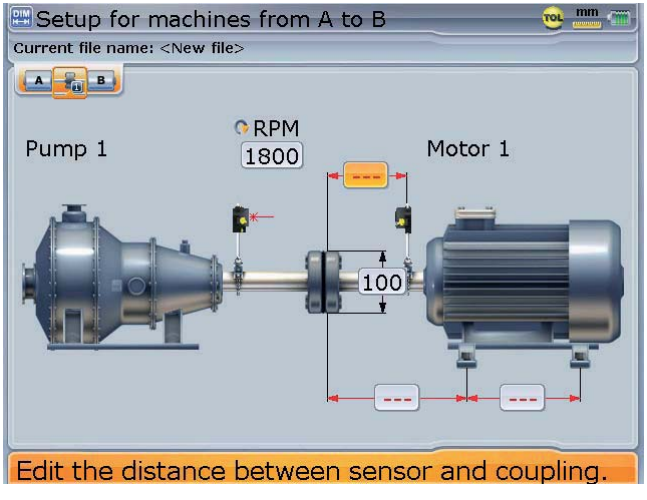
Note



6. Switch ROTALIGN Ultra on and start application

Press Enter and hold for a few seconds. The 4 alignment condition LEDs light up. Shortly afterwards, the splash screen appears, followed by the program manager screen below.

Use the navigation keys to highlight 'Shaft Alignment'. Press Enter to access the application. The opening template in the set-up screen below appears.

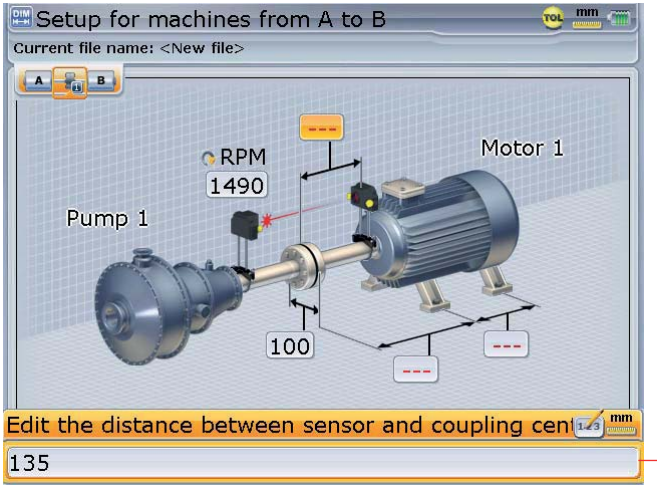


The above screen will appear only if the customization option 'Resume policy' has been set to 'Resume files manually'. (See customization - described in chapter 2)

Note

7.1 Enter machine dimensions

Machine information and dimensions are entered using the grey data entry keys. The required missing dimensions are entered directly. Use the navigation keys to highlight the dimension box and enter dimension by pressing the appropriate data entry keys. The editing box appears as soon as the first key is pressed.

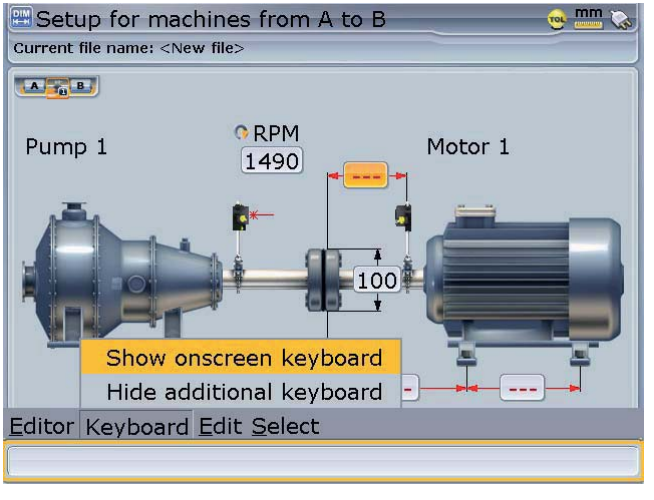


If desired, elements in the machine train can be displayed in 3-D format using the dimensions screen context menu item 'Switch to 3D mode'. One may revert to the 2-D format using the corresponding 'Switch to 2D mode' context menu item. The 2-D format is used throughout this handbook.

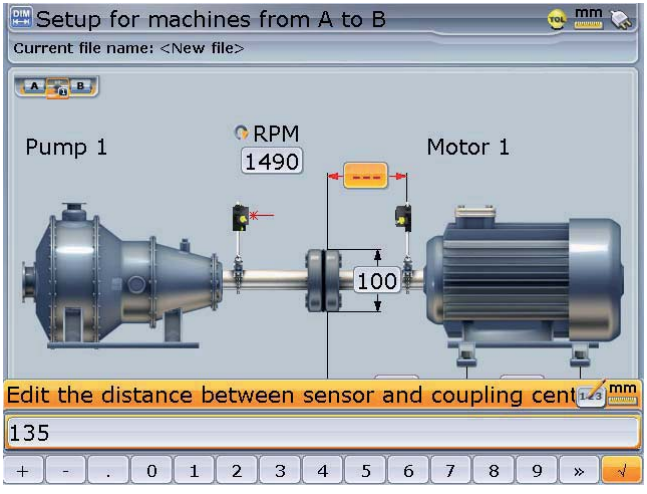
Editing box

Confirm the entered value by pressing either Enter or t. The highlight springs to the next empty dimension box. If necessary, use the navigation keys to highlight the dimension to be edited.

Alternatively, data may be edited using an on-screen keyboard-like text editor. With the editing box open, press Menu then use ◁ / ▷ to select the item 'Keyboard'.



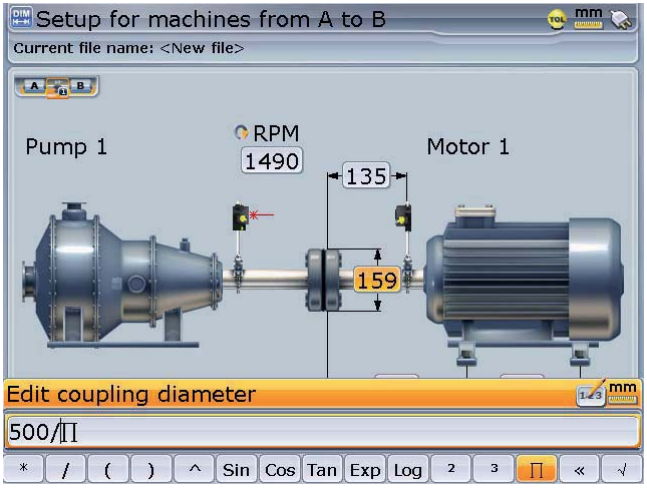
Use △/▽ to highlight 'Show on-screen keyboard. Confirm selection by pressing Enter then hide the exposed menu items by pressing t.



Data can be edited either directly using the data entry keys or using the on-screen keyboard which is navigated using the navigation keys.

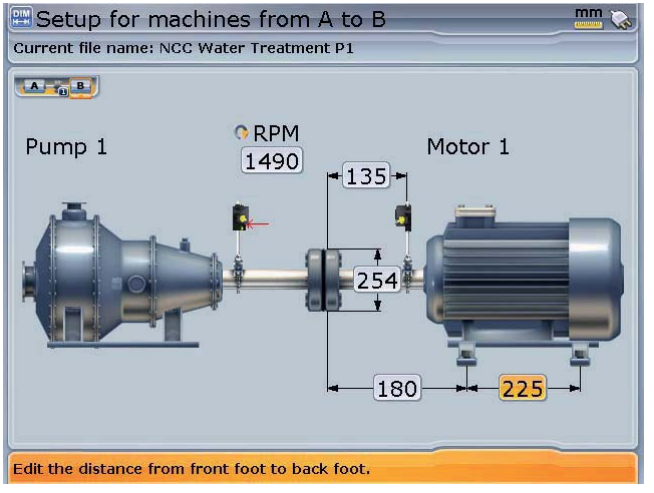
The on-screen keyboard-like text editor can accept simple formulas. For instance, to calculate and enter the coupling diameter, key in the "circumference/ π".

Note



If units are set to Imperial system, the dimension 11 3/8 inches can be keyed in as 11+3/8 using the on-screen keyboard.

The dimensions to be entered vary according to machine and type of coupling. In a standard horizontal alignment application enter dimensions as follows:



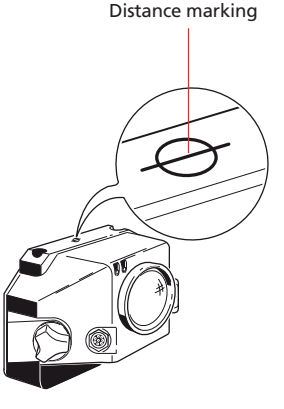
7.1.1 Coupling diameter

The coupling diameter can be obtained by measuring the circumference of the coupling and dividing the value by π (3.142).

The default value is 100 mm (10" if set to US units). Should there be need to edit the value, highlight the value using the navigation keys. Edit the value directly using the data entry keys. Confirm the new value by pressing either Enter or ↵. The highlight springs to the next dimension box automatically.

7.1.2 Sensor to coupling center

This is the distance between the "distance marking" on top of the sensor and the coupling center. Should there be need to edit the value, use the navigation keys to highlight it, and edit it directly using the data entry keys.



7.1.3 RPM (revolutions per minute)

The default value is 1500 (1800 if set to US units). Should there be need to edit the value, use the navigation keys to highlight it, and edit it directly using the data entry keys.

7.1.4 Coupling center to front foot, right machine

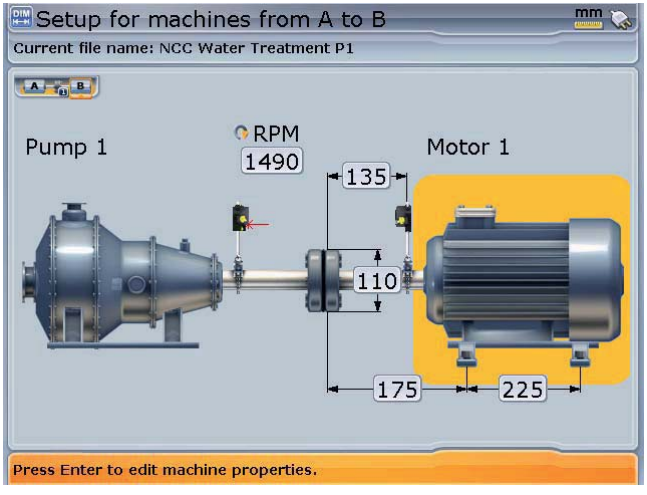
This is the distance from the coupling center to the pair of feet on the right machine nearest to the coupling.

7.1.5 Front foot to back foot, right machine

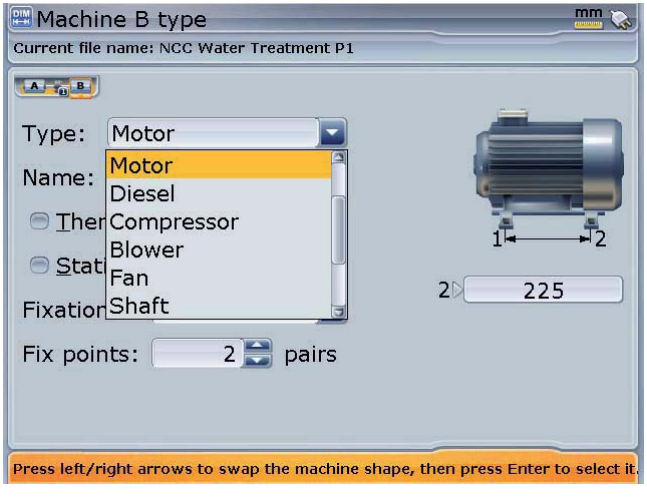
7.2 Machine properties

The set-up screen is used to enter element dimensions as well as editing machine properties.

Use ◁ / ▷ to highlight machine to edit.



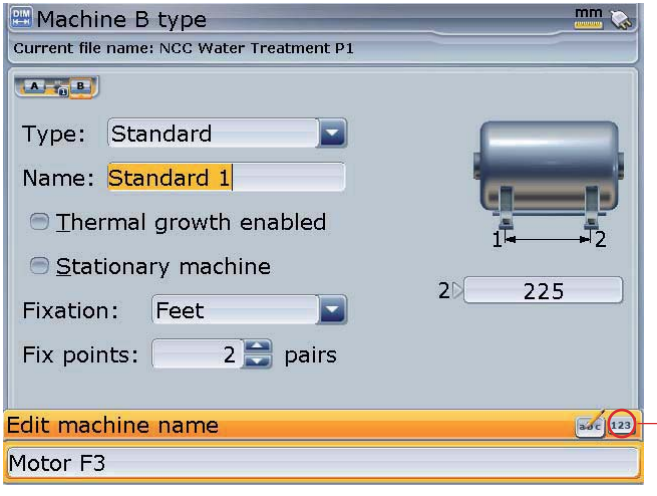
Press Enter to access machine properties. To select machine type, use the navigation keys to place cursor on the 'Type' box then press Enter. Select type of machine from the drop down menu that appears using △ / ▽.



When selecting type of machine, the orientation of the machine may be reversed by pressing ◁ / ▷.

Confirm selection by pressing either Enter or t.

To edit machine name, use ◁/▷ to place cursor on the 'Name' box then enter the machine name directly using the data entry keys. The editing box appears as soon as the first key is pressed.



Repeatedly pressing t brings you back to the set-up screen.

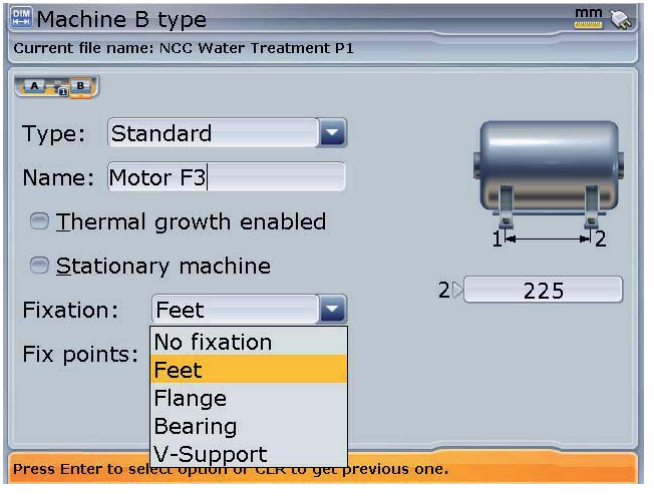
When entering names that contain both upper and lower case characters, as well as numerals, use ·/* to cycle through the three options.

Press and hold down ·/* while observing the status indicator at the bottom right corner of the screen. This displays the character to be entered.

Confirm entry by pressing either Enter or t.

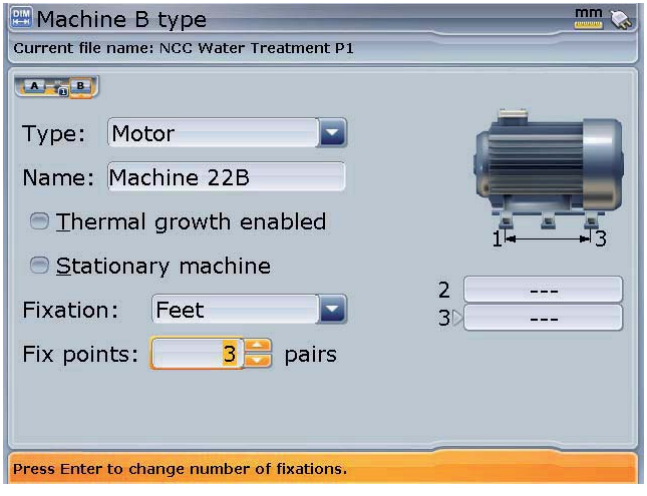
To enter the type of machine mounting, use the navigation keys to place cursor on the 'Fixation' box then press Enter. Select type of mounting from the drop down menu that appears using △/▽.

Note that the navigation is dependent on the scheme selected under 'Customization'. In this case we are using the scheme "Editing moves focus".



Confirm selection by pressing either Enter or t.

Depending on the type of mounting, either the position or number needs to be edited. If the machine is mounted on feet or bearings, the number is edited by placing cursor using ◁ / ▷ on the fixed points box. Press Enter to highlight the numeral. Edit value using △ (increases values) or ▽ (decreases value).

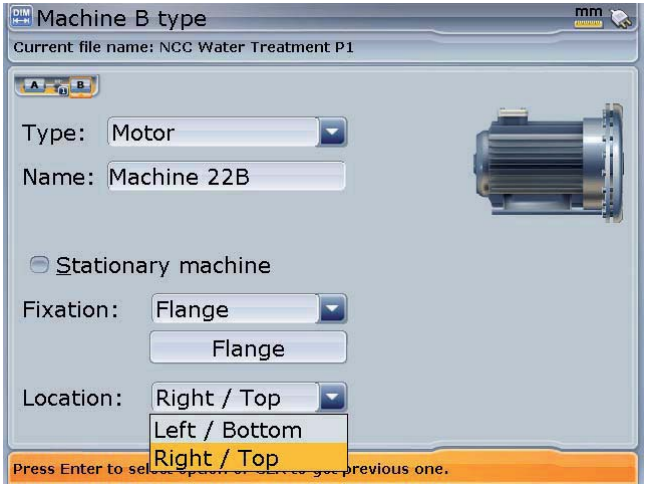


To check or uncheck the 'thermal growth enabled' or the 'stationary machine' box, highlight either box using the naviagtion key. Pressing Enter with the box highlighted, checks or unchecks the respective box.

Note that the above navigation depends on the scheme selected. In this particular case the option selected is "Editing moves focus.

Confirm value by pressing either Enter or ↵.

If however the machine is flange-mounted, the position of the flange requires to be entered. To enter flange location, use the navigation keys to place cursor on the 'Location' box then press Enter. Select location from the drop down menu that appears using △ / ▽.

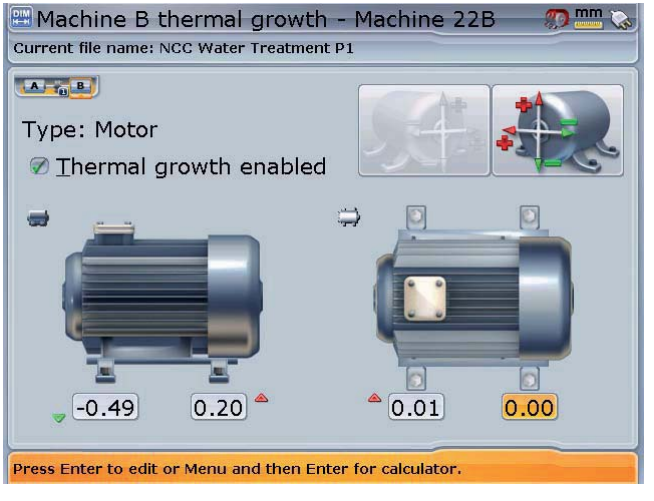


Confirm selection by pressing either Enter or t.

Thermal growth values can be entered only when the type of mounting is either machine feet or bearing or v-shaped support, and 'Thermal growth' enabled. To enter thermal growth values press Menu while in the 'Machine type' screen. The context menu appears.

Thermal growth values are activated when the 'thermal growth enabled' box is checked.

Press 2abc to access the thermal growth screen. Alternatively, use either ▵/▿ to highlight 'Thermal growth', confirming selection by pressing Enter.

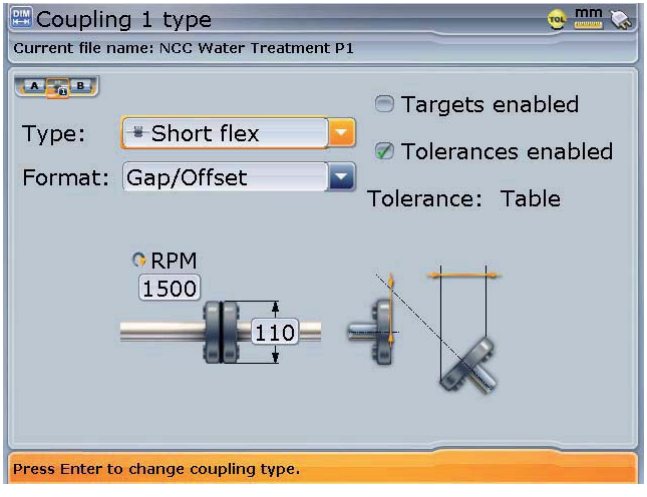


Thermal growth values may be entered directly using the data entry keys. Should the value be highlighted, it can be increased or decreased in steps of 0.10 by pressing ▵ or ▿ respectively.
Note that this navigation is possible when using the 'All features" option selected in 'Customization'.

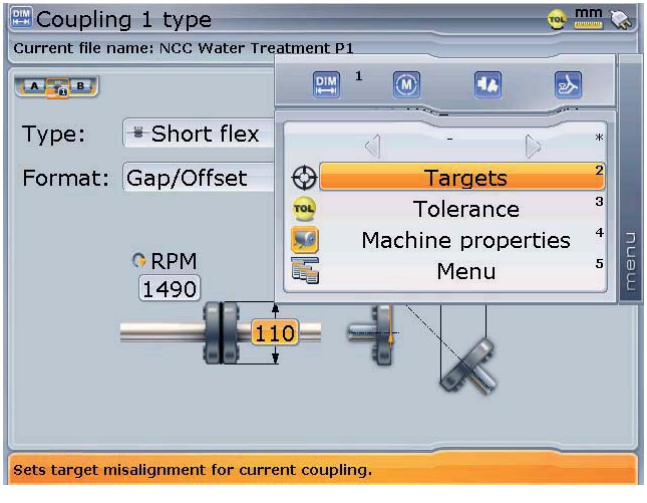
Use ◁/▷ to cycle through the feet positions, highlighting the value boxes. When a value box is highlighted, enter thermal growth value directly using the data entry keys. Confirm entry by pressing either Enter or ↵.

7.3 Coupling properties

Coupling properties are entered and edited in the same manner as for machine properties.



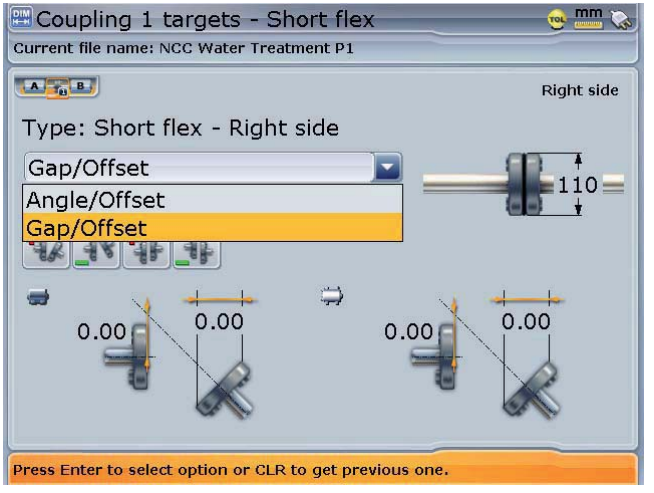
To enter coupling target values, press Menu while in the 'Coupling type' screen. The context menu appears. Use either △ or ▽ to highlight 'Targets'.



Use the navigation keys to place cursor on the 'Type' or 'Format' box then press Enter. Select type of coupling or result format from the drop down menu that appears using △/▽.
Use the navigation keys to highlight the 'targets enabled' or 'tolerances enabled' box. With either box highlighted, press Enter to check or uncheck the respective box.
Targets and tolerances are activated only when the respective box is checked.
Note that this navigation is possible when using the 'Edit moves focus" option selected in 'Customization'.

The coupling targets screen may alternatively be accessed directly from the context menu by pressing 2abc.

Press Enter to confirm selection. The coupling targets screen that follows appears.

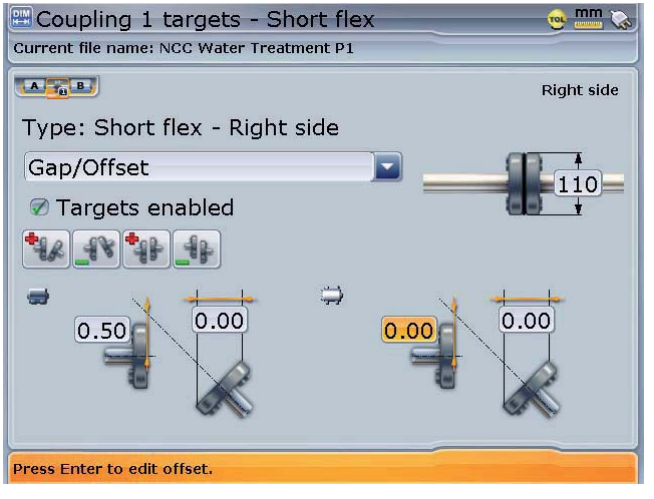


With the 'Type' box highlighted, pressing Enter reveals a drop down menu with the available coupling targets formats. Select required format using either ▵ or ▿, confirming selection by pressing either Enter or t.

Coupling target values can only be entered if the 'Targets enabled' box has been checked.

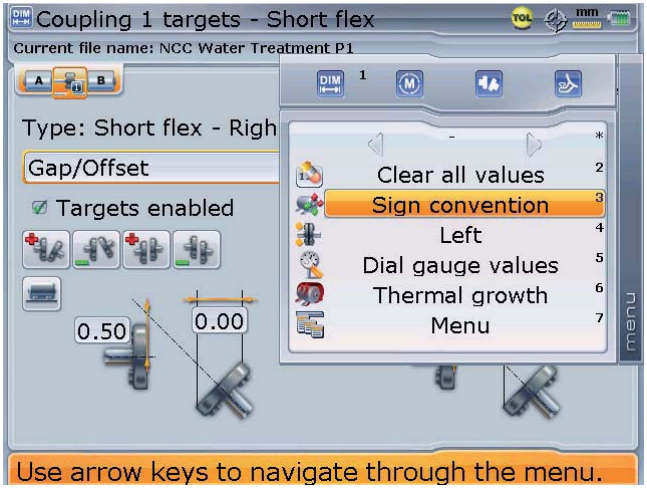
Note

Use the navigation keys to cycle through the coupling properties. To enter coupling target value, highlight the value box using the navigation keys. With the value box highlighted, enter target value directly using the data entry keys. Press Enter or t to confirm entry.



If the target value is highlighted, it may be increased or decreased in steps of 0.10 by pressing ▵ or ▿ respectively.
Note that this navigation is possible when using the "All features listed above" option selected in 'Customization'.

Pressing Menu while in 'Coupling targets' reveals the context menu shown below.

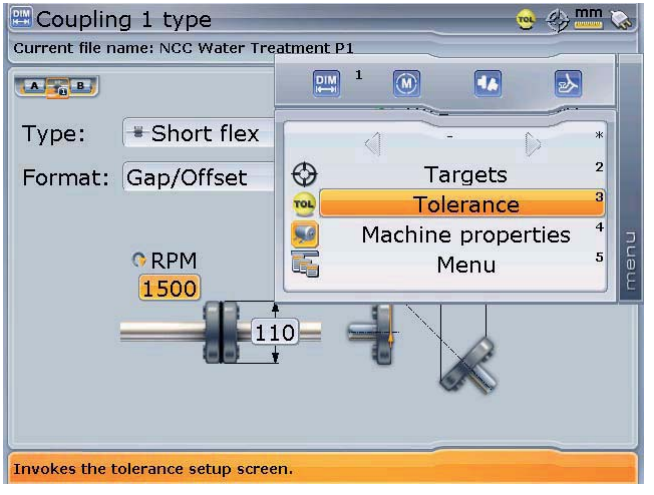


The displayed context menu items can be accessed directly by pressing the corresponding data entry key. e.g. pressing 3def opens the sign convention display.

The displayed menu items perform the following functions:

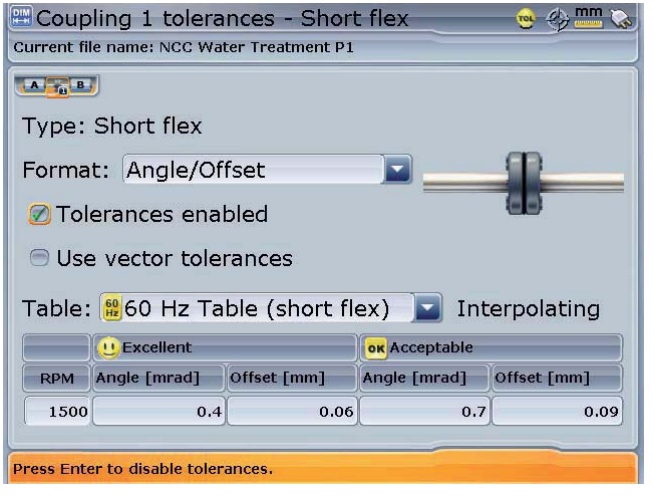
- Clear all values – used to clear all entered coupling target values
- Sign convention – displays the definition and graphic depiction of sign convention
- Left/Right/Both – used to select the direction considered when analyzing coupling targets. If the option "Both" is selected, coupling target values cannot be edited
- Dial gauge values – used to enter coupling target values as dial indicator readings
- Thermal growth – used to access the machine thermal growth screen

The context menu to the coupling type screen discussed previously has in addition to the menu item 'Targets', also 'Tolerance' and 'Machine properties'.



Press 3def to display the system tolerance table. Alternatively, highlight 'Tolerance' using ▲/▼ and confirm selection by pressing Enter. The menu item 'Machine properties' is used to access the machine properties dialog screen.

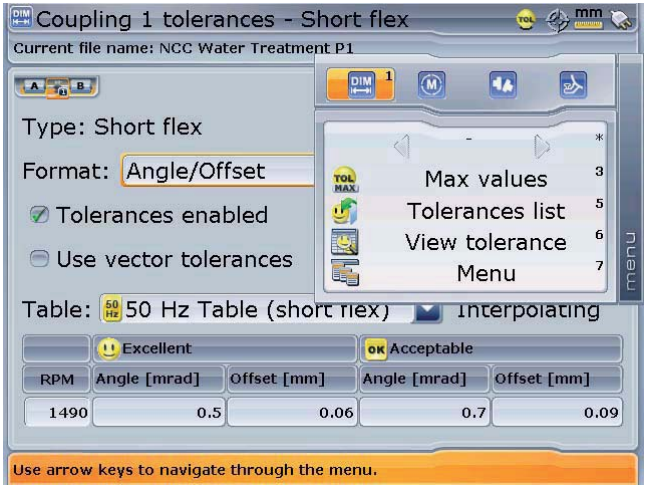
The menu item 'Tolerance' is used to display the system tolerance table.



The displayed tolerance values are coupling format, frequency and rpm dependent. These parameters may be selected from the two dropdown menus and the rpm edited directly.

Note: In the Lite Shaft version, the item "User vector tolerances" is grayed out and the box cannot be checked.

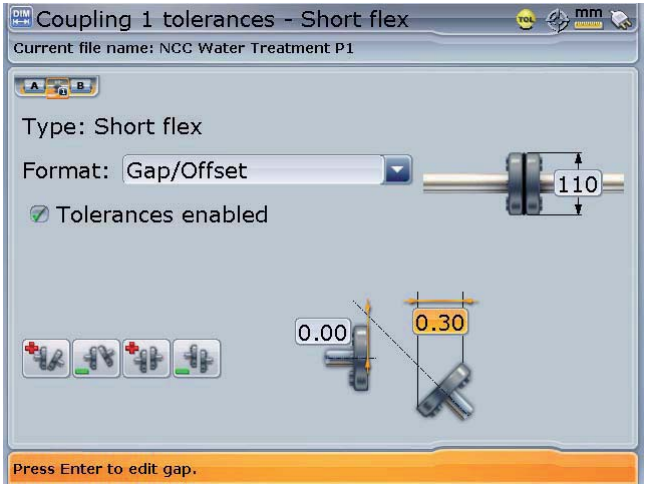
Pressing Menu while in 'Coupling tolerances' reveals the context menu shown below.



All the displayed context menu items can be accessed directly by pressing the corresponding data entry key. e.g. pressing 7pqrs opens the global menu.

The displayed menu items perform the following functions:

- Tolerances list – used to display types of couplings and rpm frequencies available in the tolerance table
- View tolerance – displays the coupling tolerance details
- Max values – used to specify individual tolerances



To enter maximum tolerance values, use the navigation keys to highlight the 'Format' box. Access the drop down menu by pressing Enter. Use ▲/▼ to highlight the required format, confirming selection by pressing Enter or ↵. Using the navigation keys proceed to highlight the respective value box and enter max tolerance values with the data entry keys directly.

The values entered above are independent of rpm. When these values are enabled, they override the system tolerance table.

After machine and coupling properties have been entered, use (t) to return to the set-up screen.

8. Laser beam adjustment

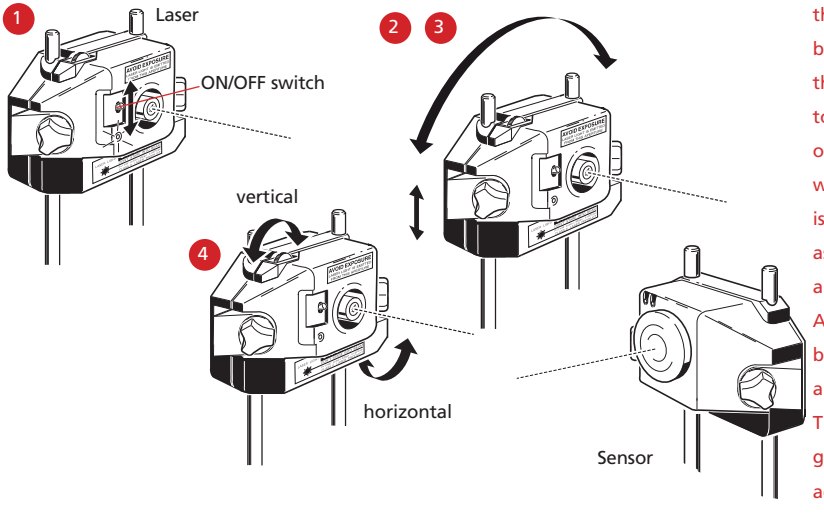
After entering all dimensions, press (M). The laser and sensor need to be adjusted so that the laser beam strikes the sensor.

1. Remove the dust cap from the laser and use the ON/OFF switch to turn it on if you have not already done so. Leave the sensor dust cap on.

Do not stare into the laser beam!

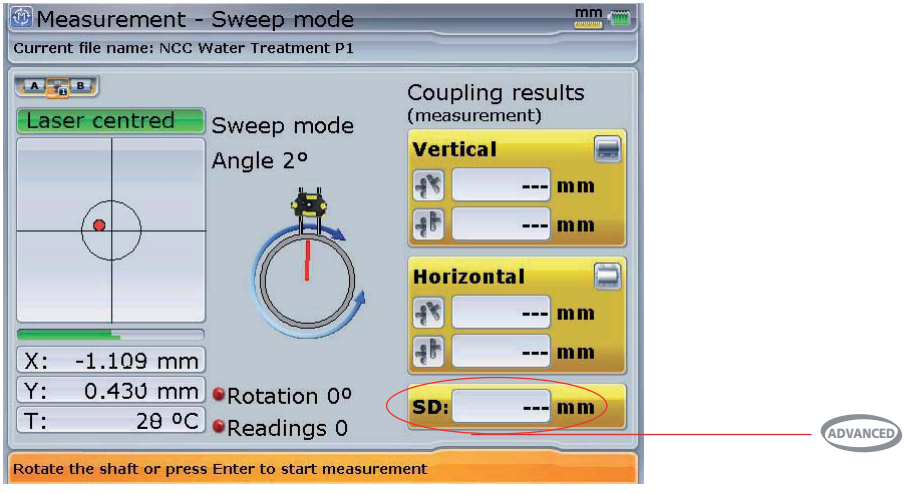
WARNING

2. If the laser and sensor have been roughly positioned to each other during mounting (see section 4 – "mounting laser and sensor"), the laser beam should strike the sensor dust cap. If the beam be so far off target that it misses the sensor completely, hold a sheet of paper in front of the reflector to locate the beam and readjust it onto the sensor as follows:
3. Reposition the components until the laser beam strikes the sensor cap:
   - vertically: loosen the locking knobs and adjust the height.
   - horizontally: loosen the bracket and turn the laser and/or sensor brackets into line with one another.
4. Use the adjustment wheels on the laser to center the laser beam on the sensor cap, then remove the cap.
   The adjustment tube ALI 3.608 can be very helpful when misadjustment is great, especially over short separations.

