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ROTALIGN®

Operating Instructions
and
Alignment Handbook

Dear Customer,

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

PRÜFTECHNIK Alignment
Documentation Department
Fax: (+49) 89/ 99 61 62 00

CE

EDITION January 2000
Order Number ALI 9.381G

Foreword

Congratulations on your decision to align your machine shafts with ROTALIGN! We have built on ten years of experience in laser alignment with OPTALIGN plus two years of experience with ROTALIGN. With feedback from customers such as yourself, we have developed a system which offers unprecedented ease of use with many new features:

- Simple operation with on-screen instructions
- Graphic display for detailed depiction of any situation
- Softkeys for program-guided operating assistance
- Industrial robustness (both computer and sensors)
- Printer and RS232 interfaces
- Wide range of applications with machine customization: handles special situations (user-definable stationary feet, single bearing machines, V-form foundations, horizontal bolt-flanged machines, various coupling types, etc.)
- Nonvolatile memory for storage of alignment results, complete with operator comments
- The computer generates alignment reports for printout or transfer to a PC for long-term storage
- Power-saving intelligent "sleep" mode
- Wide selection of measurement modes to handle restrictions (even uncoupled shafts and dial gauge value entry)
- Thermal growth entry in terms of "target" coupling misalignment or thermal growth amounts expected at machine feet
- Alignment tolerance evaluation with a choice of different methods
- Stationary feet can be designated from either or both machines to be aligned
- Select from a number of languages in which to operate the computer
- "QUICK CHECK" measures alignment with a minimum of adjustment and keystrokes for fast, convenient alignment condition confirmation
- Alignment of vertical machines with completely user-adaptable bolt flange arrangements

This list is by no means complete: please continue to share your expertise with us! As in the past, we shall do our best to accommodate your wishes in future developments.

You can learn quite a bit simply by taking the equipment out of its case and working your way through this manual. To learn all the capabilities of your new ROTALIGN and many of the finer points of shaft alignment in general, contact your local PRÜFTECHNIK agent to register for his in-depth alignment training course. You'll surely find it a few days well spent.

Most of all, we would like to express our sincere thanks to you, our customer, for your vote of confidence in ROTALIGN and for joining us in the continued commitment to alignment excellence.

January 2000
PRÜFTECHNIK Alignment

Chapter 1: Introduction

This chapter includes general information regarding the ROTALIGN system and its operation including, in particular, the intended use and safety information.

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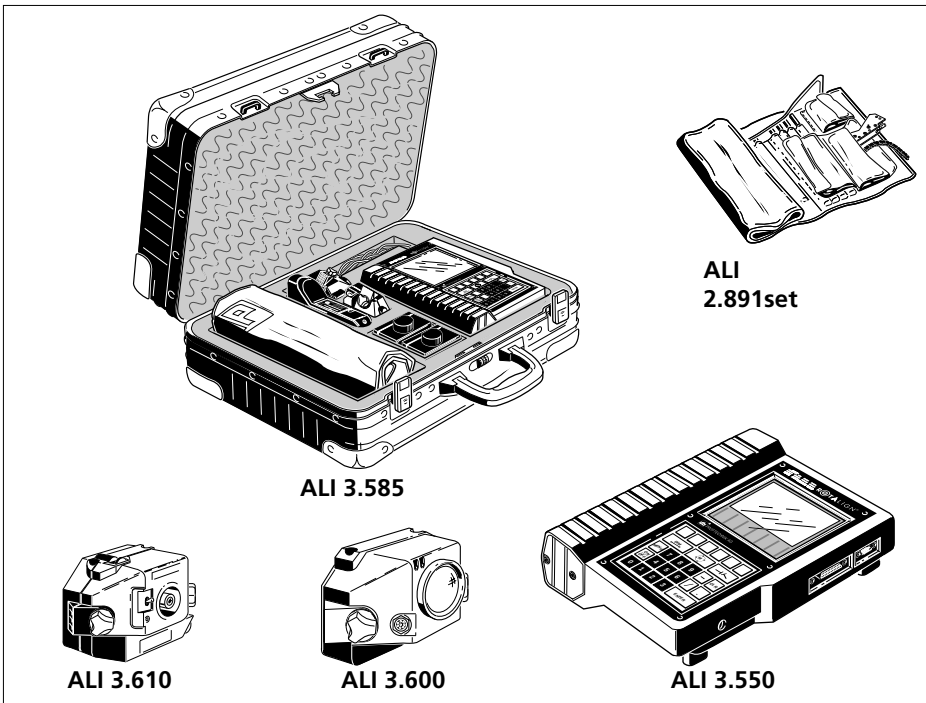
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The ROTALIGN package — ALI 3.500 / ALI 3.500EX



The ROTALIGN package contains the following items:
(Please see page 1-6 for further information on the intrinsically safe version ALI 3.500EX.)

ALI 3.585 ROTALIGN Case (ABS, black), complete with key and combination locks (page 6-14).

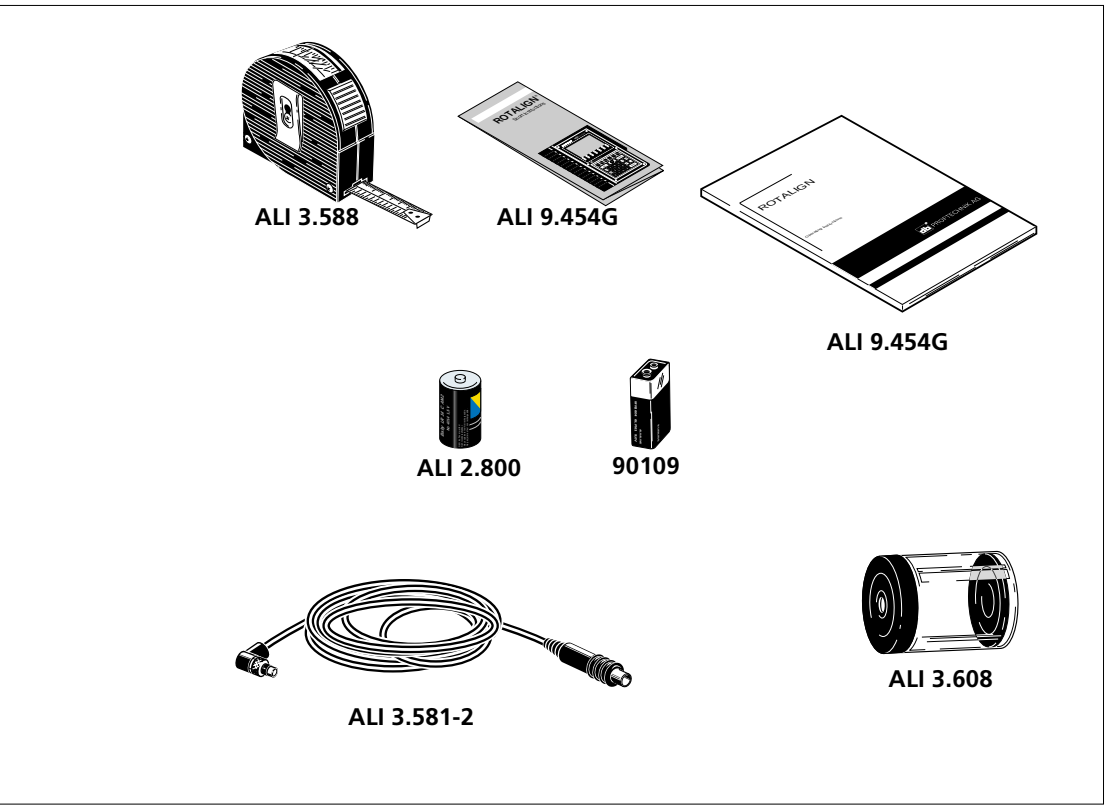
ALI 3.550 ROTALIGN Computer
Processes alignment measurements and displays results. Battery or mains operated (page 2-3).

ALI 3.610 ROTALIGN Laser incl. dust cap, incl. 9 V battery
Mounted on left side of the machine coupling (page 2-13).

ALI 3.600 ROTALIGN Receiver incl. dust cap
Mounted on right side of coupling and connected to computer (page 2-15).

ALI 3.581-2 ROTALIGN Receiver cable 2 m (6½ ft.)
Connects receiver to computer (page 2-7).

ALI 2.891set Compact chain-type bracket set in pouch
Used to mount the components on the machine shaft (page 2-16).



ALI 3.588	Tape measure, mm/inch (page 4-21)
ALI 9.454G	ROTALIGN Short Instructions
ALI 9.381G	ROTALIGN Operating instructions
ALI 2.800	6x 1.5 V alkaline battery (IEC LR 14 / size "C") (MAIN BATT) in computer (page 2-9)
90109	9 V battery (6LR 61) (AUX BATT) in computer (page 2-11)
ALI 3.608	Adjustment tube for centering laser beam (page 2-15)
ALI 2.905	Optics cleaning cloth (page 6-36)
0 0739 1055	Allen wrench, 2.5 mm for access to battery compartments (page 2-10)

Before you start!

Welcome to the ROTALIGN instruction manual and alignment handbook! The ROTALIGN alignment procedure is intended to be straightforward with self-explanatory diagrams and messages on the computer screen to show what's going on - so that you shouldn't have to consult this manual too often!

Everyone

Please acquaint yourself first with the important notes and safety, warranty and care information given on pages 1-5 through 1-9. Also important are the sections "Batteries and power supply" on pages 2-9 through 2-12 and "Warranty, Service and Care" on page 6-36.

Beginners

Read through the chapters on the ROTALIGN components and computer, and on alignment theory and practice. Then try an actual alignment by following the instructions starting page 4-7.

Experts

If you have some experience in alignment, e.g. with OPTALIGN, and are familiar with computers, you may even be able to start right away by following the on-screen messages. Step-by-step alignment for a standard horizontal machine arrangement is described starting on page 4-6. After you have mastered a standard alignment, browse through the section "Menu" to learn about ROTALIGN's special capabilities.

And finally,



Note

Remember...

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

Do not stare into the laser beam!



Note

If, while working with the ROTALIGN computer, it should "lock up" or an error message appear, refer to the troubleshooting guide found on page 6-11.

Safety and operating information

This section contains the most important information regarding the safe operation of the ROTALIGN alignment system. Before using the system, you must first familiarize yourself with this section, in particular, the safety information.

Symbols

The following symbols are used in this handbook to call your attention to important sections of text. The sections of text point out possible dangers or provide useful information for operating the ROTALIGN.



WARNING!

This symbol warns of dangers which may lead to personal injury.



ATTENTION

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



Note

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

Intended use

ROTALIGN to be used exclusively for aligning shafts in industrial environments. The device and its accessories must only be operated by specially trained personnel.

PRÜFTECHNIK assumes no liability when components or operating procedures as described in this manual are altered without permission of the manufacturer.

CE conformity

All versions of ROTALIGN fulfill the EC Guidelines for electric devices (73/23/EWG) and electromagnetic compatibility (EMC) (89/336/EWG), under the condition that data transmission from the receiver to the computer is by means of cable ALI 3.581-2 or wireless via the IR interface ALI 4.608. ROTALIGN has been tested in accordance with the following harmonized EU normatives for electromagnetic compatibility.

- EN 55011 Group 1, Class A
- EN 50082-2

Safety information

The following information must be observed to ensure the safe operation of the ROTALIGN.

General



WARNING!



ATTENTION

- Before starting up the machines, all ROTALIGN components must be removed from the shaft (or coupling). Otherwise, serious bodily injury may result from flying parts!
- The device must not be operated with the housing open or removed.
- The sensor, laser and computer housing must not be opened. Water and dust seals cannot otherwise be guaranteed.
- The device must only be operated and serviced by trained personnel.
- Repairs of the ROTALIGN system must only be carried out by an authorized technician.
- Only original spare parts and accessories must be used.
- Any unauthorized modifications to the ROTALIGN, its components and the operating procedures described herein shall render all warranty coverage void.

Intrinsically safe version



ROTALIGN is also available in an intrinsically safe version which fulfills the following specification: EEx ib IIC T4; approx. U.S. equivalent: NEC Article 500-4, Class 1, Division 1, groups D,C,B,A and special safeguards T4.

Please note that with this version, only alkali-manganese batteries or, for the main battery, the ALI 3.572 rechargeable battery must be used. Do not use lithium or NiCad batteries for the main battery (MAIN BATT), for the auxiliary battery (AUX BATT) or for the laser power supply!



WARNING!

- Risk of explosion! Batteries must not be changed in areas where the risk of explosion exists.

Laser safety

The ROTALIGN system uses a Ga-Al-As semiconductor laser, classified as a Class II laser. These 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. ROTALIGN also fulfills British standard BS 4803 (Part 1 to Part 3) and European Industrial Standard IEC 825. The ROTALIGN Class II laser operates at a wavelength of 675 nm, with a maximum pulse duration of $<400\,\mu$sec., maximum radiant power of <1 mW and maximum radiant energy per pulse of 0.4 μJ. No maintenance is necessary to keep this product in compliance with the above specifications.

Do not look into the laser beam at any time, including during setup, adjustment or operation!* Risk of injury!

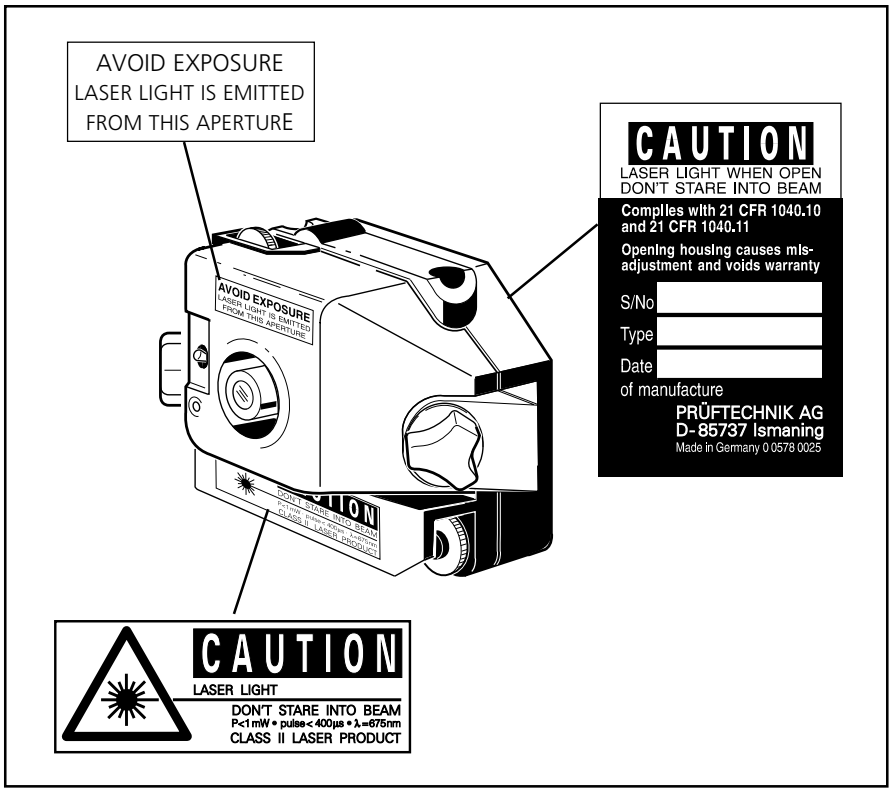
*Since the FDA specification allows maximum exposure of 0.25 seconds, the natural blink reaction of the human eye is normally sufficient to avert any danger, provided that no optical instruments other than ordinary eyeglasses or contact lenses are used. Do not insert any other optical devices into the beam path.

Caution: use of controls or adjustment or performance of procedures other than those specified herein or failure to follow these instructions may result in hazardous radiation exposure.



WARNING!

The diagram below shows all locations of laser safety labels on the ROTALIGN laser housing.

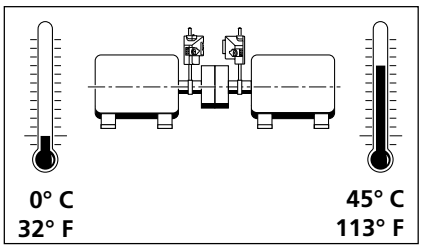


Operating information

In order to ensure proper operation of the ROTALIGN system, observe the following information:

Temperature range

The ROTALIGN system must be used at temperatures between 0° and 45° C (32° to 113° F). Outside of this range, the specified accuracy may not be maintained.



Store your ROTALIGN equipment at temperatures between -25° C and 60° C (-13° F to 140° F). Remember that on a hot day, the temperature inside a locked car can easily surpass 80° C (176 °F)!



Sudden changes in temperature and humidity (for example, when ROTALIGN is stored in an office but used in hot or cold work areas) can cause the optics to fog over with condensation: the computer displays "LASER OFF" and stops measurement. In that case, give the equipment about 10 minutes to reach the work area temperature. If the sensor temperature drops below 0 °C (32 °F) or rises above 60 °C (140 °F), the computer displays "TEMPERATURE"; measurements can still, however, be made.

Temperature effects and fluctuations

Powerful heat sources or steam located near the laser beam could influence the accuracy of measurements as a result of beam deflection. In practice, however, this effect occurs seldom at distances up to 1 m. If in doubt, the effect can be eliminated by shielding the system from the heat/steam source during measurement and adjustment.

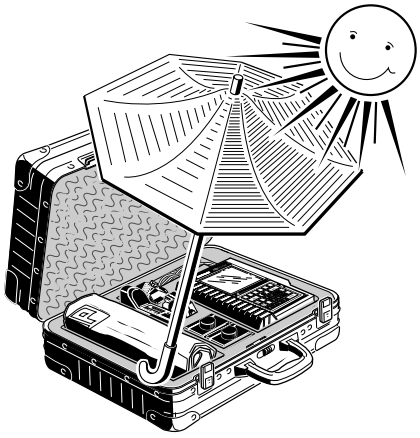
As with all precision optical measurement devices, sudden temperatures fluctuations (e.g. resulting from sunlight), could result in erroneous measurements.



Note

Allow adequate time for the ROTALIGN and the components to reach the ambient temperature.

Incident light and other sources of interference



Avoid exposing the ROTALIGN computer to strong, hot light such as direct sunlight: the pixel display can act as a solar collector (at a rate of 10 watts!) and turn dark (reversibly) if overheated. Mobile radio communication equipment should not be used near the system, as it may interfere with measurements.

If the system should ever seem to be malfunctioning, check the cable connection between receiver and computer first for signs of damage.

Installing the measurement components

Ensure that the mounting brackets for the laser and receiver are securely mounted to the shaft or coupling. Inadequate surface contact, in particular, due to edge surfaces, misaligned installation, dust or inadequate tension on straps, chains or other components may result in loosening of the brackets and, as a result, faulty measurements. These faulty measurements may even be reproducible and falsely indicate acceptable shaft alignment. Therefore, use no self-constructed mounting brackets or extensions and do not modify the mounting brackets supplied by PRÜFTECHNIK AG. Use only the support posts recommended for the current application.

Measurement distance

As no mechanical connecting parts are necessary for work with the ROTALIGN system, the system can be used to align over distance of up to 10 m (33 ft.).

Dust and water seals

The ROTALIGN computer, laser and receiver are water and contamination resistant to specification IP67. This specification requires that each component be able to withstand a water jet spray from any direction (the components are NOT guaranteed to withstand a full submersion). Note, as with most water-resistant products, the resistance must be periodically checked and re-sealed if necessary. This can be carried out during ROTALIGN service and recalibration which should be carried out every two years. During this service, the water absorbing chemicals within the components, which reduce possible condensation on the optics and the electronics, are also replaced.

Interfaces

The ROTALIGN unit is fitted with a serial and a parallel interface for data exchange with a PC or connection to a printer. An interface for the receiver as well as a connection for the mains supply are also located on the unit. Additional information is included in the device description on page 2-7.

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Chapter 2: Description

This chapter includes a description of the ROTALIGN and its components.

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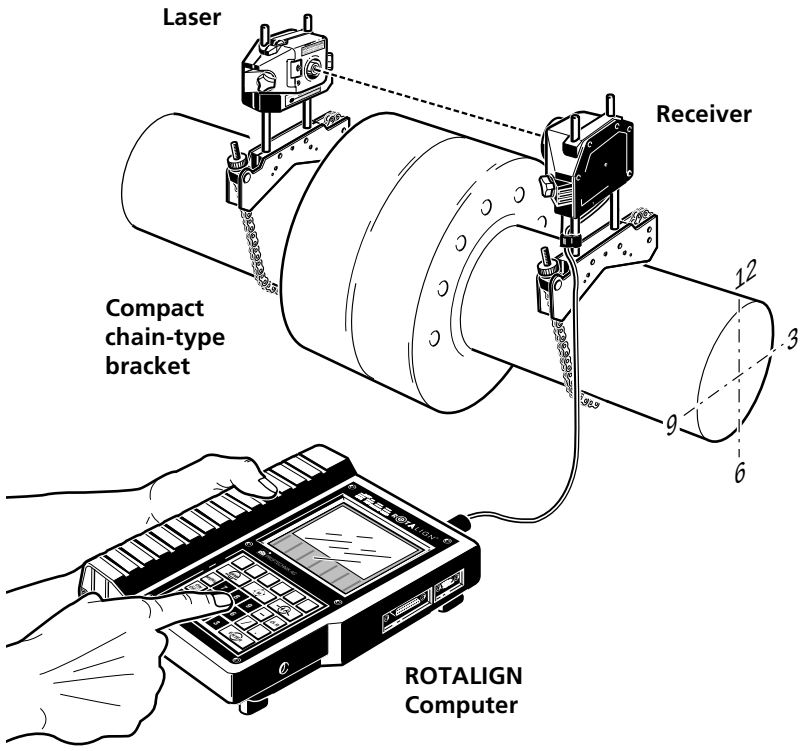
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ROTALIGN overview



The ROTALIGN system mounted across a machine coupling

The ROTALIGN laser alignment system:

BRACKETS used to mount the laser and receiver securely on the shaft on either side of the machine coupling*.

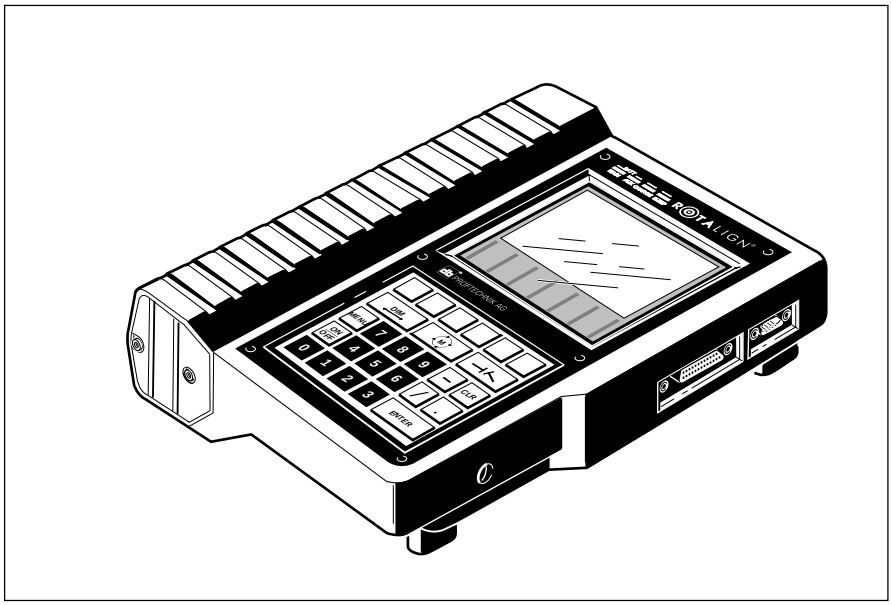
LASER fitted to the machine shaft on one side of the machine coupling, shines a beam across the coupling*. The beam has no sag and is extremely straight.

RECEIVER fitted to the shaft on the other side of the coupling*; contains two sensors to detect the precise position and angle of the incident laser beam.

COMPUTER connects to the receiver; calculates the machine alignment from data collected from the receiver during shaft rotation. The machines can then be aligned with aid of a "live" graphical display. The ROTALIGN computer can also be connected to a PC with the ROTALIGN Commander software (page 6-16).

*The laser and receiver can be mounted on the coupling or on the inside faces of the coupling when the spacer element is removed.

The ROTALIGN Computer ALI 3.550



The heart of the ROTALIGN system is the ROTALIGN computer, built to rugged industrial standards of shock and water resistance. It contains a complete desktop computer with LCD display and numeric-function keypad. Names and letters can be entered where necessary with a special on-screen character table.

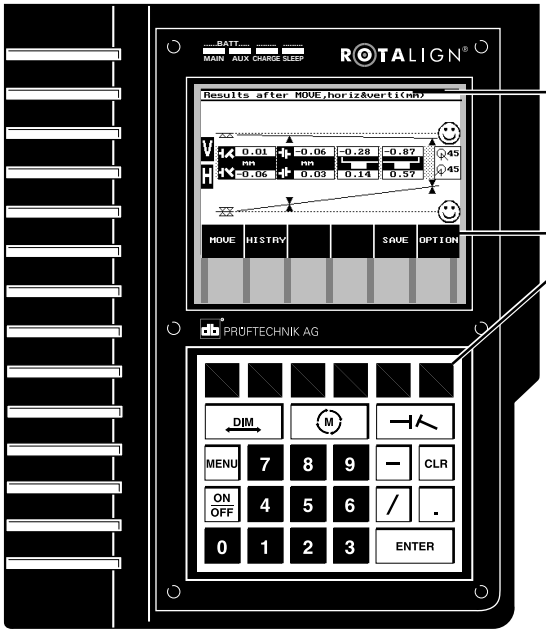
Measurement data pass directly via cable (or IR link, see page 6-23) from the receiver to the ROTALIGN computer and are then used to calculate the alignment diagram. Numerous software functions allow the computer to handle a wide range of alignment situations.

Notes on ROTALIGN operation

To ensure proper and safe operation of the ROTALIGN system, there are a few operating rules which must be observed:

- The ROTALIGN must not be operated with the housing open or removed.
- Only original spare parts and accessories must be used.
- The ROTALIGN must only be operated by trained personnel.
- Any unauthorized modifications to the ROTALIGN and its components shall render all warranty coverage null and void.
- When using the ROTALIGN laser, adhere to all safety information regarding its safe operation (see page 1-7).

The ROTALIGN keyboard and screen



Status line
Gives a short explanation of the current screen or instructs the user what to do next.

Function softkeys
Labelled at the bottom of the display, these keys are defined by the program according to the situation at hand.

START

In this manual, all instructions regarding softkeys are denoted by symbols such as the one shown here.

OPTION

The "Option" softkey calls menu options that apply specifically to the mode the ROTALIGN is in.

DIM

DIMension key
Use this key to enter machine dimensions directly into the screen (see page 4-16).

M = Measure
This key is used to enter the alignment measurement mode. (See page 4-23)

Results key
Calls alignment result diagram into the display.
(See page 4-49)

ENTER

Enter key
Confirms displayed value and proceeds to next value
(See page 4-22)

ON/OFF key
(See page 4-14)

MENU

Menu key
Offers a choice of procedures for setting up the computer and proceeding with different alignment situations (See page 3-3, 4-6). Shows all available options regardless of ROTALIGN mode. See also Option softkey.

Minus key
For entry of negative values
(See page 4-22)

CLR

Clear key
Deletes characters or numbers in a displayed value (see page 4-21) or deactivates a selected measurement point (See page 4-42)

Slash key
For entry of fractions
(see page 4-22)
and for a printed copy of the screen (See page 3-7)

Decimal point key
For entry of decimal fractions
(See page 4-22)

Computer program operation

The ROTALIGN computer program is intended to be easy to use, even for a computer novice. Feel free to experiment with the keys and options as no physical harm can come to the computer. All the screens (except the first) have a status line at the top giving simple instructions. Options are selected with the "Softkeys" along the top of the keypad.

Working your way through the program

The ROTALIGN software is comprised essentially of three sections corresponding to the three large yellow keys:



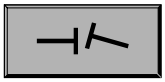
Dimensions

(Page 4-16)



Measure

(Page 4-23)



Results

(Page 4-49)

These keys are very important during program operation to switch between the sections, and are frequently used. After entering dimensions press the "Measure" key to proceed to measurement; after measurement press the "Results" key to see the results.

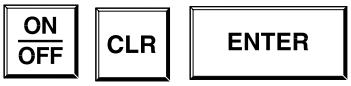
Since these keys override all other functions they may be used at any time to switch between the sections (e.g. to quickly change a dimension from the Results screen), even from several menu levels within a function.

Also important is the MENU key, 

(described on page 3-3 and 4-6) which similarly exits from any point in the program.

Resetting the ROTALIGN computer

The ROTALIGN computer, like all computers, can "lock up" when a mathematical error occurs. Should this occur and normal operation come to a halt, reset the computer by pressing the ON/OFF, CLR and ENTER keys at the same time:

Press 

simultaneously to reset the computer.

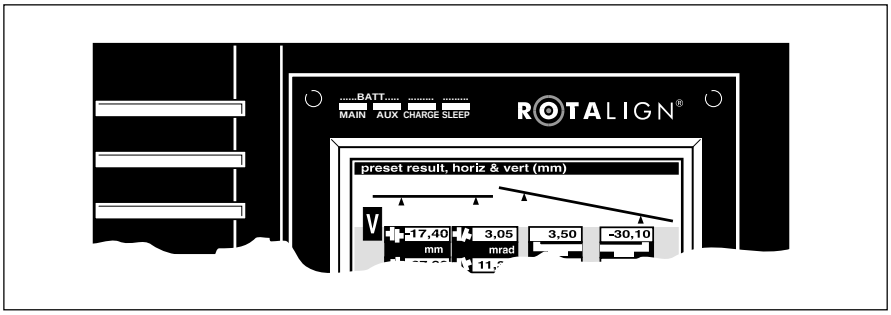
If this has no effect, or the computer locks up when switching on, consult the troubleshooting guide on page 6-11.

Upgrading ROTALIGN software

Upgrades of the ROTALIGN 2.0x computer program may become available in the future. The ROTALIGN Upgrade Manager 2.0x software program for Windows, available from PRÜFTECHNIK AG as part of the ROTALIGN Upgrade package (ALI 3.471), is used to load the newest version of the ROTALIGN software onto a ROTALIGN unit via the serial port and cable connected to a standard PC. Contact PRÜFTECHNIK or your local distributor for information on the Upgrade Manager.

Indicator LEDs

Four indicator LEDs above the computer display provide useful information on the operating status of the computer:



"MAIN" lights to indicate that the main battery is becoming depleted. In that case, replace the batteries or connect the AC power supply to the computer as soon as possible.

"AUX" lights to indicate that the auxiliary battery is low. The auxiliary battery should be replaced after each time it has been relied upon.

"CHARGE" lights to show that the mains adapter/charger is connected. (If a lead-acid rechargeable battery is fitted, 5 hours are required for a full charge.) See page 6-17.

"SLEEP" lights to indicate that the computer has entered its "sleep" mode after a given time of nonuse (see below), thereby conserving a considerable amount of battery power. Press any key to "awaken" the computer, the display is refreshed and you can resume work where you left off. See also page 2-12 for further details.

Interfaces

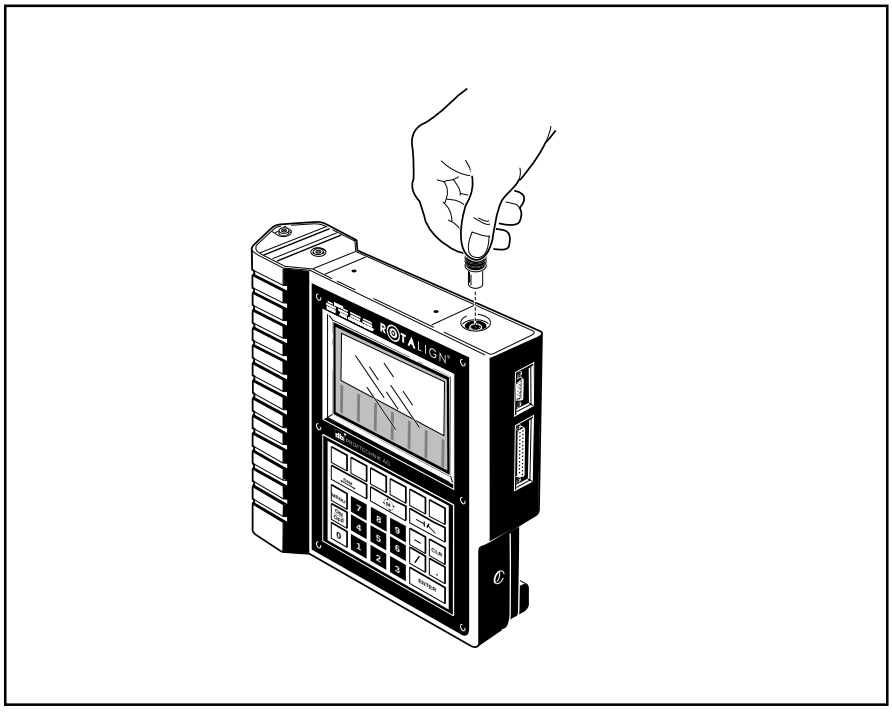
The ROTALIGN unit is fitted with four interfaces: for the measurement signal from the receiver, data exchange with a PC, printer connection and power supply.

Connecting the receiver

The receiver is connected via cable ALI 3.581-2 to the socket on the top end of the ROTALIGN computer as shown below.

Do not twist the plug while inserting it into the socket. This could result in damage to the pins.

ATTENTION

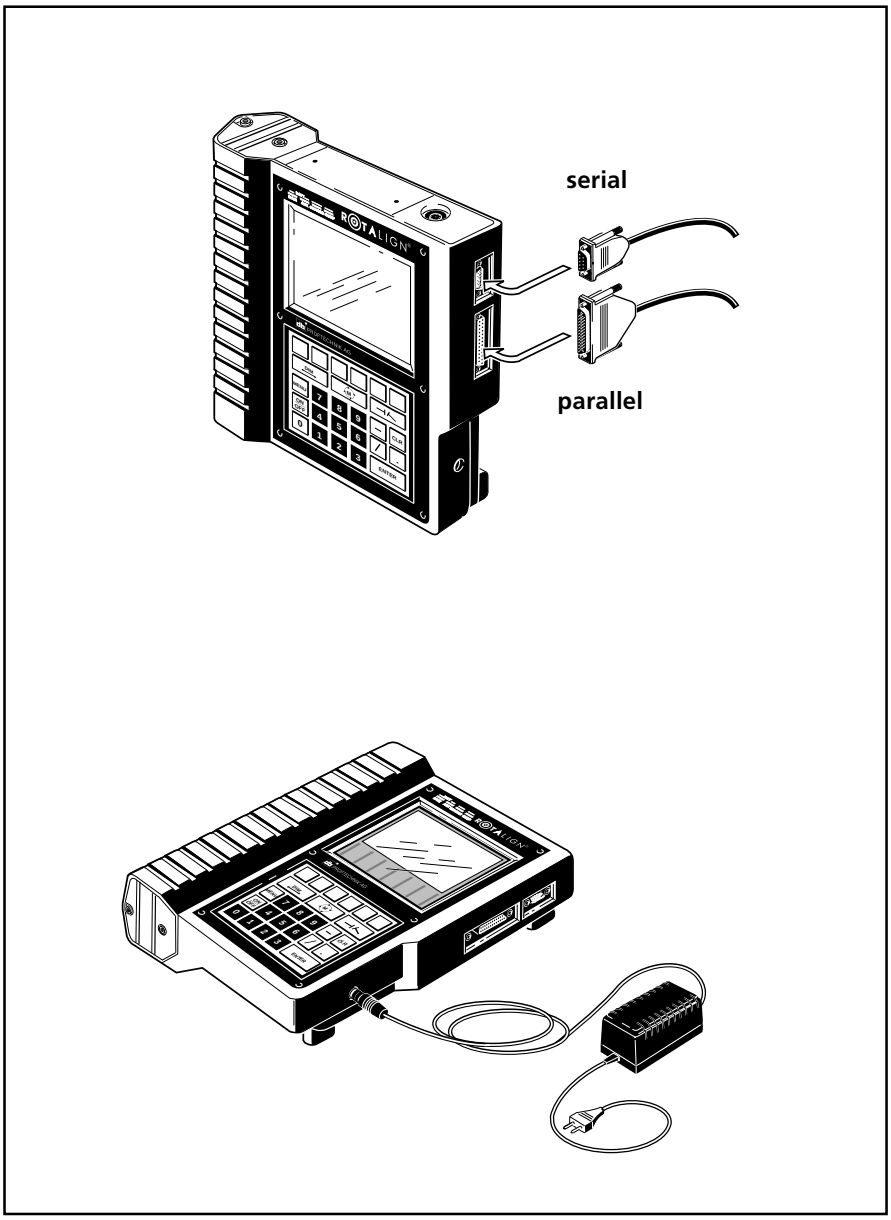


When inserting the plug, align the notch in the plug with the groove in the socket. Push the plug into the socket until it clicks into place. When removing, hold the plug at the rubber base and pull gently. PRÜFTECHNIK recommends that the receiver be left in place at all times (even when in the transport case).

Connecting PC, printer and mains supply

A 9-pin serial port (RS232) is installed in the ROTALIGN unit for connecting to a PC. Using this port, measurements can easily be documented and backed up on a PC. From the main menu (reached by pressing the Menu key), select the "RS 232 CONFIG" option. Select the necessary buttons for the desired configuration. A 25-pin parallel port for connecting to a printer is also installed. Select the appropriate printer driver under "PRINTER CONFIG" in the main menu.

The power supply unit ALI 3.576 is connected at the right side of the ROTALIGN unit (see also page 6-17).



Batteries and power supply

ROTALIGN offers you four different possibilities for power supply to the computer, which in turn powers the measurement receiver:

1. Six standard "C"-size (IEC LR 14) alkali-mangan batteries is the standard option as the main battery supply, accessed via the upper left panel of the computer housing. These typically run the system for 50 hours*.
2. Six "C"-size NiCad rechargeable batteries can be alternatively used. These typically run the system for 25 hours*.

Optional:

3. A rechargeable lead-acid battery as main battery can alternatively be fitted instead of the six batteries. This typically runs the system for 9 hours*. See page 6-17.
4. The AC power supply can be used to connect the computer to mains voltage for operation or to charge the lead-acid battery or external receiver batteries. See page 6-17.

The ALI 3.576 charger can be used to charge either one ROTALIGN computer or two external receiver batteries, but not the computer and one battery simultaneously!

*Note, these battery times assume that the batteries are originally new or fully loaded and are based on an operating cycle of 25% measurement, 25% computation and 50% "sleep" mode.

ROTALIGN intrinsically safe version



The ROTALIGN package is available in an intrinsically safe version ALI 3.500Ex (with all electrical components also suffixed by "Ex"). In this case use only alkali-mangan batteries or the rechargeable battery, ALI 3.572 (page 6-17).



ATTENTION

DO NOT USE lithium batteries or nickel-cadmium rechargeable batteries as AUXILIARY batteries for intrinsically safe versions of the computer or laser.

MAIN Battery: six "C" cells

The standard power option is six "C"-size (IEC LR 14) alkali-mangan batteries inserted into the computer battery compartment (see picture below). Access is via the upper left panel of the computer, opened with a 2.5 mm Allen key (supplied). Depending upon the batteries used and the individual computer/receiver usage pattern, one set of alkaline cells typically provides 50 hours of operation.

A set of NiCad (rechargeable) cells can alternatively be used, but beware that their voltage drops off quite abruptly when their charge is depleted, giving little or no "battery low" warning in advance. They have a typical operating duration of 25 hours. They cannot be recharged from within the ROTALIGN computer and must be removed and recharged with your own charging unit.

Main battery depletion

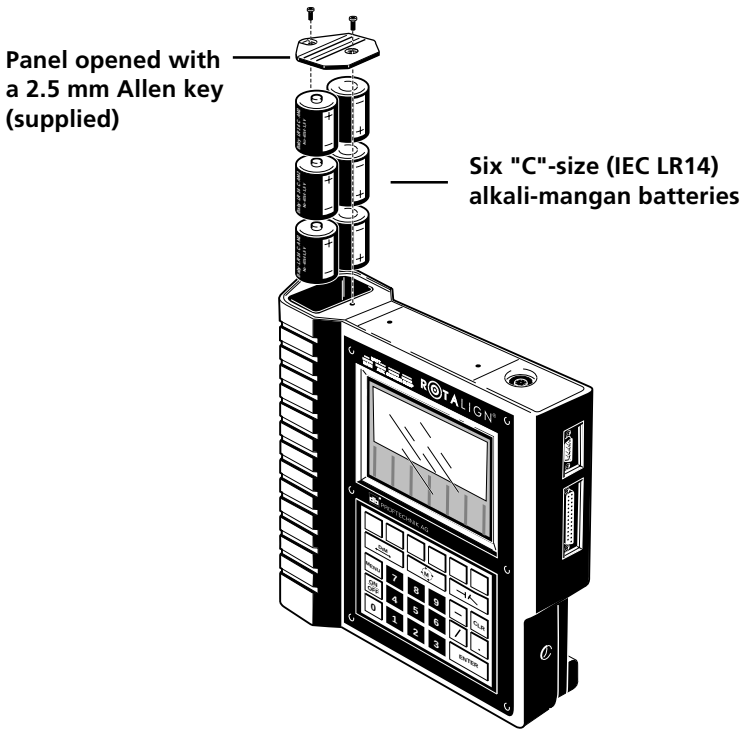
When the main battery becomes depleted, the red "MAIN" LED in the upper-left corner of the ROTALIGN illuminates. The ROTALIGN then starts to draw power from its auxiliary battery (described next), and can operate for an additional 20-40 minutes before the auxiliary battery is also depleted. The "AUX" LED, adjacent to the "MAIN" LED, will light up when the auxiliary battery is depleted.



Connect the AC power supply or replace batteries as soon as possible. Do not rely on the auxiliary battery for longer than absolutely necessary.

If replacing the "C" size batteries, replace all of them at once with new ones. Remove them as soon as they become depleted or if the computer is not to be used for an extended period to prevent battery leakage.

Used batteries should be disposed of in an environmentally-sound manner in accordance with applicable regulations!

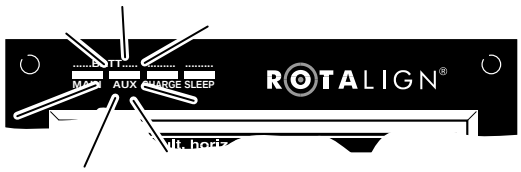


Auxiliary battery

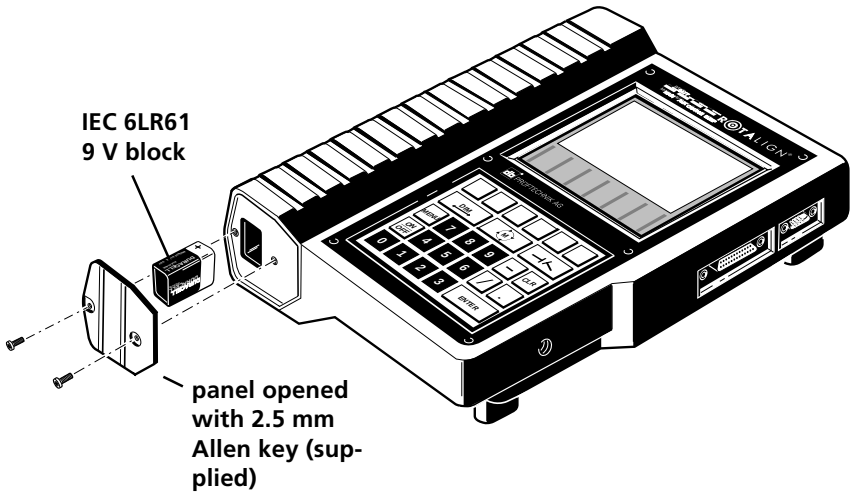
The ROTALIGN computer also contains a 9 V AUXILIARY battery which can run the computer when the main power supply is depleted or being changed. It will run ROTALIGN for between 20-40 minutes which should be ample time to change the main battery or connect the charger. Do not make a habit of relying on this battery to operate the computer for longer than absolutely necessary!

Replace the auxiliary battery as soon as there is any doubt about its remaining strength, or at least once a year. PRÜFTECHNIK recommends auxiliary battery replacement whenever the computer has used it under full load, i.e. after the "MAIN" LED has lit.

When the auxiliary battery is low, the red "AUX" LED glows:



The auxiliary battery should be replaced as shown below. Switch off the computer before replacement. Avoid using a rechargeable NiCad here due to its rapid voltage drop at the end of battery life.



Power-saving features and "Sleep mode"

The ROTALIGN computer automatically monitors its operation so that it can save battery power by shutting itself down temporarily when not in use. This is not operational when using the AC charger.

• If none of its keys is pressed for a certain time, the computer display goes blank and the "SLEEP" LED glows. The length of time before sleep is set up in the Configuration screen (page 3-3) and is ideally about five minutes.

• If none of the keys is pressed for a further period of time, the computer switches itself off altogether. When the ON/OFF key is pressed to switch the computer back on, a softkey on the computer screen marked RESUME is available to return the user exactly where he left off. The length of time before switch off is set in the Configuration screen (page 3-3) and is ideally about thirty minutes.





Note

Sleep time is automatically set to 3 hours while the ROTALIGN is in communication with a PC.

Electronic memory

The ROTALIGN computer contains an electronic memory for long-term storage of measurements and results, also when the computer is switched off.

This memory is maintained by a lithium backup battery soldered to the memory board itself which holds the data for several years.

The backup battery is not user accessible and must be replaced at the factory.



ATTENTION

NOTICE

In common with all electronic memory products of this nature, data can be lost or altered under certain circumstances.

PRÜFTECHNIK AG strongly recommends that you keep separate written or printed records of all important data.

PRÜFTECHNIK AG assumes no responsibility for data lost or altered as a result of improper use, repairs, defects, battery replacement/failures or any other cause.

PRÜFTECHNIK AG assumes no responsibility, directly or indirectly, for financial losses or claims from third parties resulting from the use of this product and any of its functions, such as loss or alteration of stored data, etc.

