

# ROTALIGN® PRO

## System

### Operating Instructions

#### Overview:

##### Part 1

ROTALIGN® PRO  
System operating instructions

##### Part 2

ROTALIGN® PRO  
Shaft alignment  
operating instructions

##### Part 3

ROTALIGN® PRO  
Straightness & flatness  
operating instructions

##### Part 4

BORALIGN®  
Operating instructions

#### Dear Customer,

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



Edition May 2003  
ALI 9.645G

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## Foreword

Congratulations! And thank you for your decision to entrust the progressive, professional ROTALIGN PRO system with your precision shaft alignment.

**Progressive:** Well over a decade of leadership in laser-optical shaft alignment has given PRÜFTECHNIK AG the know-how to provide you with the very latest technological advantages in easy-to-use form.

**Professional:** Field-tested functionality is the result of continuous improvement thanks to input from thousands of alignment specialists worldwide. ROTALIGN PRO is designed to give you the practical features you need for everyday alignment, yet lets you handle special situations with ease.

ROTALIGN PRO builds upon the successful ROTALIGN alignment system with many powerful new features:

- Machine train alignment of up to six elements
- Enhanced soft foot diagnostic function
- Machine templates, including dimensions, alignment targets, coupling type, etc.
- Straightness measurement (optional)
- Enhanced alignment history function provides step-by-step traceability of alignment job
- Cardan shaft alignment with special mounting bracket
- High-capacity 4 MB data storage card
- Computation of thermal growth based upon material coefficient of expansion and machine geometry
- Two-level tolerance tables

Of course, the new ROTALIGN PRO also includes the proven advantages of ROTALIGN:

- Convenient operation thanks to user guidance in display, graphic operating elements and on-screen softkey labels
- Rugged industrial components (IP65/67)
- Connections for printer and PC
- Ability to handle special machine characteristics such as flange-mounted machines, V-shaped foundations, coupling types, etc.
- Hard-copy alignment reports
- Power-saving functions for automatic 'sleep' and shutoff
- Different measurement procedures for different tasks, such as uncoupled shafts or entry of dial indicator values
- Compensation for thermal growth values entered either directly at the coupling or as expected growth at machine feet
- Alignment of vertical machines

Please let us know of your ideas and suggestions for development – by mail, fax or over the Internet at [www.pruftechnik.com](http://www.pruftechnik.com). As always, we will be more than happy to include them in future product versions!

**Contents**

This manual covers all general aspects of ROTALIGN PRO system hardware, including basic operating procedures for the computer. All application-specific instructions and hardware descriptions can be found the manuals for shaft alignment (ALI 9.646G) and straightness measurement (ALI 9.648G).

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## Chapter 1: Introduction

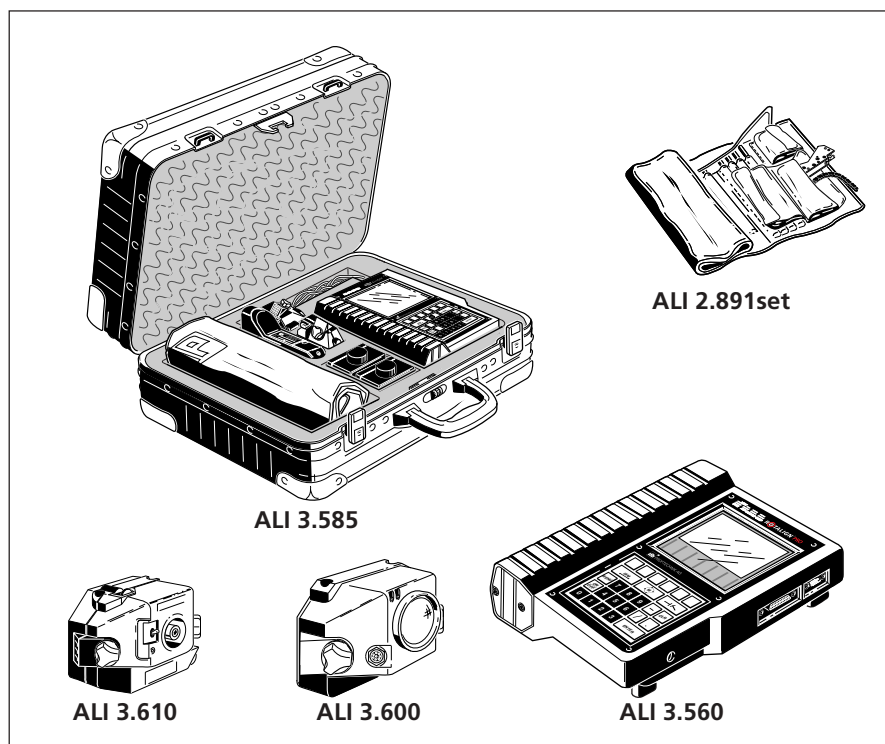
### The ROTALIGN PRO package

**ALI 3.501**



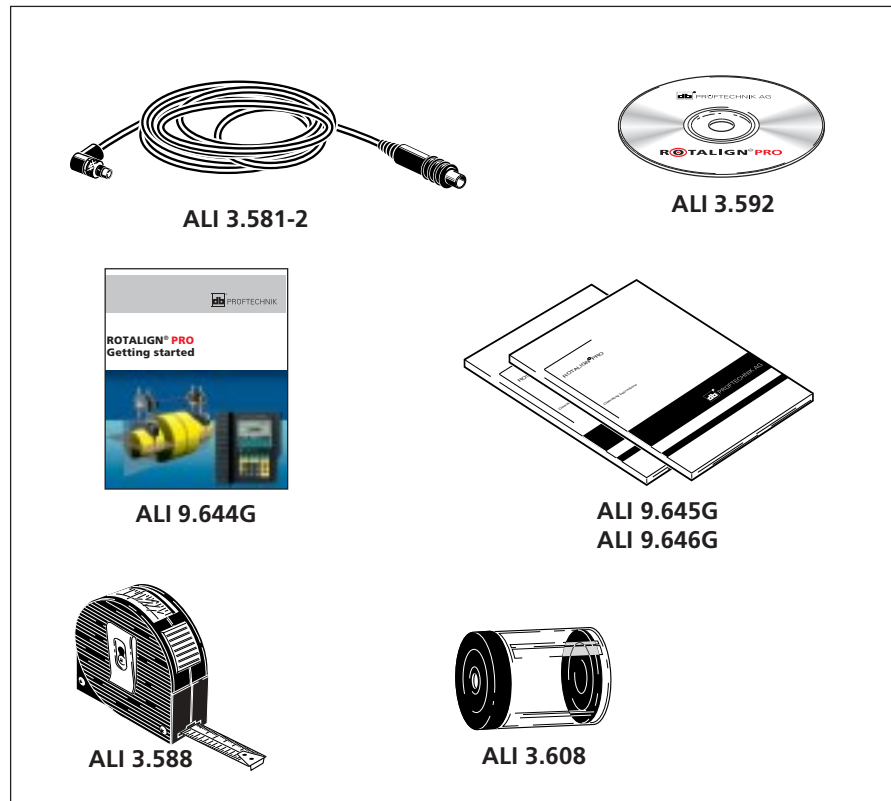
**ALI 3.501EX\***

\*Intrinsically safe version  
(see also page 1-10)



The ROTALIGN package contains the following items:

- ALI 3.585 ROTALIGN Case (ABS, black)**  
with key and combination locks (page 4-4).
- ALI 3.560 ROTALIGN PRO Computer**  
Processes alignment measurements and displays results. Battery or mains operated (page 2-2).
- ALI 3.610 ROTALIGN Laser**  
incl. dust cap, incl. 9 V battery; mounted on left side of machine coupling (page 2-12)
- ALI 3.600 ROTALIGN Receiver**  
incl. dust cap Mounted on right side of coupling and connected to computer (page 2-14).
- ALI 2.891set Compact chain-type bracket set in pouch**  
Mounts the components on the shafts (page 2-16).



Not shown:

- ALI 2.800 1.5V battery (6 pcs.)
- 90109 9V battery
- ALI 2.905 Optics cleaning cloth,
- 0 0739 1055 Allen wrench, 2.5 mm,  
for battery compartment

- ALI 3.581-2** **ROTALIGN Receiver cable 2 m (6½ ft.)**  
Connects receiver to computer (page 2-11).
- ALI 9.644G** **ROTALIGN PRO Getting Started**  
short instructions
- ALI 9.645G** **ROTALIGN PRO system instructions (Part 1)**  
system components and basic operation
- ALI 9.646G** **ROTALIGN PRO**  
**shaft alignment instructions (Part 2)**
- ALI 3.592** **ROTALIGN PRO Commander**  
demonstration version (without license)
- ALI 3.608** **Adjustment tube**  
for centering laser beam (page 2-15)
- ALI 3.588** **Tape measure, mm/inch**

More accessories can be found on pages 4-5 to 4-14. Contact your PRÜFTECHNIK AG distributor for pricing and further details.

## **Before you start!**

### **About this manual**

This first portion of the ROTALIGN PRO manual is complemented by the shaft alignment instruction manual (Part 2, ALI 9.646G) and the straightness measurement instruction manual (Part 3, ALI 9.648G). This manual contains a complete description of the ROTALIGN PRO alignment system:

1. Introduction (safety and operating notes)
2. Description of main components
3. Configuration and data handling procedures
4. Appendix (technical data, troubleshooting, accessories, etc.)

Details on operating the different measurement programs can be found in the corresponding manuals, Parts 2 and 3 mentioned above.

### **Everyone**

Please acquaint yourself first with the operating and safety notes given on page 1-9.

### **Beginners**

Read through the sections on the ROTALIGN PRO components (Chapter 2) and on alignment theory and practice (Part 2, page 5-1). Then try an actual alignment by following the shaft alignment instruction manual (Part 2, ALI 9.646G).

### **Experts**

Observe the new procedures described in the system configuration and data handling sections (Chapter 3). Follow the guidance messages that appear on screen.

### Safety and operating information

This section contains the most important information regarding the safe operation of the ROTALIGN PRO 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 PRO.



**WARNING!**

This symbol warns of potential hazards.



**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 PRO.

#### Intended use

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

PRÜFTECHNIK AG 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 PRO fulfill the EC Guidelines for electric devices (73/23/EWG) and electromagnetic compatibility (EMC) (89/336/EWG), provided that data transmission from the receiver to the computer occurs by means of cable ALI 3.581-2 or wireless IR interface ALI 4.608. ROTALIGN PRO has been tested in accordance with the following harmonized EU standards for electromagnetic compatibility.

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



## Safety notes

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

### General

- Before starting up the machines, all ROTALIGN PRO 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 receiver, 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.
- Ensure that the laser and receiver brackets fit solidly onto their mounting surfaces.
- The specified system accuracy is applicable when the components are mounted with PRÜFTECHNIK-supplied brackets. Do not use self-constructed mounting brackets or modify the original bracket configuration.
- Repairs of the ROTALIGN PRO 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 PRO, its components and the operating procedures described herein shall render all warranty coverage void.



**WARNING!**



**ATTENTION**

### Intrinsically safe version

ROTALIGN PRO 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.



**Notes for intrinsically safe models**

In addition to the general notes described on page 1-9, the following notes must strictly be observed when working in explosive atmospheres.

**WARNING!**

When equipment to be aligned is located in an explosive environment, the intrinsically safe ROTALIGN PRO EX (ALI 3.501 EX) must be used. This portable alignment instrument comprises of the ROTALIGN PRO computer (ALI 3.560 EX), the laser (ALI 3.610 EX) and the receiver (ALI 3.600 EX), and is used in the preventive maintenance of rotating machines.

ROTALIGN PRO has been developed and manufactured in accordance with the following appropriate standards: EN 58160/196/197/390 (optical), EN 40050 (enclosure), EN 60825 (laser beam safety), EN 50014 1997 and EN 50020 1994 (potentially explosive atmospheres) as contained in the directive 94/9EC, EN 50081/82 (electromagnetic compatibility) and EN 29001 (quality assurance).

Batteries must be changed only outside the explosive area! Note that only alkali-manganese batteries can be used in explosive atmospheres. With the ROTALIGN PRO EX version, use six 1.5V C size IEC LR14 alkali-manganese batteries or an 8V lead acid battery as main supply. As auxiliary supply, use 9V block batteries from Varta, Duracell or Panasonic.

The ROTALIGN PRO plastic case (ALI 3.585) must not be taken into the hazardous area. Should it be taken into an explosive atmosphere, appropriate measures must be taken to prevent static electrification.

The circuit parameters meet the intrinsic safety requirements EEx ib IIC.

The maximum cable length between the ROTALIGN PRO computer socket and the receiver must not exceed 10 m.

The installation and operation of ROTALIGN PRO must be in accordance with the regulations in ElexV and equipment safety law as well as the general recognised rules of the technology. The instructions in this manual must also be observed.

The most current regulations regarding servicing, maintenance and testing, as they appear in ElexV § 13, EN 60079-14 and EN 60079-17 must be observed. The rules of the manufacturer as they appear in this manual must also be observed.

Typical equipment marking include the symbols shown on the left column.



**Laser safety**

The ROTALIGN PRO 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 PRO also fulfills British standard BS 4803 (Part 1 to Part 3) and European Industrial Standard IEC 825. The ROTALIGN PRO Class II laser operates at a wavelength of 675 nm, with a maximum pulse duration of <math><400 \mu\text{sec.}</math>, maximum radiant power of <math><1 \text{ mW}</math> and maximum radiant energy per pulse of <math>0.4 \mu\text{J}</math>. 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!\*

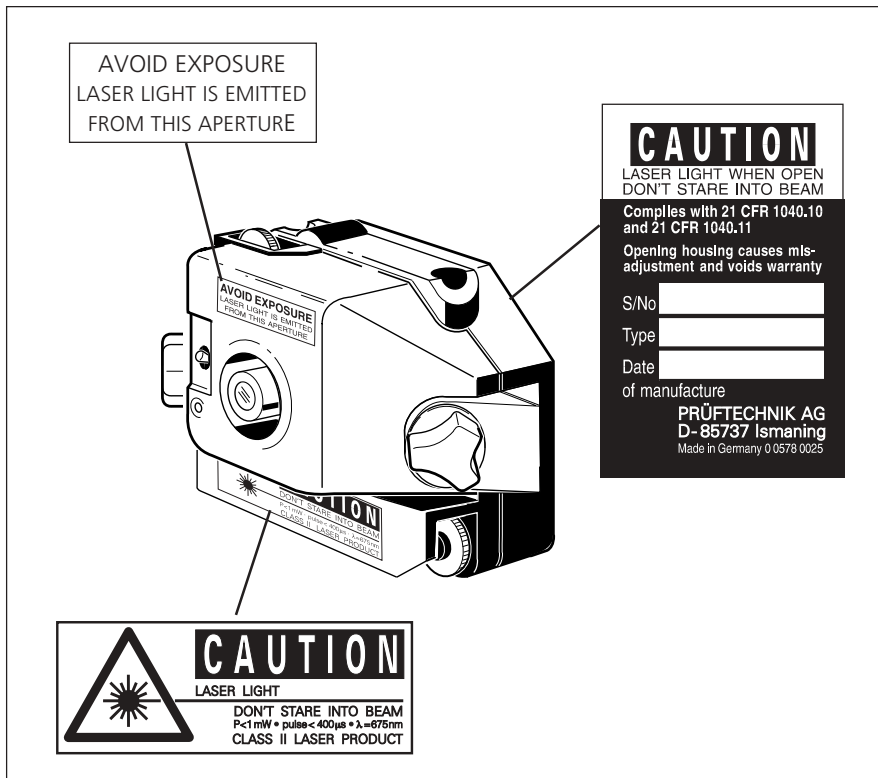
\*Since the FDA specification allows maximum exposure of 0.25 seconds, the natural blink reaction of the human eye is normally sufficient to avert any danger, provided that no optical instruments other than ordinary eyeglasses or contact lenses are used. Do not insert any other optical devices into the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



### Operating information

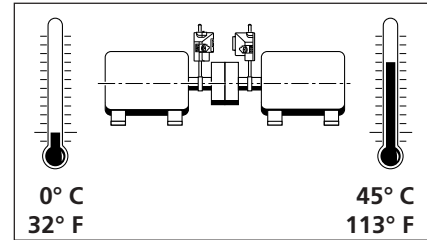
In order to ensure proper operation of the ROTALIGN PRO system, observe the following information:

#### Temperature range

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

Store your ROTALIGN PRO 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 PRO 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" and measurement stops.



#### 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 temperature fluctuations (e.g. resulting from sunlight), could result in erroneous measurements.



Note

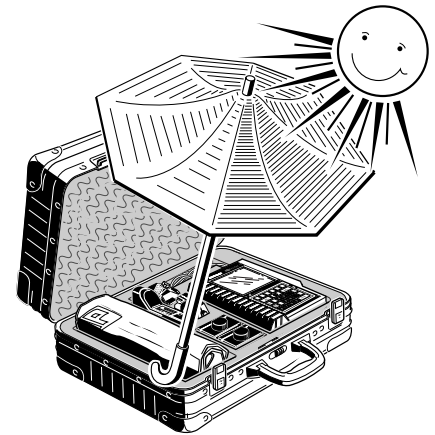
Allow adequate time for the ROTALIGN PRO and the components to reach the ambient temperature before use.

### Incident light and other sources of interference

Avoid exposing the ROTALIGN PRO 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 (cellular telephones, for example) 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, do not use self-constructed mounting brackets or extensions and do not modify the mounting brackets supplied by PRÜFTECHNIK AG. Use only the support post lengths recommended for the application at hand.

### Measurement distance

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

### Dust and water seals

The ROTALIGN PRO computer is water spray resistant and dustproof (IP65). The laser and receiver are waterproof and dustproof 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 that, as with most water-resistant products, seals must be periodically checked and renewed if necessary. This can be carried out during ROTALIGN PRO service and recalibration which should be carried out every two years. During this service, the water-absorbent chemicals inside the component housings, which reduce possible condensation on the optics and the electronics, are also replaced.

### Interfaces

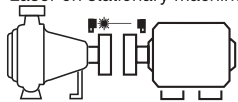


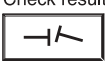
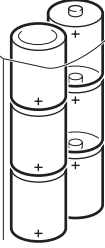

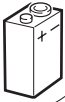


The ROTALIGN PRO unit is fitted with a serial and a parallel interface for data exchange with a PC or connection to a printer. An interface for the receiver as well as a connection for the mains supply are also located on the unit. Additional information is included in the device description on page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

### Battery disposal

Please dispose of used batteries in an environmentally acceptable manner.

**Nameplate and quick reference (rear view)**

**Nameplate and quick reference (rear view)**

<b>RS 232C/SERIAL</b>	<p><b>Quick check alignment, step by step</b></p> <p><b>1.</b> Mount system components Laser on stationary machine</p>  <p><b>2.</b> Enter machine dimensions</p>  <p><b>3.</b> Rotate shafts and take readings</p>  <p><b>4.</b> Check results</p>  <p>See manual for complete operating instructions.</p>	<p><b>A</b> MAIN BATT 6x 1,5V Size "C" IEC LR 14</p>  <p>or</p> <p><b>B</b> MAIN BATT rechargeable battery</p>  <p>AUX BATT 1x 9V IEC 6 LR 61</p> 
	<p><b>PARALLELE</b></p> <p> To be opened only by authorized service personnel. Observe ESD precautions for handling! Opening housing voids warranty.</p>	
<b>CHARGER</b>	<p>DC IN  + 12 Volt <math>\pm</math> 5% 0,4 A min.</p> <p>Manufactured under one or more of the following U.S. patents: 4,991,965; 5,049,757; 5,026,998; 4,864,148; 4,725,738; 4,698,491; 5,430,539. Other international patents pending. Made in Germany.</p>	<p><b>ALI 3.560</b></p> <p><b>00100</b></p> <p>CE</p> <p>0 0452 0105</p>
	<p>PRÜFTECHNIK AG Oskar-Messter-Str. 19-21 D-85737 Ismaning</p>	

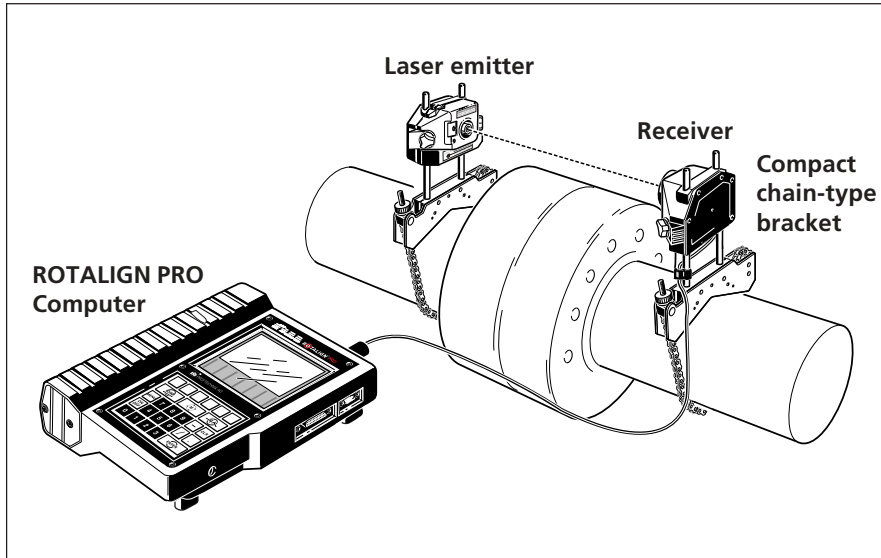


**Note**

The computer serial number (S/N) must not be confused with the firmware ID number which appears upon startup (page 3-1) and is used for firmware registration.

## Chapter 2: Description

### Overview



The ROTALIGN PRO laser alignment system:

#### BRACKETS

Used to mount the laser and receiver securely on the shaft on either side of the machine coupling.

#### LASER EMITTER

Fitted to the machine shaft on one side of the machine coupling, sends 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 PRO computer can also be connected to a PC with the ROTALIGN PRO Commander software (page 4-6).

\*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 PRO Computer **ALI 3.560**

The heart of the ROTALIGN PRO system is the ROTALIGN PRO 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.