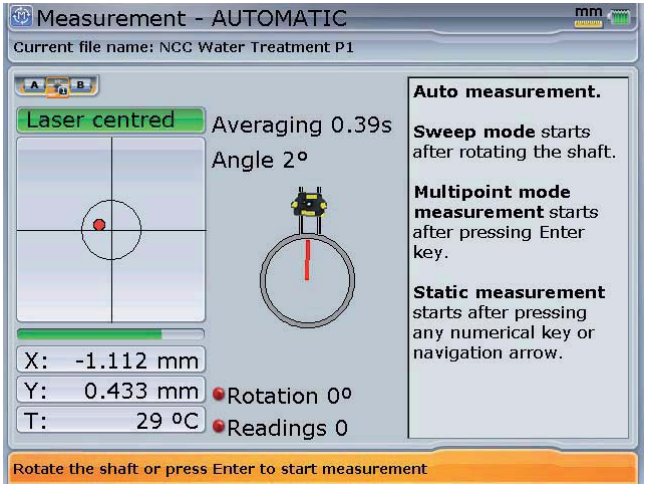


It is highly recommended that before mounting the laser on its bracket, both yellow adjustment thumbwheels be brought to the approximate center of their travel range. This will ensure that the beam is emitted from the laser as straight as possible and not at an angle. Also make sure both brackets are rotationally aligned to each other. These precautions will greatly facilitate the beam adjustment process.

Center the laser beam.



The automatic measurement screen is accessed from the set-up screen by pressing (M) twice. This screen allows measurement to be carried out using continuous sweep mode or multipoint mode or static mode.

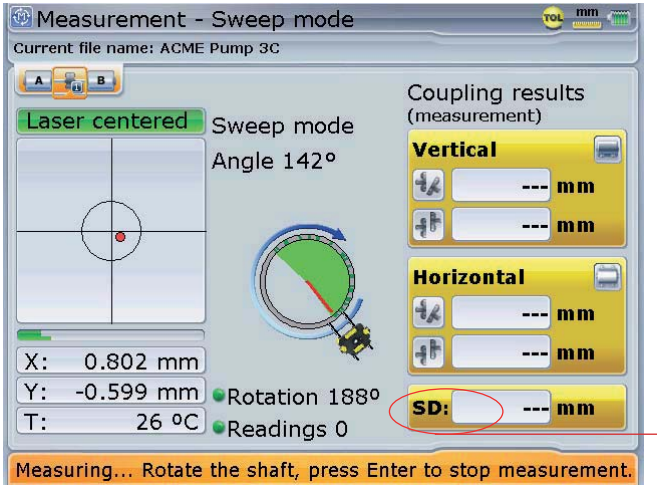


9a. Taking measurements

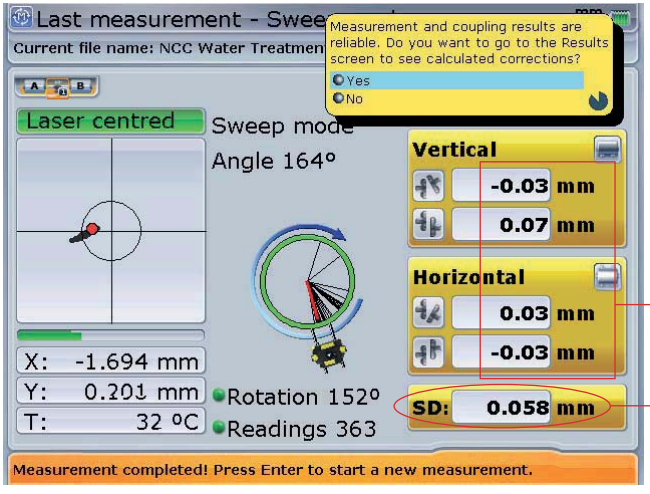
Once the beam is centered, the display prompts the user to rotate shafts. The standard measurement mode is the continuous sweep method, which automatically begins measurement when the shafts are rotated.
Other measurement modes are available. The table below gives a guide as to which measurement mode is ideal for which measurement. In this section we describe the continuous sweep. Details on the other modes can be found in the 'Measurement options' section in chapter 4.

Measurement mode	Application
Continuous sweep	Standard machines
Multipoint measurement	Uncoupled shafts, nonrotatable shafts, sleeve bearings, white metal bearings, journal (radial) bearings, shafts that are hard to turn, shafts with herky-jerky rotation, situations with long spans or severe misalignment that will readily cause the beam to fall out of range
Static measurement	Vertical machines (four feet or flange mounted)
Pass mode ADVANCED	Uncoupled shafts, nonrotatable shafts
Dial gauge	Verifying measurements taken using dial indicators

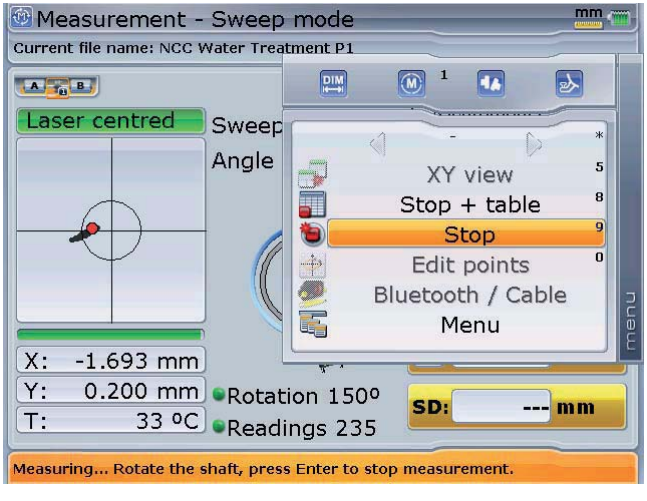
Rotate the shafts a full turn, or as far as possible.



Press Enter to finish measurement and collect data in order to display results. The following screen appears.



Alternatively, the coupling results may be displayed after shaft rotation by pressing Menu and highlighting the menu item 'Stop' from the context menu that appears.



Standard deviation will only be displayed if the 'Show on Measurement Screen' option has been selected under 'Measurement options'. However, the SD data will always be available in the measurement table, if you scroll to the right a bit.

The hint appears only if the option 'Workflow' is set to 'Always'. The option is selected via 'Configuration'->'Customization'. Highlighting 'Yes' using △/▽ and confirming selection by pressing Enter, displays feet and coupling results.

Coupling results

Standard deviation (SD) measures the spread of the data about the mean value. The lower the standard deviation of a set of measurement, the higher the accuracy of the shown result.

Pressing 9wxyz finishes measurement and displays coupling results and standard deviation. Alternatively, highlight 'Stop' using △/▽ and confirming selection by pressing Enter. Coupling results and standard deviation are displayed. This step is used in the continuous sweep mode only.

ADVANCED

Note

9b. Taking measurements using the optional RF module

OPTIONAL

The RF module passes alignment readings from the measurement sensor to the ROTALIGN Ultra internal antenna. The module covers direct line of sight distances of up to 10 m / 33' depending on the prevailing environmental conditions. Its electronic compartment complies with code IP65 (dust tight and protected against water jets). The RF module is powered using 2 'AA' size batteries. The operating time for the alkaline batteries is 14 hours – based on an operating cycle of 50% measurement, 50% standby. Lithium-ion AA batteries (such as for cameras) may also be used, in place of alkaline batteries. For lithium-ion batteries, the operating time is significantly longer; however, the drop-off rate when they become depleted is much faster than with alkaline batteries, providing less advance warning.

The RF module complies with the conducted and radiation emission limits of FCC rules part 15.247.

Note: Longer RF module cables are optionally available for use in those cases where the module must be mounted separately or at a longer distance from the sensor.

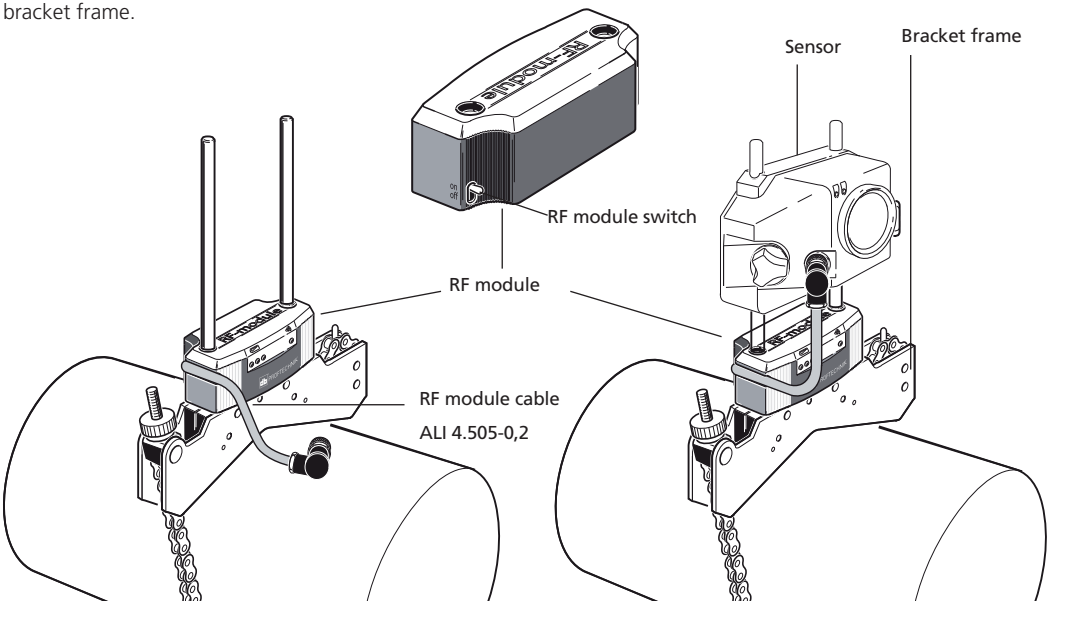
9b.i Mounting the RF module

Connect the cable ALI 4.505-0,2 to the RF module ALI 4.621 by inserting the cable plug into the four-pin socket on the side of the module with a groove.

Match the red dot on the plug to the groove on the socket to ensure proper plug orientation.

Note

Mount the RF module on the support posts of the bracket fixed on the shaft of the right machine (usually moveable machine) as shown in the figure below. The module clamps on the support posts. It is recommeded to mount the RF module on to the bracket frame.



9b.ii Switch the RF module on

After mounting the sensor on the support posts, connect the module to the sensor by inserting the opposite end of the cable into the 8-pin sensor socket, noting the keyway orientation. Switch the RF module on.
The operating time LEDs blink for 3 seconds. The module is now ready for operation. When the RF module is switched on, it supplies power to the sensor. If no measurement action is activated in ROTALIGN Ultra, the power supply to the sensor stops.

9b.iii Operating time LED indicators

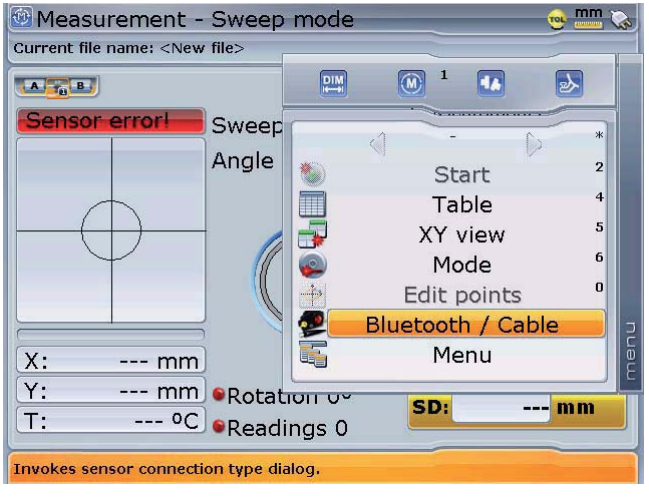
State of LEDs	Indicates
3 LEDs lit continuously	Operating time is between 75%–100%
2 LEDs lit continuosly	Operating time is between 50%–75%
1 LED lit continuously	Operating time is between 25%–50%
Only 1 LED blinking (slowly)	Operating time is under 25%
Only 1 LED blinking (very fast)	Operating time in critical phase. Measurement should not be taken

The operating time may vary significantly depending on the type of batteries used.

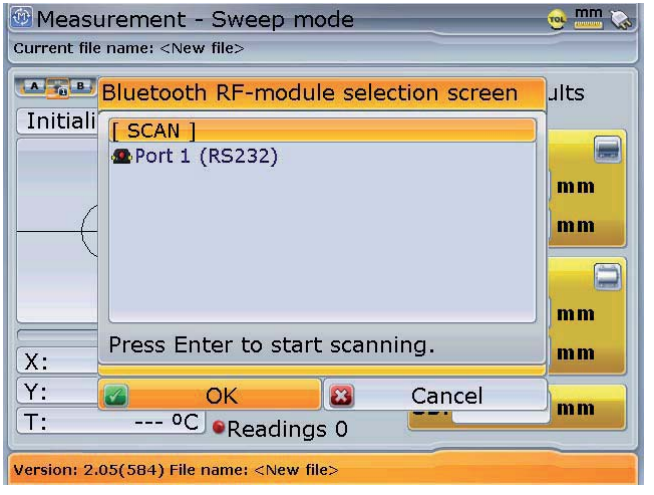
Note

9b.iii Establishing wireless communication between the sensor and ROTALIGN Ultra computer

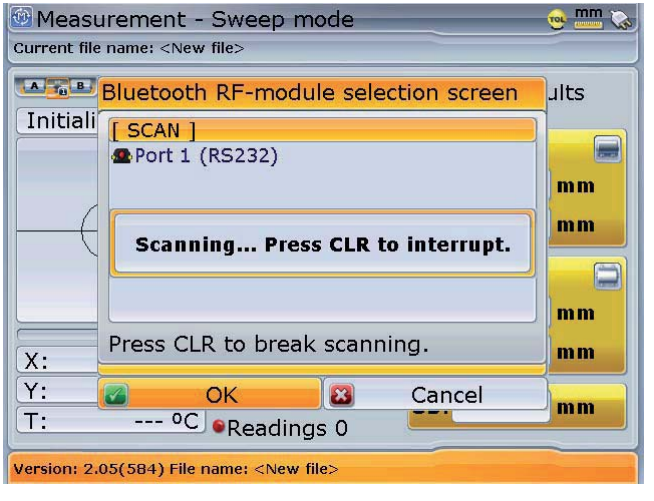
Press (M) to start measurement. The measurement screen appears. Press (Menu) and use (△)/(▽) to highlight the context menu item 'Bluetooth/Cable'.



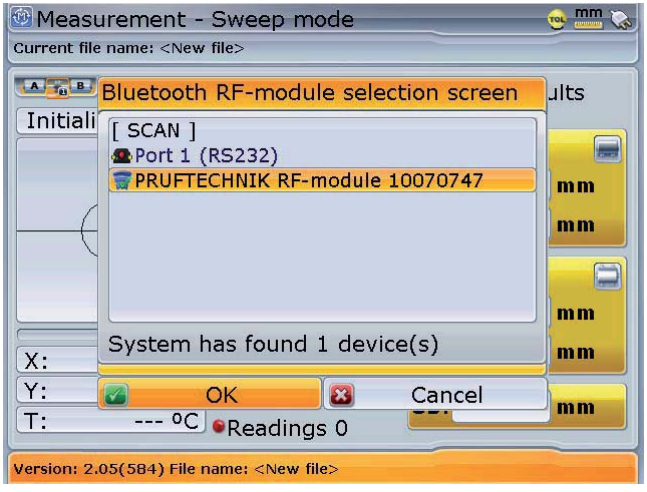
Confirm selection by pressing Enter. The selection screen appears.



Use ▵/▿ to highlight 'Scan' and then press Enter. With this step, the neighbourhood is scanned for PRÜFTECHNIK RF modules.

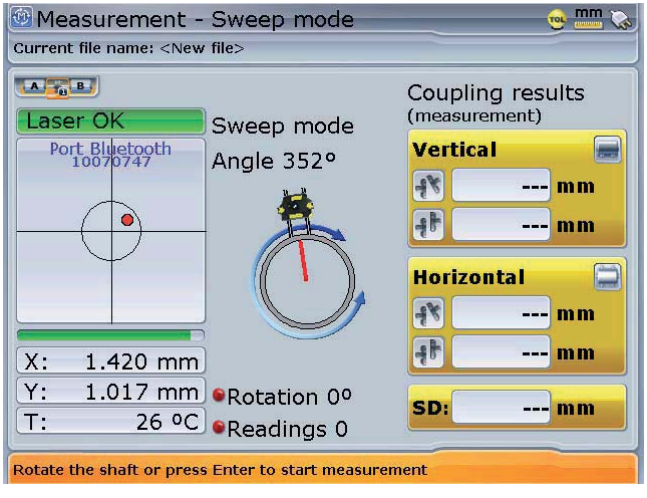


After the scanning process is completed, any RF modules detected will be listed with a green tick on the side.



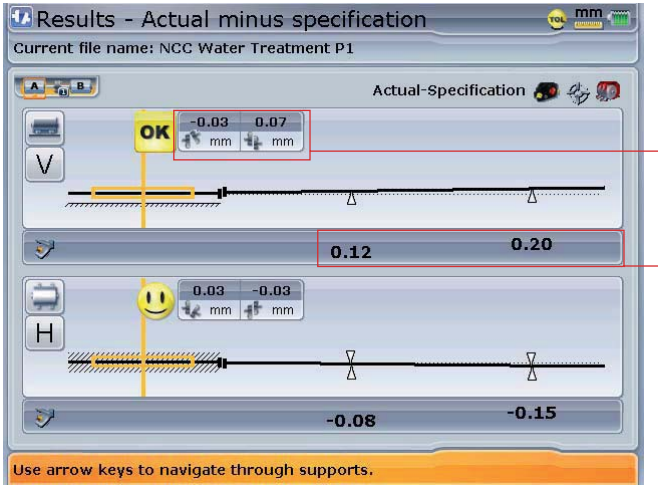
RF modules that have been detected are stored in the system and always appear in the RF-module selection screen. Unwanted modules may be deleted from the list, which is diplayed when the context menu item 'Bluetooth/Cable' is selected, by highlighting the unwanted RF-module then pressing (-+).

Use (△)/(▽) to select the appropriate RF module (e.g.'PRÜFTECHNIK RF-module 10070747'). Press (Enter) to confirm selection and proceed with measurement.



10. Results

Once measurement is completed, press (RES) to view alignment results. Reliable alignment results may be obtained after a minimum shaft rotation of 60°.



In this example, the left machine was defined during set-up as static.

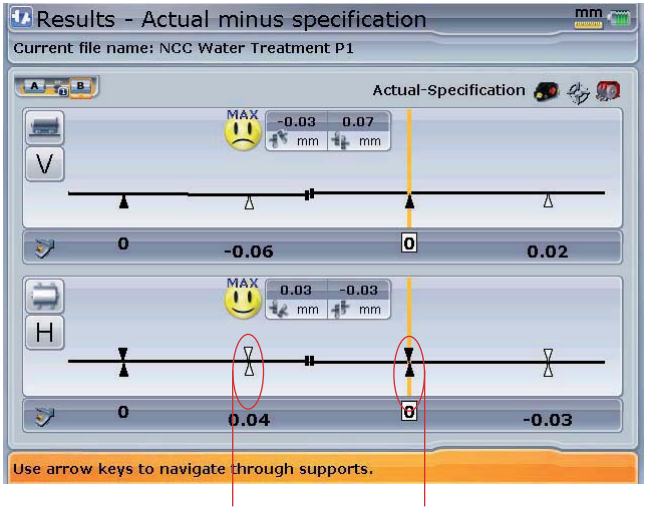
Coupling values

Feet position

The above display shows the measured alignment condition along with numerical values for the actual machine feet positions.

With ROTALIGN Ultra, any one pair of feet can be designated as static.

Note

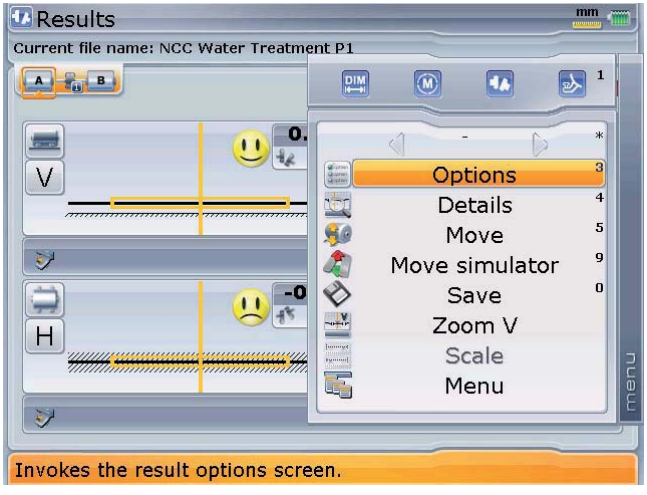


Unfixed feet pair

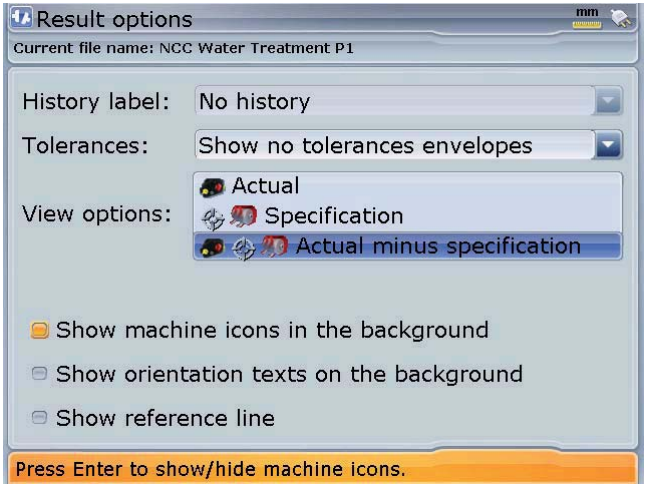
Static feet pair

To designate any pair of feet fixed, place the yellow vertical cursor line on the feet pair using ◁ / ▷. Press Enter to fix the selected pair of feet. The feet position is highlighted black. To unfix any pair of feet, place the cursor line on the static pair of feet pair using ◁ / ▷, then press Enter.

The context menu shown below appears when Menu is pressed while in results screen.



The context menu items are scrolled using △/▽. Item selection is confirmed by pressing Enter. Alternatively, access the numbered menu items directly by pressing the corresponding data entry key. The 'Results option' screen below appears by pressing 3def.

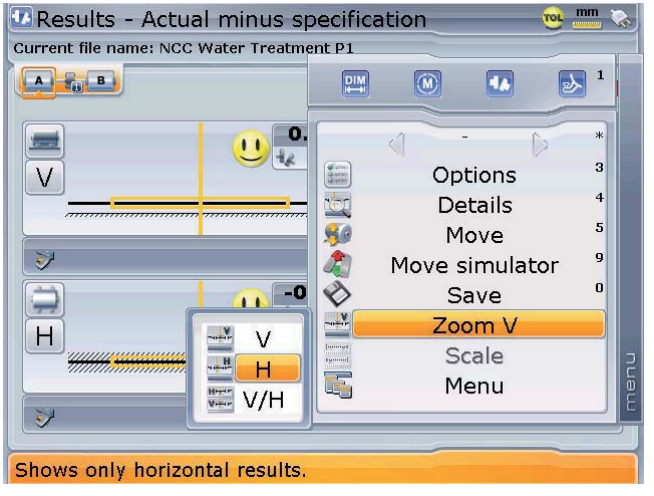


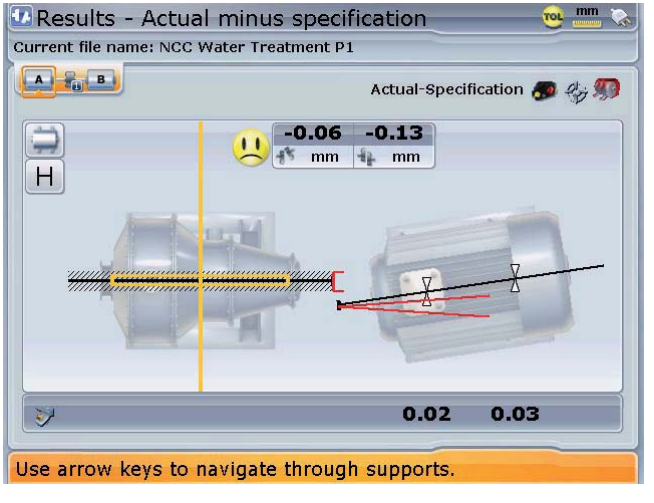
Tolerance envelopes can be activated or deactivated from the drop down menu in this screen.

Only one of these three functions can be activated at any one particular time by checking the appropriate box.

The viewing option can be set to show just the measured alignment values without regard to any target values or thermal growth values that have been entered, even if they are active. Select 'Actual' view for this option. Alternatively, you may also select 'Specification' view which shows just the effect of any target specifications and/or thermal growth values that may have been entered and activated, without regard to any measured misalignment. The default view, and the option that should be used when actually performing alignment corrections is 'Actual – Specification.

The context menu is also used to select the desired depiction.





The different views may also be cycled by pressing ▽.

In this example following options have been selected: "Show envelopes", and "Show machine icons"

10.1 Sign convention

The following sign convention is used in the evaluation of alignment results.
With left machine stationary, gap is positive when open at top or side away from viewer. The viewer is considered to be standing in front of the machines as they appear on the display.
Both vertical and horizontal results show the foot position relative to the stationary machine centerline. Positive values indicate that machine is upwards or away from viewer. Negative values indicate that machine is downwards or towards the viewer.

10.2 Alignment quality

The 'smiley' symbol by the coupling results indicates the degree to which the measured alignment condition meets tolerances. The smiley face appears only when tolerances have been enabled (see section 7.3).

Excellent

Acceptable

Out of tolerance

If all results lie within tolerance, no alignment corrections are necessary.

Note

11. Align machine

To align your machine you need to move it vertically by shimming the feet, and horizontally by shifting it sideways. You can perform these operations in either order or simultaneously.

11.1 Shim first

It is recommended to perform vertical corrections first, since the horizontal condition is easily affected by the process of loosening anchor bolts and inserting/removing shims, whereas the vertical condition is less prone to being affected when performing horizontal moves. You may need to recheck soft foot before proceeding.

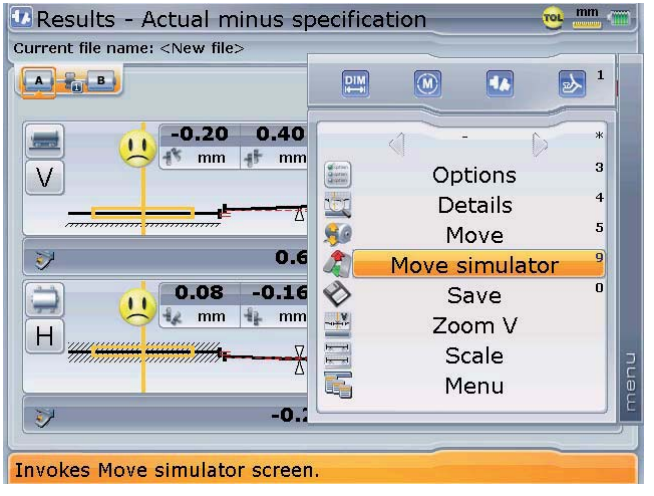
Note

11.2a Move simulator

As the name suggests, the Move simulator is used to simulate shim values and horizontal movement corrections that are required to correct the alignment condition. The simulator takes into account the shim thickness available and the amount by which the machines can be physically moved.

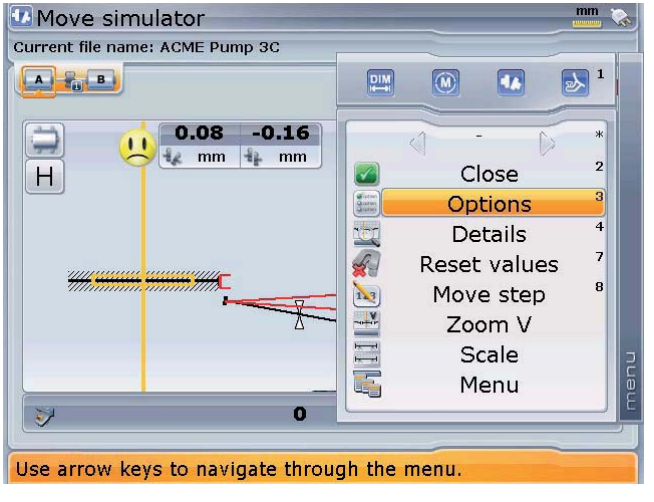
11.2b Initiating the Move simulator

Press Menu while in the results screen. The context menu appears.

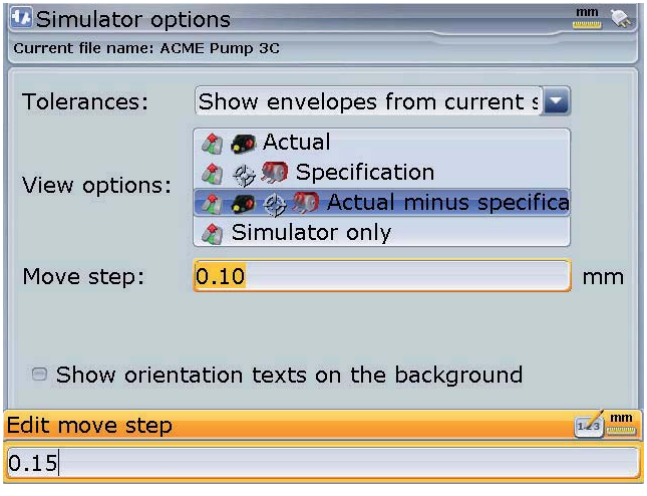


Alternatively, Move simulator may be accessed by highlighting the menu item 'Move simulator ' using ▵/▿ and confirming selection by pressing Enter.

Press 9wxyz to access the Move simulator screen. To effectively use the Move simulator, it is necessary to set the required machine movement step. To be able to set this value, press Menu while in the Move simulator screen. The context menu appears.

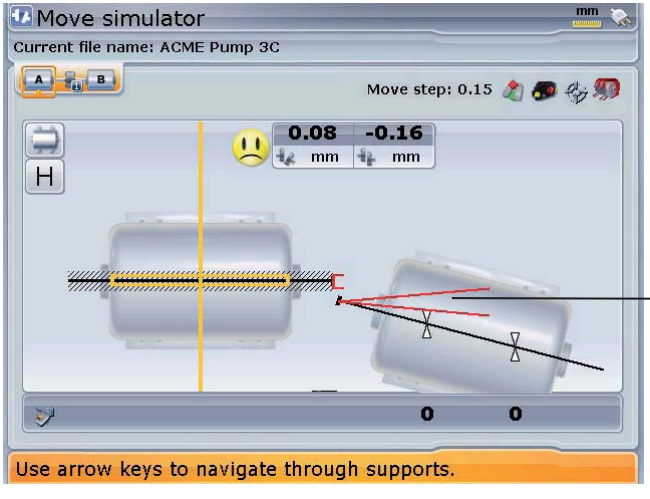


The movement step can be set via the menu items ‘Options’ or ‘Move step’. Press the corresponding data entry key access the screen to edit the movement step value. Pressing 8tuv opens the editing box and the step value may be entered directly using the data entry keys and value confirmed by pressing Enter or t.
Alternatively, press 3def to access the options screen. While in the screen, use the navigation keys to highlight the movement step value. With the value highlighted, use the data entry keys to edit this value. The editing box appears as soon as any data entry key is pressed.



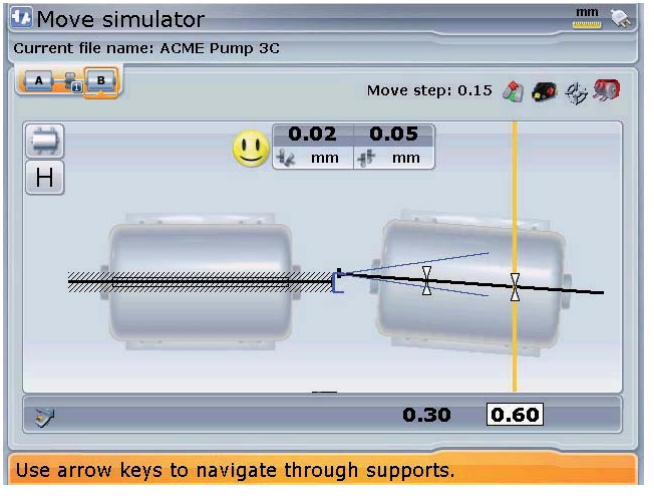
The Move simultator ‘Options’ screen may also be used to activate the tolerance envelope, set the results format and the display background elements.

After editing the movement value, press Enter or t to confirm entry. Press t to return to the Move simulator screen.



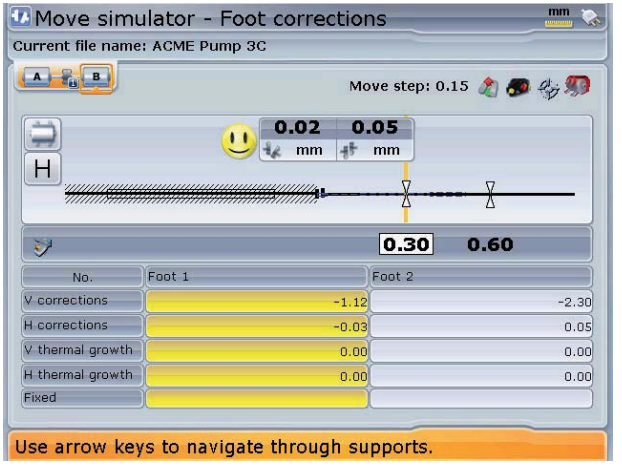
The tolerance envelope is an assistance to determining the alignment condition of machines.

Use ▷/◁ to place the cursor on the feet pair requiring simulation. With the cursor on the selected feet pair, use △/▽ to simulate the movement in accordance with the set step value. Pressing △ moves the machine away from viewer (in horizontal view) or upwards (in vertical view) by the movement value factor. Pressing ▽ moves the machine towards viewer (in horizontal view) or downwards (in vertical view) by the movement value factor.



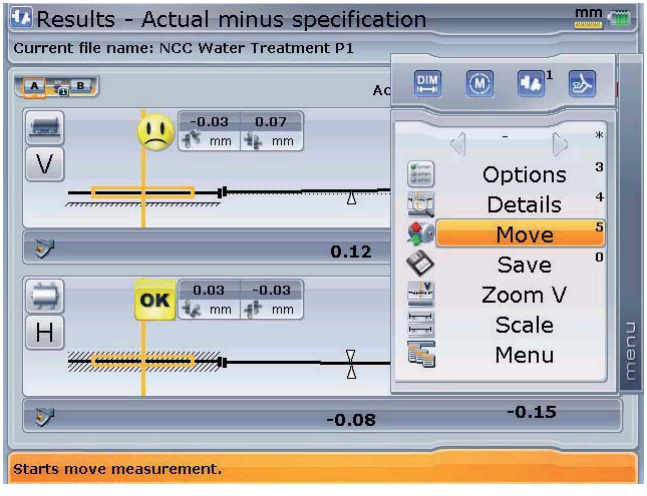
In this example, an excellent alignment condition has been achieved by moving the front feet 0.30 mm (2x the movement step value) and the back feet 0.60 mm (4x the movement step value) away from viewer.