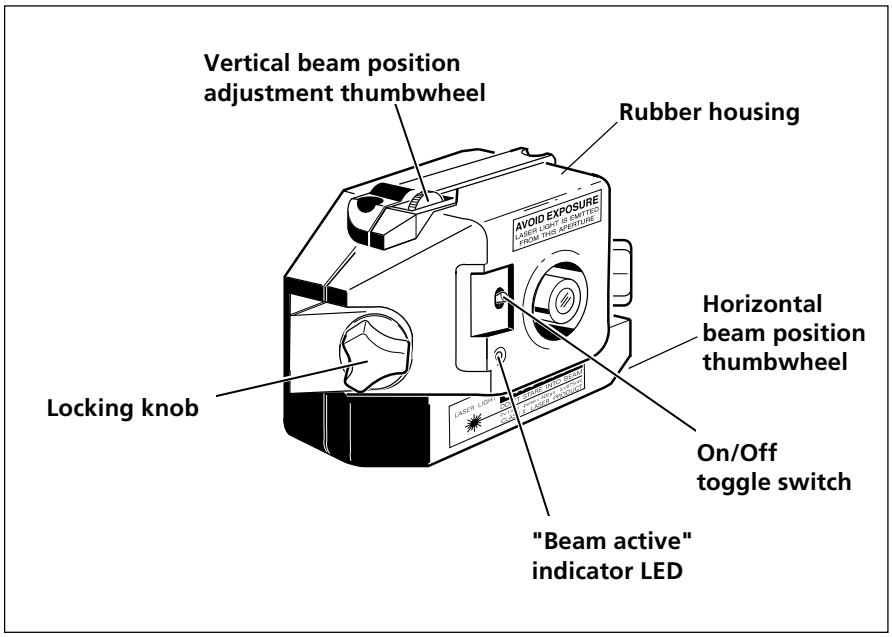
The ROTALIGN COMMANDER software program can be used to back-up data to a PC. See page 6-16 for details.

ROTALIGN components in detail

On the following pages are descriptions of the main ROTALIGN components.

Laser ALI 3.610

The semiconductor laser diode emits a ray of red light (wavelength 675 nm) which is visible where it strikes a surface. The beam is emitted with a diameter of approx. 5 mm (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 2 safety (see page 1-7 for details).



The beam is adjusted during setup by changing its vertical and horizontal angles with thumbwheels so that the beam strikes the receiver lens straight on.

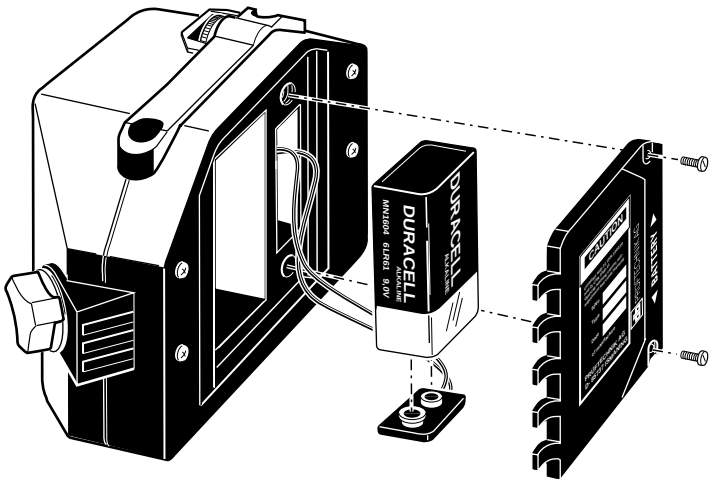
As with all the ROTALIGN components, the laser is water and dust resistant. The internal optics and electronics are internally sealed, preventing possible contamination, e.g. via the two thumbwheel slots. Note, the battery compartment is not watertight. If water enters this compartment, open it and dry it out. The battery should then be replaced.

Laser battery

The ROTALIGN laser is powered by a single 9 V battery (type IEC 6LR61) which, depending on battery make and operating patterns, provides a typical operating duration of 80 hours. Note, Lithium batteries of this size can also be used, increasing operation up to 150 hours.

Note

As the battery becomes depleted, the color of the 'laser active' indicator LED (see previous page) changes from red to yellow (or, for older models, from red to green). When this occurs, the battery should be replaced as follows:



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

Used batteries should be disposed of in an environmentally-sound manner!

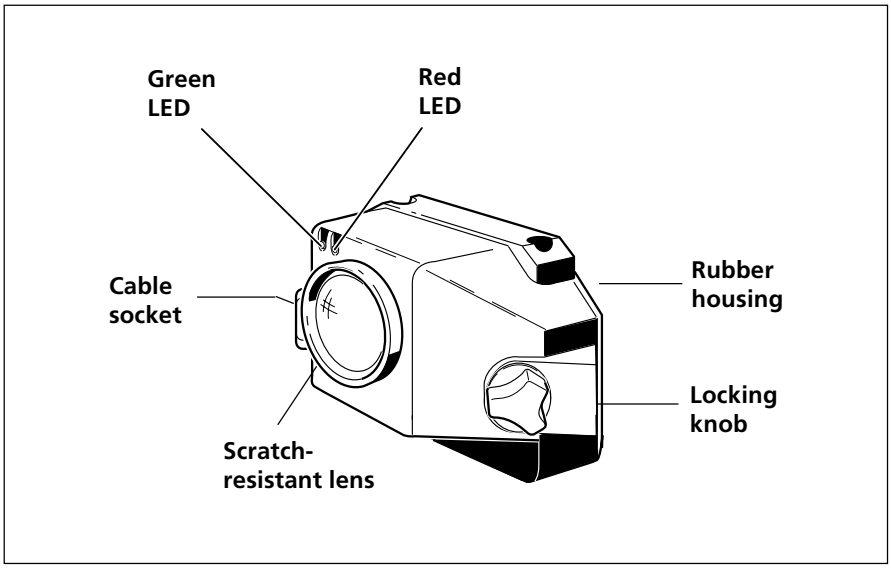
Be aware that when NiCad rechargeable batteries are used as replacements, their voltage tends to drop quite rapidly as they become depleted. This may limit the effective warning time (see note above), so a fully-charged spare should be held in reserve.

Note

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

Receiver ALI 3.600

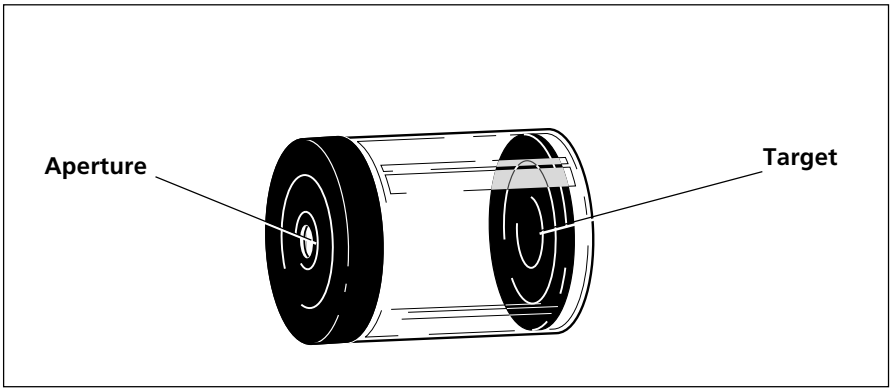
The receiver contains two position detectors, located one behind the other, which measure the exact position of the laser beam as the shafts are rotated. The detectors are biaxial, analog, photoelectric semiconductor position detectors with a resolution of better than 1 μm / 1/1000 mm (or 0.04 mils) and an area of 18 mm x 18 mm / 0.7" x 0.7". The receiver also contains an electronic inclinometer with resolution better than 1° for shaft rotation measurements.



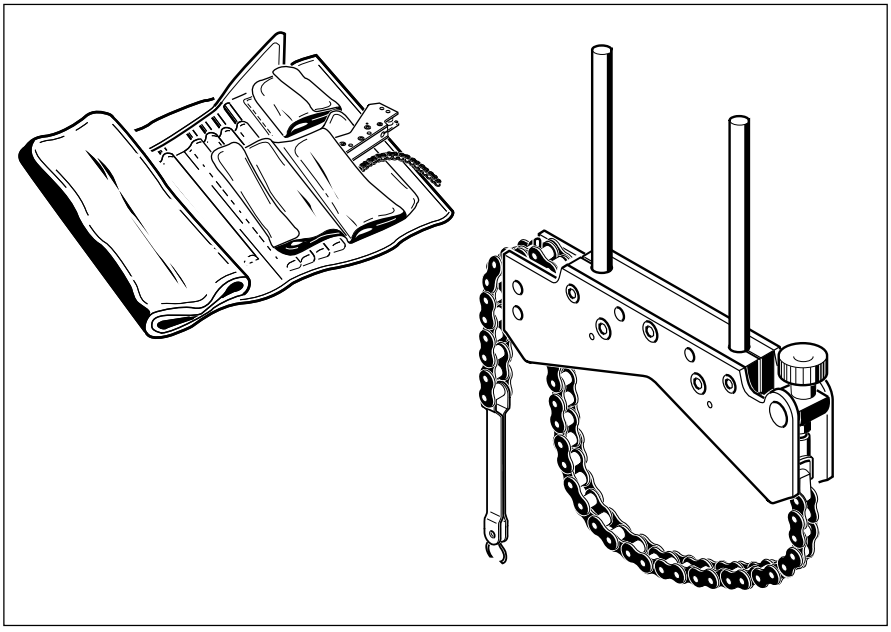
The receiver has two indicator LEDs on its front side, one green and the other red, to indicate beam adjustment (see page 4-25). The receiver is powered by the ROTALIGN computer via a cable through which measurement data also pass. An infrared link is also available. See appendix, page 6-23 for details.

Adjustment tube ALI 3.608

To help align the laser beam with the receiver, this tube is fixed onto the receiver. The beam passes through the front aperture and hits the inner target. The beam can then be aligned simultaneously with the aperture and the target (see page 4-24).



Compact chain-type bracket ALI 2.891 set



Compact and lightweight, this bracket is designed to provide extremely rigid support for the measurement components with a minimum of mounting time and effort. The compact chain-type bracket fits onto shafts and couplings ranging from 15 to 500 mm (1/2" to 20") in diameter. Longer chains are also available. Mounting instructions on page 4-11.

Other accessories

See page 6-15 for a list of popular ROTALIGN accessories.

The ROTALIGN product catalog illustrates and describes some additional accessories available for ROTALIGN. It is available under order number ALI 9.300.

Among the most useful accessories are the various brackets specially designed for mounting ROTALIGN on specific machine configurations. These are described in detail in the appendix to this manual (page 6-18).

Chapter 3: Configuration and Data Management

This chapter includes instructions for configuring the ROTALIGN and managing data, i.e. saving, storing, opening files etc.

Chapter 1 Introduction ..... 1-1 to 1-10

Chapter 2 Description ..... 2-1 to 2-16

Chapter 3 Configuration and Data Management ..... 3-1 to 3-8

Configuration and data management overview 3-2

Configuration 3-3
- USER SETUP 3-4

Data Management 3-5
- NEW 3-5
- OPEN 3-5
- FILE TYPE 3-5
- SAVE 3-6
- SAVE AS... 3-6
- DELETE 3-6
- EDIT FILE INFO 3-6
- REPORT 3-6
- PC-COMM 3-6
- PRINTER CONFIG 3-6
- RS232 CONFIG. 3-6

- REPORT 3-7
  - Screen hardcopy 3-7
- PC-COMM 3-7
- PRINTER CONFIG 3-8
- RS232 CONFIG 3-8
- CHANGE APPLIC 3-8

Chapter 4 Horizontal Alignment ..... 4-1 to 4-66

Chapter 5 Vertical Alignment ..... 5-1 to 5-18

Chapter 6 Appendix ..... 6-1 to 6-42

Configuration and data management overview

CONFIGURATION (page 3-3)	**EDIT:**	
	Units	**mm/inch**
	Language	**English/German/French/Spanish/Dutch/ Swedish/Japanese/Finnish**
	Runtime	**(time before "sleep")**
	Sleeptime	**(time before switch off)**
	Sensorport	**"Default"/COM**
	CONTR	**(screen contrast)**
	DATE	**(Enter date, time & select format)**
	USER SETUP	**(see below)**
USER SETUP (page 3-4)	**EDIT NAME**	**Company, Plant, City/State, Username, Comment**
FILE (page 3-5)	**NEW**	**(clears current data)**
	OPEN	**(loads stored file)**
	SAVE	**(saves under numerical name)**
	SAVE AS..	**(saves under new name)**
	DELETE	**(delete file)**
	EDIT FILE INFO	**(as "USER SETUP," above + machine names)**
	REPORT	**(see below)**
	PC-COMM	**(see below)**
	PRINTER CONFIG.	**(see below)**
	RS232 CONFIG.	**(see below)**
REPORT (page 3-7)	**Print alignment report from selected file**	
PC-COMM (page 3-7)	**Communicate with a PC via serial RS232 interface**	
PRINTER CONFIG. (page 3-8)	**Select printer and port (COM/LPT)**	
RS232 CONFIG. (page 3-8)	**Select baud rate, parity, data bits and stop bit for RS232 interface**	
CHANGE APPLIC. (page 3-8)	**Application menu**	
	RESUME	**(return to last point before switch off, page 2-12)**
	Horizontal machines	**(see page 4-6)**
	QUICK CHECK	**(for basic horizontal check - see page 4-3)**
	Vertical machines	**(see page 5-1)**
	FILE	**(see above)**
	CONFIG.	**(see above)**



All of the above ROTALIGN configuration and data management options can be reached from the Menu. The Menu is accessed by pressing the Menu softkey and, depending on the alignment mode, includes different functions. Horizontal alignment includes the functions listed above in addition to several others (see page 4-6 for more information). The Menu provided in Vertical alignment contains only those functions described in this chapter.

In addition to being accessible from the Menu, many of the functions described in this chapter can be accessed from various points within the ROTALIGN software using softkeys. These keys will be introduced at the appropriate points in this chapter.

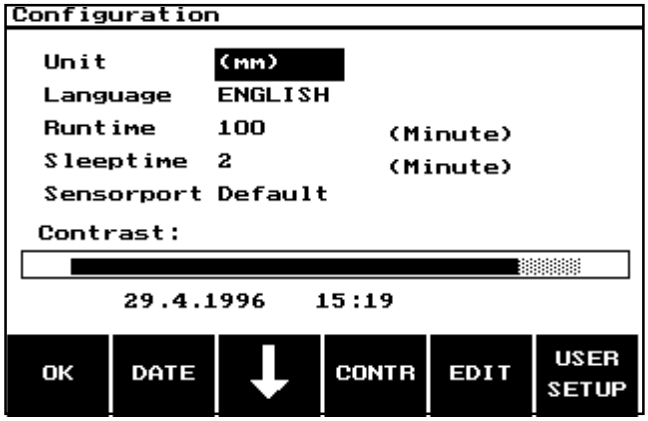


Note

The Menu cannot be accessed from the QuickCheck measurement mode.

Configuration

The CONFIGURATION option is available from the introductory screen, page 4-14, with the CONFIG softkey as well as from the MENU for both horizontal and vertical machines:



Use the arrow key to highlight one of the top five options, then press EDIT to change the setting:

UNIT selects between inches and mm.

LANGUAGE selects from English, German, Spanish, French, Dutch, Swedish, Japanese and Finnish. Select from the list of languages with the arrows and press OK.

RUNTIME if no keys are pressed for the specified "Runtime," the computer enters "sleep" mode (see page 2-12). A typical time is 5 minutes. Enter the new value and press ENTER

SLEEPTIME is the time the computer sleeps before switching off (see page 2-12). A typical time is 30 minutes. Enter the new value and press ENTER. Note, the sleep mode function is deactivated when external power is connected to the computer.

SENSORPORT selects the computer socket to which the sensor/ receiver is connected. The socket at the top of the computer is "Default"; the serial port, upper right-hand side is "COM" (e.g. for the IR link, page 6-23).

Softkeys:

CONTRAST changes the screen contrast. Press the Contrast key several times until the desired display is obtained.

CONTR

DATE Use the cursor keys to select Year, Month, Day, Hour or Minute, and key in the new value with the numeric keys. Use the CLR key to erase entries and the numeric keypad to enter digits. Press ENTER to confirm each entry. Press DATE FORMAT to change between US and European dates and their presentation. Select "OK" when finished.

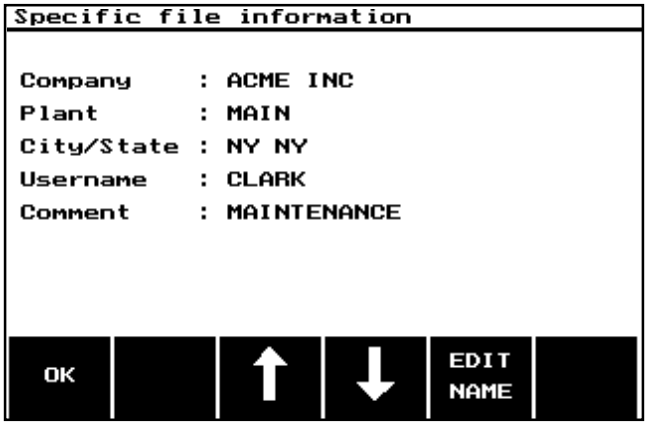
DATE DATE FORMAT

USER SETUP see next page
When finished configuring, press "OK" to return to the menu.

USER SETUP

User setup

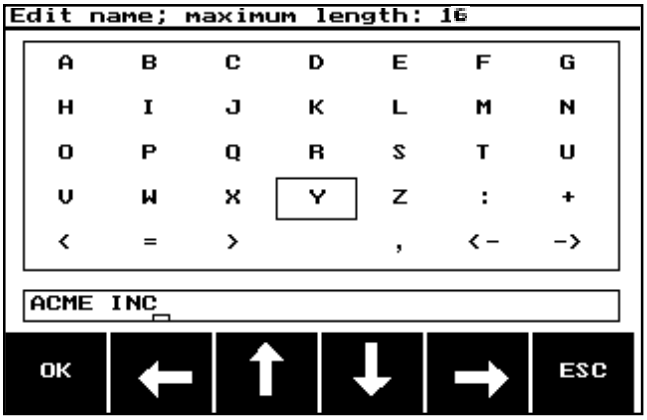
USER SETUP allows you to type in the company and plant names, location, user name, a comment and machine names:



The User Setup file is used as the default for new measurements. The data entered in this file is stored in a given measurement file when it is saved for the first time.



To edit the data, select the required line with the arrow softkeys and press EDIT NAME softkey to call up the Text Editor:



Press ENTER to select a letter and CLR to delete letters. Press the OK softkey when finished.

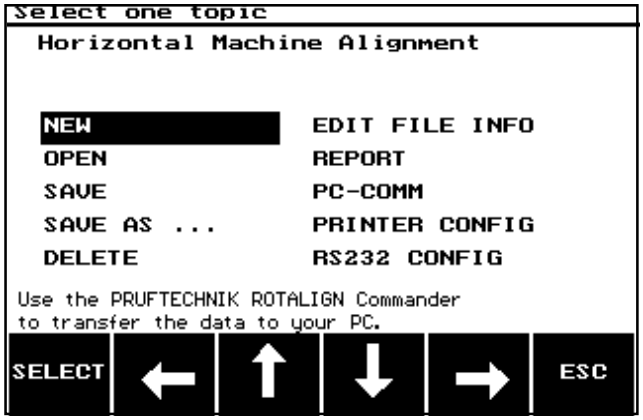
Max lengths:
General names: 16 characters
Comments: 26 characters
Machine names: 10 characters
File names: 8 characters (spaces not allowed)



Changing the data in the User Setup file will not change the contents of a particular File Info file. To change the File Info file, select FILE from the main menu, then press the FILE INFO softkey.

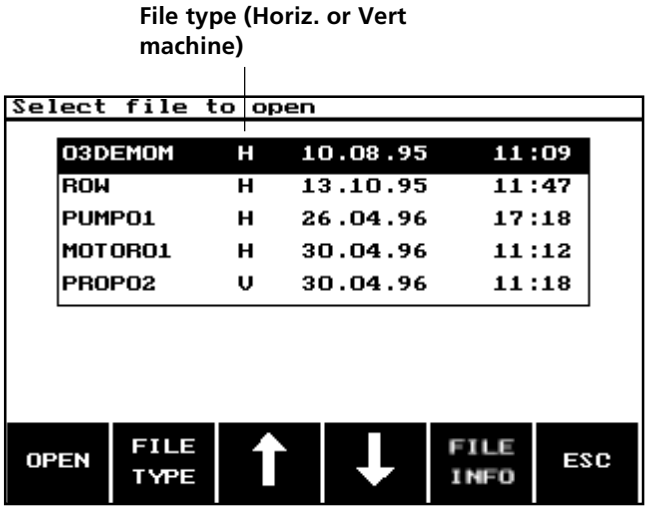
Data management

Select FILE from the Menu to call up a menu of file, printer and interfacing options:



NEW clears all current data ready for a new alignment job and puts you in the dimensions mode. If the current data have not previously been saved, then the message appears "Current data not saved. Save as <name> ?" Press "OK" to save the data under the suggested name or ESC to ignore and lose the data.

OPEN loads a stored file. The same "save?" query appears as for NEW, if applicable. Select a file from the list with the arrow keys and press OPEN. The file names, dates and times are shown in the list. FILE INFO for a selected file can be edited from this screen by pressing the FILE INFO softkey.



FILE TYPE displays either Horizontal machine files, Vertical machine files or both. Select the setting from the list with the arrow keys and press OK.

Please keep a record of important data. PRÜFTECHNIK assumes no responsibility for data lost or altered. The ROTALIGN Commander software program is available for backing up data to a PC. See page 6-16 for further information.

Note

SAVE saves the current data with the following file-naming rules:

1) If the current file is new and does not yet have a name, the computer suggests a default numerical name (sequential, starting with 01). You may either accept this name by pressing OK or press the SAVE AS key, discussed below, and enter a name up to 8 characters in length.
2) If the file already has a name, the new data will be stored under this name, overwriting the old data.

Up to 150 files can be stored. A warning appears when the memory is nearly full.

SAVE AS... saves the current data with a name of your choice, up to 8 characters in length (spaces are not allowed). Enter the new name using the text editor as described on page 3-4. If the file already exists, you will be requested to press the OK softkey to overwrite the old file. Press the ESC softkey to cancel the save. A warning appears when the memory is nearly full.

DELETE opens a window listing all files. Use the arrow keys to move up and down through the list. Press the Delete softkey to delete a selected file. No confirmation is given.

EDIT FILE INFO allows you to edit the company, plant, city, state etc. of the current file. The file name cannot be changed in this screen.

REPORT prints out a report. See next page for details.

PC-COMM communicates with a PC. See next page.

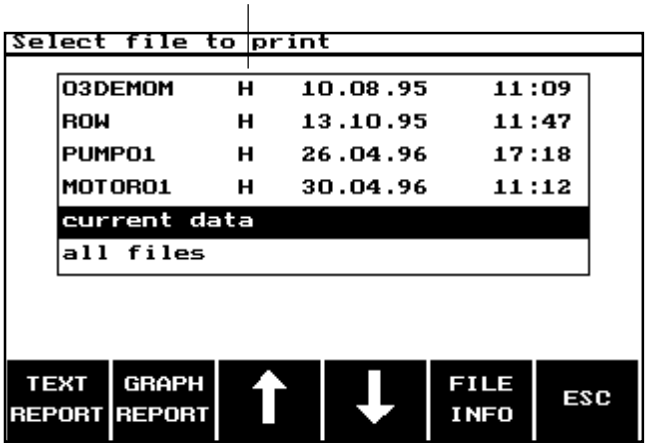
PRINTER CONFIG. selects printer and port. See page 3-8.

RS232 CONFIG. configures the RS232 port. See page 3-8.

REPORT

REPORT prints an alignment report showing machine setup and dimensions, measurements and movements. There are two types of report, either text (TEXT REPORT) or a printout of text with graphics (GRAPH REPORT).

File type (horiz. or vert. machine) Note, only the files are shown for the current application (i.e. vertical or horizontal).



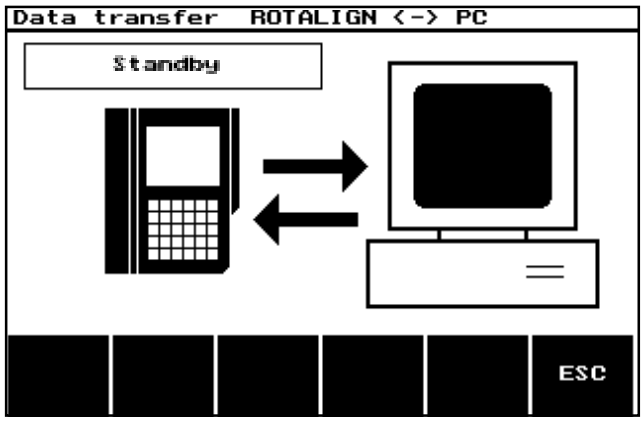
Connect your printer to ROTALIGN, switch it on and make sure that the printer configuration is correct in the Printer Config. option. Select the file to print from the list and press the appropriate Report softkey. See pages 6-30 - 6-31 for an example report.

Screen hardcopy

The current screen can be printed at any time by pressing the slash key (except when actually editing a dimension or text!). The printer must be connected to ROTALIGN and the printer configuration correctly set (see page 3-8).



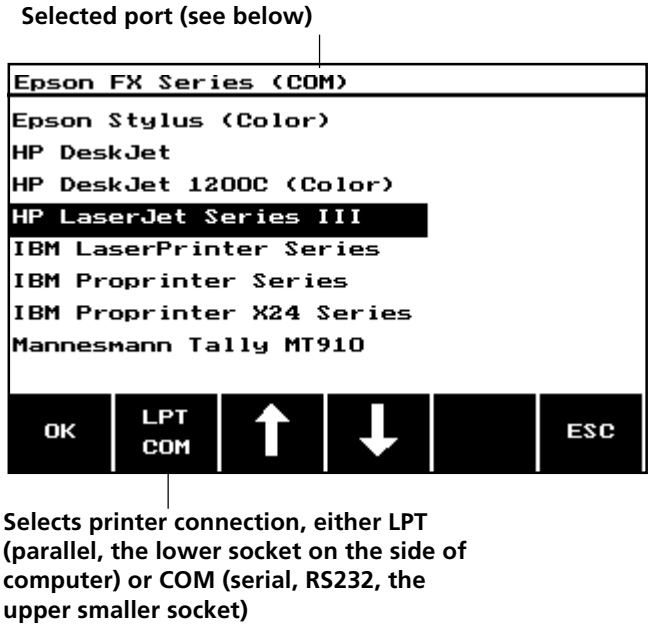
PC-COMM



PC-COMM sets up ROTALIGN to communicate with a PC via the serial port. You will require the ROTALIGN COMMANDER software package for Windows® ALI 3.591SET (see page 6-16). The Sleep function is disabled during PC communication.

PRINTER CONFIG

Use PRINTER CONFIG to select the printer type and connection. If your printer name is not shown, either select a similar model from the same manufacturer or find out with which type your printer is compatible (commonly with EPSON FX series, for example).



RS232 CONFIG

RS232 CONFIG allows you to select the serial (COM) port parameters, e.g. for a serial printer: baud rate, parity, data and stop bits. Note, if you are using the PC-Comm function to transfer data to a PC, the program automatically uses its own settings, disregarding this configuration screen.

CHANGE APPLIC

Select the CHANGE APPLIC option from the Menu screen or press the CLR key to return to the introductory screen (page 4-14). From the introductory screen you can switch to:

QUICK CHECK (page 4-3),
Horizontal (page 4-6) and
Vertical (page 5-1) applications.

Chapter 4: Horizontal Alignment

This chapter includes instructions for aligning horizontal machine arrangements. A description of the QUICK CHECK alignment mode is given first, followed by instructions for the more thorough standard horizontal alignment mode.

Chapter 1 Introduction ..... 1-1 to 1-10

Chapter 2 Description ..... 2-1 to 2-16

Chapter 3 Configuration and Data Management ..... 3-1 to 3-8

Chapter 4 Horizontal Alignment ..... 4-1 to 4-66

QuickCheck... 4-3

Menu overview - horizontal machines 4-6

The Menu 4-7

Horizontal machine alignment flow chart 4-8

Horizontal machine alignment 4-9

1. Prepare the machines 4-10
2. Mount the brackets 4-11
3. Mounting laser and receiver 4-12
   Connecting the receiver 4-13
4. Switch on the computer 4-14
   Select horizontal alignment 4-15
5. Machine dimensions 4-16
   Machine setup 4-17

Coupling type 4-19

Enter the dimensions 4-21

6. Laser beam adjustment 4-23

XY VIEW 4-25
   TRACE 4-26

Why centered AND perpendicular? 4-27

7. Measurement 4-28

Soft foot 4-29

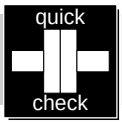
Select measurement mode 4-33
   CONTINUOUS SWEEP 4-34
   MEASURE AT 0,3,6,9 4-35
   MULTIPOINT 4-36
   PASS MODE (UNCOUPLED) 4-36
   DIAL GAUGE VALUES 4-39

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9. MOVE 4-51
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10. Alignment completion 4-55
Save 4-55
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Switching off 4-56
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MAX COUPLING VALUES 4-64
Static feet 4-65

Chapter 5 Vertical Alignment ..... 5-1 to 5-18

Chapter 6 Appendix ..... 6-1 to 6-42

QUICK CHECK



QUICK CHECK is a quick alignment measurement for standard horizontal machines. It is, as it says, QUICK, with semiautomatic operation, and a CHECK, without special options.

These brief instructions are intended for a user with some experience of alignment, e.g. with the OPTALIGN system. If you have any difficulties, please refer to the general instructions, which start on page 4-6.

Note:
The MENU is not available in QUICK CHECK mode.

QUICK CHECK is for a typical horizontal two-machine arrangement, where:

- The left machine is stationary
- The right machine is moveable
- The right machine has 4 feet
- The coupling is a basic single-plane type

QUICK CHECK displays the alignment horizontally and vertically in terms of:

- Coupling angle in mrads (milliradians)
- Coupling offset in mm or mils
- Front and back feet positions on right-hand machine

If you have any other requirements, e.g. to save results, set up tolerances etc., you can switch from the QUICK CHECK results screen to the comprehensive horizontal machine mode at the touch of a button (see page 4-8).

The QUICK CHECK procedure is described on the following two pages.

If, after switching on the ROTALIGN computer, the screen appears blank, fear not. Check that the power supply is properly connected or, as the case may be, that the batteries charged. If this does not rectify the problem, press and hold down either "1" or "0" key on the ROTALIGN keyboard. These keys can be used to set screen contrast from the initial startup screen.



Note

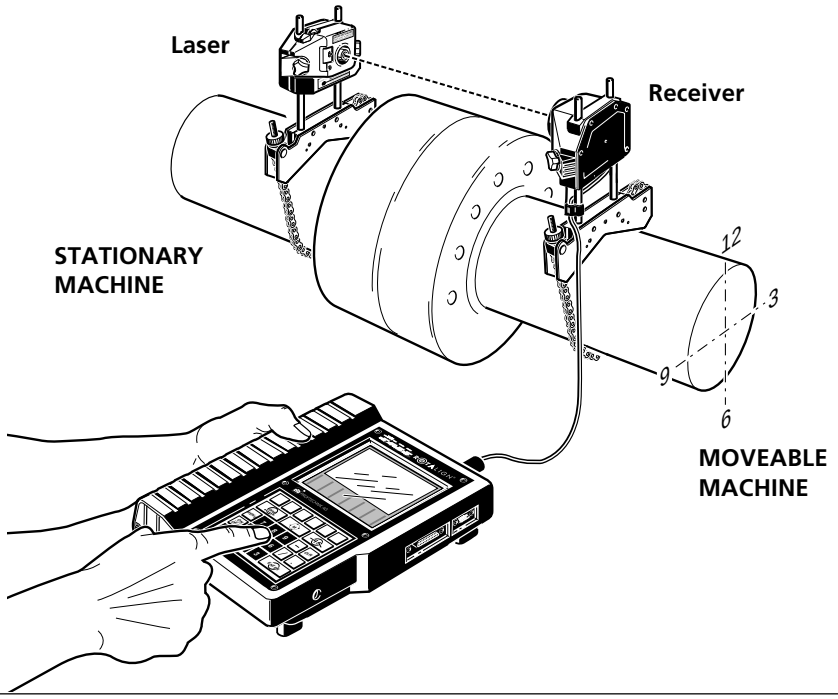
QUICK CHECK

quick check

1. Set up ROTALIGN

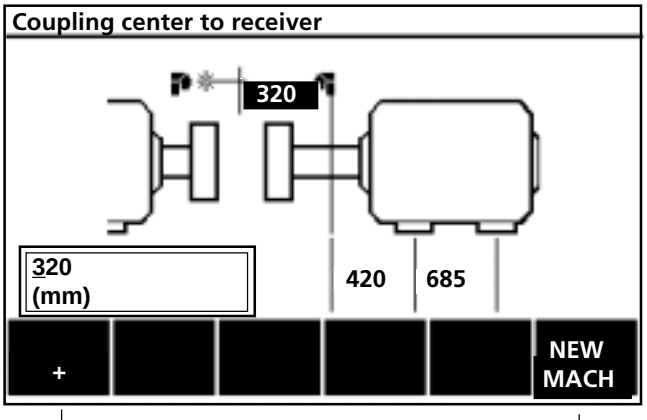
Prepare the machines for alignment (see page 4-10 for details. In particular, rigid couplings (e.g. turbines) must be loosened so as not to exert any force on the shafts.

Mount the laser and receiver on the coupling with the laser on the left (stationary) machine (page 4-12). Connect the receiver to ROTALIGN, switch on, and select QUICK CHECK.



2. Enter Dimensions

Type in the three dimensions as shown, and press ENTER to confirm the entry. Errors can be corrected with the CLR key. (See page 4-21 to change mm / inches.)

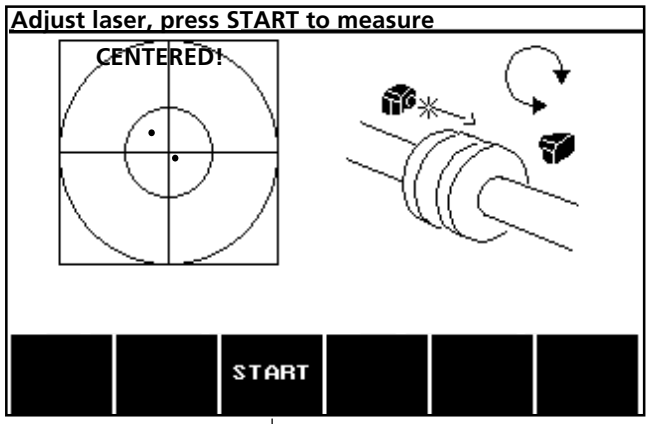


Used with inch fractions
e.g. 44 ¼" entered as
4 4 + 1 / 4 <Enter> (page 4-22)

Clears all dimensions and measurements

3. Adjust beam and measure

The measurement screen appears. Switch on laser and center the beam onto the receiver dustcap with the two thumbwheels on the laser. Remove the dustcap and view the target on the screen (page 4-23):

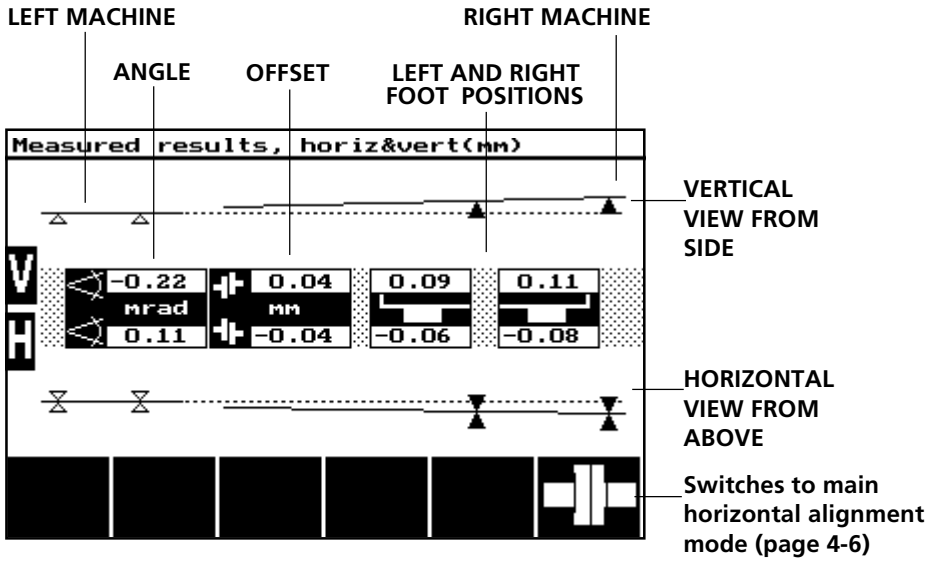


Align laser, press START and rotate

Adjust the two dots into the central ring on the screen target (Check that the laser and receiver are parallel and appear aligned by eye).

When centered, press START (if requested) and rotate the shafts a full turn, or as far as possible—at least 75°. The receiver makes a series of measurements; at least 5 are required. Once these conditions have been met, the results screen appears...

4. Results



VERTICAL VIEW FROM SIDE

HORIZONTAL VIEW FROM ABOVE

Switches to main horizontal alignment mode (page 4-6)

Compare these results with the machine specifications. If alignment is required, press the COUPLING softkey—a warning appears informing that the last measurement made will be overwritten; press OK and proceed from page 4-16.

Note:
1 mrad = 1 micron / mm
= 1 mil / inch

Remember:
Remove all components from the shaft before restarting the machine!

Menu overview - horizontal machines

MACHINE SETUP (page 4-17)

Select machine & coupling types
Normal 4 feet
6 feet
Single bearing
V form
Stationary (left machine only)
L ? R (select which machine)
EDIT NAME (enter a name for each machine)

CPLG TYPE (see below)

COUPLING TYPE (page 4-19)

Select coupling type
Short flex: CHANGE MODE: Angle/offset OR Gap/Offset
Single plane: CHANGE MODE: Angle/offset
Spacer shaft: CHANGE MODE: Alpha/beta OR Offsets A&B
CHANGE MODE selects the way the coupling results are displayed

MEASURE MODE (page 4-33)

Select measurement mode
Continuous Sweep
Measure at 0,3,6,9
Multipoint (at least 5)
FIT,RANGE AVERAGE)
Pass mode (uncoup. shafts)
Dial gages (see page 4-39)

Start measurement
TABLE (shows prev. meas.; select those to be averaged)
XY VIEW (view xy, temp., and angle values; CURVE EXTEND,
START (depending on mode)
SOFT FOOT (see below)

SOFT FOOT (page 4-29)

Select a foot, loosen, press OK and retighten
Machines to check must be "4 feet" type.
Right-hand softkey switches between machines (if both moveable)
Refer to the soft foot appendix for interpretation of the results

COUPLING TARGETS (p. 4-59)

Enter target values for "cold" machine
(displayed in the previously selected display mode)
L ? R (select left/right machine, depending on coupling type)
DIAMETER (gap/offset only)

THERMAL GROWTH (page 4-61)

Enter expected thermal growth at feet
H ? V (select horiz./vert. plane to view)

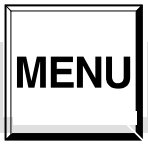
TOLERANCES (page 4-62)

Show recommended coupling tolerances
DISREGARDED
TABLE/ALT. TABLE (requires RPM value)
Excellent values
Acceptable values
User-defined values
MAX. COUPLING VALUES (requires dimensions)
SLIDING FRICTION VELOCITY (for spacer shaft couplings)

STATIC FEET (page 4-65)

Select which feet pairs are static

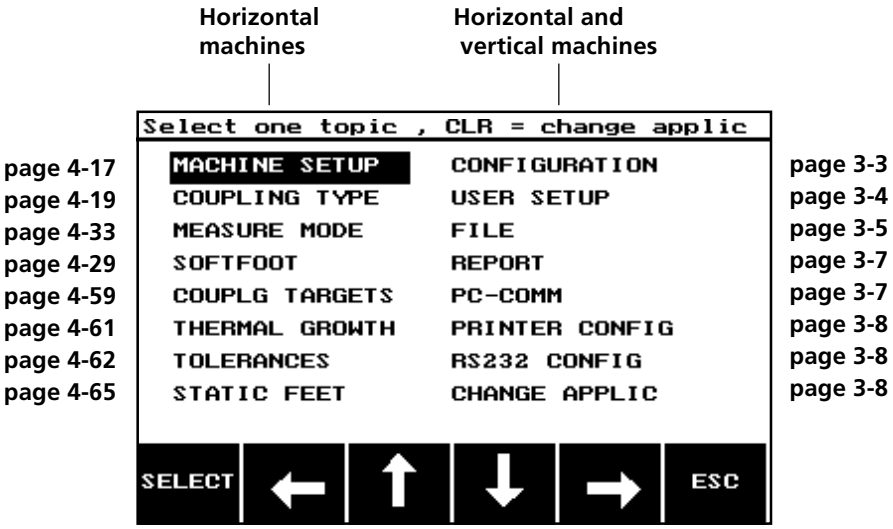
The Menu



The Menu key can be used to call up a screen displaying the available functions for the current alignment mode (i.e. horizontal or vertical—no menu is available for the QUICK CHECK mode). On the opposite page is an overview of the ROTALIGN functions which relate directly to horizontal machine alignment and the locations of the functions in the ROTALIGN software. Most of the functions can also be accessed from within the program. Details of the individual functions are provided on the following pages at the relevant points in the alignment procedure descriptions. Those functions which are only accessible from the Menu are described at the end of this chapter.

To open the menu at any time, press the MENU key. (Press MENU again to return to where you came from!) Note, this option is not available in QUICK CHECK mode.

Below is the menu for horizontal machines; for vertical machines only the right-hand column of options is available:



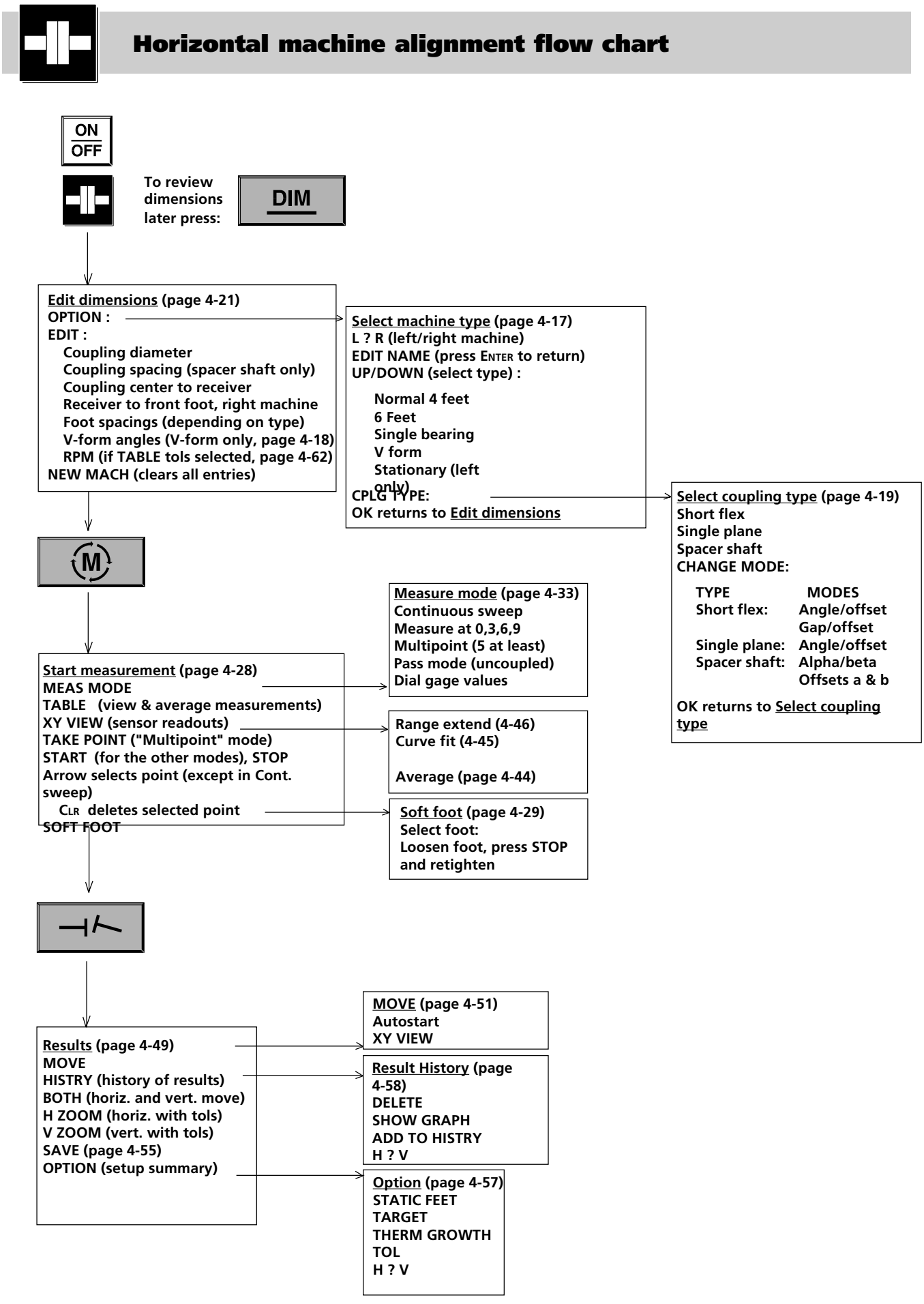
Use the arrow keys to make your choice, then press SELECT.

Note that the CLR key returns you to the introductory screen (page 4-14).

All these options are described in detail on the following pages, first those for horizontal machines only, then those for horizontal and vertical machines. Note, some of these options are also available as softkeys during the alignment procedure.

In this Menu screen the "1" and "0" keys change the screen contrast.


Note


Horizontal machine alignment flow chart
ON
OFF
To review dimensions later press:
DIM
Edit dimensions (page 4-21)
OPTION :
EDIT :
Coupling diameter
Coupling spacing (spacer shaft only)
Coupling center to receiver
Receiver to front foot, right machine
Foot spacings (depending on type)
V-form angles (V-form only, page 4-18)
RPM (if TABLE tols selected, page 4-62)
NEW MACH (clears all entries)
Select machine type (page 4-17)
L ? R (left/right machine)
EDIT NAME (press ENTER to return)
UP/DOWN (select type) :
Normal 4 feet
6 Feet
Single bearing
V form
Stationary (left only)
CPLG TYPE:
OK returns to Edit dimensions
Select coupling type (page 4-19)
Short flex
Single plane
Spacer shaft
CHANGE MODE:
TYPE MODES
Short flex: Angle/offset
Gap/offset
Single plane: Angle/offset
Spacer shaft: Alpha/beta
Offsets a & b
OK returns to Select coupling type
M
Measure mode (page 4-33)
Continuous sweep
Measure at 0,3,6,9
Multipoint (5 at least)
Pass mode (uncoupled)
Dial gage values
Start measurement (page 4-28)
MEAS MODE
TABLE (view & average measurements)
XY VIEW (sensor readouts)
TAKE POINT ("Multipoint" mode)
START (for the other modes), STOP
Arrow selects point (except in Cont. sweep)
CLR deletes selected point
SOFT FOOT
Range extend (4-46)
Curve fit (4-45)
Average (page 4-44)
Soft foot (page 4-29)
Select foot:
Loosen foot, press STOP and retighten
MOVE (page 4-51)
Autostart
XY VIEW
Results (page 4-49)
MOVE
HISTRY (history of results)
BOTH (horiz. and vert. move)
H ZOOM (horiz. with tols)
V ZOOM (vert. with tols)
SAVE (page 4-55)
OPTION (setup summary)
Result History (page 4-58)
DELETE
SHOW GRAPH
ADD TO HISTRY
H ? V
Option (page 4-57)
STATIC FEET
TARGET
THERM GROWTH
TOL
H ? V

Horizontal machine alignment

The ROTALIGN program covers practically any alignment situation. A multitude of options are available with the softkeys at the bottom of the screen. For most applications though, the "straight through" approach should apply where the default settings are perfectly suitable and the special options are not required.