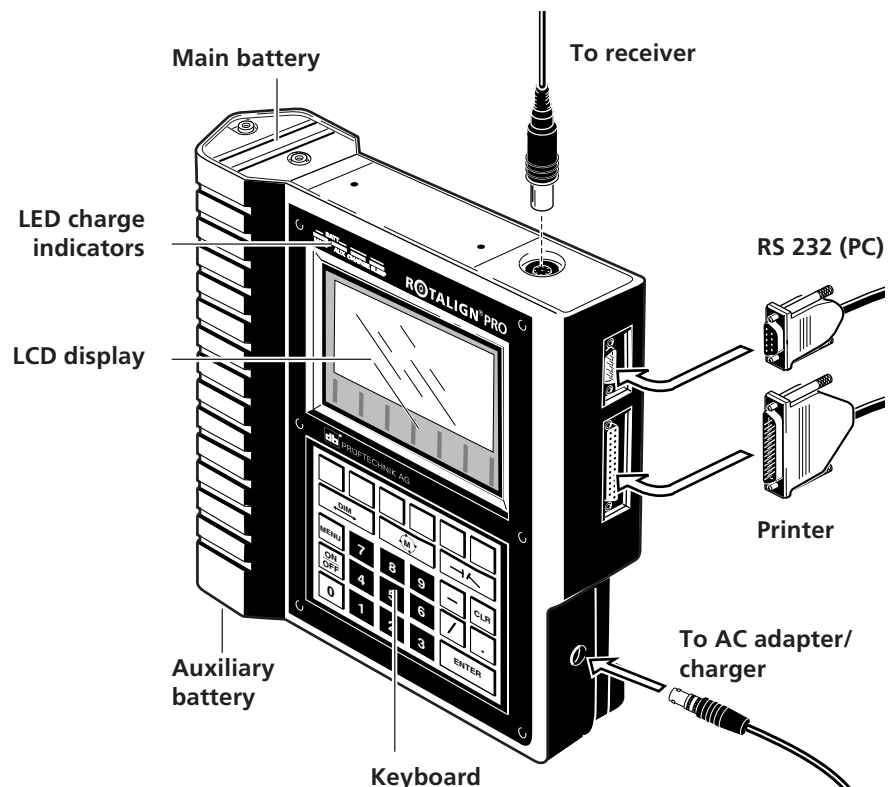
Measurement data pass directly via cable (or IR link, see page 4-9) from the receiver to the ROTALIGN PRO computer and are then used to calculate the alignment diagram. Numerous software functions allow the computer to handle a wide range of alignment situations.

### Notes on ROTALIGN PRO operation

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

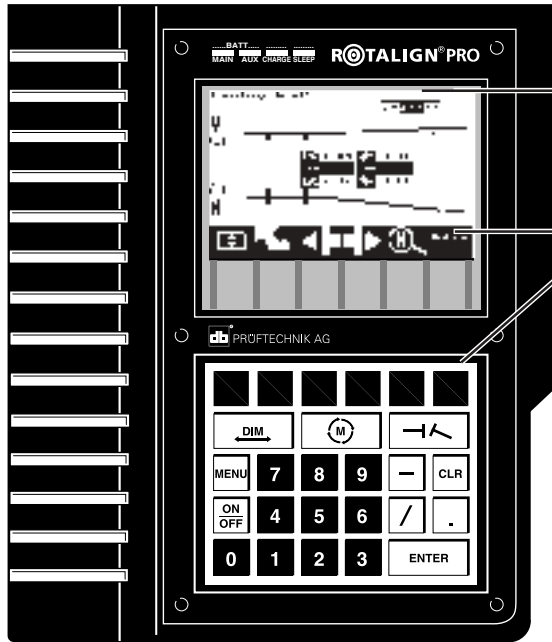
- The ROTALIGN PRO must not be operated with the housing open or removed.
- Only original spare parts and accessories must be used.
- The ROTALIGN PRO must only be operated by trained personnel.
- Any unauthorized modifications to the ROTALIGN PRO and its components shall render all warranty coverage null and void.
- When using the ROTALIGN PRO laser, adhere to all safety information regarding its safe operation (see page 1-9).

### Connections and operating elements





## The ROTALIGN PRO 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 screen context.



**DIMension key**  
Use this key to enter machine dimensions directly into the screen



**ON/OFF key**  
(See page 3-1)



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



**M = Measure**  
This key is used to enter the alignment measurement mode.



**Menu key**  
Offers a choice of procedures for setting up the computer and proceeding with different alignment situations (See pages 2-5, 3-1).



**Minus key**  
For entry of negative values



**Results key**  
Calls alignment result diagram into the display.



**Clear key**  
Deletes characters or numbers in a displayed value, deactivates a selected measurement point or deletes a machine



**Enter key**  
Confirms displayed value and proceeds to next value



**Slash key**  
For entry of fractions and for a printed copy of the screen



**Decimal point key**  
For entry of decimal fractions

## Basic operation

### Program overview



#### Program manager

- Applications
- Configuration
- Data handling (page 3-1)

(Straightness measurement optional)

\* Option: Straightness alignment



#### \* Select application

Press the softkey corresponding to the icon for the desired task. (Part 2, page 2-9)



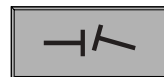
#### Set up machines and enter dimensions

(Part 2, page 2-10)



#### Adjust laser and start measurement

(Part 2, page 2-15)



#### Display results and align machines

(Part 2, page 2-18)

## General

The three main function keys 'DIM', 'M' and 'Results' are always active and can be pressed to reach the corresponding function from every step of the alignment procedure.



The 'MENU' key lets you return to the main menu:

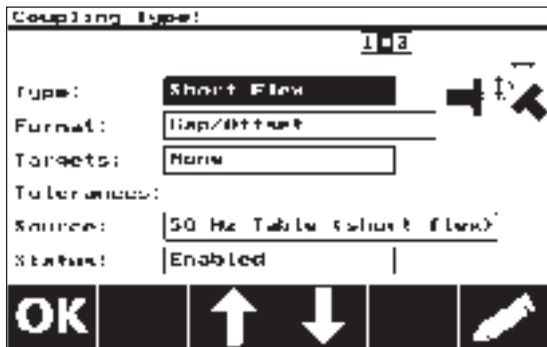
From the program manager (page 3-1), this takes you to the opening application selection screen. From an application already started, it takes you to a specific selection menu (Part 2, page 3-1).











If the program should ever fail to respond to the keyboard (e.g. if it 'crashes' due to external factors), it can be reset by pressing the following three keys at the same time:



## Entering information (example):



1. Select the desired parameter using the softkeys  and  ;
2. Open the selection/data entry window using the softkey  ;
3. Select the entry and change it as desired using the softkey  or  or the regular keyboard;
4. Confirm the changes and return to the previous screen by pressing  or  .

At any time, you may return to the previous screen without making any changes by pressing the softkey  .

## Batteries and power supply

Three different types of power supply may be used:

### Alkali-manganese batteries (6 pieces, page 2-7)

Six standard "C"-size (IEC LR 14) alkali-manganese batteries is the standard option as main battery power supply. These run for up to 50 hours.

### Mains power supply (page 4-7)

Optional AC adapter can be connected in situations where cordless operation is not needed (e.g. when downloading measurement data to an office PC) in order to save battery power.

### Lithium -Ion rechargeable battery (ALI 3.571)

Optional Li-Ion rechargeable battery can alternatively be used as main battery instead of the six "C"-size batteries. The battery can be left in place or removed from the instrument for charging. The battery requires 8-9 hours to fully charge. It is recommended to charge overnight. The operating time is typically 15 hours (25% active measurement, 25% standby, 50% 'sleep' mode). See page 4-7 for further details.



The Lithium-Ion battery is not certified for use in explosive environments. In such cases use only alkali-manganese batteries and these must only be changed outside the hazardous zone.

In explosive environments, the AUXILIARY BATTERY must be an alkali-manganese battery.

An auxiliary battery (9V, IEC 6LR61) backs up the main battery pack whenever its output voltage drops below 6V.

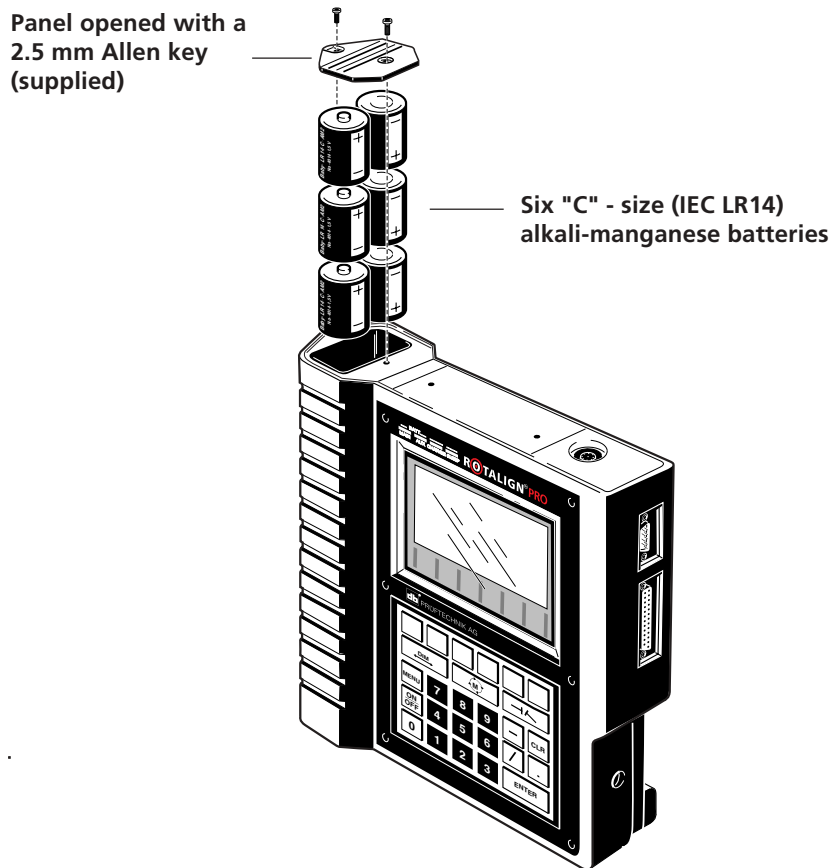
### Main battery

When the main battery becomes depleted, the red "MAIN" LED in the upper-left corner of the ROTALIGN PRO illuminates. The ROTALIGN PRO then begins drawing power from its auxiliary battery (page 2-8) and can operate for several more minutes to allow completion of the current alignment job with all measurement values being retained.



### Changing main batteries

Switch off the computer and open the main battery compartment. If replacing the "C" size batteries, replace all of them with new ones. Battery leakage is prevented by replacing the batteries as soon as they become depleted, or should the computer not be in use for an extended period of time then the batteries should be stored away.



- Damaged batteries must be removed from service.
- Rechargeable batteries contain corrosive alkali!  
If alkali leaks from a damaged battery onto skin or into the eyes, rinse immediately with plenty of water and consult a doctor.
- Keep batteries below 60°C / 140°F.
- Do not open or incinerate batteries.
- Do not short circuit the battery terminals.
- Recharging must occur at temperatures below 40°C / 104°F.
- Dispose of batteries only at authorized recycling facilities.



**WARNING!**



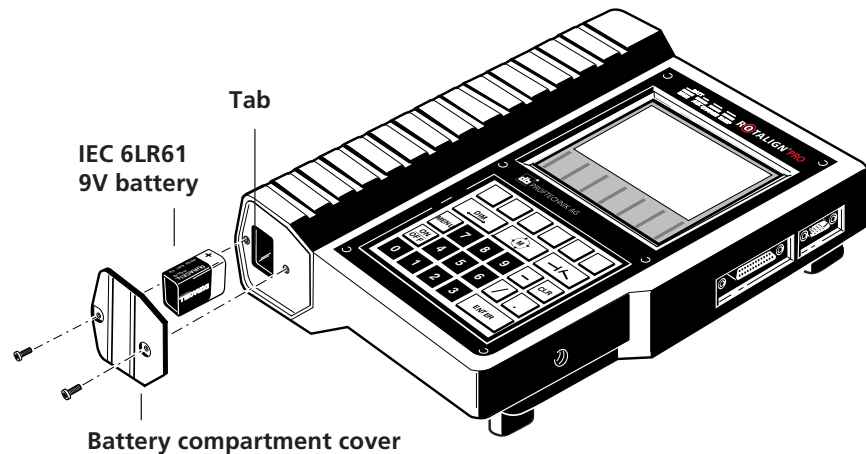
**Attention!**

### Auxiliary battery (AUX)

The auxiliary battery activates and stores current measurements whenever the main battery pack voltage drops below 6V and the 'MAIN' LED illuminates.

### Auxiliary battery replacement

1. Switch off the instrument.
2. Open the bottom battery compartment:  
Loosen screws with 2.5 mm hex key.
3. Pull out the black tab and remove auxiliary battery.
4. Insert new battery and close compartment.



INFO

The instrument switches itself off completely when neither the main battery nor the auxiliary battery can deliver sufficient voltage ( in this case  $>6V$  ).

The system clock and resume file back-up are maintained by a lithium battery when both main and auxiliary batteries are removed. The service life of the lithium battery is approximately five years with both main and auxiliary batteries removed.

Used batteries should be disposed of properly!

### Battery condition

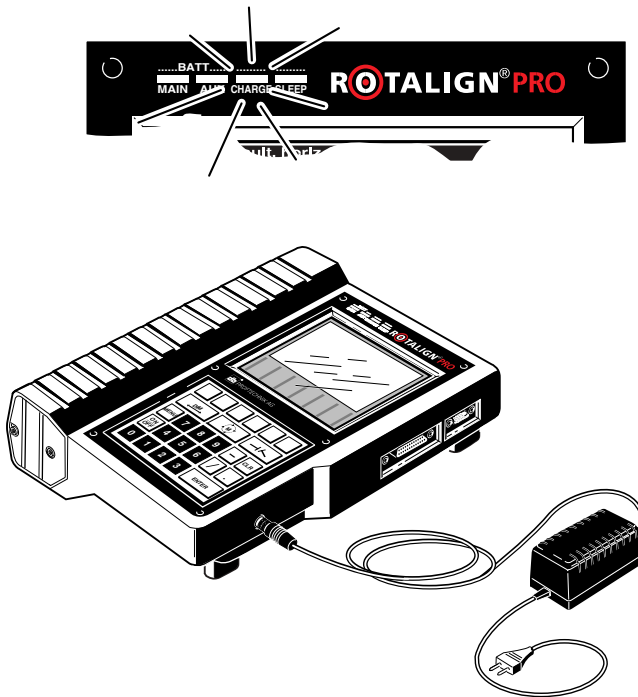
The amount of remaining charge in the main and auxiliary batteries is shown by the red MAIN and AUX LEDs:

MAIN	AUX	Main battery	Auxiliary battery
■	■	Fully charged	Fully charged
▬	■	Depleted	Backup operation
■	▬	Fully charged	Weak
▬	▬	Depleted	Depleted

### AC operation and battery charging

The ALI 3.576 AC power supply/charger can be used to run the ROTALIGN PRO computer, a useful alternative, for example, to save battery power when transferring data to a PC in an office setting. If a rechargeable battery is used, the AC power supply/charger can be used for recharging, which takes a maximum of about 5 hours and is indicated by the 'CHARGE' LED.

Please note that the voltage of rechargeable batteries tends to drop rapidly when depleted - and so the effective warning time (LED indication) is correspondingly short. Therefore, a charged spare battery should be held in reserve at all times.



### Power-saving function ('sleep mode')

If no keys are pressed for a specified duration (known here as 'minutes before sleep'), the instrument automatically deactivates its display to conserve battery power and the 'SLEEP' LED illuminates above the display. The display reactivates when any key is pressed.

If, however, no keys are pressed during the specified 'sleep' period (the 'minutes before auto-off' duration), the instrument shuts down completely and can be 'reawakened' by pressing the ON/OFF key, then pressing the 'RESUME' softkey to continue measurement from the previous status.

The CONFIG menu (page 3-5) allows you to set these 'runtime' and 'sleeptime' intervals.



### Electronic memory

The ROTALIGN PRO computer contains an electronic memory for long-term storage of measurements and results, even 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 approx. 5 years.

The backup battery is not user accessible and must be replaced at an authorized service center (for example, during regular calibration checking).

In addition, make sure that the auxiliary battery (page 2-8) is in good operating condition at all times: the ROTALIGN PRO computer automatically uses its auxiliary battery power to store the current measurement data whenever the main battery becomes depleted. Of course, this automatic storage can take place only if the auxiliary battery still has sufficient power.



#### Note

As 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 PRO COMMANDER software program can be used to back up data to a PC. See page 4-6 for details.



## Receiver cable

The receiver is connected via cable ALI 3.581-2 to the socket on the top end of the ROTALIGN PRO computer as shown below and on page 2-2. The cable serves as a data and power conduit for the receiver. (An infrared data transfer module is also available optionally; see page 4-9 for details.)

Never twist the plug in its socket, as that can damage the contact pins.

Observe the correct plug orientation as indicated by the guide groove on the plug and the socket. When correctly inserted, a positive click should be felt.

Remove the plug by grasping the plug firmly on its ribbed rubber surface and pulling it straight out.

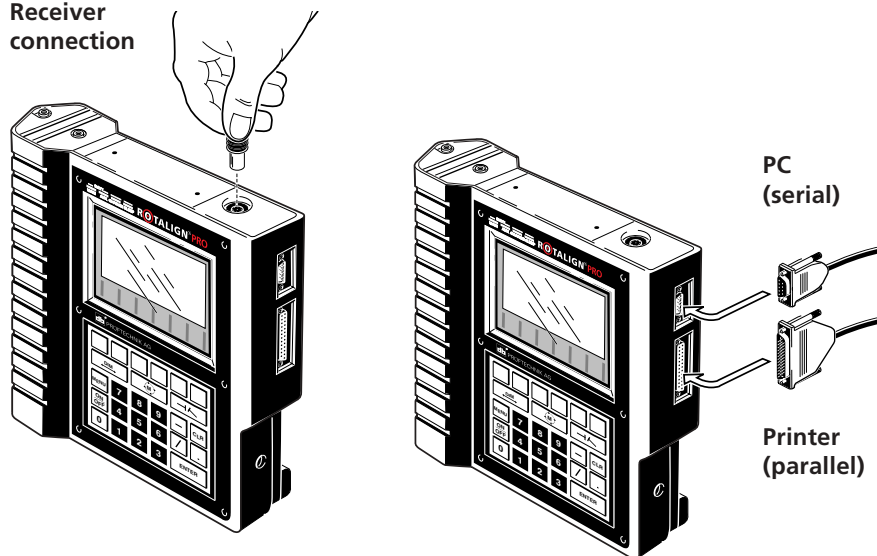


**ATTENTION**

## PC and printer connection

The ROTALIGN PRO computer has a serial interface (RS-232C, 9 pin) for connection to a PC. This allows you to use the Windows-compatible ROTALIGN PRO Commander program to transfer measurement results to a PC, analyze and store them and issue printed reports. The parallel interface (Centronics, 25 pin) lets you print screen contents (Part 2, page 3-18) or alignment reports (Part 2, page 3-18) directly from the ROTALIGN PRO computer. The interface parameters (page 3-5) can be set in the program manager or the main menu of the application program ('MENU' key).

**Receiver connection**



## ROTALIGN PRO sensors

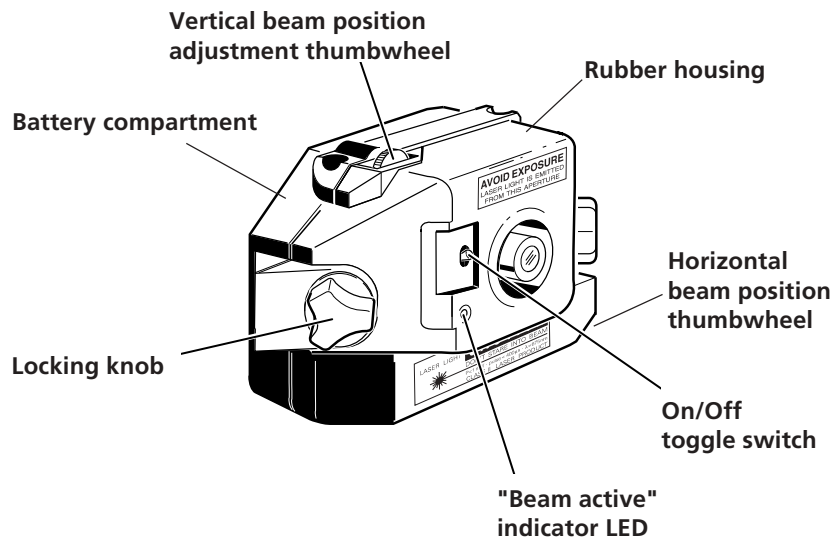
### Laser

### 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 1-11 for details).



Do not stare into the laser beam!



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 PRO 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.

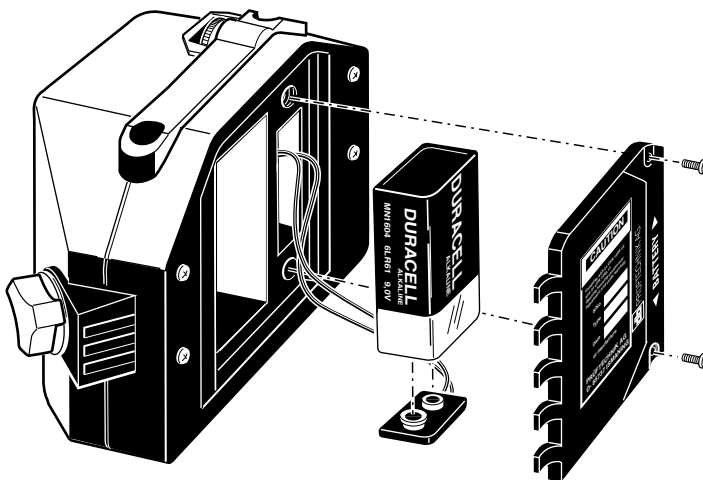
### Laser battery

The 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. NiCad rechargeables may also be used, but not with the intrinsically safe version (see page 2-6).