The Move simulator context menu contains items that are helpful in analyzing a simulation. Two important items include 'Details' and 'Reset values'. Selecting 'Reset values' and confirming selection resets the simulator to the original result values. Selecting details and confirming selection reveals the feet corrections to zero alignment for the shown simulation and any entered thermal growth values.



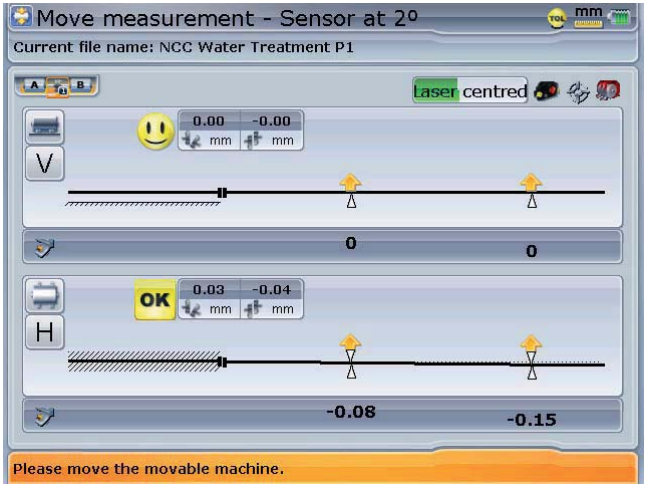
11.2a Horizontal and vertical live MOVE

The alignment corrections involving shimming and the lateral positioning of the machines can be followed in a real-time interactive display. From the results screen, press Menu. The context menu appears.



Alternatively, live Move may be started by highlighting the menu item 'Move ' using △/▽ and confirming selection by pressing Enter.

Press 5 jkl to start live Move.



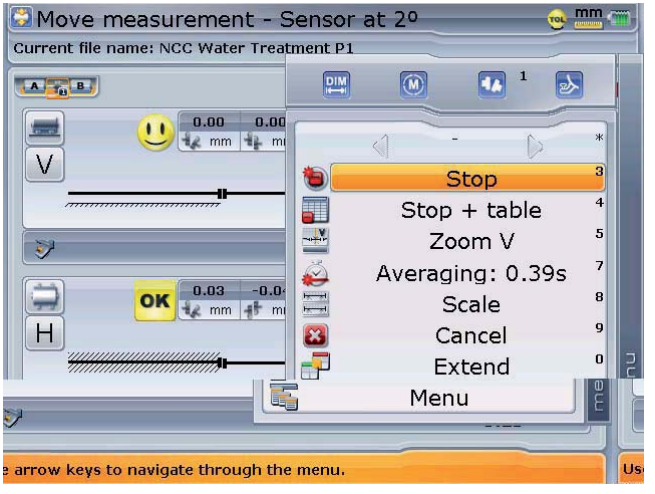
Live horizontal and vertical Move can be monitored simultaneously in Advanced Shaft only. Move is carried out in one direction (say vertical shimming first) then in the other direction (say horizontal Move). The two Live Move steps appear as two entries in the measurement table.

If the laser beam is centered proceed to carry out live horizontal and vertical Move.

If however the laser beam is not centered, use the 'XY view' that appears to center the laser and then press (t) to go back to the results screen to proceed with live Move.

Note

Live Move may be stopped via the 'Move measurement' context menu item 'Stop'.



To stop the live Move measurement and view move results, press (Menu) while in live Move, then (3def). Alternatively, highlight the menu item 'Stop ' using (△)/(▽) and confirming selection by pressing (Enter).

If the results view is zoomed to the vertical view when the Move function is started, only the vertical condition will be monitored. Likewise, if the results view is zoomed to the horizontal view when the Move function is started, only the horizontal condition will be monitored. If the view is set to both vertical and horizontal (as illustrated above) then both conditions will be monitored simultaneously. This information is recorded in the measurement table.

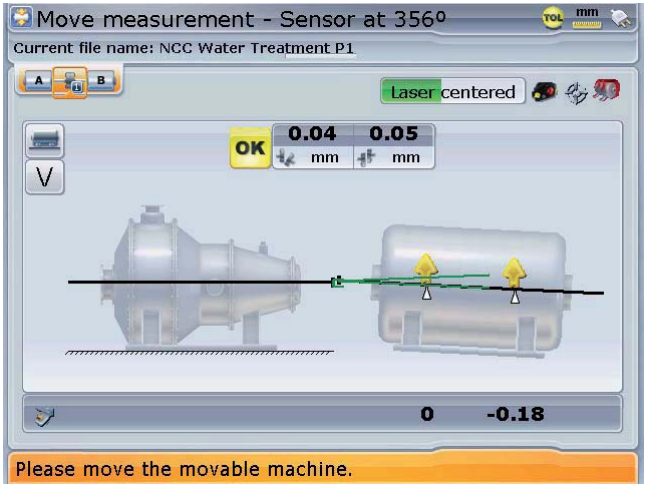
Note

11.2b Shimming

i) Prepare the machines for shimming by ensuring the following:
   The foot bolts are clean, intact and removable
   Soft foot has been eliminated
   The feet have enough shims under them should lowering the machine be necessary.
   Good quality shims such as PERMABLOC, MYLAR or LAMIBLOC are available from PRÜFTECHNIK Alignment Systems

ii) Loosen foot bolts while avoiding to move the machine horizontally. If any foot comes off the ground when loosened, suspect soft foot.

iii) Use the vertical foot correction values to shim BOTH front and back feet as required. Positive feet values indicate that the feet are high and therefore shims should be removed, while negative feet values indicate that the feet are low and suggest addition of shim thickness.

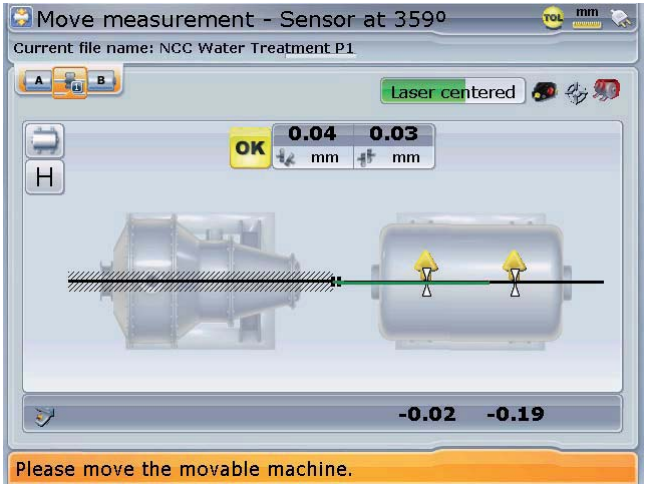


iv) Retighten and remeasure to verify shimming results and determine the exact alignment condition.

11.2c Lateral positioning

i) With foot bolts loosened, move machine feet keeping an eye on the smiley on the display screen.

ii) Note the following sign convention – Positive feet values indicate that the machine feet should be removed towards viewer, while negative feet values suggest the moving of machine feet away from viewer.



Do NOT attempt to move the machine using heavy sledgehammer blows. This can cause bearing damage, and also produce inaccurate Move results. Jack bolts on the feet or other mechanical or hydraulic devices are recommended for moving machines.

CAUTION

iii) Tighten anchor bolts and recheck alignment by taking another set of measurements and viewing results. If they are in tolerance, then the machines are aligned.

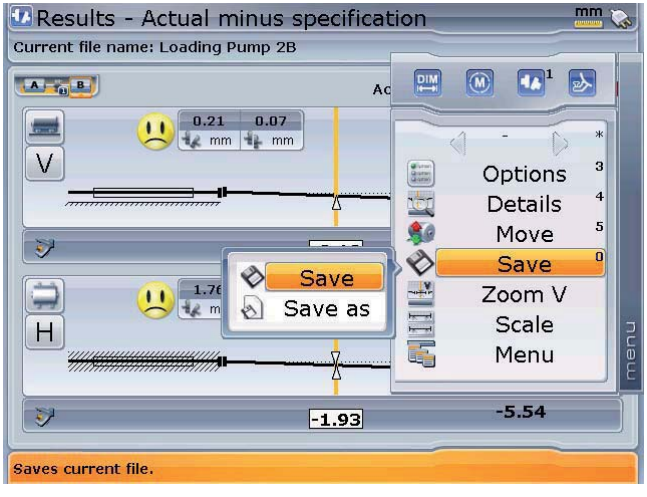
12. Saving and printing measurement files

Before switching off the instrument, dimensions, measurements, results and all settings can be saved for analysis, future use or record purposes in the instrument's non-volatile memory.

Files can be set up and then saved with or without carry out measurement.

If a measurement file was saved during set-up, the results may be saved after measurement in the following manner.

With results displayed, press Menu and use the navigation keys to highlight 'Save'/'Save', confirming selection by pressing Enter.

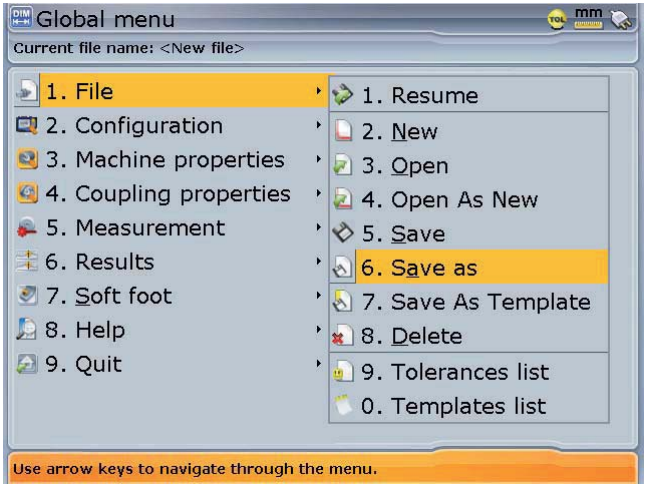


The results may also be saved by pressing Menu followed by 0␣.

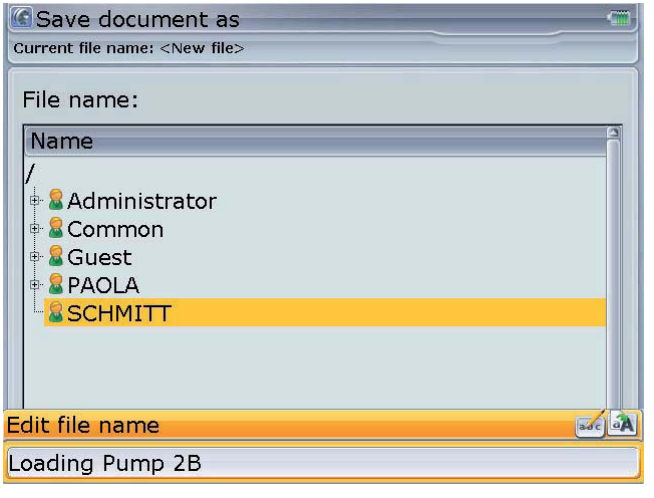
The global menu which is opened by pressing Menu twice may also be used. In this case, highlight 'File'/'Save' then press Enter to confirm saving.

12.1 To save a file the first time

a) Measurement files may be saved using the global menu. Open the global menu by pressing Menu twice.



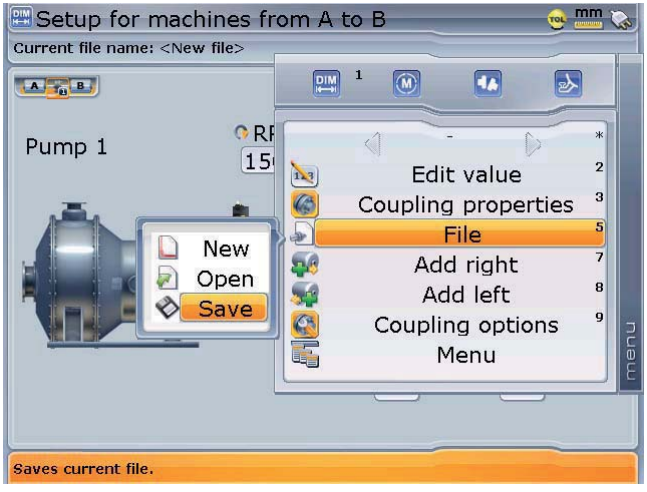
b) Use the navigation keys to highlight either 'File'/'Save as' or 'File/'Save'. Confirm selection by pressing Enter. The "Save document as" screen appears.



In this example, the measurement file 'Loading Pump 2B' has been saved in the folder 'SCHMITT'. Parent folders are created in 'Users list' which is accessed through 'Configuration' within the program manager.

c) Use △/▽ to select a location to save the file. Press Enter and proceed to enter the file name using the data entry keys. Confirm file name by pressing either Enter or t.

d) Measurement files may also be saved from the set-up screen. Press Menu while on set-up screen. The context menu appears.

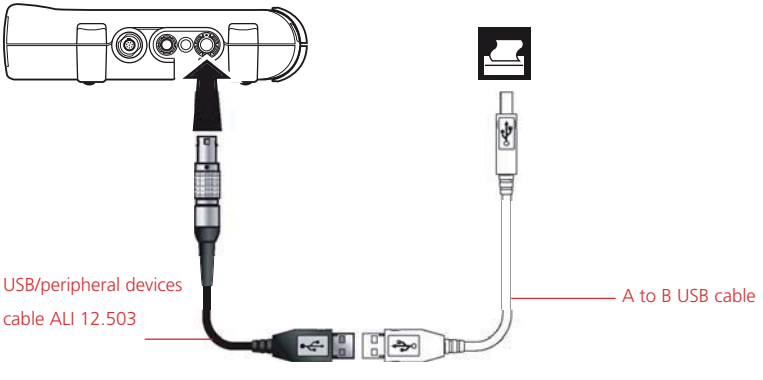


Use the navigation keys to highlight 'File' followed by 'Save'. Press Enter to confirm selection. The 'Save document as' screen appears and file may be saved as described previously in step (c).

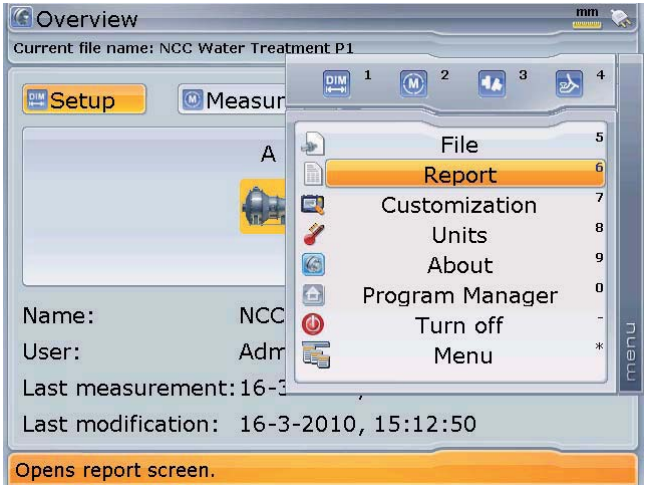
12.2 To print report after measurement

Measurement files can be printed either direct from the results screen or from the shaft alignment overview screen.

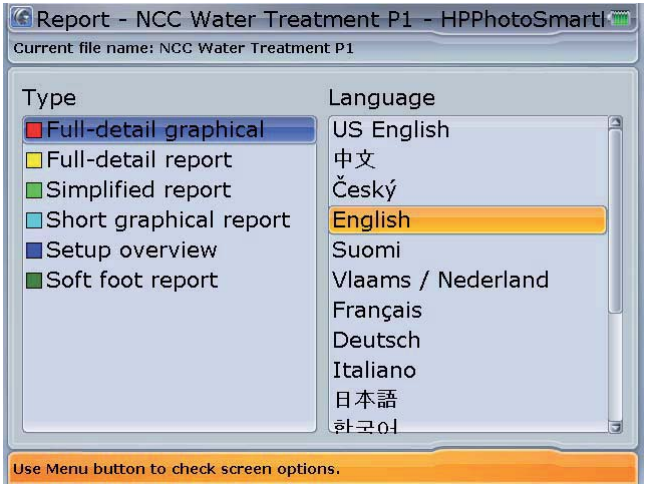
a) Connect the ROTALIGN Ultra computer to your printer using the USB/peripheral devices cable ALI 12.503. Depending on your printer interface, you may require an A to B USB cable. Most printers are delivered with this USB cable which is also readily available from most electronic goods dealers.



b) Press (t) repeatedly until the machine configuration overview appears on the display screen. Press (Menu). The context menu appears.



c) Select 'Report' using either (△)/(▽) and confirm selection by pressing (Enter). Alternatively, the 'Report' screen may be accessed by pressing (6mno) while the context menu is displayed.



Use (◁)/(▷) to switch between the two panes. Use (△)/(▽) to select the required report format and language. Item selected from any pane appears in blue when the opposite pane is highlighted. Note the navigation scheme used here is "Edit moves focus"

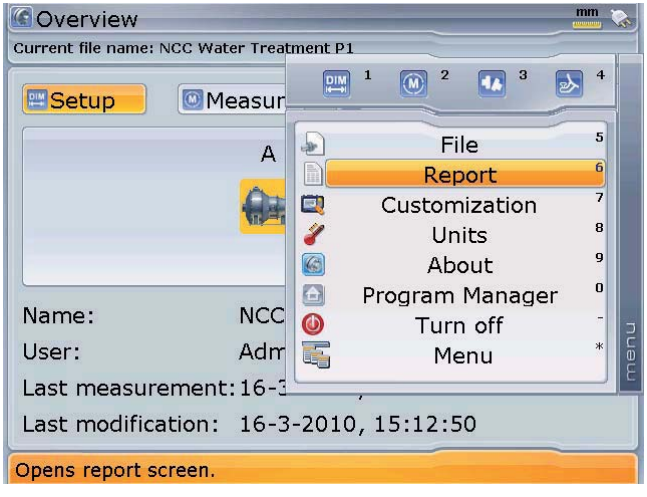
d) Use the navigation keys to select language and type of report to be printed. The title bar shows the printer to which the report will be printed. When ready, press (Enter) to print report.

If no report is printed, check the printer set-up described on page 27.

12.3 Saving report as a PDF

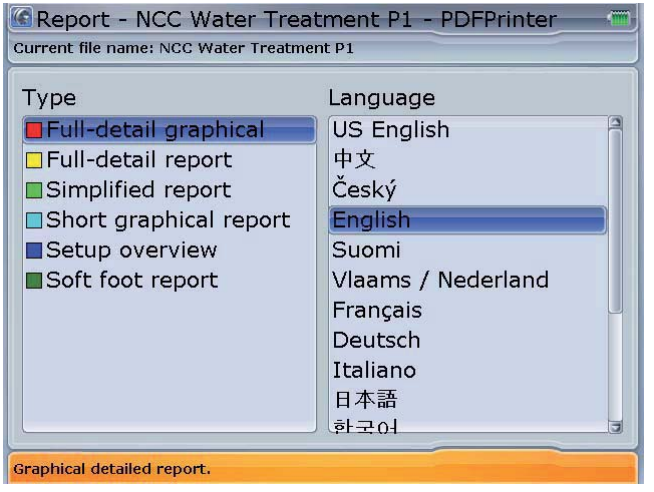
a) Measurement files may be saved directly from the system as a PDF copy.

b) Press (t) repeatedly to open the machine configuration overview screen. Press (Menu). The context menu appears.



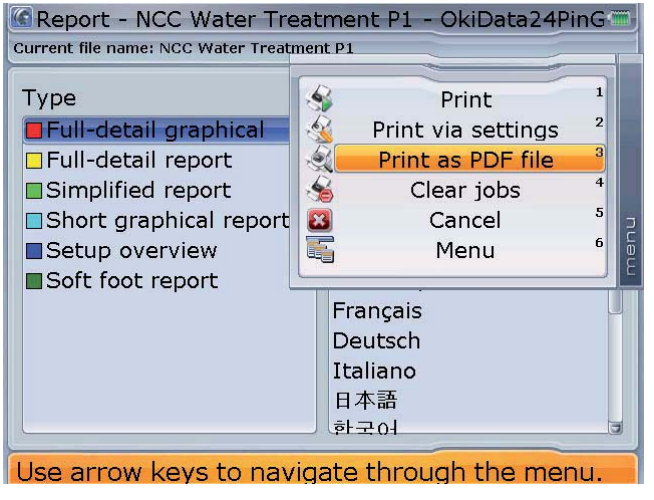
c) Select 'Report' using either (△)/(▽) and confirm selection by pressing (Enter). Alternatively, the 'Report' screen may be accessed by pressing (6mno) while the context menu is displayed.

Note the navigation scheme used here is "Edit moves focus"



Report screen accessed via "Report" menu item

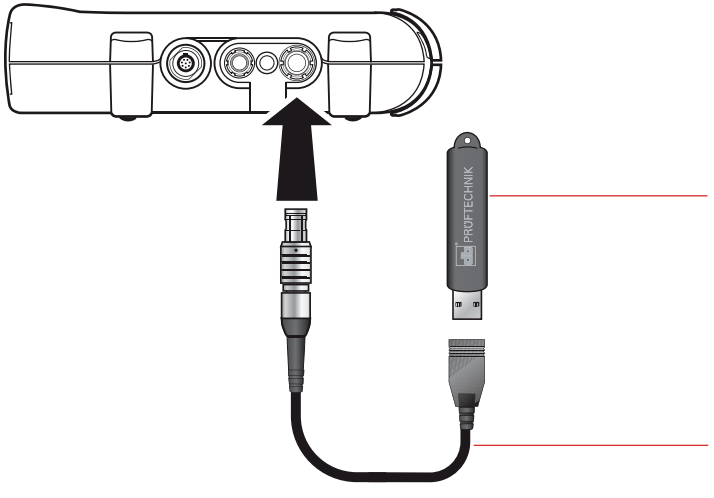
d) Press (Menu) with the 'Report screen' displayed. The context menu appears. Use (△)/(▽) to highlight the menu item 'Print as PDF file'.



Note that the submenu items may be accessed directly by pressing the corresponding data entry key:
Pressing (1π) prints the selected report, in the higlighted format and language, to the configured printer.
Pressing (2abc) opens the "Printer" screen where the desired printer is selected.
Pressing (3def) prints the report to PDF.
Note that when using the data entry keys for direct access, ensure that the ROTALIGN Ultra computer is connected to the necessary accessory as described here in section 12.

e) Before proceeding to print to PDF connect the 'short' ROTALIGN Ultra USB/ peripheral devices cable ALI 12.503 to the ROTALIGN Ultra USB port. Attach the especially approved PRÜFTECHNIK Alignment Systems memory stick (aka jumpdrive) ALI 4.451-1GB into the 'short' USB cable.

f) When all set, press Enter. When printing to PDF is finished the message "PDF file has been saved" appears on the display. The report has now been saved onto the memory stick as a PDF copy and may be transferred to a PC for archiving or printing to any Windows compatible printer.



PRÜFTECHNIK Alignment Systems memory stick (aka jumpdrive) ALI 4.451-1GB. Other PRÜFTECHNIK approved memory sticks may also be used.

ROTALIGN Ultra USB/peripheral devices cable ALI 12.503

13. Alignment completion

After completion of an alignment measurement or job, press Enter and hold down for a moment to switch ROTALIGN Ultra off. Alternatively one may use the global menu combination 'Quit'/'Turn off device'. If the measurement file has not been saved, the following query appears:

- 'Do you really want to turn off the system?'

Selecting 'Yes' to turn off the system prompts the following question:

- 'Do you want to save changes in file?'

Save file if required for record and analysis. If it is not required, selecting 'No' turns off the system.

- After ROTALIGN Ultra has been switched off, disconnect the sensor cable from the system.
- Switch the laser off and replace both laser and sensor dust caps.

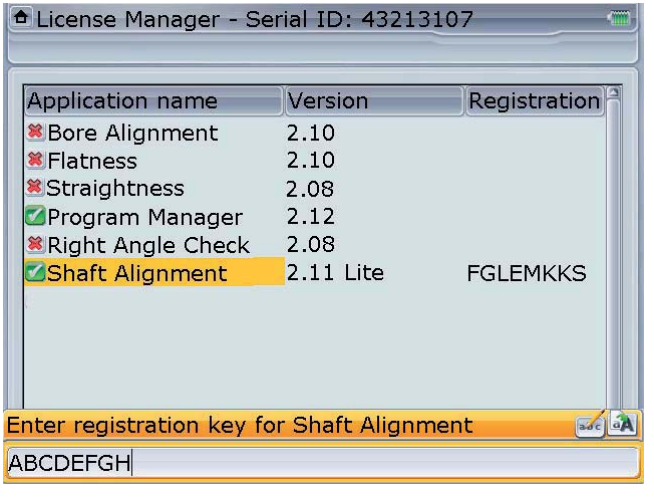
Remove the components from the shafts and store them in the case.
Replace guards before you switch the machine back on.

WARNING

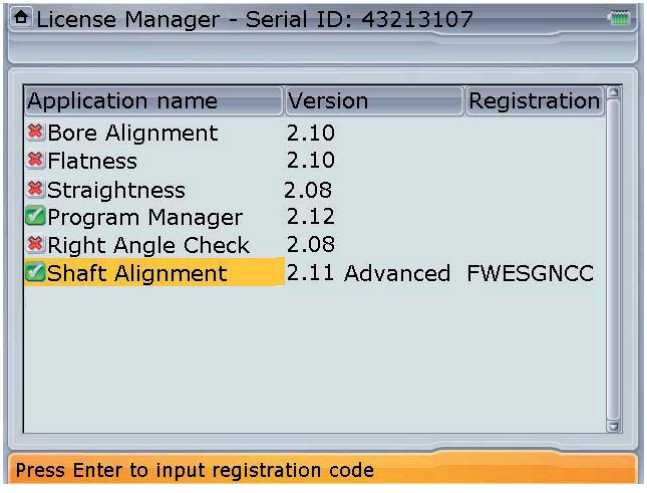
Upgrading from Lite Shaft to Advanced version

To upgrade from ROTALIGN Ultra Lite to Advanced version, only the Advanced Shaft firmware registration certificate ALI 4.741 needs to be purchased. Use the licence manager and the licence code supplied on the registration certificate to activate the ROTALIGN Ultra Advance Shaft firmware.

After starting the licence manager, use △/▽ to highlight the application 'Shaft Alignment'. Press Enter and use the data entry keys to enter the licence code in the editing box.



Confirm entry by pressing either Enter or t.



ADVANCED

The suffix 'Advanced' appears next to the version number indicating successful registration.

ADVANCED

On successful registration, following features in addition to the standard features of ROTALIGN Ultra Lite Shaft will be available:

- Live simultaneous Move in both horizontal and vertical directions
- Soft foot diagnosis using the wizard
- Alignment of trains with up to 14 machines
- Measurement in Pass mode
- Standard Deviation
- Editable ellipse
- Thermal growth calculator
- Under- and over-constrained feet
- File and machine templates
- Vector tolerances
- History table

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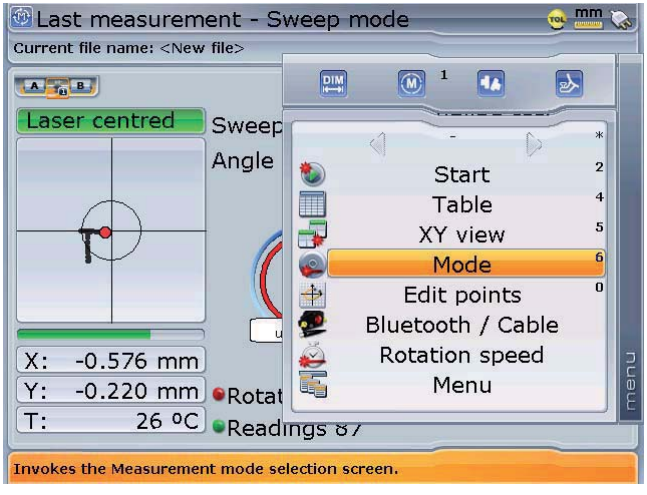
Chapter 4: Special alignment options

4.1 Measurement modes

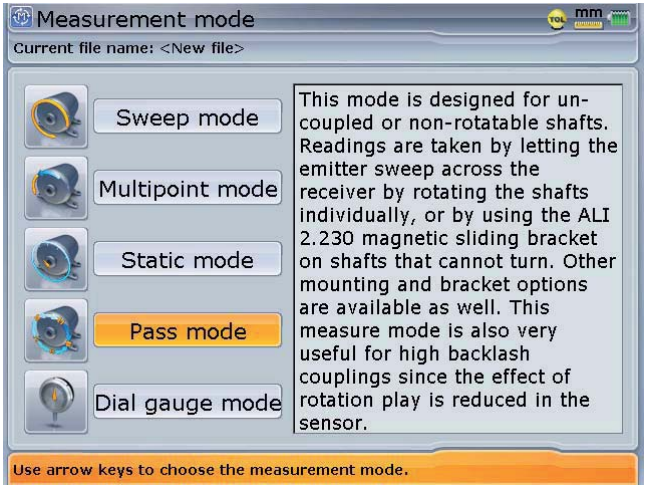
In addition to the standard 'continuous sweep mode', ROTALIGN Ultra also offers multipoint, pass, static (0369) and dial gauge measurement modes.

The measurement modes are accessed via the measurement screen. Press (M) to access the measurement screen. While on this screen, press (Menu). The context menu appears.



Alternatively, with the context menu displayed, access the measurement modes screen using ▲/▼ to highlight 'Mode' then pressing (Enter) to confirm selection.

With the context menu displayed, press (6mno) to access the measurement modes screen.

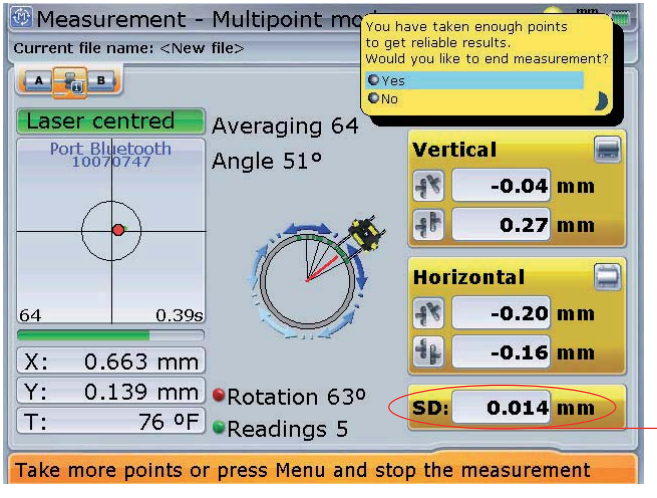


Use the navigation keys to select the required measure mode. Confirm selection by pressing (Enter).

Multipoint measurement

This mode is used to measure shafts which are either difficult to turn continuously or allow measurement only in certain rotational positions. The method can also be used to measure uncoupled shafts, nonrotatable shafts, sleeve bearings, white metal bearings and journal (radial) bearings, shafts that are difficult to turn, shafts with herky-jerky rotation, situations with long spans or severe misalignment that will readily cause the beam to fall out of range.

After centering the laser beam as described in chapter 3, press Enter to take the first measurement point. Rotate shafts in their normal direction of operation from one measurement position to the next. Press Enter to take measurement at each new position. Measurements must be taken in at least three positions over at least 60° of rotation, but more measurements over a wider angle is recommended.



Coupling results are displayed after a minimum of three measurement points have been taken. The standard deviation (SD) appears after 4 or more readings. For best results take 5 or more points. The more points that are taken the more points can be deleted in the 'Edit points' screen to maximize accuracy. A detailed description of this utility appears under "Edit raw data" in section 4.2.

After finishing measurement, press RES to view results.

Static measurement

This measurement mode is used for uncoupled shafts, nonrotatable shafts and vertical foot-mounted or flange-mounted machines.

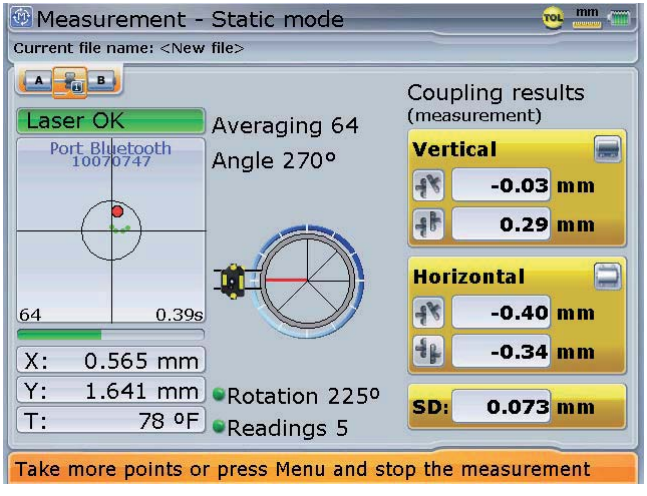
After centering the laser beam as described in chapter 3, turn the shaft to any of the eight 45° positions (i.e. 12:00, 1:30, 3:00, 4:30, 6:00, 7:30, 9:00 or 10:30 o'clock position viewed from sensor towards laser). Position shaft as accurately as possible using either an external inclinometer or protractor. Press Enter to take the first measurement point.

Rotate shaft to the next measurement position. Use the navigation keys to change the orientation of the laser unit on the display screen to correspond to the shaft position.

Take next measurement point by pressing Enter.

If shaft rotation restrictions hinder the taking of measurements at particular shaft positions, bypass these using the navigation keys.

Note



The navigation keys are used to position the laser unit on the display screen to correspond to the actual shaft position. Measurement may be stopped or finished using the context menu item "Stop measurement"

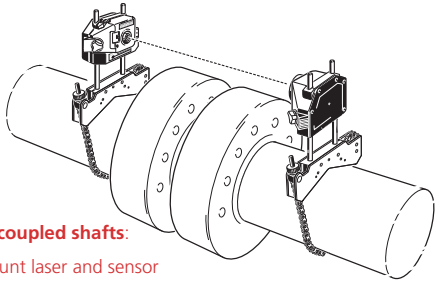
Measurements must be taken in at least three positions over 90°, but more measurements over a wider angle is recommended. After finishing measurement, press RES to view results.

Pass mode

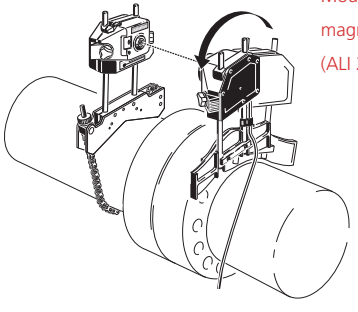
ADVANCED

Uncoupled or nonrotatable shafts (one or both) can best be measured in 'pass' mode, where the laser is rotated past the sensor in several different rotational positions. The laser and sensor can be mounted in a variety of ways depending on the alignment situation.

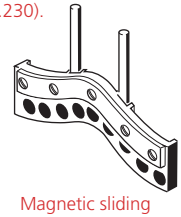
After centering the laser beam as described in chapter 3, press Enter to take the first measurement point, then rotate the sensor to the next measurement point.



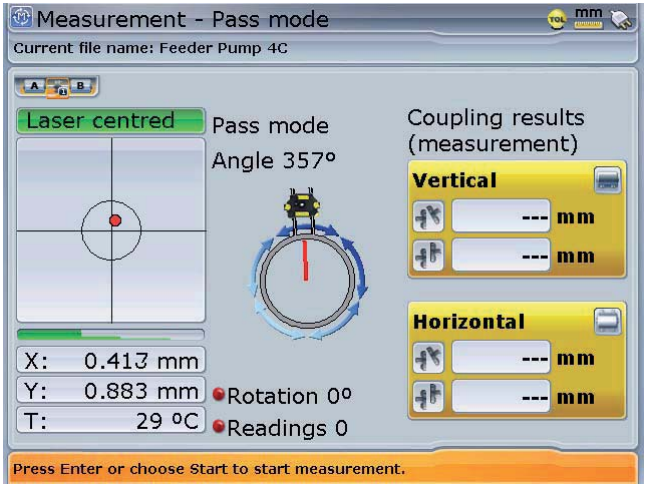
Uncoupled shafts:
Mount laser and sensor using chain-type brackets



Nonrotatable shaft(s):
Mount sensor using magnetic sliding bracket (ALI 2.230).