Therefore, for clarity, only the "straight through" method is described in detail here. The options are mentioned briefly in smaller print and page references are provided to their complete descriptions which are also included in manual. The flow chart on the opposite page gives a complete overview.

As this is the main instruction procedure, it is important to acquaint yourself with this chapter before moving to vertical machines or special cases.

Step by step

1. Prepare machine for alignment!
2. Mount the brackets.
3. Mount laser and receiver.
4. Switch on the ROTALIGN computer.
5. DIMENSIONS: enter machine dimensions.
6. Adjust laser beam onto the receiver.
7. Check for soft foot.
8. MEASURE: take measurements.
9. RESULTS: coupling offset and corrective values for machine feet
10. MOVE:
    a) Move vertically with shims
    b) Move horizontally
    } or both together!
11. Repeat measurement and MOVE if necessary until aligned!

1. Prepare the machines

Before using ROTALIGN, make sure the machine is properly prepared for alignment as described below. See page 6-7 for further information.



WARNING!

Ensure that the machine cannot accidently be started before commencing work.

a. Solid, flat foundation

b. Machine mobility

Start with about 2 mm (80 mils) of shims beneath each foot. Hydraulic or screw-type positioning aids are recommended for horizontal movement.

c. Rigid couplings and coupling play

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

Note: coupling backlash has no affect on ROTALIGN measurement repeatability or accuracy.

d. Shaft play

The ROTALIGN soft foot function can measure radial play when the shafts are lifted. Axial shaft play—up to 3 mm (1/8")—can be tolerated during measurement (although not necessarily for machine operation!).

e. Soft foot

Soft foot allows the machine to tip into a different position every time the bolts are loosened, making proper alignment difficult or impossible. This can be checked with ROTALIGN immediately before measuring alignment (pages 4-29 and 6-24).

f. Thermal growth, alignment targets, tolerances

Find out from specifications what these values are for your machines. They can then be entered into the program as explained later (pages 4-61 and 6-32).

g. Measurement separation

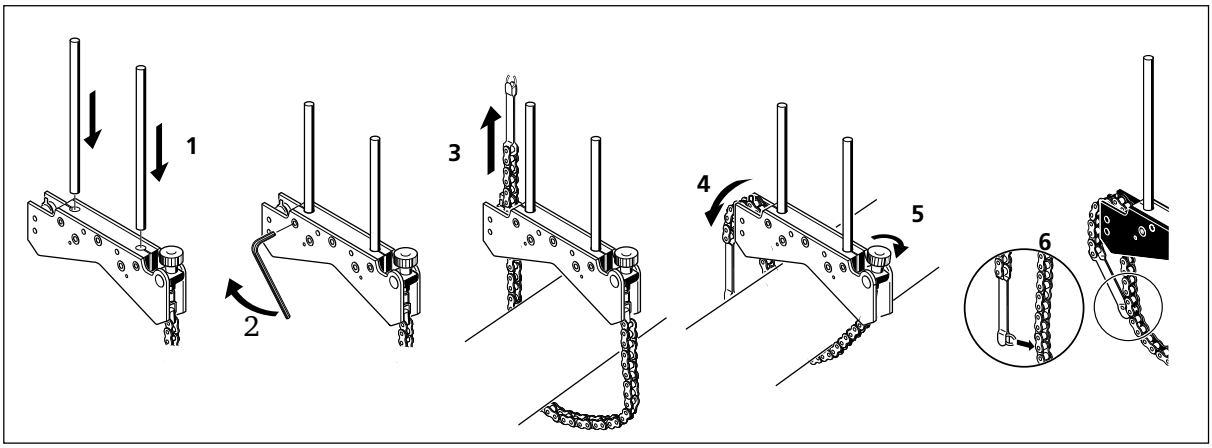
Since the ROTALIGN system requires no mechanical connections (such as cantilevered dial indicator brackets) to span over the coupling during measurement, alignment may easily be performed over laser–receiver separations of up to 10 meters (33 feet). Longer separations are possible when angular misalignment is not too large. Alternatively, use the "Extend" function and/or additional averaging (see pages 4-46)

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 coupling manufacturer's specifications.

2. Mount the brackets

Mount the brackets on either side of the machine coupling, and both at the same angle.

Here is how to fit the compact chain-type brackets:



1. Choose the shortest support posts which will still allow the laser beam to pass over the coupling flange. 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 above; 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. Small clips are provided to secure the loose ends of the chain back onto itself.

Note: Tighten the support posts into the bracket first! Otherwise this may be difficult once the bracket is mounted on the shaft.

Now the bracket should be tight upon the shaft. Do not push or pull on the bracket to check, since that would only loosen its mounting.

Important: The brackets MUST be correctly mounted to ensure accurate measurements.

Note

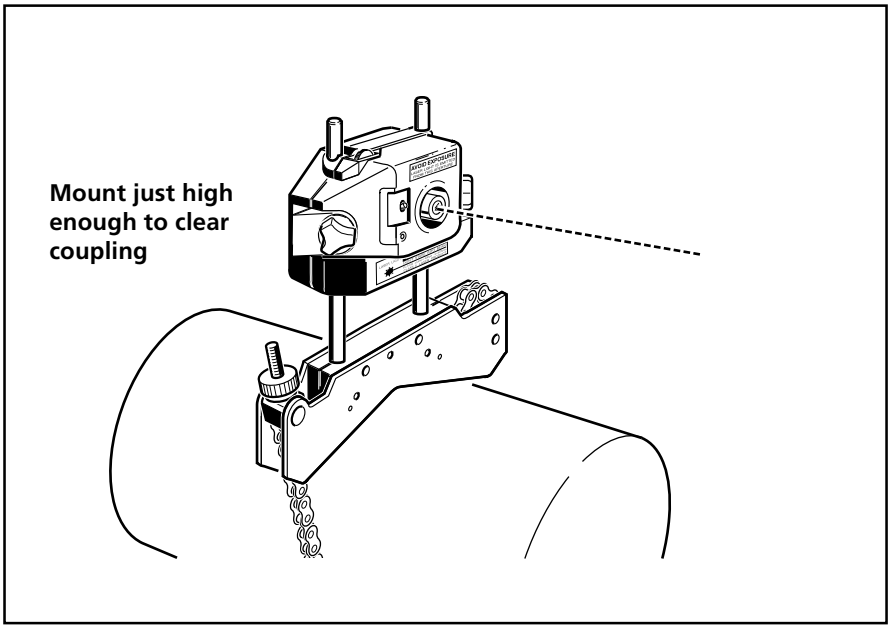
To remove the brackets, first loosen the thumbscrew, then remove the chain from its anchor peg.

Note: the compact chain-type brackets cover most situations, but in cramped or special cases, others may be required, see pages 6-18 - 6-22. If one or both sides of the coupling cannot be rotated, you will require the sliding magnetic brackets, pages 4-36 and 6-18.

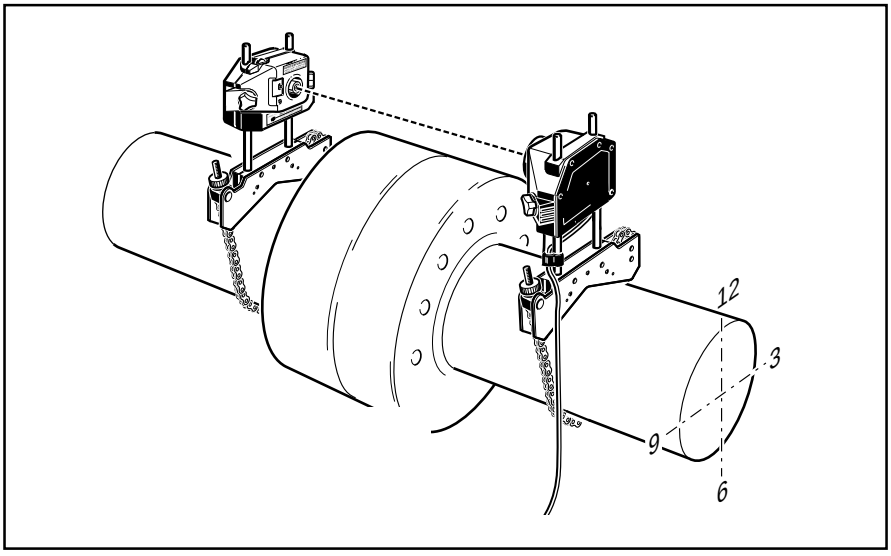
3. Mounting laser and receiver

Install the laser on the support posts of the bracket installed on the shaft of the machine on your left (as viewed from normal working position). Note: The cable should be permanently connected to the receiver, also during storage, to save wear and tear on the components.

Ensure that the yellow knobs on both components are loosened enough to let you slide the housings onto the support posts.



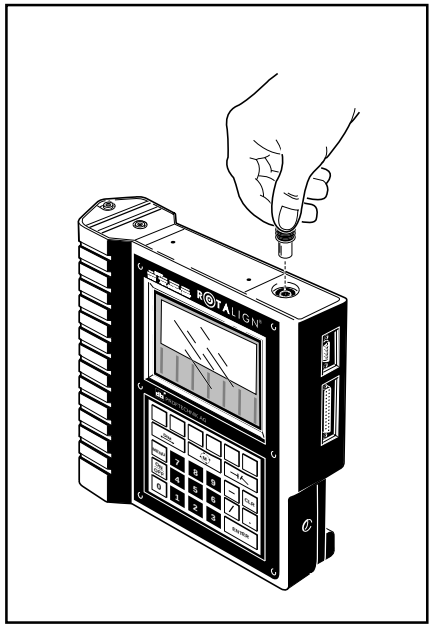
Both laser and receiver should be at the same height, as low as possible, yet just high enough for the beam to clear the coupling flange as shown below.



Tighten the yellow knobs to lock the components onto the posts, then remove the dust cap from the laser.

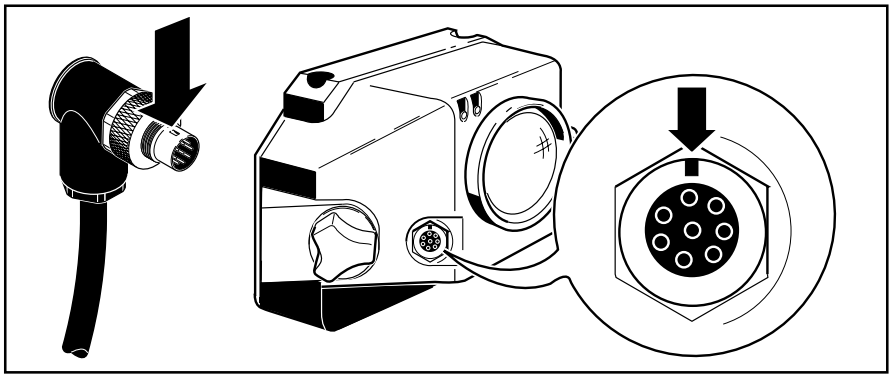
Connecting the receiver

Insert the straight-ended cable plug into the eight-pin socket on the top of the computer housing as shown at right; note the keyway indicating proper plug orientation. A gentle push is required until the plug clicks into place. To remove the plug, squeeze its ribs closest to the computer and gently pull.

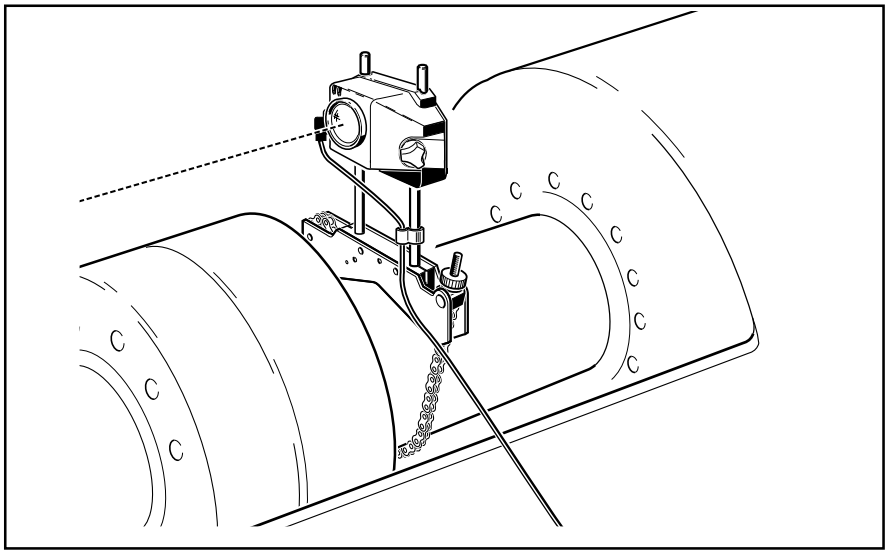


Important : "pull, don't twist" the cable when disconnecting. PRÜFTECHNIK advises leaving the cable connected to the ROTALIGN at all times, even when in its case.

The angled plug should be permanently left connected to the receiver, also when storing ROTALIGN in its case, as this will help avoid damage to cable pins, plugs and sockets. If it is disconnected, screw it in to the receiver socket, observing the proper keyway orientation.



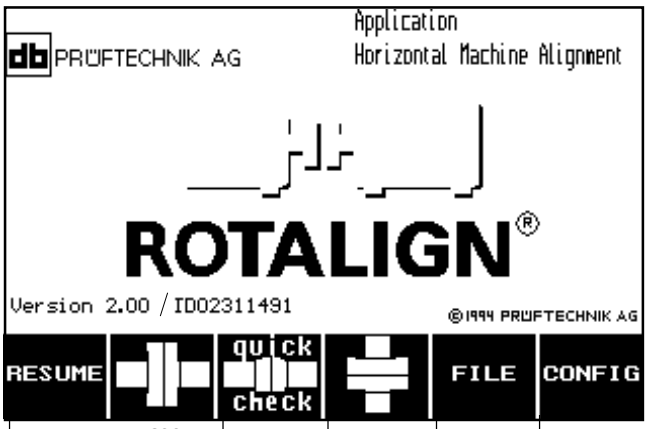
Attach the plastic cable clip to the lower portion of the support post as shown. This helps avoid measurement disturbance and damage to the cable or socket if the cable is pulled.



4. Switch on the computer

ON/OFF

Press the ON/OFF key to switch on the ROTALIGN computer. Wait about 10 seconds for the program to load. The opening screen then appears:



see opposite

Select Units, inch/mm
Select language
Set screen contrast
Set time, date & date format
Set "sleep" times
Enter company name etc.
page 3-3

Open a previously-stored file **page 3-5**

Vertical machines and horizontal machines with bolt "C" flanges **page 5-1**

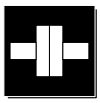
Resumes from where you were at the last switch-off **page 2-12**

QUICK CHECK: a semiautomatic measurement for basic machines **page 4-3**

- Note the black squares at the bottom of the screen: each of these acts to mark the current function of the blue "softkey" located directly below it on the computer keyboard. These key labels are changed automatically by the program to offer a variety of choices appropriate to the situation at hand. This softkey arrangement helps to make the computer extremely simple to use, yet it allows access to the full range of ROTALIGN's many special features.
- Under each screen picture in this chapter is a brief description of each softkey with a page reference if required. Those often used are described starting on the following pages.
- In this introductory screen the "1" and "0" keys change the screen contrast.
- The identification number, located in the lower left adjacent to the version number, is required when registering the software upgrade.

Select horizontal alignment

Press the softkey marked with the coupled horizontal shafts to enter the standard horizontal machine alignment application.



Hints on using the program


Note

The ROTALIGN computer program is intended to be easy to use—even for a computer novice. Feel free to experiment with the keys and options as no physical harm can come to the computer. All screens have a status line at the top giving simple instructions.

Remember to use the three large yellow keys to switch between options at any time.



Dimensions **Measure** **Results**

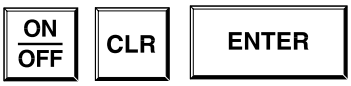
These keys allow you, for example, to quickly switch from the results screen to the dimensions screen to change a dimension.

Also important is the MENU key, 

(described on page 4-7 and 3-2) which similarly exits from any point in the program and returns to the main menu.

Resetting the ROTALIGN computer

The ROTALIGN computer, like all computers, can "lock-up" when a mathematical error occurs. Should this occur and normal operation come to a halt, reset the computer by pressing the ON/OFF, CLR and ENTER keys at the same time:

Press 

all at once to reset the computer.

If this has no effect, or the computer locks-up on switch-on, consult the troubleshooting guide on page 6-11.

ROTALIGN Commander

With the ROTALIGN Commander PC program, machine dimensions and parameters can be entered from a personal computer then downloaded to the ROTALIGN. The Commander can also be used to arrange machine trains (consisting of up to 6 machines). See page 6-16 for more information.


Note

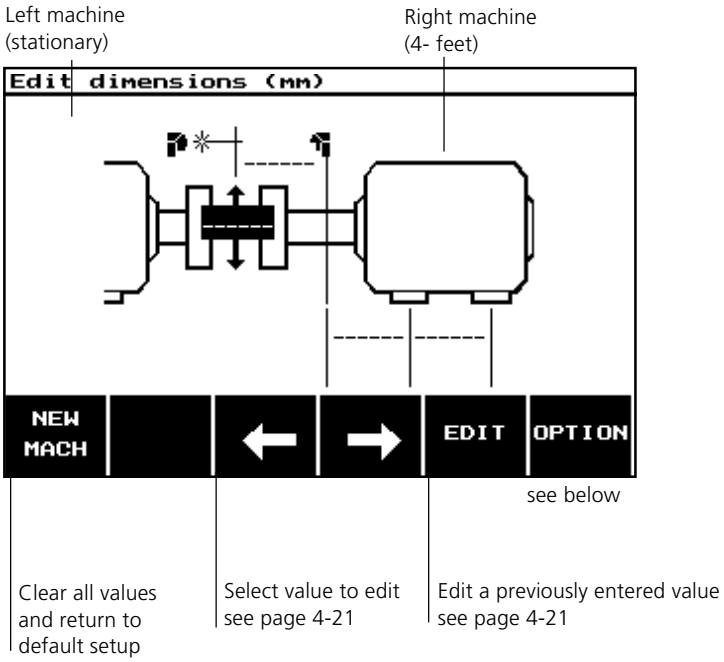
DIM

5. Machine dimensions

After selecting the Horizontal machine application, the computer displays a diagram of the machines to be aligned and prompts for the machine dimensions. (You can also reach this screen from elsewhere in the program at any time by pressing the DIM key.) The default arrangement is:

- The left machine is stationary
- The right machine is moveable and has four feet
- The coupling is a short-flex type (compact and flexible)

If you need to change these settings, use the option softkey.



OPTION

With **OPTION** you can:

·**UP/DOWN**: Select the machine types: 4-feet, 6-feet, single bearing, V-form, stationary (left machine only). You can make the right machine stationary with static feet, page 4-65

·**L ? R**: Select left or right machine

·**CPLG TYPE**: Select the coupling type: short flex, single plane, spacer shaft.
Select CPLG display mode—gap/offset, angle/offset etc.
Note: dimensions are retained in memory when the coupling mode is changed after the dimensions have been entered, e.g. spacer length remains in memory when coupling mode is switched to "Offset & Gap."
See page 4-20.

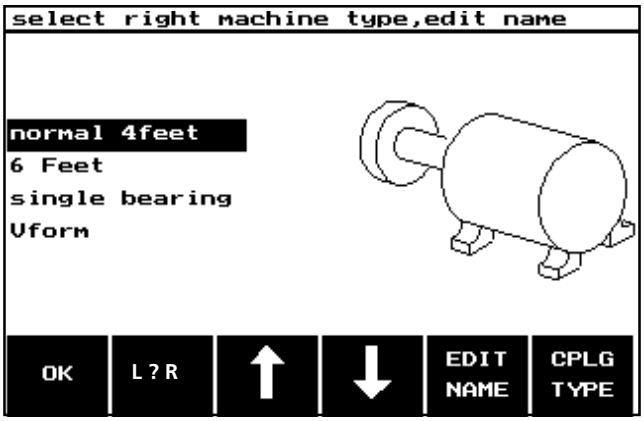
·**EDIT NAME** : Enter the machine names if wished.

Machine setup

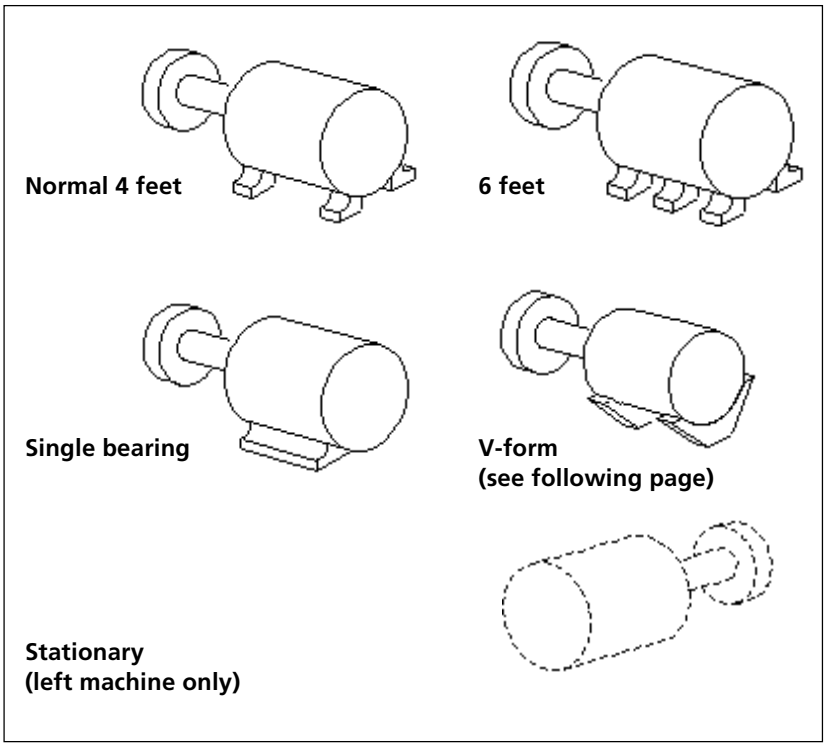


The MACHINE SETUP can be selected from either the Dimensions screen with the OPTION softkey (see page 4-16) or from the Menu.

Machine Setup allows selection of horizontal machine and coupling types, and you can give each machine a reference name. The setup determines how calculations will be made during program operation. Here is the first screen showing the right-hand machine:
Proceed as follows:



1. Select the right machine type (the machine with the receiver mounted) from the options with the Up and Down arrows:



EDIT NAME

2. Press EDIT NAME to call up the Text Editor (described in detail on page 3-4). Use the softkeys to select a name up to 10 characters long, e.g. "MOTORXX101" or "FEEDPUMP." When finished, select "exit" or press the ENTER key.

L ? R

3. Now press the "L ? R" softkey to switch to the left machine. This is normally the stationary machine, but can be made "movable" by selecting one of the other options. Note, you can make the right machine stationary with the Static feet options (page 4-65).

4. You can also press CPLG TYPE to select the coupling type, see next page for details.

5. When finished, press OK to return to the menu.

V-form machines

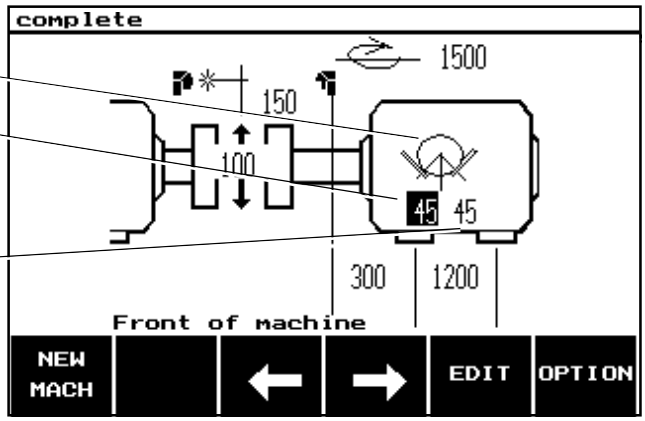
When you select a V-form machine, the angles of both sides of the V mounting are requested in the Dimensions screen:

The V-form symbol is as viewed towards the laser

Angle to nearest side of right machine (this screen depicts the front in this case)
A 0° surface is vertical, 90° is horizontal

Angle to rear side of right machine

Note, 90° and 0° together give a horizontal/vertical corner arrangement.

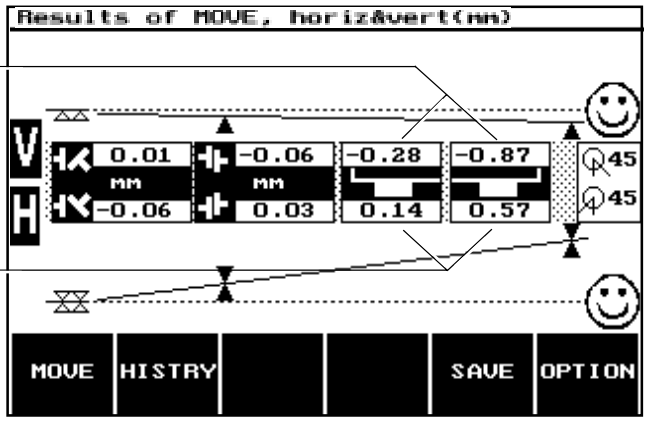


The spacings for both sides of the V mounting are displayed in the Results screen instead of the foot values:

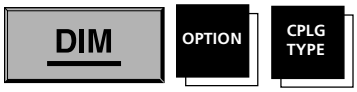
Spacings at BACK of machine (the picture above shows the front of the machine in this case)

Spacings at FRONT of machine

Note, Thermal growth values are still determined in the horizontal/vertical axes for V-form machines.

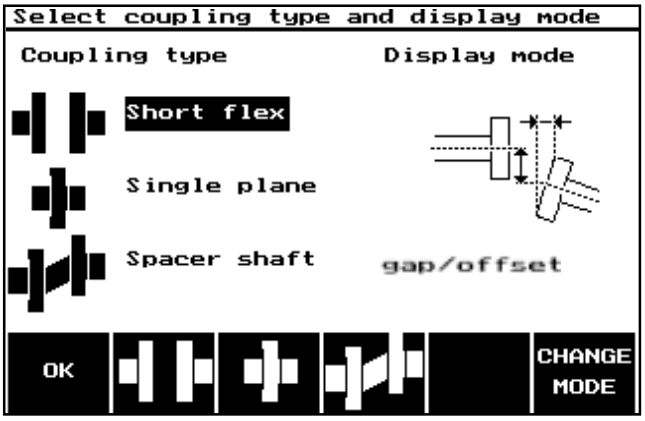


Coupling type



Before entering the dimensions, select the coupling type. This can be selected from either the Dimensions screen with the OPTION and CPLG TYPE softkeys (page 4-16), or from the Menu.

Selecting a coupling type allows the program to calculate and display the alignment conditions appropriate to your machine. Shown below is the Coupling Type screen:



SHORT FLEX is for most common types of "compact" flexible coupling, e.g. chain, bellows, diaphragm, elastomeric, gear, spring, grid or pin types.

SINGLE PLANE is for simple nonflexible couplings which are usually just two flanges bolted together. Note: these should be loosened slightly during alignment so that one machine does not influence the other.

SPACER SHAFT is a coupling with two bending planes and a spacer. Note, the length of the spacer must be entered when entering machine dimensions.

Select the appropriate coupling type with the softkeys.

Sign convention

Vertical

Offset is positive when the coupling plane center of the right machine lies above the shaft line of the left machine.

Offset A is the distance from the right coupling half to the shaft line of the left machine.

Offset B is the distance from the left coupling half to the shaft line of the right machine.

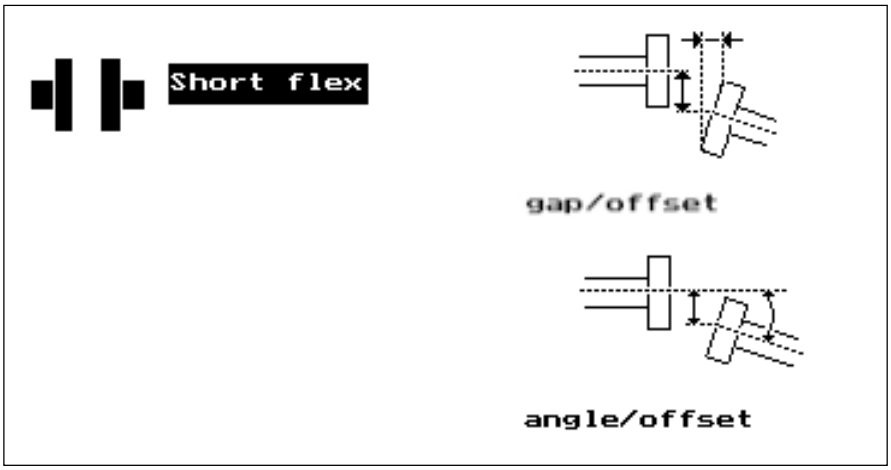
Angularity is positive when the coupling opens toward the top.

Horizontal

Same as vertical when viewing the computer screen with the stationary machine on the left and the movable machine on the right.

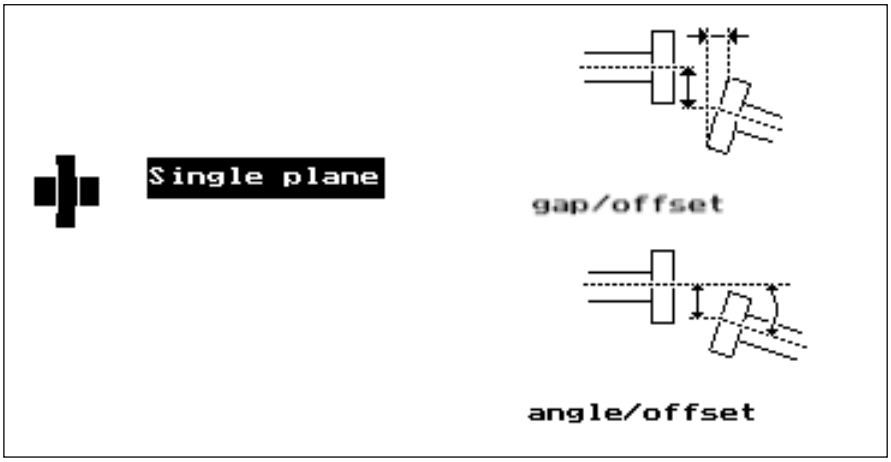
CHANGE MODE

CHANGE MODE selects the way the coupling misalignment will be displayed. This allows depiction of results in the same format as that specified by the machine manufacturer. The format selection depends on which type of coupling you have, thus:

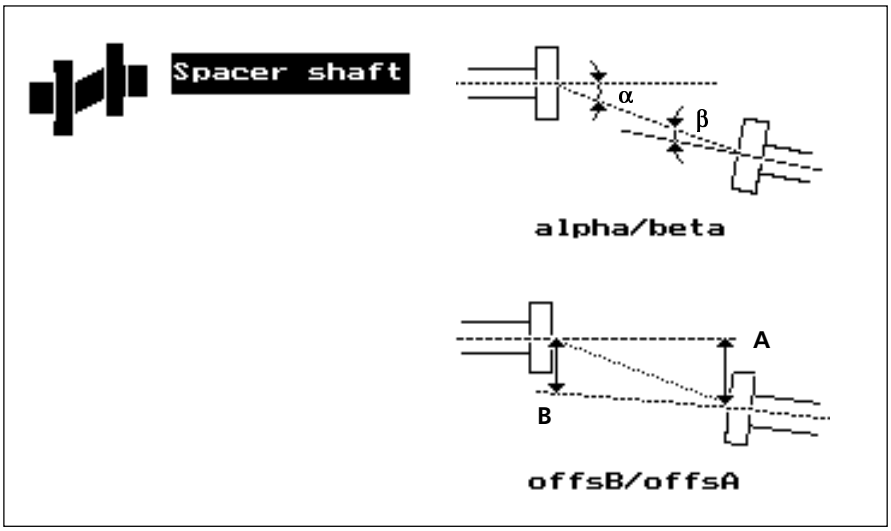


Angles are given in millirads (mrad) where:

1 mrad = 1 micron / mm
= 1 mil / inch



With spacer shafts the results will be given in terms of angles a and b or offsets A and B. Sign convention is explained on the facing page.



Select the appropriate format, and when finished press OK to return to the Menu.

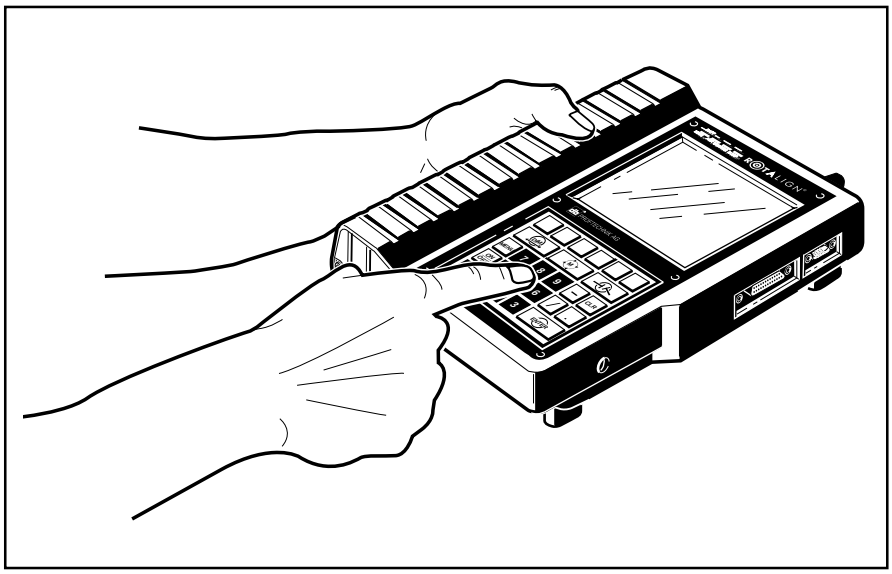
Enter the dimensions

- Tape measure readings are perfectly sufficient for determining dimensions. In the status line is shown which dimension to enter, and whether you are in inch or mm mode.

To change the units, press the MENU key and select "Configuration" (see page 3-3 for details). To return to the Dimensions screen, press the DIM key.

Note

- In the metric mode, enter the dimensions in millimeters; when working in inches, enter whole inches and fractions (next page). Press ENTER after each entry, and use the CLR key to make corrections.

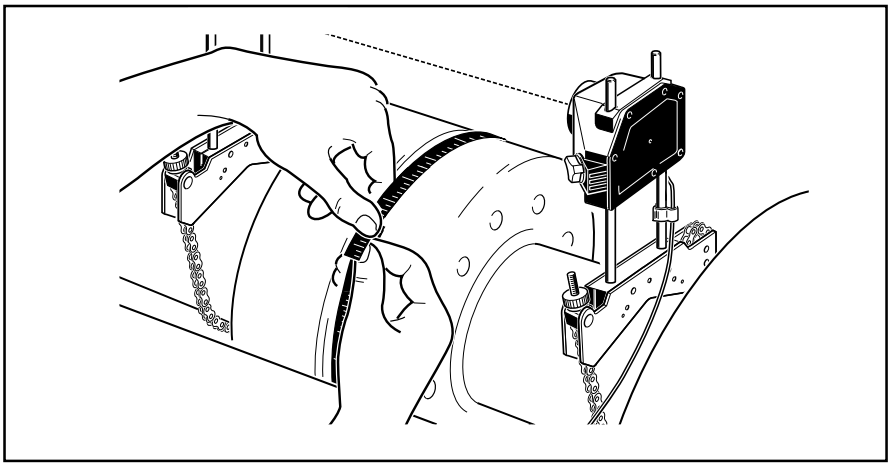


To enter or edit an entry: use the left and right arrow softkeys to highlight the desired dimension. Next, press either the EDIT softkey or the first digit of the value to be entered. Pressing the EDIT softkey will open a dialog box containing the existing value (if one has been previously entered). This dimension can be overwritten, deleted with the CLR key or selectively edited using the arrow keys. If you instead entered the first digit, a dialog box will likewise be displayed, however, it contains only the entered digit. When finished entering the dimension, press the ENTER key.

EDIT

The dimensions you need to enter vary according to machine and coupling types. In the default mode proceed as follows:

1. Enter the coupling diameter
If it's easier to measure the coupling circumference, use the softkey Pi symbol, Π by typing:
Circumference / Π [ENTER].
The computer display then switches to the next dimension.



2. Enter coupling center to receiver
Measure from the coupling center to the marking on the top of the receiver housing. Confirm with ENTER. (For spacer couplings measure from the midpoint between the two couplings.)

3. Enter receiver to front foot, right machine
i.e. the distance from the marking on the receiver to the pair of feet on the right machine nearest the coupling. Confirm with ENTER.

4. Enter front foot to back foot, right machine
Confirm with ENTER.

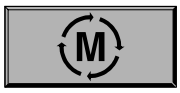
Entering inch fractions

For example: to enter a distance of 3' 8¼" (= 44¼"), press the keys 4 4 + [softkey] 1 / 4 [ENTER]

The computer display is rounded to the nearest 0.01", but calculations are made internally using the full fractional value. Fractions may be entered in decimal form using the "." key.

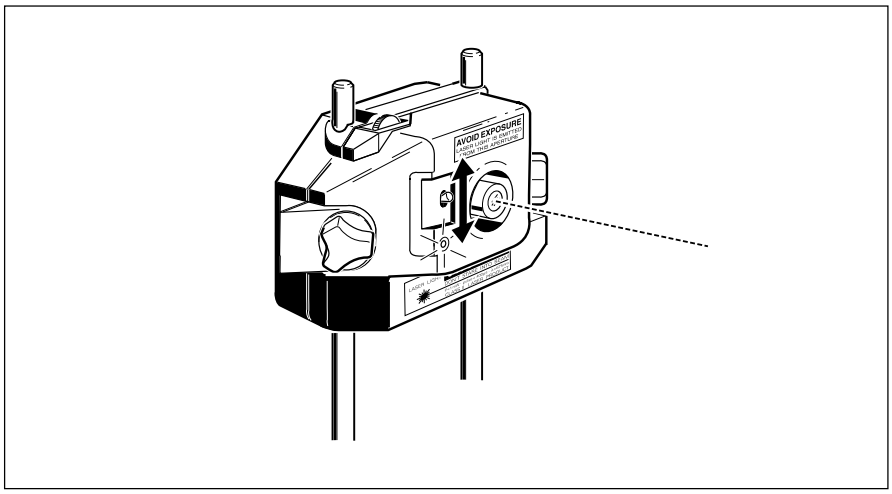
The multiplication softkey "x," and the MINUS key "-" can also be used during entry.

6. Laser beam adjustment

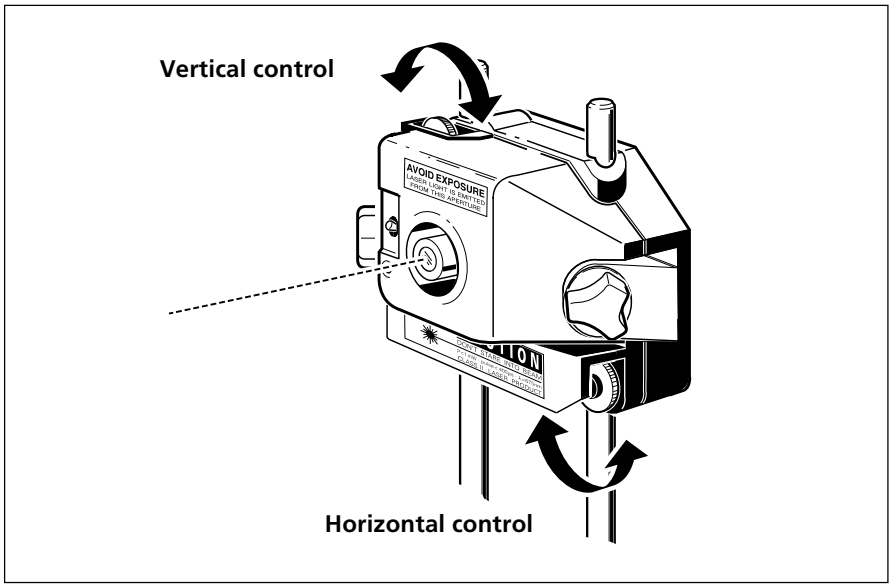


Press the "M" key to start the measurement process. When first mounted, the laser and receiver may be misadjusted. The laser and receiver must then be adjusted to direct the laser beam into the middle of the receiver housing aperture. Adjust the beam as follows:

1. Remove the cap from the laser and flip the laser switch upwards as shown below. Do not look into the laser beam aperture.



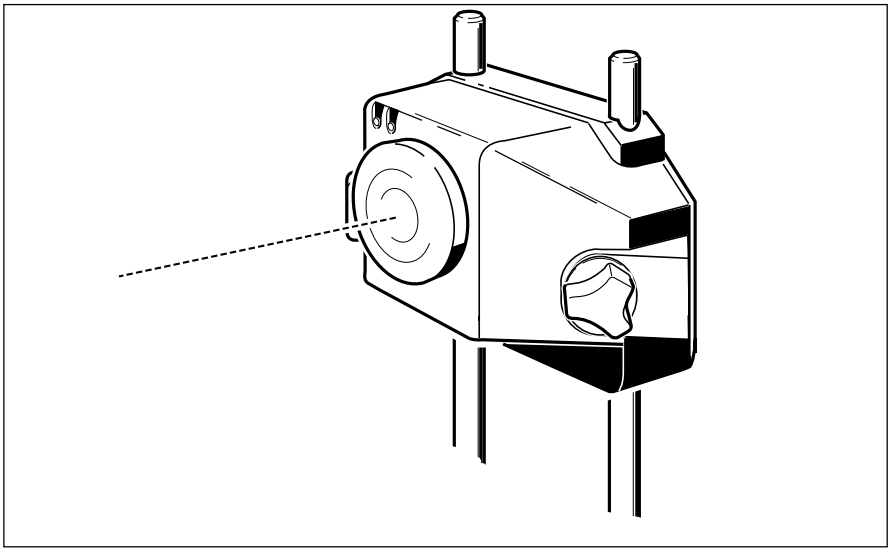
2. With the receiver cap still mounted, adjust the height of the laser and/or receiver to bring the laser beam level with the center of the receiver aperture. Fine adjustment can be made by turning the thumbwheel on top of the laser housing:




Note

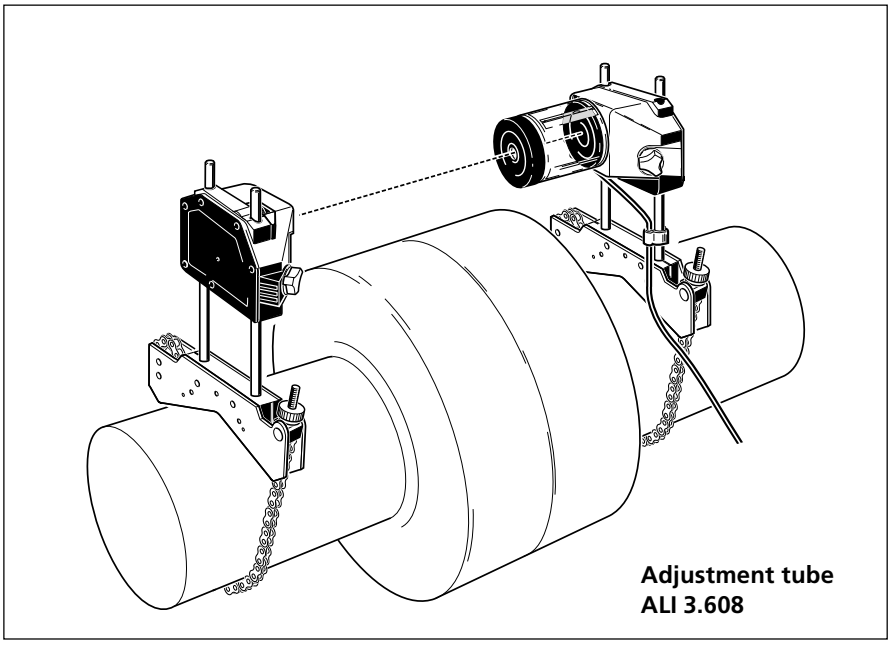
If, approximately 10 seconds after pressing the "M" key or entering "Soft Foot" mode, the ROTALIGN fails to establish contact with the sensor, the "SENSOR ???" message is displayed on the screen. The message is also displayed if the receiver cable is disconnected while ROTALIGN is in XY, Move or Soft Foot modes. Check that both ends of the cable are properly detected.

3. Use the lower thumbwheel on the laser housing to adjust the lateral position of the laser beam. The beam spot should now strike the center of the cap covering the receiver aperture.



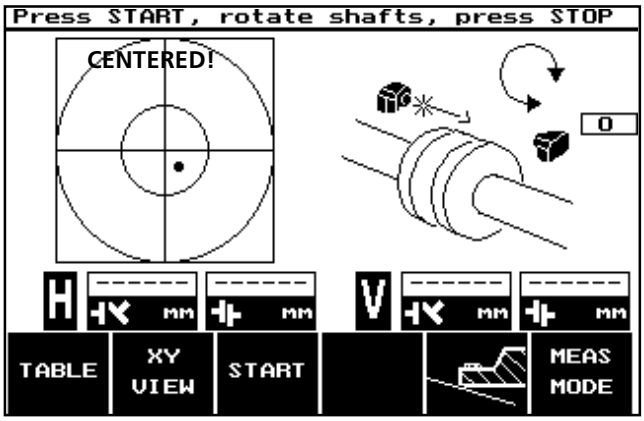
4. It is essential that the beam hits the receiver reasonably centrally AND perpendicularly, i.e. straight-on (see discussion on opposite page). This is particularly important with large machine misalignments, and one way to check this is with the adjustment tube (see below).

   Fix the tube onto the receiver and direct the beam through the front aperture. If the beam is not centered on the inner target, the laser must be either moved along its support posts or the laser mounting bracket loosened and rotated slightly. Make the necessary adjustments to "straighten" the beam, then retighten the fixings.



Adjustment tube ALI 3.608

5. Remove the cap or beam tube from the receiver. The computer display should resemble that pictured below.



Details of these softkeys on page 4-28

The target diagram in the left portion of the display represents the FRONT position detector within the receiver (there are two detectors, see page 2-15). The current beam position is shown as a dot on this target diagram which should fall within the inner circle. If not, use the laser thumbwheels to bring the dot into the inner circle. (QUICK CHECK, page 4-3 shows points for both detectors simultaneously.)