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:



Note



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

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

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

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



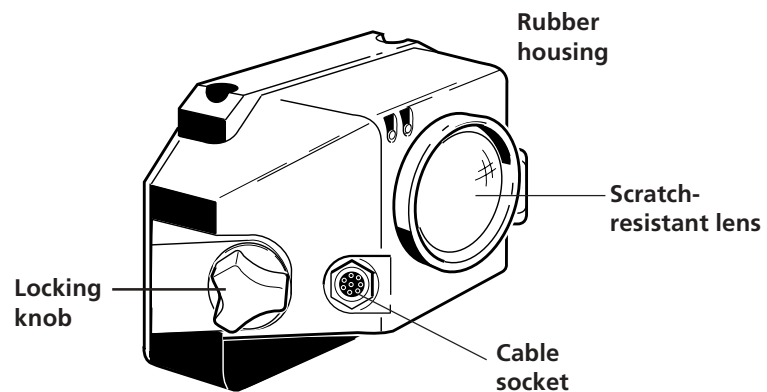
ATTENTION



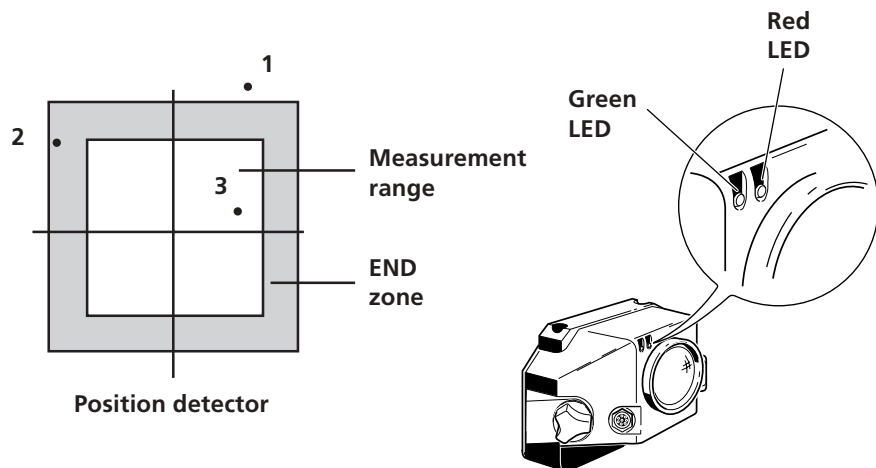
Note

**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  $1\ \mu\text{m}$  / 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  $2^\circ$  for shaft rotation measurements.



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



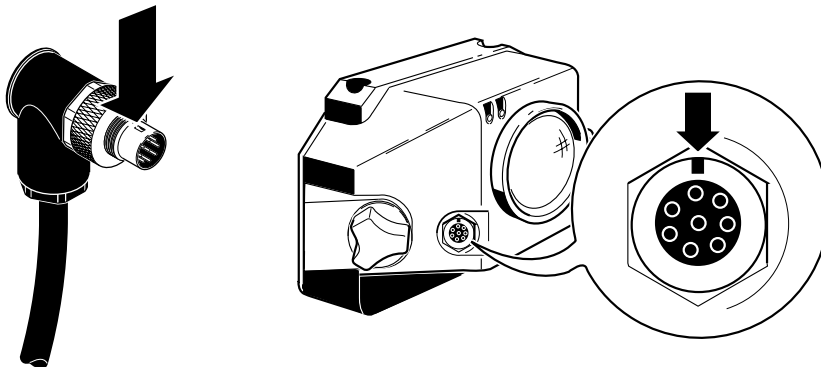
Laser in	red LED	green LED	computer displ.
1. Out of range	lit	off	'LASER OFF'
2. Edge	blinking fast	blinking fast	'LASER END'
3. Meas. range	off	blinking slow	'Sensor OK'

The receiver is powered by the ROTALIGN PRO computer via a cable (ALI 3.581-2) through which measurement data also pass. An infrared link is also available. See page 4-9 for details.

### Cable connection

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

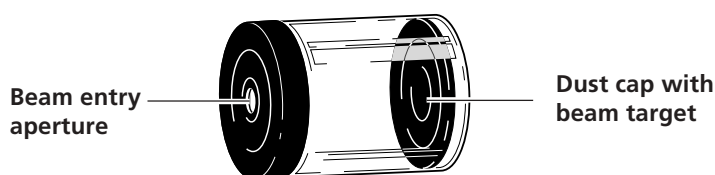
Never turn the plug itself, as that can damage the cable pins!  
Note correct plug orientation indicated by the markings on the plug and the socket.



### Adjustment tube

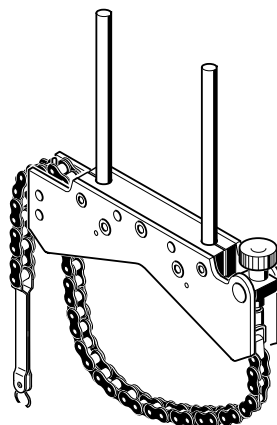
#### ALI 3.608

This tube fits onto the receiver to help align the laser beam with 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 Part 2, page 3-9).



**Compact chain-type bracket****ALI 2.891set**

Compact and lightweight, this bracket (included in the standard ROTALIGN PRO package ALI 3.501) 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. All parts (frame, posts, chains and hooks) store in a rollable cloth pouch. Mounting instructions can be found on page 2-4 of the shaft alignment instruction manual ALI 9.646G.

**Compact chain-type bracket**  
**ALI 2.891set**
**Other accessories**

Further popular ROTALIGN PRO accessories can be found starting on page 4-5.

The Laser Alignment Product Catalog (ALI 9.300) describes additional accessories and other alignment systems as well.



Product catalog  
ALI 9.300

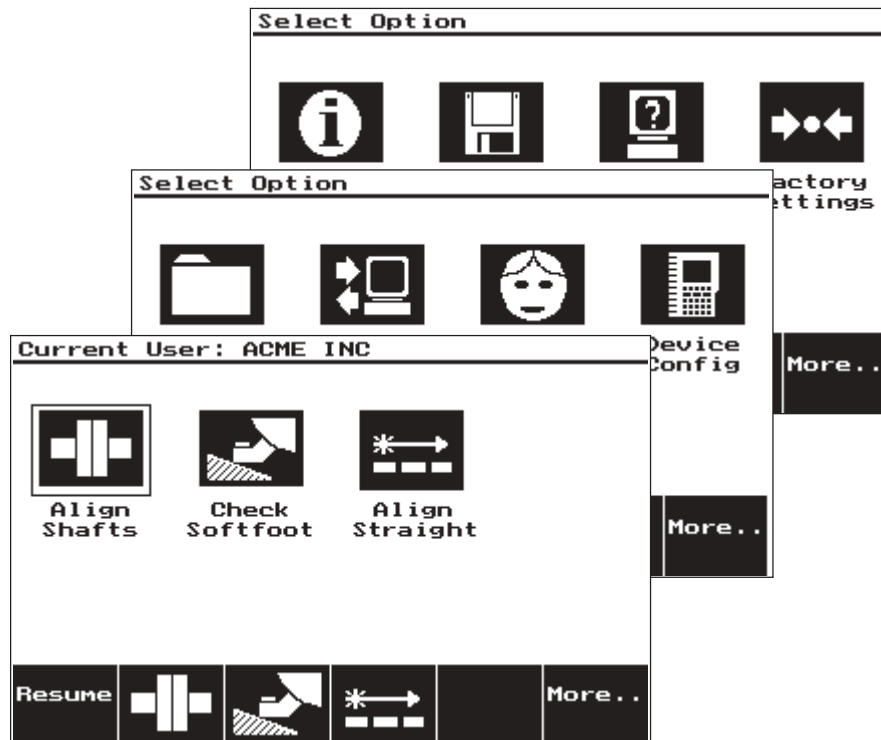
**Chapter 3: configuration and data handling**

**Program manager**

The program manager appears when the computer is first switched on. It is used to select and start the desired individual application. It also allows instrument setting adjustments and performance of maintenance functions.






The MENU key: From the program manager, this key takes you to the initial screen. From within any application, this key calls up a context-sensitive selection menu.



Opens the most recently used application

Proceeds to the next screen

**Applications (initial screen)**

-  **Shaft alignment**  
of horizontal and vertically-mounted rotating machines
-  **Soft foot measurement**  
on machines with two pairs of feet
-  **Straightness alignment\***  
of machine beds

\* Option

Details on the respective application programs can be found in their own separate instruction manuals:

Shaft alignment	ALI 9.646G
Straightness measurement	ALI 9.648G

## Screen 2: Data management and basic configuration



### File functions

Find and open a file; set file search criteria; file information (page 3-3)



### PC communication

Activate PC mode for data transfer with a PC (page 3-3)



### User name and address

These general user information settings are stored along with each set of measurement data (page 3-4)



### Device configuration

Units, time, date, printer, interfaces etc. (page 3-5)

## Screen 3: Service functions



### ROTALIGN information

Software and hardware version numbers; receiver version number; all information can be printed directly (page 3-6).



### Update / upgrade

Load the latest program version into the computer (page 3-3)



### System test functions

Test hardware functions (page 3-7)



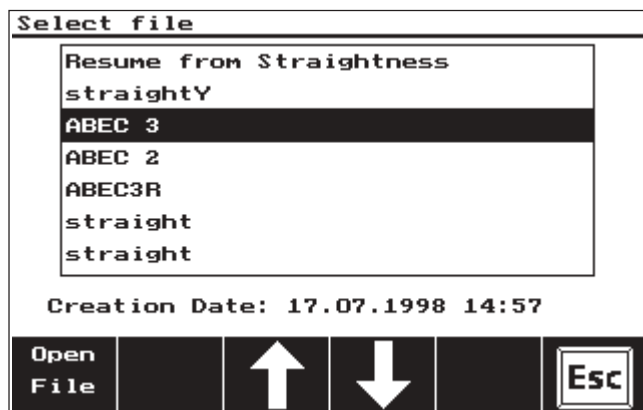
### Factory settings

Reset all user-defined adjustments back to factory default settings (page 3-8)



## Find and open file

1. Press the softkey marked **FIND FILE**:



2. Use the arrow softkeys to mark the desired file, then press **OK** to start the corresponding application and load the file into it.



**FILE INFO** displays further information stored with the file (file name, application, user, creation/measurement date, measurement location).



**SEARCH OPTION** can be used to speed up the file search by defining search parameters (such as file name by first letters, application, user or earliest file creation date/time).

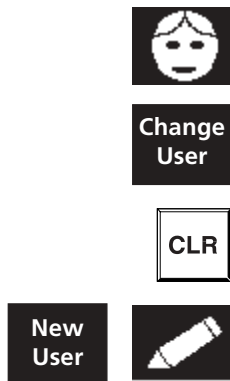


## PC communication

1. Connect ROTALIGN to the PC (page 2-11).
2. Press the **PCCOMM** softkey or if you are bringing ROTALIGN up to the date with the latest software version, press the **UPDATE/UPGRADE** key.



In both cases the unit enters its PC communication mode and waits on a control signal from the PC program. All further actions are controlled by the PC.

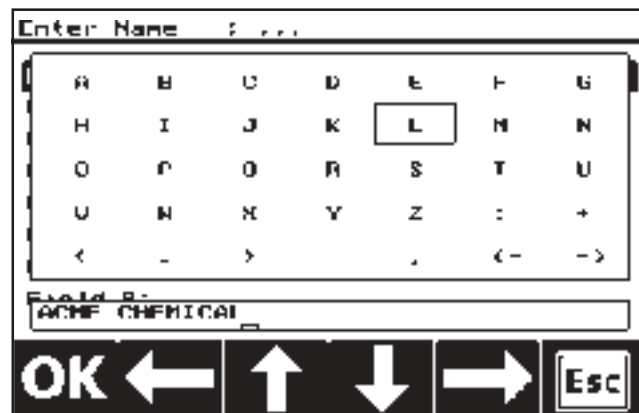


### User name and address

Each time a set of measurements is stored, certain information regarding the operator is stored along with it. Before beginning measurement, check this user information and correct it if necessary. Once information on several different operators is entered, the corresponding name may be selected from a list for quicker setup.

- Checking information: press the USER NAME & ADDRESS softkey. The information regarding the current user setting is displayed.
- Changing users: press the CHANGE USER key, then select the corresponding name from the list that appears.
- Deleting users: select the desired name from the list, then press the CLR key.
- Entering a new user: press the NEW USER softkey, then EDIT (pencil symbol). The text editor then appears:

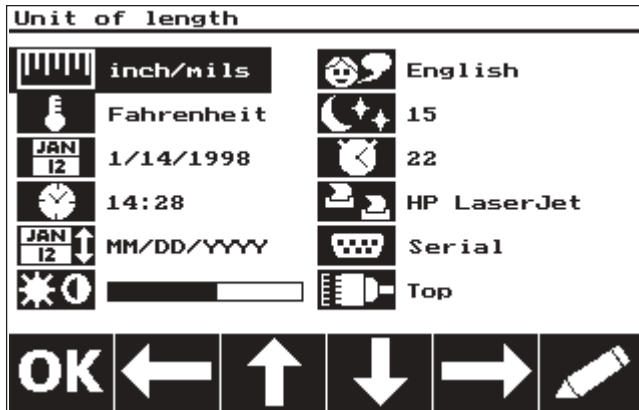
### Text editor



- Entering text: Use the arrow keys to select desired characters, pressing the ENTER key on the keypad to confirm each in turn.
- Entering numbers: Use the ROTALIGN keypad to enter numbers directly.
- The CLR key deletes the last character.
- Select the characters <- and -> to move the cursor to the left and right along the line of entered text.
- The ESC softkey may be pressed to cancel the operation at any time; the OK softkey confirms and stores the entire entry.













## Device configuration

1. Press the DEVICE CONFIG softkey:



2. Use the arrow keys to select the desired menu option for editing, then press EDIT softkey.



	Length units mm; inch/mils; inch/thou		Language English, German
	Temperature units °Celsius; °Fahrenheit		Sleep time: display shuts down after X minutes
	Date		Auto shutoff time: Unit shuts off after X minutes in 'sleep' mode
	Time of day, time zone		Printer selection; set the interface on the ROTALIGN computer (LPT, COM)
	Date format: dd.mm.yyyy; mm/dd/yyyy; yyyy-mm-dd		Interface parameters (RS232)
	Screen contrast		Sensor connection on <i>top</i> for data transmission via cable; on <i>side</i> for wireless infrared communication



### ROTALIGN information

- Press the ROTALIGN INFO softkey to display the following:

Card: Storage capacity in MB / card type  
 Hardware: SYSTEM1 followed by version number  
 ID number: IDxxxxxxx (this number is required for software registration)  
 Board version: 0 (hardware version, for service use)  
 Sensor status: OK  
 Sensor version: Version numbers of application program (e.g. 'ROTA\_4') and operating system ('ROTA\_BOOT') with date and time



The last two entries appear only when a sensor is connected. Press the READ SENSOR softkey to collect this information again.



- Press the SW-INFO softkey to display the following:

Installed software  
 Program manager: version no.  
 PC Comm: version no.  
 Shaft Alignment: version no.  
 Soft foot: version no.  
 Straightness (optional) version no.



All these entries can be printed by pressing the PRINT softkey indicated by the printer symbol (see page 3-5 for printer configuration).

## System test functions

The computer features a range of self-diagnostic functions for checking the proper function of all important system components.

Press the SYSTEM TEST softkey.

If the data medium is to be checked, then press the DOS softkey.

CHKDSK checks the data storage card.

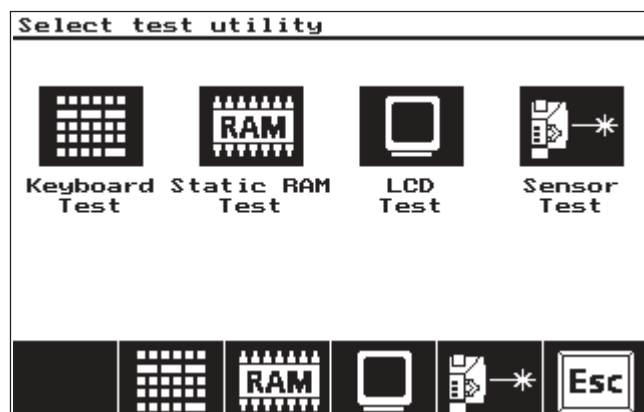
CHKDSK\_F checks the data storage card and repairs any errors automatically (this check is always performed when the computer is switched on).

RS232TST tests the 9-pin serial interface using a 'loopback plug' as described in the display.

Further test functions can be started using the softkeys TEST PART I and TEST PART II.



## Test part I



### Keyboard test

Press any key. If it is working properly, the corresponding element is activated in the display. To end the test, press the MENU key, then the CLR key.



### Static RAM test

- Clear SRAM: deletes the contents of unused memory.
- Read/write test: tests the function of unused memory.



### LCD test:

- Reverse b/w display (return to normal with ENTER or SELECT)
- Contrast: adjust screen contrast by individual steps (+1/-1) or continuously (+...+...+...)
- Pattern 1 / 2: displays a coarse (1) or fine (2) screen pattern. Press any key to end the test.
- LCD off: screen shuts down for 5 sec. while SLEEP LED illuminates.

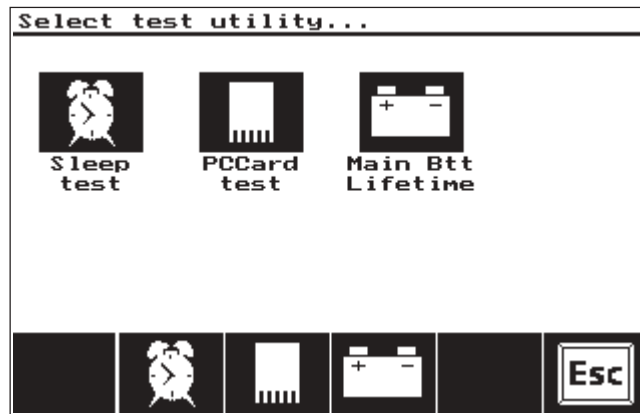


Connect the sensor to the ROTALIGN computer for the **Sensor test**

- Sensor OFF -> red 'ready' LED on sensor goes out
- Sensor ON -> red 'ready' LED on sensor illuminates



## Test part II



### Sleep test

Checks power-saving functions by shutting down the display ('sleeping') or by shutting off the entire computer. The display can be reactivated by pressing any key; the ON/OFF key must be used to restart the computer.



### PC card test

- Recursive dir: lists all file names on the PC card
- List INI files: displays contents of all initialization files
- Check flash: checks all sectors of flash card memory for faults



Main Btt  
Lifetime

### Main batt lifetime

Checks charge status of batteries/rechargeables. Press any key to end the test.



Factory  
Settings

## Factory settings

All user-defined changes in the configuration settings can be returned to their default values by pressing the **FACTORY SETTINGS** softkey.

## Chapter 4: Appendix

This section offers a list of possible errors along with their corresponding notification messages and remedies. This manual then concludes with popular accessories for ROTALIGN PRO and technical data.

### Troubleshooting

#### **Computer does not switch on:**

Replace main batteries (page 2-7) or connect charger (pages 2-9, 4-7). If there is still no response and you are quite certain that the replacement batteries are new, contact your local PRÜFTECHNIK distributor.

#### **Computer fails to respond:**

Reset the computer by pressing the ON/OFF, CLR and ENTER keys at the same time.

#### **Screen goes blank:**

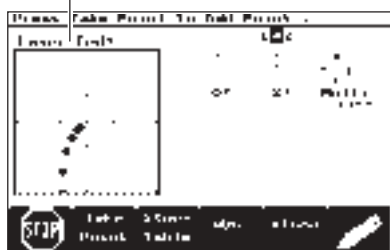
In sleep mode: press any key to reawaken (page 2-9)

OR auto-shut off: press ON/OFF to reactivate, then press RESUME.

#### **Screen is too dark or too light:**

Switch on the computer. From the main opening screen, adjust screen contrast by pressing and holding the 0 or 1 key: contrast will cycle from dark to light and back again while you hold down the key. Release the key when the desired screen contrast setting is reached. From any other screen, you must first press the 'Menu' key, then select 'Device Config' (page 3-5) to access this contrast adjustment function.

Sensor status line



### ROTALIGN PRO error messages

The following error messages may appear in the sensor status line (Part 2, page 2-16):

- *Sensor...*: The measurement program is attempting to address the receiver sensor and to begin measurement. This message appears even when the receiver is not connected.
- *Laser Off*: The laser beam is not striking the receiver detector: readjust the beam and make sure the receiver cap is removed.
- *Laser End*: The laser beam is striking the edge of the detector: readjust the beam; during measurement: extend the measurement range (Part 2, page 3-14).
- *Sensor OK*: The laser beam is in the outer measurement range; measurement can be started.
- *Centered*: The laser beam is centered in the inner measurement range. Start measurement.
- *Inclinometer*: The electronic inclinometer built into the receiver has failed. Return the receiver to an authorized PRÜFTECHNIK AG service center for repair.
- *Temperature*: If the receiver temperature rises above 60°C / 140°F or falls below 0°C / 32°F, then this message appears and measurement stops.
- *Ambient Light* or *Laser bright*: The position detector is overloaded by excessive ambient light or the more intense laser beam emitted just after switching on (in order to facilitate beam location). Shade the receiver or wait for the beam to switch to normal power.

### Missing dimensions

Results cannot be calculated without entering the machine dimensions.

### Out of paper, Printer error, Printer timed out!

Check the printer and connections.

### Chkdsk return ...

Upon startup, the flash memory card (containing the measurement program) is checked by the 'chkdsk' program, which can return the following error messages:

- |                           |  |
|---------------------------|--|
| system check              |  |
| verifying file system ... |  |
| chkdsk return 0           | → 'OK'   |
| chkdsk return 1           | → 'Error found and repaired'   |
| Computer 'hangs'          | → Use emergency diskette (page 4-16);<br>if no change, then error is irreparable:<br>return the computer and<br>flash memory card to an authorized<br>PRÜFTECHNIK AG service center. |



**Not ready reading drive A: ...Abort, Retry, Fail**

If the program stops in the middle of its startup sequence, the flash memory card is either damaged or corrupted.

Press the ON/OFF key for 15 seconds in order to shut down the computer.

Now use the emergency diskette ALI 3.496 (page 4-16) included in the ROTALIGN PRO package to reformat the flash card and reload it with a PC communication program (PCCOMM).