Magnetic sliding bracket ALI 2.230

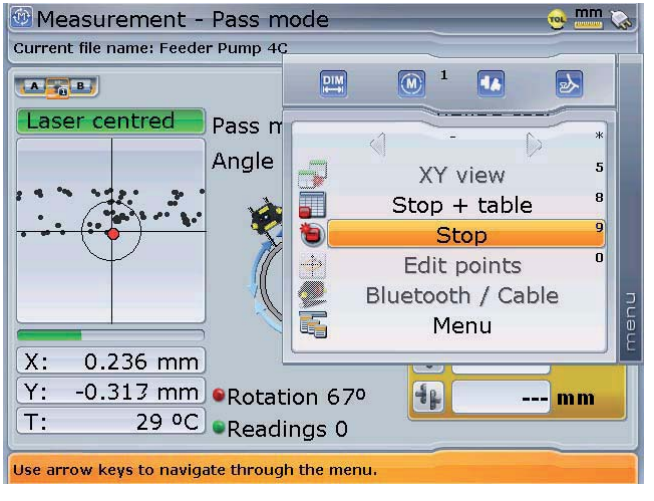


In this example, the SD box has been hidden. The option to show or hide the SD box is accessed via the global menu. When in global menu press 5jkl followed by 9wxyz to access the 'Measurement options' screen.

Rotate the laser slowly past the sensor. When the sensor takes a measurement at its current position, the green LED on the front of its housing lights for about one second.

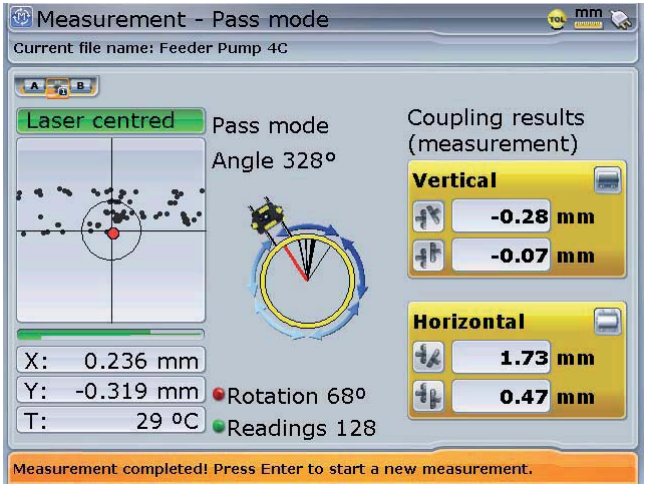
Cover the laser aperture (i.e. with one hand) and rotate the sensor to the next measurement position; repeat the procedure to take measurements in at least three positions over at least 60° of rotation, but more measurements over a wider angle is recommended.

After finishing measurement, press Menu. The context menu appears.



Use △/▽ to highlight 'Stop' and then press Enter to confirm selection.

On confirming selection, the coupling results are displayed.

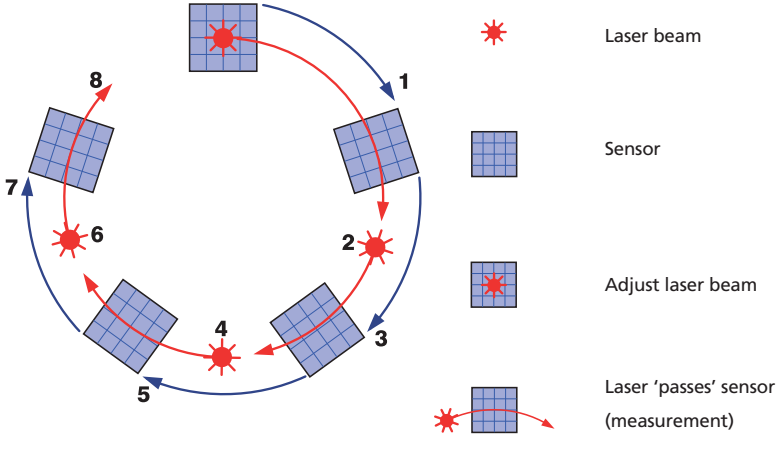


It is recommended to take several sets of readings and then compare them for repeatability in the measurement table (accessible from the context menu by pressing 4ghi). If necessary average together multiple sets of readings for greater accuracy.

Press RES to view results.

If only one shaft is nonrotatable while the other can be freely rotated, always mount the sensor on the nonrotatable shaft (use the magnetic sliding bracket ALI 2.230). Do NOT mount the laser emitter on the nonrotatable shaft, even if this means setting up your laser and sensor opposite to the way you normally would for alignment purposes. You can always invert the movable and stationary machines by using the static feet utility in the results screen. Enter all dimensions in accordance with your actual set-up, following the normal orientation of the laser and sensor in the dimensions screen.

Note

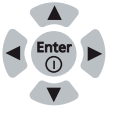


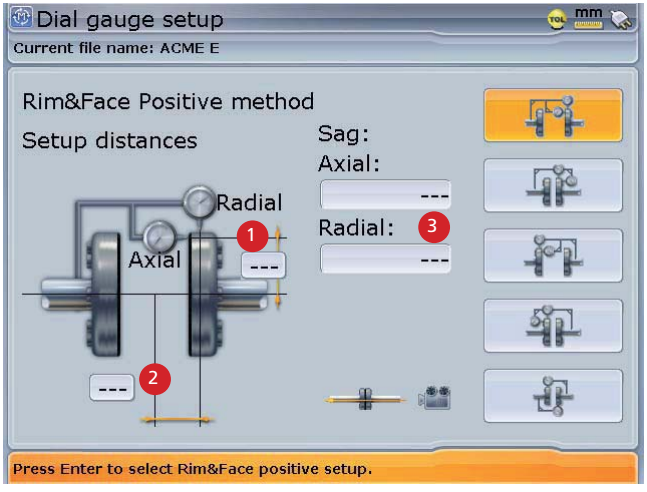
Dial gauge mode

This mode is used to convert dial gauge readings into ROTALIGN Ultra values, hence verifying calculations and comparing measurement results with those obtained using ROTALIGN Ultra. It can also be used to convert alignment results obtained with the laser into the commensurate dial gauge readings.

a. Press (M). The measurement screen appears. From the measurement screen press (Menu). The context menu appears. Use (△)/(▽) to select 'Mode'. Press (Enter) to confirm selection. From the measurement mode screen that appears, use the navigation keys to select 'Dial gauge mode'. Press (Enter) to confirm selection.
b. Press (Menu) and use (△)/(▽) to highlight 'Dial gauge set-up'.

c. Press (Enter) to confirm selection.
d. Use the navigation keys to select the desired dial gauge method. Press (Enter) to confirm selection. Proceed to enter required values using the data entry keys

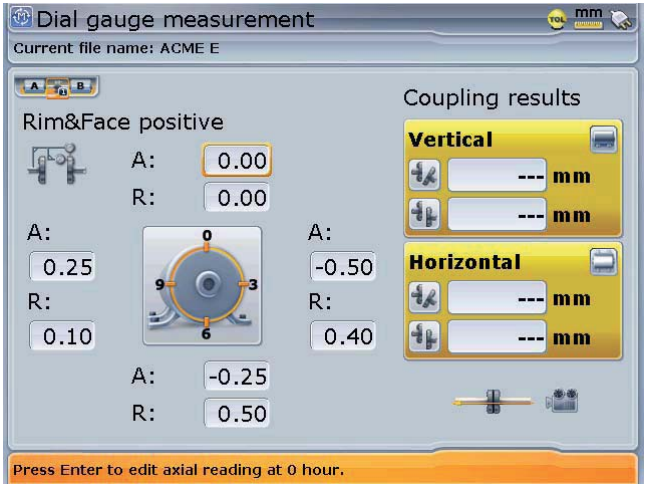




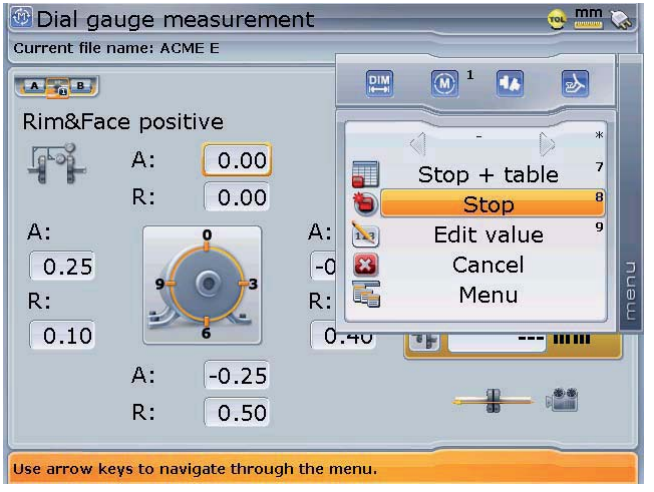
1. In this method, enter the radius of the axial gauge from the shaft center.
2. Here, we enter distance from the radial gauge to the coupling center.
3. Enter radial and axial sag values.
   Values are entered directly using the data entry keys and confirmed by pressing either Enter or t.

e. After entering the required dimensions and the amount of bracket sag, press t to return to the dial gauge measurement screen to enter the dial gauge values. Press Enter to access a value entry box.

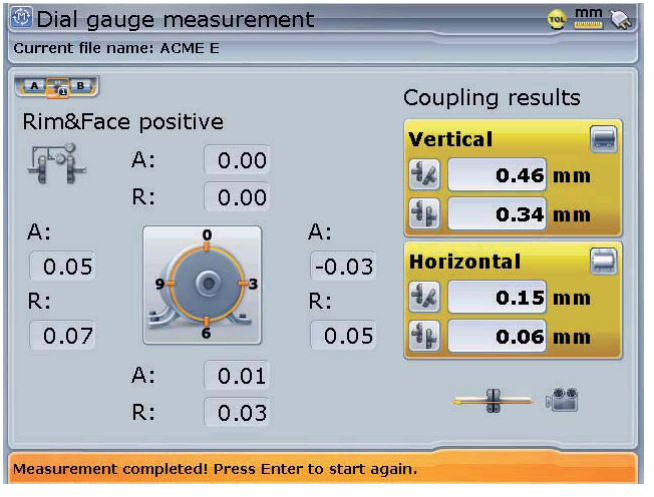
f. Enter the dial gauge reading directly using the data entry keys. Confirm entry by pressing either Enter or t. The next empty entry box is highlighted. You may use the navigation keys to cycle through the value entry boxes.



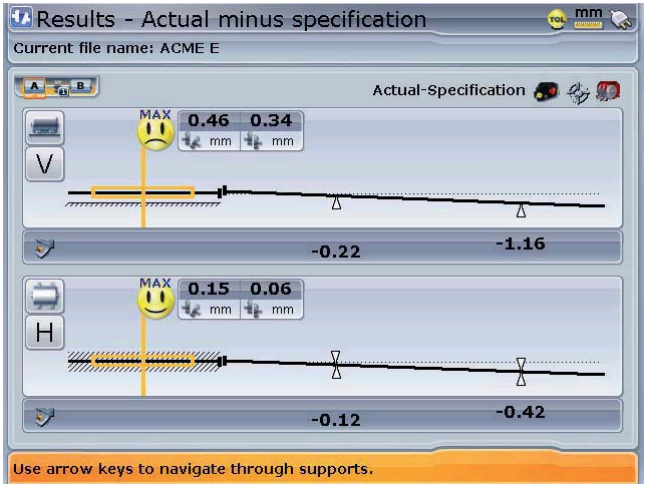
g. To view ROTALIGN Ultra gap and offset coupling values, press Menu. From the context menu that appears, use △/▽ to highlight 'Stop' as shown on the next page.



h. Confirm selection by pressing Enter. Coupling results are displayed.



i. Press (RES) to view foot results.



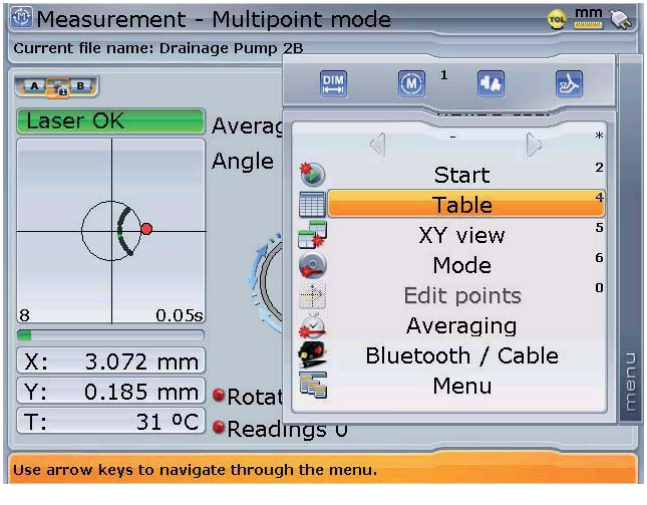
Pressing (RES) reveals the results screen showing feet positions if the dimensions have already been entered. If dimensions are missing, the set-up screen prompting dimensions appears.
In the displayed results, a maximum tolerance value has been set, therefore the 'MAX' on the smileys (Refer to coupling properties on pages 55-59.)

4.2 Measurement options

Measurement table

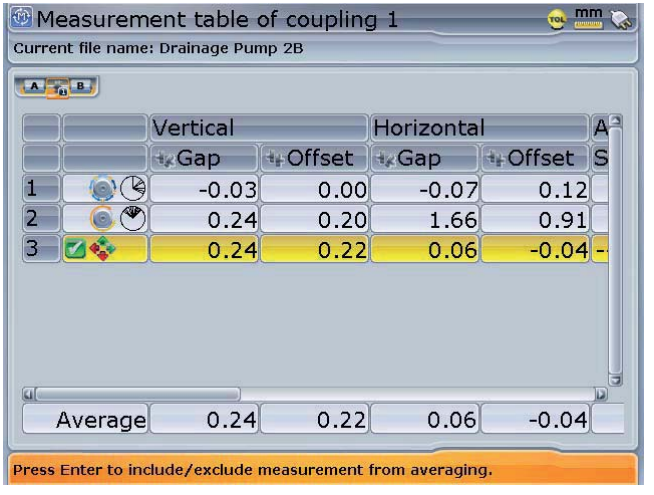
All measurements taken on the current set of machines are registered in a measurement table which can be viewed directly following measurement.

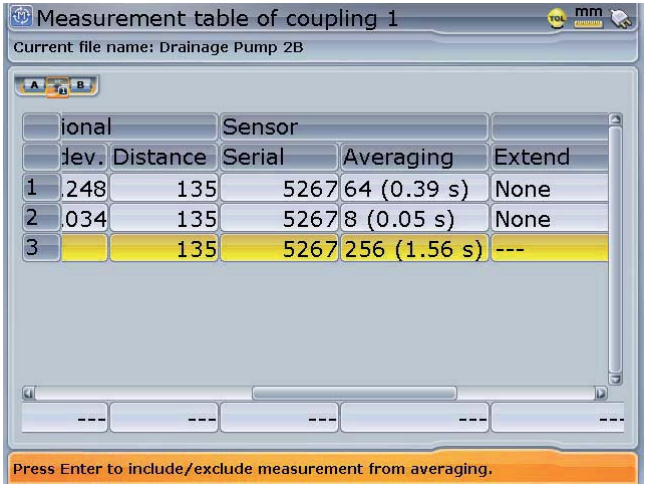
The measurement table is accessed through the 'Measurement' screen. Press (Menu) while in measurement. Use (△)/(▽) to highlight 'Table' from the context menu that appears.



Measurement table can also be accessed via the global menu. Press (Menu) twice to open the global menu. Open the measurement table by pressing (5jkl) then (8tuv).

Press Enter to view the measurement table.





The contents of the measurement table from left to right include the measurement position (indicated by nos. 1,2,3 ...), measurement mode (or live move), vertical and horizontal coupling values, standard deviation, distance from coupling center to sensor, and the date and time when a particular measurement was taken.
Up to 50 measurements can be stored in a measurement table. Changes made in the set-up screen affect only later results, not earlier ones.

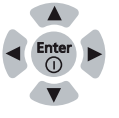
Measurement modes

Multipoint

Continuous sweep

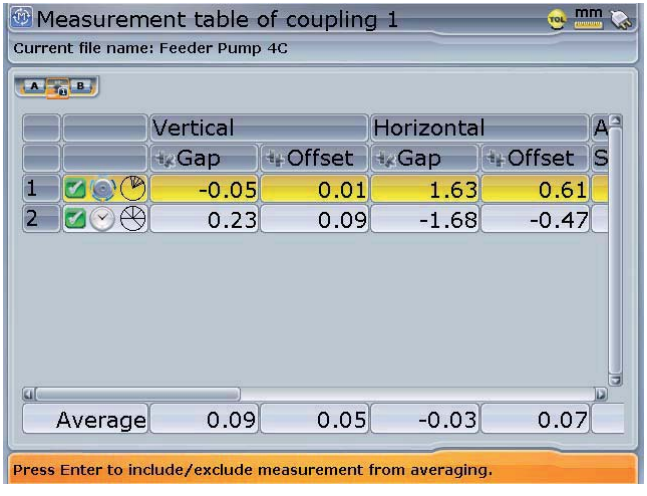
Move in both planes

The measurement table is scrolled downwards, upwards and sideways using the navigation keys.



Multiple measurement sets can be averaged to achieve more representative results. This feature is particularly useful for uncoupled shafts or when bearing play is considerable. To calculate this average, proceed as follows:

1. Use △/▽ to highlight a measurement for inclusion in the average.
2. Press Enter to select the measurement. A check mark appears next to the measurement position indicating that the measurement has been included in calculating the average.
3. Repeat steps 1 and 2 for all other measurements to be included.



Note

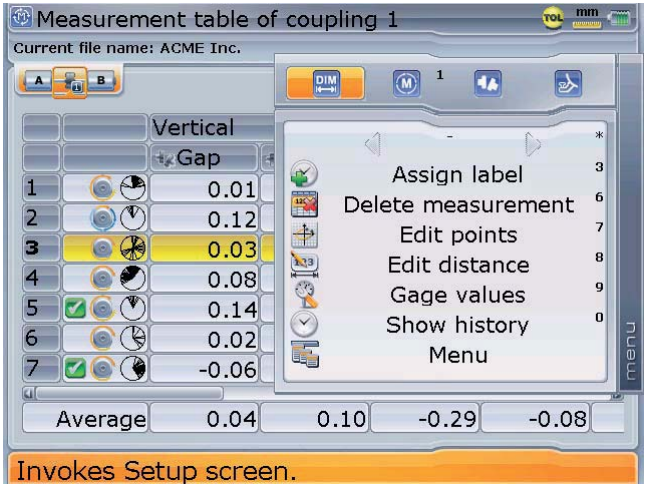
To remove a measurement from the average calculation, highlight the measurement using △/▽ then press Enter. The check mark next to the measurement position disappears indicating that the measurement is not included in calculating the average.

Measurement table may also be accessed directly via the global menu

Measurement points, alignment records, and the coupling to sensor distance can be edited from the measurement table screen. To access these items, press Menu while in the 'Measurement table' screen. Use △/▽ to highlight item required from the context menu that appears.

Note

The action to be taken (highlighted in the context menu) will be applied to the measurement highlighted on the measurement table.

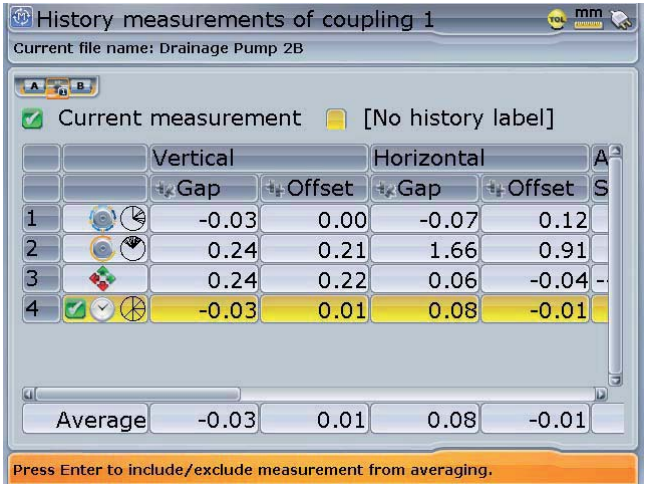


The screen opposite shows the context menu items available when no single measurement has been assigned any label

Assigning label to measurement

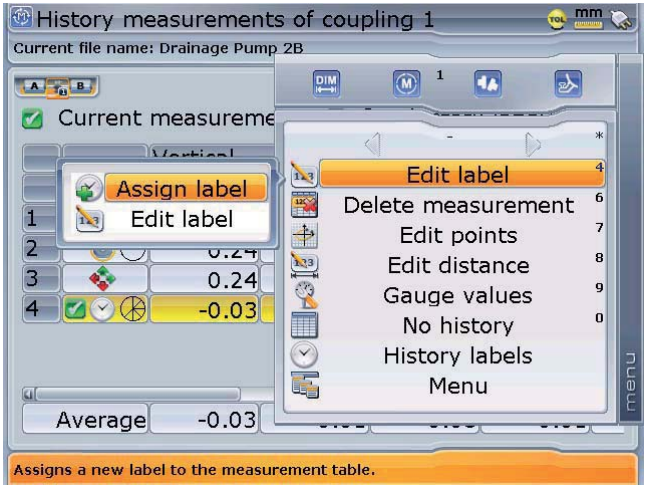
To assign a label to a measurement, proceed as follows:

a. After taking (a) measurement(s), press Menu while in the measurement screen. From the context menu that appears, use △/▽ to highlight 'Table'. Press Enter to confirm selection. Alternatively, open the measurement table directly by pressing 4ghi with the context menu displayed. Use △/▽ to highlight measurement to be assigned a label.



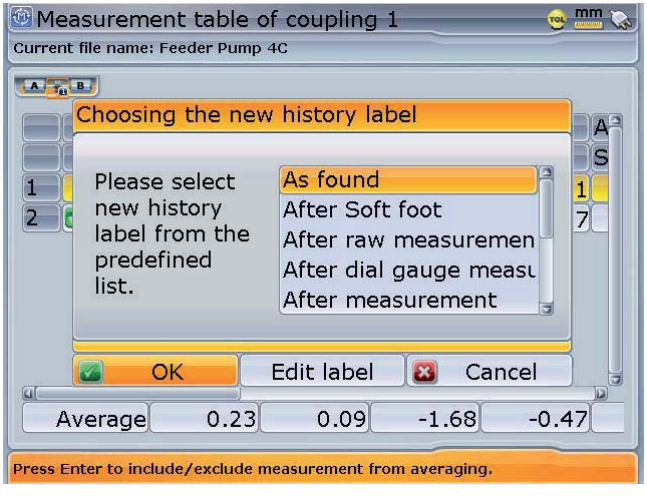
In this example, measurement no. 4 has been highlighted

b. Press (Menu) then use the navigation keys to highlight 'Assign label' from the context menu that appears.



Note that the menu item 'Edit label' appears after any single measurement has been assigned a label. The submenu items under "Edit label" now allow measurements be assigned labels or existing labels be edited.

c. Press (Enter) to confirm selection. A dialog window with predefined labels appears.

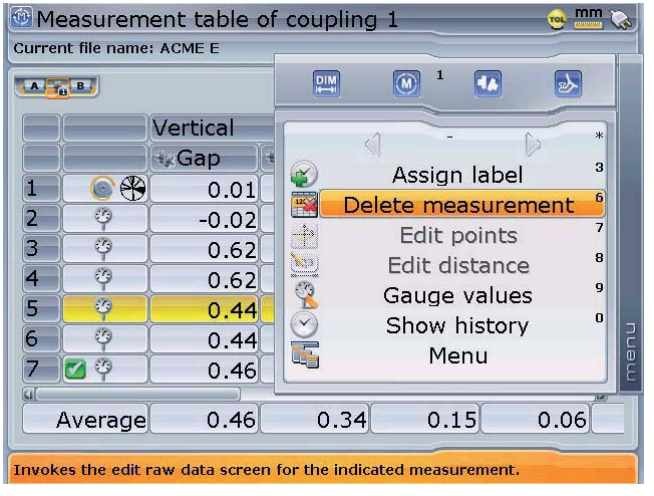


d. Use (△)/(▽) to highlight the appropriate label. Confirm selection by using (◁)/(▷) to highlight 'OK', then press (Enter) to accept label.

Deleting measurent

a. With the measurement table displayed, use △/▽ to highlight measurement to be deleted.

b. Press Menu then use △/▽ to highlight 'Delete measurement' from the context menu that is displayed.



Pressing 6mno with context menu displayed prompts the 'delete measurement' hint box. Highlighted measurements can also be deleted by pressing CLR. Note that measurements assigned with labels cannot be deleted.

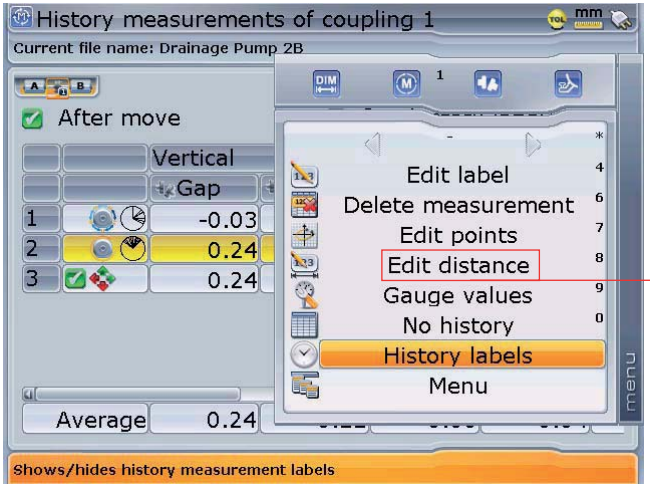
c. Press Enter to confirm selection. A hint box requesting confirmation to delete measurement appears. Use the navigation keys to highlight 'Yes'. With 'Yes' highlighted, pressing either Enter or t deletes the measurement permanently.

Identifying history labels

ADVANCED

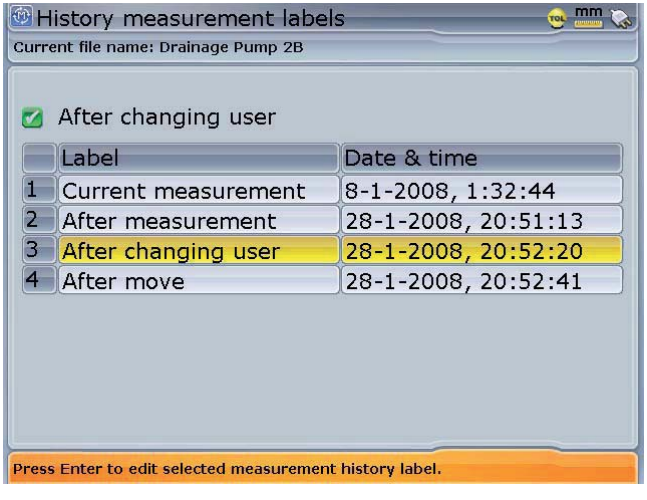
To find out how many different labels have been assigned in measurement history table, proceed as follows:

a. With measurement table displayed, press Menu then use △/▽ to highlight 'History labels'.

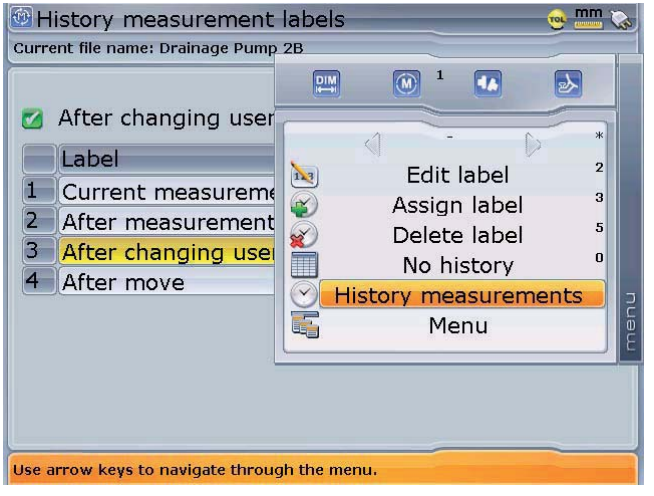


The measurement table context menu item 'Edit distance' is used to edit the dimension coupling centre-to-sensor.
This function makes it possible to interpret new results without necessarily having to remeasure.

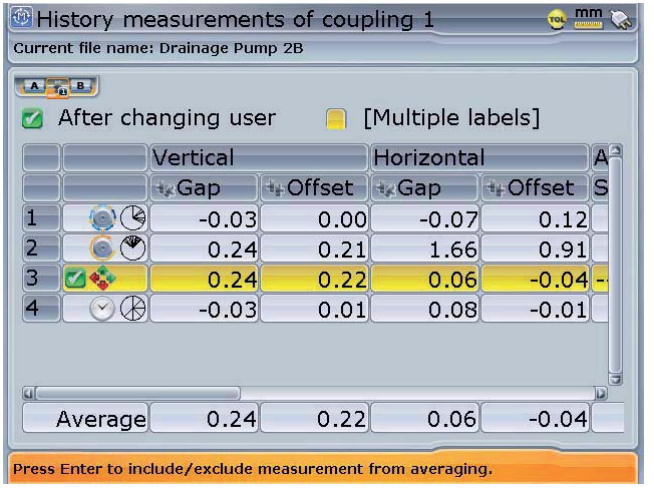
b. Press Enter to confirm selection. The 'History measurement labels' screen appears showing all labels used on the file.



c. To identify the measurement related to a particular label, use △/▽ to highlight the respective label, then press Menu. Use △/▽ to highlight the context menu item ‘History measurements’.



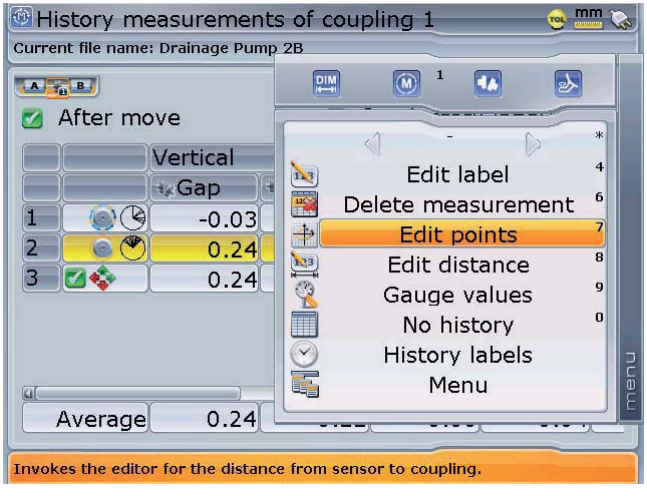
d. Press Enter to view the measurement under the selected label (in this case ‘After changing user’).



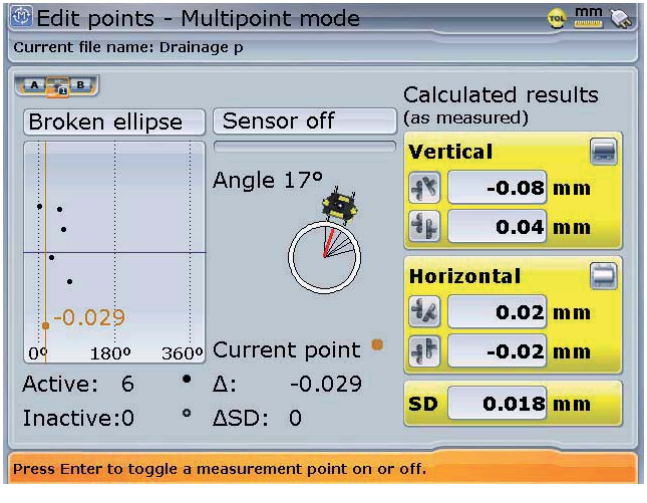
Edit raw data

ADVANCED

To improve the quality of the alignment results, it may be necessary to edit measurement data that deviates severely from other measurements taken.
After completion of measurement, press Enter then Menu. The screen below appears.



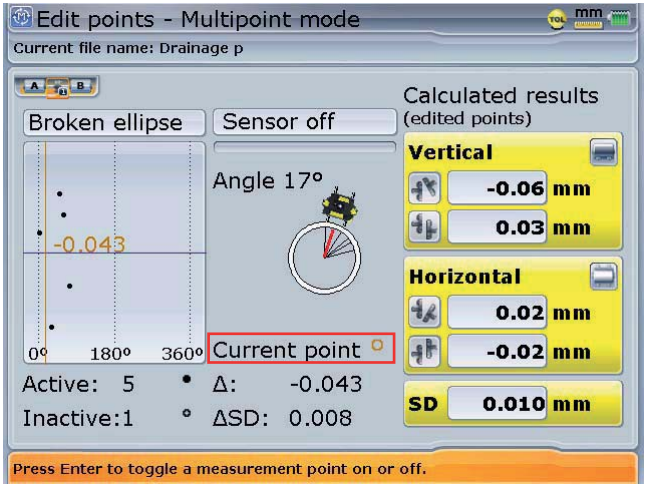
Use △/▽ to highlight 'Edit points'. Press Enter to view and edit ellipse points.



Any measurement point that deviates severely from the other values can be deactivated from the measurement set.

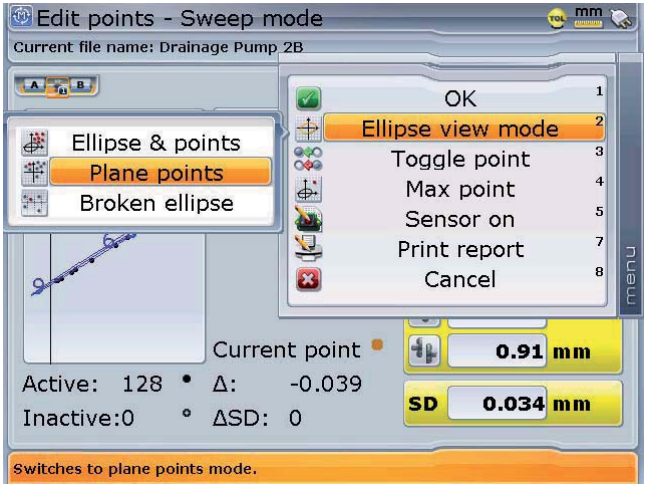
In this example, the selected ellipse view mode is a broken ellipse.
The currently selected point deviates by -0.029. The standard deviation SD is 0.018.

Use the navigation keys to select the measurement point to be deactivated. Any selected point can be deactivated by pressing Enter.



In this example, the deactivated point is the one that was highlighted in the previous example. The point appears as a clear circle on the display and SD has improved to 0.010. The change in SD is recorded on the screen.
The current status of the marked point is displayed on the screen allowing the reactivation of points by pressing Enter.

The context menu of the 'Edit points' screen includes the items 'Ellipse view mode', 'Toggle point', 'Max point' and 'Sensor on/off'.



The 'view mode' allows raw data to be examined from three different views. The three views are: ellipse and corresponding points, plane points and broken ellipse. The desired view is selected from the context menu using the navigation keys to highlight desired view then pressing Enter to confirm selection.

In the "Ellipse and points" view, the width of the ellipse along the X axis gives an indication of shaft angularity, and its height (on the Y axis) indicates shaft offset. When shafts are perfectly aligned, the ellipse is reduced to a single point.