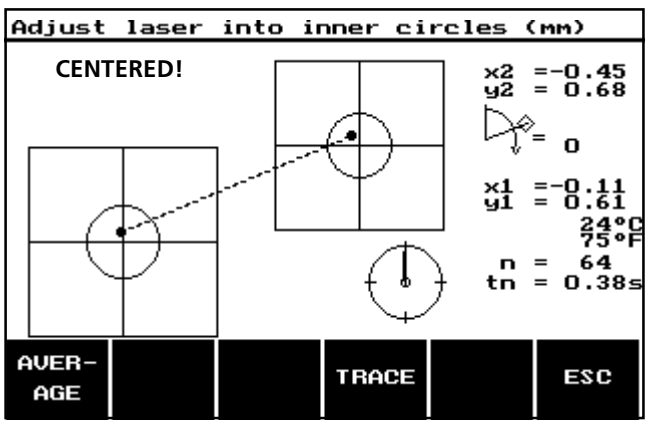
Make sure that the receiver lens is clean! Otherwise measurement accuracy may be reduced!



Note

6. As explained on the previous page, the beam should not only be centered, but also reasonably perpendicular, i.e. straight-on (see discussion on following page). To check this, centration must be seen in both position detectors. Press the softkey marked XY VIEW:





Full description of XY View on page 4-43

The two detectors can be seen in this display. The beam should be centered in both planes which may require using the thumbwheels. It some cases it may be necessary to move the receiver and/or laser along their posts or the bracket may have to be loosened and slightly rotated. Retighten the components when finished and press ESC.

Note

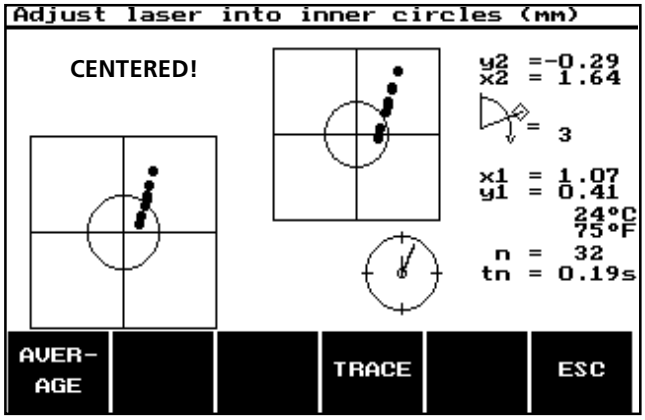
If there are measurements available for the current machine, the CURVE FIT softkey appears for displaying the YY ellipse (see page 4-45 for a complete description of the CURVE FIT option).

TRACE

TRACE

In TRACE mode, entered by pressing the TRACE softkey in the XY View screen, a line representing the laser beam is traced between the two sensors. Although it cannot be used while taking actual measurements, this mode provides quick insight into angularity and offset conditions and is also of use while aligning the laser and receiver.

If, while rotating the shafts, the traces on the left (front) sensor

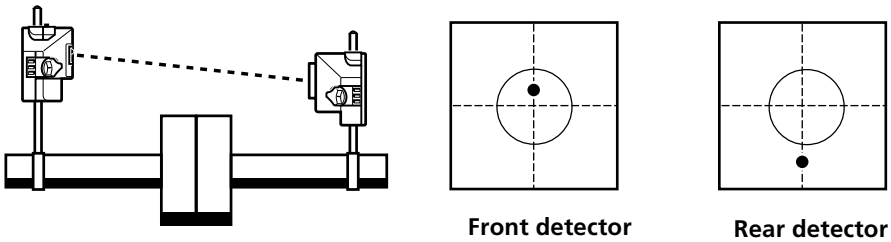


remain in the same position and the traces on the right (rear) sensor change, suspect angularity. On the other hand, if the traces move equal amounts on both sensors, offset is most likely the culprit. To exit trace mode, either press ESC softkey or select the TRACE softkey again.

When you have completed measuring, return to the menu and select another option or press the (results) key.

Why centered AND perpendicular?

If the laser and receiver are not reasonably in-line, the beam could be centered on one detector and off center on the other:



Laser and receiver not in-line (exaggerated example)

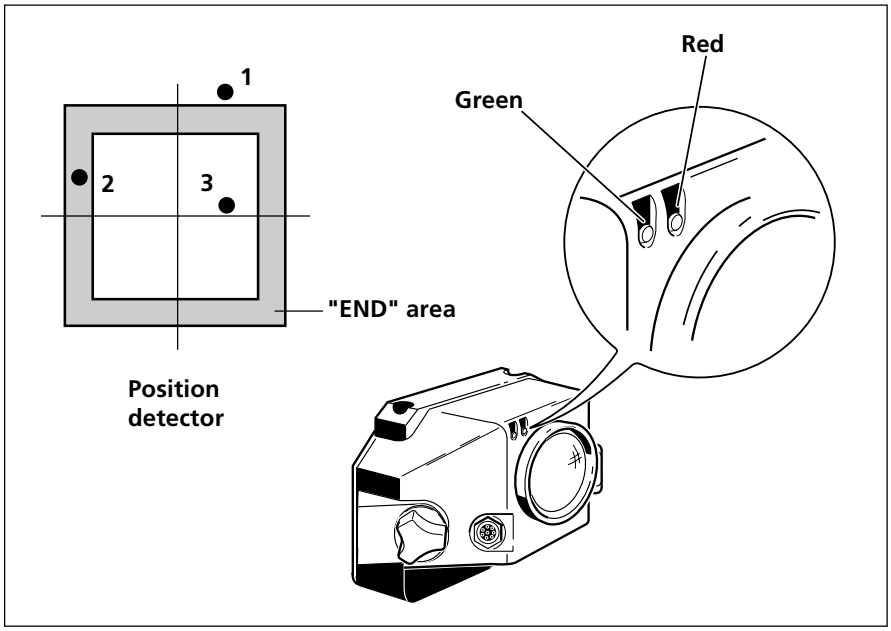
Front detector centered

Rear detector off-center

Tip: slide the laser up and down on its posts and rotate the bracket around the shaft to center the laser on the front of the display. Use the two thumbscrews to center the laser on the rear display.

Receiver LEDs

The two indicator LEDs above the receiver aperture blink to indicate one of three possible beam adjustment conditions:



	Red LED	Green LED	Computer display
1. Out of range	Steady	Off	"LASER OFF!"
2. Edge of range	Blinks (fast)	Blinks (fast)	"LASER END!"
3. Adjustment OK	Off	Blinks (slow)	"CENTERED!"

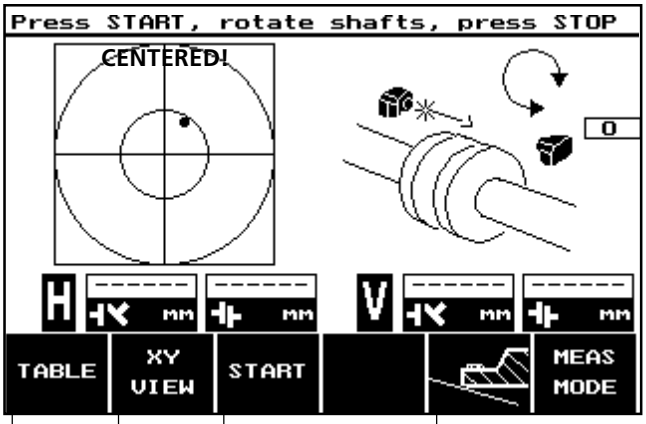
(Note, in the Pass measurement mode the green LED lights up for one second after each laser pass to confirm that the measurement was accepted. See page 4-36.)

7. Measurement

Once the laser beam is adjusted, the alignment can be measured. There are several measurement modes to choose from, the default being "Continuous Sweep." This is the standard and simplest method for measuring alignment, whereby the shaft is rotated and a series of measurements are automatically made during rotation. The various measurement modes are described in detail starting on page 4-34.

Note: now is a convenient point to check "soft foot," if suspected. Press the SOFT FOOT softkey, located second from right to enter the A thorough description of the Soft Foot function is described on the following page. When finished, press "OK" and continue with alignment.

Shown below is the measurement screen again:



Start measurement **4-34**

Soft foot page **4-29** **see below**

View detector planes **page 2-15**

A series of measurements, are listed in a table, which can be selected and averaged **page 4-48**

MEAS MODE

MEAS. MODE has the following measurement mode selections:

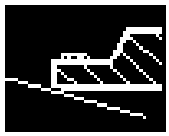
Continuous Sweep	(default "automatic" mode, described here)
Measure at 0,3,6,9	(set shaft to each clock position and measure)
Multipoint	(measure at least 5 points of your choice)
Pass mode	(for uncoupled or non-rotating shafts)
Dial gage values*	(enter the readings from traditional dial gauge methods and calculate alignment from them)

See page 4-33 for details.

Soft foot, described on page 4-29**,** measures machine movement when each foot bolt is loosened

*This option is provided primarily to calculate equivalent dial values from a laser-based measurement. An added feature is that dial values can be entered and the graphical result calculated.

Soft foot



SOFT FOOT is the condition whereby one or more machine feet are not resting properly on the foundation but are being held down by force with the foot bolts. Soft foot could be a result of:

- Non-coplanar machine mounting surfaces,
- Deformed machine frame or feet,
- External forces, e.g. from a connecting pipe or bracket, or
- Improper shimming or soiled machine feet.

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

Soft foot should be checked before aligning the shafts. This can be done quickly and conveniently using the soft foot function. With the laser and receiver mounted on the shaft in the usual way, the system is able to sense any machine movement when the machine bolts are loosened individually; if the computer is given the machine dimensions, ROTALIGN can calculate from the shaft movement how much each foot has raised as it is loosened.

Once you have established the foot movements, the results need to be interpreted and translated into the thicknesses of the shim to be placed under the feet. How straightforward this is depends on the type of soft foot you have. The two main types are:

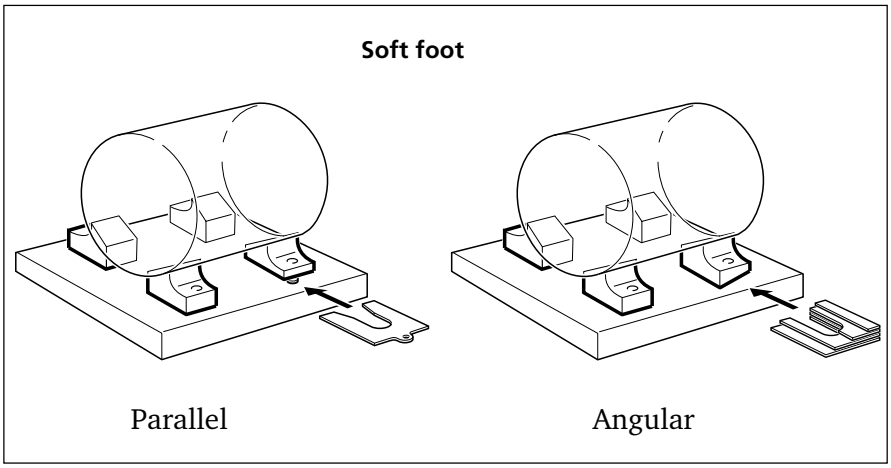
Parallel soft foot: One or more feet are too short or too long. This usually results in the machine rocking on the longer feet. This is corrected by placing a shim under ONE of the short feet (see illustration opposite).

Angular soft foot: The base of one or more feet is at an angle to the foundation and is only partly in contact. In this case it is usually necessary to check suspect feet with a feeler gauge and build up wedged shims.

Sometimes a combination of soft foot errors are present, making correction somewhat more complicated. Please refer to the Soft Foot appendix at the end of this manual for more examples.


Note

If, approximately 10 seconds after entering "Soft Foot" mode, the ROTALIGN fails to establish contact with the sensor, the "SENSOR ???" message will be displayed on the screen. The message is also displayed if the receiver cable is disconnected while ROTALIGN is in Measure, Move or Soft Foot modes. Check that both ends of the cable are properly connected.

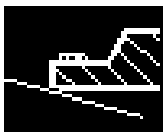


Procedure:

Note: the machine(s) to be checked are assumed to have four feet in an approximately square formation. If your machine has six feet then it should be measured in two parts, first the front four feet, then the rear.

You can also measure soft foot on the left machine (the one with the laser mounted on its shaft) by selecting it as "4-feet" instead of "Stationary."

Proceed as follows:



1) With the laser and receiver mounted on the shaft in the normal way, select the Soft Foot softkey.
2) If the machine dimensions have not yet been entered, the program will issue the warning "Missing dimensions":

    a) Press OK and the Dimensions screen appears (page 4-16).

    b) Press OPTION to check the machine types. You must select "4-feet" machine types for the machine(s) to be checked.

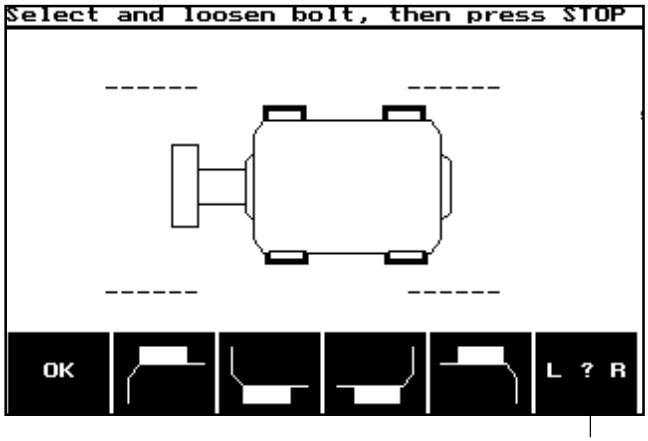
    c) When finished with machine setup, press MENU again and reselect SOFT FOOT.


Note

For maximum accuracy during soft foot measurement (and especially when coupling play is present), the shafts should be rotated so that the sensors are oriented vertically (12:00 - 6:00 direction).

The Average function, set in the XY View screen, is automatically used during soft foot calculations. With this option, you can set the number of measurements (up to 2048) to be taken and averaged at each foot (see page 4-44).

3) The Soft Foot screen now appears:



Select left/right machine if both are moveable

4) Check that the laser is switched on. If NO LASER or LASER OFF is flashing, then adjust the beam (see page 4-23).
5) Select one of the feet with the softkeys and loosen the corresponding anchor bolt.
6) The measured distance that the foot has risen is shown on the screen. Press "STOP" to store the maximum value and retain it in the display. Retighten the bolt.
7) If the AVERAGE function has been given a value greater than 8 (the minimum value), a slide bar appears in the left side of the window displaying the fraction of measurements made (see page 4-44).
8) Repeat this procedure for each foot and for each movable machine, selected with the right-hand softkey if shown. With four values per machine, the shimming corrections can now be determined.

The CLR key **CLR** resets all readings.

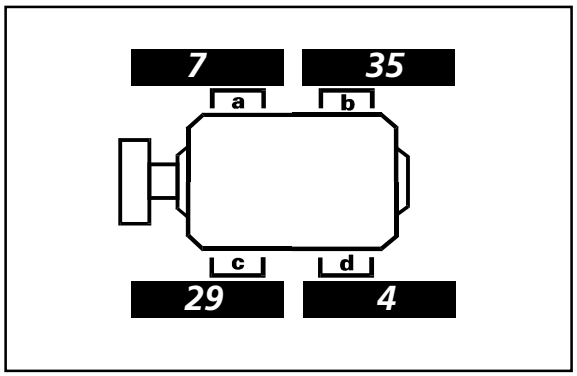
Note

Determining soft foot corrections

The two basic types of soft foot, parallel and angular, are relatively straightforward to identify:

Parallel soft foot

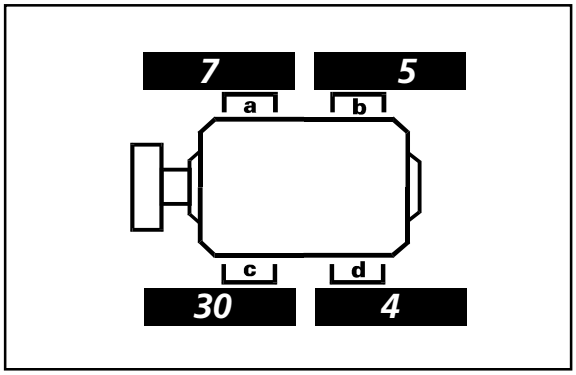
If two diagonal values are roughly equal and significantly higher than the others, then correcting parallel soft foot can be assumed as a first solution. The machine is rocking on two diagonal feet which are longer than the other two see example on next page.



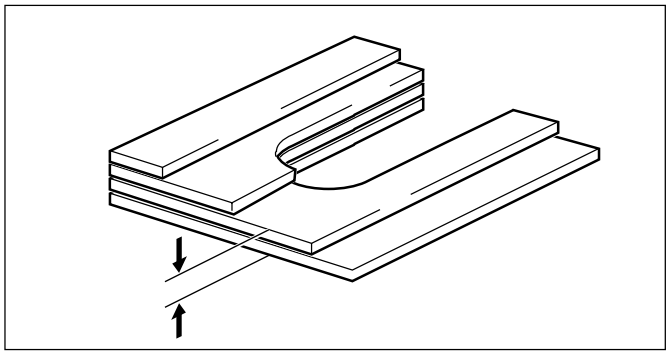
In the above example the correction would be to place a 35 mil (35 x 0.001") shim under foot "b" (the foot with the largest gap)—just like placing a beer-mat under a wobbly bar table!

Angular soft foot

If one value is significantly higher than the others, then angular soft foot can be suspected:



The "problem foot" or machine frame is probably bent or distorted in some way. In this case loosen the bolt and examine the foot more closely. Use a feeler gauge to establish the variation of the gap and use these measurements to sketch the shape and dimensions for a stepped shim.



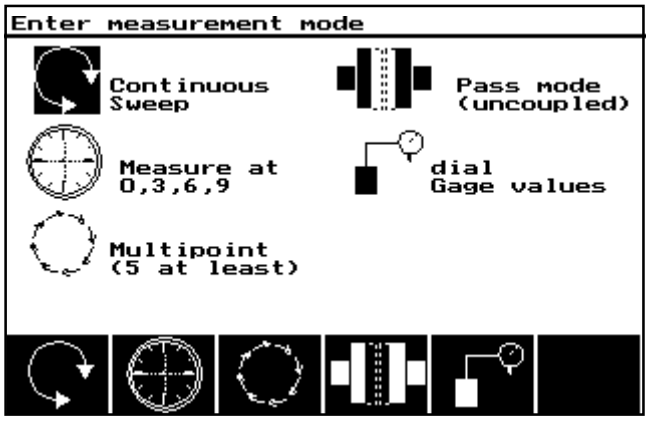
If the soft foot is purely "angular," then the stepped shim will vary in thickness from about zero to twice the displayed ROTALIGN value.

Select measurement mode



The MEASUREMENT MODE can be selected from either the Enter Measurement Mode screen with the MEAS MODE softkey or the Menu.

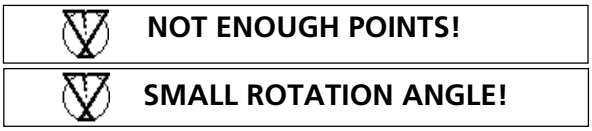
This option for horizontal machines allows you to choose the method of measurement and begins actual measurement. Here is the first screen:



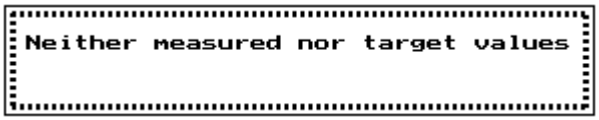
When one of the first four softkeys is pressed, the program immediately goes into the Measurement Mode as described starting on the next page.

Note: warnings

If you have too few measurement points or the rotation angle is less than 75°, one of two warning messages will appear when you complete the measurement or try to view the results:



The computer requires at least 5 points to calculate the alignment. If it has fewer than 5, no result can be given and the following additional message appears (press OK to proceed):

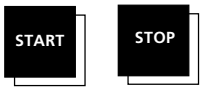


Below follows an explanation of each measurement mode:

CONTINUOUS SWEEP



This is the simplest procedure for horizontal measurement and is the default method in "QUICK CHECK" (page 4-3), basic horizontal alignment (page 4-8) and horizontal alignment with two-bolt flanges (page 5-13). Please see these pages for details.



To start the "Continuous Sweep" procedure, press START. Then slowly rotate the shafts through 360° in either direction (or as far as possible). Press STOP when finished.

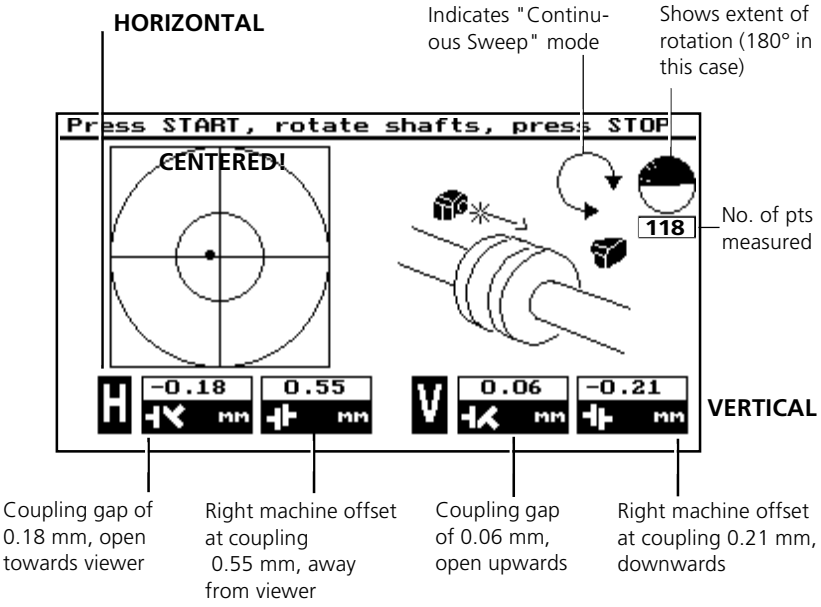
You can select and deactivate "rogue" points with the arrow softkey and "–" softkey (see page 4-41 for details).

Display of alignment values at coupling

The offset and angularity in horizontal and vertical directions are now calculated and displayed.



indicates angle is too small or too few points. Remeasure! See page 4-33 for details



The coupling symbols and the signs of the values indicate the direction of misalignment.

RULE

- Positive values are upwards or away from viewer
- Negative values are downwards or toward viewer



Note

The values displayed in the Measurement screen are the absolute values and are not corrected for thermal growth or targets. These values refer to the right-hand machine. The Results screen, discussed on page 4-49, gives corrected values. horizontal and vertical directions are now calculated and displayed:

MEASURE AT 0,3,6,9



This method is included for "compatibility" with the OPTALIGN system. This mode does not use the receiver's inclinometer readings to calculate the alignment results.

1. Mark out four clock positions around the shaft by dividing the shaft circumference by four, or you can use an inclinometer of your own if the machine is horizontal.
2. Choose one of the positions to be 12:00 and name the others 3:00, 6:00, 9:00 as viewed along the shaft toward the machine with the laser.
3. Turn the shaft to each of the four* clock positions and press the corresponding key: "0" for 12:00, "3" for 3:00, "6" and "9". A result can be calculated from just three points, but four naturally give better accuracy. If your machine is arranged horizontally, you can set the shaft positions with the inclinometer "clock" displayed on the screen.
4. Rogue measurements can be selected with the arrow softkey and deactivated with the "–" softkey (see page 4-41 for details).


Note

Note: measurement at each position begins when a number key is pressed. Therefore, please wait 2 seconds after pressing the position key before you begin to rotate the shafts to the next position.

If you are measuring a vertical machine which is mounted on a wall by its feet, the subsequent calculated feet positions can be shimmed in the normal way.



MULTIPOINT (5 at least)

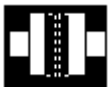
In this measurement mode for horizontal machines only, you rotate the shaft to any desired angles and press TAKE POINT. This is recommended when you have very restricted shaft rotation or if you want to have more control over the measuring points than with the "Continuous Sweep" mode. This may be the case with turbines.

You can select and deactivate "rogue" points with the arrow softkey and "–" softkey (see page 4-41 for details).



Note

Note: measurement at each position begins when the key is pressed. Therefore, please wait 2 seconds after pressing the TAKE POINT key before you begin to rotate the shafts to the next position.



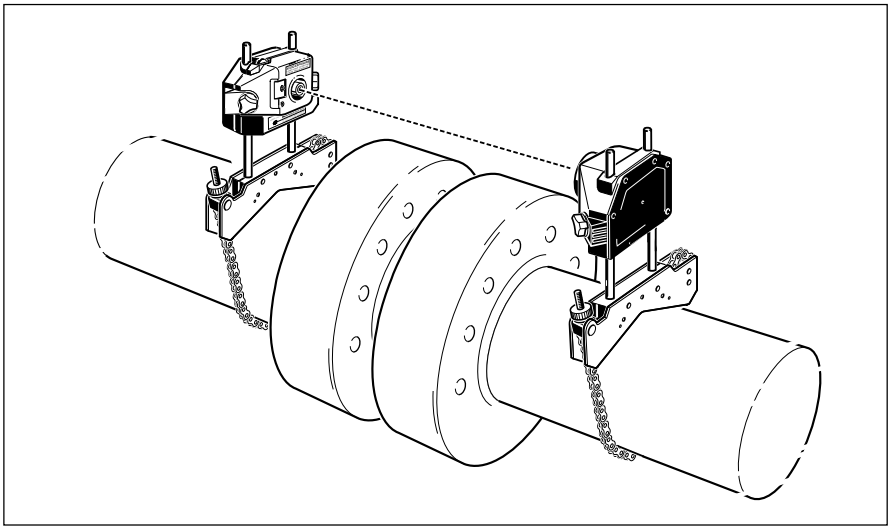
PASS MODE (UNCOUPLED)

This mode is used when either:

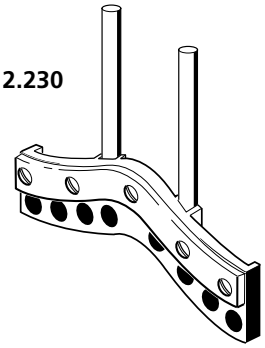
1. The shafts are uncoupled, or
2. One or both of shafts cannot be rotated.

Proceed as follows:

1. If the shafts are rotatable but uncoupled, mount the laser and receiver on chain brackets in the normal way:



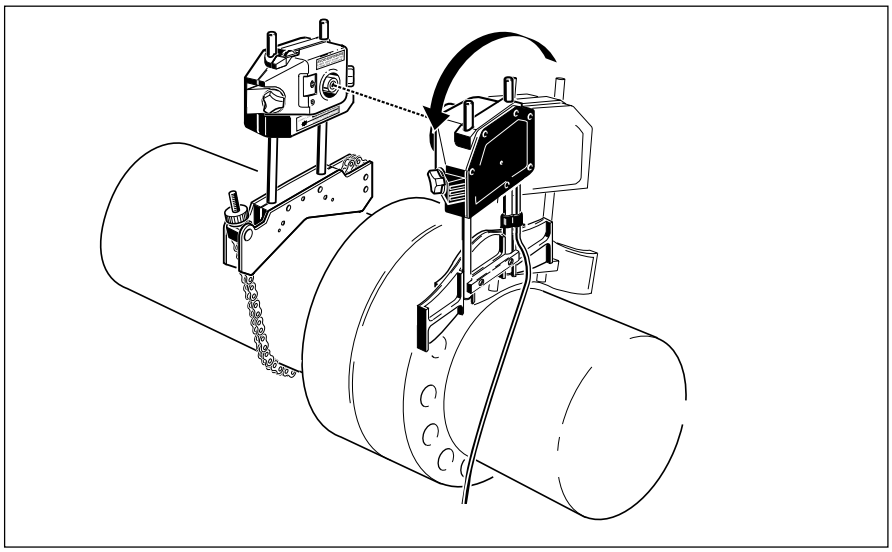
ALI 2.230



2. If a shaft cannot be rotated, the ALI 2.230 magnetic sliding bracket must be used (see Appendix, page 6-18):

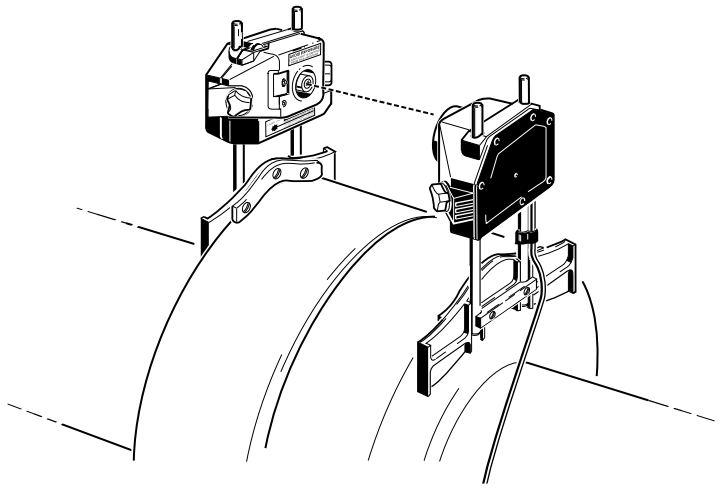
   Mount the sliding bracket on the coupling flange or exposed end of the nonrotatable shaft. The flange or shaft must be steel, surface-finished, clean and lightly oiled. Alignment accuracy depends on these conditions! Aligning two nonrotatable shafts both with sliding brackets is possible but very dependent on the surface finishes and should be regarded as a method of last resort.

3. Mount the laser and receiver. If one shaft is nonrotatable then mount the receiver on it if possible:



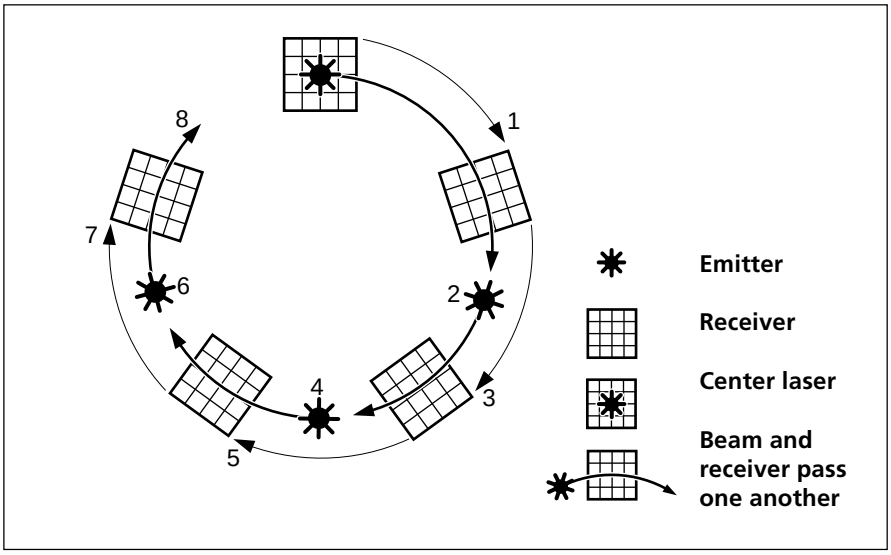
Receiver on nonrotating shaft, mounted on magnetic sliding bracket

If neither shaft can be rotated, the laser and receiver can both be mounted on magnetic sliding brackets. Note, this is regarded as a method of last resort.



Note

4. Select PASS MODE and align the laser as usual.
5. Press START; the first measurement is immediately taken. Now rotate the receiver (or slide the bracket) by about 60° to the next measuring position.
6. Slowly rotate (or slide) the laser past the receiver so that the beam traces an arc across the lens. The green LED on the receiver lights for one second to confirm that the measurement was accepted.



7. Repeat at a series of angles, alternating movement of the laser or receiver in a fashion similar to shown above. The exact pattern is not critical.
8. Press STOP. Measurement is now complete.
9. You can select and deactivate "rogue" points with the arrow softkey and "–" key (see page 4-41 for details).

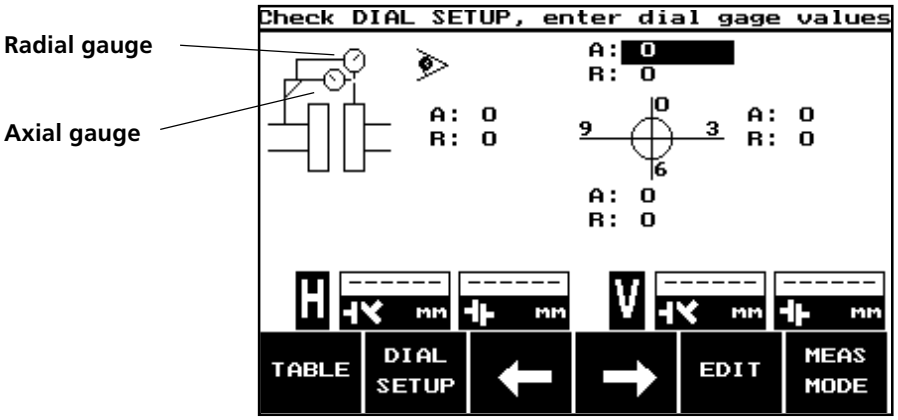
Note

Shield the laser beam with hand when the receiver is moved. Take pass measurements by passing the laser across the receiver.

DIAL GAUGE VALUES

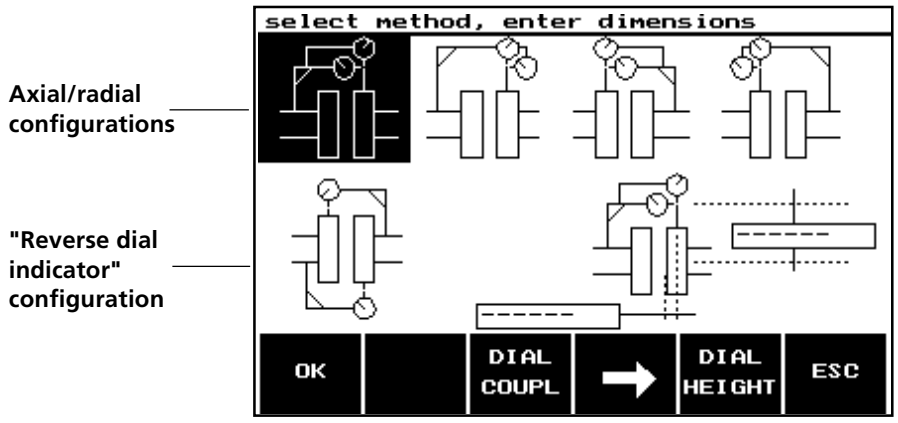


This option allows you to calculate equivalent dial indicator values from a laser measurement. After making a set of measurements with any of the horizontal machine measurement modes, press the MEAS MODE softkey and select the DIAL GAUGE option to display the following screen:



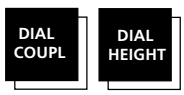
Here we see the dial configuration together with the axial and radial clock positions. Press the DIAL SETUP softkey to enter the dial setup dimensions and/or to select a different dial configuration screen:





Study the configuration diagrams and use the arrow key to select the one which matches your setup. Then enter the two distances:

DIAL COUPL (distance from radial dial to coupling center)
DIAL HEIGHT (height of axial dial from shaft center)



OR for "reverse dial indicator" option:

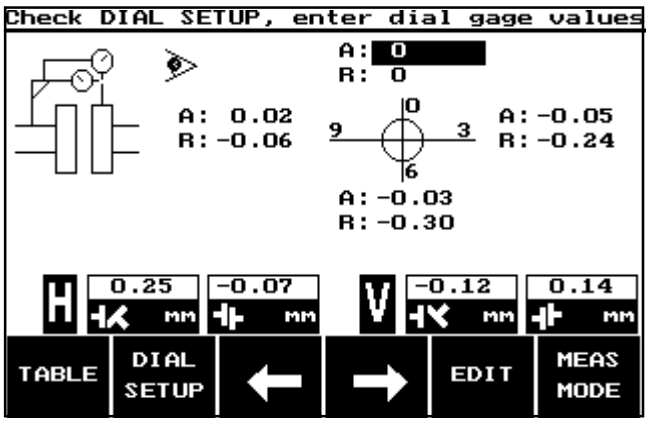
LENGTH R1..R2



Press OK to return to the main screen.

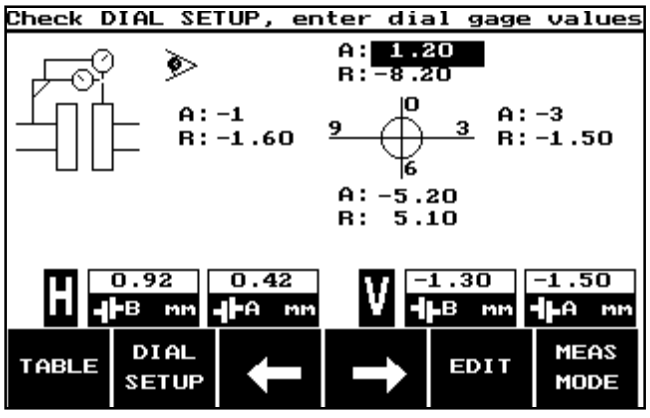
EDIT

The calculated dial gauge values are now displayed. These calculated values are zeroed to the 12 o'clock position:



It is also possible enter dial gauge readings and to calculate misalignment and corrections. After entering machine dimension as would be done for any machine, select the DIAL GAUGE option from the MEAS MODE screen. Enter the gauge configuration and dial dimensions as described on the previous page. Press OK to return to the main screen.

Enter the Axial and Radial clock dimensions, using the arrow key to navigate through the values. Misalignment is calculated after the values have been entered:



You can now align the machines using the dial measurements with the ⊣⊬ key.

Note

Note, a laser-assisted MOVE cannot be performed without actual laser measurements.

Deactivating stray measurements

If a point on the target display seems somewhat astray, it can be deactivated and remeasured. The first measurement points taken in a given measurement are often victims of "stiction"—resulting from the initial force necessary to overcome static friction. Particularly noticeable in the continuous sweep mode, the force jars the shaft, resulting in inaccurate measurement values. Use the following procedure to deactivate these points:

1) After 2 or more measurement points have been taken, the arrow softkey, shown left, appears. Once this appears, points may be activated (or deactivated).



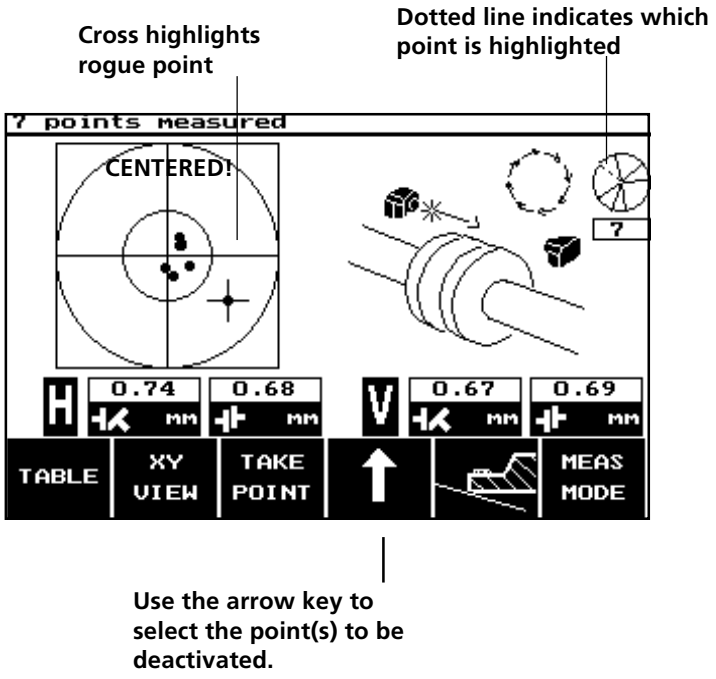
2) Use the ARROW softkey to highlight the rogue point with a cross;

3) Press the "–" key. The point will be deactivated and displayed as a small circle. The status line and "clock" in the top right corner will also be updated to show which points are still valid.



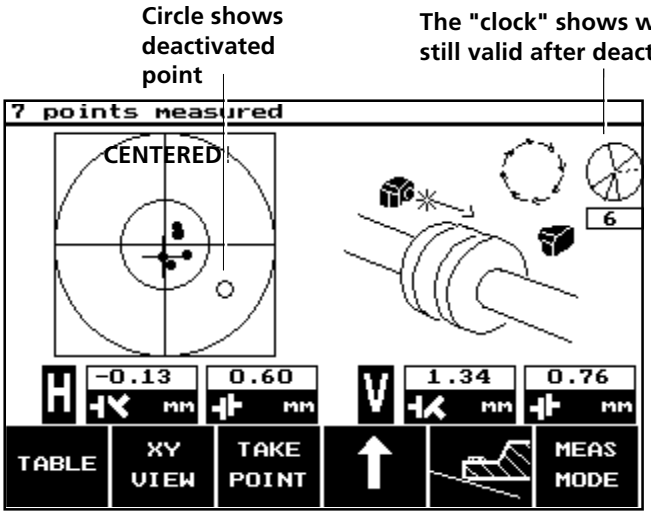
4) The deactivated points can be remeasured. Note, however, that the circles representing the deactivated points remain on the screen.

5) Restore deactivated points by pressing the "–" key again. If more than one point is active for a given measurement, they will be averaged.



As shown below, the deactivated point is indicated by a white circle:

Point deactivated!



CLR

Press the CLR key to delete all current measurement values. Although this clears the measurement values from memory, thereby speeding up transitions between options in measure mode, the measured results remain visible in the Measure screen. They may also be viewed in the Results and Table screens.

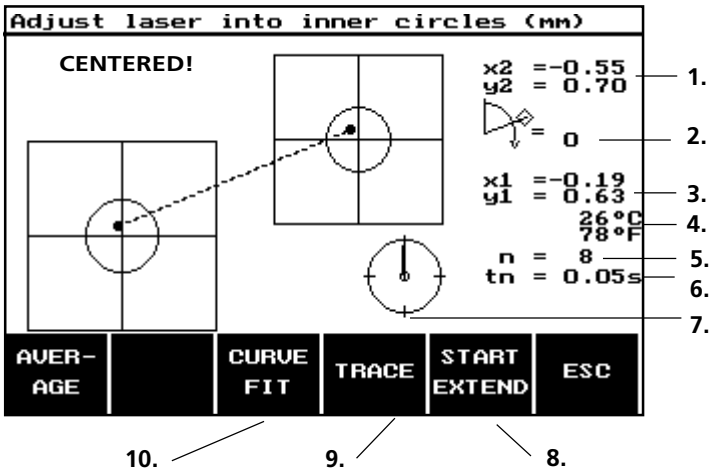
Options during measurement

In addition to the aforementioned functions available in the measurement modes, several additional features are also provided. Described on the following pages are the XY View and the functions available in the screen and the TABLE option.

XY VIEW

Select this option to show a 3D display of the two position detectors inside the receiver. An overview of the display is given below.

XY VIEW



1. X,Y coordinates at rear detector
2. Shaft rotation angle (horizontal machines)
3. X,Y coordinates at front detector
4. Temperature at receiver
5. Number of measurements to be averaged
6. Time required to make measurements
7. Shaft rotation in terms of a clock position as viewed from receiver towards laser (horizontal machines)
8. Appears only if measurements are currently being made
9. Displays laser trace across sensors
10. Appears only if measurement data are available

Inside the receiver are two detectors, one behind the other, which allow ROTALIGN to determine the angle at which the beam enters the receiver as well as its position. Depicted on the screen shown above are the two detectors with the beam trace between them.

Ideally, the beam should hit both central circles for initial adjustment. If the beam appears to have a large angle then the laser and receiver are not yet properly adjusted.

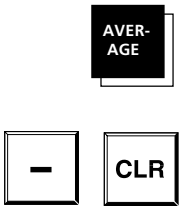
When you have adjusted the beam using the laser thumbwheels or by repositioning the components, press the ESC softkey to return to the Measurement screen.

A thermometer measures the current temperature in the receiver. This value is displayed on the right side of the XY VIEW screen. A warning appears should the ambient temperature fall below or rise above the specified operating temperatures: 0 °C - 60 °C (32 °F - 140 °F). The value is displayed in both °C and °F. Although a warning appears, measurements can still be taken. It is, however, the responsibility of the operator to determine whether or not accurate measurements can be made under the conditions.

AVERAGE

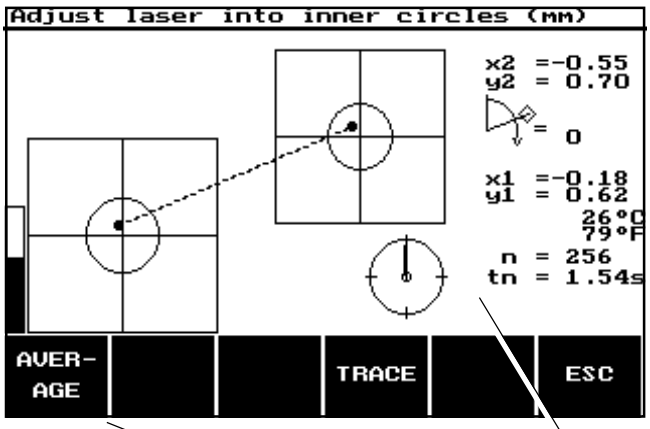
To deliver increased accuracy in situations where accurate alignment measurements may be difficult to make, e.g machines with long shafts, ROTALIGN is equipped with a variable average function.

With this option, up to 2048 samples can be made at each measurement point. AVERAGE is available in the "Measure at ..." and "Multipoint" measurement modes (both horizontal and vertical machines), with a default value of 32 samples. For the "Continuous Sweep" and "Pass" measurement modes, the average value is fixed at 8 samples. Furthermore, the average value set in this option is also used in Soft Foot and Move modes. Note: the AVERAGE function is not operative in the normal XY view in the Measurement screen.



Press the AVERAGE softkey to set the number of points to be averaged. This value can be set from a minimum of 8 to a maximum of 2048 in increments of factors of 2. The available averaging values are, therefore: 8, 16, 32, 64, 128, 256, 512, 1024 and 2048. The "–" key reduces the averaging value by one increment; the CLR key resets the value to 8.

A window containing a sliding bar appears on the left side of the Measurement screen displaying the current percent of measurements which have been taken. This window also appears in the Soft Foot and Move modes.



Sliding bar showing percentage of measurements which have been taken.