The ROTALIGN PRO program manager and applications can then be loaded from a PC using the ROTALIGN PRO Upgrade Manager (ALI 3.491).

If this procedure fails to resolve the problem, then the flash card must be replaced. Please contact your PRÜFTECHNIK AG distributor for assistance.

**Wrong licence code!**

This message appears when ROTALIGN PRO is switched on for the first time ever or following an update of its operating firmware from Version 3.03 to a later version. A registration password ('license code') must be entered before operation can be continued.

This password is supplied by PRÜFTECHNIK AG when the completed registration card is returned.

To enter the password:

- Press the OK softkey. The text editor appears (see page 3-4).
- Enter the password (press the ENTER key after each letter to confirm).
- Conclude the entry by pressing the OK softkey.

**General**

Erroneous entries are ignored by the program and no error messages appear.

**Note**

### The ROTALIGN PRO case

Key:

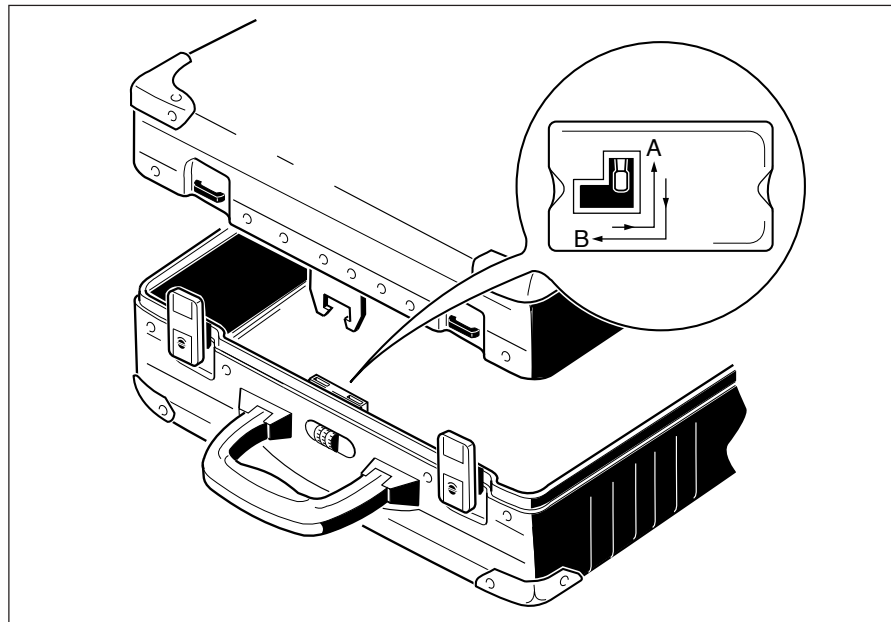


The keys are taped to the inside of the case lid.

The ROTALIGN PRO 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.



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.

Combination:



Note

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

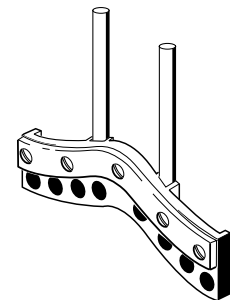
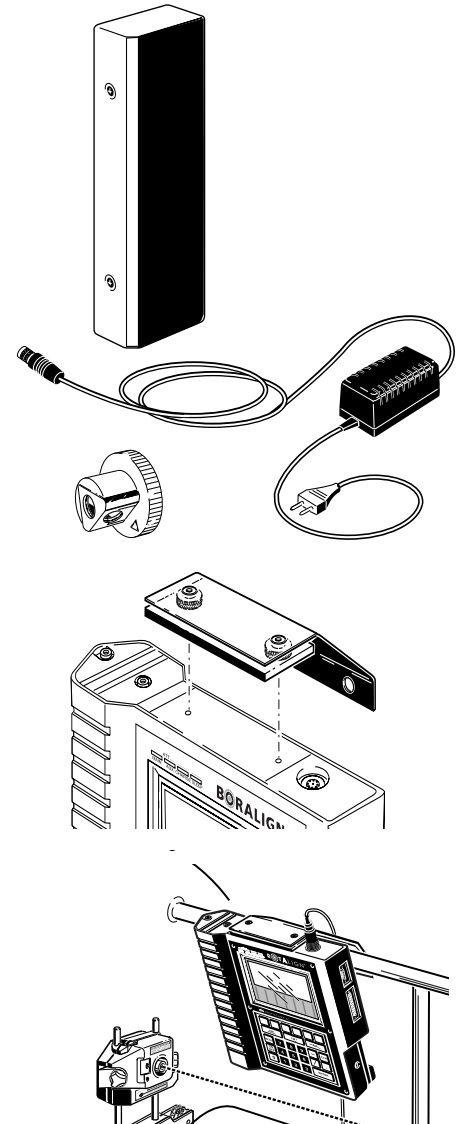
## ROTALIGN PRO accessories

- ALI 3.492 Firmware upgrade 'straightness measurement' (page 4-6)
- ALI 3.496 ROTALIGN PRO Emergency Diskette (page 4-16)
- ALI 3.571 Lithium-Ion rechargeable block battery (MAIN BATT) (page 4-7)
- ALI 3.576 110V/220V Mains adapter (page 4-7)
- ALI 3.580set External charger incl. spare battery
- ALI 3.581-5 Receiver cable 5 m
- ALI 3.579 ROTALIGN PRO Beam Deflector (page 4-8)
- ALI 3.606 Receiver dust cap (spare)
- ALI 3.607 Laser dust cap (spare)
- ALI 3.573 Computer stand
- ALI 3.574 2 Hex screws for computer stand  
The stand angles the computer on a table at a convenient reading position, or lets it hang from a pipe etc.
- ALI 3.595 ROTALIGN PRO case (aluminium), complete
- ALI 3.592set ROTALIGN PRO EXPLORER (page 4-6)
- ALI 4.609set ROTALIGN infrared interface (page 4-9)

### Accessory mounting brackets, bracket parts

(see following pages and the Laser Alignment 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 2.893set Cardan shaft bracket set



**ROTALIGN PRO Explorer**
**ALI 3.592SET**

The ROTALIGN PRO Explorer is a suite of Windows™-compatible programs which includes the Alignment Explorer, the Shaft Alignment Editor and the Straightness Editor.

The Alignment Explorer can be used to transfer measurement files from ROTALIGN PRO to a PC for secure storage and download new alignment job setups to ROTALIGN PRO. The File Commander also lets you prepare and print reports from the PC.

The Editors are used for entering and editing machine dimensions and parameters, for reviewing results as well as preparing and printing reports. The Shaft Alignment Editor can be used to join together up to six machines into a train, then download them to the ROTALIGN PRO computer to save time and effort during alignment preparation.

The ROTALIGN PRO Explorer ALI 3.592SET includes:

The communication certificate	ALI 3.531
Editor registration certificate	ALI 3.535

The program CDs are included in the respective standard packages, but full functionality requires entry of a licence code which is obtained from PRÜFTECHNIK Alignment Systems after filling out and sending back a purchase order form to PRÜFTECHNIK Alignment or your local representative. This form is generated using the Licence Manager.

**System requirements**

Operating system	Windows 98 / Me / NT / 2000 / XP
Processor	Pentium 300 MHz or faster
Memory	64 MB RAM
Disk drive	Hard drive with 100 MB free
Monitor	VGA Color
Mouse	Required
Serial interface	One free

**'Straightness' add-on package**
**ALI 3.630SET**

This application program lets you use your ROTALIGN PRO system for convenient and highly accurate straightness measurement, e.g. of machine beds, foundations, guide rails, etc. This package includes the following parts:

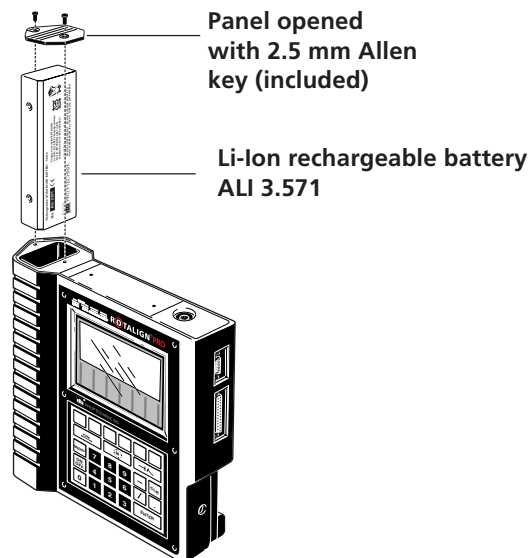
CD for straightness and flatness measurement	ALI 3.474 CD
Registration card for straightness firmware	ALI 9.552
Magnetic foot for laser	ALI 4.501
Magnetic sliding bracket for receiver	ALI 3.198
Operating instructions	ALI 9.648G
Storage case	ALI 3.197
Allen key, 6 mm	0 0739 1059

**ROTALIGN PRO emergency diskette**
**ALI 3.496**

In the unlikely event that the operating program cannot be started, this emergency diskette lets you reformat the flash memory card in the ROTALIGN PRO computer and reestablish communication with a PC (see page 4-16).

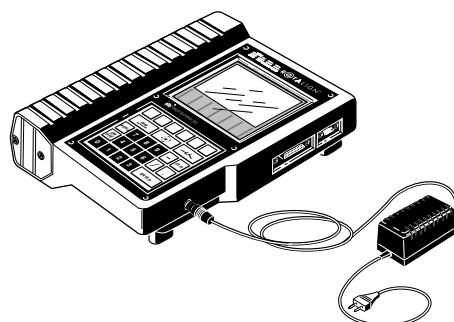
**Li-Ion rechargeable battery****ALI 3.571**

Six 'C'-size alkali-magnesium batteries (IEC LR 14) serve as the standard ROTALIGN PRO power supply. The six batteries can be replaced with a 7.2 volt Li-Ion rechargeable battery. The battery has a capacity of 1.35 Ah (which, under normal operating conditions, is adequate for 15 hours - exact duration will vary depending on usage pattern). The battery is charged by connecting the computer to the AC power supply (see "AC adapter/charger" below). Alternatively, the battery can be charged externally using the optional battery charger ALI 3.580 set. Note that maximum battery life can be ensured by keeping the battery fully charged whenever possible. To fully charge the battery takes 8-9 hours.

**AC adapter/charger****ALI 3.576**

The AC adapter/charger can be used to power ROTALIGN PRO in order to conserve battery power, for example during office use or instrument firmware updating. The 110/220VAC (switchable) power supply is attached to the computer as shown below. When properly connected, the LED marked "CHARGE" above the computer display illuminates. The supply may be left connected to the computer indefinitely with no danger of damage.

It can also be used to charge two ALI 4.610 external receiver batteries. If the computer battery is depleted, however, the computer can be powered by the adapter/charger immediately only if no external batteries are connected (which would draw excessive current).



**AC adapter/charger**  
**ALI 3.576**

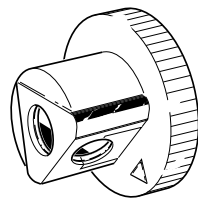
**ROTALIGN PRO Beam Deflector****ALI 3.579**

The beam deflector simplifies and improves accuracy of taking machine dimensions. This practical 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.

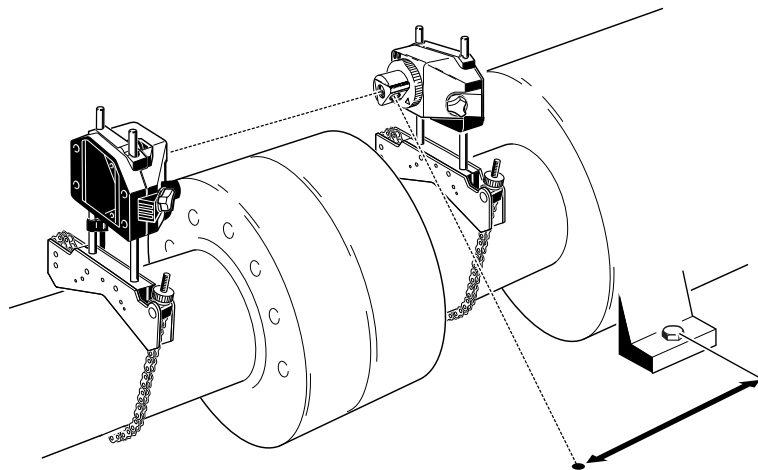
When the beam deflector is used, 50 mm / 2" must be subtracted to compensate for the distance between the point of reflectance inside the deflector and the white marking on the receiver housing.



The deflected beam is to be used only for measuring machine dimensions.



**Beam deflector  
ALI 3.579**

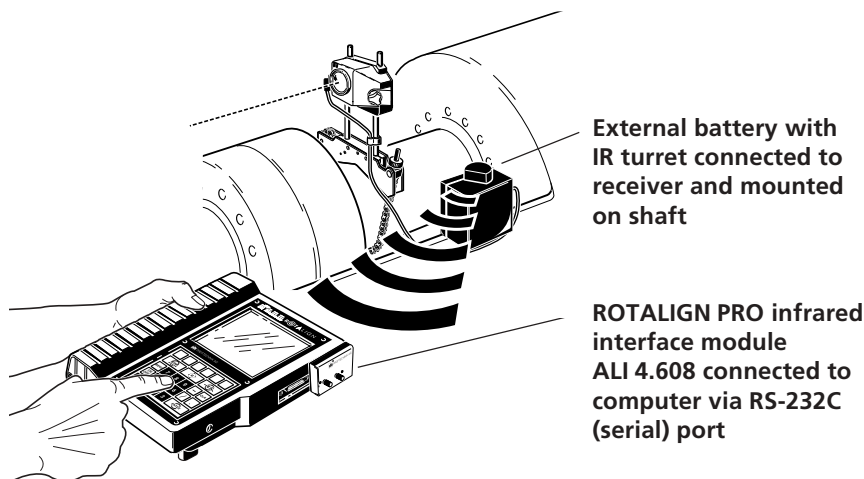
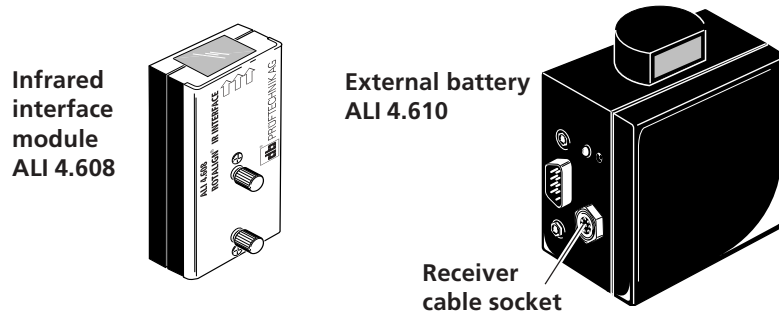


### Wireless data transfer with the IR interface ALI 4.609set

The ROTALIGN PRO 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. It is especially invaluable when large shafts require use of a turning gear and cannot be stopped readily.

The infrared interface package ALI 4.609set includes:

- ALI 4.608 ROTALIGN PRO infrared interface module
- ALI 4.610 External receiver battery with IR interface
- ALI 4.701-2 Cable, 2 m / 6' 6" from receiver to external battery



The infrared interface module (ALI 4.608) connects to the serial (COM) interface of the ROTALIGN PRO computer. The module is then activated by entering the 'Device config' menu and setting the 'Sensorport' option to 'Side' (see page 3-5).

The external battery is equipped with two strong magnets which hold it securely on any ferromagnetic shaft or coupling surface.

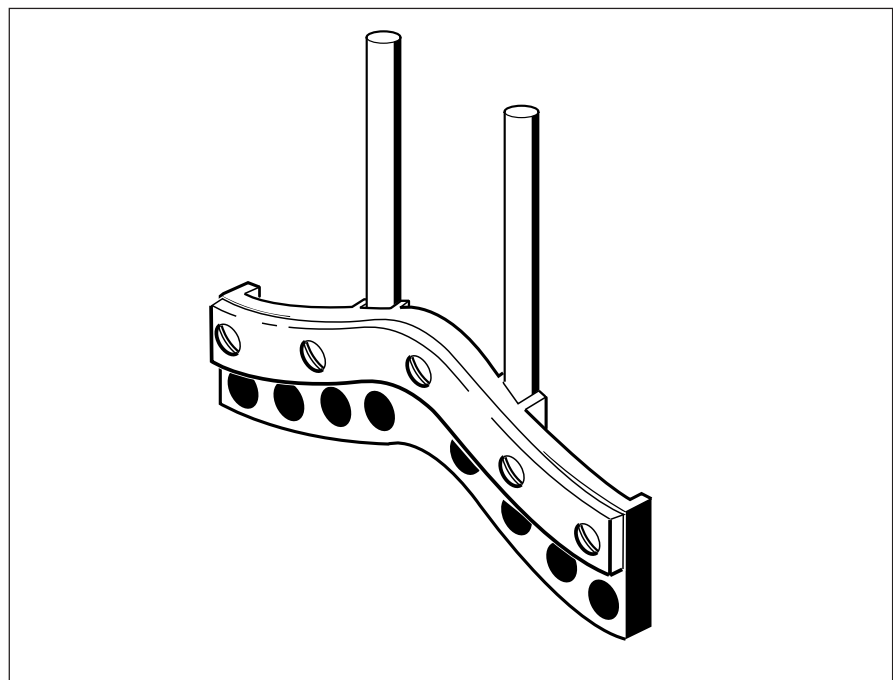
## Accessory brackets

### Magnetic sliding bracket for non-rotatable shafts

**ALI 2.230**

In order to accurately align two machines to one another, the position of their shafts must be determined by measuring radial displacement (such as ROTALIGN PRO 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.

However, the ALI 2.230 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 of diameter 80 mm / 3 1/8" and greater.



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, 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 PRO 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.



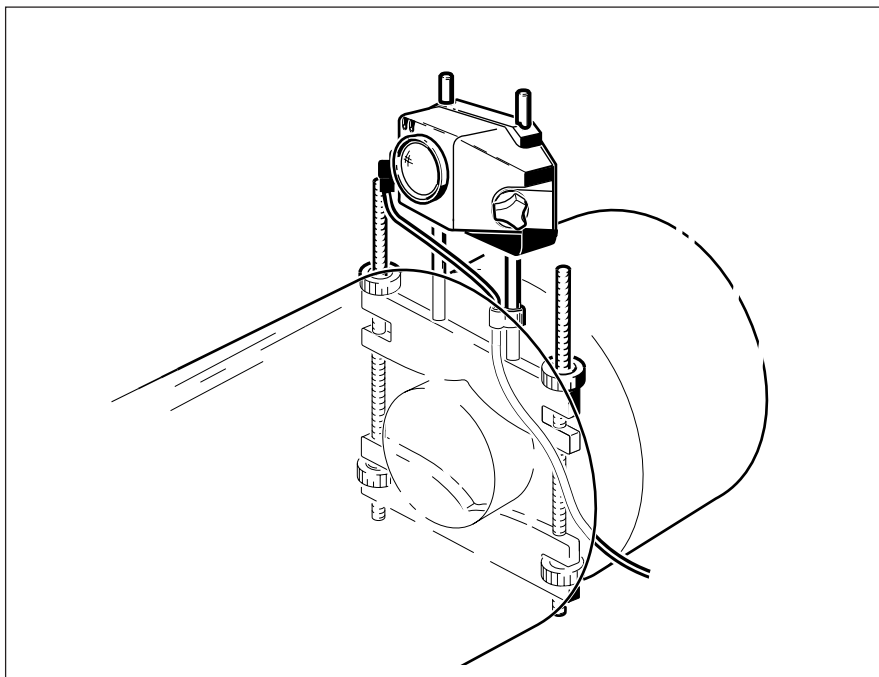
**Note**

### Extra-thin bracket

### ALI 2.109set

### ALI 2.109Lset

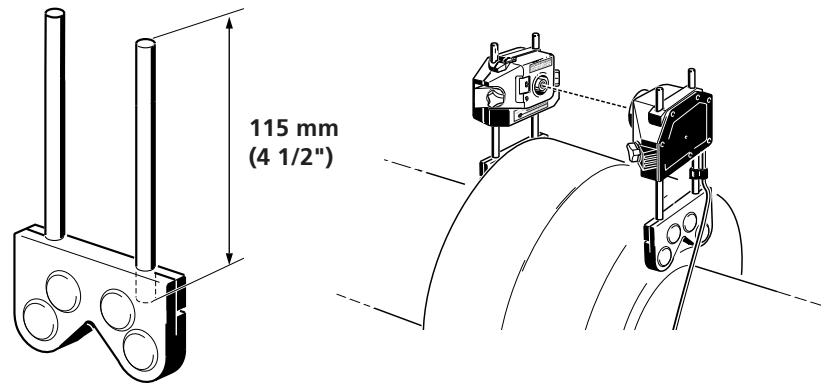
With a thickness of just 8 mm (less than 3/8"), the extra-thin bracket is perfect for handling 'tight squeezes' and comes in two sizes, one for shaft diameters up to 160 mm / 6 5/16" (ALI 2.109set), and a smaller version for shaft diameters up to 100 mm / 3 15/16" (ALI 2.109Lset). ALI 2.109set contains two pairs of brackets, one in each size; ALI 2.109Lset contains only one pair in the smaller size.



**Compact magnetic bracket**
**ALI 2.112set**

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

This compact bracket uses four powerful magnets to hold the standard bracket 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 PRO brackets.

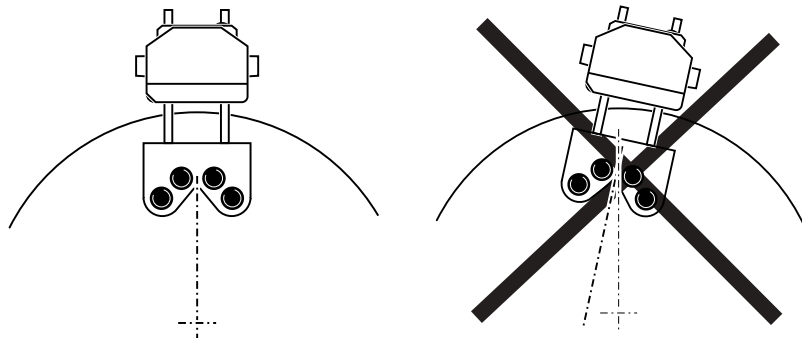
**Compact magnetic bracket  
ALI 2.112set**


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.