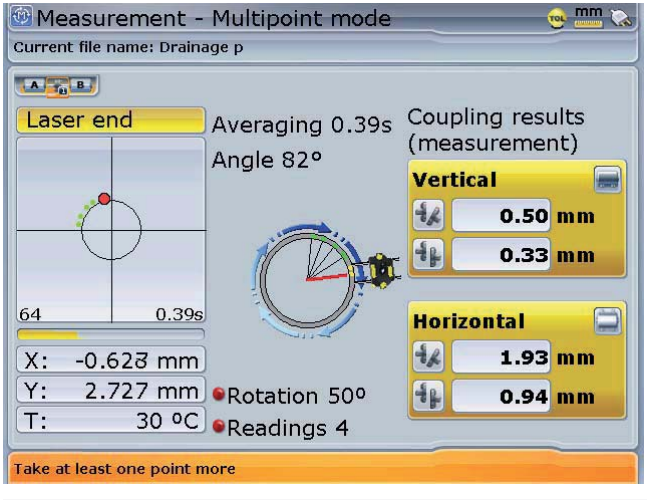
'Toggle point' is used to deactivate any selected measurement point. Use △/▽ to highlight 'Toggle point', then press Enter to deactivate the selected point. This point may be reactivated by the same procedure. The 'deactivated' measurement position can be remeasured in the 'multipoint', 'pass' and 'static' measurement modes. If several 'active' points result for the same position, they will be averaged together.

'Max point' is used to highlight the measurement point with the maximum deviation from the calculated ellipse.

Selecting **'Sensor on'** shows the current beam position on the screen. With this function, repeatability can be checked by following the path of the beam as the shafts are turned through the measurement positions again. The beam should move along the curve of the ellipse without appreciable deviation.

Extending the measurement range

Gross misalignment of shafts or small angular misalignment over large distances can cause the laser beam to miss the detector surface during measurement. When this happens, 'Laser End' appears on the display screen and the instrument's 'extend' function can be used.

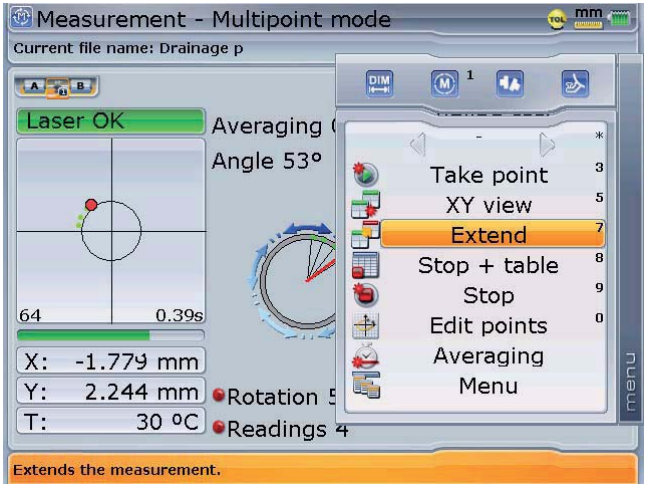


'Laser END' is displayed when the reflected beam misses the detector.

The 'extend' option is available only in 'multipoint' and 'static' measurement modes.

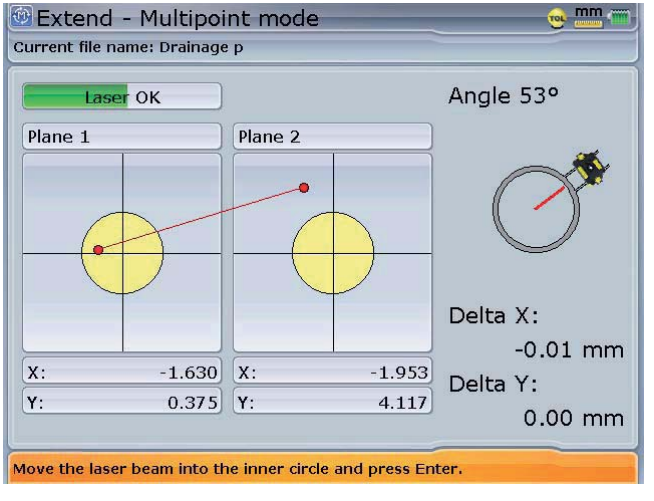
Note

1. When measuring and ‘Laser End’ message appears, rotate the shafts backwards until the laser beam reenters the measurement range. The message ‘Laser OK’ reappears on the display. Press (Menu). The context menu as seen below appears.



The XY beam adjustment screen may be directly accessed by pressing (7 pqrs) with the context menu displayed.

2. Use (△)/(▽) to highlight ‘Extend’, and then press (Enter). The program interrupts measurement and switches to ‘XY View’. The current beam position is automatically taken as the starting point for range extension.



3. Readjust the beam into the target circles using the yellow laser emitter adjustment wheels and then press (Enter) or (t).

The adjusted beam position is taken as the end point of displacement.

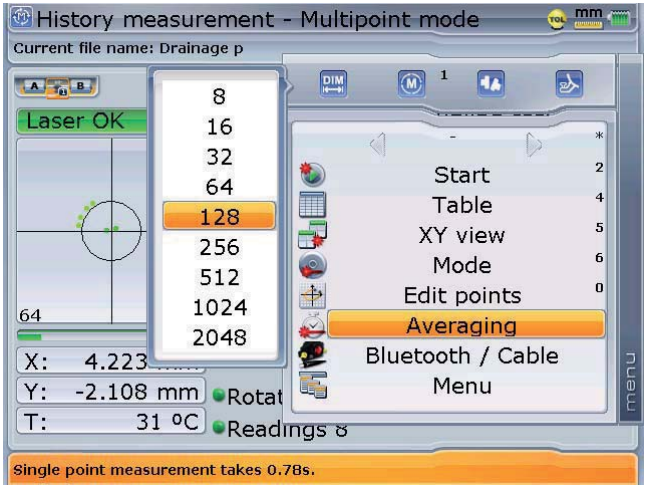
4. Continue measurement as before, rotating the shafts and pressing Enter to take measurement at the desired positions.
   The program includes the displacement of beam readjustment in its alignment calculations.

Averaging

In certain industrial conditions, it may be necessary to increase the number of measurements (recorded laser pulses) to be averaged when taking readings to attain the desired accuracy. Particular cases include plants with increased machinery vibration. An increased averaging also improves the accuracy when measuring sleeve bearings, white metal bearings and journal bearings.

The number of individual readings which are averaged together to form one measurement is selected from either the measurement screen or via the XY view screen. The XY view screen is primarily for live Move and soft foot measurement.

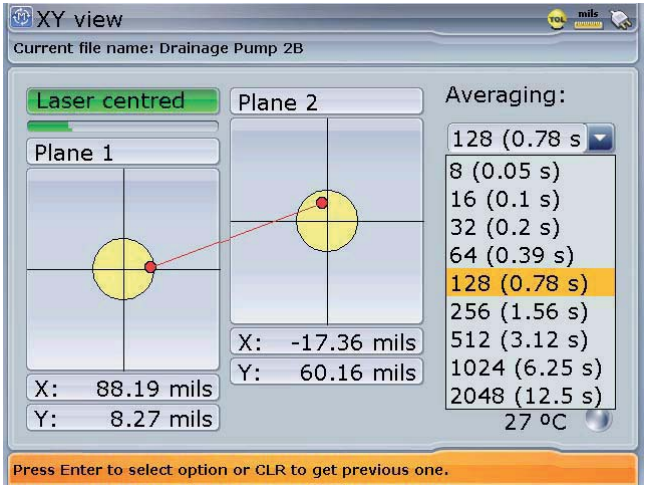
When setting the average from the measurement screen, press Menu and use △/▽ to highlight 'Averaging'. Use ◁/▷ to select averaging value and confirm value by pressing Enter.



Setting averaging in multipoint and static measurement modes.

The selected averaging value and the corresponding time appear at the bottom of the laser adjustment pane.

If averaging is set via the XY view, press Menu from the corresponding measurement screen and use △/▽ to highlight 'XY view'. Press Enter to confirm selection. The XY view screen appears with the averaging box highlighted. Press Enter to expand the drop down menu.



Setting averaging in the XY view screen

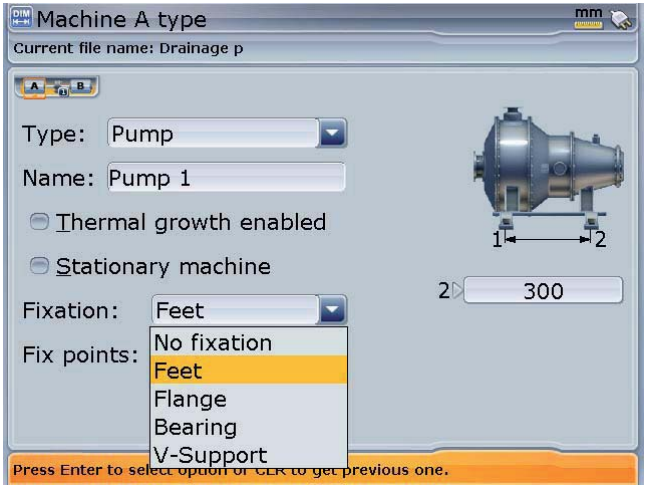
Use △/▽ to select averaging value from the drop down menu and confirm value by pressing either Enter or t.

4.3 Set-up options

Machine type and fixation

ROTALIGN Ultra provides the user with a feature to designate the type and fixation for both left and right machines.

Please refer to "Machine properties in chapter 3, section 7

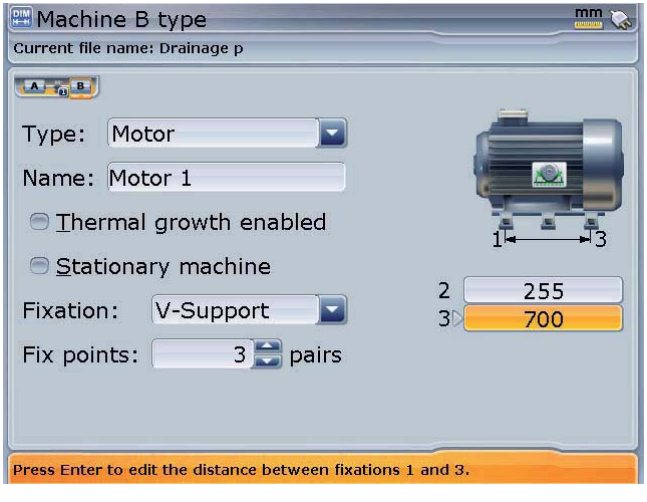


Use the navigation keys to highlight machine item boxes. Press Enter to either check selected item box or prompt the corresponding drop down menu.

Machine mounting

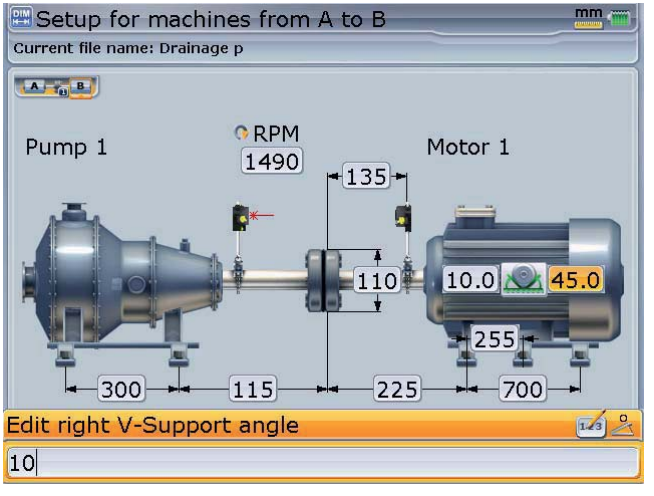
Detailed machine mounting can be specified in set-up.

In the set-up screen that follows, machine mounting has been defined as 6 feet (3 pairs of feet), has a V-foundation and is moveable.

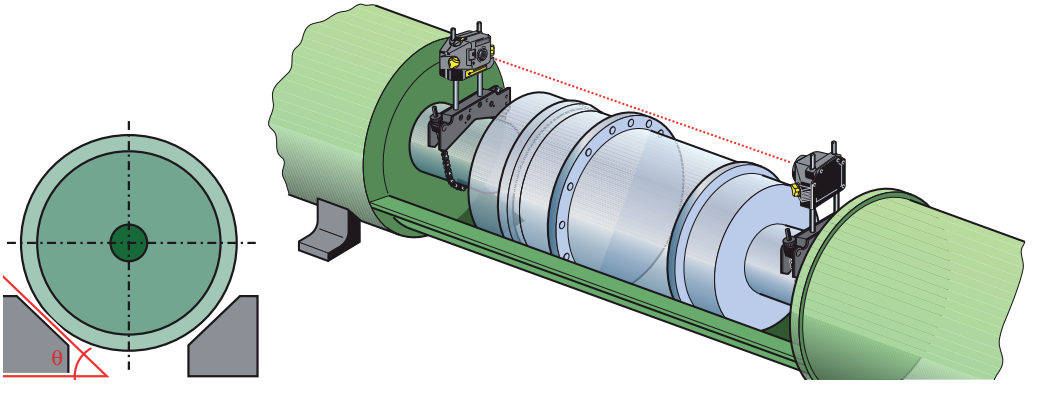


For machines with V-shaped supports, the angle between support surfaces and foundation must be entered in order to calculate corrections.
The respective angles are entered as follows:

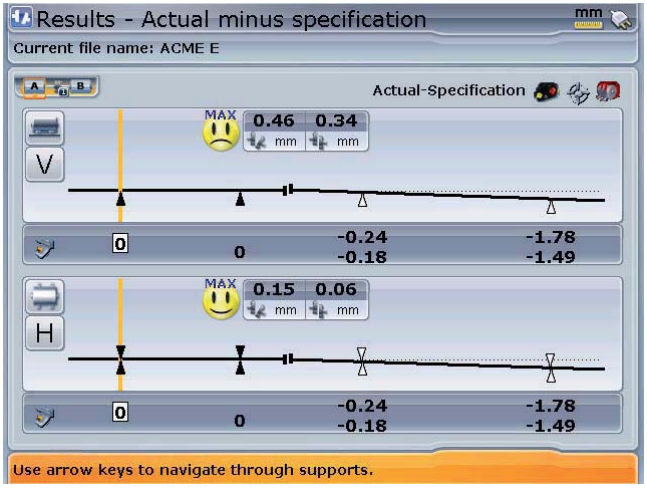
› From the dimension screen, use the navigation keys to highlight either of the support angle boxes (left side or right side). Note that the default angle is 45°, and a 0° angle indicates that the machine feet are parallel to the foundation, while a 90° angle indicates that the feet are perpendicular to the foundation.



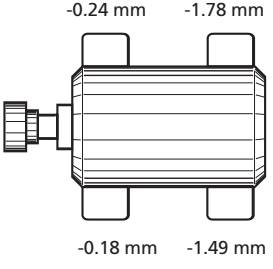
› Use the data entry keys to enter the support angle for the selected feet position, confirming entry by pressing either Enter or t.
› Select next position using the navigation keys and enter the support angle as described above.



All alignment corrections are achieved solely by inserting and removing the proper combination of shims; corrections are indicated for each individual machine foot to yield the required horizontal and vertical displacement for the machine upon angled supports.
These corrections correspond to the values in the results screen as shown below.



The vertical corrective values for each foot are shown below.



Coupling type

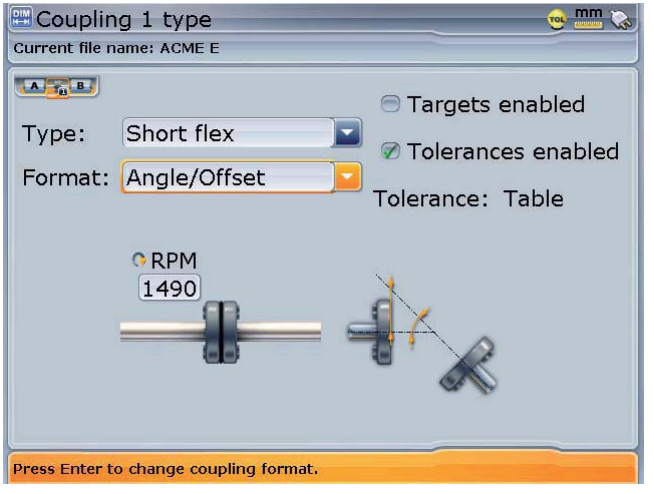
The following coupling types are available for selection:

- **Short flex** – These couplings feature fitted transmission elements with play (such as teeth, claws or bolts) or elastic connecting elements like rubber 'tires' or springs.
- **Single plane** – The coupling halves are bolted directly together. Loosen the bolts before taking measurements, since they would otherwise distort the true alignment condition.
- **Spacer shaft**: When the coupling halves are joined by a spacer element, its length must be entered.
- **Cardan shaft**: Just as with regular spacer shafts, the shaft length (between coupling planes) must be entered.

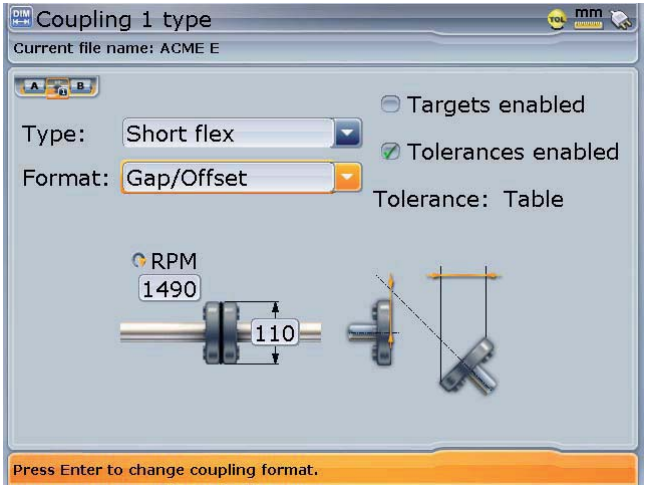
Coupling results format

This parameter allows the desired display format to be selected for depicting the coupling alignment condition. This allows direct comparison with the manufacturer's alignment tolerances. The proper format setting depends upon the coupling type used.

Short flex

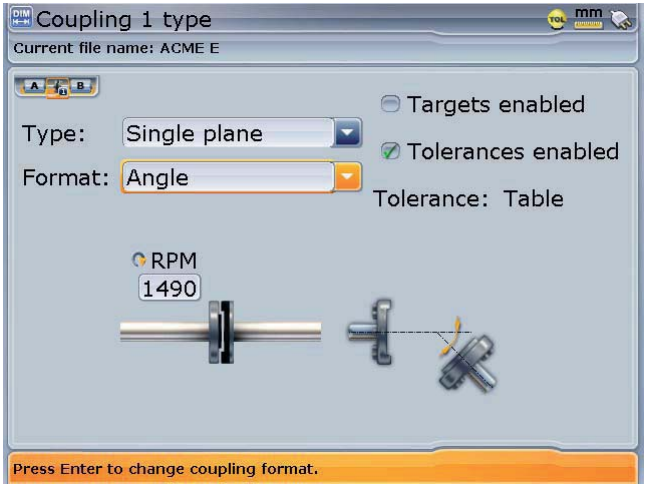


Shaft angle and offset at the coupling plane

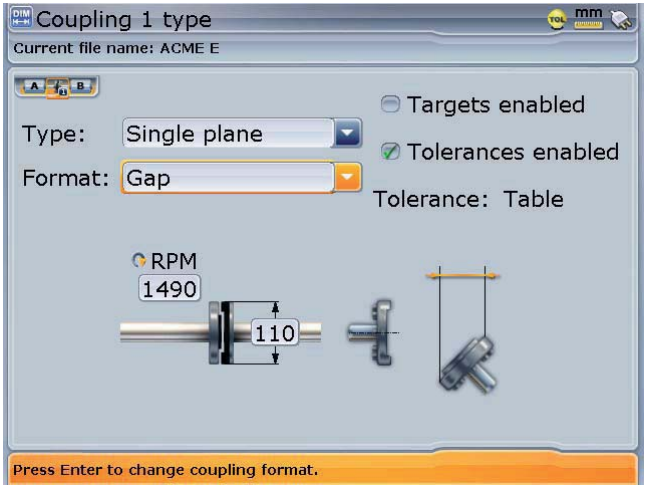


Gap difference at entered diameter of coupling and shaft centerline offset

Single plane

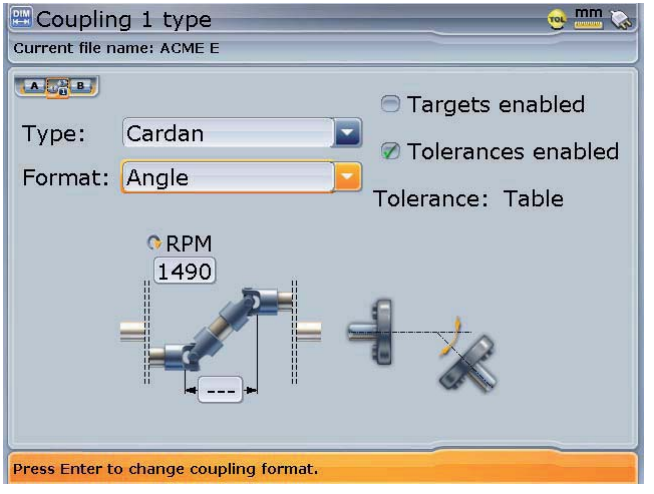


Shaft angle

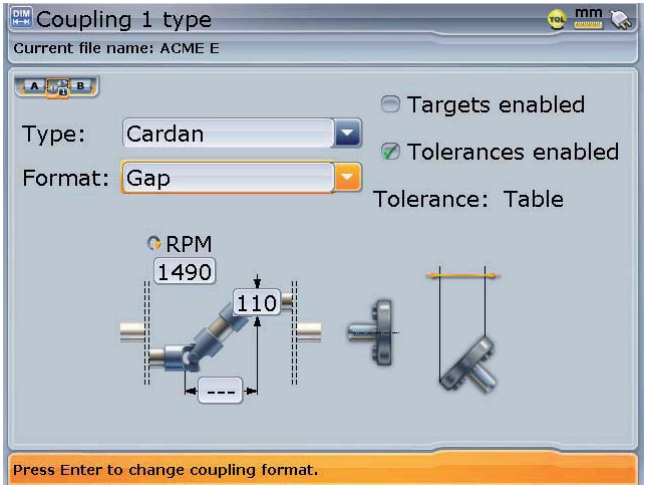


Gap difference at entered diameter of coupling

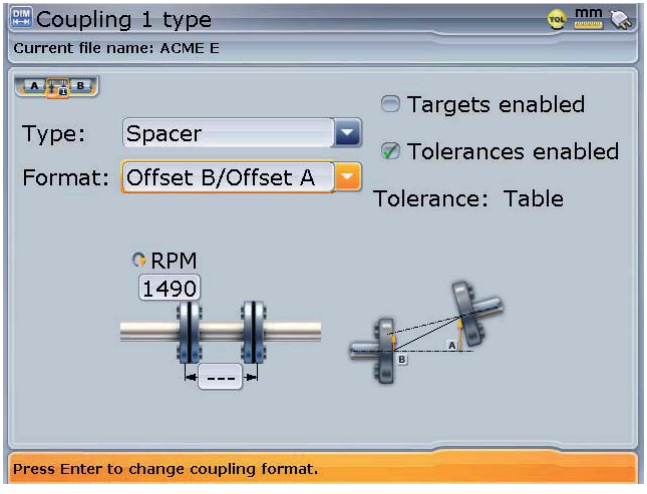
Cardan shafts



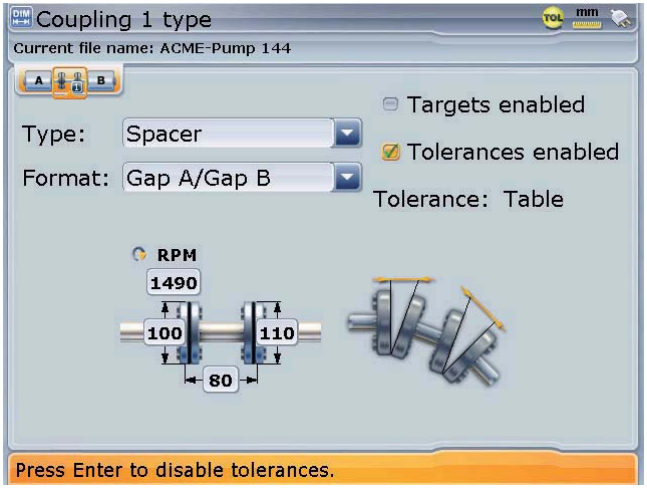
Only angularity is of concern with cardan shafts



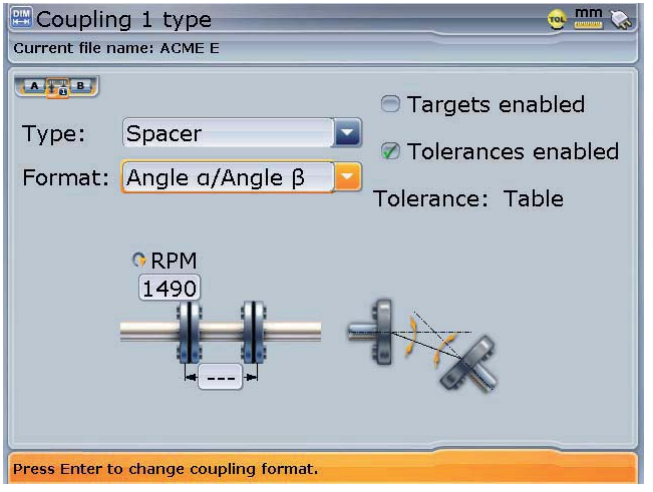
Spacer shaft



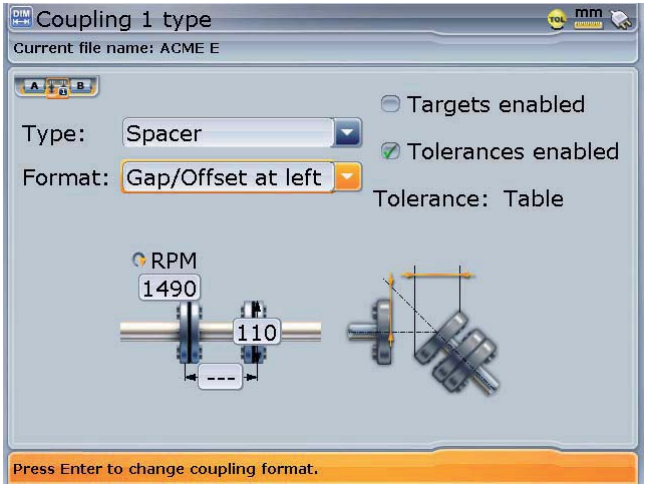
Projected shaft offset at left (B) and right (A) coupling flex planes



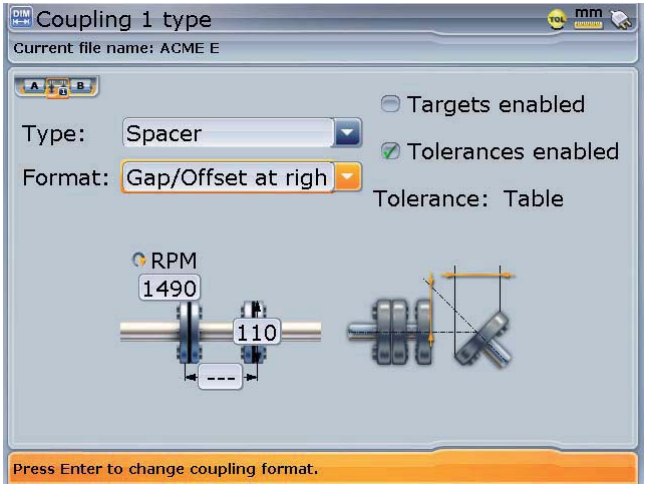
Gap difference at entered coupling diameter of left coupling (A) and right coupling (B) of spacer shaft
Note that coupling A and B could have different diameters



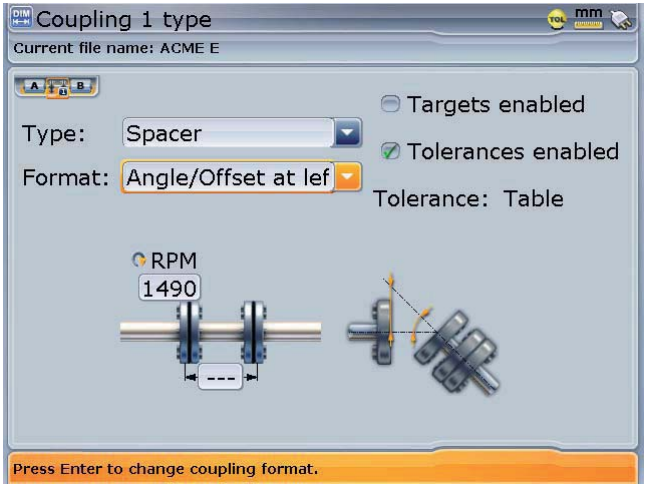
Angle at left coupling (α) and right coupling (β) of spacer shaft



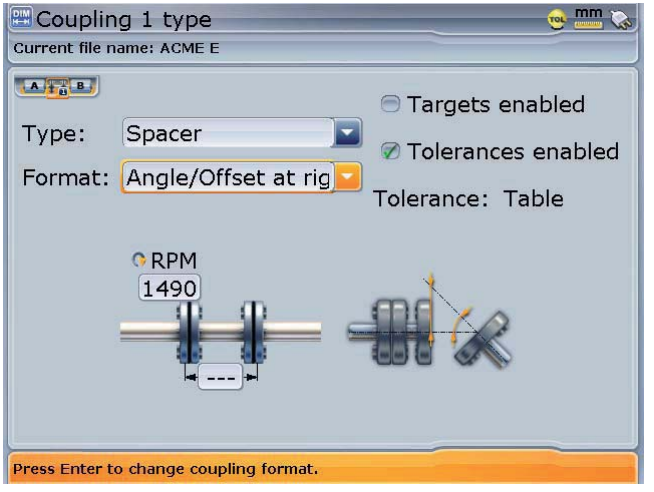
Gap difference for entered coupling diameter and projected offset at left coupling of spacer shaft



Gap difference for entered coupling diameter and projected offset at right coupling of spacer shaft



Angle and offset at coupling on the left of spacer shaft



Angle and offset at coupling on the right of spacer shaft

Sign convention

- Vertical alignment plane:
  - › Offset is positive when the right shaft centerline is higher than the left centerline.
  - › Gap and angularity are positive when the coupling opens toward the top.
- Horizontal alignment plane:
  - › Offset is positive when the right axis is further away from the viewer than the left axis.
  - › Gap and angularity are positive when the coupling opens away from the viewer.

Coupling targets

The position of machines at rest can be considerably different than that during operation (e.g. due to thermal growth or load-related displacements). This effect can be compensated through use of alignment target values for the coupling, which allow precise 'misalignment' when the machines are at rest so that they will be in proper alignment position during operation.

Alignment target values may be found in the machine documentation or upon request from the manufacturer or can be measured using PERMALIGN. For details on PERMALIGN, contact your local PRÜFTECHNIK representative.

The coupling type determines the targets to be entered. These values are entered as described in Chapter 3 section 7.3 – 'Coupling properties'.

Tolerances

Alignment quality is evaluated through comparison with tolerances based upon entered machine dimensions and RPM.

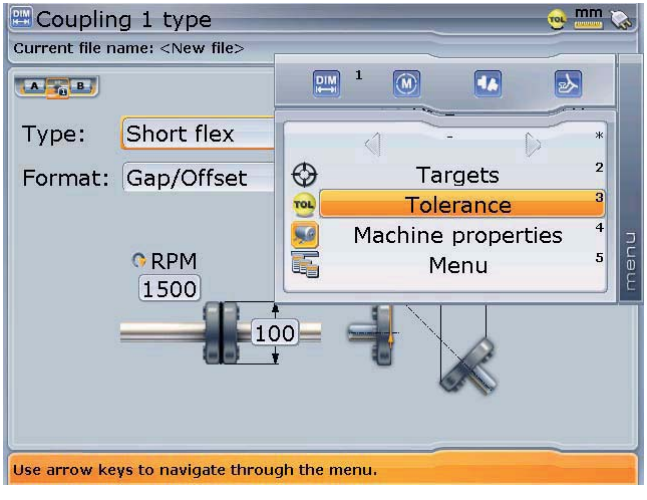
The tolerance ranges are compiled as tables according to coupling type and diameter as well as RPM. When the coupling type is spacer, the tolerance table values are determined by the length of the spacer shaft and the RPM. (See suggested shaft alignment tolerances at the end of chapter 5.)

In ROTALIGN Ultra the 'live' tolerance function can be activated or deactivated from either the coupling properties window or the tolerances window. When the function is checked active, the alignment quality is indicated with the 'smiley' symbol.

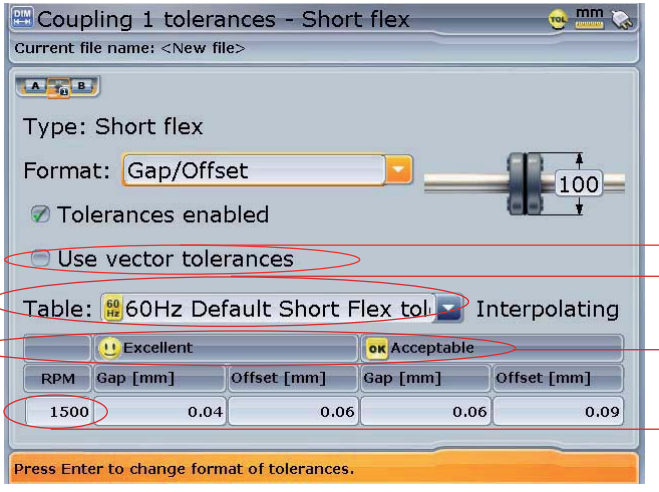
Tolerance tables are viewed as follows:

Access coupling properties as described in chapter 3 section 7.3 'Coupling properties'.

Press Menu. The context menu appears. Use △/▽ to select 'Tolerance'.



Press Enter to confirm selection. The tolerance screen appears.



The tolerance table drop down menu shows all tolerances available for the coupling type selected.

Alignment tolerances are divided into two quality ranges -'acceptable' values are relatively generous and intended for noncritical machines and RPM ranges; 'excellent' values are intended for machines and RPM ranges that require especially accurate shaft alignment.

The RPM can be edited by highlighting the value and then entering required value directly using the data entry keys. Confirm entry by pressing either Enter or t.

The given alignment tolerances are based upon standard industry norms and must not be exceeded, and they are to be used only if existing in-house standards or the machine or coupling manufacturer has not given any binding values.

Note

Thermal growth calculator ADVANCED

Machine conditions change from the time the machine is off line to when it is running under normal operating conditions. Some of these changes are due to process forces (e.g. fluid pressures, airflow). The most notable of these changes is the change in the temperature of the machine bearings and supports. This is called the machine's thermal growth.

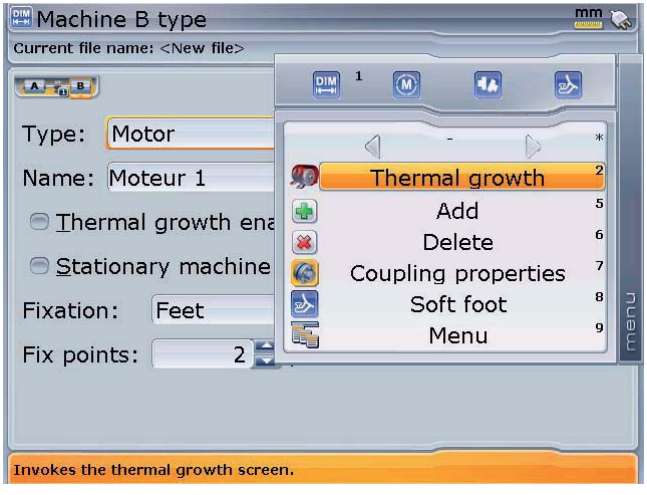
ROTALIGN Ultra may be used to calculate thermal growth compensation if no other values are available. Thermal growth is calculated from the material characteristics, expected temperature difference and height of the shaft centerline above the shim plane.