Click on the AVERAGE softkey to increase the number of measurements to be averaged by a factor of 2

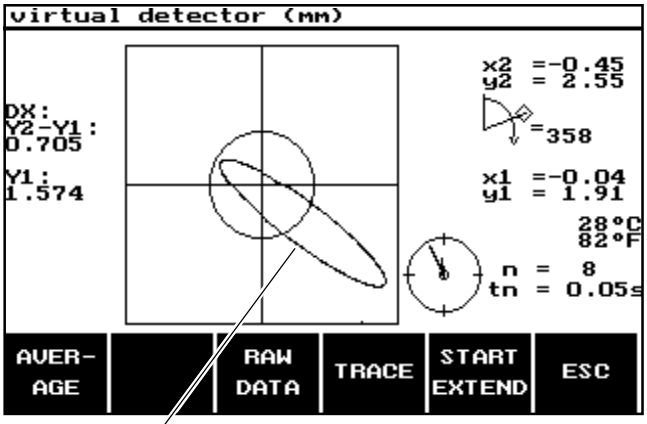
n: number of measurements to be averaged

tn: time required to make measurements

CURVE FIT

CURVE FIT

Once sufficient measurement data are available, the CURVE FIT option appears in the XY VIEW screen. Displayed in this screen is the YY ellipse, a representation of angularity (X-axis) versus shaft offset (Y-axis). If the trace is a thin ellipse centered around the X-axis (horizontal), angularity is extreme and offset is minimal. In the case of perfect alignment, the ellipse is reduced to a point. In the situation shown, both angularity and offset contribute to shaft misalignment.



Based on the orientation and shape of the YY ellipse shown here, both angularity and shaft offset can be assumed to play a role in this shaft's alignment problems.

Press the RAW DATA softkey to exit the CURVE FIT screen and display the actual measurement data. Toggle back to the measurement screen from the RAW DATA screen by pressing the XY VIEW softkey.

RAW DATA

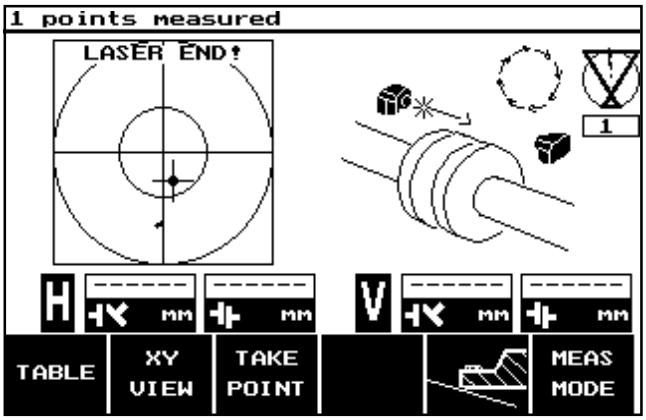
RANGE EXTENSION

In rare cases where shaft offset or gap is so extreme that the laser beam "wanders" out of the receiver range during rotation, the laser must be repositioned. The ROTALIGN "EXTEND" option guides you through the necessary adjustment. Once the laser–receiver pair are back in contact with one another, the shaft alignment procedure can be continued.

Note

This option is available in the "Measure at ..." and "Multipoint" modes for horizontal and vertical shafts.

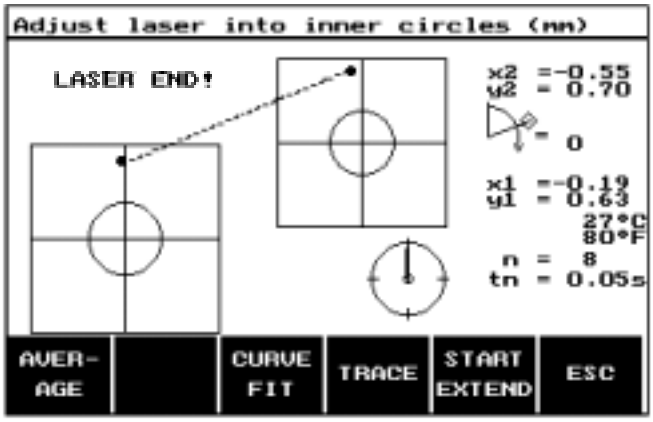
If the "LASER END!" message appears on the screen while you are making shaft alignment measurements as shown in the figure below, the laser beam is not making adequate contact with the receiver.



Follow the procedure outlined below to adjust the laser–receiver pair:

XY VIEW

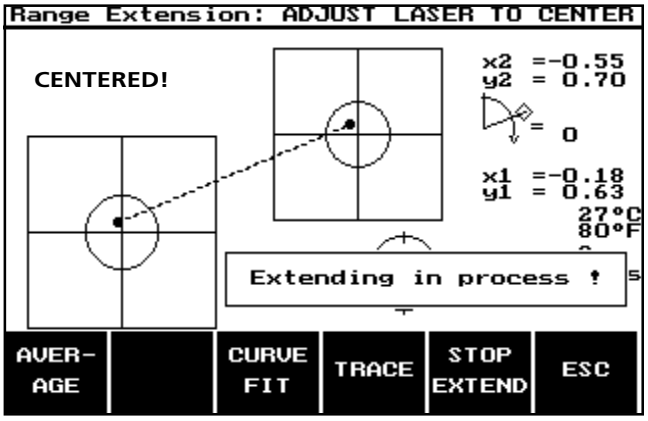
1. Press the XY VIEW softkey to switch to XY VIEW mode.
2. Turn the shaft backwards until the "LASER END!" message disappears:



3. Press the START EXTEND softkey to inform the ROTALIGN to take a reference measurement. "Extending in process!" will appear on the screen.

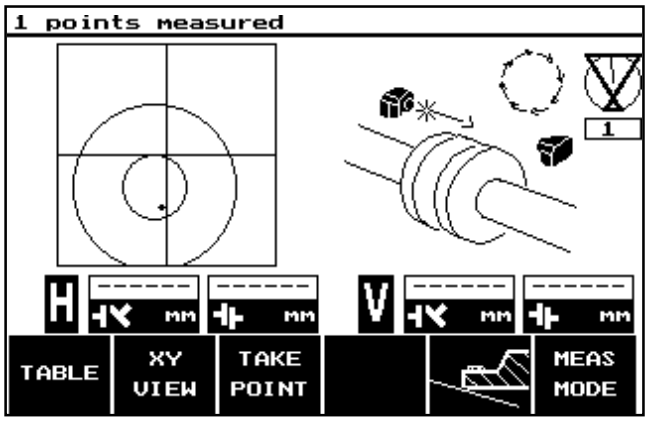


4. Use the two thumbwheels on the laser to recenter the laser beam. The laser beam should fall within the two centering circles in the ROTALIGN display:



5. Once the beam has been centered, press the "STOP EXTEND" softkey. The ROTALIGN display returns to the MEASUREMENT mode. The two centering circles are, however, now slightly offset with reference to the crosshairs as can be seen below:





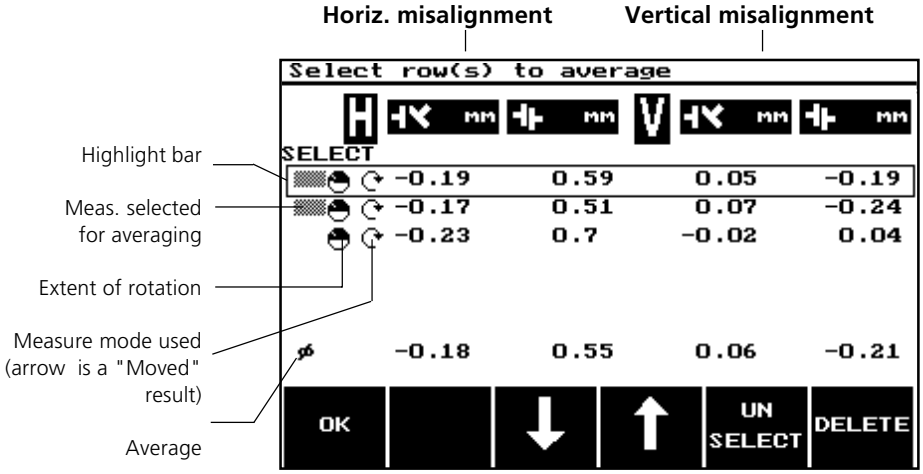
6. The laser beam should again be positioned inside the two centering circles. Continue the shaft alignment procedure at the point where it was interrupted.

TABLE

TABLE

Table is a list of up to five measurements made on the same machine. These can be selectively averaged for greater accuracy, especially if you are measuring nonrotating shafts.

To select measurements from the list for averaging, highlight each in turn with the arrow key and press SELECT. A small square appears alongside the measurement which you can clear by pressing UNSELECT. Average values appear at the bottom of the screen.



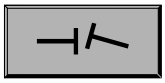
You can also DELETE a highlighted measurement (no confirmation is given). Return to the Measurement screen with OK. The most recent measurement points are still displayed on the target diagram—unless you have:

1) deleted that set from the table,
2) selected more than one set in the table for averaging
   or
3) turned off the computer in the meantime.

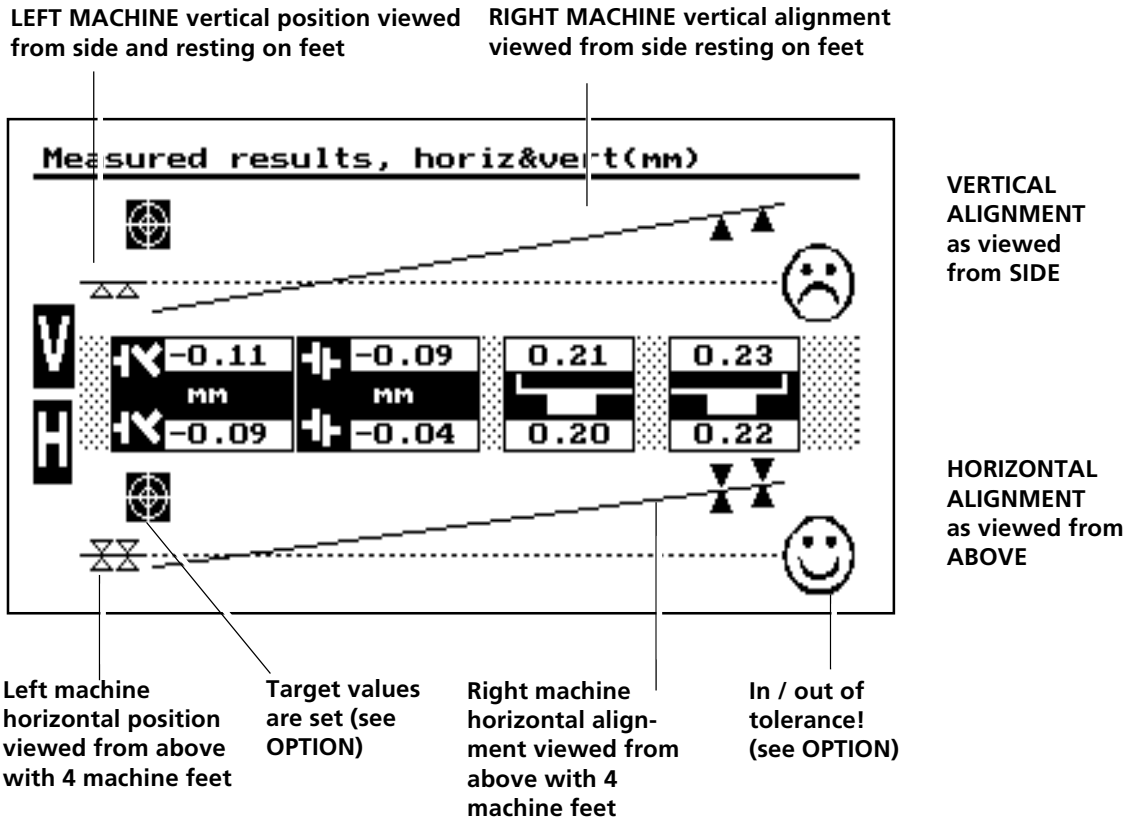
In any of these instances, the Measurement screen target diagram shows only the momentary point of laser incidence (i.e. just as if you were starting measurement anew).

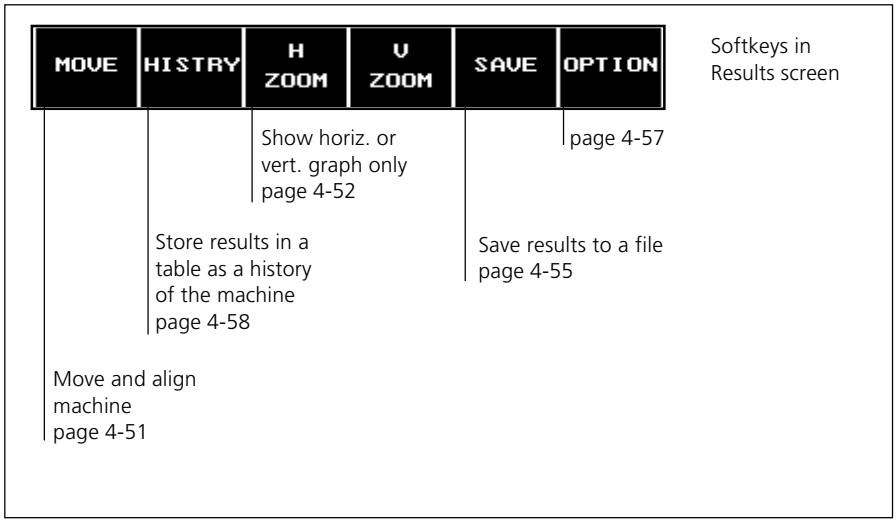
If desired, you may now proceed with additional measurements by following the instructions in the status line.

8. Results



Press the RESULT key to display a graph of the alignment condition in both vertical and horizontal directions:





Note, the alignment diagram is scaled according to the entered machine dimensions. The smiley faces appear if a tolerance mode has been set, see page 4-62 for details.

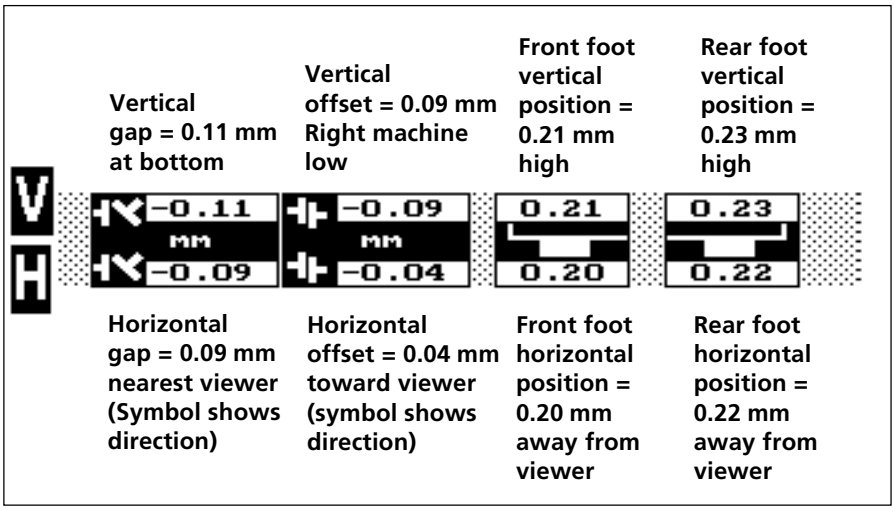
The calculated misalignment values are displayed In the middle of the screen. Study these and compare them with the machine tolerances.

If you are using V-form machines, see page 4-18.

If the coupling values are within your machine tolerances, then the machines are aligned!

Example of coupling and foot misalignments

These values take into account thermal growth and target settings. See OPTION below.



The general rule for the direction of the misalignments is:

- Positive values are upwards or away from viewer
- Negative values are downwards or toward viewer

OPTION

OPTION has the following selections (see page 4-57 for overview):

STATIC FEET	Select feet which cannot be moved. If left machine is "Stationary" in MACHINE SETUP (page 4-17), the entire right machine must be moveable. See page 4-65.
TARGET	Set "cold" coupling target alignment based on display mode selected in COUPLING TYPE (page 4-19). The target symbol appears in Results when set. See page 4-49.
THERM GROWTH	Set thermal growth values for nonstatic feet, horiz. and vertically. The target symbol appears in Results when set. See page 4-61.
TOL	Set tolerances: TABLE tolerances are based on machine size and RPM. Press EDIT key to enter RPM. Select TABLE TYPE : Excellent, Acceptable and User-defined. ("50 Hz/60 Hz" shows RPM increments suited to European/US machines.) The smiley face appears in results when a mode is selected. See page 4-62.
H ? V	Display Horiz. or Vertical targets and tolerances. See page 4-58.

9. MOVE

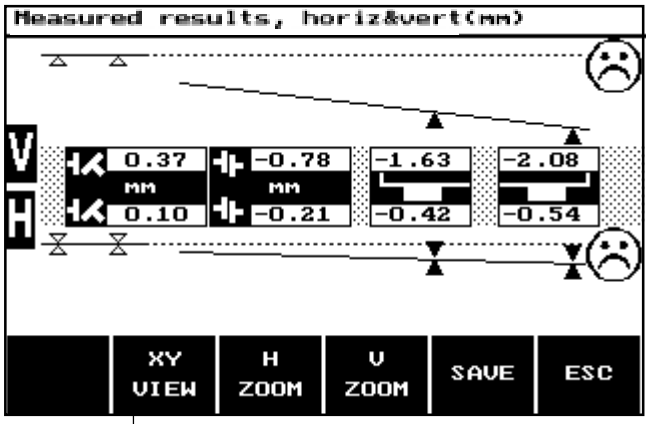


Thanks to its five-axis sensor design, ROTALIGN lets you monitor alignment corrections on screen as they are being made.

If the machine suffers from excessive soft foot, the MOVE function may be hampered by the fact that the machine changes its position on its own every time the anchor bolts are loosened and tightened. Therefore, please use the soft foot function as directed on page 4-29 and correct the situation before beginning an alignment.

In the Results screen (see previous pages), press the softkey marked MOVE. An intermediate screen, shown below, appears briefly while the ROTALIGN restarts the sensor.

Important:
If, approximately 10 seconds after entering "Soft Foot" mode, the ROTALIGN fails to establish contact with the sensor, a "SENSOR ???" message is displayed on the screen. This message is also displayed if the receiver cable is disconnected while ROTALIGN is in "Measure" either "Move" modes. Check that both ends of the cable are properly connected.

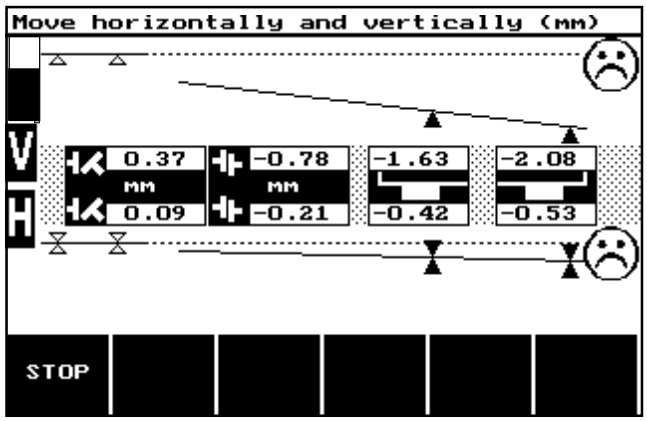


Use XY VIEW to check laser and shaft inclinations

See following pages for information on the vertical and horizontal zoom functions.

If the laser is on and centered, ROTALIGN will automatically switch to the screen shown below. Otherwise, press the START softkey which will appear in the lower-left corner of the screen.

AVERAGE bar



In this MOVE screen, both horizontal and vertical corrections can be made simultaneously. In most cases, vertical alignment should be performed first by shimming the feet of the machine to be aligned. Horizontal alignment should be the final step before the machine foot bolts are tightened firmly. Otherwise, inadvertent horizontal movement could occur and go unnoticed during vertical shimming.

Detailed descriptions of the shimming and positioning procedures, including the ZOOM mode, are described on the following pages. Also available in the MOVE mode are XY VIEW, H and V ZOOM and SAVE, described in detail on the following pages.

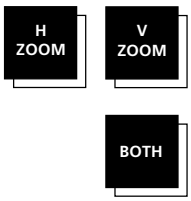
The AVERAGE function, set in XY VIEW screen, is automatically used during Move measurements. With this option, the number of measurements to be taken and averaged during readjustment can be set (up to 2048), see page 4-44. A bar appears in the left corner of the screen (see above figure) displaying the fraction of measurements made.

Note, while in MOVE mode, sleep time is automatically extended to 50,000 seconds. This helps to ensure that the ROTALIGN will not enter SLEEP mode while the machines are being repositioned.



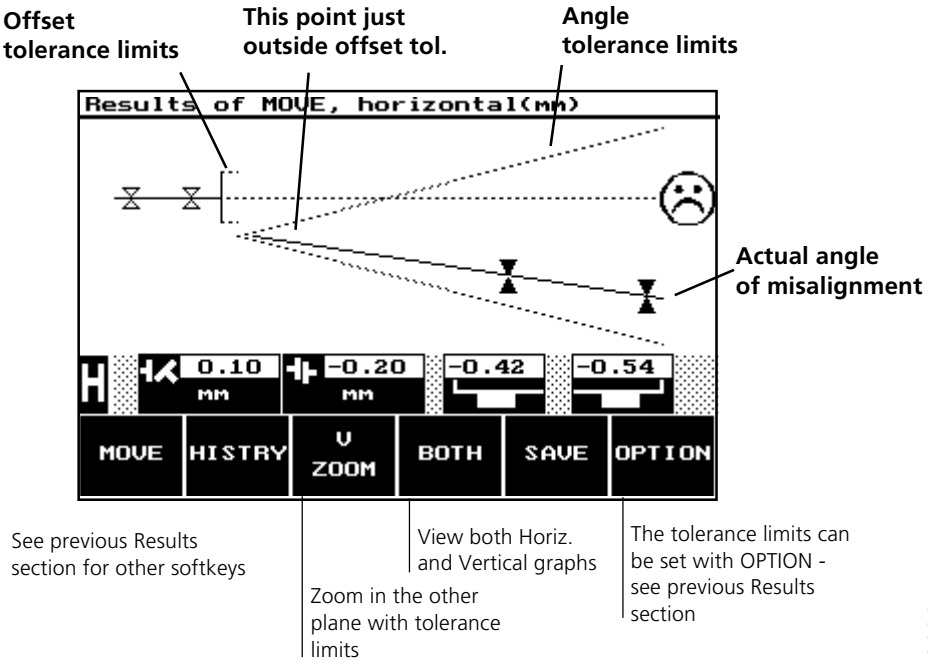
After making the desired adjustments, press the STOP softkey to return to main MOVE screen.

ZOOM



The two options available in the ZOOM mode allow you to focus in on either the vertical (V ZOOM) or horizontal (H ZOOM) axis. These options display an enlarged view of one axis and are useful for fine tuning the alignment corrections. (The computer continues to monitor in the other direction not displayed.) Tolerance limits are also displayed in ZOOM mode if set. Press BOTH to display horizontal and vertical results simultaneously.

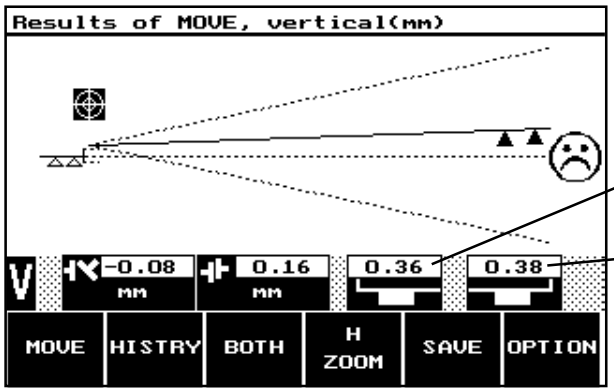
Below is an example of a horizontal zoom:



Tolerance limits are set with the OPTION key as summarized in the previous Results section and in detail on page 4-57. In the above example, the angle is within tolerance, and the offset is just out of tolerance.

Vertical movement

1. The accuracy-compromising effects of backlash—caused by torsional play between shafts—can be reduced by rotating the shafts so that the sensors are oriented in the move direction. For vertical moves, this means that the sensors should ideally be positioned in either the 12:00 or 6:00 position. The laser and receiver MUST remain in the same position during a move.



> During the vertical move procedure it is recommended simply to adjust the shims to the indicated values and NOT to try to adjust the machine by trial-and-error while watching the screen display.

Note

2. Press the V ZOOM softkey to display the vertical axis (viewed from the side):

V ZOOM

3. Before pressing the MOVE softkey, write down the shimming values on a piece of paper and prepare the necessary shims.

4. Press the MOVE softkey. An intermediate window appears while the ROTALIGN restarts the sensor. If the laser–receiver pair has been moved to within ±15° of the 12:00 or 6:00 position and the laser is on and centered, ROTALIGN automatically enters the active measurement mode.

MOVE

   If either (or both) of the criterion mentioned above is not fulfilled, you will be prompted to press the START softkey before ROTALIGN enters the active measurement mode (see page 4-51).

START

   Tip: use XY View to recenter the laser and set the correct inclination if necessary.

5. You may loosen the machine anchor bolts after ROTALIGN has entered active measurement mode! Otherwise, ROTALIGN cannot measure any small displacements that may occur during loosening.

6. Insert or remove shims from the machine feet according to the values you previously wrote down. If a foot value is positive, then the machine is high at that point and shims must be removed. Remove/insert shims equally from BOTH feet at the front or from BOTH feet at the back, as applicable.

7. When finished with shimming, retighten the anchor bolts, then press the STOP softkey.

STOP

Horizontal movement

Before horizontal positioning is carried out, a new set of alignment readings should be taken due to the fact that machines usually move slightly during vertical shimming. However, this second measurement cycle takes relatively little time since the machine dimensions have already been entered:

1. Remeasure the alignment using any of the measurement modes. Press the RESULT key to display the alignment graph.

   If horizontal coupling misalignment values are outside tolerance, the machine must be repositioned.

2. For maximum accuracy, rotate the shafts so that the sensors are oriented in the 3:00 or 9:00 position. The laser and receiver MUST remain in the same position during a move.



3. Press the H ZOOM softkey.

4. Proceed as before by pressing the MOVE softkey. As in the vertical movement case, if the laser–receiver pair is not within ±15° of the specified position (either 3:00 or 9:00) or if the laser is not centered, you will be prompted to press the START softkey (see page 4-51) before ROTALIGN enters the active measurement mode.



5. Loosen the machine anchor bolts after ROTALIGN has entered the active measurement mode! ROTALIGN cannot otherwise measure any small displacements that may occur during loosening.

6. Move machine horizontally while viewing the screen.



ATTENTION

Temptation may be great to move the machine with a few hefty blows of a sledgehammer. Though perhaps more satisfying in the short run, this may jog the laser and receiver and could also cause bearing damage. Jack bolts on the machine feet or other mechanical or hydraulic adjustment methods are therefore recommended.



7. Retighten the anchor bolts and press STOP to conclude the horizontal alignment procedure.



Note

Because the true position of the shaft rotation axes can only be determined by rotating the shafts during measurement, you must take a final set of rotated-shaft readings to confirm the alignment condition. As before, press the "M" key, check laser adjustment, then press START. Rotate the shafts, press STOP and the RESULT key to display the alignment graph.

10. Alignment completion

This completes the horizontal machine alignment!

If you have had difficulties with a particular alignment, common causes are:

- Soft foot (page 4-29)
- Beam play
- Pipe strain
- Oil film thickness variation in white metal bearings
- Incorrect or loose bracket mounting on the shaft (page 4-11)
- Foundation flexing (combined with a stiff, flexible coupling)

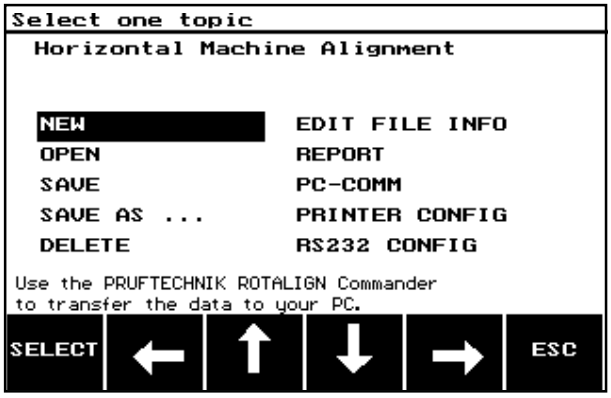
Remember:
Remove the components from the shaft before switching on the machine!


ATTENTION

Save

Your measurements and results can now be saved and printed out if desired. Press SAVE to open the file options screen:





Please keep a record of important data. PRÜFTECHNIK assumes no responsibility for data lost or altered. The ROTALIGN Commander software program is available backing up data to a PC. See page 6-16 for further information.


Note

SAVE AS If the file on which you are working does not yet have a name, select SAVE AS. A text editor will appear on the screen. Enter a file name up to eight characters in length. When finished, confirm with OK. If the file already exists, you will be asked to give confirmation before the file is overwritten.

SAVE Saves the file under the current name. If the file has not been given a name, a sequential number starting with "01" will used. A current name will be overwritten without confirmation. Up to 150 files can be stored.

PRINTER-CONFIG Allows you to select your printer from a list. If your exact model is not listed, select one with which your printer is compatible, e.g. EPSON FX series or HP LaserJet.

REPORT Prints a full report of the alignment situation. Make sure the printer is connected to ROTALIGN and is online and loaded.

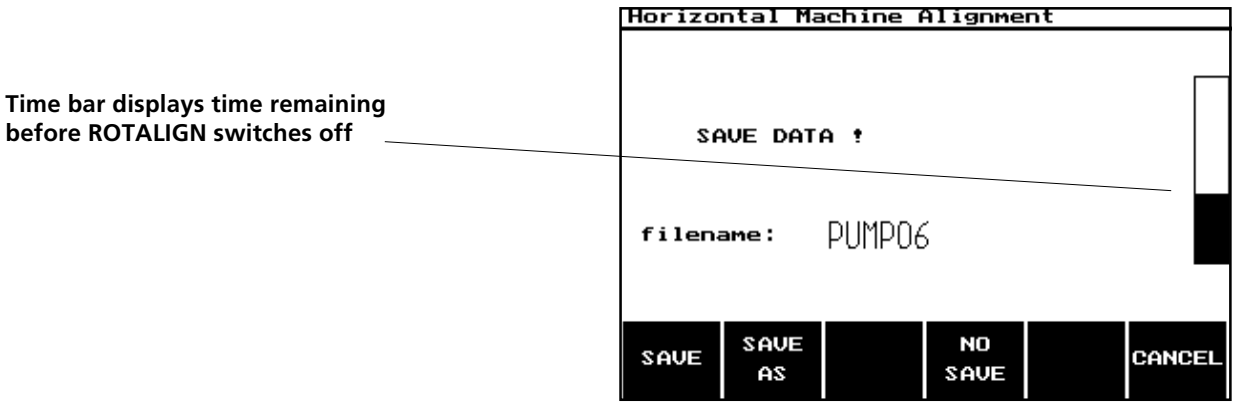
See Chapter 3 for more details and other file options

Switching off



Press the ON/OFF key at any time to switch off the computer.

If the current data have not been saved, the computer prompts you to save them with the following screen:



You may either save the file under the current name (SAVE), save it under a new name (SAVE AS), not save it at all (NO SAVE), or return to the program (CANCEL). You have approximately 10 seconds decide before the computer switches off *without* saving! But don't worry; the current measurements and results remain in memory after ROTALIGN switches off and can be recalled by pressing RESUME the next time you switch it on.



Don't forget to switch off the laser!

When replacing ROTALIGN in its case, you can leave the cable connected to both the receiver and computer. If ROTALIGN is not used for an extended period of time, check and recharge the lead-acid battery (if fitted, page 6-17).

Further reading

QUICK CHECK, pages 4-3 through 4-5, is a quick horizontal alignment;
Vertical alignment is covered in Chapter 5;
ROTALIGN's many options are described in Chapter 3 "Configuration and data management".

Options during Results

In the Results screen described on page 4-49 are two softkeys not described in the main instructions: OPTION and HISTRY (abbreviated due to space constraints in the ROTALIGN display).

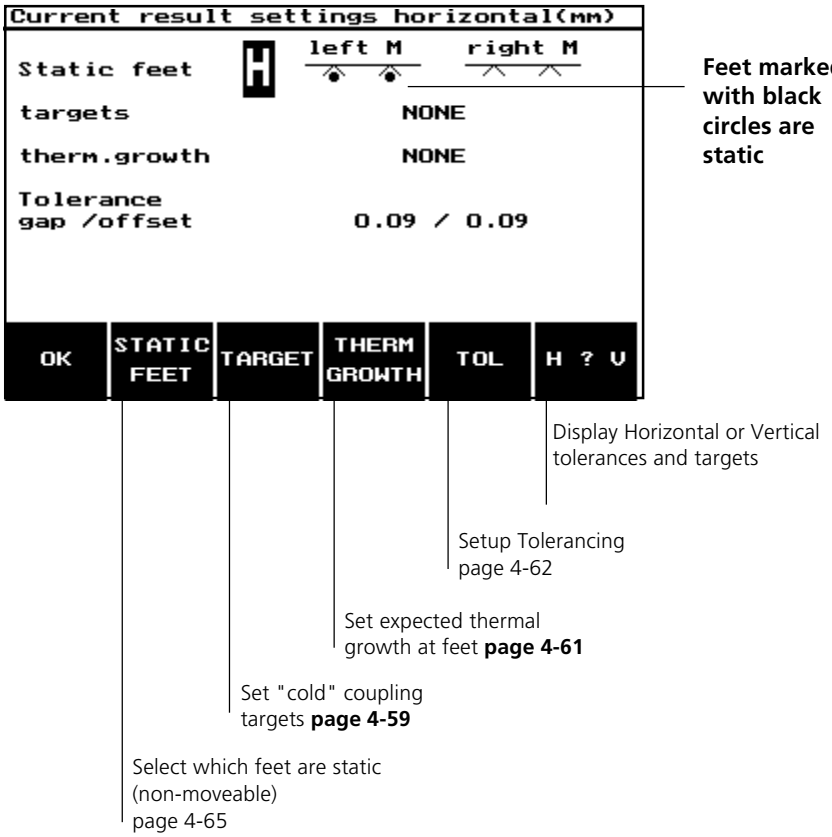
OPTION calls up the "Results Setup Options" showing a summary of targets, tolerances and machine setups. This screen also appears when you select either "Coupling Targets" or "Thermal Growth" from the Menu (pages 4-61).

HISTRY is a table of machine results. This is not actually directly accessible from the MENU.

Results Setup Options

Press OPTION from the Results display or select either "Coupling Targets" or "Thermal Growth" from the MENU to show the following screen:





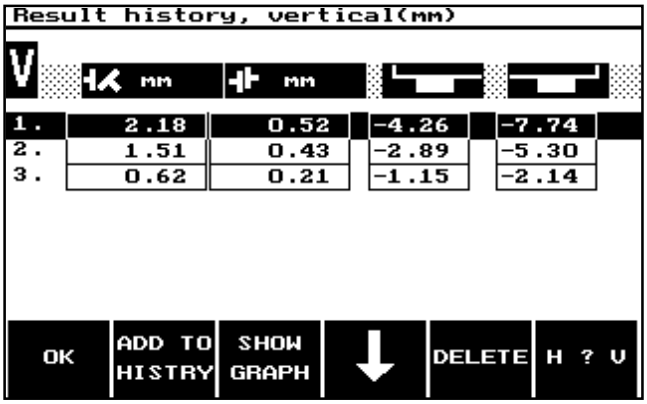
Here is a summary of the target, growth and tolerance settings. If tolerancing is set, smiley faces appear on the Results display. Refer to the pages specified above for more details.

Select OK to return to the previous screen, i.e. Results or the MENU.



History

Results can be accumulated for a record of your alignment jobs. Press HISTRY from the Results screen to show this list of results:



OK	Returns to the original results display you had before HISTRY was pressed.
ADD TO HISTRY	Adds the latest result to the table.
SHOW GRAPH	Displays selected line graphically.
"Arrow" key	Selects and highlights one result line.
DELETE	Deletes the selected line without confirmation.
H ? V	Switches between horizontal and vertical results.

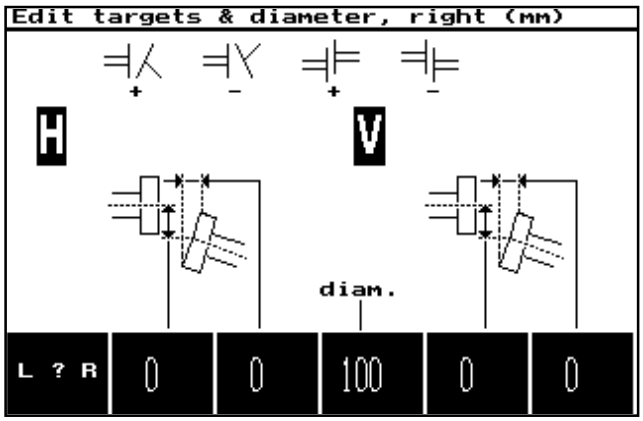
Coupling Targets

When you select COUPLING TARGETS from the Menu, the Result Setup Options appears as shown on page 4-57. Press the TARGET softkey which will allow entry of the desired coupling condition for "cold" alignment.

TARGET

Make sure that the required coupling display mode has been selected in the COUPLING TYPE option (page 4-19). This mode must match that of the coupling target specifications for your machine (commonly Gap and Offset).

Shown below is the Coupling Targets screen for Gap/Offset:



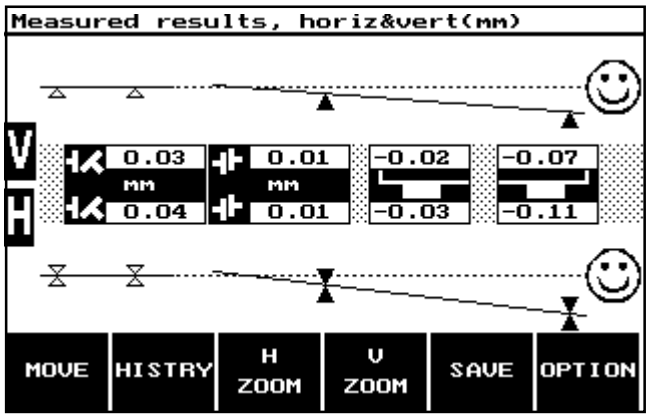
Depending on the chosen coupling display mode, the softkeys point to the horizontal and vertical parameters; in the middle is the coupling diameter. "L ? R" switches between left and right machine relative to the machine to be aligned.

Press the softkeys and type in the data, pressing ENTER after each entry.

To exit this screen press ENTER. ROTALIGN returns you to the Results Setup Options (page 4-57).

The Coupling Target function is used if it is known that changes in the alignment condition, i.e. gap and offset values, will occur when the machines are put into operation. Take, for example, the case of a gearbox (left machine) which drives a compressor (right machine). The machines will almost certainly have different operating specifications. The manufacturer of the gearbox may specify that, as the bearings heat up, the offset may change slightly. The compressor specifications, on the other hand, may indicate angularity changes resulting from high rotation speeds.

Shown in the first of the two figures below are the results obtained for a typical pair of machines. At first glance the results appear to be satisfactory and within tolerance:

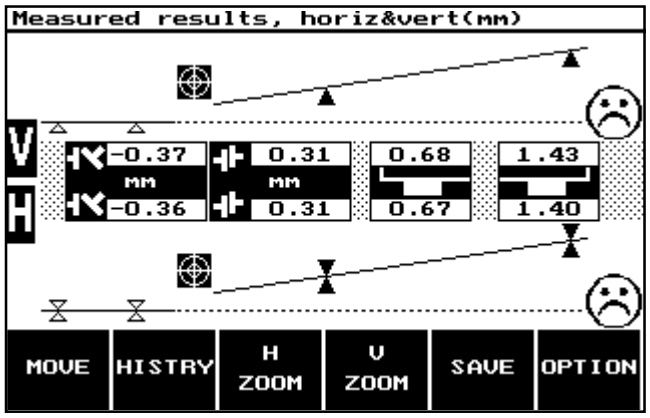


If, however, the following operating specifications for the machines are entered in the Coupling Targets screen, the results are somewhat different:

Operating specifications

Left machine:		Right machine	
horizontal gap:	0.2 mm	horizontal gap:	0.0 mm
horizontal offset:	0.3 mm	horizontal offset:	0.2 mm
vertical gap:	0.2 mm	vertical gap	0.0 mm
vertical offset:	0.3 mm	vertical offset	0.2 mm

ROTALIGN combines the operating specifications then incorporates these values in the results screen. The values displayed are, therefore, the corrective measures which must be taken to ensure that the machines are aligned during operation.



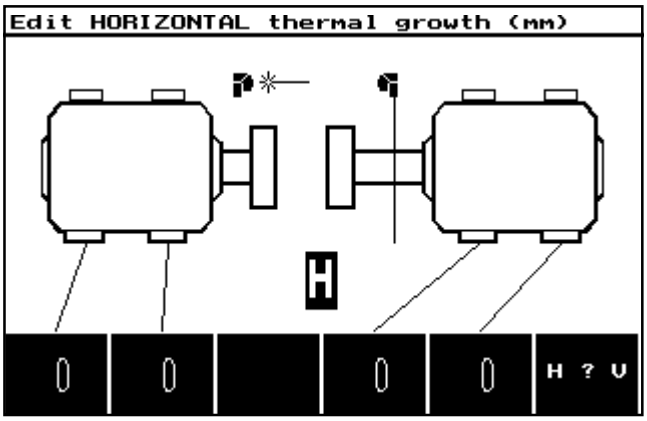
Thermal growth

When you select THERMAL GROWTH from the Menu, the Result Setup Options appears as shown on page 4-57. Press the THERM GROWTH softkey which allows you to enter the expected thermal movements for the nonstatic machines (see page 4-17).

THERM GROWTH

Note, for a 6-foot machine only the front and rear feet thermal growths can be entered.

The computer uses the entered values to determine how the machine should be aligned "cold." Here is the Thermal Growth screen:



Select either horizontal or vertical movement with the "H ? V" key and type in the expected foot movement with the indicated softkeys; press ENTER after each entry.

H ? V

To exit this screen, press ENTER to return to Results Setup Options (page 4-57).

"V"-form machines: Thermal growth is still determined in the horizontal and vertical axes.

See also page 6-32 for a numerical example of thermal growth entries.

Tolerances

The TOLERANCES option allows you to compare alignment results with standard recommended tolerance limits, based on the RPM and machine size, or on your own coupling parameter tolerances. If a tolerance mode is activated, the program shows a happy face when measurements are within tolerance!





You can reach the Tolerance option either from the Menu or from the Results Setup Options screen (page 4-57) and the TOL softkey.

When you enter the Tolerance option, a list of tolerance methods appears. Press the OPTION softkey if this list is not shown. The displayed options are then selected with the up/down softkeys. Confirm your selection with "OK" (or you can return to the MENU with the ESC softkey)

DISREGARDED deactivates any tolerance checks.

TABLE uses the entered machine RPM, coupling type, and machine dimensions to determine the alignment tolerances from standard accepted values or from user-defined values. This is the simplest tolerancing mode for standard machines.

The tolerance values remain constant regardless of machine dimensions for short flex and single plane coupling types. Offset values are, however, directly dependent on spacer distance when the spacer shaft coupling type is entered in the Dimensions screen. Gap values are dependent on coupling diameter for short flex and single plane coupling types. If a spacer length of 100 mm had been used in the figure on the following page instead of the 200 mm distance, the offset values would be one half that of the values shown. This applies only to spacer shafts.

MAX COUPLING VALUES allows you to enter your own coupling tolerances. See page 4-64 for details.

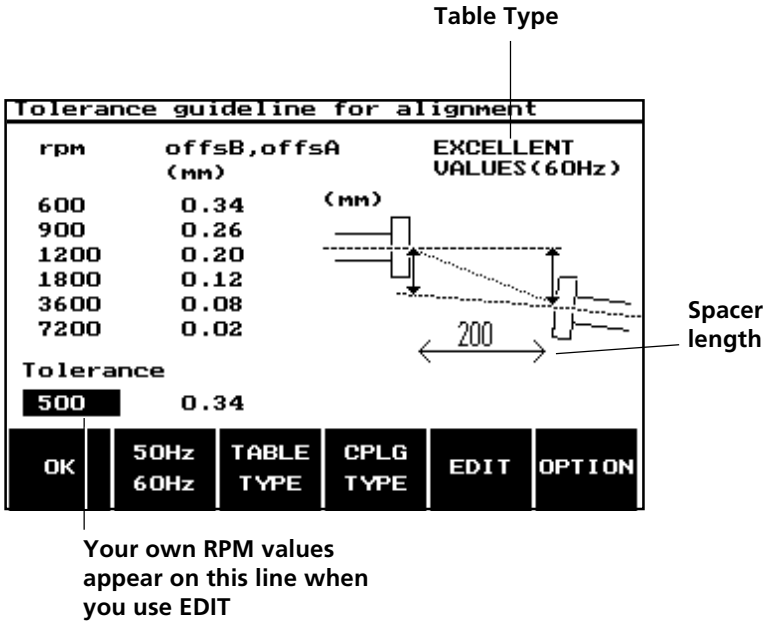
SLIDING FRICTION VELOCITY (for spacer-shaft couplings) When a misaligned spacer shaft coupling rotates, the flexible components are constantly in motion and wearing out. This wear increases with the velocity at which the components are sliding against each other and also with the amount of misalignment. Coupling manufacturers often recommend a maximum "Sliding friction velocity" for a given coupling, and if you have this data you can enter it in this option. The program then calculates the appropriate coupling tolerance. Note: the RPM value is also required, see TABLE above.

From within these options "OK" returns you to your previous screen (either the Menu or the Results Setup Options, page 4-57) and OPTION takes you back to the list of tolerance options.

The Table and Coupling options are described in more detail on the following pages.

TABLE TOLERANCES

The tolerances listed in the table are the standard accepted values based on the coupling type and machine sizes you entered in the Dimensions and on the entered RPM value. Shown below is the Table screen for "Excellent values" for a horizontal machine arrangement with a spacer shaft:



When the spacer shaft coupling type is used, offset values are directly dependent on the gap (spacer) distance entered in the Dimensions screen. If a gap distance of 100 mm had been used instead of the 200 mm distance used in this figure, the offset values would be one half that of the values shown here. This applies only to spacer shafts.

Press TABLE TYPE to select between the following three options:

TABLE TYPE

EXCELLENT VALUES: high tolerances for high precision and reliability

ACCEPTABLE VALUES: tolerances for noncritical machines

USER-DEFINED VALUES: Enter your own tolerances based on manufacturer's data. See opposite page.

"50 Hz/60 Hz" selects different RPM increments with multiples/fractions of either 3000 RPM (50 Hz) or 3600 RPM (60 Hz) (Excellent and Acceptable values only).

50 Hz 60 Hz

The machine operating RPM must be entered: either enter the value directly from the keypad or press EDIT and enter the RPM value. This will then appear in a line below the table with its calculated tolerances.

EDIT

(The RPM value can also be entered in the Dimensions screen in the box above the machine, but only if a tolerance mode has been selected beforehand.)

OPTION takes you back to the different tolerance modes.