**Note**

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.

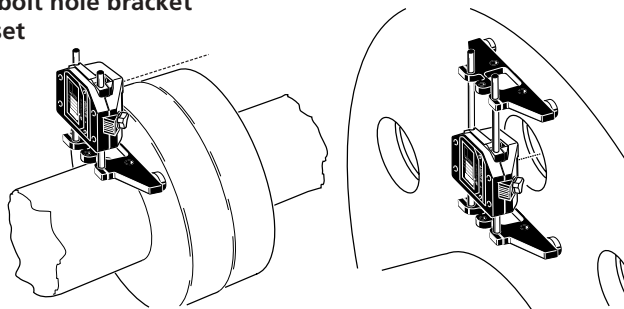


**Coupling bolt hole bracket****ALI 2.106set**

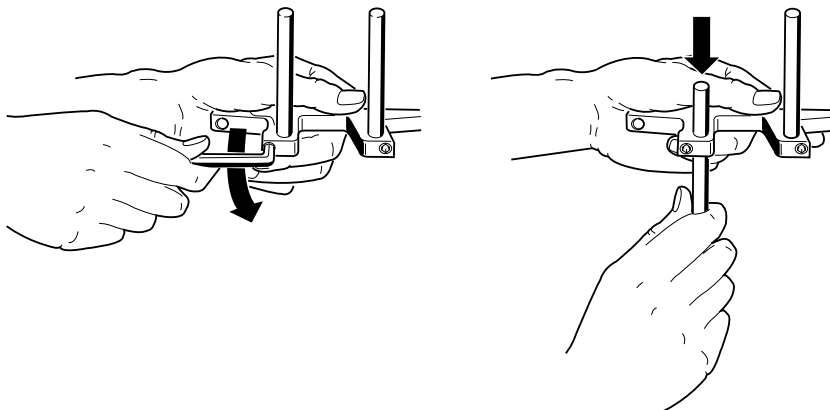
This magnetic bracket can serve as a useful substitute for the standard chain-type bracket when the system must be mounted on large couplings with large bolt holes. Thanks to its four powerful samarium-cobalt magnets, this bracket provides quick and sturdy mounting by straddling the bolt hole; no radial 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 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. On smaller couplings, the beam can be directed above the coupling as shown below at left.

**Coupling bolt hole bracket**  
**ALI 2.106set**



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 that clamp them in the bracket.



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

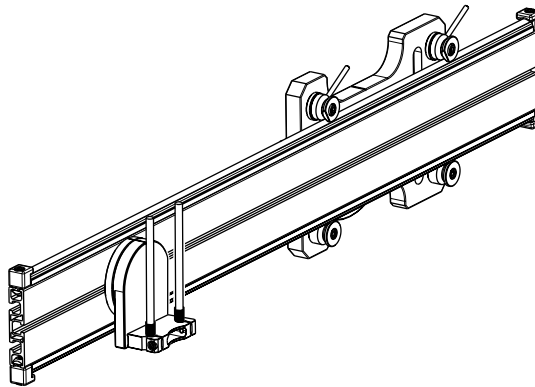


**Note**

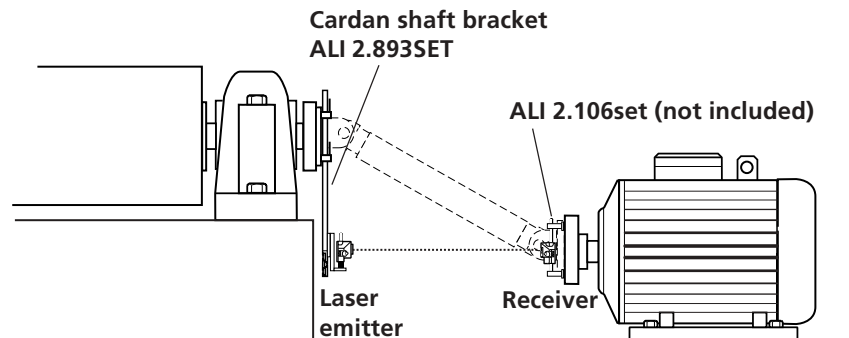
**Cardan shaft bracket**
**ALI 2.893SET**

Machines joined by cardan shafts require use of this special bracket to mount the receiver onto the moveable machine. The bracket faceplate attaches onto the coupling face by either of two methods:

- 1) if the shaft end or coupling face has a threaded hole in its center, a center bolt can be used
- or
- 2) coupling bolt holes can be used for three-point mounting onto bolt circle diameters of 100 mm to 212 mm (3 15/16" to 8 5/16").



The Receiver mounts onto the movable machine using e.g. the coupling bolt hole bracket (ALI 2.106set, not included).



Typical cardan shaft alignment configuration (see Part 2, page 4-5).

This configuration allows convenient and highly accurate shaft alignment at shaft offsets of up to 810 mm (31 7/8") and separation distances up to 10 m (33 ft.).

The cardan shaft bracket set ALI 2.893SET includes:

- Faceplate assembly
- Slide, length 970 mm / 38"
- Receiver holder assembly
- Center bolts, M16 and M201
- Center bolt thread adapters, M24 and M301
- Center bolt wrench
- Faceplate nuts and bolts, M10 (3 pcs.), with washers and spacers
- Hex keys, 1.5 mm, 4 mm and 5 mm
- Heavy-duty flight case w/contoured foam insert

## **Warranty, service and care**

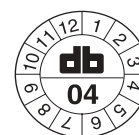
ROTALIGN PRO is a precision measurement instrument which should be handled as such. When not in use, it should always be stored in its protective carrying case.

### **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 PRO 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 right) located on the back of the receiver housing. Please return ROTALIGN PRO to your authorized PRÜFTECHNIK AG distributor or service center 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 4-1 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 spare parts may be used.

## Emergency rescue

The rescue program offers a means of quickly restoring the computer in the unlikely event that its flash memory card should fail, thereby preventing the program from starting. The program, which can be found in ROTALIGN PRO/BORALIGN Explorer CDs, lets you reformat the card and load a PC communication program onto it. The measurement firmware can then be re-installed from a PC using the ROTALIGN PRO Upgrade Manager program.

### Procedure

1. Switch off the ROTALIGN PRO computer by pressing the ON/OFF key for 15 seconds (see page 4-3).
2. Install the Emergency program from the Explorer CD onto the PC by running the 'SETUP.EXE' file and following the standard installation instructions as they appear on the screen.
3. Connect the AC adapter/charger to the ROTALIGN PRO computer or make sure that the main battery supply has sufficient charge left for at least 10 minutes.
4. Connect the ROTALIGN PRO computer to the PC (see page 2-11) using only a fully-leaded serial cable such as the SYS 2.711-2 PC cable.
5. Start the 'ROTALIGN PRO Rescue' program on the PC.
6. In the first screen, select the 'Emergency boot' application and click on 'Next'.

OR

Select 'Backup' if you want to copy the entire contents of the card (with any errors) to the PC. Enter a name for the backup file and then click on 'Next'. This procedure takes about 30 minutes.

7. Select the COM port to which the ROTALIGN PRO computer is connected, then click on 'NEXT'.
8. Switch on the ROTALIGN PRO computer and follow the instructions in the display.
9. As soon as the message "Checking COM1 for access" appears, click on the 'Connect' button on the PC screen.  
(Be sure to watch the monitor closely for this message, because it appears for only about five seconds!) When the connection is made, the ID number appears; then click on 'Next'.
10. Click on 'Finish' and confirm your intent to launch the emergency salvage procedure.
11. Once the card has been reformatted and communication reestablished, the ROTALIGN PRO computer starts automatically and loads the PCCOMM program. You may now use the ROTALIGN PRO Upgrade Manager to reload the program firmware.

## 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
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.
Intrinsic safety (option)	EEx ib IIC T4
Certificate number	TÜV 02 ATEX 1864

### 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
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.
Intrinsic safety (option)	EEx ib IIC T4
Certificate number	TÜV 02 ATEX 1974

### Laser emitter/receiver

Max. separation, emitter to 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, inter- rupts 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 (Cen- tronics) and RS232C (serial)
Memory	Nonvolatile, 4MB for up to 250 measurement sets with labels, comments etc.
Power supply	6x 1.5 V (IEC LR 14) Size "C" (standard alkaline-magnesium)  Alternatively: - ALI 3.576 AC adapter for 110V/220V (switchable), output 400 mA min. at 12 V ± 5% - Li-Ion battery rechargeable by computer Nominal voltage: 7.2 V Capacity: 1.35 Ah Charging duration: max 5 hours
Auxiliary battery	9V block (IEC 6LR61) for several minutes of emergency operation
Backup battery	Lithium (laser welded type), maintains memory for 5 years
Operating time, computer/receiver*	50 hours (alkaline batteries) 15 hours (Li-Ion battery)
*Based upon 25% measurement, 25% computation and 50% "sleep" mode.	
Environmental protection	waterproof, dustproof, shockproof (IP 65)
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.
Intrinsic safety (option)	EEx ib IIC T4
Certificate number	TÜV 02 ATEX 1975

### 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® PRO Explorer** PC software ALI 3.592SET:
  - Back up and restore machine alignment files under Windows®
  - Configure machine arrangements, enter dimensions and file infor-  
mation on a PC then upload the files to the  
ROTALIGN® PRO
  - Issue alignment reports
  - Display ROTALIGN® PRO screens
  - View 5 alignment measurements as a 6-machine train  
Includes PC software, manual, serial interface cable and adapter.

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**Productive maintenance technology**

# ROTALIGN® PRO

## Part 2

### Shaft alignment operating instructions

Dear Customer,

If you have any suggestions for improving this manual, the instrument itself or its accessories, please let us know!

We look forward to hearing from you!

**A printed copy of this manual in book form  
can be obtained from PRÜFTECHNIK Alignment**



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ALI 9.646G

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## Foreword

Welcome to the world of laser-optical shaft alignment with ROTALIGN PRO. As a supplement to the foreword in the first part of this set of operating instructions, this page discusses only a few of its most important aspects specific to shaft alignment.

ROTALIGN PRO is the result of continued development of the enormously successful ROTALIGN shaft alignment system. ROTALIGN PRO offers a variety of additional practical functions designed to enhance user convenience and application functionality.

The most obvious improvement has been made in the program operating interface: on-screen operating elements have been graphically redesigned and clarified so that, for example, you can now select detailed depictions of the desired machine type (pump, motor, gearbox, etc.) during alignment job setup.

Several other important, if less immediately visible, improvements have been made as well: entire trains of up to six machines can now be aligned at the same time. Cardan shafts that could previously be aligned only through use of complicated procedures are now handled by a specific program function and can be aligned quickly and easily thanks to a new cardan shaft bracket.

Alignment job setup has been improved, too. Predefined machine setups, known as 'templates', offer a timesaving alternative to keying in all machine dimensions, names etc. before every alignment job. Simply select the most suitable template for the job at hand, make any necessary changes, and you can begin measurement immediately.

Please let us know of your ideas and suggestions for development – by mail, fax or over the Internet at [www.pruftechnik.com](http://www.pruftechnik.com). As always, we will be more than happy to include them in future product versions!

Ismaning, Germany

December 2000  
PRÜFTECHNIK AG

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## **Chapter 1: Introduction**

This manual constitutes the second part of the ROTALIGN PRO instruction series and deals exclusively with shaft alignment of rotating equipment mounted horizontally or vertically. Please consult the first part ALI 9.645G for a detailed description of system components and the third part ALI 9.648G for instructions on the optional program application for straightness measurement.

### **Before you begin**

#### **About this manual**

This instruction manual is divided into five sections:

1. Introduction (safety and operating notes)
2. Machine alignment
3. Alignment options
4. Alignment of special machines
5. Appendix (basics, practical examples, problem solutions)

#### **Everyone**

Please acquaint yourself first with the operating and safety notes given in Part 1, page 1-9.

#### **Beginners**

Read through the sections on the ROTALIGN PRO components (Part 1, Chapter 2) and on alignment theory and practice (page 5-1). Then try an actual alignment, following these instructions.

#### **Experts**

Observe the new procedures described in the system configuration and data handling sections (Part 1, Chapter 3). Follow the guidance messages that appear on screen.



## Intended use

ROTALIGN PRO to be used exclusively in industrial environments for the purposes specified in the respective application instructions published by PRÜFTECHNIK AG. The device and its accessories must be operated only by specially trained personnel.

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

## 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 PRO.



**WARNING!**

This symbol warns of potential hazards.



**ATTENTION**

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

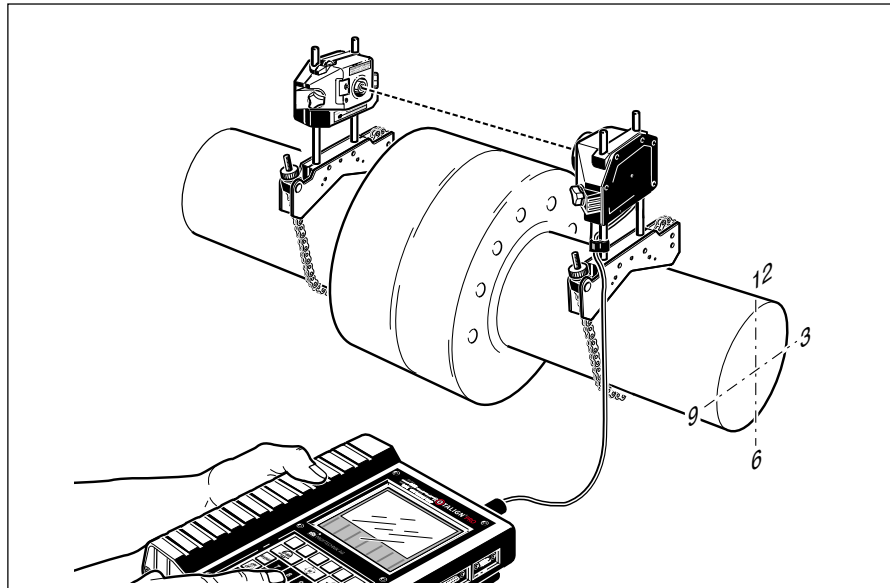


**Note**

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

### ROTALIGN PRO measurement principle

The ROTALIGN PRO alignment system uses a visible laser beam to determine the position of the shafts in space. The laser emitter is mounted on the shaft in front of the coupling and is aimed at the laser receiver mounted on the other side of the coupling.



The receiver contains two semiconductor position detectors that precisely measure the angle of incidence and the position of the beam. When the shafts are turned, the laser beam changes its position in the receiver according to the degree of shaft misalignment. This beam displacement is used along with the distance between the receiver and the coupling and the distance between sensor planes to calculate the precise geometric orientation of the shafts to one another.

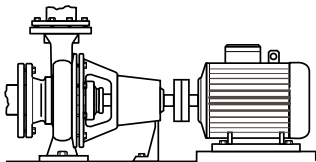
The ROTALIGN PRO computer uses the laser beam coordinates from the detectors to calculate the exact shaft offset and angularity at the coupling plane(s) and displays the alignment condition as a diagram. The vertical and horizontal position values of the machine are displayed for the machine foot locations.

A selection of different measurement procedures allows alignment in special situations such as those presented by uncoupled shafts, cardan shafts or when shaft rotation is limited.

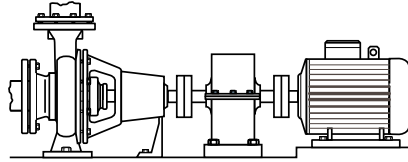
## Chapter 2: Machine alignment

This chapter describes alignment of two horizontally-mounted machines (standard case) and comprises the main part of this manual.

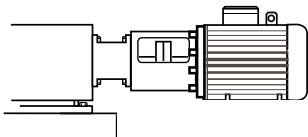
The following examples illustrate a number of typical machine configurations for which ROTALIGN PRO offers the ideal shaft alignment solution:



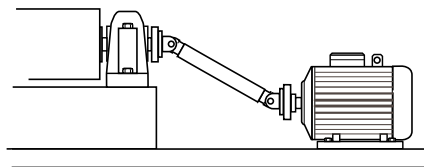
**Standard two-machine configuration**



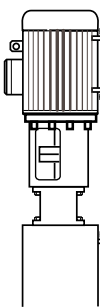
**Machine train of three elements  
(can be up to six machines in all)**



**Horizontal flange-mounted machines**



**Machines joined by cardan shafts**



**Vertical flange-mounted machines**

The following pages outline a typical machine alignment procedure. The numerous options for each step are then explained thereafter.

The alignment of special machines (machine trains, cardan shafts, flange-mounted machines) is described in Chapter 4. All operating steps similar to those already described appear here in brief form along with cross references.

## Alignment preparation

Several points should be checked prior to alignment in order to avoid problems later and to achieve good results.



Tag out (lock out) the machines before beginning work on them!

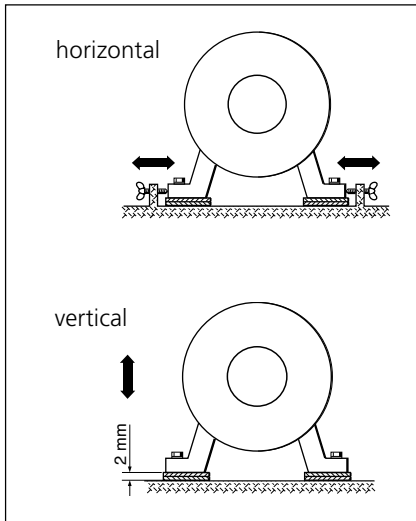
### Foundation

A solid, rigid foundation is essential for successful alignment. Be on the lookout for possible effects of elastic deformation of the foundation or machine frame.

### Machine mobility

If the machine to be moved stands directly on the foundation, 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 5-4). 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:

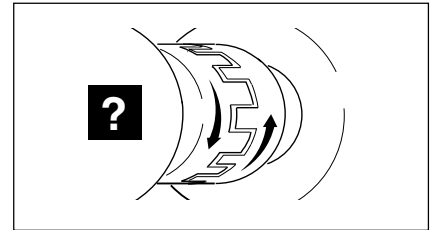
Steam turbines with single bearing shafts: Remove the coupling bolts, split the coupling faces 2-3 mm (1/8") and insert a couple of undersize dummy bolts.

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 3-11) or b) loosen the coupling as above and use the Multipoint mode (page 3-10).

### Coupling play

Excessive torsion play in large couplings can cause the laser beam to leave the detector (such that 'LASER END' appears in the display). Therefore, it is always best to take up the coupling play rotating a few degrees before adjusting the beam, then rotating the shafts in that same direction during measurement. Uncoupled shafts can be measured using the 'Pass' mode described on page 3-11.



When coupling play is suspected:

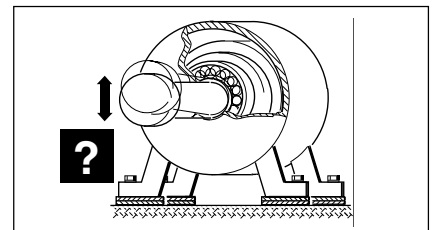
For maximum accuracy during soft foot measurement and alignment adjustment, the shafts should be rotated so that the sensors are oriented horizontally (for horizontal adjustment) or vertically (for vertical adjustment and soft foot measurement).



**Note**

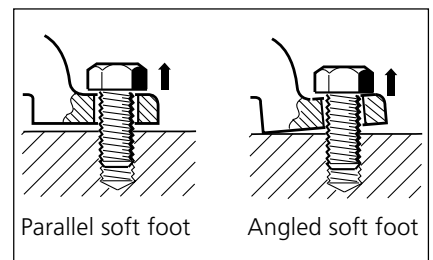
### Bearing play

Excessive radial play of the shaft within the bearing will lead to poor alignment results. The ROTALIGN PRO Soft Foot function can be used to 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.



### 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 cause the machine frame to become distorted when the feet are tightened. 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 PRO soft foot wizard 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 5-3).



### Thermal growth, coupling targets, tolerances

These values consider the machine position during operation and are automatically included in calculations. Tolerances allow objective evaluation of the measured alignment condition. See pages 2-12 and 3-6 for details on entering these parameters.

### Measurement separation

Since ROTALIGN PRO uses no mechanical fixtures to cross the coupling (in contrast to dial indicator-based systems, for example), it can deliver accurate alignment results at separation distances of 10 m / 33 ft. or more between the laser emitter and receiver. Even greater separations can be achieved when angularity is not excessive.

Extremely long shafts may be subject to sag. Coupling manufacturers specify target values to compensate for this.

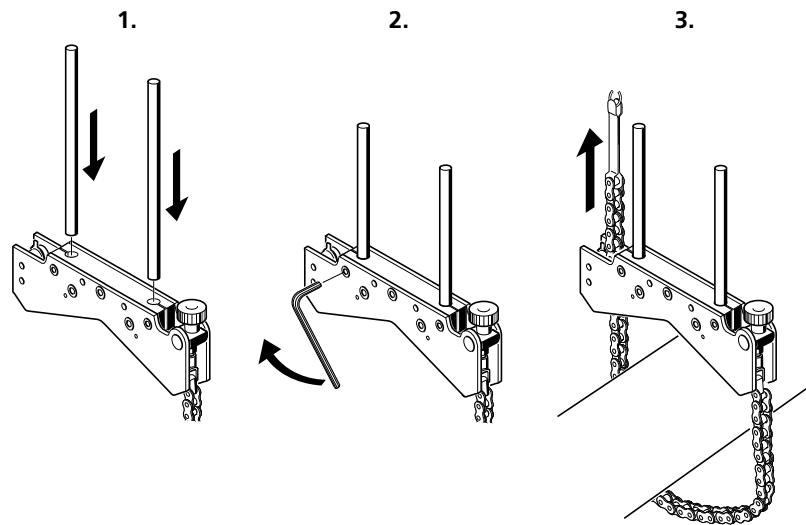


**Note**

## Mounting sensors

A universal chain-type bracket is included in the ROTALIGN PRO case in order to mount the components securely and rigidly onto the shafts.