Thermal growth is calculated as follows:

From machine set-up, use the navigation keys to highlight the machine whose thermal growth requires calculating.

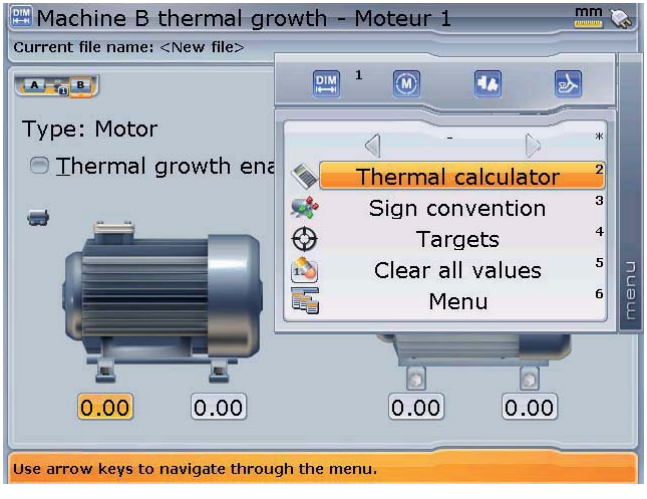
With the machine highlighted, press Enter to access the machine properties screen.

Press Menu. The context menu appears. Use ▵/▿ to select 'Thermal growth'.

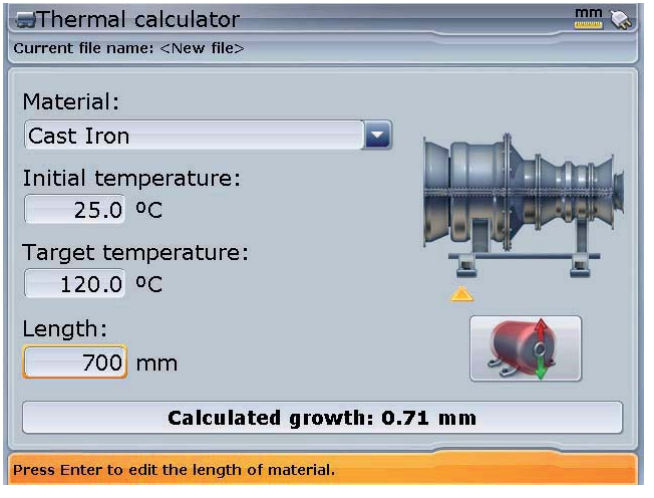


Press Enter. The thermal growth screen appears.

Press Menu. The context menu appears. Use ▵/▿ to select 'Thermal calculator'.



Press Enter to access the thermal calculator screen.
Proceed to select type of material using the drop down menu.
Use the navigation keys to highlight the respective value boxes and enter directly, the ambient temperature, the machine running temperature and the distance from machine base to the shaft centerline using the data entry keys.



In the example opposite, the motor material is cast iron, the ambient temperature is 25°C, the machine running temperature is 120° C and the distance from the bottom of the turbine feet to the shaft centerline is 70 cm. This gives a growth of 0.71 mm.

4.5 Soft foot

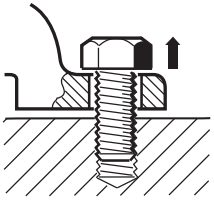
SOFT FOOT is the condition of machine frame distortion. Any cause that results in machine frame distortion when the machine is anchored to its foundation is a soft foot. Some principal causes are:

- Non-coplanar machine mounting surfaces,
- Deformed machine frame or feet,
- External forces e.g. from connecting pipe or bracket,
- Improper shimming or dirty machine feet.
- Too many shims under a machine foot (a maximum of 3 should be used)

The consequences of forcibly tightening down the feet are deformed machine frames, bent shafts and distorted bearings. This leads to high vibration and premature failure.

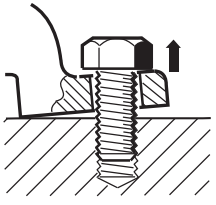
Soft foot should be checked before aligning the shafts, and this can be done quickly and conveniently with the aid of the ROTALIGN Ultra soft foot function. With the laser and sensor mounted on the shaft in the usual way, the system is able to sense any machine movement when the machine bolts are loosened individually. By entering the machine dimensions, the computer is able to calculate, from shaft movement, by how much each foot has moved as it is loosened.

Once foot movements have been established, the results are interpreted and translated into shim thicknesses to be placed under the feet. How straightforward this is, depends on the type of soft foot present.



Parallel soft foot

One or more feet are too short or too long. This usually results in the machine rocking on the longer feet. This is corrected by shimming the shorter feet.



Angular soft foot

The base of the foot is at an angle to its foundation and they are only partly in contact. In this case, suspect foot is checked with a feeler gauge and corrected by building a custom ‘shim wedge’ or machining the underside of the foot

Checking and correcting soft foot conditions

The three main types are parallel soft foot, angular soft foot, and induced soft foot. There are instances where the soft foot is a combination of two or more types. Checking for soft foot is part of machine and job preparation.

The machine(s) to be measured should be treated first as normal four-feet machines. A machine with 6 or more feet is set up and measured like a four-footed machine (provided it is a compact rigid frame), with all the middle feet left loose, and after soft foot is corrected at the four main supports, the rest are feeler gauged and shimmed according to the feeler gauge readings or dial indicator readings on the foot itself.

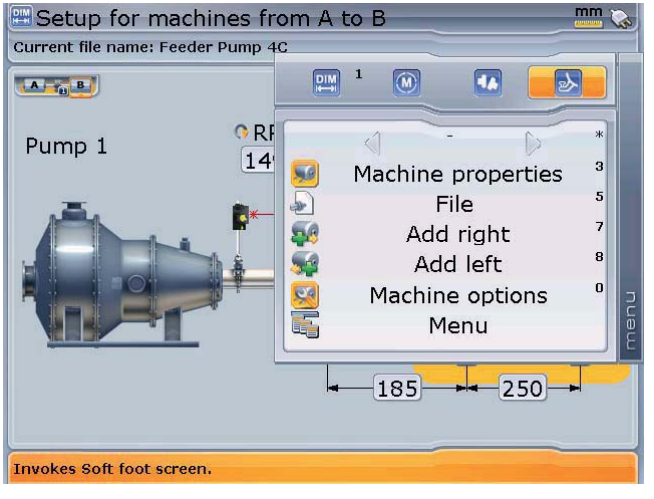
Note

The measurement procedure

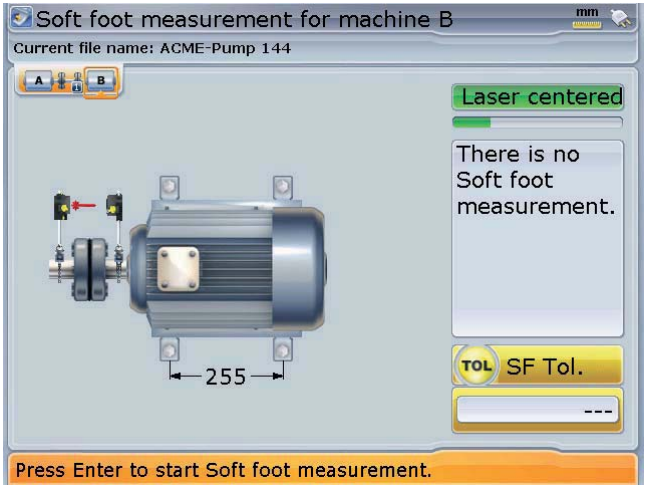
Soft foot may be measured from virtually any screen.

Note

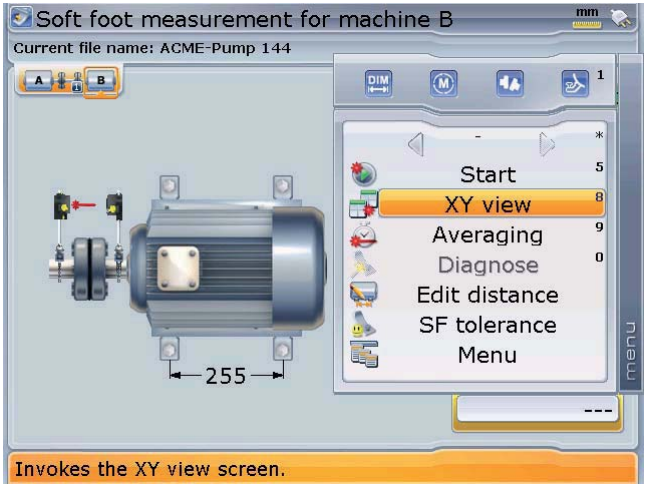
1. Mount the laser and the sensor in the normal way, and then switch on the laser. Adjust the beam onto center of the sensor dust cap.
2. Remove the sensor dust cap.
3. Use the navigation keys to highlight machine whose feet are to be measured.
4. With the machine highlighted, press Menu. The context menu appears. Use the navigation keys to highlight .



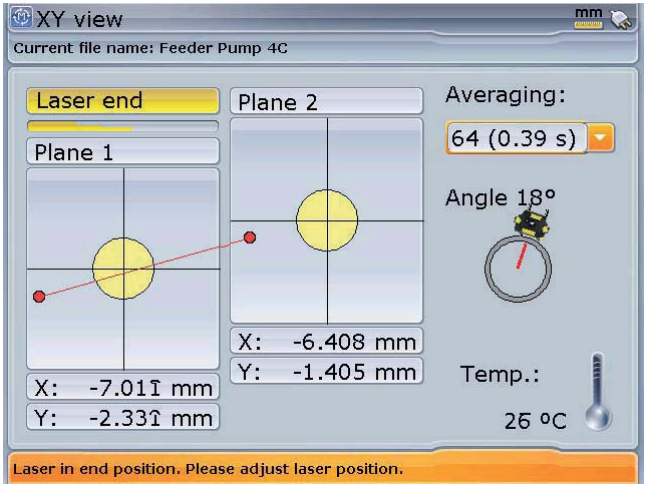
5. Press Enter to confirm selection. If the laser is centered the following screen appears.



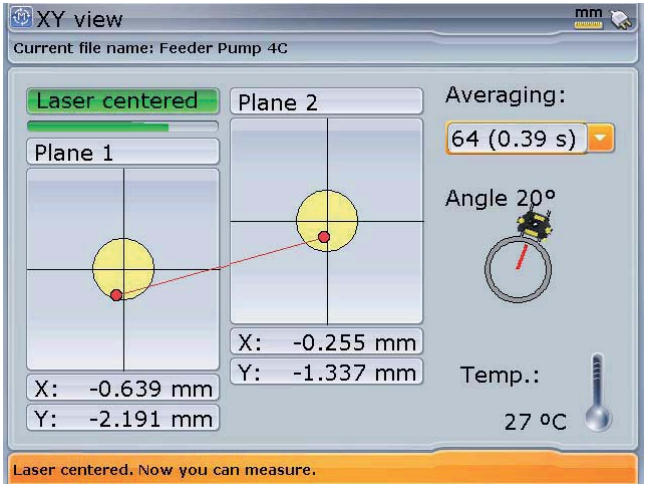
6. Press Enter to continue with soft foot measurement. If however, the laser beam is not centered, press Menu. The context bar appears. Use △/▽ to highlight 'XY view'.



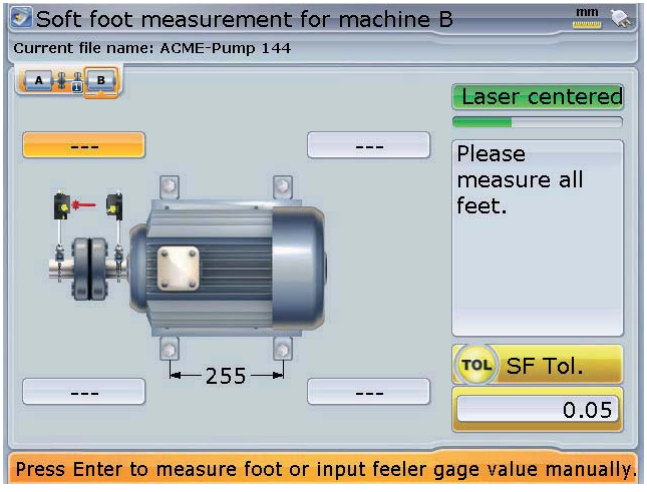
7. Press Enter to access the XY view screen.



8. Use the adjustment thumbwheels to center the laser beam. Use the top thumbwheel to move the beam up/down. The side thumbwheel is used to move the beam sideways.

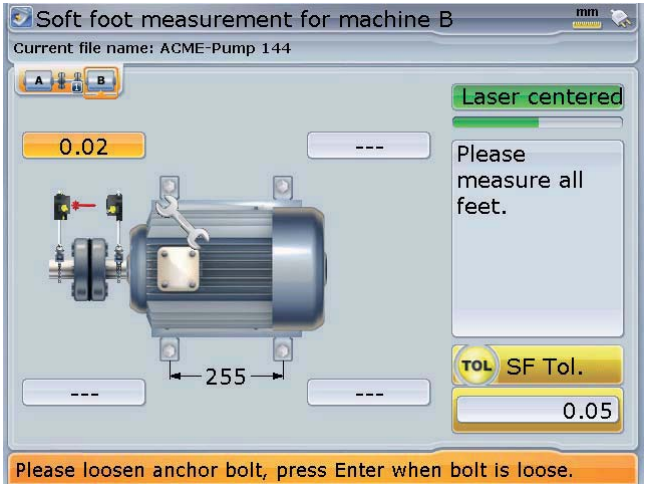


9. After centering the laser beam, press (t) to return to the soft foot screen. Press (Enter) to proceed with measurement.

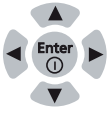


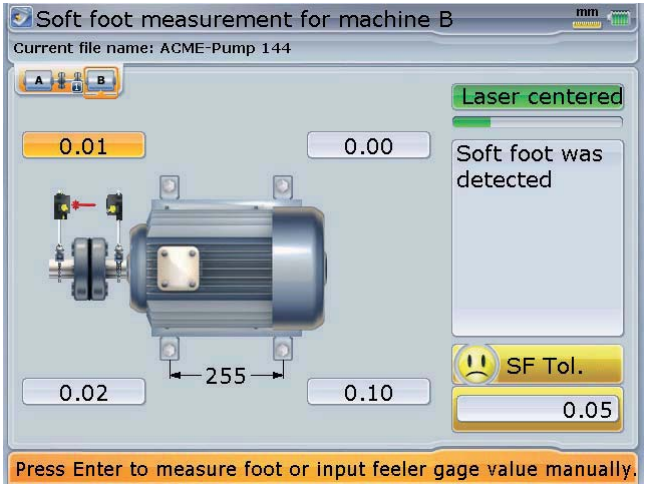
If machine dimensions have not been entered, pressing Enter prompts the entering of the missing dimension.

10. With foot to be measured highlighted, press Enter. A wrench symbol appears on the screen. Loosen the corresponding foot bolt. When the displayed value no longer rises, press Enter. The wrench symbol disappears and the highlight springs to the next empty value box. Tighten the bolt.



11. Repeat step 10 for each machine foot. You may use the navigation keys to highlight any foot to measure.

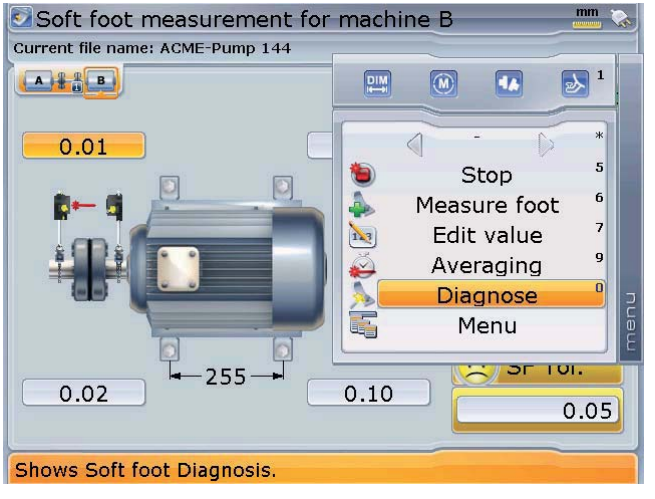




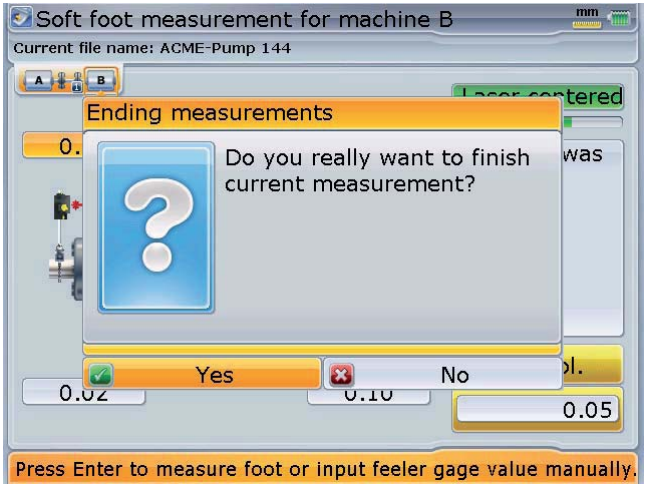
In this example, soft foot has been detected and must be eliminated before proceeding with the alignment of the machines.

12. To correct soft foot, press Menu. The context menu appears. Use △/▽ to highlight 'Diagnose'. ROTALIGN Ultra presents the user with concise instructions on how to eliminate the prevailing soft foot.

ADVANCED



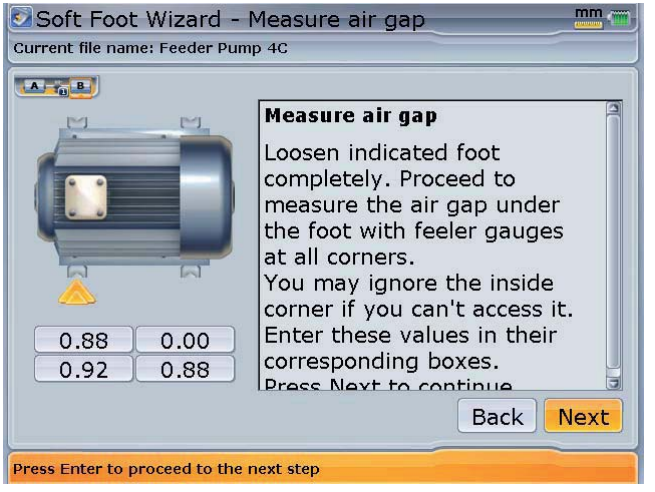
13. Press Enter to proceed. A hint appears requesting confirmation as to whether the sof foot measurement should be ended and diagnosis started.



14. Use ▷/◁ to highlight 'Yes' confirming selection by pressing Enter, then proceed with diagnosis using the soft foot wizard.

The wizard screen indicates that induced soft foot has been detected.

15. Proceed with wizard instructions to find a solution to the detected soft foot by highlighting 'Next' using the navigation keys then pressing Enter.



The wizard offers the relevant remedy instructions for each different soft foot situation.

16. Follow the wizard instructions by highlighting 'Next' using the navigation keys then pressing Enter until the diagnosis and correction is completed.

17. After correcting the soft foot, continue with alignment of the machines.

Chapter 5: Updating ROTALIGN Ultra firmware

Updating ROTALIGN® Ultra to version 2.1x

Current ROTALIGN Ultra firmware updates are carried out with the use of the especially approved PRÜFTECHNIK 1 GB USB memory stick (aka jumpdrive).

Note

Old PRÜFTECHNIK memory sticks must be disposed of in in accordance to the directive on Waste Electrical and Electronic Equipment (WEEE).

The necessary update may be downloaded from the PRÜFTECHNIK website.

1. Transferring update files to the memory stick

If you are acquiring the update via the website, you will require to transfer it to the approved memory stick before commencing the upgrading.

2. Downloading the update from the PRÜFTECHNIK website

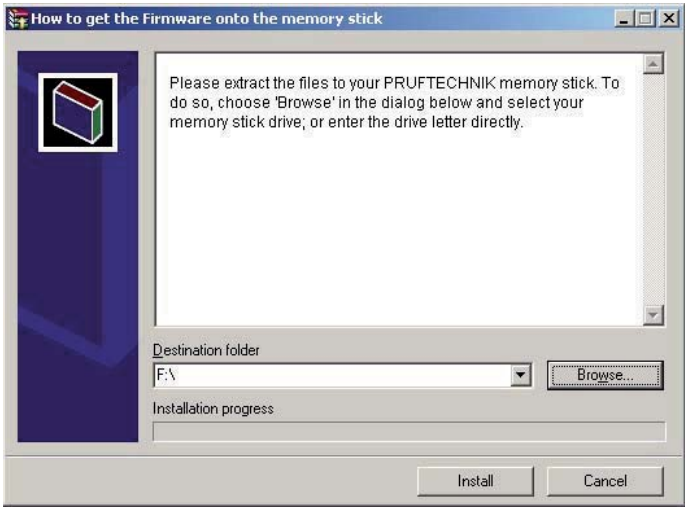
a) Go to: <*http://www.pruftechnik.com/alignment-systems/press-and-downloads/software-and-firmware-downloads/rotalign-ultra.html*>.
Download the upgrade to a folder on your PC. It is a large file, this may take several minutes.

DO NOT download directly to your approved memory stick!
If you had previously carried out an update using the memory stick, ensure that you DELETE all old folders.

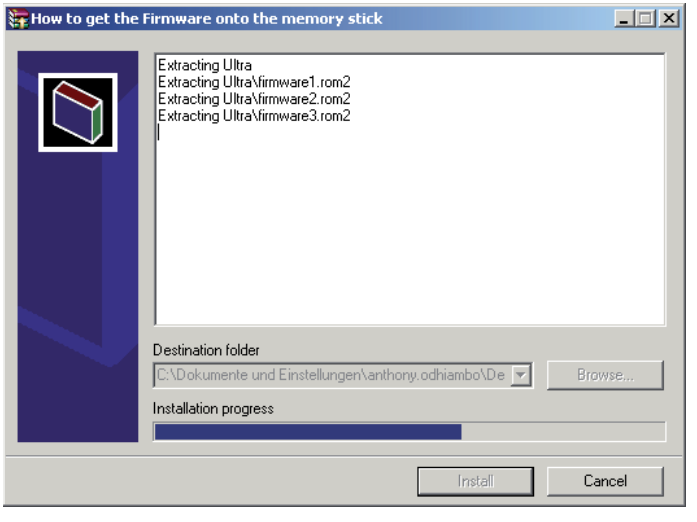
Note

b) Connect the approved PRÜFTECHNIK memory stick with not less than 100 MB of free space to your PC. Double-click the "ROTALIGN_Ultra_Firmware_2.1x.exe" file in your PC. You will be prompted to extract the file to a memory stick (See the next screen).

The following approved PRÜFTECHNIK memory sticks may also be used:
ALI 4.451-128 and
ALI 4.451-256



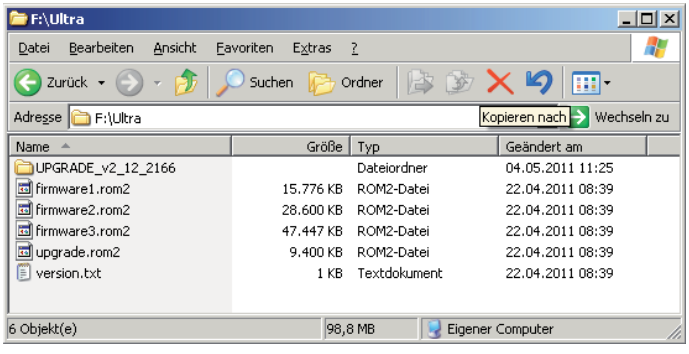
c) Select the location of your memory stick with ‘Browse’. Then click ‘Install’. The files extraction process begins.



d) If the extraction has been successful, the update is now on the memory stick, and you may proceed to section 3 - ‘Carrying out the firmware update.

3. Carrying out the firmware update

Before starting the upgrade verify that your memory stick has the files shown below in the 'Ultra' directory.



Note

a) Connect your ROTALIGN® Ultra to the mains adapter/charger, or ensure that the rechargeable battery is fully charged.

b) Switch ROTALIGN® Ultra on and wait for Program Manager screen to appear.

c) Attach the 'short' USB/peripheral devices cable ALI 12.503 to your ROTALIGN Ultra.

d) Insert the approved PRÜFTECHNIK memory stick ALI 4.451-1G into the 'short' USB cable.

e) On inserting the memory stick, ROTALIGN Ultra beeps and all 4 alignment condition LEDs blink followed by the screen below

Should the firmware on the memory stick be of the same version as that present on the instrument, the instrument beeps and the 4 LEDs will blink but no update action will take place.

You are about to start the upgrade process therefore pay special attention to the hints appearing on the display. Do not remove the memory stick during the entire upgrade process. This may take up to 15 minutes.
To start the upgrade process press and hold down Enter until the device resets. DO NOT be irritated by the hint as to whether you want to turn off the instrument or not.

Note

f) The "Flashing firmware" screen as shown next appears with the hint not to turn off the device.

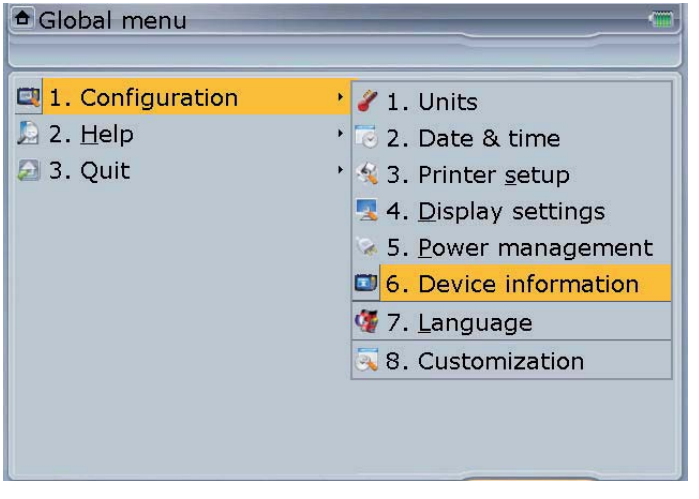
The following messages appear on the numbered locations on the screen opposite:
1 "Flashing firmware... Do not turn the device off"
2 "flashing firmware 1

g) When the final flashing phase is completed, the hint "Verifying the last firmware upgrade flashing" appears on the display with the 4 LEDs blinking continuously.
h) After the automatic update is completed, the next screen appears.

i) Press and hold down Enter until the device resets. This is indicated with a beep and the blinking of the 4 LEDs.

j) After reset, the "Flashing firmware" screen appears again followed by the loading of the program manager. The update is now completed and the 'short' USB cable may be disconnected from ROTALIGN Ultra.

k) The new version may be confirmed using the menu item 'Configuration' / 'Device information'.



Chapter 6: Special applications

This chapter deals with alignment of machines that require use of special procedures rather than those for the standard horizontal alignment. These special applications include:

- Machine trains (groups of up to 14 machines coupled together for Advanced Shaft and groups of up to 6 machines coupled together for Lite Shaft)
- Cardan drive machines
- Flanged machines (mounted vertically or horizontally)

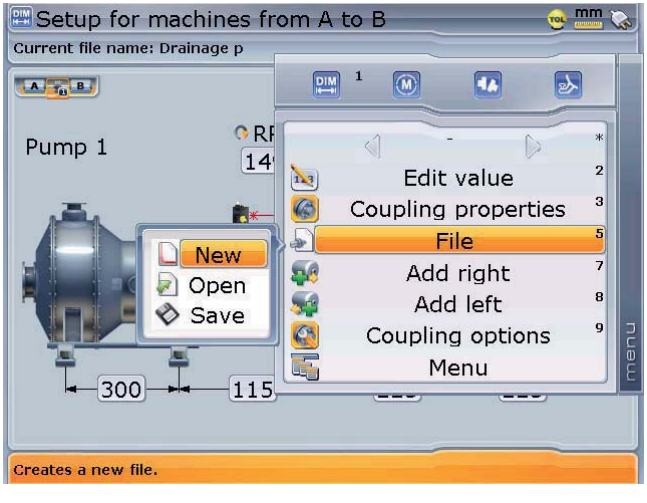
6.1 Machine train alignment

Set-up

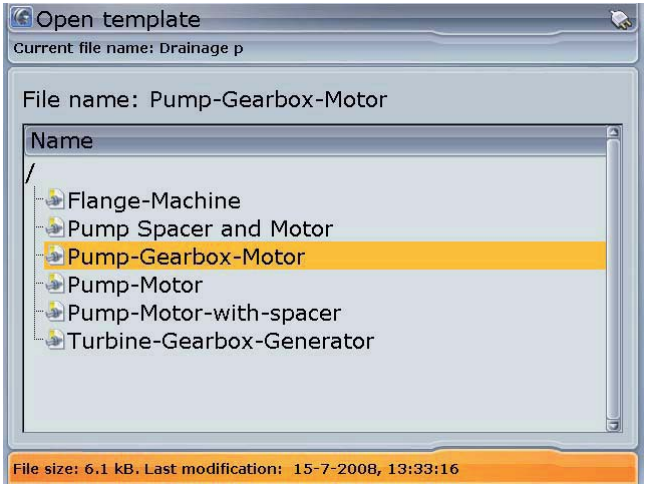
a. After starting the alignment application, either select a suitable template or configure the machines as appropriate.

b. To select a suitable template, press Menu while in the set-up screen. The context menu appears.

c. Use △/▽ to select 'File'/'New'.

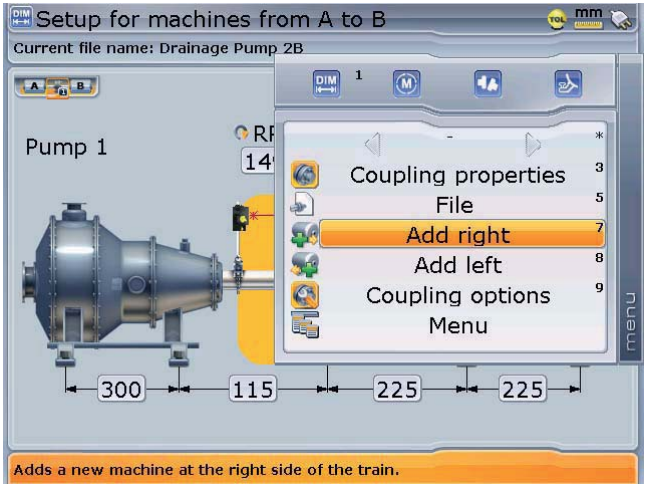


d. Press Enter. The 'Open template' screen appears. Use △/▽ to select required template.



After highlighting the required template, confirm selection by pressing Enter.

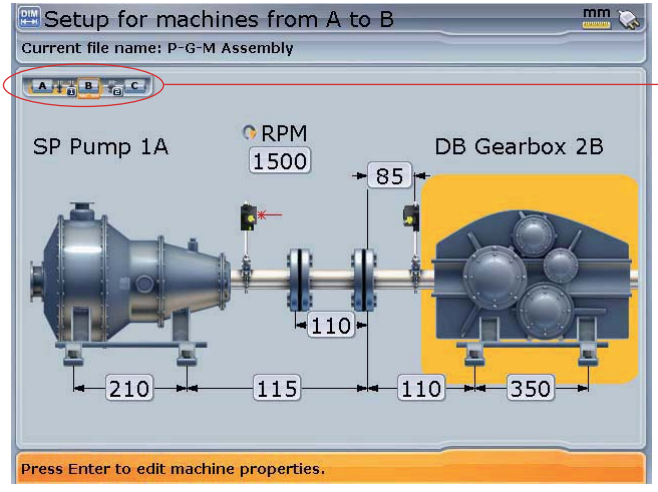
e. Multiple machine trains can also be configured from the set-up screen. Press Menu. The context menu appears. Use △/▽ to highlight 'Add left' or 'Add right' depending on which end of the machine train a machine is to be added.



With the context menu displayed, pressing 7pqrs or 8tuv automatically adds a machine to the right or left end of the machine train respectively.

After highlighting the required train end, confirm selection by pressing Enter.

f. After either selecting an appropriate template or configuring the machine train, proceed to define the machines and enter the corresponding dimensions as detailed in chapter 3.



Machine elements in view are highlighted

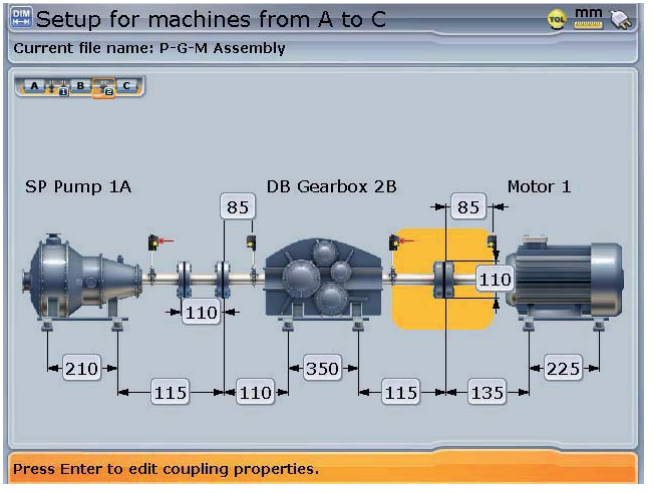
How to align machinery trains

The following step-by-step approach is recommended for multi-element trains.

a. Measure alignment at each coupling
b. Display results and optimize corrections (by defining 'stationary' machine feet)
c. Align two machines (remount sensors if necessary)
d. Check alignment results
e. Align the next two machines and repeat alignment check
f. Repeat step (e) until all machines have been aligned.

Measurement

a. While in the set-up screen, use △ to zoom out the machine train. Pressing the key repeatedly will zoom out until the entire machine train fills the display screen.



b. Use ◁ / ▷ to select the machine coupling to be measured first.
c. Ensure the laser is mounted on the left side of the selected coupling.
d. Remove the dust cap from the laser and switch it on. Leave the sensor dust cap on.
e. Press (M) and adjust the beam onto the sensor (see chapter 3).
f. Proceed to carry out measurement as described in chapter 3, observing the requirements for valid measurement – shafts must be turned by at least 60°, a minimum of 3 measurement points to be taken.
g. Press Enter to stop measurement.

If the measurement mode used is not continuous sweep, measurement is stopped by pressing Menu and then highlighting 'Stop', and confirming selection by pressing Enter.

h. Switch the laser off and mount the laser and sensor across the next coupling.
i. While in 'Measure', press and hold ◁ / ▷ to move to the next coupling to be measured.

Note

Please make sure when moving the laser and sensor to each coupling that the dimension from sensor to coupling center is entered correctly in the dimensions screen.

To view any respective part of the train closely, highlight the section using ◁ / ▷ then zoom in by pressing ▽.

A machine train of up to a maximum of 14 machines (13 couplings) can be configured [Advanced Shaft]. You may view the entire machine train at once through the ‚zoom out' function, however, the maximum number of machines for which all dimensions can be viewed at one time is 5 machines (4 couplings) Simply use ◁ / ▷ to scroll through the machines in the train. While in the measurement screen, you may jump to the desired coupling to be measured by pressing and holding ◁ / ▷.