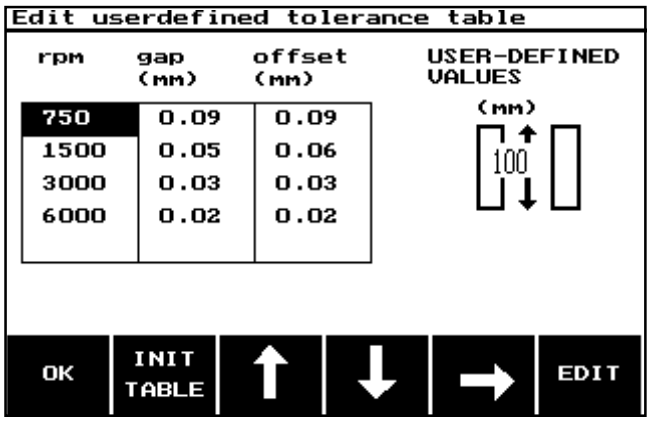
OPTION

OK adopts the tolerance settings you have chosen and exits the tolerance mode.

OK

EDIT TABLE

When the title USER DEFINED TOLERANCES is displayed, you can press EDIT TABLE to enter an editing mode :



INIT TABLE

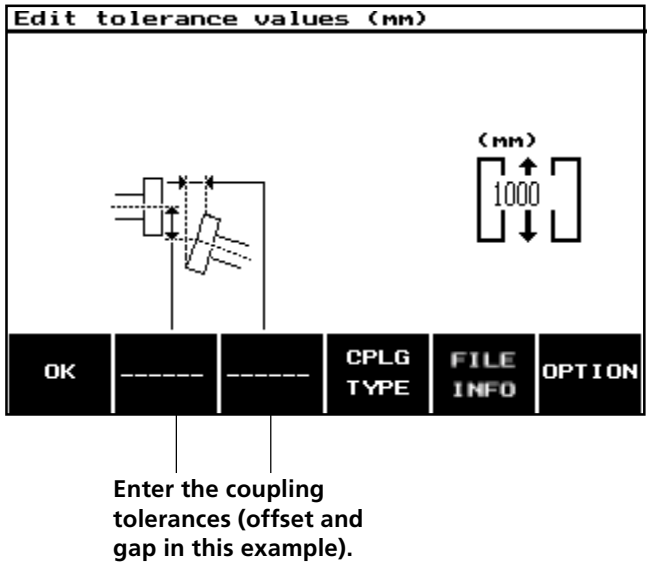
INIT TABLE resets all the values to equal the "Excellent values."

EDIT

The arrow keys can be used to navigate in the table. Type in values for the machine and press enter after each entry. EDIT is used to correct the highlighted value. Press OK when finished to return to the previous screen.

MAX COUPLING VALUES

With this option, the coupling tolerances based on the selected coupling type can be entered (page 4-19). Use the softkeys to select the dimensions to be edited and key in the maximum coupling values; press OK when finished.

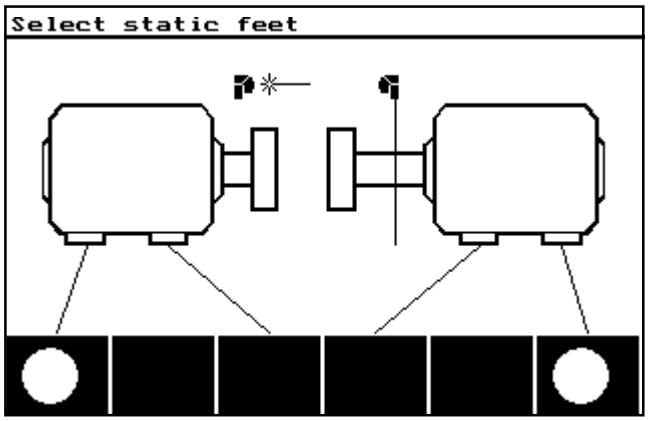


Static feet

STATIC FEET

The STATIC FEET option can be selected from either the MENU or from the Results Setup Options (page 4-57). This option allows you to define which pair(s) of feet on the two machines are deemed static, i.e. cannot be moved for some reason (e.g. the rear of one machine connected to other machinery). Note: if the left machine is set as stationary or becomes bolt-bound, then the entire right machine must be movable.

Below is an example for two 4-foot machines with the rear feet static:



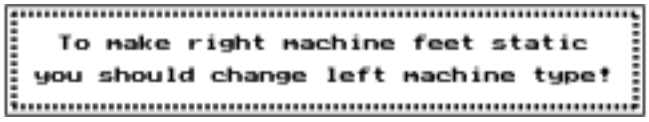
The feet which are currently defined as static are indicated with circles in the softkey bar. Select/deselect the required feet with the indicated softkeys. The computer will make the necessary deselections.



Note

With Static feet you can reverse the default machine configuration, i.e. make the left machine moveable and the right machine stationary.

If you try to make an invalid selection, the program issues a warning:



In such instances it is usually necessary to change the left machine type from "Stationary" to one of the moveable options. Press "OK" and enter the machine setup (pages 4-16 and 4-17). Make the necessary changes and press ENTER to return to the Static feet option.

Press ENTER when finished to return to the previous screen, i.e. either the Menu or the Results Setup Options (page 4-57).

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Chapter 5: Vertical Alignment

This chapter includes instructions for aligning vertical machine arrangements. Also included in this chapter are instructions for aligning flanged horizontal machine arrangements—an arrangement very similar to standard vertical machines.

Chapter 1 Introduction ..... 1-1 to 1-10

Chapter 2 Description ..... 2-1 to 2-16

Chapter 3 Configuration and & Data Management ..... 3-1 to 3-8

Chapter 4 Horizontal Alignment ..... 4-1 to 4-66

Chapter 5 Vertical Alignment ..... 5-1 to 5-18

Vertical machine alignment flow chart 5-2

Vertical machine alignment 5-3
- 1) Set up ROTALIGN 5-4
- Shaft numbering 5-4
- Fit the laser and receiver 5-5
- 2) Enter dimensions 5-5
- 3) Measure 5-6
- 4) Results 5-9
- 5) Fit shims 5-9
- 6) Remeasure 5-10
- 7) Move Horizontally 5-10
- 8) Final check 5-10

OPTION: Nonsymmetrical flange shape 5-11
- Altering a rectangle or ellipse 5-11
- Adjusting center position 5-11
- Moving or deleting bolts 5-12

Flange-mounted horizontal machines 5-13
- Alignment procedure 5-13
  - 1) Set up ROTALIGN 5-13
  - 2) Enter dimensions 5-14
  - 3) Measure 5-15
  - 4) Results 5-16
  - 5) Fit shims 5-16
  - 6) Repeat readings 5-16
  - 7) MOVE to eliminate offset 5-17
  - 8) Final check 5-17

Chapter 6 Appendix ..... 6-1 to 6-42



Vertical machine alignment flow chart





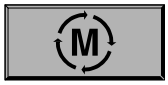
To review dimensions later press: DIM

Edit dimensions (page 5-5)
NEW MACH
NUMBER BOLTS
EDIT:
Bolt distance
Flange diameter
Coupling center to receiver
CIRCLE/SQUARE
OPTION (nonsymmetrical setup) :

OPTION (page 5-11)
Edit nonsymmetrical dimensions
NORMAL ORDER
(clear and return to symmetrical)
EDIT (X-axis, Y-axis, etc.)
ADJUST CENTER:
EDIT BOLTS:

Move center
Up, Down, Left, Right
STEP SIZE: small, med., large, XL
OK returns to previous menu

Edit bolt positions
Up, Down (select bolt from list)
EDIT X-POS, EDIT Y-POS (move bolt)
DELETE (delete bolt)
OK returns to previous menu

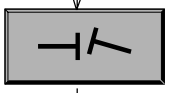


Measure (page 5-6)
TABLE (page 4-48)
XY VIEW (page 4-43)
Arrow selects point
CLR key deactivates selected point
MEAS. MODE:

Range extend (4-46)
Curve fit (4-45)
Trace (4-27)
Average (page 4-44)

Vertical and horizontal shafts:
Measure at 1, 2, 3, 4, 5, 6, 7, 8 (5-6)

Horizontal shafts only:
Multipoint (4-36)
Continuous Sweep (4-34)



Results (page 5-9)
SAVE (page 3-6)
+/-, -/+, 0/+ (+ve/-ve shim calculations)
MOVE (press START, then STOP)

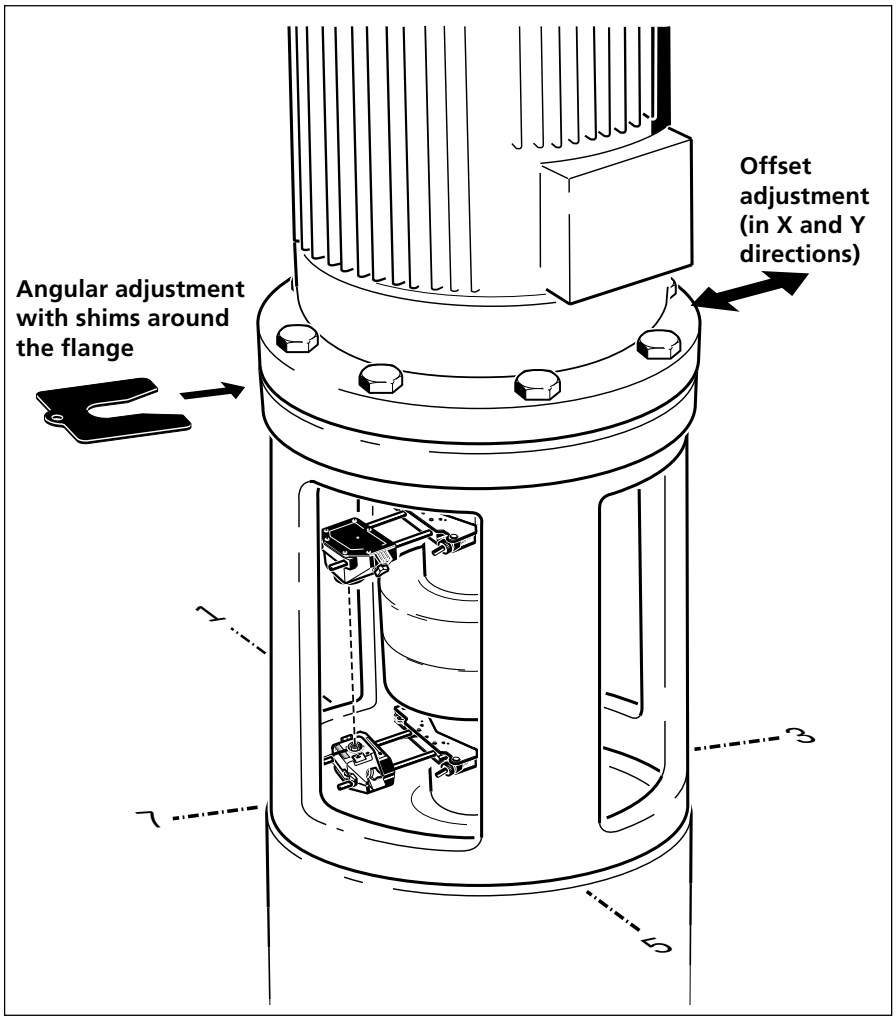


Note

Certain functions and options are available in both horizontal and vertical alignment modes. Where necessary in this chapter, cross-references are provided to the relevant sections of Chapter 4.

Vertical machine alignment

Vertical machine arrangements typically comprise one machine mounted on top of another and are secured with a bolt flange as shown below:



The ROTALIGN laser and receiver are mounted on either side of the coupling as for coupled horizontal machines, with the laser below and the receiver above. Measurements are then made at a series of 90° or 45° rotational positions.

Based on these measurements and the flange shape and size, the computer calculates the offset correction. Alignment is achieved by inserting shims of thickness determined by the computer between the flanges at each bolt.

The vertical alignment procedure is described in detail on the following pages.

This section of the program also includes an option for aligning horizontal machine arrangements connected with bolt flanges. Turn to page 5-13 for more information.

Note

1) Set up ROTALIGN

Since the ROTALIGN sensor is unable to detect the rotational position of the vertical shaft, it is necessary to mark out a series of angular positions for measurement. This may be done in one of two ways: either the shaft or the coupling housing can be numbered. It is a matter of convention. In both cases the shaft will be rotated clockwise during measurement. The two methods are described below. Choose one of the numbering conventions and adhere to it.

Shaft numbering

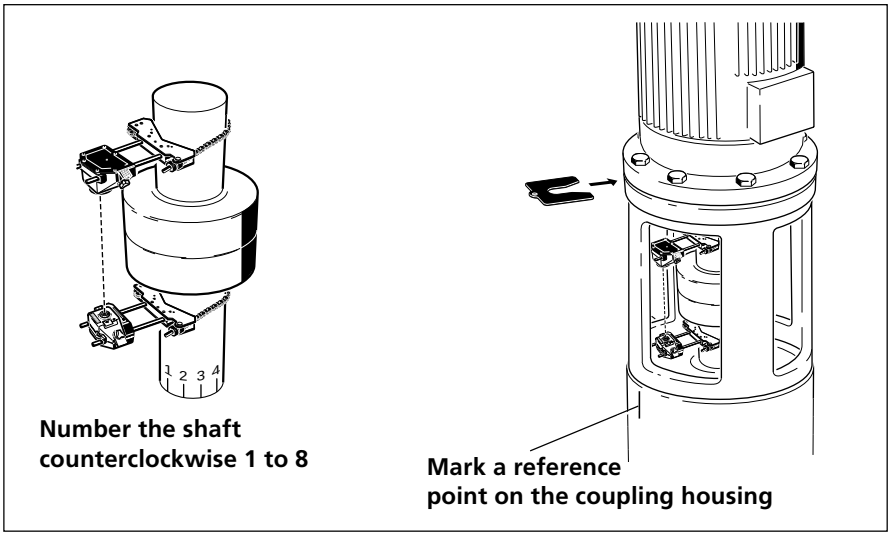
a) Mark a reference position on the coupling housing close to the shaft and in line with one of the pillars or bolts. Likewise, mark a starting point on the shaft. This ensures that lateral corrections can be performed with the minimum of effort.

b) Measure the circumference of the shaft and divide by four. Use this distance to make four evenly-spaced marks on the shaft beginning at your chosen start point. Number the points counter-clockwise looking down onto the shaft with "1" as your first followed by 3,5 and 7 (see diagram on previous page). Important: the laser-receiver pair must be exactly in line with mark at number 1.

During measurement, you will align the numbers on the shaft with the reference point on the coupling housing.

c) Note, if you have restricted rotational movement, you can mark out eight 45° positions (dividing the circumference by 8) on the shaft. During measurements you can measure at as few as 3 of these positions. Keep in mind that accuracy increases with the number of points measured—try, therefore, to make the maximum 8 measurements whenever possible. Continue with "Fit the laser and receiver" on the following page.

Shaft numbering



Coupling housing numbering

If you are accustomed to making measurements with the coupling housing numbered, proceed as described on the following page:

a) As for the shaft numbering method described on the previous page, mark a starting position on the coupling housing close to the shaft and in line with one of the pillars or bolts. Likewise, mark a reference point on the shaft.

b) Measure the circumference of the coupling housing and divide by four. Use this distance to make four evenly-spaced marks on the coupling housing beginning at your chosen start point. Number the points clockwise looking down onto the shaft with "1" as your first followed by 3,5 and 7 (illustrated on page 5-3).

During measurement you will align the reference point on the shaft with the numbers on the coupling housing.

c) Note, if you have restricted rotational movement, you can mark out eight 45° positions (dividing the circumference by 8) on the housing. During measurements you can measure at as few as 3 of these positions. Continue below.

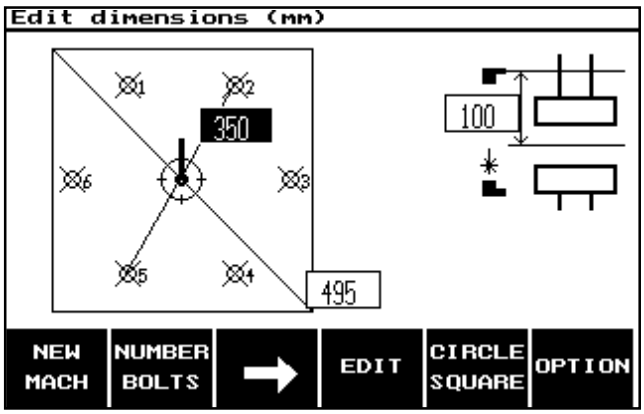
Fit the laser and receiver

Fit the ROTALIGN laser and receiver on the coupling. See page 4-12 for mounting and connection details. The laser mounts on the lower machine, which is defined as the stationary machine. The mounting brackets MUST be correctly mounted to ensure accurate measurement.

Switch on ROTALIGN and select the VERTICAL application from the introductory screen.



2) Enter dimensions





a) The above dimension screen appears showing a circular bolt pattern with the first marker position defined at the top. Press CIRCLE/SQUARE if you want to change this bolt pattern to a square.



b) The above figure shows 6 bolts around the flange. Press NUMBER BOLTS to change this (min. is 4, max. is 99). Type the new value and press ENTER.





Note

For a square bolt pattern, only a symmetrical number of bolts is accepted, i.e. 4, 8, 12, 16, etc. If the flange to be aligned has, for example, 6 bolts, enter 8 or 12 and the extras can be deleted as explained starting on page 5-11.

c) If the flange is not symmetrical, i.e.

· it is rectangular or elliptical, or
· the axis is not centered or
· there are nonsymmetrical bolts,



then these can all be set with OPTION. Please see page 5-11 for more details. If you select this function, you can return to the symmetrical flange screen with NORMAL ORDER which also resets any alterations.

d) Now use the arrow key to enter the following:

BOLT DISTANCE: the diagonal diameter between the bolts as shown on the screen; press ENTER.

FLANGE DIAMETER : the widest part of flange.

COUPLING CENTER TO RECEIVER; press ENTER



e) Values can be edited later with EDIT.

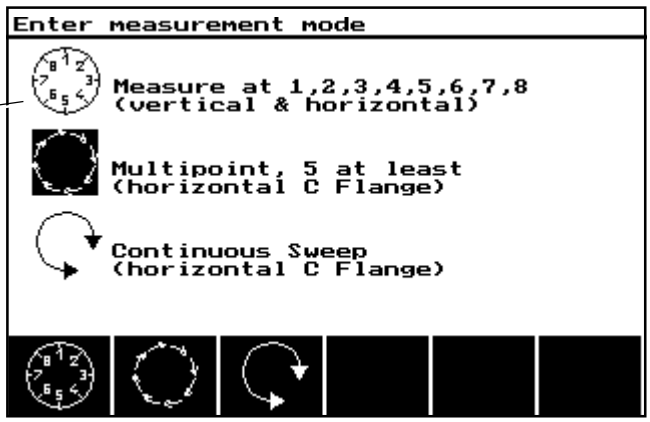
You are now ready to make measurements.



3) Measure

a) Press the "M" key.
Before making measurements, you must ensure that the measurement mode is properly set. Press the "Meas Mode" softkey to display the three measurement modes:

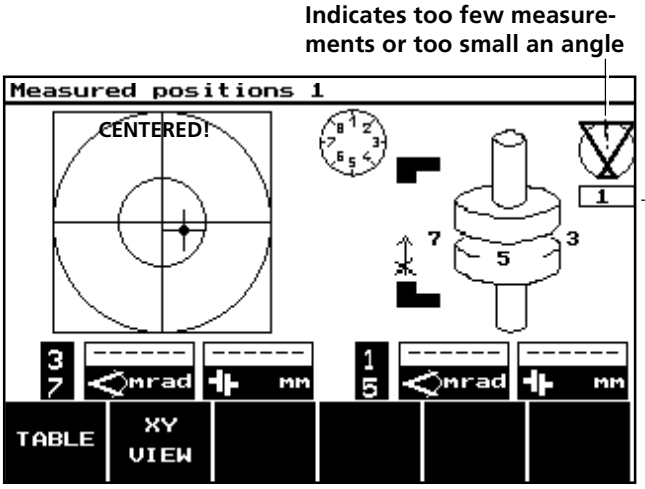
Important!
Only the uppermost measurement mode may be used with vertical machines!



Only the uppermost measurement mode (Measure at 1,2,3,4,5,6,7,8) is available for vertical machines. The bottom two modes rely on the inclinometer in the sensor and must only used with horizontal machines (see page 5-13).

b) Set the shaft to one of your 4 or 8 marked positions, switch on the laser and align it with the thumbwheels onto the receiver. Use the target on the receiver dust cap if necessary (see page 4-24 for more details). You can also use the XY VIEW option if desired (page 4-25).

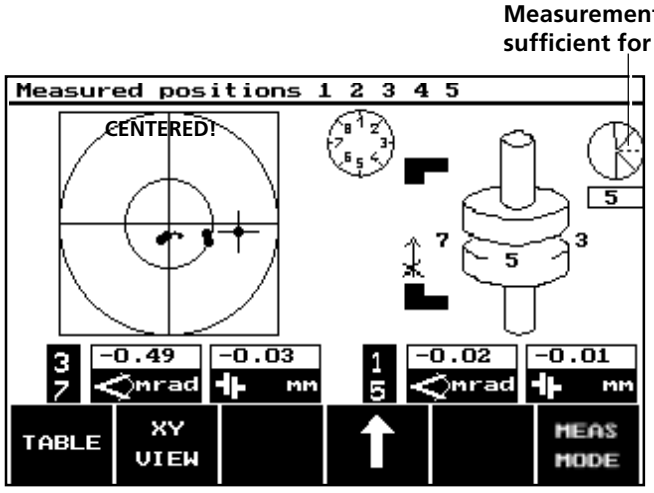
c) Ensure that the sensors are exactly at the chosen position and press the numeric key corresponding to the position, e.g. "1":



Screen after one measurement

d) Turn the shaft to each measurement position, rotating the shaft clockwise, and press the corresponding numeric key.

Note, if rotation is restricted, measure at the points to which you can turn, e.g. 3,4,5,6 and 7. At least three points are required for a result. Additional measurements should be taken for greater accuracy.



Screen after five measurements

e) The TABLE option, described on page 4-48, can be used for averaging multiple measurement sets.

f) A 3D display of the two position detectors can be viewed by selecting the XY VIEW softkey. Press the CURVE FIT softkey to switch from the XY display to the YY display. See page 4-43 for a complete description of the XY VIEW option.

g) Deactivating stray measurements: if a point on the target display seems somewhat astray, it can be deactivated and remeasured:

1) Use the ARROW softkey to highlight the rogue point with a cross;

2) Press the "–" key. The point will be deactivated and displayed as a small circle. The status line and "clock" in the top right corner will also be updated to show which points are still valid.

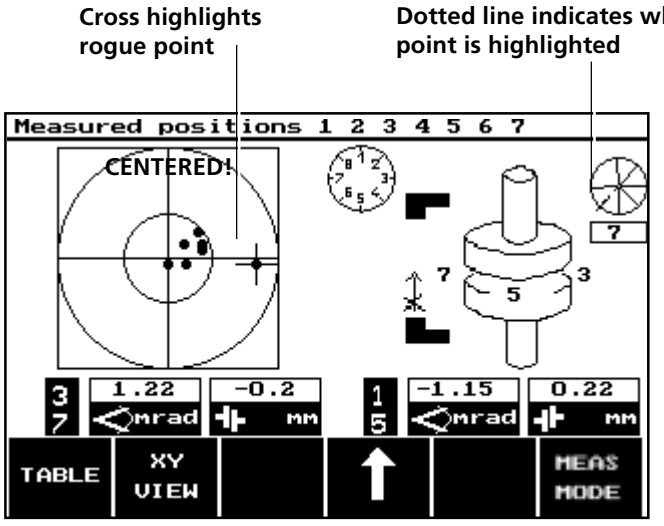


3) The deactivated points can be remeasured. Note, however, that the circles representing the deactivated points remain on the screen.

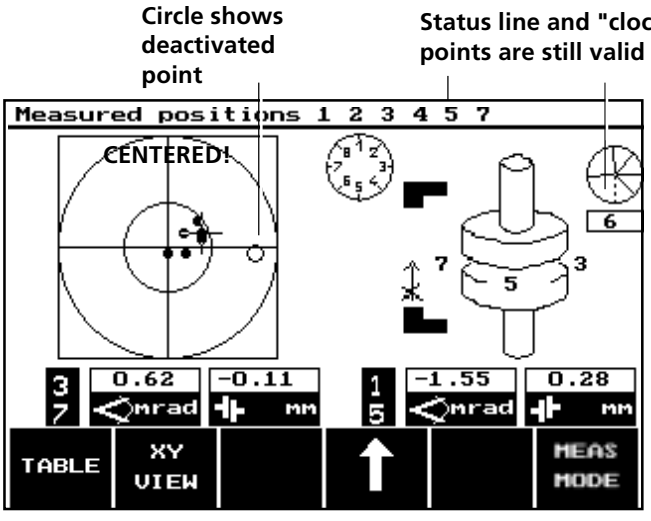
4) Restore deactivated points by pressing the "–" key again. If more than one point is active for a given measurement, they will be averaged.

Press the CLR key to delete all current measurement values.

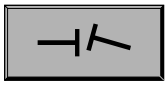
Use the arrow key to select the point(s) to be deactivated.



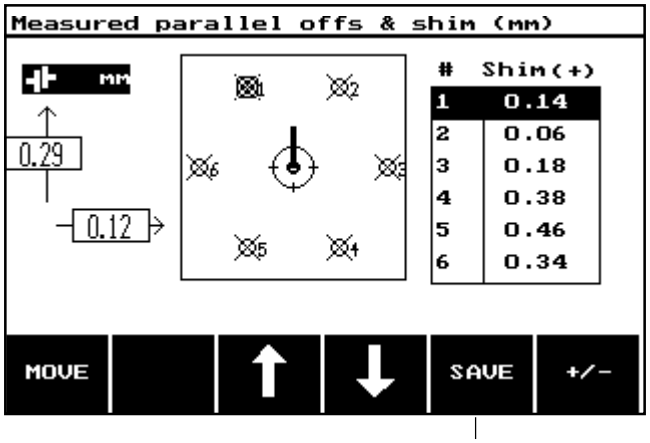
Point deactivated!



4) Results



When measurement is complete, press the "Results" key:



Page 3-6

These are the alignment corrections. The display shows the flange viewed from above. The first measurement position is at the top of the screen.

On the left portion of the screen are the offsets: in the above example these are 0.29 mm towards the back and 0.12 mm to the right.

In the right portion of the screen is a table of the calculated shims (in mm in this example) at each bolt position. In the above example the table is titled "Shim (+)" which means that shims are all positive, i.e. the shims are all added. Press the "+/-" key to display negative shim values, i.e. shims removed (-). The minimum change (+/-) can be displayed by pressing the "+/-" softkey again. The final option available under the "+/-" softkey normalizes the smallest shim thickness to zero and makes all other shims positive (0+).



Browse through the list with the arrow keys. The corresponding bolts are highlighted in the table.

5) Fit shims

Position the shaft so that the number 1 is aligned with the reference mark. Press the MOVE softkey. An intermediate screen will appear, prompting you to press the START softkey. After pressing the key, loosen the bolts and fit the shims according to the table values. Try to keep horizontal movement to a minimum. When finished, retighten the bolts. Press the stop key when finished. The results after the move will now be displayed in the results table. Confirm your results be remeasuring.



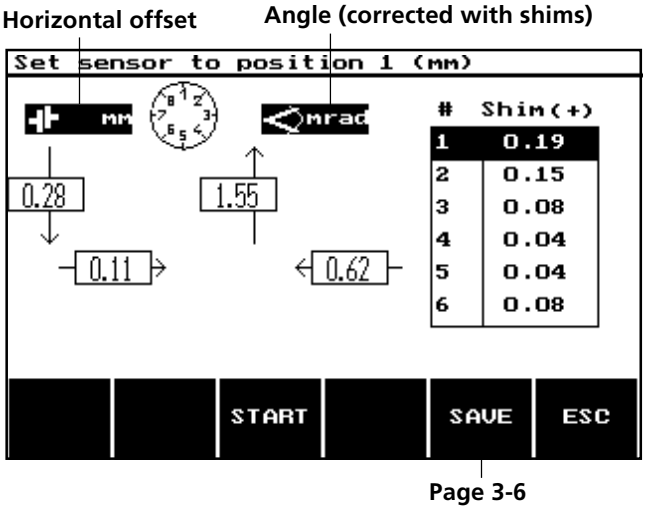
6) Remeasure

If flange has drifted horizontally, it is necessary to remeasure. Press the "M" key and remeasure as before.

7) Move Horizontally

MOVE

The machines can now be aligned horizontally: press MOVE to show the following screen:



START

Rotate the sensor to your first marker position and press START. Note: do not loosen the flange bolts until START has been pressed, otherwise ROTALIGN will not be recording any slight movements.

Position the machine laterally, while following the horizontal movement coordinates on the screen. The shim values will also be seen to change slightly. When satisfied with the horizontal offset values, tighten down the bolts and press STOP.

STOP

8) Final check

After pressing STOP, the display shows the position "after MOVE." If this is within machine tolerances, the alignment is complete! If not then press the "M" key and take a final remeasurement.



WARNING!

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

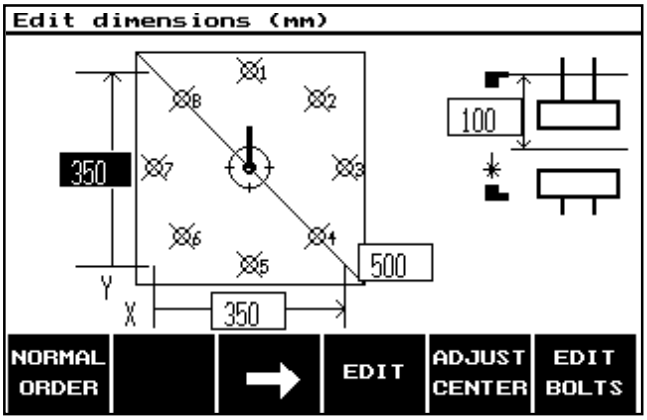
OPTION: Nonsymmetrical flange shape

OPTION

From the Vertical dimensioning screen you can select OPTION to set up a nonsymmetrical flange:

Altering a rectangle or ellipse

Press option to change the overall flange dimensions:

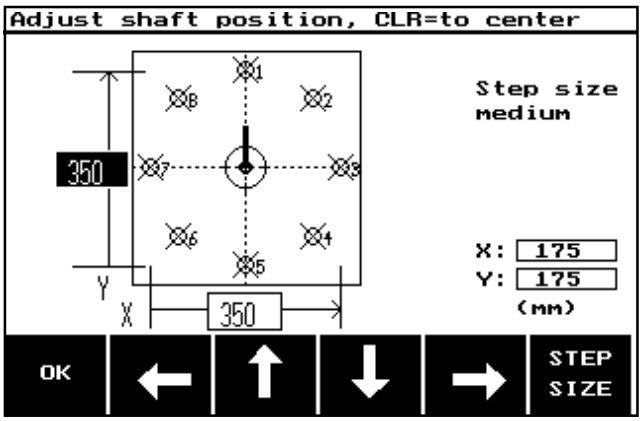


Use the arrow key to highlight the Y-AXIS (front to back) or X-AXIS (along the front) dimensions then press EDIT to change them.

Adjusting center position

Press ADJUST CENTER to move the central axis to a new position:

ADJUST CENTER



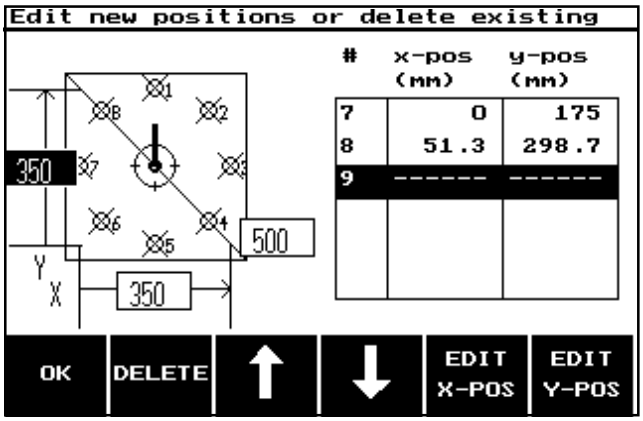
Use the arrow keys to move the center to a new location shown by the X and Y coordinates, lower right. Press STEP SIZE to make the center move inward: X-large (100"/1000mm), large (10"/100mm), medium (1"/10mm) or small (0.1"/1mm) steps. The available steps depend on the machine diameter you entered. The CLR key recenters. Press OK when finished.

OK

Moving or deleting bolts

EDIT BOLTS

Press EDIT BOLTS to show this screen:



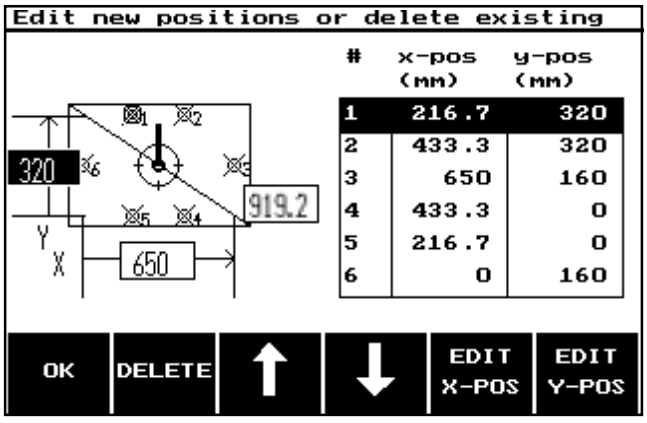
To the right is the bolt list showing each bolt, its number and its X and Y coordinates. Browse through the list with the arrow keys; the corresponding bolt is highlighted on the diagram.

You can delete a bolt by selecting it with the arrows and pressing DELETE.

You can move any bolt by selecting it and editing its coordinates. Press EDIT X-POS and enter its X-position, noting that the zero position is in the lower left-hand corner of the diagram. Repeat for EDIT Y-POS. The bolt will then be moved on the diagram.

You can create a new bolt by going to the dashed line at the bottom of the table (#9 in the above example) and entering its coordinates with EDIT X-POS and EDIT Y-POS. The new bolt will then appear on the diagram.

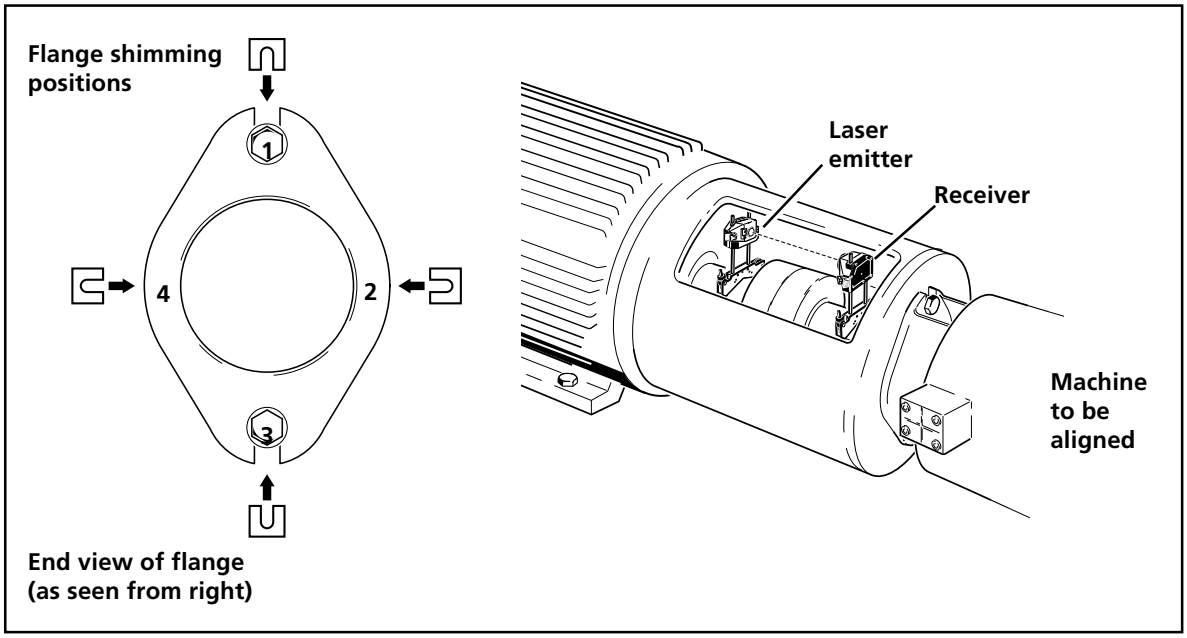
An example of a 6-bolt flange created from a 12-bolt square with a few simple changes.



When finished with bolt editing, press OK. You can now start measurement as described earlier. Do not press NORMAL ORDER unless you want to delete all your changes and return to a symmetrical arrangement!

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, at the sides of the flange. In fact, the requirements are actually quite similar to those for aligning vertical machines, and ROTALIGN provides the same precision and convenience by means of the procedure described here. Shown below are the shimming locations for a two-bolt flange, a special case of the normal circular flange shape.



When the shaft rotates around a horizontal axis, the electronic inclinometer built into the receiver can be used to detect the rotational position during measurement, and so either the Multipoint or Continuous Sweep measurement mode may be used to align the shafts. These two modes are described in detail starting on page 4-34. The "Measure at 1-8" measurement mode may also be used, but does not incorporate the advantages offered by the inclinometer. 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

1) Set up ROTALIGN

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

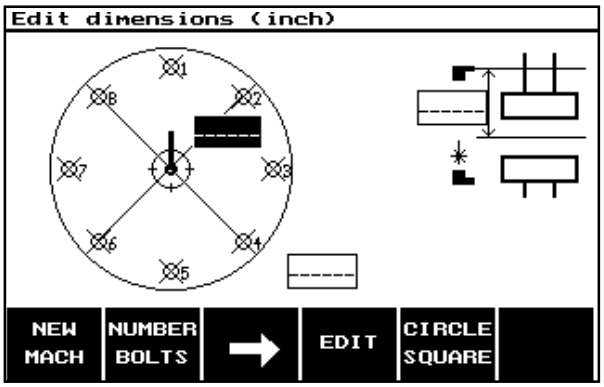
b) Switch on ROTALIGN and select the vertical application from the introductory screen.



DIM

2) Enter dimensions

a) The flange dimension screen appears as shown below:

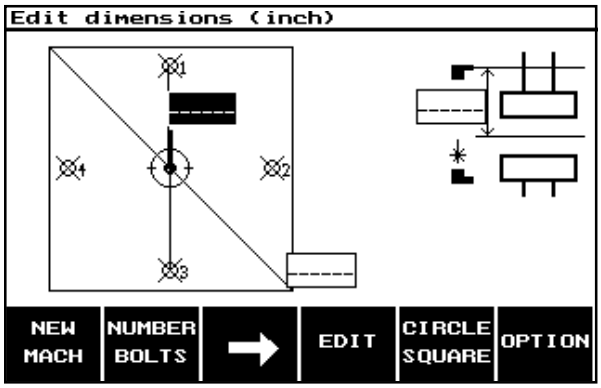


CIRCLE SQUARE

b) The default bolt pattern is circular. Press CIRCLE/SQUARE once to change this to a circular bolt pattern within a square flange (see page 5-11).

NUMBER BOLTS

c) The default shows a flange with 8 bolts. To change this to the two-bolt flange with four shimming locations, press NUMBER BOLTS, then "4," then press ENTER.



d) Since the two-bolt flange is not symmetrical, set the proper flange dimensions:

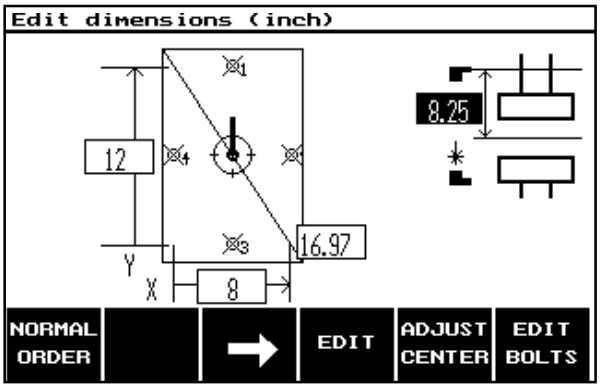
OPTION

EDIT

1. Press the OPTION key. The vertical distance between bolts is now highlighted in the displayed end view of the flange.
2. Enter the (vertical) distance between the centers of the flange bolts. Press ENTER to confirm the entry.
(Note: for this and all other entries, the EDIT key may be pressed, if desired, in order to display a description of the required dimension in the status line at the top of the screen.)
3. Enter the (horizontal) distance between the centers of the left and right flange shimming locations. Press ENTER to confirm the entry.

(The diagonal dimension is calculated automatically and can be ignored for machines with two-bolt flange mountings.)

e) Press the arrow key to proceed to the distance between coupling center and ROTALIGN receiver. Key in this distance and confirm with the ENTER key.

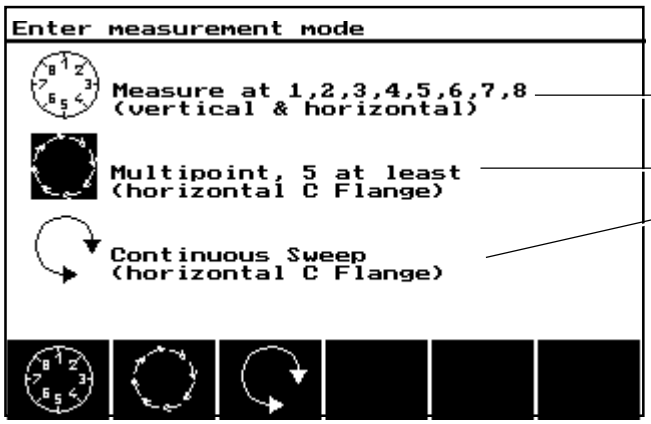


3) Measure

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

a) Press the M key to open the measurement screen, then press the MEAS MODE softkey to obtain the following display:





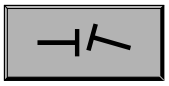
For vertical machinery with bolt flanges

For horizontal machinery with two-bolt flanges

The lower two options rely on the inclinometer in the receiver to determine rotational position; these are, therefore, reserved for horizontal shafts.

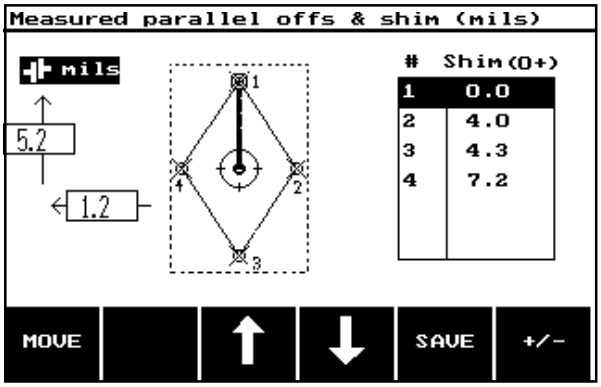
b) Press the corresponding key to select the desired measurement method.

Center the laser beam and proceed with measurement as would be done for a standard horizontal machine (see page 4-34).



4) Results

When you have finished taking measurements, press the RESULTS key:



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 marked "1."

The offsets are shown on the left portion of the screen. In the example shown here, the values are 5.2 mils up and 1.2 mils to the left (i.e. toward the viewer in the standard ROTALIGN screen described in Step 1 above).

The table on the right lists the calculated shim corrections. Press the "+/-" key, if necessary, to set the column heading to "Shim (0+)," which means that shimming is calculated such that one bolt requires zero shimming, and all remaining bolts are shimmed by positive amounts. (The solid line joining the bolts in the diagram indicates that the vertical axes of the bolts now function as "corners," with the original bolt flange dimensions appearing as a dashed line.)

5) Fit shims

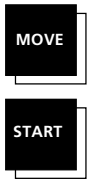
Loosen the bolts and fit the shims according to the values given in the table. Try to avoid any lateral movement of the machine when doing so. When finished, retighten bolts.

6) Repeat readings

Press the "M" key to take a new set of readings before beginning offset corrections. The results should now show little if any shimming corrections after shim fitting in step 5 above.

7) MOVE to eliminate offset

Press the softkey marked "MOVE" to start the offset correction function. Rotate the shafts such that the sensors are located at bolt position number 1 (the top position for horizontal shafts; see step 4 above), then press the "START" softkey to begin lateral positioning for correction of offset.



Do not loosen the machine anchor bolts until after START has been pressed! Move the machine laterally while viewing the screen; note the order of the bolts for correct orientation (refer to step 4 above if necessary). Jack bolts or other mechanical or hydraulic adjustment methods are recommended for best results.

The Average function, set in the XY VIEW screen is automatically used during Move measurements. With this option, you can set the number of measurements (up to 2048) to be taken and averaged during readjustment, see page 4-44.

Tighten down the anchor bolts, then press STOP to conclude the horizontal alignment procedure.



8) Final check

Press the "M" key to take a final set of readings in order to confirm proper alignment.

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



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Chapter 6: Appendix

This chapter provides background to alignment and tolerance methods. To assist you in identifying and rectifying errors, a troubleshooting guide and list of error messages are also included. Following an extensive list of ROTALIGN accessories is a discussion on soft foot diagnosis.

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Chapter 3 Configuration and Data Management ..... 3-1 to 3-8

Chapter 4 Horizontal Alignment ..... 4-1 to 4-66

Chapter 5 Vertical Alignment ..... 5-1 to 5-18

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- How accurate should alignment be? 6-5
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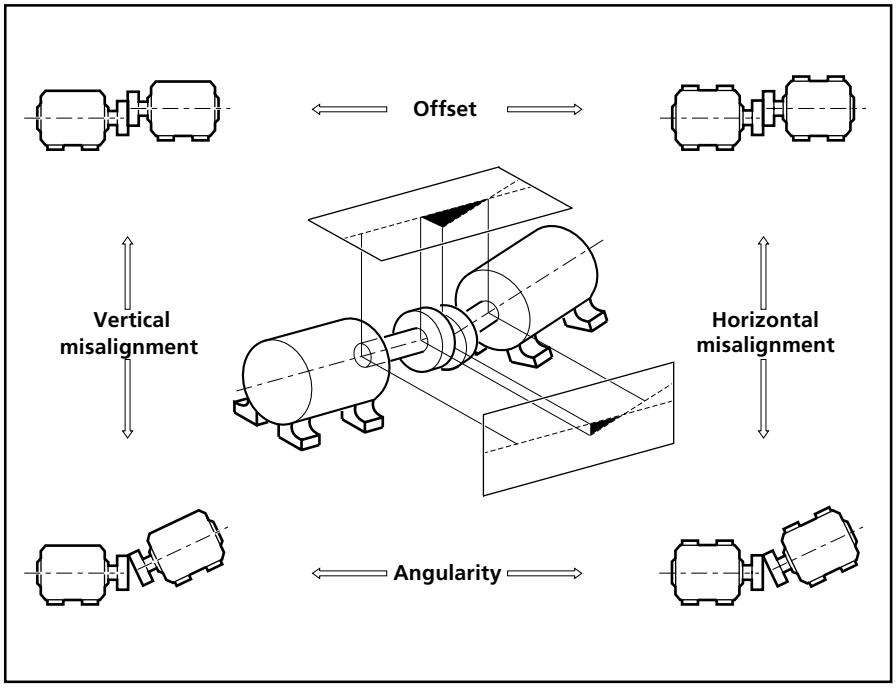
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What is "alignment?"