### Bracket mounting

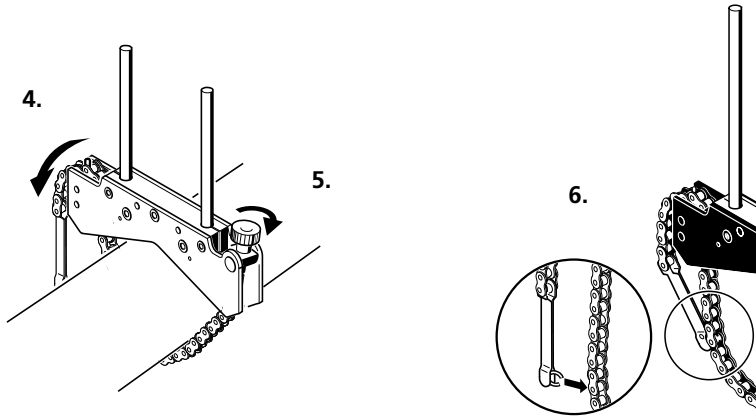


1. Choose the shortest support posts which will still allow the laser beam to pass over the coupling flange. Insert the support posts into the bracket.
2. Fasten them in place by tightening the hex screws on the sides of the bracket frame.
3. Place the bracket on the shaft or coupling, wrap the chain 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.



**ATTENTION**

The bracket must not rub against any part of the machine when the shafts are turned.



4. Catch the chain loosely on the anchor peg.
5. Turn the bracket thumb nut to tighten the assembly onto the shaft.
6. A small clip is provided to secure the loose end of the chain back onto itself.

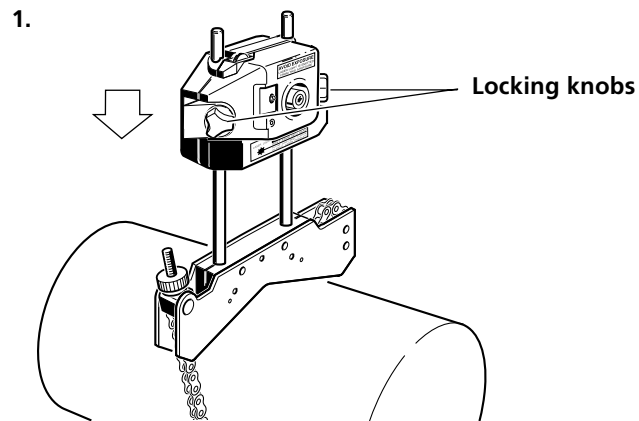
Now the bracket should be tight upon the shaft, without excessive force. Do not push or pull on the bracket to check, since that would only loosen its mounting. To remove the brackets, first loosen the thumbscrew, then remove the chain from its anchor peg.

The compact chain-type bracket is suitable for the vast majority of alignment jobs. Brackets designed for special situations can be found in the appendix of the system operating instructions (Part 1, ALI 9.645G).

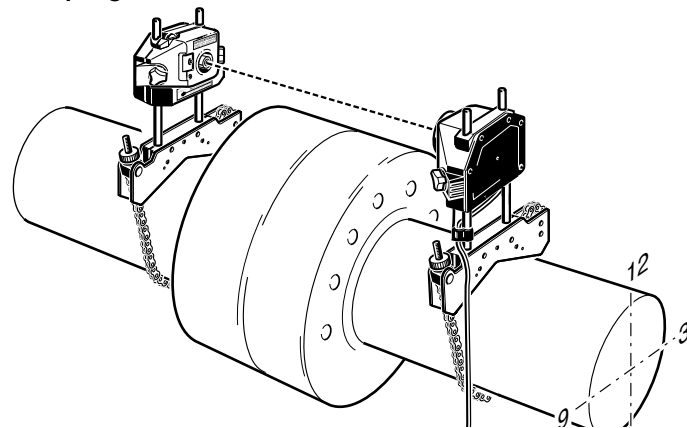
**Mounting laser and receiver**

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).

1. Ensure that the yellow knobs on both components are loosened enough to let you slide the components onto the support posts.
2. 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.
3. Tighten the yellow knobs to lock the components onto the posts, then remove the dust cap from the laser.



2. Mount just high enough to clear coupling





### Connecting the receiver

4. Plug the receiver cable (ALI 3.581-2) into the ROTALIGN PRO computer: note the keyway indicating proper plug orientation, and make sure you hear the plug 'click' securely into place.
5. Insert the right-angled cable end into the receiver socket, noting the keyway orientation, and screw the plug fitting into place.

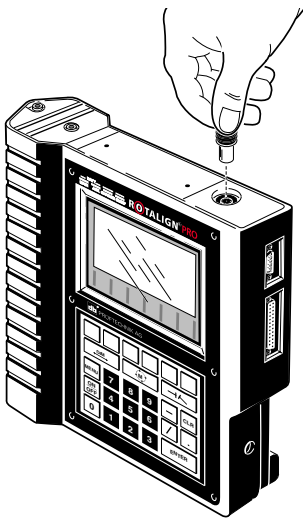
Do not twist the cable when disconnecting it! Otherwise, damage to the conductor pins may result.

The angled plug should be permanently left connected to the receiver, even during storage in its case, as this will help avoid damage to cable pins, plugs and sockets.

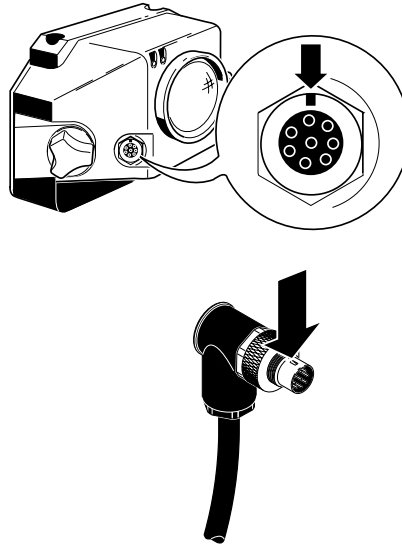


6. Attach the plastic cable clip to the lower portion of the support post as shown. This helps avoid measurement disturbance and damage to the cable or socket if the cable is pulled.

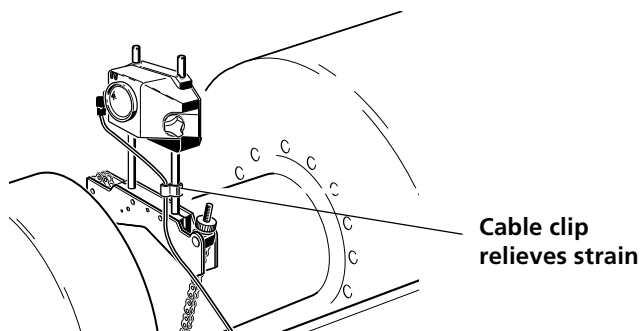
4.



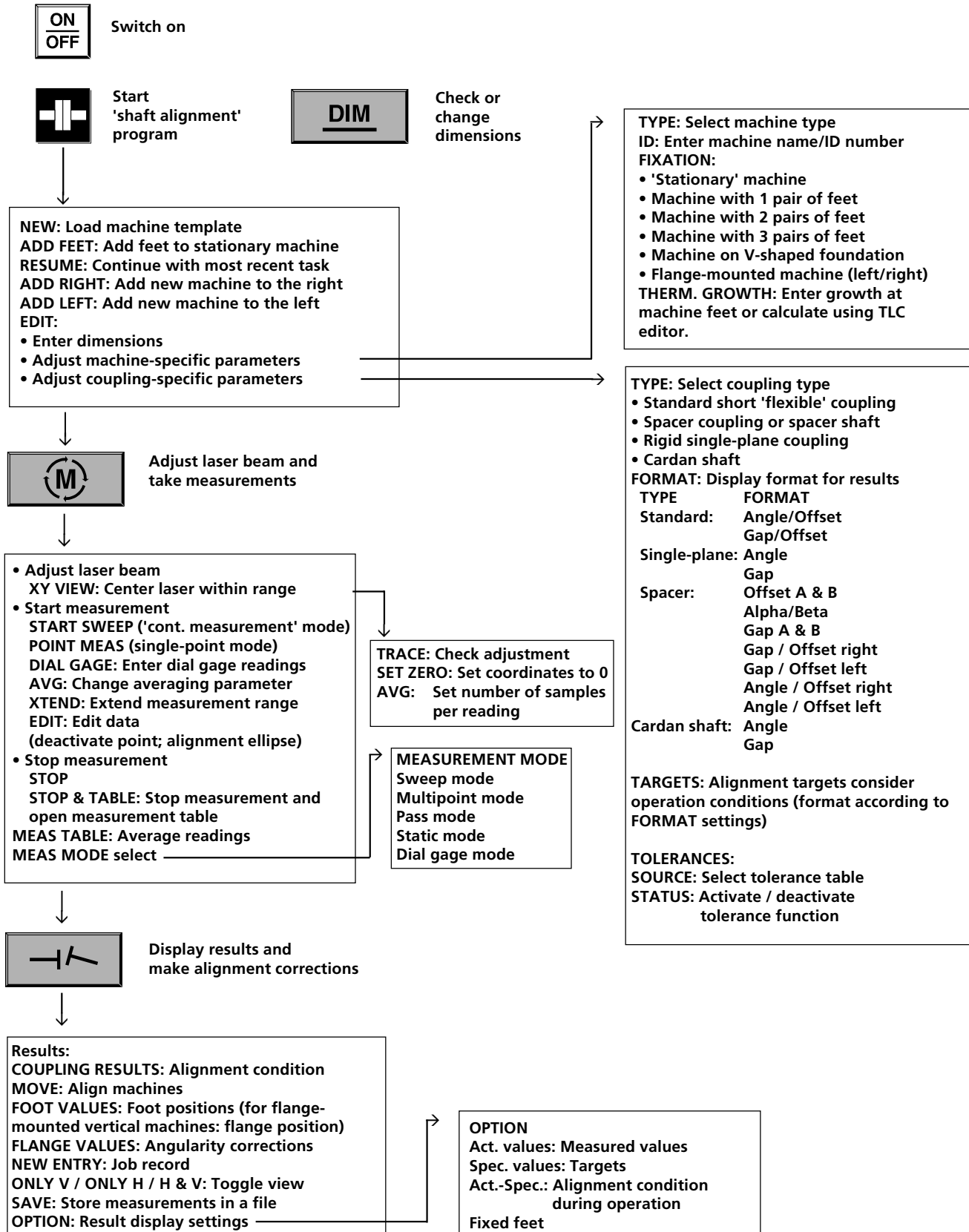
5.



6.

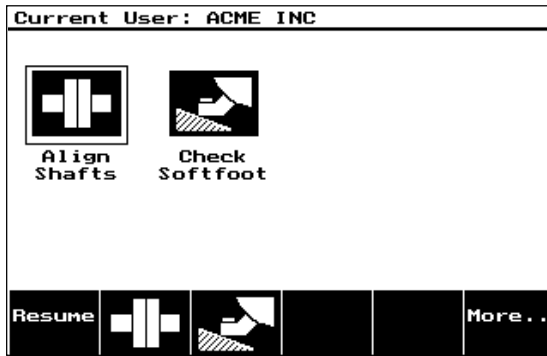


## Alignment overview



### Switching on

Press the ON/OFF key to switch on the ROTALIGN PRO computer. The operating software ('firmware') loads in approx. 10 seconds, and then the opening screen appears:



Return to the most recent application

Proceed to next screen

'Soft Foot' application (page 5-5)

'Shaft Alignment' application program

This screen is the main display of the 'Program Manager', which takes precedence over the individual measurement applications and handles global functions such as file management, PC communication and administration of the computer system. Chapter 3 of the system operating instructions (Part 1, ALI 9.645G) contains detailed information on the Program Manager.

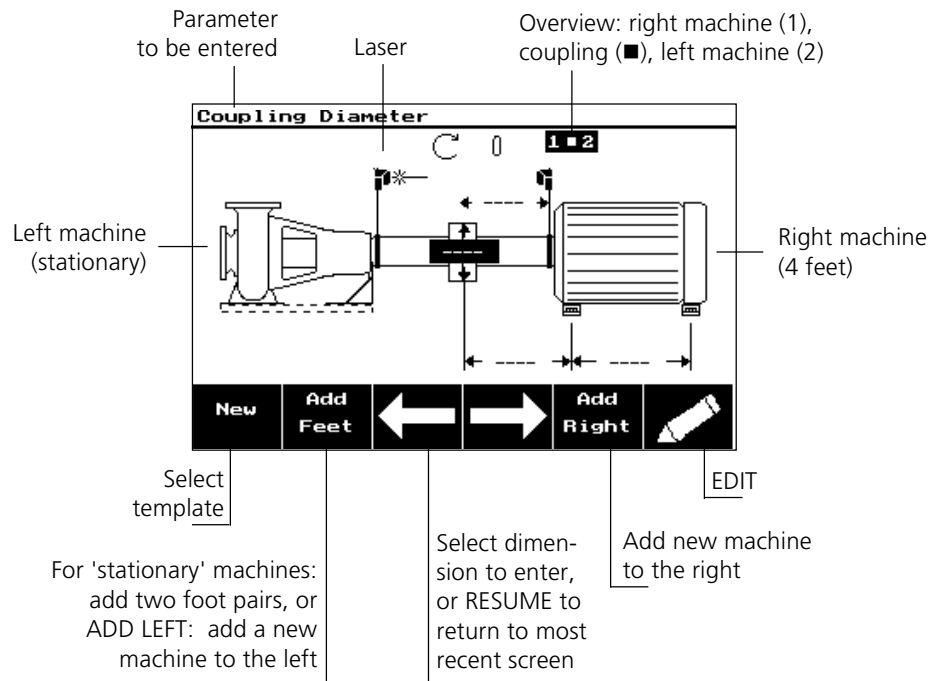
- The six softkeys below the display are used to operate the program. The labels for each of these softkeys appears in the bottom of the screen, so that the function of each key is defined precisely according to the situation at hand (or the screen context; see also the system operating instructions, Part 1).
- The program manager can be accessed at any time by pressing the MENU key and selecting the 'Program Manager' option (page 3-1).
- Screen contrast can be adjusted from the opening screen using the keys '0' and '1'.
- Press the 'Shaft Alignment' softkey to enter the application program.



### Set up machine

The next step is to enter machine dimensions and adjust other parameters.

The 'dimensions' screen depicts the machines to be aligned and their coupling. The dimensions to be entered are marked with arrowheads. The laser emitter is normally mounted on the stationary machine (on the left side by default) and the receiver on the movable machine.



\*User-defined templates can be created only through use of the ROTALIGN PRO Commander program for PC, then downloaded to the ROTALIGN PRO computer.

If you have already established templates\* for your machines, you may open them and begin with measurement (page 2-15) by pressing NEW and selecting the appropriate template. Check the distance 'coupling center to receiver' and change it if necessary, then press the 'M' key.

Changed templates are stored as regular files and can be reopened with the keys 'MENU - File - Open'.

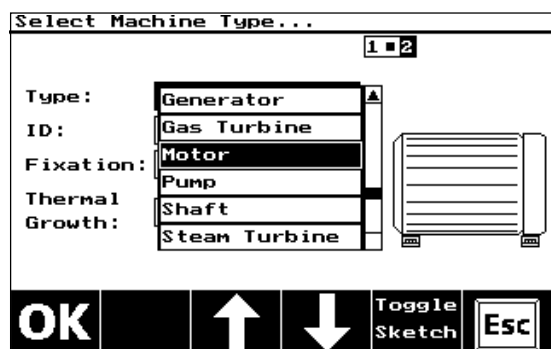
The following steps are to be performed only when necessary. If, for example, the machine type shown in the main screen already matches that of your aggregate, you can skip the following section.



The 'dimensions' screen can be accessed at any time by pressing the 'DIM' key.

### 1. Select machine type

- Use the arrow softkeys to highlight the machine in the display.
- Press the EDIT softkey . The machine selection screen appears with the options 'Type', 'ID', 'Fixation' and 'Thermal growth'.
- Use the arrow softkeys to select 'Type', then press the EDIT softkey:



- Use the arrow softkeys to select the machine type. The 'Toggle sketch' softkey lets you select machine orientation and other variants of the selected machine type (see page 5-15).
- Press the OK softkey to confirm your selection.

### 2. Naming the machine

- Use the arrow keys to select 'ID', then press the EDIT softkey.
- Enter the name using the text editor (see Chapter 3 of system operating instructions Part 1), then press OK to confirm.

The machine setup screen accepts entries up to 14 characters long.  
The dimension screen accepts entries up to 11 characters long.



Note

### 3. Machine mounting type

- Use the arrow keys to select 'Fixation', then press the EDIT softkey.
- Select the type of machine mounting, then press the OK softkey. Besides two or four machine feet, selections are also available for machines with six feet or mounted on V-shaped foundations. The 'Flange left/right' mounting type is usually (but not always) used for vertical machine sets (see page 4-10). Some mounting types require additional dimension information to be entered (page 3-2).

When 'stationary' machine fixation is selected, any thermal growth values entered for the machine are ignored in its alignment results.



Note

#### 4. Thermal growth

- a. Select 'Thermal growth' and press the EDIT softkey.

The machine appears as seen from the side (V) and from the top (H, plan view) with boxes for entering the corresponding thermal growth values. Enter the values here by which the machine rises/sinks or moves laterally as it reaches steady state during operation.



- b. Use the arrow keys to highlight the desired entry, then press the EDIT softkey:



- c. Enter the value on the keyboard and confirm it with the ENTER key.

- Positive and negative values are determined according to the following sign conventions:
  - Side view (V): Positive value = machine moves toward 12 o'clock position.
  - Top (plan) view (H): Positive value = machine moves toward 3 o'clock position.
- Clock positions (12, 3, 6, 9 o'clock) are defined as viewed along the shafts toward the laser.
- The '+' and 'x' softkeys can be used to add and multiply numbers directly in the display. (The '-' and '/' keys on the regular keypad can be used for subtraction and division).
- For machines with more than two pairs of feet, only the front and rear feet must be considered.
- For machines on V-shaped foundations, enter the growth amounts in vertical and horizontal direction.



Note

If no values are already provided for thermal growth compensation, the computer may be used to calculate them (see TLC, page 3-3).

- d. Press the OK softkey to confirm the entry.

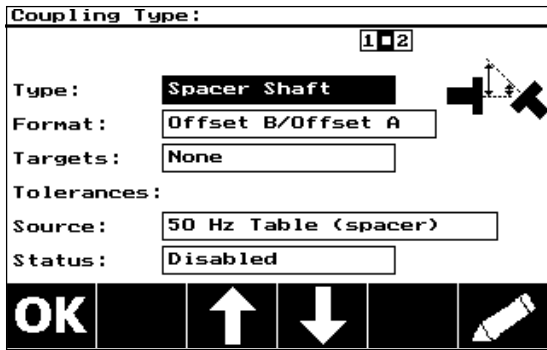


Note

You may proceed directly to the next machine without having to return to the dimension screen: press the 'Next Machine' softkey.

**5. Select coupling type**

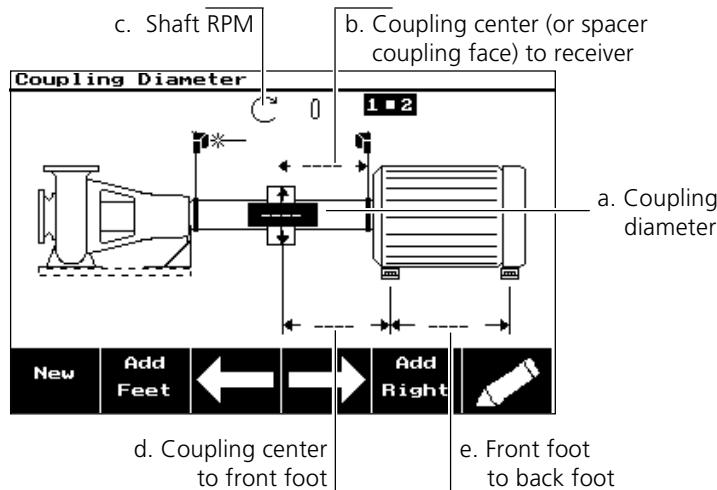
- a. Use the arrow softkeys to highlight the coupling in the dimension screen (page 2-10), then press the EDIT softkey:



- b. Use the arrow softkeys to highlight the 'Type' line, then press the EDIT softkey.  
The selections here include 'Short flex', 'Spacer shaft', 'Single plane' and 'Cardan shaft'. Details on these types and on the other coupling parameters ('Format', 'Targets' and 'Tolerances') can be found in the 'Setup options' section on page 3-2.
- c. Select the appropriate coupling type, then confirm your selection by pressing OK.

**6. Enter dimensions**

The dimensions to be entered depend upon your selections of machines and couplings. The 'Setup options' section on page 3-2 describes special situations. However, certain dimensions must always be entered in order for the computer to calculate alignment:



## a. Coupling diameter

The easiest way to determine this on the spot is to wrap a tape measure around the coupling circumference, then enter this value followed by '/' on the regular keypad, then the 'π' softkey. Press ENTER to confirm, and the computer calculates the diameter – or simply enter a generic diameter for tolerance comparisons.

## b. Coupling center to receiver

Measure from the center of the coupling to the white marking on the top of the receiver housing.

## c. Shaft RPM

The RPM is used to determine tolerances for evaluation of measured alignment condition. The higher the operating speed, the greater the alignment precision required.

## d. Coupling center to front foot

Measure the distance from the center of the coupling to the front foot of the machine. If a beam deflector (ALI 3.579, see the 'Accessories' section of the system operating instructions, Part 1) is available, you can determine this distance as follows:

- Place the beam deflector on the receiver, switch the laser emitter on and adjust the beam into the receiver lens.
- Rotate the beam deflector so that the laser beam strikes the base.
- Measure the distance from the laser spot to front foot and add this value to the distance from coupling center to receiver (see step b above). The distance from the deflector mirror to the white marking on the receiver housing is 50 mm / 2 in. and must be considered in this calculation.

## e. Front foot to back foot

For machines with three pairs of machine feet, the distance to the middle pair of feet must also be entered.



**Note**

Press the ENTER key to 'jump' directly to any dimension that may still be missing (except RPM and receiver-to-coupling distance), even in a different machine within the train.