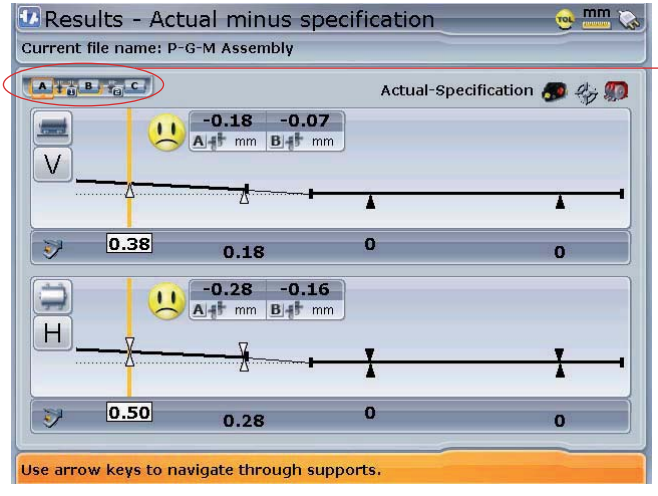
Note

Always make sure the coupling you are measuring is the one actually highlighted in the machine train!

l. Repeat the measurement procedure (step c through h) until measurements have been taken across all couplings.

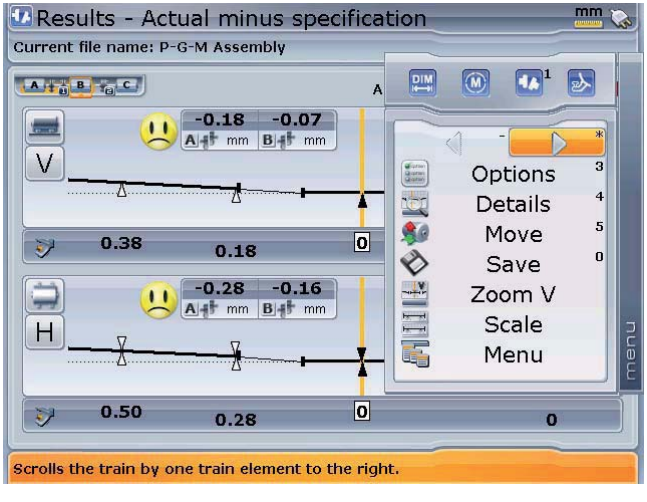
Evaluating results

a. Press (RES) to view the alignment results at the individual couplings.

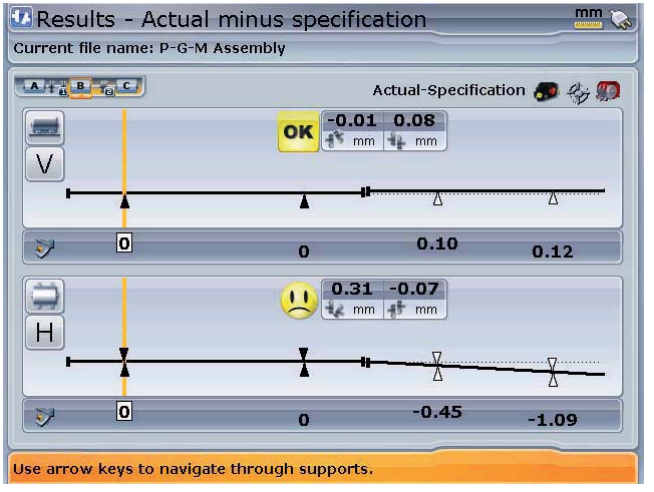


Highlights coupling being viewed

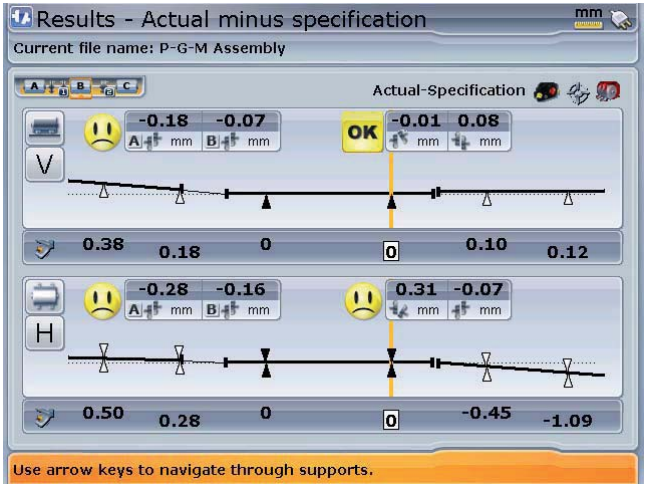
b. To view the results at the next coupling, press (Menu) and use (△)/(▽) to highlight the direction arrow to the next coupling or, simply press and hold (◁)/(▷) to jump to the next coupling in the train.



c. Press (Enter) to view the alignment results at the next coupling.



d. To view the alignment results of the entire machine train, press △ and hold to zoom out the train, or simply press RES .



After deciding on which pair of machines to move in a train, you may need to reinstall and readjust the laser and sensor across the chosen coupling. Be sure to install the sensor at exactly the same location on the shaft or coupling as previously. If you discover later that you made a mistake, you can always correct the sensor-to-coupling dimension in the Measurement table individually for any alignment measurement or move, without affecting any of the other measurements or moves.

6.2 Cardan shaft alignment

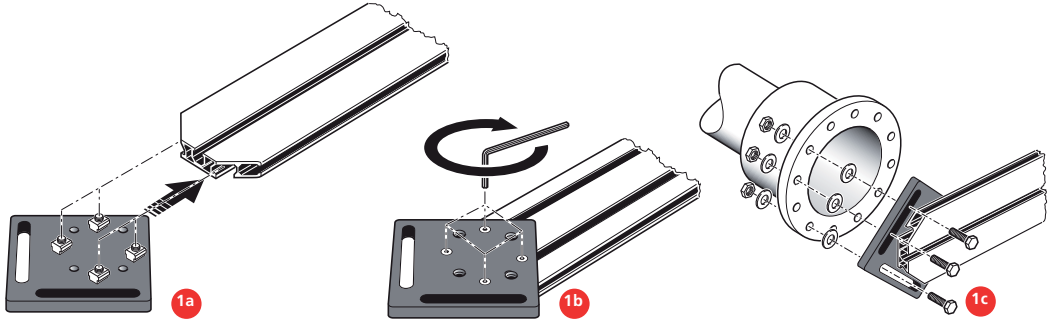
This section describes the aligning of cardan shafts using the cardan shaft bracket lite ALI 2.874 SET in conjunction with ROTALIGN Ultra. Cardan drives are installed and operate with a large offset between the driver and the driven shaft. The spacer shaft is set at a considerable angle (usually 4° to 6°) in order to ensure sufficient lubricant circulation, which in turn prevents the universal joints from seizing. Excessive misalignment of such a configuration leads to rapid fluctuation of the driven shaft RPM during

operation, which holds grave consequences for electronically-controlled synchronous and asynchronous AC drive motors.
Precise alignment reduces the rotational irregularities of the cardan shaft to a minimum, so that the uneven bearing loading during cardan shaft rotation is also minimized, the service life of the components is extended and the chance of unexpected machine failure is reduced.
The measurement procedure described here allows precise measurement of machines joined by cardan shafts over distances of up to 3 m (10 ft) and shaft offsets of up to 400 mm (15 3/4 in.) using ROTALIGN Ultra.

1. Mounting the faceplate to the rail

a. Slide the the faceplate down the rail as shown in figure (1a) below. The four T-nuts should sit in the grooves.
b. After positioning the faceplate on the rail, tighten the four socket head screws using the provided M6 allen key.
c. Mount the bracket assembly to the coupling face of the non-rotatable shaft. If the coupling face has a raised rim, the precision machined spacers are used as shown in order to separate the bracket faceplate from the coupling face.

(Without the spacers, there would be no direct contact between the faceplate and the coupling surface surrounding the bolt holes – exactly the location where the faceplate and coupling are being joined.) The washers prevent the nuts from marking the coupling surface when tightened.
Depending on the relative positions of the machines joined by the cardan shaft, an inclinometer or spirit level should be used to position the bracket assembly at the same angle as the cardan shaft when installed, before tightening down the bolts. A design drawing from the machine manufacturer can be helpful in determining the intended horizontal and/or vertical offset between the machine coupling halves. The inclination can be calculated from these horizontal and vertical distances as follows:
Inclination = arctan (vertical offset / horizontal offset)



2. Mounting the laser holder assembly on to the rail

a. Loosen the handwheel slightly, then slide the laser holder assembly down the center groove of the rail, with the T-nut acting as a guide.
b. Fasten the laser holder assembly onto the rail at the appropriate position by tightening the handwheel.

3. Mounting and adjusting the ROTALIGN laser

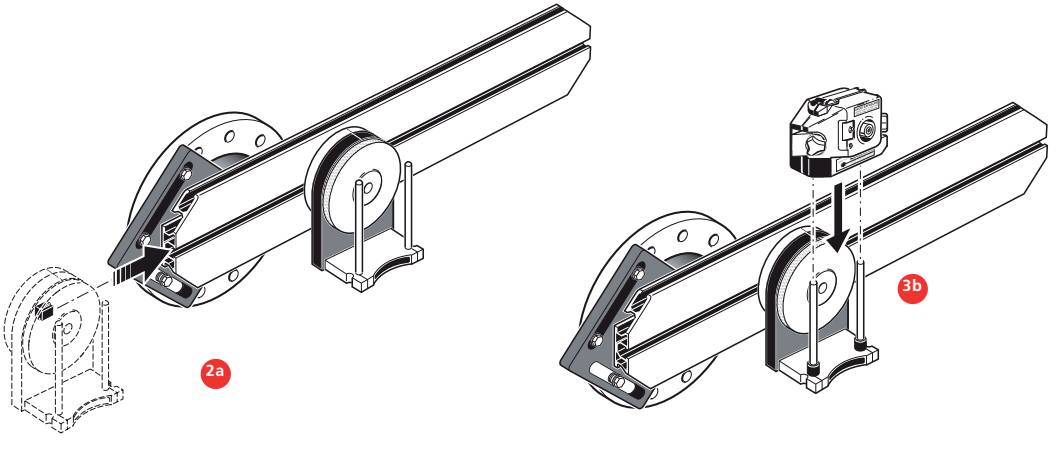
a. Slide the two black distance sleeves down the support posts.
b. Slide the laser onto the posts until it rests on the distance sleeves.
c. Mark a set of target crosshairs on the shaft rotation centerline of the other machine coupling (if the flange has a center hole, a dust cap can be inserted to provide a temporary target surface).
d. Switch on the laser and adjust the beam to strike the center of the target on the opposite coupling:

Prior to mounting the laser, adjust both yellow adjustment thumbwheels to the approximate center of their travel range so that the laser beam is emitted as straight as possible.

› For rough adjustment, loosen the handwheel and slide the holder along the rail; loosen the yellow locking knobs to adjust the beam height.
› For fine adjustment, use the thumbwheels on the laser housing to center the laser beam onto the target.

If a specific offset between the driver and driven machine shaft centerlines is desired, slide the laser holder along the rail to a point where its own centerline of rotation is located precisely at this desired amount of offset from the centerline of rotation of the coupling to which the faceplate is attached.

Note

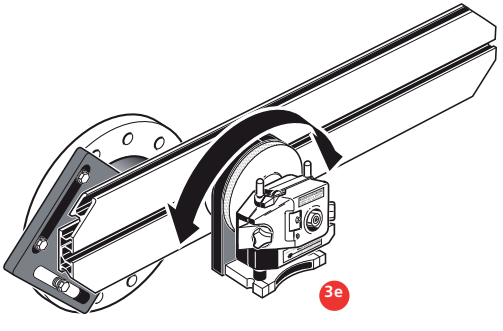


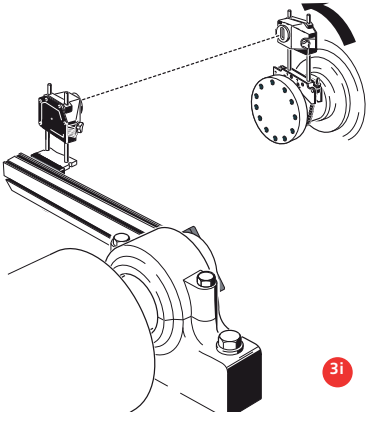
e. Rotate the laser holder one complete revolution. The laser beam should not drift from its target at any time; if the laser drifts away from the target, repeat the previous step.

To adjust the beam, note start position of the beam, then rotate the laser holder 180°. Note position of the beam. Return to the start position and using the yellow adjustment thumbwheels, adjust the beam in the horizontal and vertical directions to a position midway between the beam's start position and 180° position. Repeat this process until you can rotate the laser holder through one complete revolution without the beam moving from its original position.

Note

f. Switch off the laser and remove it from its holder.
g. Using the provided M5 allen key, loosen the support posts and slide them through the bracket frame so that they protrude from the other side.
h. Remount the laser onto the support posts
i. Use the chain-type bracket to mount the sensor on the opposite machine shaft, then connect it to the ROTALIGN Ultra computer.
j. Switch the laser back on, then adjust the beam onto the sensor (refer to 'Laser beam adjustment' in chapter 3).

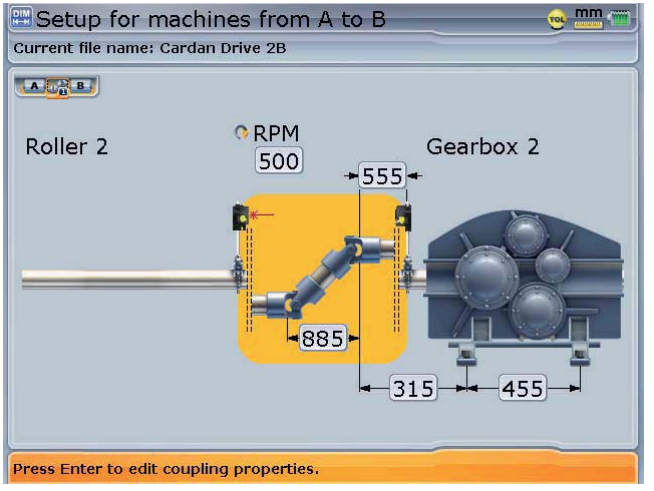




4. Set-up and measurement

a. Switch on the ROTALIGN Ultra computer.

b. Set up the machines (refer to chapter 3) and select the coupling type ‘cardan shaft’.



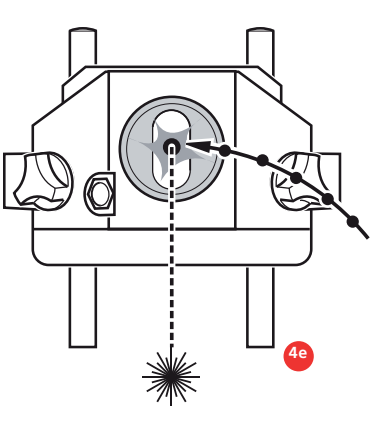
In this configuration, the coupling type display format selected is ‘Angle’

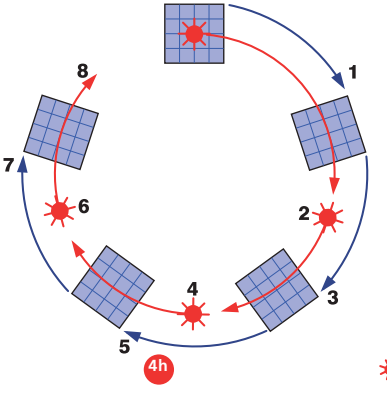
c. Remove the sensor dustcap and press (M). The laser beam location should be apparent in the adjustment screen.

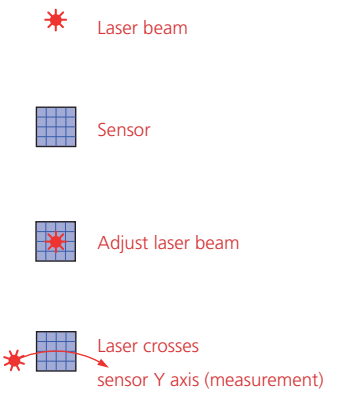
d. Press (Menu). A context menu appears. Use the context menu item ‘Mode’ to select the ‘Multipoint’ measurement mode. (For details about this mode refer to chapter 4.)

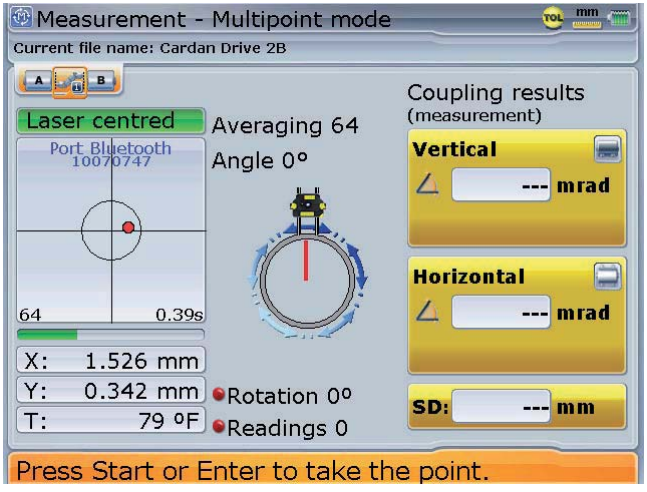
e. Place the specially designed beam adjustment cap (ALI 3.606 UN) that helps with monitoring the position of the beam during rotation on the sensor lens and center laser beam (for details to ‘laser beam adjustment’ refer to chapter 3).

If “Pass mode” measurement is used, please refer to the relevant technical information which is available from your local PRÜFTECHNIK representative.









f. Press Enter to take the first measurement.

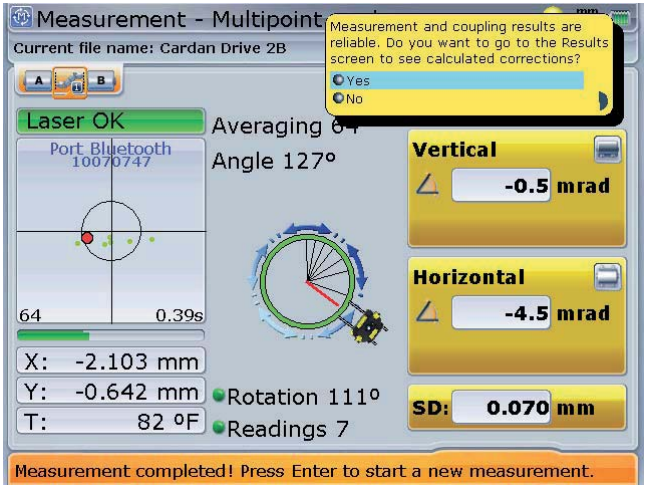
g. Rotate the sensor to the next measurement position.

h. Turn the laser-side shaft and observe the detector view in the measurement screen (above): at the moment when the laser dot crosses the Y-axis, press Enter to take the next measurement.

i. Repeat steps g and h to take measurements in at least three positions over at least 60° of rotation. (Taking more position measurements improves the reliability of results.).

j. When enough measurement points over at least 60° rotation have been taken, press Enter to stop measurement.

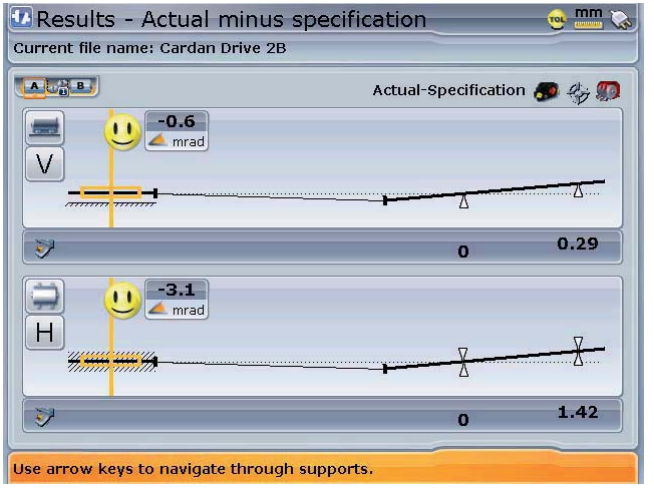
Alternatively, stop measurement by pressing Menu followed by 9wxyz.



5. Evaluation and alignment

Since offset does not affect the performance of cardan shafts, only angularity must be corrected here.

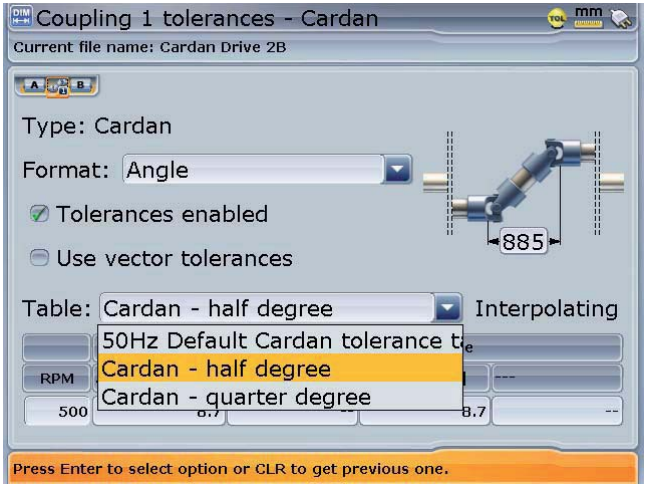
a. Press (RES) to view alignment results.



In this example the automatic tolerance evaluation returns a happy face in both horizontal and vertical directions. This indicates that the machines are aligned within the specified tolerances and therefore no further aligning action may be required.

Note

A PRÜFTECHNIK cardan shaft tolerance table is available for 1/2° and 1/4° limits. The tolerance table is accessed via 'Coupling properties' (for details refer to chapter 3).



The tolerance table may also be accessed as described under 'Tolerances' in chapter 4.

If a specific amount of offset between the machine shafts was desired and the laser holder assembly was set up to this precise offset as described in step 2b above, then, after the angular alignment of the movable machine is completed, remount and readjust the laser as described in steps 3a through e and proceed to adjust the movable machine in a parallel manner both vertically and horizontally until the beam spot hits the movable machine shaft's centerline of rotation, taking care not to change its angular alignment.

b. If the machines are out of tolerance, reposition them with the help of the MOVE function (refer to chapter 3).
c. Remeasure to determine the new alignment condition.

6.3 Flanged machines

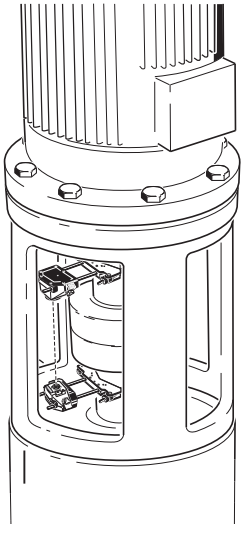
A typical vertical machine arrangement comprises one machine mounted on top of the other using a bolted flange.
Flange-mounted machines can be situated vertically or horizontally. In either case, alignment corrections are made directly at the flange.
Angularity is corrected by inserting or removing shims between the flanges. ROTALIGN Ultra calculates the shimming thickness for each flange bolt. Offset is corrected by positioning the flange laterally.

1. Overview - vertical machinery

Before commencing with this section, please acquaint yourself with 'Horizontal shaft alignment' in chapter 3.

Note

The laser and sensor are mounted on either side of the coupling as for horizontal machines, with the laser on the shaft of the machine designated stationary. The electronic inclinometer cannot determine the rotation angle of vertical shafts; therefore measurements must be taken on vertical machines using static measurement mode. The eight 45° measurement positions used with this procedure must be marked accordingly on the machine.



A typical vertical machine arrangement consists of one machine mounted on another, bolted together at a flange

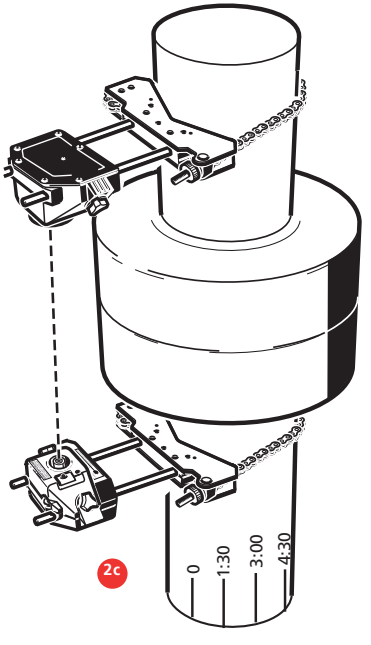
2. Marking measurement positions

a. Mark a reference position on the coupling housing close to the shaft and in line with a convenient external reference or flange bolt. Likewise, mark a reference point on the shaft.
b. Measure the circumference of the shaft and divide by eight.
c. Use this distance to make seven more evenly-spaced marks on the shaft beginning at your chosen start point. Number the points counterclockwise as seen from sensor to laser, beginning with 0 first, followed by 1:30, 3:00,4:30, 6:00, 7:30, 9:00 and 10:30.

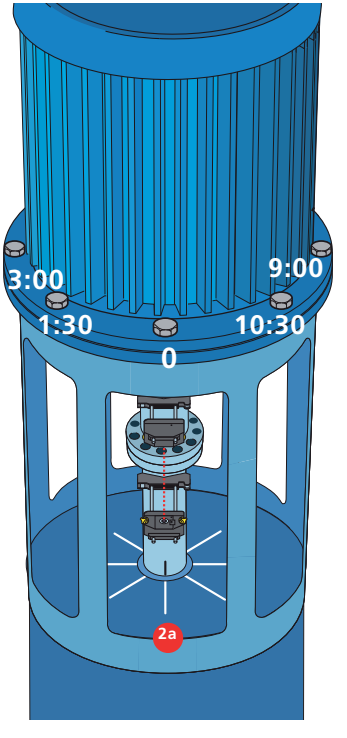
For circular housings, measure the circumference of the coupling housing and divide by eight. Use this distance to make eight evenly-spaced marks on the housing beginning at your chosen start point. Number the points clockwise looking down onto the shaft with 0 as the first, followed by 1:30, 3:00,4:30, 6:00, 7:30, 9:00 and 10:30.

3. Set-up

a. Mount the laser and sensor on either side of the coupling, ensuring that they are aligned exactly with the 0 or reference mark.

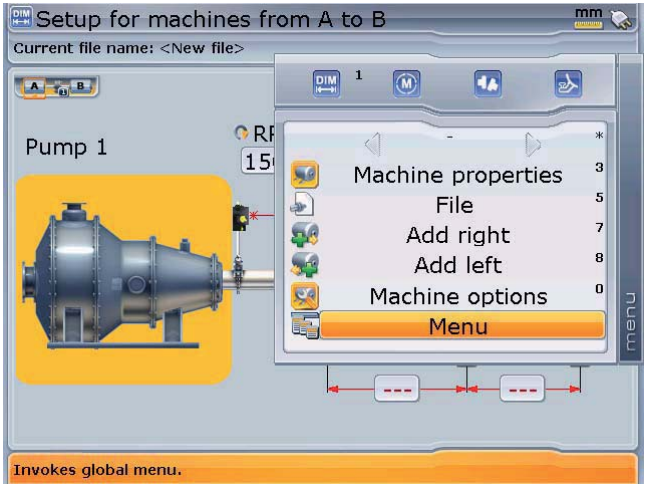


Evenly-spaced marks are made on the bearing housing beginning with 0 as the reference and numbered clockwise looking down onto the shaft.



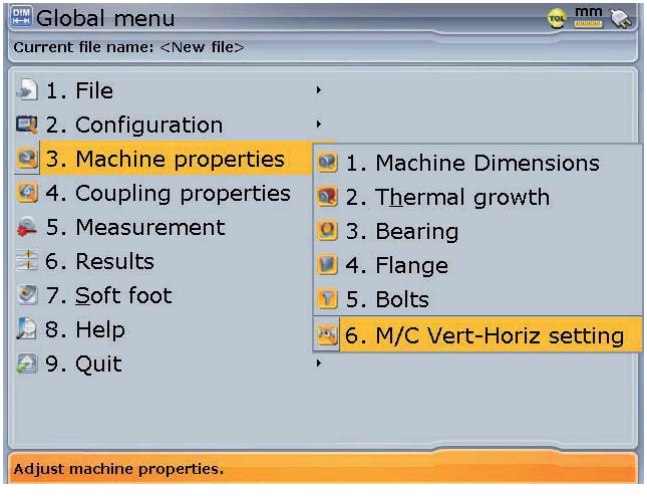
b. Connect the sensor to ROTALIGN Ultra and switch on the device.

c. Start the shaft alignment application. When the opening set-up screen appears, press (Menu). The context menu appears. Use (△)/(▽) to highlight 'Menu'.



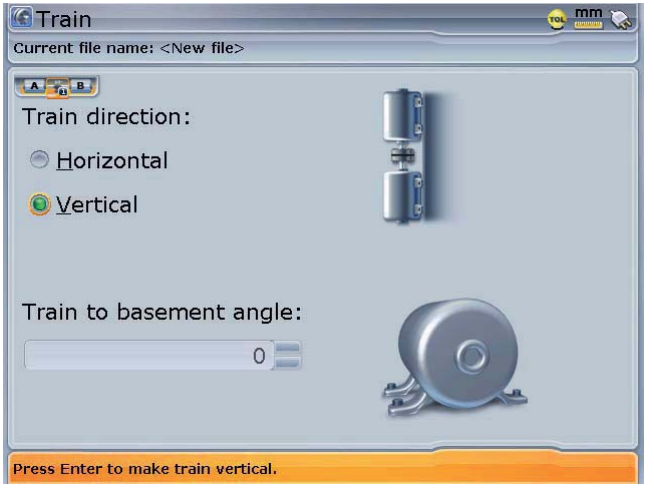
The global menu can be opened directly from this screen by pressing (Menu) twice.

d. Press (Enter) to access the global menu, then use the navigation keys to select 'Machine properties' / 'Machine vertical-horizontal setting'.



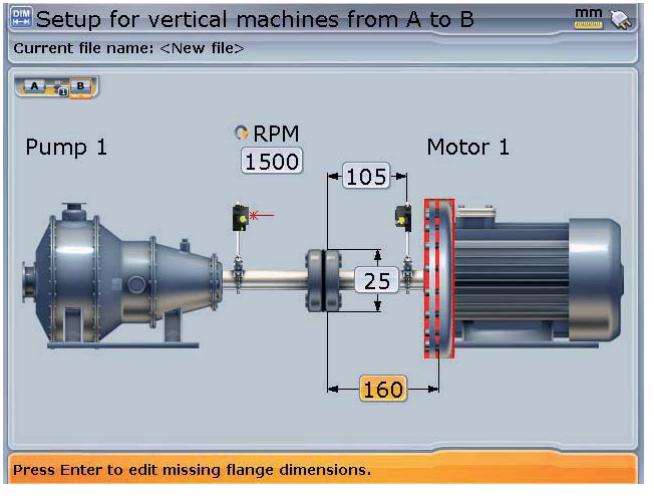
The train orientation screen may be accessed directly from the global menu by pressing (3def) followed by (6mno).

e. Confirm selection by pressing (Enter). The train orientation screen appears.

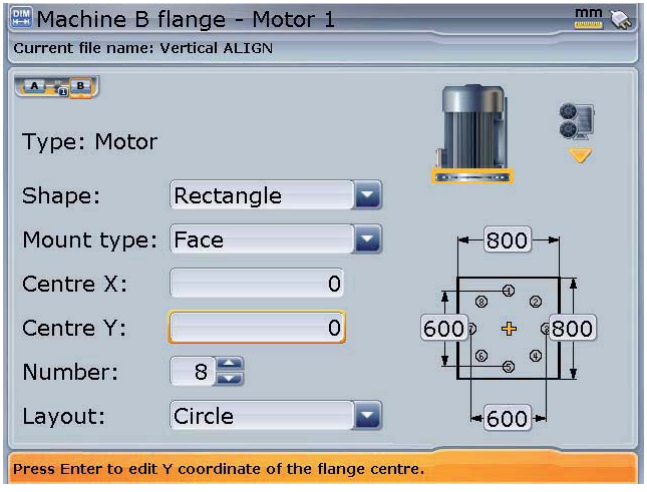


f. Use the navigation keys to select the train orientation 'Vertical'. Confirm selection by pressing Enter. The confirmed machine orientation is depicted on the screen. Use t to return to the set-up screen.

g. Configure the machines as appropriate. (Refer to 'Enter machine dimensions' in chapter 3).



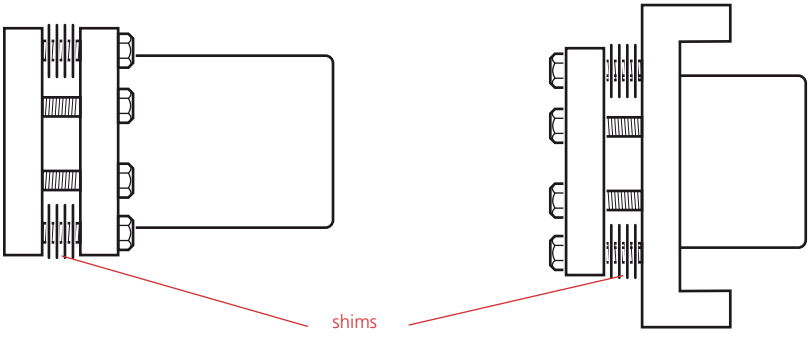
h. When entering machine dimensions, the flange geometry must be taken into account. Use the navigation keys to highlight the flange-mounted machine then press Enter. A hint requesting the definiton of the flange appears. Confirm by pressing Enter. The flange editing screen shown next appears.



Details on how to navigate and edit items on this screen are discussed under 'Machine properties' in chapter 3.

i. Use the naviagtion keys to cycle through the flange properties.
   - › The shape of the flange is selected from the 'Shape' drop down menu. Any one of the following shapes may be selected from the menu: 'Circle', 'Rectangle', 'Polygon'
   - › Flanges can either be face or reverse-mounted. The mounting is selected from the 'Mount type' drop down menu.
   - › The exact location of the center of the shafts is defined in the boxes 'Center X' and 'Center Y'
   - › The number of bolts is edited directly using the data entry keys or △/▽
   - › The pattern formed by the bolts is selected from the 'Layout' drop down menu. The following bolt patterns are available: 'Circle', 'Rectangle', 'Polygon
   - › The flange dimensions and bolt pattern lengths are entered directly using the data entry keys

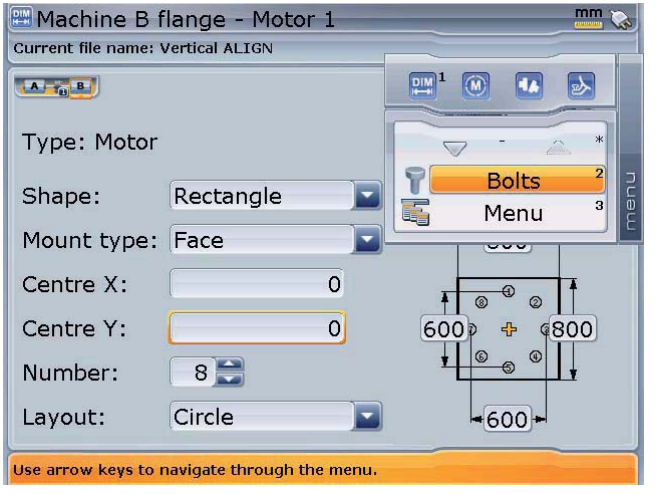
An elliptical flange and bolt pattern may also be configured. Simply select a 'circle' flange shape and 'circle' bolt layout, then edit the flange length and width and bolt pattern length and width dimensions individually.



face-mounted (standard)

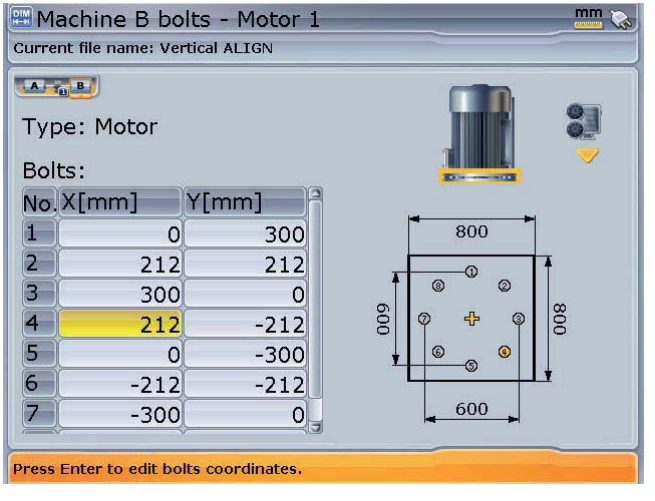
reverse-mounted

j. It may be necessary to edit the bolt coordinates. To do this, press Menu while in the machine flange screen. The context menu appears.