Two machines are aligned with one another when the rotational axes of both shafts are colinear during operation. The following chart shows the possible deviations from this ideal condition:



Any misalignment between the two machine shafts, as shown above, may be considered in terms of four basic alignment parameters:

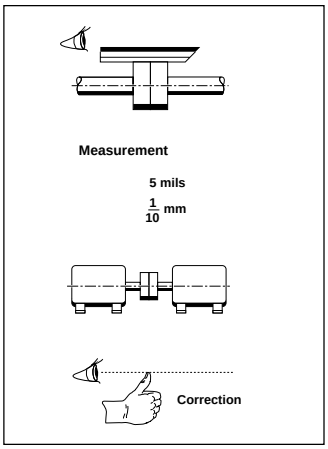
Vertical offset	Vertical angularity
Horizontal offset	Horizontal angularity

These four degrees of freedom must be measured in order to achieve correct alignment. ROTALIGN displays four values which combine to correct all these parameters simultaneously by

· raising or lowering the front and back feet of the machine
and
· moving the front and back ends of the machine left or right.

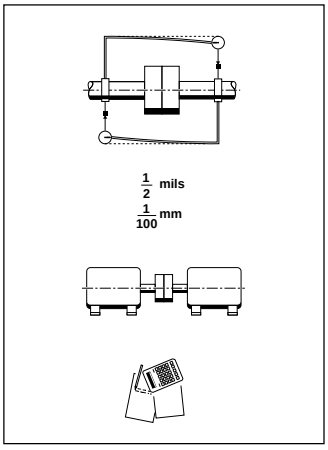
Precut shims (available from your ROTALIGN dealer), such as PERMABLOC or LAMIBLOC, can greatly reduce the time and effort needed for vertical alignment adjustments (see page 6-9). ROTALIGN's MOVE function allows you to monitor the horizontal and vertical positions simultaneously on screen for quick and reliable alignment.

Comparison of alignment methods



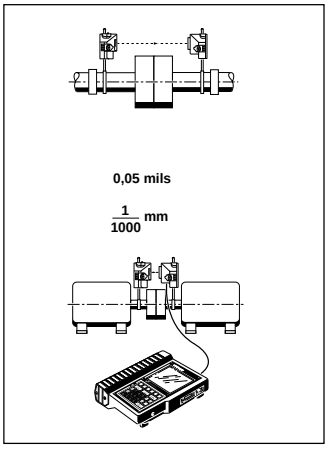
Straightedge

The straightedge is the most well-known and widespread shaft alignment tool. If both the coupling surface and the measuring eye are in good condition, alignment accuracy may approach 1/10 mm (5 mils). This may be sufficient for some machines and couplings.
Thanks to its simplicity, the straightedge is ideal for quickly performing a rough, preliminary alignment.



Dial indicators

Dial indicators offer much more accurate alignment readings: when used correctly, they can achieve shaft alignment accuracy of 1/100 mm (1/2 mil). To do so, however, bracket sag must always be measured first, and the mounting arrangement must be very rigid. The measurement values must be recorded correctly (without mixing up +/- signs or transposing values, of course) and then the alignment corrections must be correctly calculated from the indicator readings.



Laser optics

This approach has the highest accuracy available. ROTALIGN has an actual resolution of 1/1000 mm—better than any other available system (except for our other products!). Laser optics also give the user several other distinct advantages. Custom-made brackets are no longer required for each individual machine/coupling arrangement. Instead, since no mechanical linkage across the coupling is involved, just a few universal brackets can be used to mount quickly on nearly every machine. Measurements must no longer be read and written down, and correction values for the machine feet appear automatically in the display.

How accurate should alignment be?

The suggested alignment tolerances shown at right are general values based upon experience and should not be exceeded. They are to be used only if existing in-house standards or the manufacturer of the machine or coupling prescribe no other values.

To use the table, consider all values listed to be the maximum allowable deviation from the alignment target, be it zero or some desired value to compensate for thermal growth. In most cases, a quick glance at the table will tell whether coupling misalignment is allowable or not.

As an example, a machine running at 1500 rpm has coupling offsets of -0.04 mm vertically and +0.02 mm horizontally: both these values fall within the "excellent" limit of 0.06 mm.

Inch examples:

e.g. at 1800 rpm offsets are -1.3 mils vertically, and +.6 mils horizontally: both values fall within "excellent" limit of 2 mils.

Angularity is usually measured in terms of gap width at the edge of the coupling. For a given amount of angularity, the larger the diameter, the wider the gap at the coupling edge. The table lists values for coupling diameters of 100 mm or 10". You may compare results directly by entering this coupling diameter into ROTALIGN, or alternatively, if actual coupling diameter is entered, then multiply the value from the table by the appropriate factor.

For example, a machine running at 1500 rpm has a coupling of diameter 75 mm. At this diameter, the maximum allowable gap would be

(0.07 mm) x 75/100 = 0.0525 mm (or 5/100 mm)

e.g. 1800 rpm, Diameter = 20"
5 mils x 20"/10" = 10 mils gap

For spacer shafts, the table gives the maximum allowable offset for each 100 mm or inch of spacer shaft length. To take an example, a machine running at 6000 rpm with a 300 mm spacer shaft installed would allow a maximum offset of

(0.03 mm) x 300/100 = 0.09 mm (or 9/100 mm)

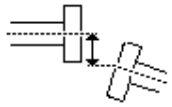
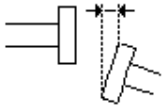
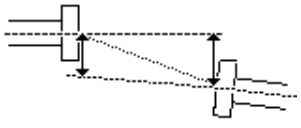
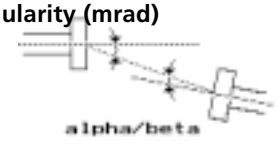
e.g. 7200 rpm, Length = 10"
0.25 mils x 10"/1" = 2.5 mils offset

at either coupling at the ends of the spacer shaft.

"Acceptable" limits are calculated from sliding velocity of lubricated steel on steel, using a conservative value of 12 mm/sec. (0.5 in./sec.) for allowable sliding velocity. These values also coincide with those derived from elastomer shear rates, so they also apply to short couplings with flexible elements. The "excellent" values draw on vibration observations made upon a wide variety of industrial machines to determine the critical misalignment for vibration; however, compliance with these tolerance values does not guarantee vibration-free operation of a particular machine.

Since rigid (flanged) couplings have no tolerance for misalignment, they should be aligned as accurately as possible.

Suggested Shaft Alignment Tolerances

	[RPM]	Tolerance metric [mm]		inch [mils]	
Soft foot	any	0.06 mm		2.0 mils	
Short "flexible" couplings		Acceptable	Excellent	Acceptable	Excellent
Offset	600			9.0	5.0
	750	0.19	0.09		
	900			6.0	3.0
	1200			4.0	2.5
	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	600			15.0	10.0
(gap difference at coupling edge	750	0.13	0.09		
per 100 millimeters diameter	900			10.0	7.0
or per 10" diameter)	1200			8.0	5.0
	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
Spacer shafts and membrane (disk) couplings					
Offset	600			3.0	1.8
(per 100 millimeters spacer length	750	0.25	0.15		
or per inch of spacer length)	900			2.0	1.2
	1200			1.5	0.9
	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
		mrad		**mrad**	
Angularity (mrad)	600			3.0	1.8
	750	2.5	1.5		
	900			2.0	1.2
	1200			1.5	0.9
	1500	1.2	0.7		
	1800			1.0	0.6
	3000	0.7	0.4		
	3600			0.5	0.3
	6000	0.3	0.2		
	7200			0.3	0.2

Note:
Metric tolerances are given for machines with a 50Hz supply running at multiples/fractions of 3000 RPM.

Imperial tolerances are given for machines with a 60 Hz supply running at multiples/fractions of 3600 RPM.

Machine preparation

Certain preparations should be made before beginning any alignment to ensure efficient measurement and successful results.

Ensure that the machine cannot accidently be started before commencing work.

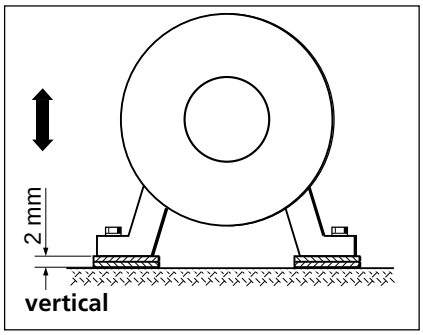


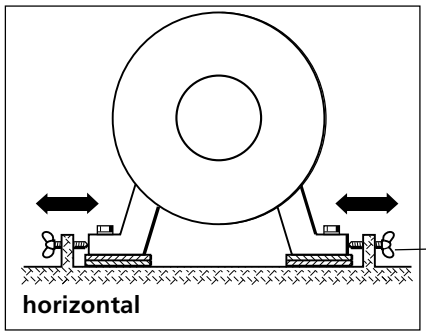
WARNING!

Solid, flat foundation

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

Machine mobility





Tip:
Adjustment screws can easily be made be tack welding a bolt to the foundation and inserting a screw

If the machine to be moved stands directly on the foundations, it cannot be lowered for alignment correction. Therefore, it is generally advisable to start with about 2 mm (80 mils) of shims beneath the feet of both machines.

Precut shims such as single-thickness PERMABLOC or laminated LAMIBLOC shims, available individually or as complete assortments in carrying cases, should be on hand before beginning alignment (see page 6-9). Horizontal alignment can be made easier and more precise if hydraulic or screw-type positioning aids are available. The "hammer method" is not only inexact, but it can also damage the machine housing and bearings (by chatter marking).

Rigid couplings

Rigid couplings, typically found on turbines, must be loosened before measurement so that they do not distort the alignment condition. How this is done depends on the type of machine:

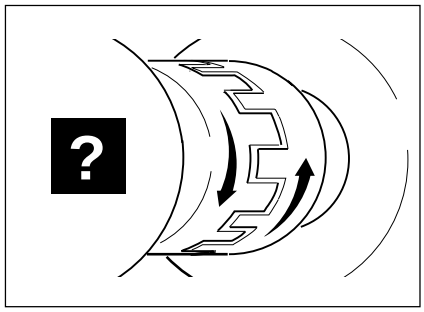
Steam turbines with single bearing shafts: Remove the coupling bolts, split the coupling faces 2-3 mm (1/8") and insert a couple of undersize dummy bolts.

Steam turbines with two bearing shafts: The coupling faces normally locate together; the coupling must, therefore, be split sufficiently in order to dislocate them. Alternatively, there may be a spacer component which can be dropped out and the two halves linked with a bar.

Gas turbines: These are usually fitted with a spacer shaft to accommodate large thermal growths. Either a) remove the spacer and use the Pass mode (page 4-36) or b) loosen the coupling as above and use the Multipoint mode (page 4-36).

When coupling play is suspected: For maximum accuracy during soft foot measurement and alignment adjustment, the shafts should be rotated so that the sensors are oriented horizontally (for horizontal adjustment) or vertically (for vertical adjustment and soft foot measurement).

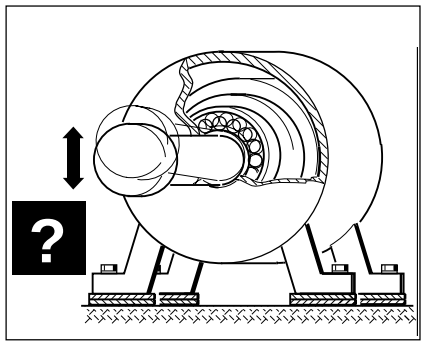
Coupling play



Thanks to its five-axis detector system, ROTALIGN can distinguish between coupling torsion play (backlash) and true shaft misalignment, so that even uncoupled shafts can be measured accurately (using the "Pass mode" measurement option, page 4-36).

The laser and receiver must, however, make contact during some portion of rotation in order to take readings. It may be easiest to link the coupling halves for rotation.

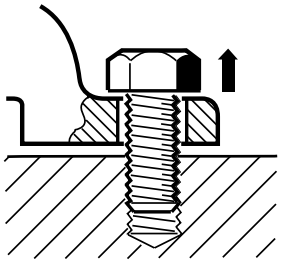
Shaft play



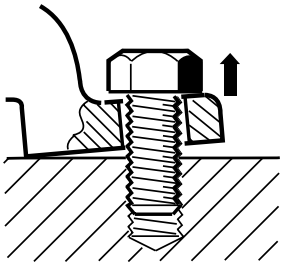
Excessive radial play of the shaft within the bearing will lead to poor alignment results. The ROTALIGN Soft Foot function can measure radial play when the shafts are lifted.

A small amount of axial shaft play (up to 3 mm / 1/8") will have no adverse effect on accuracy.

Measuring and eliminating soft foot



parallel soft foot



angular soft foot

One of the most important prerequisites for achieving good shaft alignment is ensuring that all machine feet contact the foundation properly without requiring that excessive force be exerted by the anchor bolts. Such forces, caused by nonparallel contact surfaces, can deform the machine feet and housing. Uneven foundations and dirty or corroded machine feet can leave the machine standing on only three feet. If not corrected before alignment, the resulting "soft foot" allows the machine to tip into a different position every time the bolts are loosened, making proper alignment difficult or impossible.

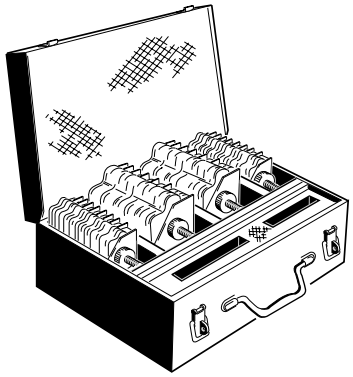
The ROTALIGN Soft Foot function is invaluable in checking and correcting this condition. Thanks to its simple operation, there is less temptation to skip this crucial step when alignment must be done quickly. See page 4-29.

Shims

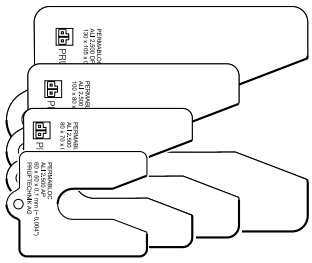
Proper shims must be used for satisfactory alignment results based upon ROTALIGN shimming corrections.

What constitutes a "proper" shim? First, its thickness must match the correction values (within 0.025 mm, [1 mil] since shimming stock is not made thinner than this). The thickness must be consistent over the whole shim area, without any thick or thin spots. The shim must be flat, without seams or folds from bending. Burred edges must be removed or the shim will act as a spring, compressing a bit each time the foot bolt is tightened, especially when several burred shims are stacked upon one another. The shim material must be dimensionally stable, without appreciable cold flow effects when subjected to high compression over long periods of time. It must also withstand the demands of the service environment without corroding, since rusty shims can also act as springs.

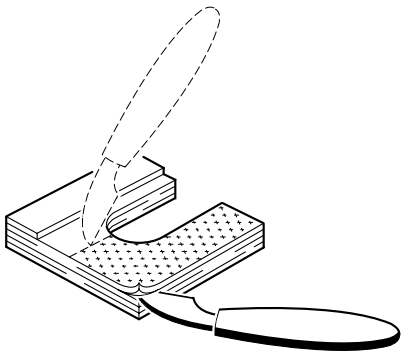
Commercial precut shims fill these requirements best, while saving a major portion of alignment time compared with shims hand cut from rolls of sheet stock. PRÜFTECHNIK offers two different types of shims in a wide range of metric thicknesses and sizes to fit most machine feet. Check with your ROTALIGN dealer for inch thicknesses and other custom shims.



Complete set of shims



PERMABLOC®

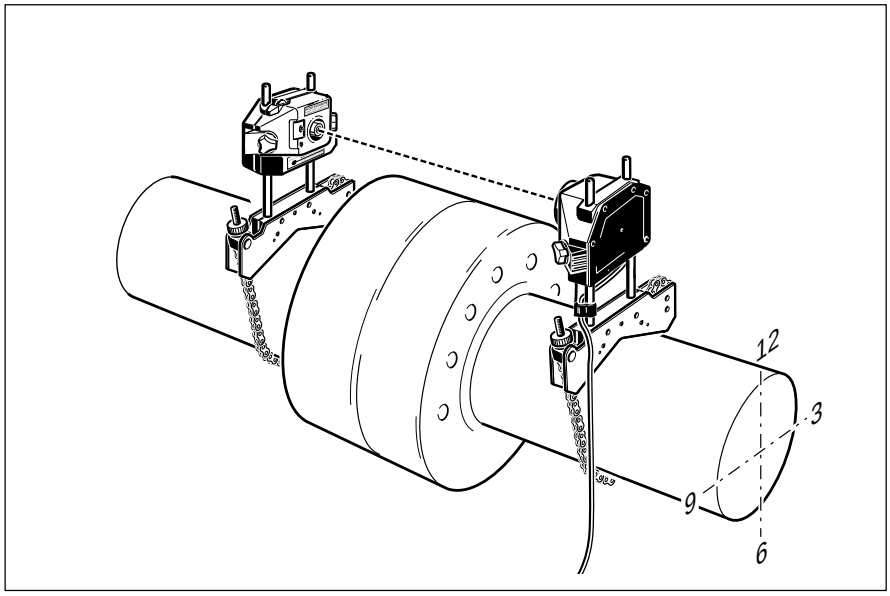


LAMIBLOC®

PERMABLOC® individual stainless steel shims are obtainable in single thicknesses or as complete sets in their own carrying case. Each shim is permanently etched (not printed or stamped) with its thickness. By simply pulling the single shims from the case, the proper thickness can be achieved in just a few seconds.

LAMIBLOC® shims are laminated from 12 layers to give a total thickness of 1 mm; the correct shimming amount is obtained simply by peeling off the excess layers. Only a handful of shims are, therefore, needed at the job site. They may also be ordered as a complete set in their own case and are available in brass or stainless steel.

The ROTALIGN measurement principle



To measure the misalignment, the shafts are rotated. The laser beam shines onto the receiver detector, and during rotation any misalignment in the shaft causes the laser beam to change its position in the receiver.

The exact location of the beam is recorded by registering its coordinates along with the corresponding rotation angle of the shafts. This takes place at a number of points during shaft rotation through 360° or less. Several different measurement procedures (described on page 4-34) are available to handle special situations such as uncoupled shafts and limited rotation.

The computer then uses the minute displacements measured by the detector to calculate the current alignment condition. It displays the resulting machine alignment diagram complete with coupling alignment values and position values for the machine feet. The former allow the operator to compare the situation at hand with prescribed tolerances.

Checking alignment with vibration analysis

One very impressive method of demonstrating the importance of good alignment for smooth operation of rotating equipment is comparative vibration measurement (for example, using PRÜFTECHNIK VIBROSPECT® FFT or VIBROTIP®) before and after alignment. A comprehensive vibration analysis can also point out other specific machine problems.

Troubleshooting guide

Here is a list of possible problems encountered with ROTALIGN. See also the Error messages on page 6-13.

Computer will not switch on:

Replace Main batteries (page 2-10) or connect charger (page 2-8). If this doesn't help, replace the Auxiliary battery (page 2-11) as well. If there is still no response and you are quite certain that the replacement batteries are new, contact your local PRÜFTECHNIK distributor.

Computer lockup:

1) Normally, press the ON/OFF, CLR and ENTER keys all at once.
2) If the message "Not ready reading drive A:..Abort, Retry, Fail" appears, then press ON/OFF for 15 seconds and release to switch off.
3) If the computer locks up each time its switched on then you will have to clear the memory. Proceed as follows:
   a) Reset the computer: press ON/OFF, CLR and ENTER all at once.
   b) During rebooting, press and hold the CLR key until the computer ID (the letters "ID" followed by the 8-digit CPU number) appears on the screen, then release the key.
   c) From the three-item menu select DEVICETEST by pressing "2."
   d) From the eight-item menu select MRAM by pressing "1."
   e) From the eight-item menu select INIT ALL by pressing "3."
   f) Press CLR to clear all stored measurements, setups and results. (Press ON/OFF to back up one level.)
   g) Switch the ROTALIGN off and on again with the ON/OFF button, then reconfigure.

You may press ON/OFF to escape backwards one menu level from any of the menus in steps C through F:

Screen goes blank:

In sleep mode: press any key to reawaken (page 2-12)
OR auto-shut off: switch on again and press RESUME.

Screen is solid black or clear:

Switch on the computer and wait 2 minutes for it to finish "booting up." Then adjust screen contrast by pressing and holding the 0 or 1 key: contrast will loop from dark to light and back again while you hold down the key. Release the key when the desired screen contrast setting is reached.

Inconsistent measurements:

1) Brackets incorrectly mounted: are the brackets slipping or loose or mounted at an angle? (page 4-11). Were the brackets accidentally knocked during or between measurements?
2) Measurement range too small or too few points: rotate through a larger angle with more measurement points (page 4-33)
3) Machine preparation problem: excessive bearing play? Check with Soft foot function (page 4-29). Is the foundation stable? If suspect, split the coupling and measure with Pass mode (page 4-36). Is the coupling too stiff, e.g. membrane coupling? See page 6-7.
4) Are the receiver and laser lenses clean? (page 6-36)

Difficulties in alignment:

1) Poor measurement, see reasons listed above.
2) Are corrections being made in the wrong direction? See the rules on pages 4-34 and 4-50.
3) Check Soft foot (page 4-29)
4) Check machine preparation details (page 4-10). Is the foundation stable? Are your horizontal moves reasonably accurate with jack screws or similar?

ROTALIGN error messages

LASER OFF — Laser is either switched off, not pointing into the center of the receiver, or there is an obstruction, e.g. dustcap or dirt on the receiver lens.

If laser moves out of receiver range during a rotational measurement, the RANGE EXTEND function may be used, depending on how far out of range the laser is (see page 4-46). If the laser moves out of range or during a Move, turn back the shaft until the laser is back in contact with the sensors. Press STOP, re-center the laser and repeat the measurement/move one step further. Is there large misalignment? Try aligning the machines first by eye! Then measure with a fairly small rotation angle and make a preliminary alignment.

Temperature — If the temperature rises above 60 °C (140 °F) or falls 0 °C (32 °F) below the rated operating range, this message is displayed and the ROTALIGN stops making measurements (see page 4-44).

LASER END — Laser is not centered on the receiver and is hitting the outer area. Use the RANGE EXTEND function described on page 4-46.

SENSOR ??? — Receiver is not connected or the cable is damaged. See page 4-13.

Missing Dimensions
Results cannot be calculated without entering the machine dimensions. See page 4-16.

Syntax Error — Unacceptable dimension entry. Clear with arrow and CLR keys, and try again (page 4-21)

Neither measured nor target values or Not enough points!
At least three measurement points are required for a result (page 4-33).

Small rotation angle!
The rotation angle should be at least 75°. You will still obtain a result with less than 75° but it may not be accurate (page 4-33).

Memory is nearly full
This is your last chance to save a file! Start deleting unwanted files, or backup the lot to a PC with ROTALIGN COMMANDER (see page 6-16).

File already exists! Press OK to overwrite
You have entered an already existing filename. Each filename must be unique.

Out of paper, Printer error, Printer timed out, etc.
ROTALIGN displays printer error messages. Check the printer and connections.

The ROTALIGN case

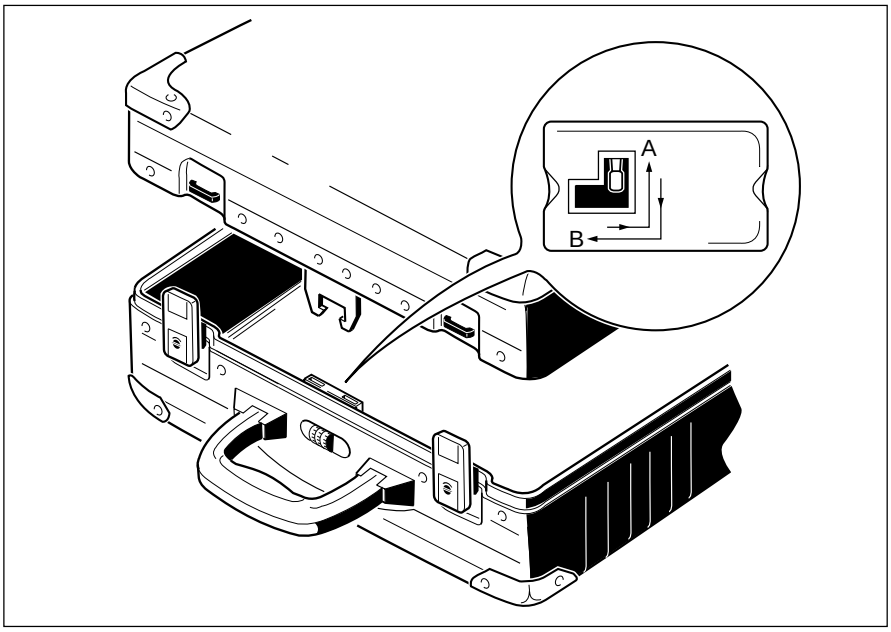
Key:

The keys are taped to the inside of the case lid.

The ROTALIGN case has two key locks and a 3-digit combination lock. Write down the key number in the boxes at left:

The combination lock is set when purchased in such a way that it can be opened when its three digits read "000." It may be left at this setting or set to a new combination on the three dials as follows:

1. Starting point (for example, "000.")
2. Look at the back of the lock inside the case to locate the combination locking lever. Now push this lever toward the center of the lock and raise it (see sketch below), allowing it to catch in this raised position.



Combination:

3. Now set the three dials to your own secret code. Note this new combination in the boxes at left and keep this combination in a secure location in case you should ever forget it.
4. Without changing the setting of the dials, push the combination locking lever back to its original position.

Before closing the case and using the lock, make sure that the above instructions have been correctly followed.

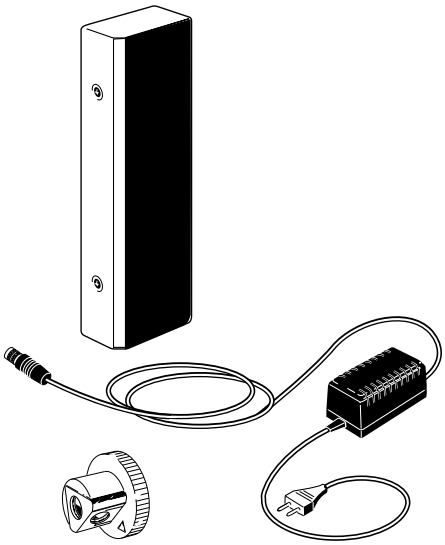
To lock the case, turn the dials from the combination just set. The lock can then be opened only when set to the new combination. If the key locks on the case latches are used, they should be locked first and unlocked last so as not to place any load on the combination lock. If the case is packed very full, push the two halves of the case together snugly to assure proper functioning of the combination lock.

Note

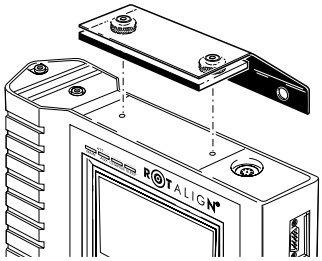
Depending upon local market requirements, the ROTALIGN case may also be supplied without a combination lock.

ROTALIGN accessories

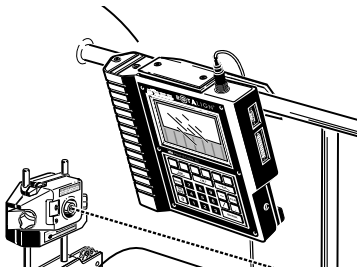
ROTALIGN accessories



ALI 3.572	Lead-acid rechargeable block battery (MAIN BATT) (see page 6-17)
ALI 3.576	110V/220V Mains adapter/charger (see page 6-17)
ALI 3.581-5	ROTALIGN Receiver cable 5 m
ALI 3.579	ROTALIGN Beam Deflector
ALI 3.606	Receiver dust cap
ALI 3.607	Laser dust cap
ALI 3.573	Computer stand
ALI 3.574	2 Thumbscrews for computer stand The stand angles the computer on a table at a convenient reading position, or lets it hang from a pipe etc.
DEMO-FIX	ROTALIGN Compact Demonstration Stand
ALI 3.595	ROTALIGN Case (aluminium), complete
ALI 3.591set	ROTALIGN COMMANDER 2, see next page
ALI 3.591uset	ROTALIGN COMMANDER 2 upgrade
ALI 3.471	ROTALIGN Upgrade Package



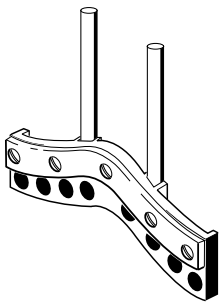
ROTALIGN infrared interface, see page 6-23 for details.



Accessory mounting brackets, bracket parts

(see following pages and the Laser Alignment System product catalog ALI 9.300 available free of charge.)

ALI 2.230	Magnetic sliding bracket, individual
ALI 2.109set	Extra-thin bracket, two pairs in different sizes
ALI 2.112set	Compact magnetic bracket, set of 2
ALI 2.106set	Coupling bolt hole bracket, set of 2
ALI 2.114	300 mm chain for ALI 2.891 bracket
ALI 2.115	600 mm chain for ALI 2.891 bracket
ALI 2.116	1500 mm chain for ALI 2.891 bracket
ALI 2.117	Bracket frame (ALI 2.891) & Allen wrench
	Support posts, 4 pieces each, with colored end caps:
ALI 2.170	115 mm / 4 ½”, white
ALI 2.171	150 mm / 5 15/16", black
ALI 2.172	200 mm / 7 7/8", grey
ALI 2.173	250 mm / 9 7/8", green ALI 2.173
ALI 2.174	300 mm / 11 13/16", yellow
0 0593 0054	Storage pouch



ROTALIGN Commander 2 **ALI 3.591set**

ROTALIGN Commander 2 Upgrade **ALI 3.591uset**

The ROTALIGN Commander 2 is a suite of Windows™-compatible programs which includes the ROTALIGN File Commander, the ROTALIGN Horizontal Editor and the ROTALIGN Vertical Editor. Together, the programs can be used to transfer measurement files between the ROTALIGN and a PC, review and edit measurement files—which can be downloaded to the ROTALIGN, and prepare and print reports.

The ROTALIGN File Commander is used for transferring data between the ROTALIGN and PC. Not only does it allow backup of ROTALIGN data on a PC, but machine parameters can also be downloaded from the PC to the ROTALIGN.

The Horizontal and Vertical Editors are used for entering and editing machine dimensions and parameters, for reviewing results as well as preparing and printing reports. Moreover, the Horizontal Editor can be used to join together up to five sets of horizontal machine measurement data to form a 6-machine train.



The ROTALIGN Commander 2 Set ALI 3.591set includes:

PC program	ALI 3.591
Installation manual	ALI 9.545G
Registration card	ALI 9.546
PC cable, 2 m / 6' 6"	SYS 2.711-2
Cable adapter (25F-9M)	ALI 3.264
ROTALIGN Upgrade program	ALI 3.490
Upgrade instructions	ALI 9.472G
ROTALIGN operating instr.	ALI 9.381G

Included with the ALI3.591uset upgrade set is the PC program upgrade for owners of previous versions of ROTALIGN Commander software.

The minimum requirement for ROTALIGN Commander 2 is Microsoft Windows v.3.1, an 80486DX processor, VGA and 4MB RAM or better.

ROTALIGN Upgrade Manager 2.0x **ALI 3.490set**

ROTALIGN Upgrade Manager 2.0x is a Windows™-compatible program which copies an upgraded version of the ROTALIGN alignment program from a PC onto a ROTALIGN unit.

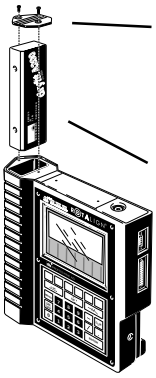
ROTALIGN Upgrade 2 Package **ALI 3.471set**

The ROTALIGN Upgrade 2 Package ALI 3.471set includes:

ROTALIGN Upgrade Manager 2.0x diskette (3.5")	ALI 3.490
ROTALIGN Upgrade 2 Instruction Manual	ALI 9.472G
ROTALIGN Instruction Manual	ALI 9.381G
ROTALIGN Upgrade registration card	ALI 3.522

Lead-acid rechargeable battery ALI 3.572

A rechargeable block battery can be used in place of the six "C" cells. The 8-volt lead-acid battery has a capacity of 1.1 Ah (which is adequate for 9 hours of operation under normal operating conditions; exact duration will vary with your particular usage pattern). The battery is charged by connecting the AC power supply to the computer for 5 hours (see "Mains adapter/charger" below). The lead-acid battery fits in the same compartment as the six "C" cells. Note, the lead-acid battery has a longer life if kept charged and should not be left for periods of time uncharged.

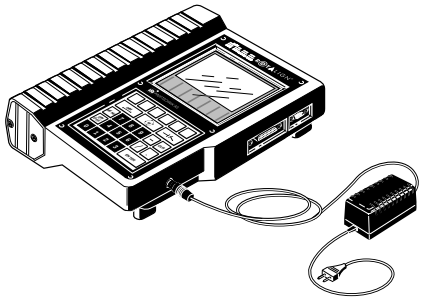


Panel opened with a 2.5 mm Allen key (supplied)

Model 071 90191
Order no. ALI 3.572

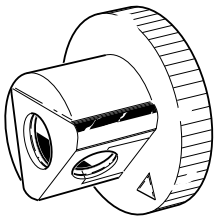
Mains adapter/charger ALI 3.576

The 110/220VAC (switchable) power supply/charger is attached to the computer as shown below. It provides 400 mA of current at 12 volts. When properly connected, the LED marked "CHARGE" above the computer display is illuminated. The supply/charger may be left connected to the computer indefinitely (also when batteries are installed) with no danger of damage. If a lead-acid rechargeable battery is fitted, the supply/charger will simultaneously run the computer and recharge the battery (the lead-acid battery recharges in 5 hours). Charging continues also when the computer is switched off. The ALI 3.576 charger can be used to charge either one ROTALIGN computer or two ALI 4.610 external receiver batteries—but not the computer and one battery at the same time.

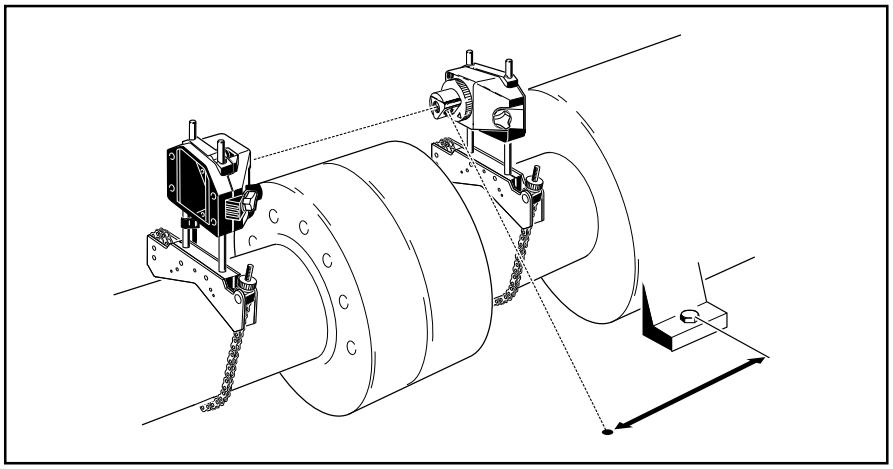


ROTALIGN Beam Deflector ALI 3.579

To simplify and improve accuracy of the machine dimensioning process, PRÜFTECHNIK offers a beam deflector. This simple device attaches to the receiver and, by means of a mirror, directs the incident laser beam 90°. By positioning the device so that the beam is reflected downwards onto the floor, a precise point of reference is created for measuring the receiver to front distance.



When the beam deflector is used a corrective value (50 mm / 2") must be subtracted to compensate for the distance between the point of reflectance inside the deflector and the white marking on the receiver housing. The reflected beam is to be used only for measuring machine dimensions.

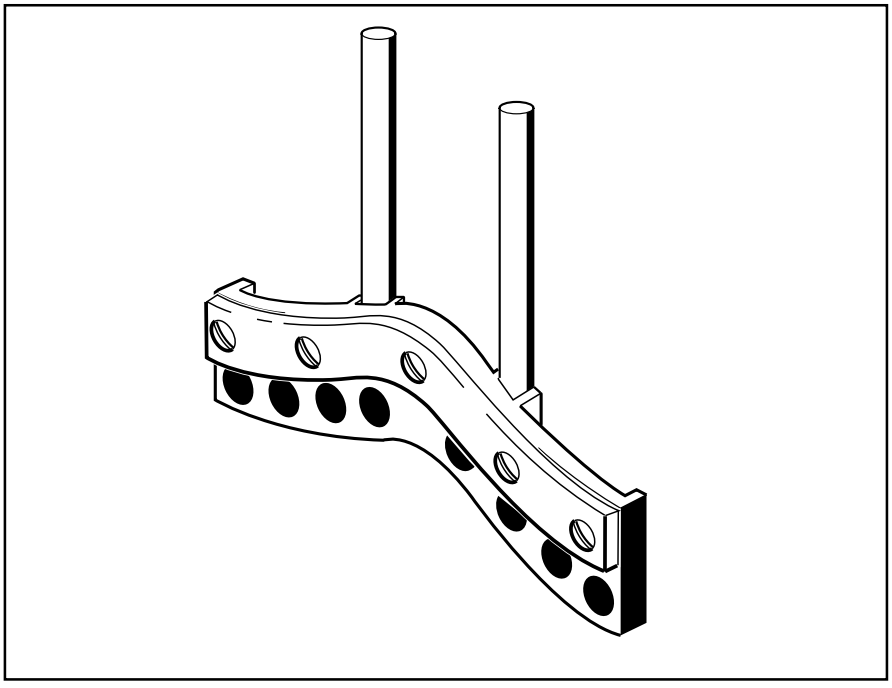


ROTALIGN accessory brackets

Magnetic sliding bracket ALI 2.230I

n order to accurately align two machines with each another, the position of their shafts must be measured by measuring radial displacement (such as ROTALIGN does) while the shafts are rotated. Unfortunately, some machines do not fulfill this requirement as their shafts cannot be rotated slowly for measurement. Especially when long separations between machines are involved, this condition compromises alignment accuracy when conventional measurement methods are used. See "Pass" measurement mode, page 4-36.

However, the ROTALIGN magnetic sliding bracket offers an elegant solution to this dilemma. The bracket fits onto the coupling flange as shown and simply slides around to the required measurement positions. Its powerful magnets ensure the mounting stability needed for accurate measurement. The magnetic sliding bracket for stationary shafts is suitable for all shaft diameters over 80 mm (3 1/8").



Anytime shafts cannot be rotated during measurement (regardless what method is used), alignment accuracy becomes dependent on angular positioning accuracy and machining quality of the shaft and coupling:

- The flange and perimeter of the coupling or shaft must be surface-finished.
- The coupling or shaft must be made of ferrous material (steel) with a large magnetic contact area over which the magnets can guide the bracket.

- Before mounting the sliding bracket, the coupling or shaft should be cleaned, then lightly lubricated at the appropriate location to allow the bracket to slide around smoothly.
- The laser should always be mounted on the side with the highest-quality finish.

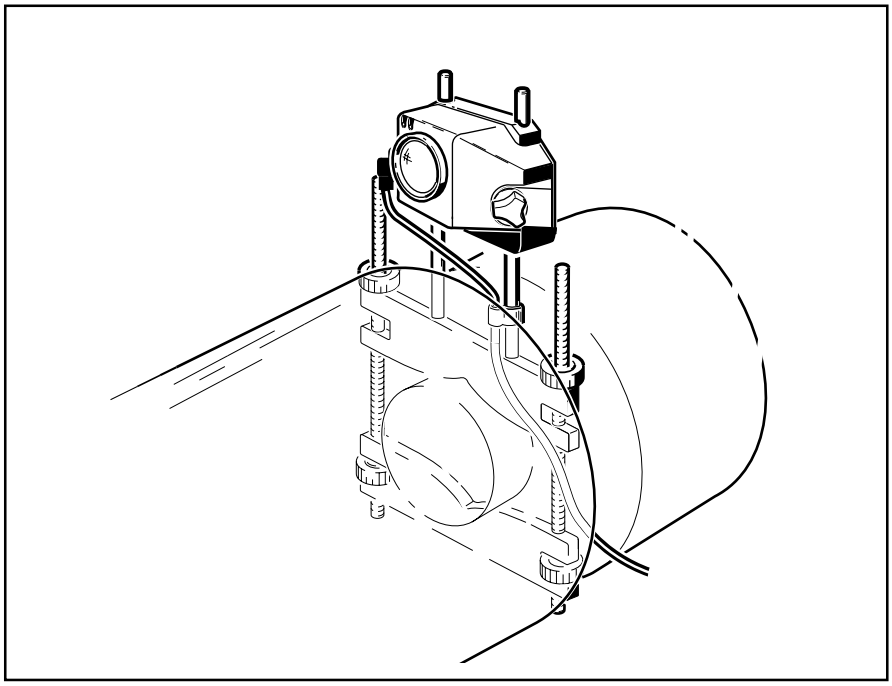
For best possible alignment accuracy, always try to rotate at least one shaft (with the coupling bolts removed). If at all possible, always mount the laser on the shaft that can be rotated (any quick-fit bracket can be used on the rotating side).

Accuracy achieved from nonrotating shaft alignment methods is always less than that of the ROTALIGN when both shafts are rotated and the usual chain-type brackets are used. Therefore, nonrotating measurement should be seen only as a method of last resort.

Note

Extra-thin bracket — ALI 2.109set / ALI 2.109Lset

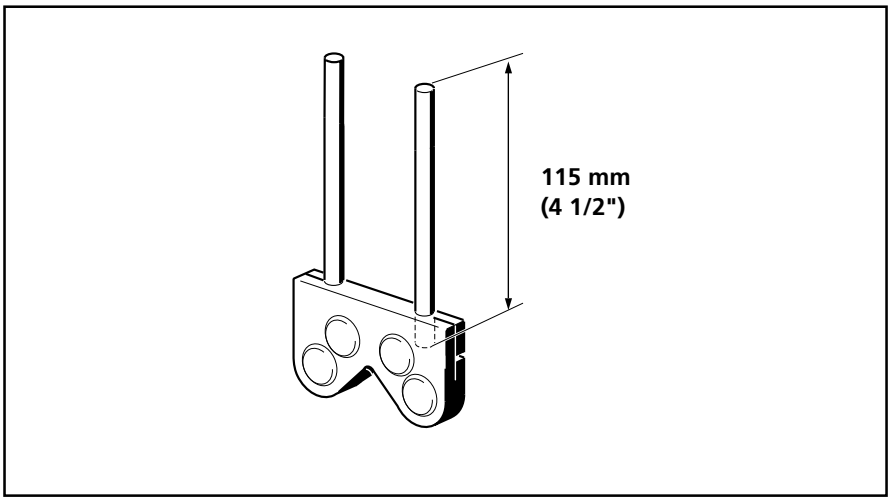
The extra-thin bracket is just 8 mm (less than 3/8") thick and comes in two sizes, one for shaft diameters up to 160 mm (6 5/16") ALI 2.109set, and a smaller version for shaft diameters up to 100 mm (3 15/16") ALI 2.109Lset. Each set constitutes a pair of brackets.

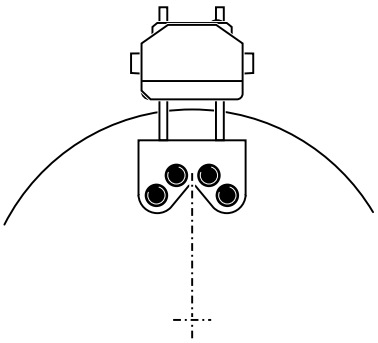


Compact magnetic bracket ALI 2.112 set

Especially when large machines are to be aligned, the coupling flange may be the most advantageous surface for mounting the ROTALIGN laser and receiver.

This compact bracket uses four powerful magnets to hold the standard ROTALIGN support posts against any flat, smooth ferromagnetic surface. This makes mounting extremely quick and convenient while maintaining the same high accuracy as that achieved with other ROTALIGN brackets.

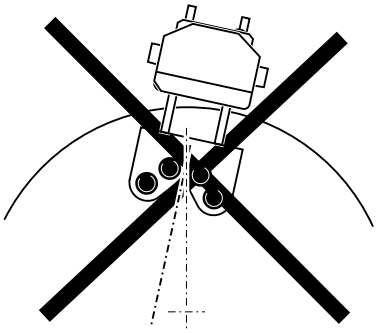


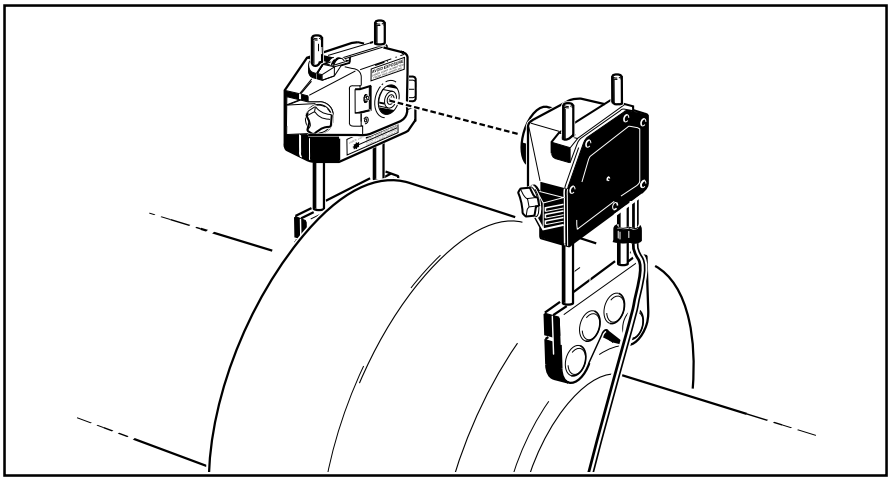


Important:
Use a leveling device (such as the ALI 2.207 inclinometer) if necessary to ensure that magnetic brackets are mounted perfectly square to the shaft radius. Otherwise, skewed mounting can result in measurement error.

Wipe any traces of grease or oil from the mounting surface to avoid bracket slippage (which would reduce measurement accuracy).

Mount the bracket on the coupling flange. Although the bracket fits onto even very small shaft/coupling configurations, all four magnets should contact the mounting surface completely for maximum holding power. Use only the 115 mm (4½") support posts supplied.