## Laser beam adjustment

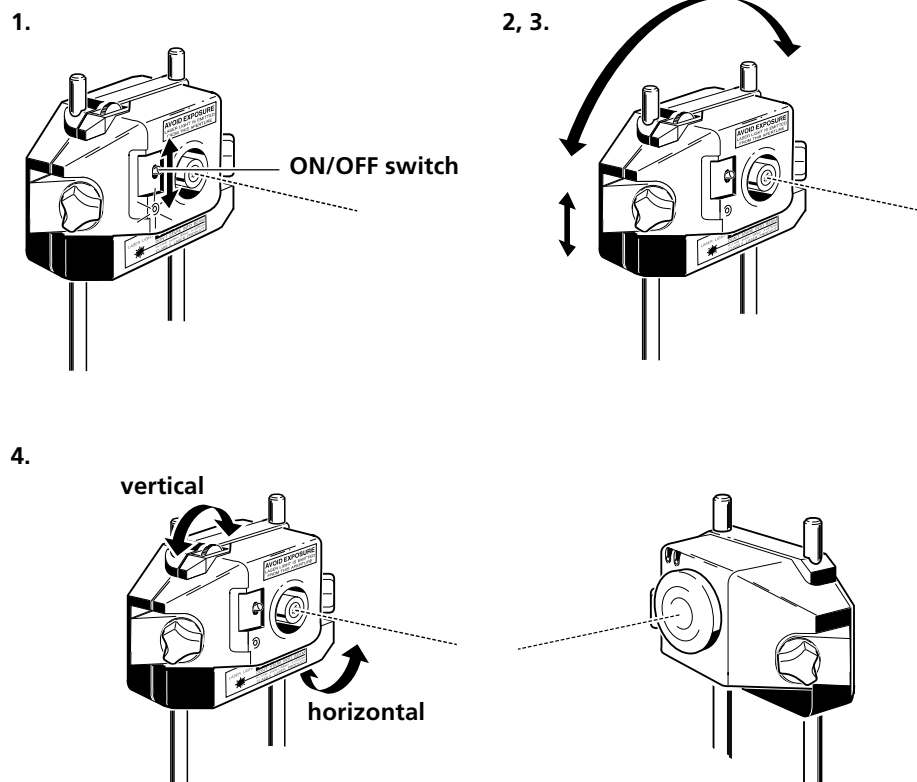
1. Remove the protective cap from the laser emitter and switch it on if you have not already done so.

Do not stare into the laser beam!



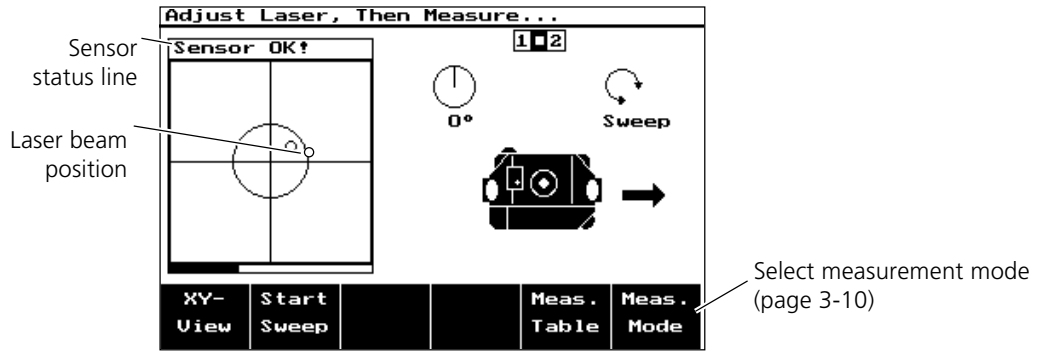
2. If the laser emitter and receiver have been roughly positioned to each other during mounting (see page 2-6), the laser beam should strike the red cap of the receiver. If not, use a white piece of paper to locate the beam and readjust it onto the receiver as follows:
  3. Reposition the components until the laser beam strikes the receiver cap:
    - vertically: loosen the locking knobs and adjust the height.
    - horizontally: loosen the bracket and turn the laser and/or receiver brackets into line with one another.
  4. Use the adjustment wheels on the laser emitter to center the laser beam on the receiver cap, then remove the cap.

The adjustment tube ALI 3.608 can be very helpful when misadjustment is great, especially over great separations (see page 3-9).





- Make sure that the receiver is connected correctly to the ROTALIGN PRO computer, then press the M key. The adjustment screen now appears:



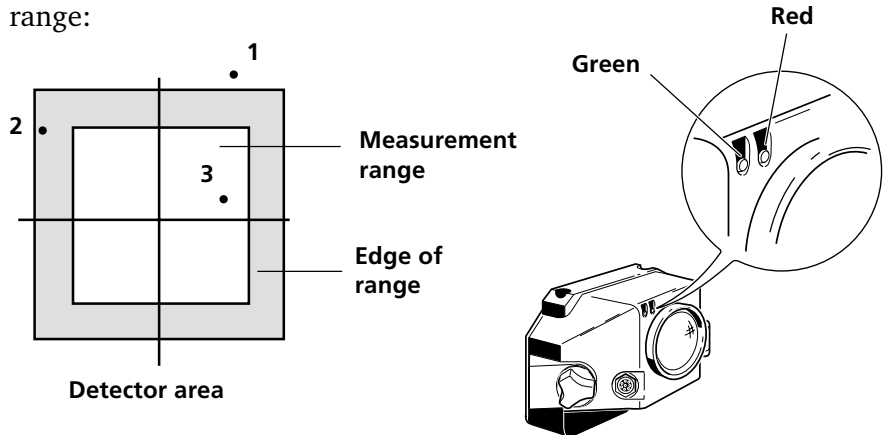
- The position of the laser beam is marked with a large dot on the axes in the left portion of the screen. If the beam strikes the receiver at an excessive angle, its position on the two position detectors within the receiver is shown by two dots instead of only one. Use the adjustment wheels on the laser emitter to bring the beam into the inner circle.

The sensor status line informs you of the momentary receiver condition. The status messages are explained in detail in the appendix on page 5-14.

The 'XY-view' shows the position of the laser beam as it strikes both the front and the rear position detectors. This allows you to center the beam and verify that it is perpendicular to the detectors (page 3-9).

**Receiver status LEDs**

The LEDs on the front of the receiver housing can also help with beam adjustment. The green and red LEDs blink or glow steadily according to the beam position with regard to the measurement range:



Beam location	Red LED	Green LED	Status message
1. Out of range	on (steady)	off	'LASER OFF'
2. Edge of range	alternating	↔ alternating	'LASER END'
3. Inside range	off	blinks slowly	'Sensor OK'

### Taking measurements

Once the beam is centered, the display automatically switches over to measurement mode and the display prompts you to 'Turn Shafts'. The standard measurement mode is the continuous 'sweep' method, which automatically begins measurement when the shafts are rotated.

Details on the other measurement modes can be found in the 'Measurement options' section on page 3-10.

If the laser is not centered (with 'Sensor OK!' in the status line), you may press the 'Start Sweep' softkey to begin measurement manually:



Sensor rotation angle (viewed from receiver to laser emitter)

Measurement mode

Total rotation (min. 75° required)

Stop & display table (page 3-15)

Edit raw data (page 3-13)

1. Rotate the shafts in the direction of operation in a single sweep, if possible. Shafts must be turned by at least 70°.
  - The receiver records the position of the laser beam and the corresponding rotation angle. The computer uses this data to calculate the alignment condition at the coupling.
  - The slower the shafts are rotated, the greater the number of points continuously measured over a given rotation angle and the higher the accuracy of results.
  - If shaft rotation is restricted, a different measurement mode may be more suitable. See page 3-10 for details.



2. Press the STOP softkey to quit measuring and to display results.

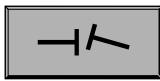
Measurement points (max. 128 for 'sweep' mode)

Measured alignment condition expressed at the coupling

Measurement table (page 3-15)

**Evaluating results**

Press the 'results' key to switch to the results screen:



**Feet Results [mm] (as left)**

Alignment in

vertical plane (V)

horizontal plane (H)

Smiley (tolerance)

0.10	0.71
0.00	0.15

MOVE (page 2-20)

Coupling values

Save (page 2-22)

History (page 2-22)

Options (page 2-19)

Change view

This display shows the measured alignment condition along with numerical values for the actual machine feet positions. Any targets that were entered are taken into consideration; i.e. the machines are shown just as they would stand under operating conditions. Thermal growth, however, is ignored for machines defined as 'stationary' (see page 2-11).

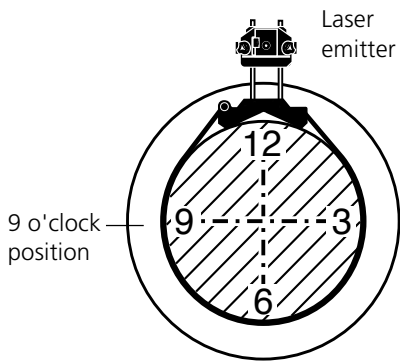
This default view can be set to display machine foot values or coupling alignment values through use of the ROTALIGN PRO Commander software for PC.

**Sign convention**

Positive = machine feet too high (vertically) or too far away from viewer (horizontally); the viewer is considered to be standing in front of the machines as they appear in the display (or at 9 o'clock position as shown at left).

**Coupling values**

Press the 'Coupling' softkey to display the alignment condition at the coupling; the screen layout is the same as that shown above except for the numerical results:



Coupling results are shown in the form of gap and offset values.

V	-0.27 mm	-0.37 mm
H	-0.07 mm	-0.11 mm

-0.37 mm

Shaft centerline offset at the coupling center

-0.27 mm

Gap width (angularity) specified for the coupling diameter entered in the dimensions screen

### Sign convention

- Offset: negative = right machine (to be moved) is offset toward 6 o'clock (vertically) or toward 9 o'clock (horizontally).  
Clock positions are determined as viewed along the shafts toward the laser.
- Gap: negative = coupling opens toward the bottom (vertically) or toward the viewer (horizontally).

### Alignment quality

The 'smiley' symbol on the left side of the screen indicate how well the measured alignment condition meets tolerances:



The smiley face appears only when the 'Tolerance' option is activated (pages 2-13, 3-7). If all results lie within tolerance, no alignment corrections are necessary.

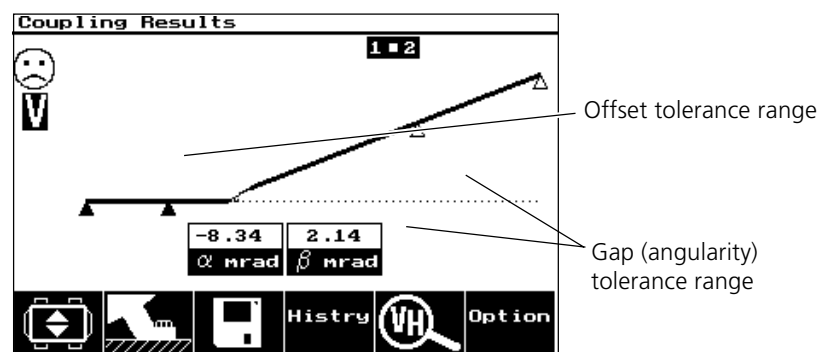
### Select view

Press the 'Change view' softkey to obtain the desired depiction (vertical only, horizontal only, or both in the same display):



### Options

The results screen automatically shows the alignment results relative to targets ('actual value' minus 'specification value').



To view the alignment condition as measured, press the OPTION softkey and select 'actual'. The receiver symbol appears in the top of the screen.

If only 'spec' values (targets) are selected, the target symbol appears in the display.

The 'Fix Feet' option lets you specify which machine feet are to be considered stationary. This option is especially helpful during machine train alignment (page 3-17).



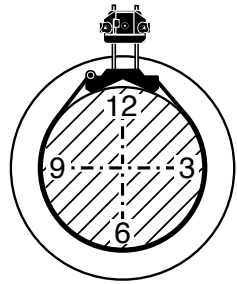
## Correcting alignment

The advanced design of the receiver allows you to follow alignment corrections in a real-time interactive display.



Note

Be sure to eliminate soft foot (page 5-5) and to start the MOVE function before loosening the machine foot bolts! Otherwise, the machine can change its position before correction, jeopardizing your chances for good alignment.



### 1. Raise/lower the machine

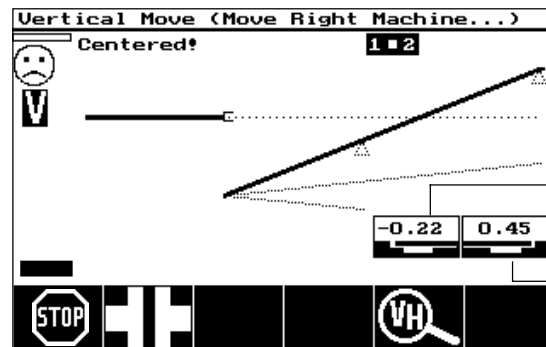
- Press the 'V' key to switch the display to vertical alignment.
- Turn the shafts so that the sensors are oriented vertically (12 o'clock - 6 o'clock direction). This position is especially important when coupling play is present.
- Press the MOVE softkey.
- Confirm 'Move right machine' or 'movable feet'; this selection depends upon the 'fixed feet' selected (page 3-17). The program starts the receiver and switches to correction monitoring mode.



Note

If the laser beam is not centered on the receiver, the program automatically switches to an 'XY-View' of the position detectors: readjust the beam as directed on page 2-16, then press OK to proceed.

If values appear to fluctuate on their own, stability may be enhanced by pressing the AVG. softkey and raising the number of readings (and length of time) taken and averaged together for display.



Front feet to be raised by 0.22 mm

Rear feet to be lowered by 0.45 mm

- Place shims of the indicated thickness beneath the feet on both sides of the machine. Remember that positive values mean that the machine must be lowered (see 'Machine mobility', page 2-2).



Note

If the laser beam leaves the receiver during positioning, the program interrupts correction monitoring and displays 'Laser off' (or 'Laser end') in the status line. In that case, you must extend the measurement range as follows:

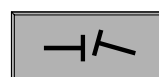
- Move the machine back until 'Sensor OK' or 'Centered' reappears in the status line, then
- Press M, then 'XY-View' and readjust the laser beam (see pages 2-16, 3-9).
- Now press OK, then the Results key. Press MOVE again to resume positioning from step b above.

- Tighten the foot bolts back down, then press the STOP softkey.

## 2. Remeasure

Take another set of alignment readings before beginning lateral positioning, in case the machine has shifted slightly during shimming.

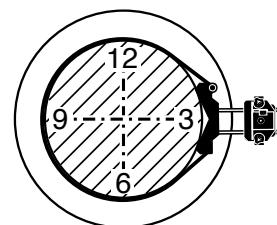
- Press the 'M' key and take a new set of readings (page 2-16).
- Then switch to the results screen and check the corrected vertical alignment condition. If it still fails to fall within tolerance, adjust shimming as indicated on the previous page (see also 'Alignment problems' on page 5-14).



## 3. Lateral positioning

If the horizontal alignment condition (page 2-18) fails to fall within tolerance, the machine must be positioned laterally.

- Turn the shafts so that the sensors are oriented horizontally (3 o'clock - 9 o'clock direction).
- Press the MOVE softkey in the results screen.
- Select 'Move right machine' or 'movable feet' as required.



If the laser beam is not centered on the receiver, the program automatically switches to an 'XY-View' of the position detectors: readjust the beam as directed on page 2-16, then press OK to proceed.

If the laser beam leaves the receiver during positioning, the program interrupts correction monitoring and displays 'Laser off' (or 'Laser end') in the status line. In that case, you must extend the measurement range as follows:

- Move the machine back until 'Sensor OK' or 'Centered' reappears in the status line, then
- Press M, then 'XY-View' and readjust the laser beam (see pages 2-16, 3-9).
- Now press OK, then the Results key. Press MOVE again to resume positioning from step b above.



**Note**

If values appear to fluctuate on their own, stability may be enhanced by pressing the AVG. softkey and raising the number of readings (and length of time) taken and averaged together for display.



- Press the 'Foot' softkey if necessary.
- Loosen the foot bolts while observing the screen. If the displayed values change, soft foot is present and must be eliminated.
- Press the 'H' key to switch the display to horizontal alignment.
- Move the machine feet using jack screws or hydraulic tools (see page 2-2). Positive values mean that the machine must be moved in 9 o'clock direction.

Never use a sledgehammer to move the machine! This method is not only imprecise, but can damage machine bearings as well.

- Follow the movement on the screen as the values fall within tolerance.
- Tighten down the machine foot bolts, press the STOP softkey, then take a final set of readings (see above) to confirm the alignment condition.



**ATTENTION**

## Saving measurement results

Before concluding the alignment job, you should save the results so that they remain available for future use.

ROTALIGN PRO lets you document each individual step of the alignment procedure in a detailed 'job record'.

### 1. Job record



- Press the 'History' softkey in the results screen.

Job Record		
Info	Date	Time
as left	03.04.1998	15:58
after shimming	07.04.1998	14:04
Current Selection		
View	New Entry	↑ ↓

Record entry

Show result



- Press the 'New Entry' in the job record screen and select a suitable label or enter your own using the text editor.



The VIEW softkey displays the alignment results for the selected record entry.



Note

Measurements recorded in a job record are marked as such in the measurement table (see page 3-15). The measurement cannot be deleted from the table until it has been unmarked.

### 2. Saving results



- Press the 'Save' softkey in the results screen.
- If so desired, comments regarding the measurement location can be entered by selecting 'Edit Location' in the File Operations menu, then the OK softkey. Select a blank line, press the EDIT softkey, and enter the desired text using the text editor (see system operating instructions Part 1, Chapter 3).
- Select 'Save as' and enter the file name using the text editor.



The same file name can be used more than once without overwriting the older file, since the file system uses its own identification. However, files with identical names can be distinguished only by their detailed information such as creation date, last measurement, etc.

The 'View Info' selection displays the user information, which can be edited only from the Program Manager (see system operating instructions Part 1, Chapter 3).

Always make a copy of important files on data storage medium (using the ROTALIGN PRO Commander program for PC) and on paper. PRÜFTECHNIK AG can assume no liability for lost or altered data!



Note



ATTENTION

## Switching off

- Press the ON/OFF key to switch off the ROTALIGN PRO computer. If results have not been saved, the following query appears:

'Save changes in file  
*filename?*'

You now have approx. 10 seconds to decide whether to 'save' 'don't save' or 'cancel' (i.e. do not switch off) before the computer saves all changes to a file and switches off.

The current measurement data remains in the working memory and can be loaded directly after the computer is restarted; press the 'Resume' softkey to do so (see page 2-9).

- Switch the laser off and replace the caps on the laser emitter and receiver.
- Remove the components from the machine.

Leave the receiver connected to the computer when you store the system in its case. If an extended period of nonuse is anticipated, remove the batteries from the computer and the laser emitter. (An internal battery will preserve all stored data.)



Be sure to remove all ROTALIGN PRO components from the shaft (or coupling) before starting up the machines. Otherwise, serious bodily injury may result from flying parts!



WARNING!

blank page

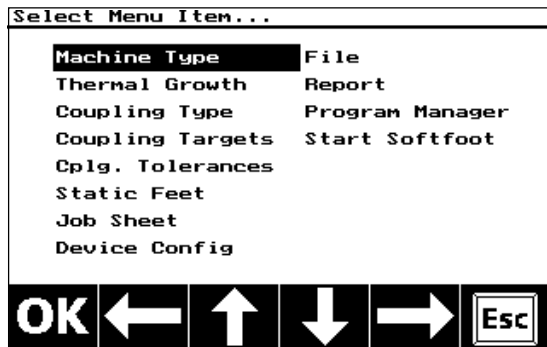
## Chapter 3: Alignment options

The functions and procedures described thus far offer a solid framework for standard alignment.

But ROTALIGN PRO would not be the ultimate professional alignment system if it did not offer further selections and adjustments. The options described in this section have been omitted from the previous chapter in the interest of clarity. Here they are arranged by program function, e.g. 'setup options', 'measurement options' and 'alignment options'.

### Menu key

The menu key offers direct access to the options most frequently used, which otherwise could only be reached by stepping through numerous submenus. This key thus acts as a time-saving shortcut.



<b>Machine type</b>	Select machine type (page 2-11)
<b>Thermal growth</b>	Enter thermal growth values (page 2-12)
<b>Coupling type</b>	Select coupling type (page 2-13)
<b>Coupling targets</b>	Targets compensate the coupling alignment for conditions during operation (page 3-6)
<b>Coupling tolerances</b>	Select tolerance range (page 3-7)
<b>Static feet</b>	Select non-movable machine feet (page 3-17)
<b>Job sheet</b>	Documentation of alignment steps and results (page 2-22)
<b>Device Config</b>	Select computer settings (see system operating manual Part 1, Chapter 3)
<b>File</b>	File handling (new, open, save, ....)
<b>Report</b>	Print alignment report (page 3-18).
<b>Program Manager</b>	Open Program Manager (close application)
<b>Start Softfoot</b>	Start program for eliminating soft foot (page 5-5)

**DIM**

**'Setup options**

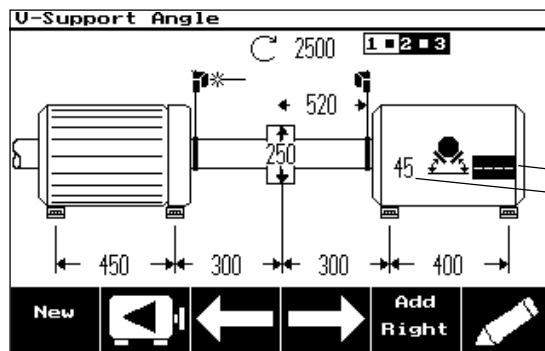
The description of machine 'dimensions' (page 2-10) has already given a brief introduction to the most basic steps in machine setup. Details and advanced settings are described here.

**Machine mounting**

'Six feet': Here the distance from front to middle feet is also required. The results screen then includes corrections for the middle feet.

'Two feet': This mounting type requires entry of only the distance from the machine feet to the coupling.