Alternatively, the bolts coordinates screen may be accessed by using ▵/▿ to highlight 'Bolts' then pressing Enter to confirm selection.

m. Press 2abc to directly access the bolts coordinates screen. This screen shows the polar and cartesian coordinates of the bolts relative to the chosen shaft center.



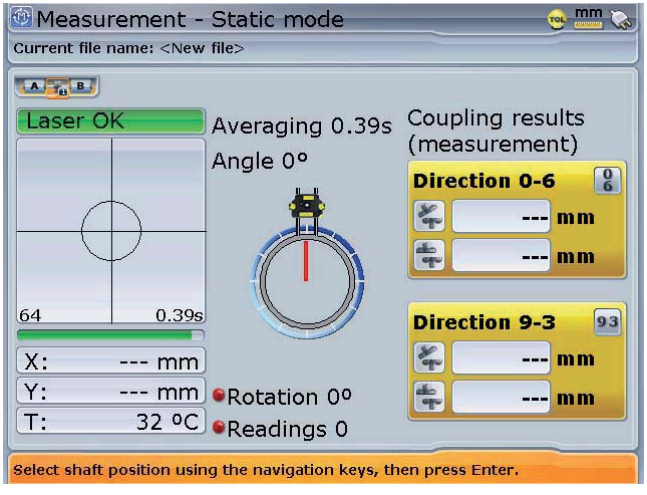
Use the navigation keys to highlight the X/Y coordinate of any bolt position. The highlighted value may be directly edited using the data entry keys.
In this example, the X-coordinate of bolt number 4 has been highlighted. The corresponding bolt pattern position also appears highlighted.

4. Measure

a. After entering the required dimensions, press (M) and proceed to center the laser beam.

For vertically oriented machine trains, static measurement mode is selected automatically.

Note

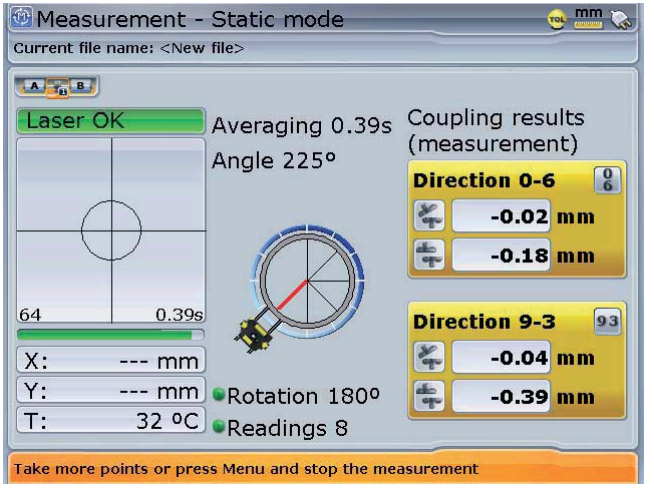


b. Rotate the shafts to the first measurement position. If using the coupling housing numbering convention, the reference mark and the measurement position 0 should be aligned or matched to each other.

c. Press (Enter) to take the first measurement point.

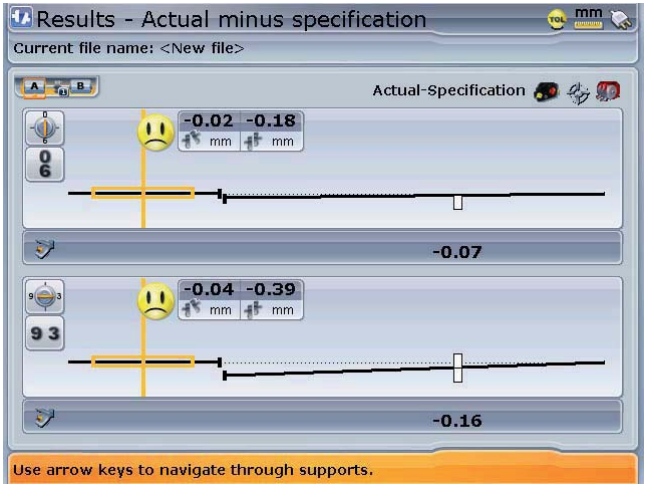
d. Rotate shaft to the second measurement position (e.g. 1:30). If the chosen measurement position does not correspond with the selected position, move the screen's red cursor (or 'hour hand') to the desired position using the navigation keys.

e. A minimum of three measurement positions are required to obtain results, but it is recommended that maximum number of measurement points be taken to maximize the quality of results.



5. Results

a. Press (RES) to evaluate results.



The results screen shows the coupling gap and coupling offset in the 0-6 and 3-9 directions. Offset corrections in the side and top view are also shown.
In this example, the 0-6 correction indicates moving the flange by 0.07 mm towards 0:00 and by 0.16 mm towards 3:00.
The screen values represent POSITION.

Sign convention

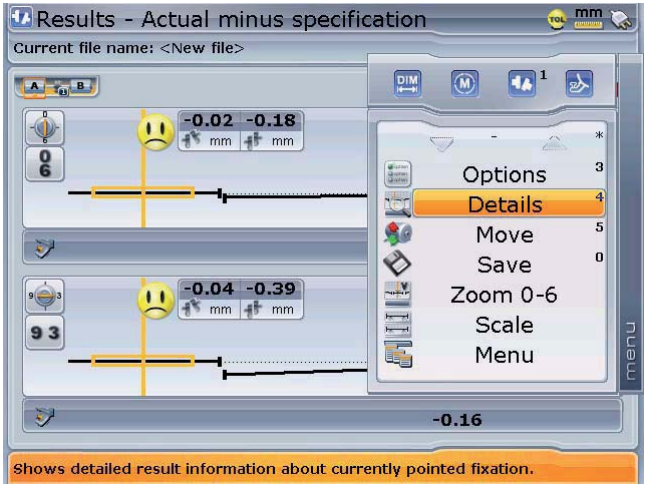
POSITIVE GAP opens towards 0:00 or 3:00

POSITIVE OFFSET if the top machine is towards 0:00 or 3:00

Remember, viewpoint is always determined by looking from the sensor towards the laser emitter. Note the little white clock face on the laser serves as a reminder of this.

Note

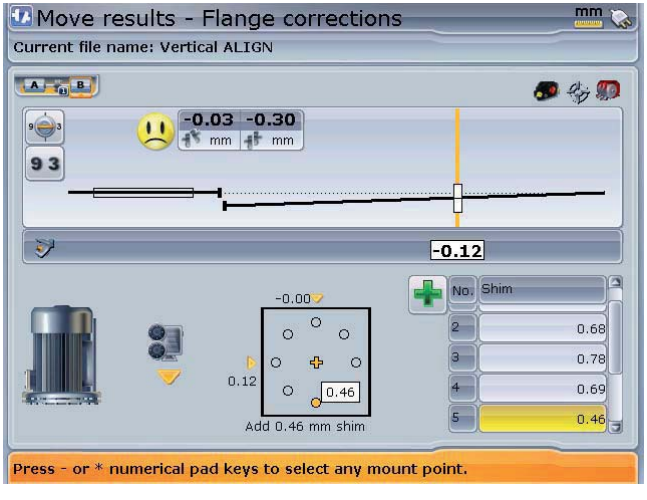
b. To obtain the shimming corrections for each flange bolt, press Menu while in the results screen. The context menu appears.



Alternatively, the 'Flange corrections' screen may be accessed by using ▵/▿ to highlight 'Details' and confirming selection by pressing Enter.

c. With the context menu displayed, press 4ghi. The 'Flange corrections' screen appears.

Flange correction details are displayed only when the cursor is on a movable element.

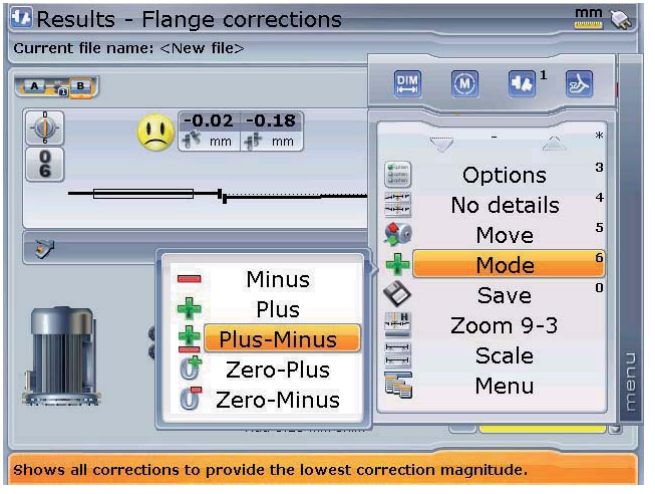


Note

The flange corrections screen shows the shimming corrections for each flange bolt. The value for each bolt position appears on the shim table and as an inset next to the flange pattern. Any bolt position can be selected by pressing either -+ (counterclockwise) or .* (clockwise).

The offset corrections to be performed on the flange are displayed along the sides of the flange schematic.

d. To choose the shimming solution best suited for the situation at hand, press Menu while in the results screen. The context menu appears.



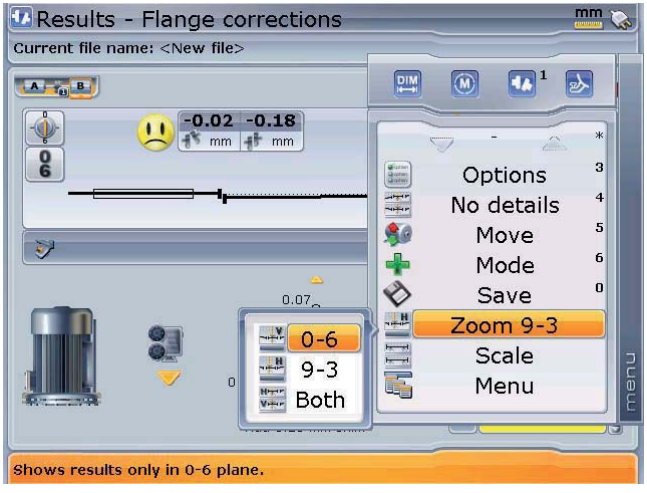
Use the navigation keys to highlight the appropriate mode, confirming selection by pressing Enter.

- (–) mode indicates all negative shimming
- (+) mode indicates all positive shimming
- (±) mode indicates optimized shimming. In this mode, half of the corrections will positive, and the other half negative.
- (0+) mode indicates zero plus shimming. In this mode, one bolt position is forced to zero and the rest are positive.
- (0–) mode indicates zero minus shimming. In this mode, one bolt position is forced to zero and the rest are negative.

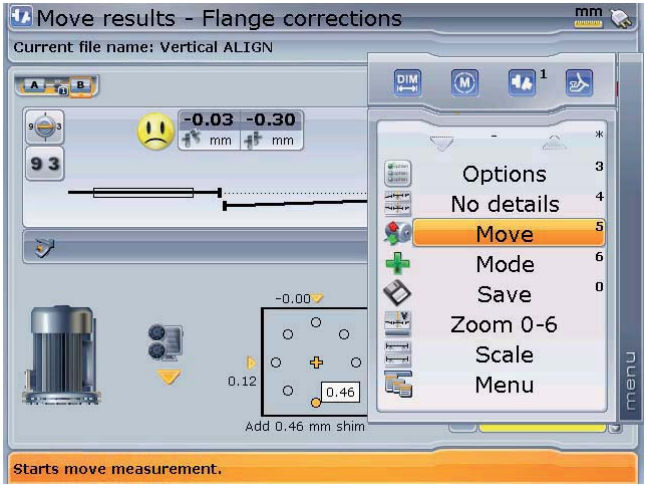
Good quality shims such as PERMABLOC, MYLAR and LAMIBLOC should be used. Contact your local PRÜFTECHNIK representative for details.

Note

e. It may be necessary to switch the view from say 0-6 to 9-3, and vice versa. From the result screen, press Menu. The context menu appears. Use the navigation keys to highlight the desired view, confirming selection by pressing Enter.

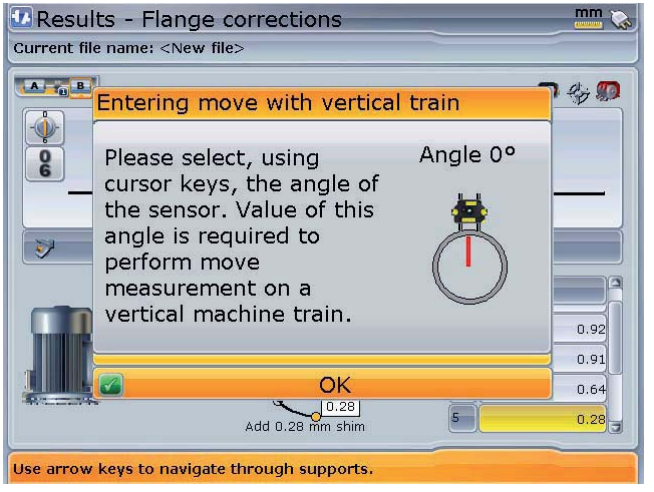


f. Offset is corrected using the 'Move' function. From the result screen, press Menu. The context menu appears.

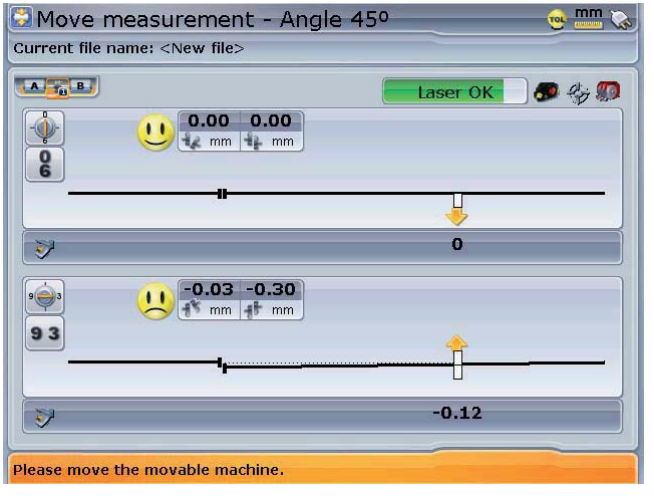


With the context menu displayed, press 5jkl to access the live Move screen. A hint requesting the setting of the sensor angle appears on the screen.

Alternatively, live MOVE may be accessed by using △/▽ to highlight 'Move' and confirming selection by pressing Enter. The sensor angle selection hint appears.



g. Use the naviagtion keys to position the sensor image on the screen to correspond to the physical position of the laser and the sensor. Press Enter to confirm selected position. The Move function auto starts.



If the Move function does not auto start, the beam is not centered. ROTALIGN Ultra will automatically switch to XY view. After centering the laser beam, press t and wait for the Move function to auto start.

Note

5. Alignment

It is recommended (but not necessary) to correct angularity first:

a. Loosen the flange bolts and lift the movable machine to a small degree.
b. Adjust shimming to make angularity corrections:
   › For face-mounted flanges, insert the indicated thickness of shims between the flanges at the respective bolt locations.
   › For reverse-mounted flanges, insert the indicated thickness of shims behind the flanges at the respective bolt locations.
c. Tighten the bolts back down, then take another set of readings to confirm alignment corrections; repeat shimming if necessary.
d. Once satisfied that overall angular misalignment is in tolerance, and no more shimming is required, proceed to correct offset.

Correcting offset misalignment:

e. Press Menu while in the results screen. Preferred is a results screen showing both 0-6 and 9-3 alignment results.
f. From the context menu that appears, access live Move by pressing 5jkl. Alternatively, access live Move by using △/▽ to highlight 'Move' and confirming selection by pressing Enter.
g. Ascertain at which position your laser and sensor are located or turn them to any desired position. Use the navigation keys to match the sensor position on the screen to the physical position of the laser and sensor. Confirm selected position by pressing Enter.
i. Loosen the flange bolts and perform offset corrections in the 0 to 6 and 9 to 3 o'clock directions while monitoring the live Move on the screen.
   › Corrections should be brought as close as possible to zero.
   › Use appropriate tools (e.g. jackscrews) to position the machine.
   › Take care not to let the shims slip out of place during lateral positioning.
j. When offset is in tolerance, tighten the flange bolts. Remeasure to check if the new alignment condition is in tolerance.
k. If not, repeat the above steps until alignment is in tolerance.

6.4 Flange-mounted horizontal machines

When machines are joined by means of flange, their alignment is determined by inserting the proper combination of shims at the flange bolts and, depending on the flange type, between the faces of the flanges. The requirements are quite similar to those for aligning vertical machines.

When the shaft rotates around a horizontal axis, the electronic inclinometer detects the rotational position during measurement, which may be taken in any desired measurement mode.

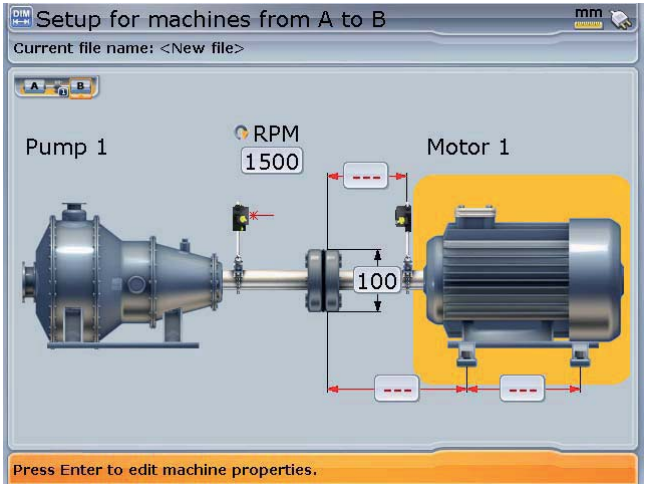
Based on the measurements taken, the computer determines the thicknesses of shims to be fitted between the flanges required to align the shafts.

Alignment procedure

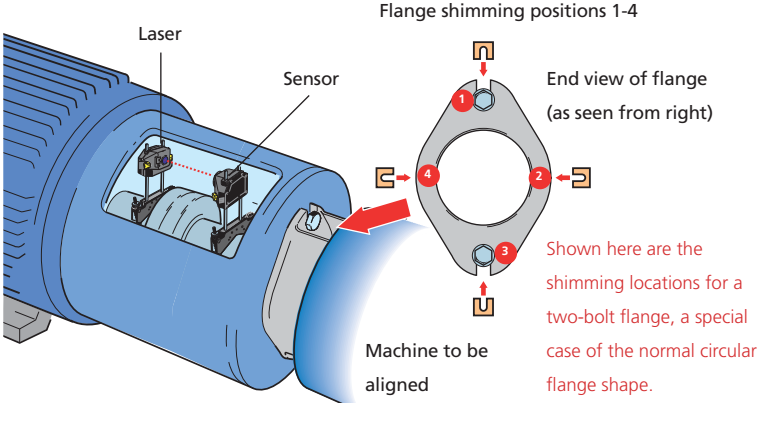
Set-up

a) Mount the laser and sensor on the shaft. The laser mounts on the left machine and the sensor on the right. This arrangement is identical to the standard ROTALIGN Ultra screen display for horizontal machines.

b) Switch on ROTALIGN Ultra by pressing Enter and holding for a few seconds. When the program manager screen appears, use the navigation keys to highlight 'Shaft Alignment'. Press Enter to access the application. The opening template in the set-up screen appears.

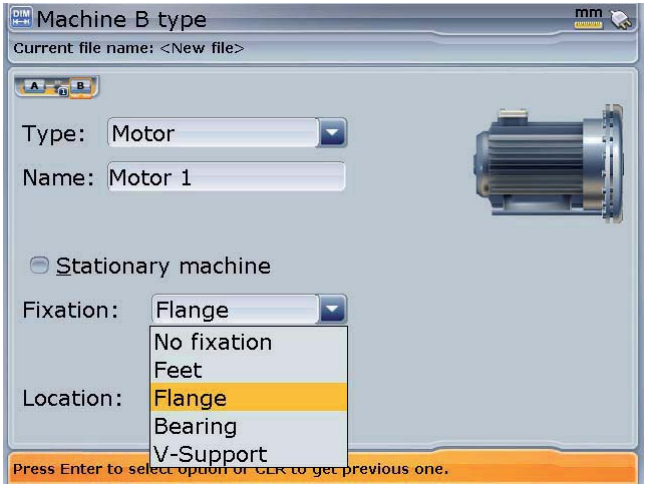


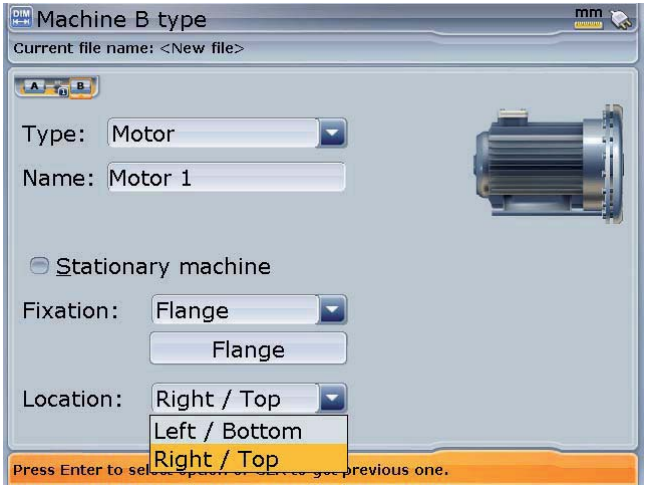
Configure the machines directly from this screen as descibed in chapter 3.



Shown here are the shimming locations for a two-bolt flange, a special case of the normal circular flange shape.

c) Important in this configuration is the flange position and configuration. Edit these as described in chapter 3.

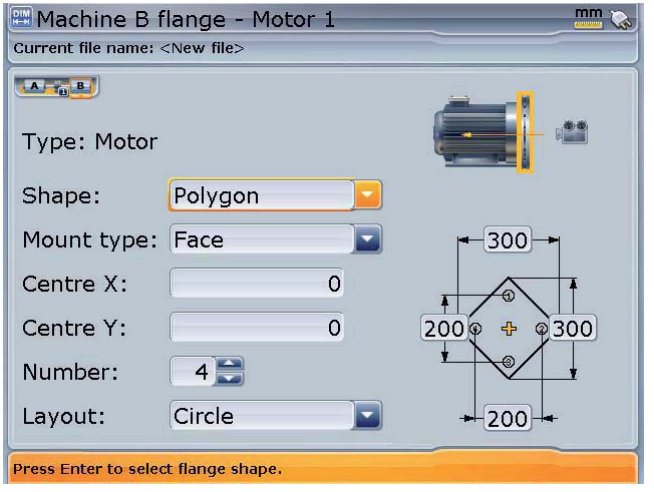




Flange geometry and dimensions

a) After configuring the machines, proceed to enter all necessary dimensions as described in chapter 3.

b) Edit the flange geometry by highlighting the flange-mounted machine then pressing Enter. A hint requesting the definition of the flange appears. Confirm by pressing Enter. The flange editing screen appears.



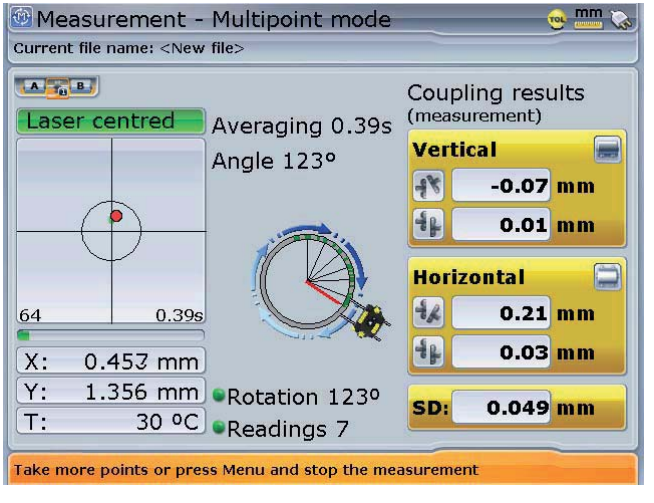
c) Edit the flange geometry as described in section 5.3 (Flanged machines).

Measure

Since the flanged machines under consideration here are mounted horizontally, a wider choice of measurement methods is available.

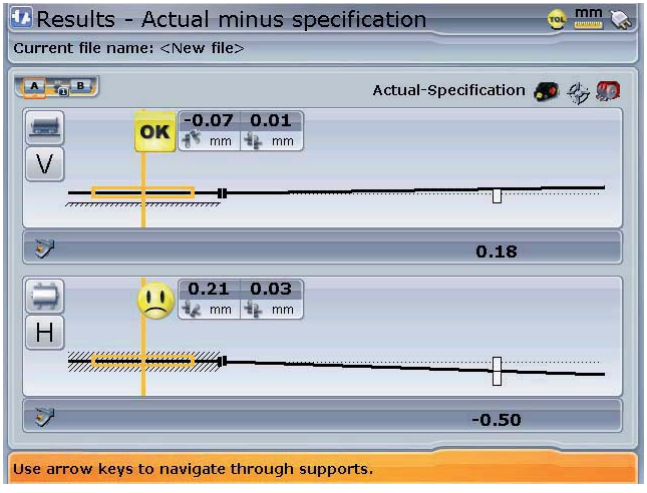
a) Press (M) and proceed to center the laser beam. The desired measurement method may be selected using the context menu as described in chapter 4.

b) Depending on the measurement mode selected, rotate shafts and take measurement as described in chapter 3 (continuous sweep measurement mode) or chapter 4 (other measurement modes).

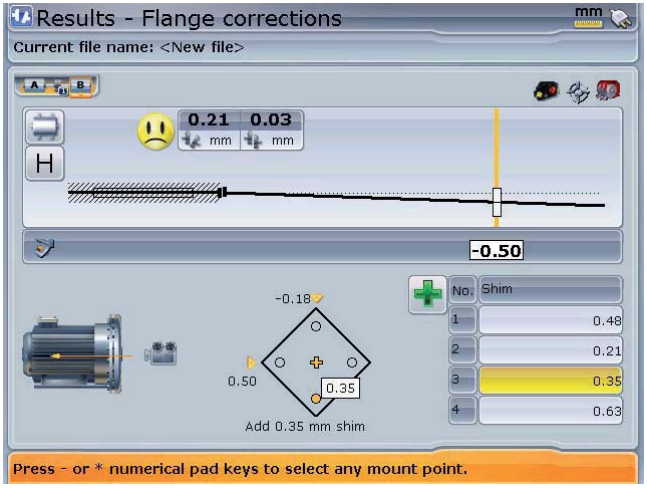


Evaluating results

a) After finishing taking measurements, press (RES) to evaluate results.



b) To view the flange shimming details, place the cursor on the movable element, then use the context menu to select the item 'Details' (This step has been described fully in section 5.3 - 'Flanged machines')



The flange is depicted as viewed from the right machine toward the left. The bolts in the figure correspond to the bolts (or shimming positions) on the flange, with the top position corresponding to number "1". The respective offset appears on the top half of the screen.

In this example, the horizontal offset value is 0.03 mm positive. The table on the right lists the calculated shim corrections. The interpretation of the shim corrections has been described in section 5.3 – 'Flanged machines'.

Shimming

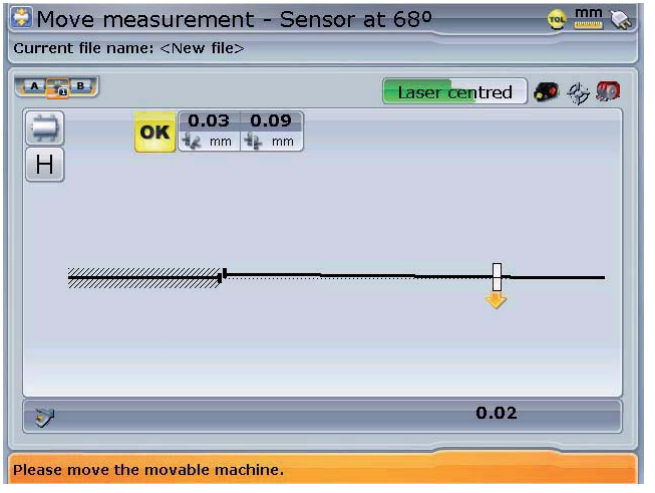
Loosen the bolts and fit the shims according to the values given in the table. Try to avoid any lateral movement of the machine while doing so. When finished, retighten bolts.

Remeasure

Press (M) and take a new set of readings before beginning offset corrections. The results should now show little if any shimming corrections.

Live Move to eliminate offset

Start live Move as described in section 6.3 - 'Flanged machines'.



Do not loosen the machine anchor bolts until live Move starts. Move the machine laterally (for horizontal) while viewing the screen. Jack bolts or other mechanical or hydraulic adjustment methods are recommended for best results. Tighten down the anchor bolts, then press (Enter) to conclude the horizontal alignment procedure.

Final check

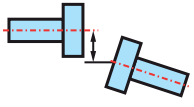
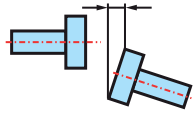
Press (M) and take another set of readings in order to confirm the alignment condition.

Remove the components from the shaft before switching on the machine!

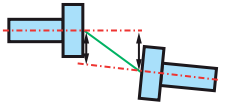
WARNING

Appendix

Suggested shaft alignment tolerances

	[RPM]	metric [mm]		inch [mils]	
Soft foot	any	0.06 mm		2.0 mils	
Short "flexible" couplings Offset 		Acceptable OK	Excellent	Acceptable OK	Excellent
	600			9.0	5.0
	750	0.19	0.09		
	1500	0.09	0.06		
	1800			3.0	2.0
	3000	0.06	0.03		
	3600			1.5	1.0
	6000	0.03	0.02		
	7200			1.0	0.5
Angularity (coupling gap difference per 100 mm or 10" diameter 	600			15.0	10.0
	750	0.13	0.09		
	1500	0.07	0.05		
	1800			5.0	3.0
	3000	0.04	0.03		
	3600			3.0	2.0
	6000	0.03	0.02		
	7200			2.0	1.0

[continued]

	[RPM]	metric [mm]		inch [mils]	
		Acceptable	Excellent	Acceptable	Excellent
Spacer shafts and membrane (disk) couplings Offset (per 100 mm spacer length or per inch of spacer length) 	600			3.0	1.8
	750	0.25	0.15		
	1500	0.12	0.07		
	1800			1.0	0.6
	3000	0.07	0.04		
	3600			0.5	0.3
	6000	0.03	0.02		
	7200			0.3	0.2

ROTALIGN Ultra technical data

Computer	
CPU	Intel XScale® Processor 520 MHz
Memory	64 MB RAM, 64 MB Internal Flash,1024 MB Compact Flash Memory
Display	Type: Transmissive (sunlight-readable) backlit TFT colour graphic display
	Resolution: Full VGA, 640 x 480 Pixel
	Dimensions: 5.7 inch diagonal
	Keyboard elements: Navigation cursor cross with up, clear and menu keys; Alphanumeric keyboard with dimensions, measure and results hard keys
LED indicators	4 LEDs for laser status and alignment condition
	2 LEDs for wireless communication and battery status
Power supply	Operating time: 25 hours (using Li-Ion rechargeable battery) 12 hours (using disposable batteries) typical use (based upon an operating cycle of 25% measurement, 25% computation and 50% 'sleep' mode)
	Disposable batteries: 6 x 1.5 V IEC LR14 ("C")
	Lithium-Ion rechargeable battery: 7.2 V / 6.0 Ah (optional)
External interface	2 x USB host for printer, keyboard or PC communication
	1 x USB slave for printer, keyboard or PC communication
	RS232 (serial) for sensor I-Data socket for sensor Ethernet
	Integrated wireless communication, class 1, transmitting power 100 mW
	AC adapter/charger socket
Environmental protection	IP 65 (dustproof and water spray resistant), shockproof
	Relative humidity 10% to 90%
Temperature range	Operation: 0°C to 45°C [32°F to 113°F]
	Storage: -20°C to 60°C [-4°F to 140°F]
Dimensions	Approx. 243 x 172 x 61 mm [9 9/16" x 6 3/4" x 2 3/8"]
Weight	1 kg / 2.2 lbs (without battery)
CE conformity	EC guidelines for electric devices (2004/108 EWG) are fulfilled
Sensor	
Particulars	5-axis sensor: 2 planes (4 displacement axes), 1 inclination 360°
	Environmental protection: IP 67 (submersible, dustproof)
	Ambient light protection: yes
	Storage temperature: -20°C to 80°C [-4°F to 176°F]
	Operating temperature: 0°C to 60°C [32°F to 140°F]
	Dimensions: approx. 105 x 67 x 47 mm [4 5/32" x 2 5/8" x 1 55/64"]
	Weight: approx. 190 g [6 7/10 oz.]
	Measurement area: unlimited, dynamically extendible (U.S. Patent 6,040,903)
	Resolution: 1 µm (0.04 mil) and angular 10 µRad
	Accuracy (avg): > 98%
	Measurement rate: approx. 20 Hz

continued

Laser

Particulars	Type: GaAlAs semiconductor laser
	Beam divergence: 0.3 mrad
	Environmental protection: IP 67 (submersible, dustproof)
	Beam power: < 1 mW
	Wavelength (typical) 675 nm (red, visible)
	Safety class: Class 2, FDA 21 CFR 1000 and 1040
	Safety precautions: Do not look into laser beam
	Power supply 9V block battery (IEC 6LR61, alkali or lithium)
	Storage temperature: -20°C to 80°C [-4°F to 176°F]
	Operating temperature: 0°C to 60°C [32°F to 140°F]
	Dimensions: approx. 105 x 67 x 47 mm [4 5/32" x 2 5/8" x 1 55/64"]
	Weight: approx. 165 g [5 13/16 oz.]

Carrying case

Particulars	Standard: ABS, drop tested (2 m / 6 1/2 ft.))
	Case dimensions: approx. 565 x 375 x 193 mm [22 2/9" x 14 3/4" x 7 7/12"]
	Weight, including all standard parts: approx. 9 kg [19.8 lb]

RF module for wireless communication with transducer (optional)

Particulars	Class 1, wireless transmitter, transmitting power 100 mW
	Transmission distance: 10 m [33 ft.]
	Complies with FCC rules part 15.247
	LED indicators: 1 LED for wireless communication, 3 LEDs for battery status
	Power supply: Batteries 2 x 1.5 V IEC LR6 ("AA")
	Operating time: 14 hours typical use (based upon an operating cycle of 50% measurement, 50% standby)
	Operating temperature: -10°C to 50°C [14°F to 122°F]
Environmental protection	IP 65 (dustproof and water spray resistant), shockproof
Dimensions	Approx. 81 x 41 x 34 mm [3 1/8" x 1 11/16" x 1 5/16"]
Weight	Approx. 133 g [4.7 oz.] including batteries and cable

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PRÜFTECHNIK
Alignment Systems GmbH
Freisinger Str. 34
85737 Ismaning
Germany
Tel +49 89 99616-0
Fax +49 89 99616-100
info@pruftechnik.com
www.pruftechnik.com

A member of the PRÜFTECHNIK Group