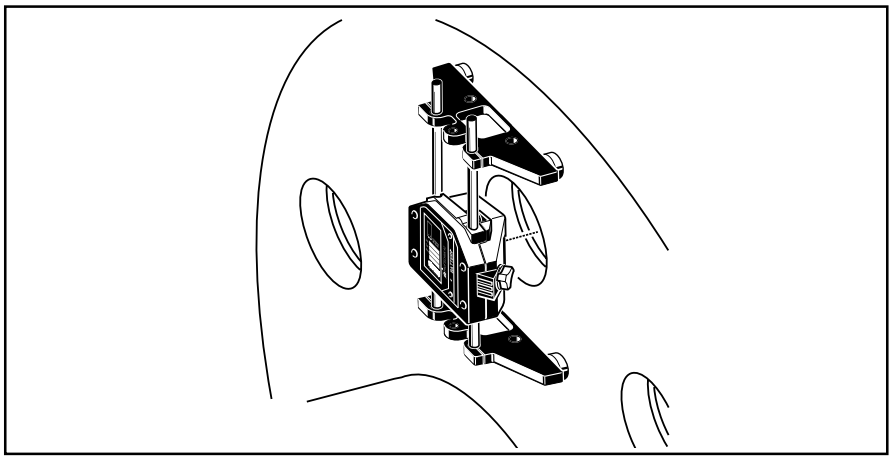




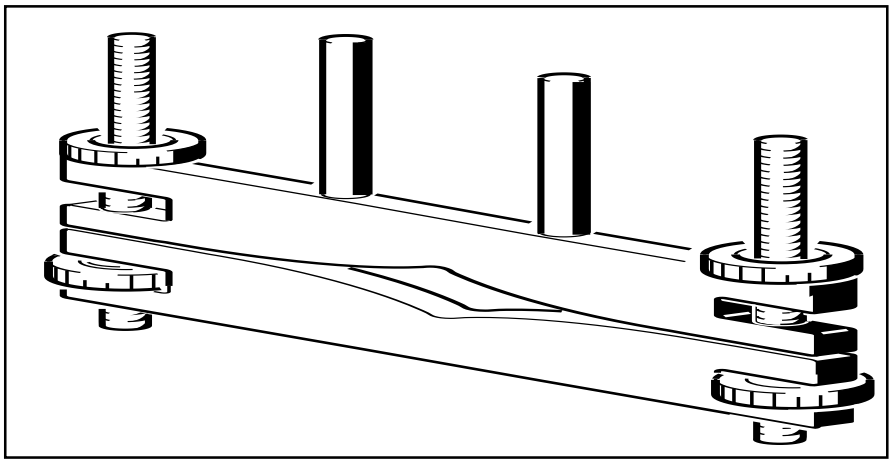
Coupling bolt hole bracket ALI 2.106 set

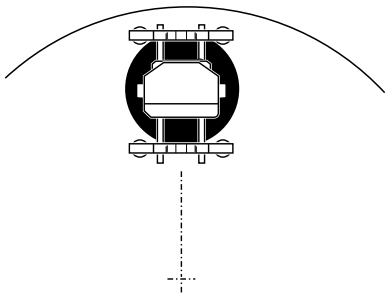
This magnetic bracket can serve as a useful substitute for the standard chain-type bracket when the system must be mounted on large couplings with large bolt holes. Thanks to its four powerful samarium-cobalt magnets, this bracket provides quick and sturdy mounting by straddling the bolt hole; no radial clearance is required beyond the coupling circumference. This space-saving design can save alignment time when space is tight around the coupling.

The basic principle remains the same as when other ROTALIGN brackets are used. However, once the coupling bolt is removed, this bracket can be placed upon the coupling flanges as shown below. The ROTALIGN laser and receiver simply slide onto their support rods and are fixed into place by the upper bracket arm. The entire assembly is then positioned on the coupling so that the laser beam passes directly through the bolt hole. The spring bridge allows easy and precise adjustment of the components and provides additional rigidity for optimum measurement results.

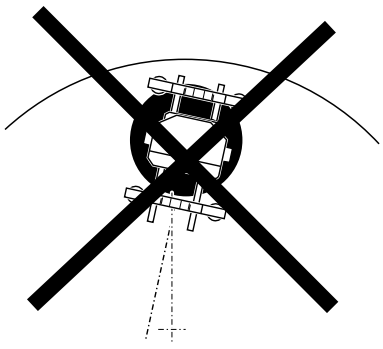


Use only the 115 mm (4½") support rods supplied with the bracket. The position of the support rods may be changed by loosening the hex screws which clamp them in the bracket.





Important:
Avoid skewed mounting by using a leveling device (such as the ALI 2.207 inclinometer), see previous page.



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Infrared interface package ALI 4.609set

The ROTALIGN computer and receiver can be set up with an infrared link instead of a cable. This is useful for continuously rotating shafts, or where a cable could get caught during rotation. The infrared interface package ALI 4.609set includes:

ALI 4.608 ROTALIGN infrared interface
ALI 4.610 External receiver battery with IR interface
ALI 4.701-2 Cable, 2 m (6.5') from receiver to external battery

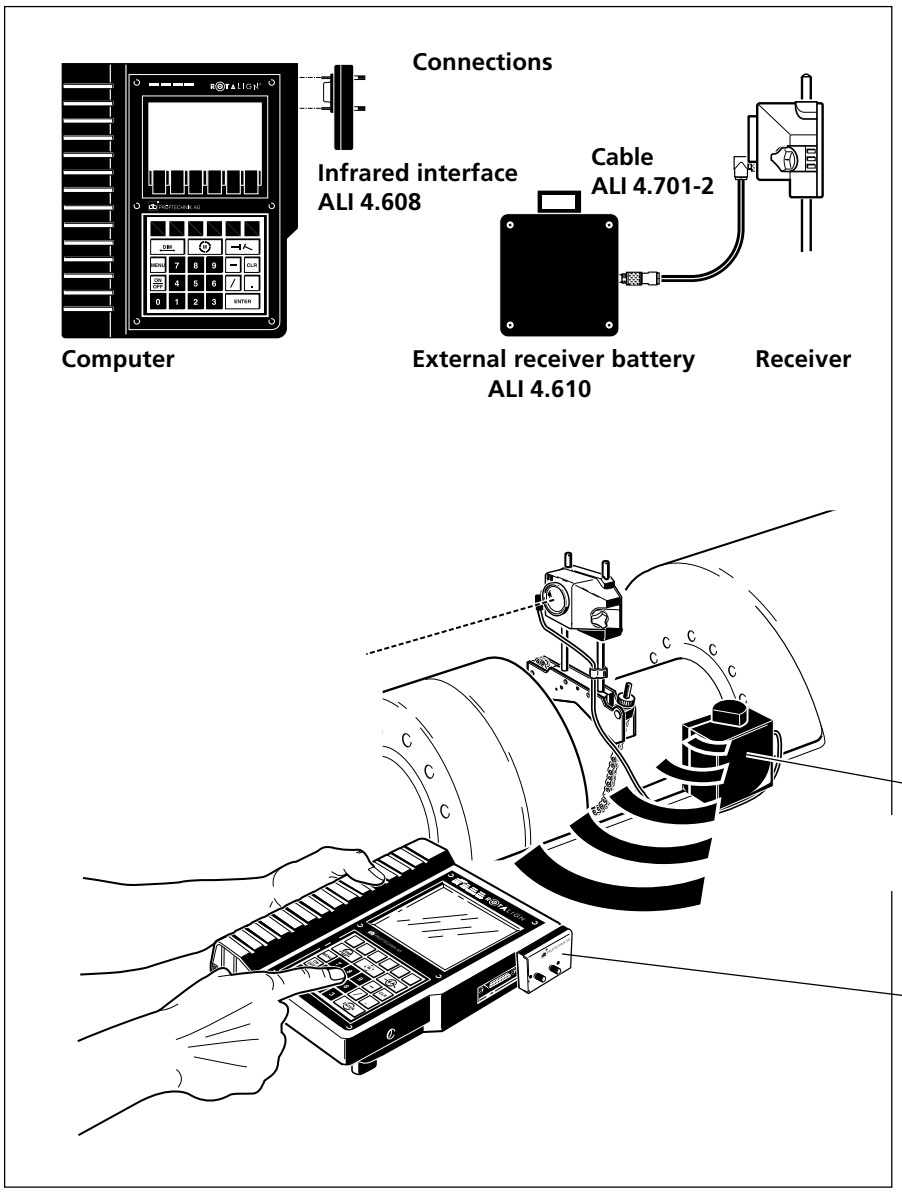
When using this system, the "Sensorport" in the CONFIG options must be set to "COM" - page 3-3.

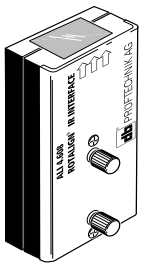
The external receiver battery has two strong permanent magnets built flush into one side of its housing. These let you mount the battery quickly and easily onto any ferromagnetic shaft or coupling surface.

Recommended accessories:

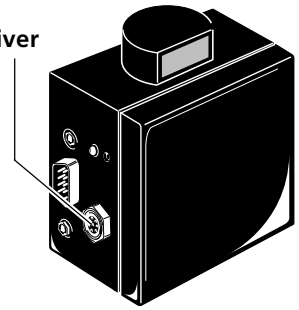
ALI 3.576 **Charger for external battery**

ALI 3.582 **Charger T-cable for two external batteries simultaneously**





Infrared interface ALI 4.608



Advanced diagnosis & correction of soft foot

Besides the two most common types of soft foot previously discussed (page 4-29)—parallel and angular soft foot—a number of other problems may cause excessive soft foot readings:

If ROTALIGN measures a soft foot, but feeler gauges cannot be inserted beneath the foot, there may be rust or dirt beneath the foot: This type of "spongy" foreign matter can expand when the foot bolt is loosened so that ROTALIGN reads a soft foot, yet still keep a feeler gauge from being inserted. Correct the situation by using a power wire brush to clean the undersides of the machine feet and the base, and replace any damaged shims. Take care to completely remove all dust and dirt from the top and sides of the feet as well to prevent recontamination, and limit the number of shims beneath any one foot to 4.

External forces, such as those exerted by attached piping, supports, couplings or other machine parts, may induce soft foot readings until the shaft alignment is improved. This may be checked by removing the suspected source of strain, then taking a second set of readings for comparison.

Sometimes ROTALIGN will register little or no soft foot, yet feeler gauge measurements indicate quite a substantial gap beneath the machine feet. This can occur if either the base or machine feet bend without bending the machine housing (for example due to underdimensioning or damage). As a result, shimming corrections may not bring the expected improvement, but often satisfactory alignment may still be achieved, even without filling the foot gap beforehand. So long as the ROTALIGN shows no soft foot reading when the foot bolts are tightened or loosened, the shaft is not moving, so no harm can occur to the rotor, bearings or coupling.

In some cases, the ROTALIGN soft foot function registers shaft deflections which are actually caused by irregularities of the individual feet. The only way to check the contact of each foot to the machine base is to use feeler gauges at the corners of the feet. These readings may then be considered in combination with the ROTALIGN soft foot results as illustrated by the examples on the following pages.

Soft foot examples

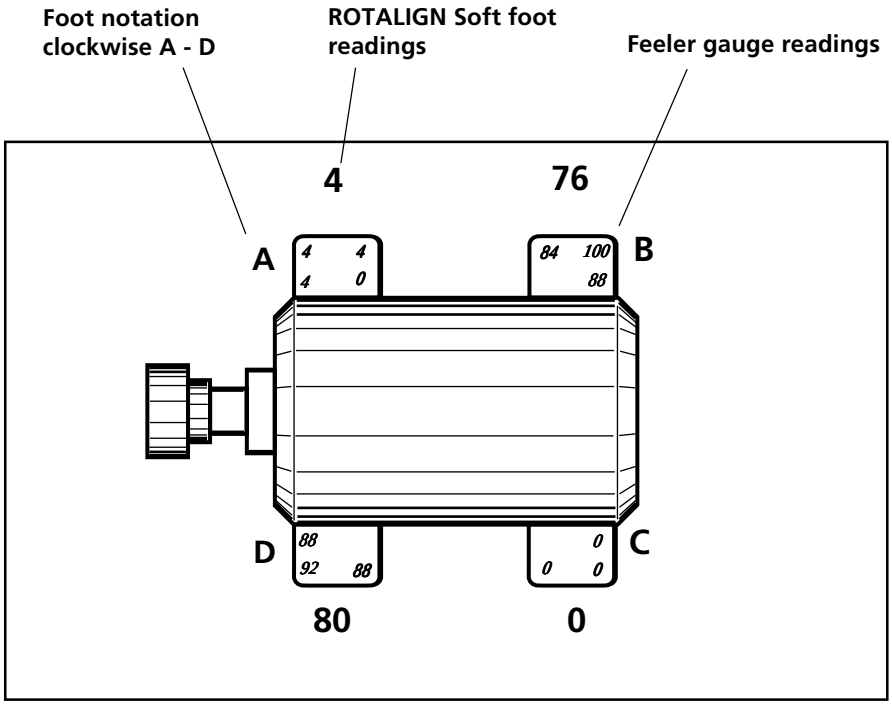
The following notation is used for these examples:

- The feet are shown oversize outside of the machine outline.
- ROTALIGN readings are outside the feet.
- Feeler gauge readings are inside the feet.
- Blank spaces mean the reading is not available.
- Feet are named clockwise A to D

For maximum accuracy during soft foot measurement (and especially when coupling play is present), the shafts should be rotated so that the sensors are oriented vertically (12:00 - 6:00 direction).

Note

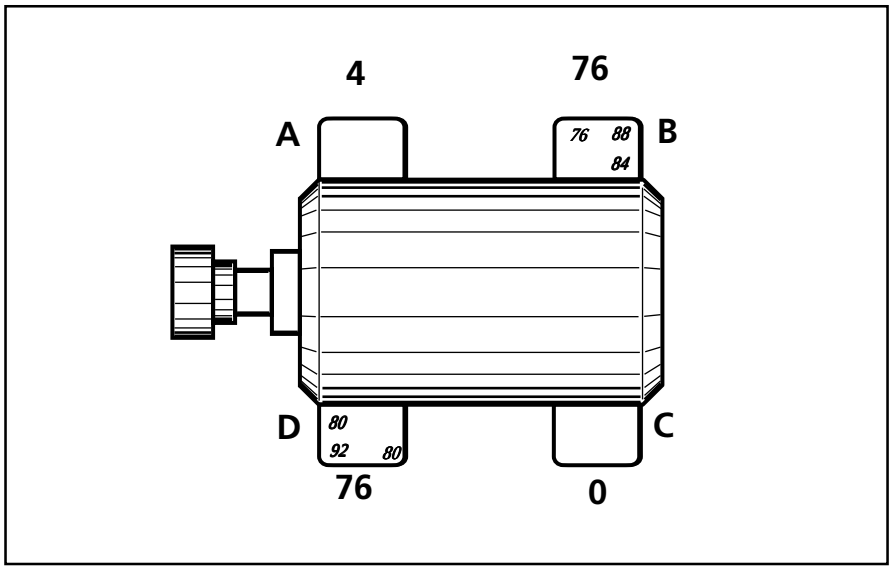
Example 1



ROTALIGN readings show near perfect rock, tempting the inexperienced aligner to shim feet B and D. In this case, that would be a mistake. The 4/100 mm difference diagonally, with near zero readings on the other diagonal, prompts feeler gauge examination of feet B and D. The feeler gauge results show very similar average gaps between feet B and D, but one is plainly sloped while the other is nearly flat.

Conclusion: shim only foot D 88/100 mm and recheck all four feet.

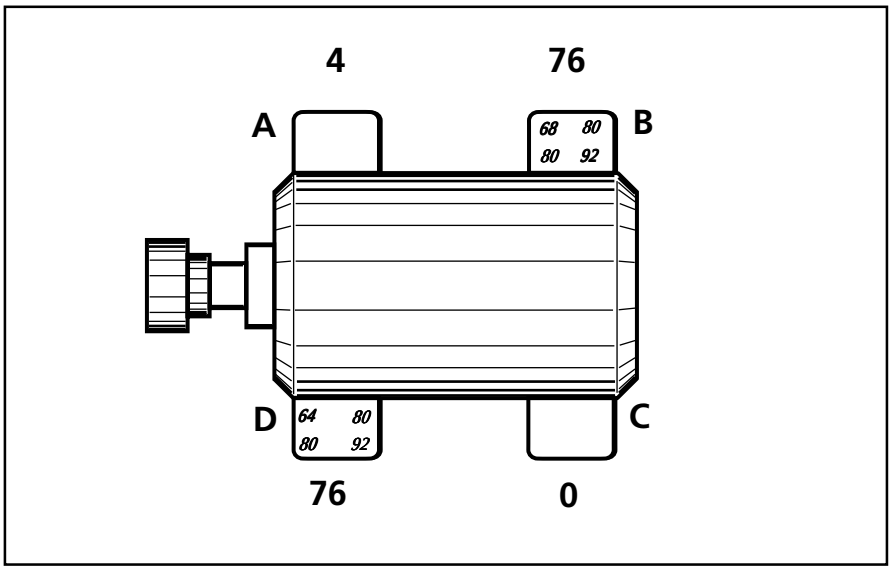
Example 2



Identical and opposing ROTALIGN readings prompt feeler gauge examination of feet B and D. Feeler gauges indicate equal rock from one foot to another. Feet B and D are equally out of plane with feet A and C. The inside feeler gauge readings were left out of this example because they are often impossible to take in the field.

Conclusion: Shim both feet B and D about 50-60% of the feeler gauge amount and recheck all four feet.

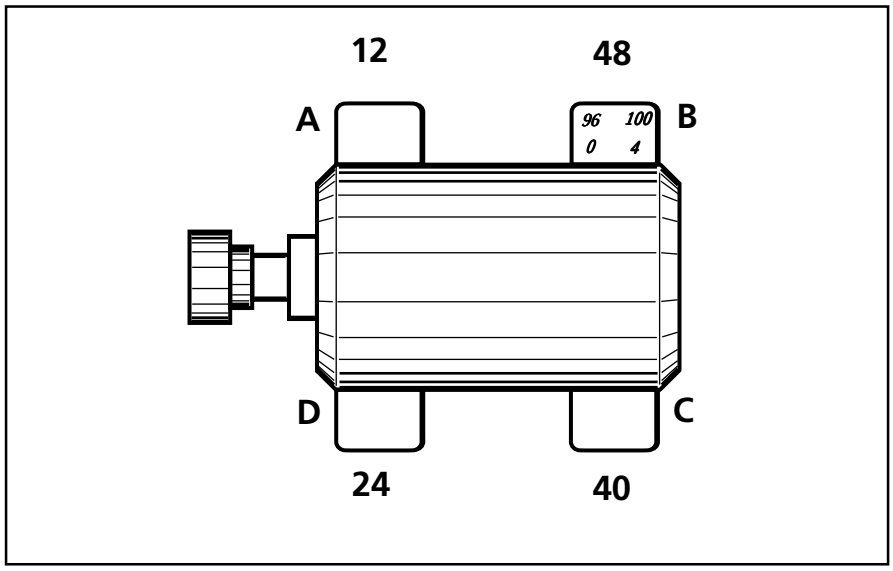
Example 3



Identical ROTALIGN readings to example 2. Feeler gauge are used to examine feet B and D. Feeler gauges indicate equal rock, but definite slope from foot C to foot A. This suggests that foot C is out of plane relative to feet A, B and D.

Conclusion: remove 80/100 mm from foot C (or add 80/100 mm to feet A, B and D). Then recheck all four feet.

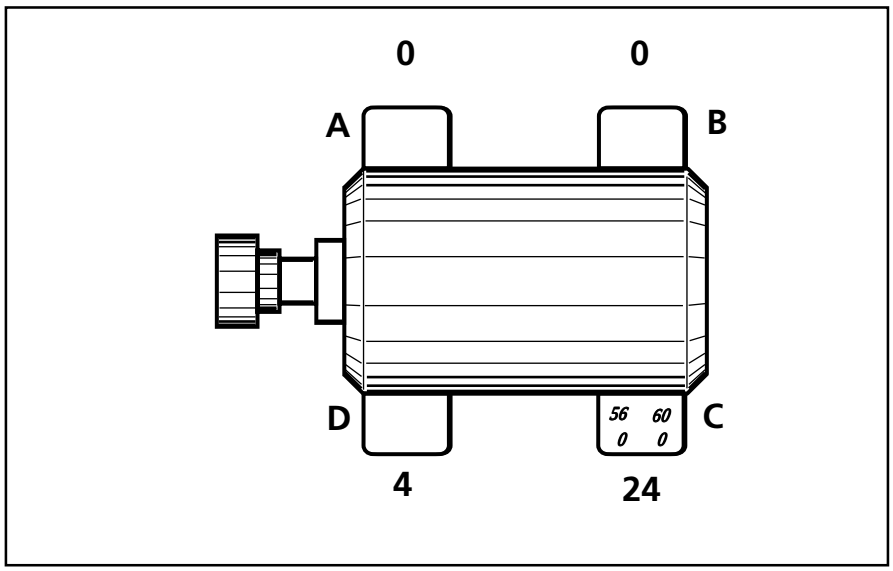
Example 4



One foot having high ROTALIGN readings prompts feeler gauge examination of foot B. The feeler gauge readings show a clearly defined bent foot. It is possible that all of the other readings are being induced by the bend in foot B.

Conclusion: step shim 0-1 mm at foot B and recheck all four feet.

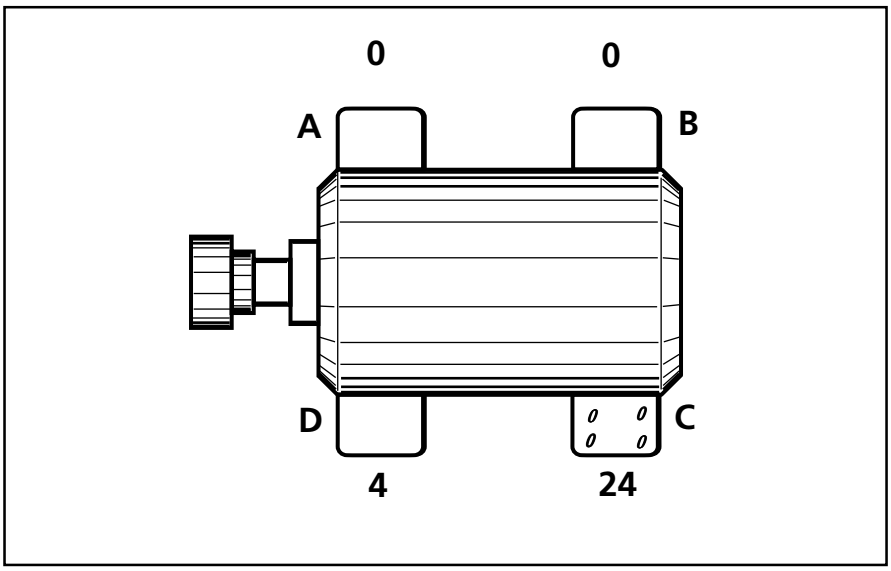
Example 5



Feeler gauge readings are taken to examine the foot with the high ROTALIGN reading, and a bent foot is found. It is possible that other feet have problems which are being masked by foot C.

Conclusion: step shim 0-60/100 mm at foot C and recheck all four feet.

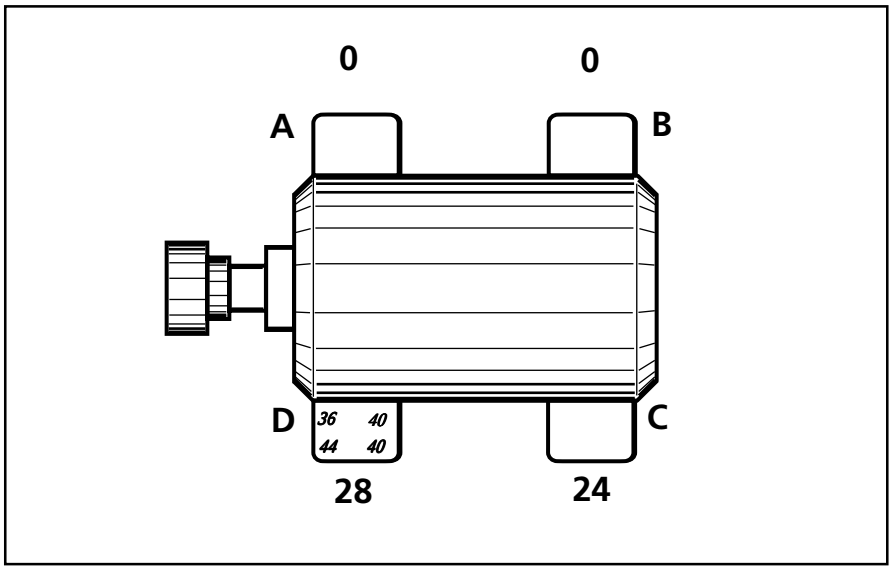
Example 6



Feeler gauges are used to examine the foot with the largest ROTALIGN reading, but no gap is found.

Conclusion: "squishy foot:" do not add or remove shims, rather eliminate the cause of the spring action. Recheck all four feet.

Example 7



Two large ROTALIGN readings on one side with opposite side near zero cause suspicions of induced soft foot. Feeler gauge readings are taken at foot D (with the largest ROTALIGN value). Presence of parallel gap at foot D supports these suspicions. Presence of parallel gap at foot C as well would prove induced soft foot.

Conclusion: relieve external forces (probably caused by horizontal offset misalignment or by pipe strain).

Summary

When eliminating soft foot follow these steps:

1. Check all four feet of one machine with ROTALIGN. If any of the feet shows a soft foot reading over 8/100 mm (or 2 mils), proceed with step 2, otherwise go to step 5.
2. Examine the largest (or two largest, if the same) soft foot with feeler gauges to determine the type of soft foot. It never hurts to examine the other feet as well, but concentrate on finding and fixing the largest single problem.
3. Correct the condition diagnosed, usually by shimming only one foot, if any.
4. Go to step 1.
5. If both machines have been checked for soft foot and are within tolerances, perform final alignment.

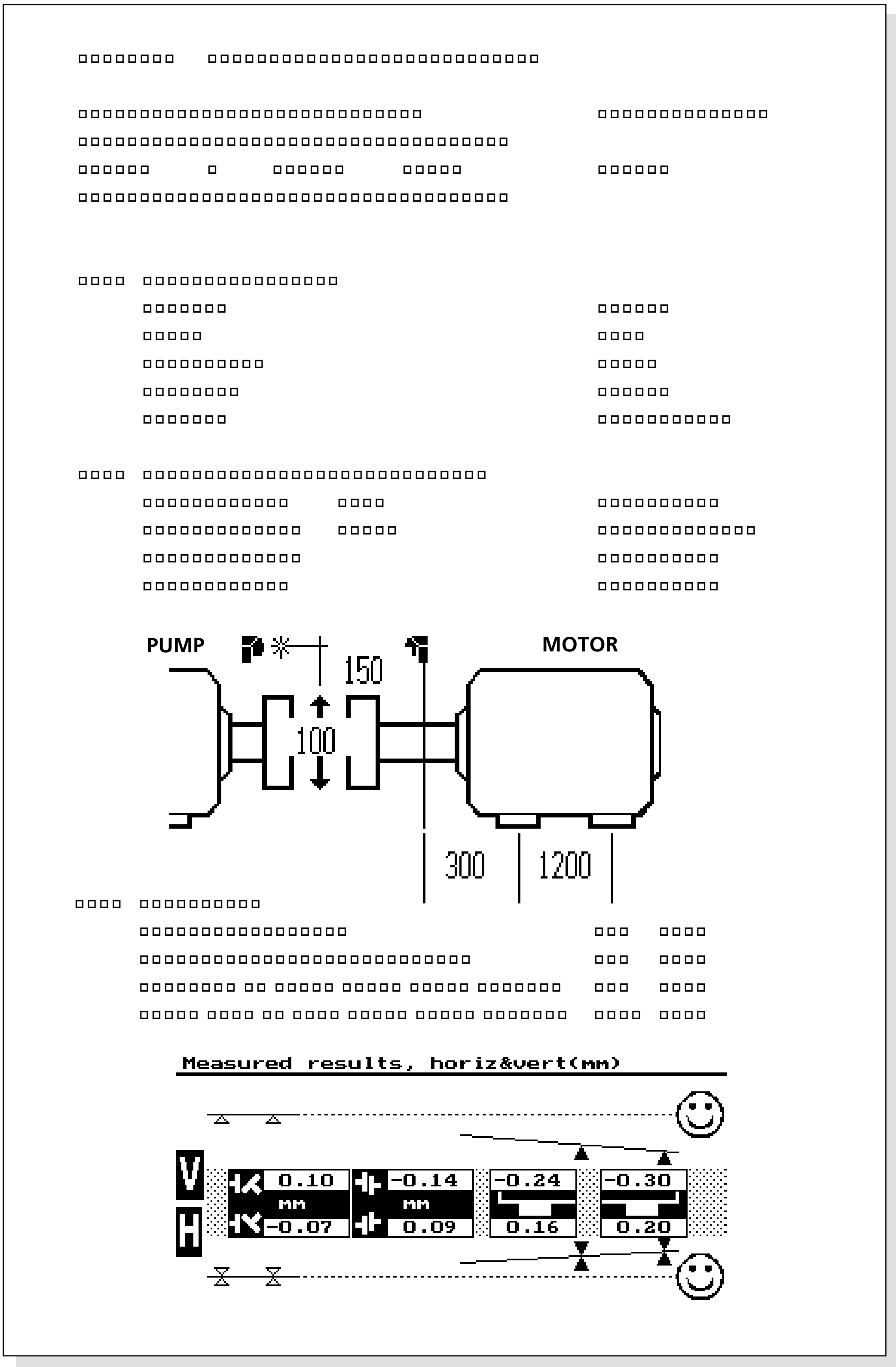
If the adjoining machine is not stationary (page 4-17) then it can also be checked for soft foot. Press the "L ? R" softkey and go to step 1.

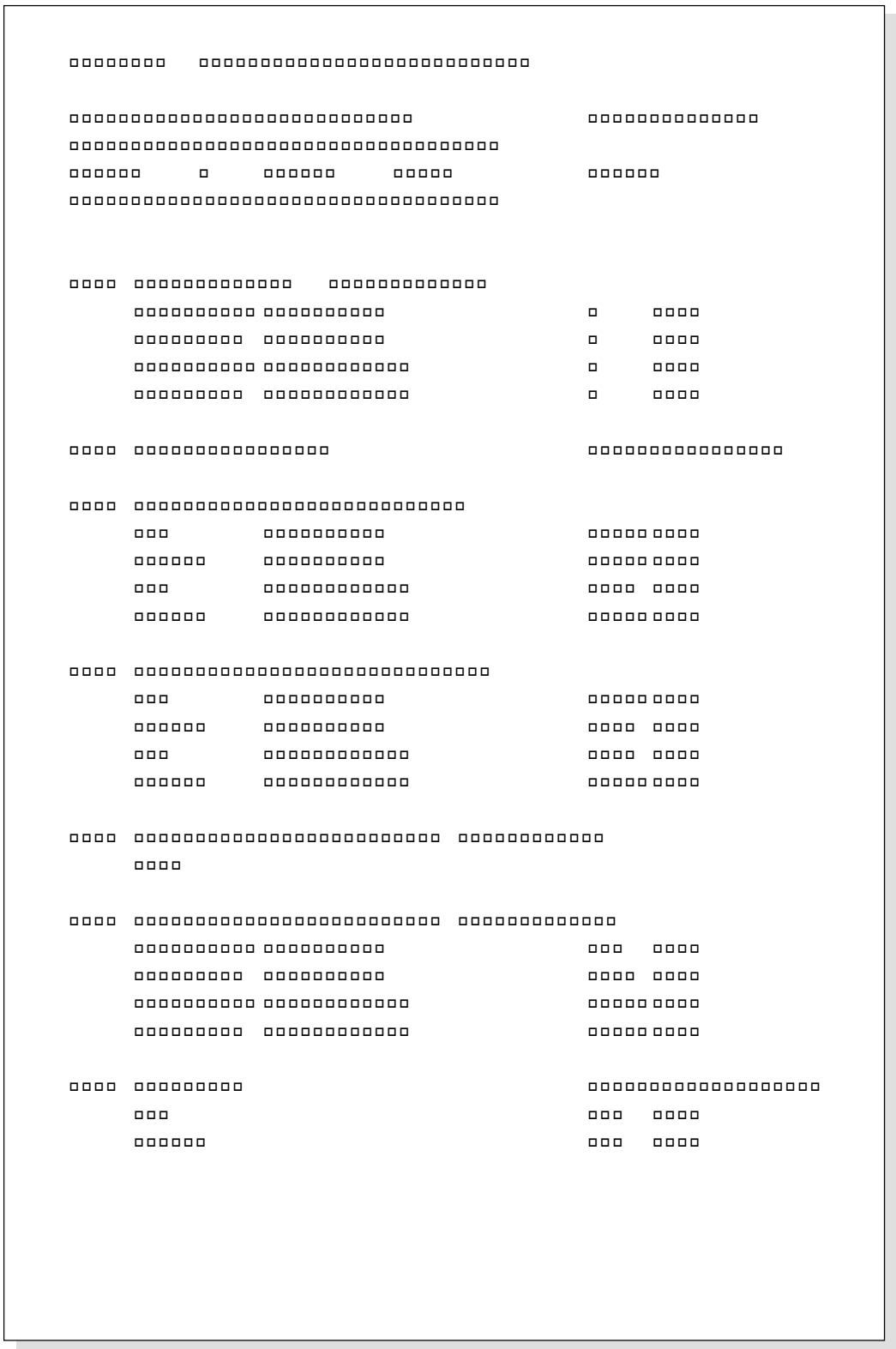

Note

Using the AVERAGE function while making soft foot corrections will improve accuracy (page 4-44).

Sample ROTALIGN Report

Here is an example of a ROTALIGN "graph report" (see page 3-6). The "print report" is identical but without the diagrams. Each report normally takes two pages.

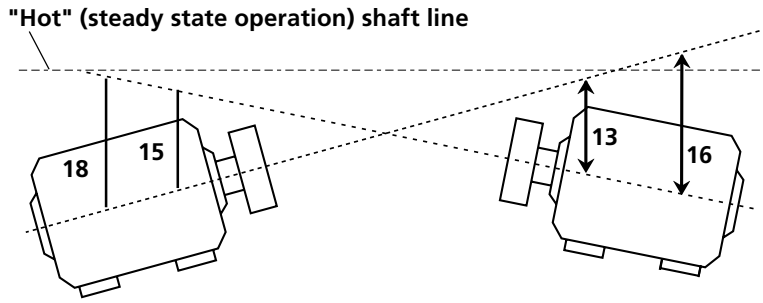




Practical examples of thermal growth entries

A general description of the thermal growth function is given on the following pages. Entered values reflect the expected amount of thermal growth at the individual machine feet.

Consider, for example, the following diagram of "cold" alignment condition, i.e. before the machines are started:

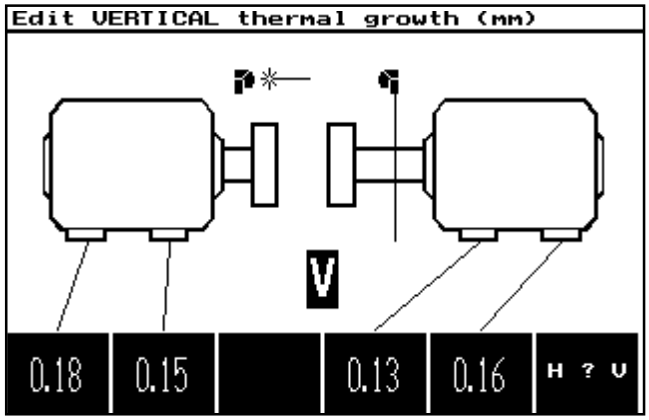


(All values are expressed here in 1/100 mm)

The individual values for entry into the ROTALIGN computer are simply read from the diagram: the distance between the "cold" shaft line to the "hot" shaft line is read for each machine foot. These amounts are entered via softkeys as follows into the thermal growth screen:

Sign convention:
+ Machine moves upwards as it warms up

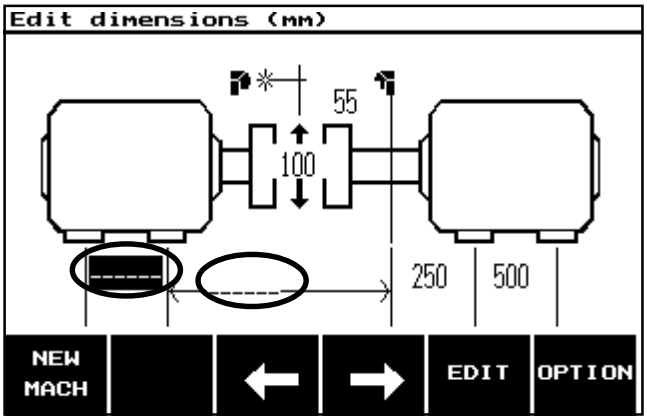
- Machine moves downwards as it warms up



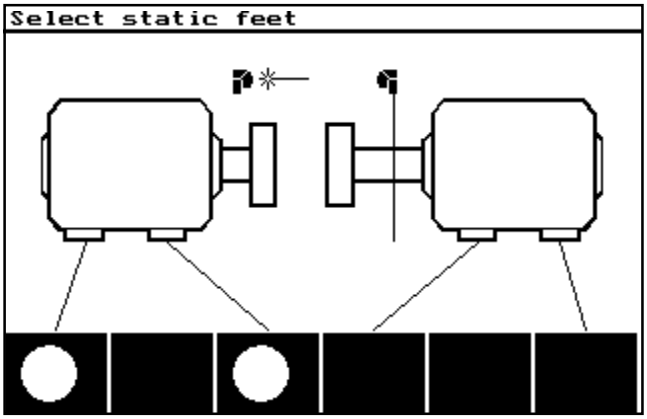
Thermal growth for stationary machine

If one of the machines cannot be moved during alignment, yet exhibits thermal growth, the following procedure is used:

The stationary machine is first defined under the ROTALIGN menu item "Machine type" to be a "normal 4-foot machine." The machine dimensions of foot separation and distance from front foot to receiver must then be entered into the dimension screen.



The menu item "static feet" is used next to designate the front and rear feet of the stationary machine as immovable.

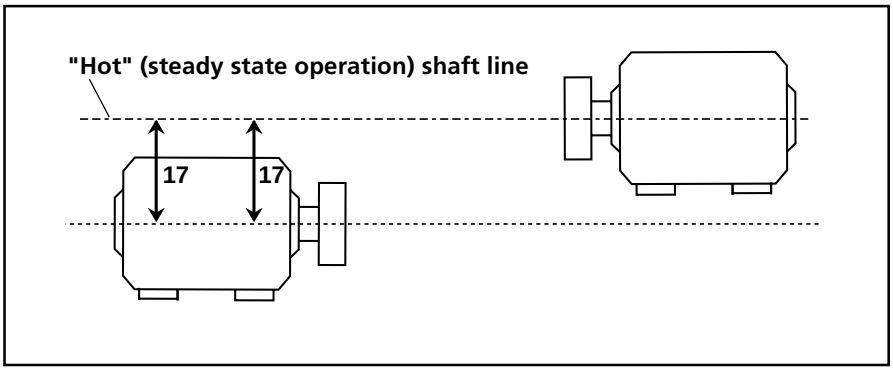


Expected thermal growth values for the stationary machine feet are then entered as usual (see bottom of previous page).

The computer calculates the alignment corrections such that only the moveable machine is adjusted to compensate for all thermal growth entries, including those made for the stationary machine.

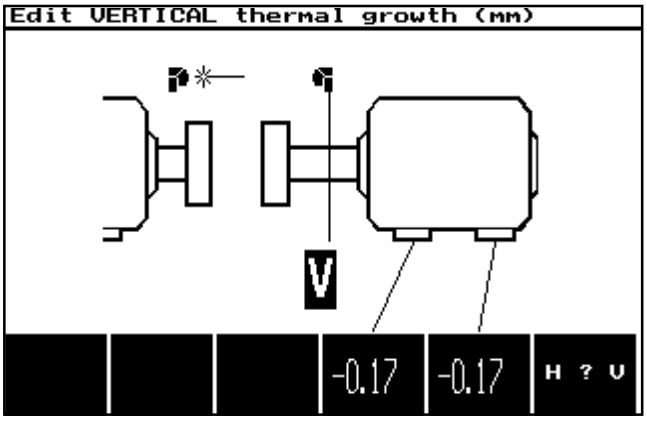
Special case: parallel growth

Pumps, in particular, often present the special situation in which they must be handled as stationary machines, yet exhibit thermal growth of a pure parallel nature (i.e. both front and back feet rise by the same amount as the machine warms up).



The motor (right) is unaffected by thermal growth, but must be positioned during "cold" alignment such that it compensates the expected parallel offset due to thermal growth of the pump.

Contrary to the standard procedure described on the previous page, the desired offset could also be attained in this special case by using the thermal growth function and entering a negative expected "growth" of -0.17 mm for both front and rear feet of the right machine; i.e. the motor on the right "sinks" by 17/100 mm relative to the pump on the left:



ROTALIGN® Technical data

Laser emitter

Laser	GaAlAs semiconductor laser
Wavelength	675 nm (typical)
Beam diameter	5 mm
Beam divergence	<0.3 mrad
Beam power	<1 mW
Laser safety class	Class 2; FDA 21CFR 1000 and 1040
Safety precautions	Do not look into laser beam.
Power supply	9 V block battery, IEC 6LR61 (alkaline or lithium)
Operating time, continuous	80 hours, depending upon battery type
Temperature range	0°C - 60°C / 32°F -140°F
Weight	approx. 165 g / 5.8 oz.

Laser receiver

Directions of 5-axis detector measurement	2 planes (4 displacement axes) 1 inclination 360° (angle to plumb)
Two detector areas	18 mm x 18 mm / 0.7 x 0.7 in. each; 10 x 10 mm / 0.4 x 0.4 in. linearized
Separation between measurement planes	Approx. 160 mm / 6 1/4"
Resolution	1 µm / 0.04 mil, angular 10 µRad
Error	<2%
Rotation angle measurement accuracy	better than 2° (fully automatic)
Measurement rate	approx. 20 Hz
Temperature range	0°C - 60°C / 32°F -140°F
Weight	approx. 190 g / 6.7 oz.

Laser emitter/receiver

Max. measurement separation between emitter and receiver	10 m / 33 ft.
Measurement stability	Ensured by temperature-stabilized light metal housing
Environmental protection	shockproof, waterproof, dustproof (IP 67)
Protection from ambient light	yes
Dimensions, W x H x D	approx. 105 x 67 x 47 mm 4 1/8" x 2 5/8" x 1 7/8"

Computer

LCD screen	60 x 95 mm / 2 3/8" x 3 3/4", 200 x 320 pixels, with contrast control
LED indicators	Main battery low, auxiliary battery low, battery charging, "sleep" mode
Power conservation	"Sleep" mode blanks screen, interrupts measurement after user-defined period of nonuse; automatic shutoff after a further defined period.
Keyboard	6 variable-function keys (softkeys) 20 fixed-function keys (hard keys)
External interface	Parallel printer interface (Centronics) and RS232C (serial)
Memory	Nonvolatile, up to 99 measurement sets with labels, comments etc.
Power supply	6x 1.5 V (IEC LR 14) Size "C" (alkaline standard, NiCad rechargeable optional) Optional: Lead-acid block battery rechargeable by computer Optional: ALI 3.576 mains adapter for 110V/220V (switchable), output 400 mA min. at 12 V ± 5%
Auxiliary battery	9V block (IEC 6LR61), provides 20 - 40 min. operation
Backup battery	Lithium (laser welded type), maintains memory for 5 years
Operating time, computer/receiver*	50 hours (alkaline batteries) 25 hours (NiCad batteries) 9 hours (lead-acid battery pack)
Environmental protection	waterproof, dustproof, shockproof (IP 67)
Operating temperature	0° C - 45° C / 32° F - 113° F
Dimensions, W x H x D	Approx. 210 x 240 x 70 mm 8 1/4" x 9 1/2" x 2 3/4"
Weight with battery	Approx. 1.75 kg / 3.8 lb.

Carrying case

Standard	ABS, drop tested / 2 m / 6 1/2 ft.
Optional	Aluminum shell Both cases feature 2 key locks and 1 combination lock.
Case dimensions, W x H x D	Approx. 550 x 380 x 205 mm 21 5/8" x 15" x 8 1/8"
Weight, including all standard parts	Approx. 11.2 kg / 24 lb.

Options

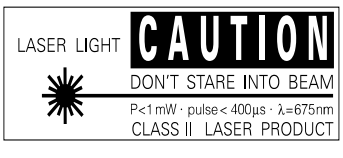
Noncontact IR data transmission from receiver to computer

Max. range	Approx 8 m / 26 ft. depending upon surrounding conditions.
Intrinsic safety 	EEx ib IIC T4; approx. U.S. equivalent: NEC Article 500-4, Class 1, Division 1, groups D,C,B,A and special safeguards T4

ROTALIGN® Commander 2.0x PC software ALI 3.591SET lets you:

- Back up and restore machine alignment files under Microsoft Windows®
- Configure machine arrangements, enter dimensions and file information on a PC then upload the files to the ROTALIGN
- Issue alignment reports
- Display ROTALIGN® screens
- View 5 alignment measurements as a 6-machine train

Includes PC software, manual, serial interface cable and adapter.



*Based upon an operating cycle of 25% measurement, 25% computation and 50% "sleep" mode.

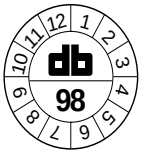
Warranty, service and care

ROTALIGN is a precision measurement instrument which should be handled as such. When not in use, it should always be stored in its protective carrying case.

Warranty

The ROTALIGN laser diode is guaranteed for two years. All other system components are covered by a one-year warranty. Please note that any attempt to service the components by unauthorized personnel will render all warranty coverage void.

Service and care



Although the ROTALIGN system is essentially maintenance-free, the following points should be observed: The calibration accuracy of the system should be checked every two years as indicated by the colored label (shown at left) located on the back of the receiver housing. Please return ROTALIGN to your authorized PRÜFTECHNIK distributor for calibration checking.

All optical surfaces (laser aperture, receiver lens) must be kept clean. Use the ALI 2.905 cleaning set or a fine dusting brush such as that normally used to clean other optical devices; avoid vigorous polishing to preserve the anti-reflective coatings of the glass elements. The computer housing may be wiped clean using a soft cloth dampened with a mild, nonabrasive detergent.

If any problems are encountered during use, consult the troubleshooting guide on page 6-11 for help in locating and correcting the problem. If the problem still cannot be resolved, then contact your PRÜFTECHNIK AG representative for further assistance.

Only original PRÜFTECHNIK replacement parts must be used.

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PRÜFTECHNIK Alignment
P.O. Box 12 63
85730 Ismaning
www.pruftechnik.com
Tel. +49 (0)89-99616-0
Fax +49 (0)89-99616-200
eMail: info@pruftechnik.com

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