'V-shaped foundations': The program requires entry of the angle between support surfaces and foundation in order to calculate corrections. Enter this angle as follows:

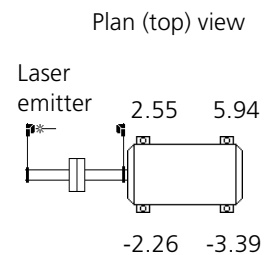
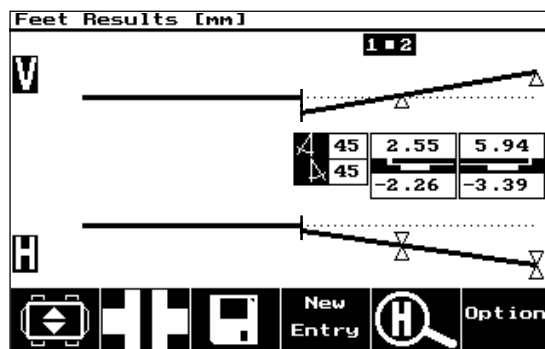


Support angle (viewed from behind):  
 Right side  
 Left side

- 0°: Feet are parallel to foundation
- 90°: Feet are perpendicular to foundation

All alignment corrections are achieved solely by inserting and removing the proper combination of shims; corrections are indicated for each individual machine foot to yield the required horizontal and vertical displacement for the machine upon angled supports.

These corrections correspond to the values in the results screen as follows:



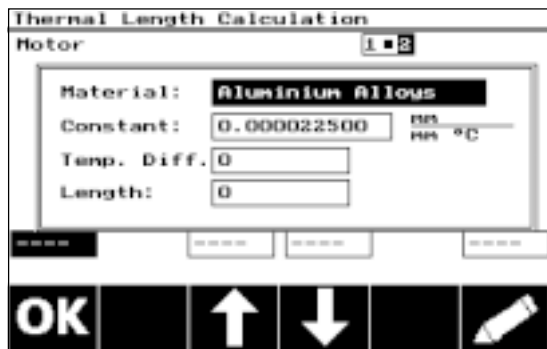
### Thermal growth editor

The ROTALIGN PRO computer may be used to calculate thermal growth compensation if no other values are available.

As a rule, several different machine elements (e.g. housings, bearings and feet) all contribute to total thermal growth. The TLC (Thermal Length Calculation) editor allows calculation of growth for each individual element; these amounts can then be added together (page 2-12, step 4c) and the total value then entered for the respective machine foot location.

The computer calculates thermal growth for the machine element from its material (thermal growth coefficient), its original length dimension and the expected temperature difference.

1. Open the thermal growth screen (page 2-12).



TLC  
Editor

2. Press the 'TLC editor' softkey:
3. Enter the required information and confirm each entry with the ENTER key.
4. Press the OK softkey to close the TLC editor screen.  
If an additional machine element must be included, press the '+' softkey and then 'TLC Editor'. Repeat the entry procedure described above.

### Thermal growth of a 'stationary' machine

If a 'stationary' machine is affected by thermal growth, this effect can be compensated in the corrections for the machine to be moved:

1. Change the 'fixation' parameter of the 'stationary' machine from 'stationary' to the number of machine feet.
2. Select the 'thermal growth' parameter and enter the growth values.

The formerly 'stationary' machine now appears in the results screen with machine feet, but they are still defined as 'fixed' (solid).

### Coupling type

You may select among the following coupling types:

**Short flex:** These couplings feature fitted transmission elements with play (such as teeth, claws or bolts) or elastic connecting elements like rubber 'tires' or springs.

**Spacer shaft:** When the coupling halves are joined by a spacer element, its length must be entered.

**Single plane:** The coupling halves are bolted directly together. Loosen the bolts before taking measurements, since they would otherwise distort the true alignment condition.

**Cardan shaft:** Just as with regular spacer shafts, the shaft length (between coupling planes) must be entered. This selection activates the special cardan shaft alignment function of ROTALIGN PRO.

### Coupling results format

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

Short flex:



#### Angle / Offset

Shaft angle and offset at the coupling plane



#### Gap / Offset

Gap width at edge of coupling and shaft centerline offset

Single-plane and cardan shafts: Only angularity is of concern with these coupling types.



#### Angle

Shaft angle



#### Gap

Gap width at edge of coupling

Spacer shaft: Two coupling planes must be considered, resulting in a seven different possible combinations of formats:



**Offset B / Offset A**

Shaft offset at left (B) and right (A) coupling faces.



**Alpha / Beta**

Angle of shafts to spacer shaft centerline ( $\alpha$ : left machine)



**Gap/Offset, right coupling**

Gap and offset of right shaft to spacer shaft



**Gap/Offset, left coupling**

Gap and offset of left shaft to spacer shaft



**Angle/Offset, right coupling**

Angle and offset of right shaft to spacer shaft



**Angle/Offset, left coupling**

Angle and offset of left shaft to spacer shaft



**Gap A / Gap B**

Gap at edge of left coupling (A) and right coupling (B) of spacer shaft

**Sign convention**

Vertical alignment plane:

- Offset is positive when the right shaft centerline is higher than the left centerline.
- Gap and angularity are positive when the coupling opens toward the top.

Horizontal alignment plane:

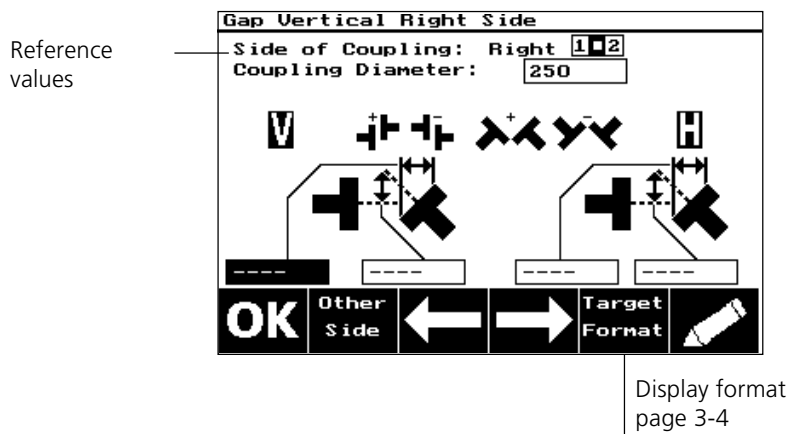
- Offset is positive when the right axis is further away from the viewer than the left axis.
- Gap and angularity are positive when the coupling opens away from the viewer.

\*Such values can generally be found in the machine documentation or upon request from the manufacturer.

### Targets

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

The coupling type (page 3-4) determines the targets to be entered. The following example is for a short flex coupling:



Coupling side: the reference plane can be changed according to the coupling target specification using the 'Other Side' softkey.

Coupling diameter (only for 'Gap/Offset':) Enter the coupling diameter according to the target specification; this diameter can be different than that entered in the 'dimension' screen.

Spacer shaft targets are entered according to the respective display format setting (page 3-4). The coupling diameter and/or spacer length serve as reference values.

The results screen (page 2-18) automatically shows the alignment condition relative to targets ('Act. - Spec.'). The condition as measured can be viewed by pressing the 'Option' softkey and selecting 'Act.'. The 'Spec.' option displays the optimum machine position at rest, i.e. during alignment.

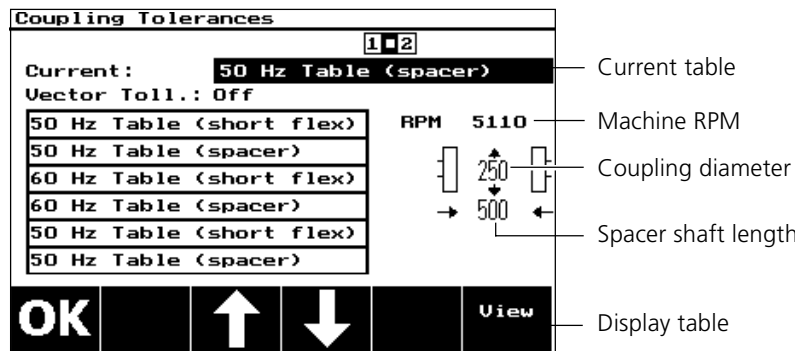


**Tolerances**

Alignment quality is evaluated through comparison with tolerances based primarily upon machine size and RPM. Large machines with large couplings and low RPM are less affected by, say, 0.07 mm offset than a small machine operating at higher speed.

The tolerance ranges are therefore compiled as tables according to coupling type and diameter as well as RPM. The latter is listed in multiples of 750 RPM or 600 RPM for machines operating from 50 Hz or 60 Hz supplies, respectively.

Tolerance evaluation is activated and deactivated in the 'status' area of the 'coupling setting' screen (page 2-13). When active, the tolerance function uses 'smiley' symbols to indicate alignment quality in the results display (page 2-18). Select tolerance parameters by pressing the 'Tolerance/Source' softkey from the results display or selecting the 'coupling tolerance' option from the menu (page 3-1):



Vector Tol. Off: The alignment quality is evaluated separately for vertical and horizontal alignment planes.

Vector Tol. On: The offset values in the two alignment planes are combined into a vector which is then used to evaluate alignment quality.



Select a table type and press the View softkey:

The following screen shows tolerance values based upon manufacturer specifications:

RPM	Acceptable [mm]	Excellent [mm]
750	1.25	0.75
1500	0.60	0.35
3000	0.35	0.20
6000	0.15	0.10
5110	0.21	0.13

Annotations:  
 - Current table: Points to the table title 'Table: 50 Hz Table (spacer)'.  
 - Tolerances for selected RPM: Points to the tolerance values in the table.  
 - Change RPM: Points to the pencil icon at the bottom right.

Type: Interpolation procedure for intermediate RPM values; 'linear' = linear interpolation; 'discrete' = intermediate values are placed at the next higher step.

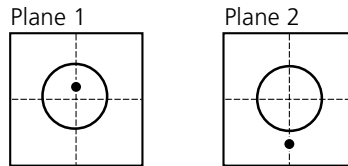
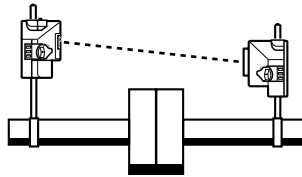
Format: Display format (according to display format setting for coupling results, page 3-4).

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

The 'EDIT' softkey can be pressed to enter a new RPM setting.

### Adjustment options

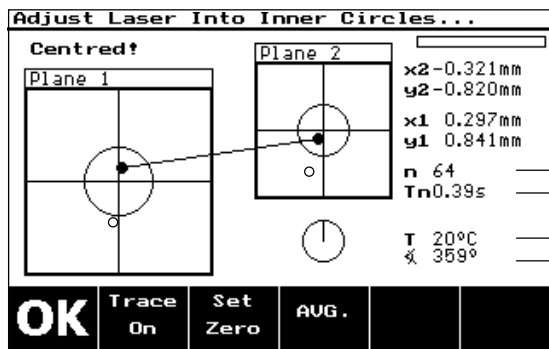
Before measurement begins, the laser beam must usually be adjusted into the receiver (page 2-15). The beam should strike both of the receiver's position detectors as close to their centers as possible. To facilitate adjustment, the laser and receiver height should be aligned and the brackets should be rotationally aligned.



Laser emitter and receiver are not at same height and/or are laterally misadjusted.

Front position detector (plane1):  
Beam is centered within measurement range.  
Rear position detector (plane 2):  
Beam is outside measurement range.

The adjustment screen (page 2-16) appears when the 'M' key or 'Adjust' softkey is pressed. The option 'XY View' can be activated to help meet the requirements mentioned above.



#### XY View

- Coordinates
- No. of readings to average
- Cycle time
- Ambient temperature
- Rotation angle

This screen shows the beam position in both detectors along with their (x, y) coordinates and the beam path between them.

Adjust the beam so that it falls within the target circles of both detectors if at all possible. The 'trace' softkey can help with adjustment by letting you follow the beam path in the detectors.



Set zero: The adjusted beam position is set to '0' to serve as a reference; the 'Absolute' softkey can be pressed to return to the original status.



AVG.: When measurement separation is great or when air turbulence is encountered (e.g. from heat sources or steam) over the beam path, the number of readings to average per measurement can be raised to enhance accuracy. The measurement cycle time increases accordingly.



This averaging setting also applies to the 'multipoint' and 'static' measurement modes (page 3-10). 'Sweep' and 'pass' mode measurements are always made with eight readings per measurement.





**Measurement options**

ROTALIGN PRO offers several different measurement modes with which nearly any alignment situation can be mastered. Besides the standard 'sweep mode', the following modes are also available:

- Multipoint measurement
- Pass mode
- Static measurement
- Dial indicator values (conversion of results between ROTALIGN PRO and dial indicator readings; see page 5-12)



Press the 'Meas. mode' softkey in the beam adjustment screen (page 2-16). You may then select among the following modes:

Press the 'M' key twice to set measurement to 'sweep mode'

**Continuous 'sweep' measurement**



This measurement mode is the quickest and easiest way to determine the shaft alignment condition, and so it is used as the default mode for most alignment jobs.

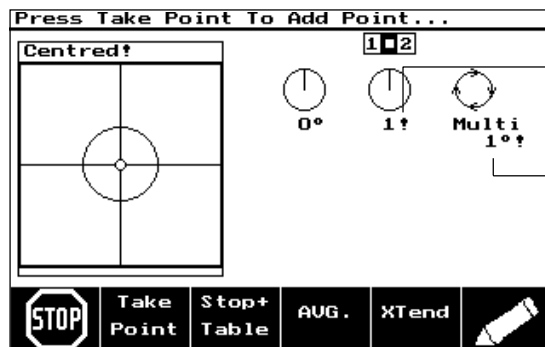
When the shafts are rotated through at least 75° in any direction, the receiver continuously records measurements. The screen prompts the user to 'turn shafts' (page 2-17) before and during measurement.

**Multipoint measurement**



This mode is used to measure shafts which are difficult to turn continuously or which allow measurement only in certain rotation positions. The shafts are rotated from one measurement position to the next, stopping to press the 'Take point' softkey at each position. Measurements must be taken in at least three positions over at least 70° of rotation. (Five positions, however, will yield more reliable results.)

An exclamation point indicates that measurements taken thus far may not reliably indicate the true alignment condition.



Measurement positions and number of measurement points (min. 3)  
Rotation angle (min. 75°)

Number of readings to average (page 3-12)

Extend measurement range (page 3-14)

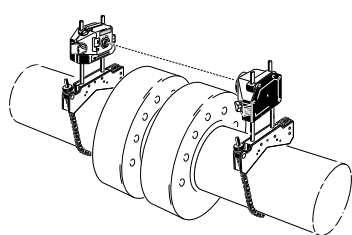
Edit raw data (page 3-13)



Measurement begins as soon as the 'Take point' softkey is pressed. According to the number of readings set for averaging, you may have to wait several seconds before turning the shafts further.

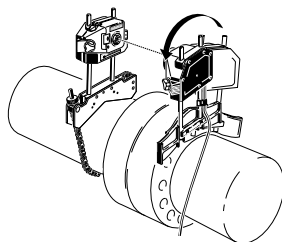
### Pass mode

Uncoupled or nonrotatable shafts (one or both) can best be measured in 'pass' mode, where the laser emitter is rotated past the receiver in several different rotational positions. The sensors can be mounted in any of several different ways, depending upon the particular alignment situation:



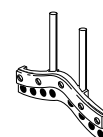
#### Uncoupled shafts:

Mount sensors using chain-type brackets



#### Nonrotatable shaft(s):

Mount sensors using magnetic sliding bracket (ALI 2.230).



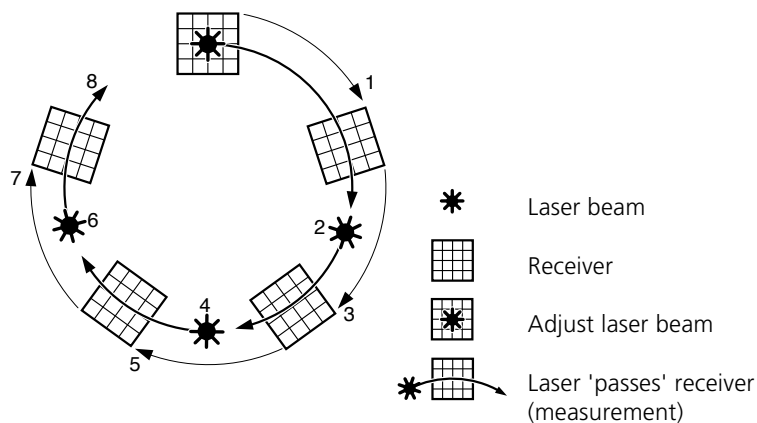
ALI 2.230

One nonrotatable shaft: mount the receiver on the nonrotatable side.

1. Press the 'start pass' softkey to take the first measurement, then rotate the receiver to the next measurement position.
2. Rotate the laser emitter slowly past the receiver. When the receiver takes a measurement at its current position, the green LED on the front of its housing lights for about one second.
3. Cover the laser emitter aperture (i.e. with one hand) and rotate the receiver to the next measurement position; repeat the procedure to take measurements in at least three positions over at least 70° of rotation. (Five positions, however, will yield more reliable results.)



An exclamation point indicates that measurements taken thus far may not reliably indicate the true alignment condition.





### Static measurement

This measurement mode is used to measure fixed rotational positions at 45° intervals. It is useful for a range of applications, from uncoupled or nonrotatable shafts to vertical machines with flange mounting (page 4-10) or four feet.

1. Mark the shafts with at least three measurement positions at 45° or 90° intervals.

Mark these angles with their respective clock positions, i.e. 0° as '0:00' (twelve o'clock), 45° as '1:30', 90° as '3:00', 135° as '4:30' etc. (as viewed from the receiver toward the laser emitter).



2. Begin measurement by pressing the 'Take point' softkey.

3. Enter the first measurement position.

The ROTALIGN PRO computer accepts 'clock positions corresponding to the eight different 45° positions during a single revolution ('0' for 0°, '1.30' for 45°, '3' for 90° etc.) .



#### Note

Measurement begins as soon as you confirm the measurement position with the ENTER key. Depending upon the averaging setting for number of readings per measurement (see below), you may have to wait momentarily before turning the shafts to the next position.

4. Repeat the procedure until at least three measurements have been taken.



#### Note

In all measurement modes, results appear either automatically or after stopping measurement. These results are absolute 'actual' values, i.e. they depict the measured alignment condition without considering targets or thermal growth. The results screen (page 2-18), however, always shows the relative 'actual minus spec' values or other views as chosen.

Individual measurements can be deleted during measurement (except in 'sweep' mode) with the CLR key and remeasured (e.g. for stray points or erroneous measurements.)

Additionally, the 'Edit raw data' option also allows deactivation of individual measurements. This function can be accessed during measurement using the 'Edit' softkey.



### Averaging

The number of individual readings which are averaged together to form one measurement can be selected using the 'Average' key.

This parameter is permanently set to 8 individual readings for the 'sweep' and 'pass' modes.

The default value for 'multipoint' or 'static' measurement is 32 individual readings. This setting can be changed to a minimum of 8 or a maximum of 2048 readings, the latter of which take over 12 seconds to measure!

### Edit raw data

The data registered can be edited during measurement. Press the EDIT key in the measurement screen (page 2-17):



The screenshot shows the 'Edit Raw Data...' screen. On the left is a circular detector view with several points. On the right, there are data fields: '1 2' at the top, '127' and '128' below it, and 'Sweep 178°' to the right. Below these are two rows of data: the first row shows '0.16' and '-0.00' with units 'nrad' and 'mm' respectively; the second row shows '0.67' and '0.06' with units 'nrad' and 'mm' respectively. At the bottom are buttons: 'OK', 'Change View', left and right arrow keys, 'Toggle Point', and 'Sensor On'.

The detector view is adapted to the distribution of points and scaled accordingly.

Deactivated measurement point

Currently selected point

Any measurement that deviates severely from the other values can be deactivated from the measurement set: use the arrow softkeys to select the desired point and press the 'Toggle point' softkey. The point can be reactivated using the same key.



The 'deactivated' measurement position can be remeasured in the 'multipoint', 'pass' and 'static' measurement modes. If several 'active' points result for the same position, they will be averaged together.

Coupling angularity and offset can be displayed graphically when a sufficient number of values has been measured: press the 'Change view' softkey to do so.



The screenshot shows the 'Edit Raw Data...' screen with a linear detector view. The data fields are the same as in the previous screenshot: '1 2', '127' and '128', 'Sweep 178°', '0.16' and '-0.00' (nrad and mm), and '0.67' and '0.06' (nrad and mm). The buttons at the bottom are 'OK', 'Change View', left and right arrow keys, 'Toggle Point', and 'Sensor On'.

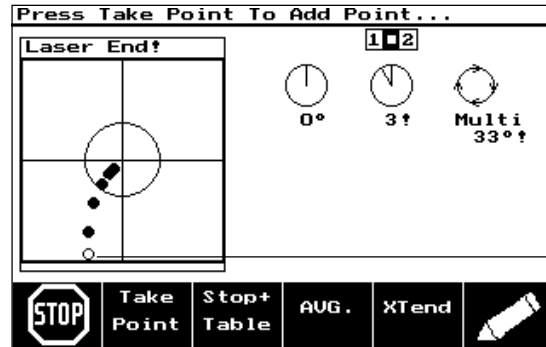
An ellipse normally appears on the screen. Its width along the X axis gives an indication of shaft angularity, and the height (on the Y axis) indicates shaft offset. When shafts are perfectly aligned, the ellipse is reduced to a single point.

Sensor on: the current beam position is shown on the screen, allowing you e.g. to check repeatability by following the path of the beam as the shafts are turned through the measurement positions again; the beam should move along the curve of the ellipse without appreciable deviation.

This option is available only in the 'multipoint' and 'static' measurement modes.

### Extending the measurement range

Gross misalignment of shafts can cause the laser beam to leave the detectors during measurement. This condition is indicated by the message 'Laser End!' appearing in the sensor status line.



Laser leaves measurement range

1. Turn the shafts back until the laser reenters the measurement range and the message 'Sensor OK' reappears.
2. Press the 'XTend' softkey. The program interrupts measurement and switches to 'XY View' (page 3-9). The current beam position is automatically taken as the starting point for range extension.
3. Readjust the beam into the target circles and press OK. The adjusted beam position is taken as the end point of displacement.
4. Continue measurement as before, rotating the shafts and pressing the 'Take Point' softkey at the desired positions. The program includes the displacement of beam readjustment in its alignment calculations.

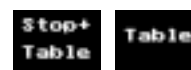




### Measurement table and history

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

Press the 'Stop & Table' or 'Table' softkey in the measurement screen (page 2-17):



Select row(s) to average...

U/H	mm	mm	mm	mm
0.92	-0.26	-0.71	0.19	
-0.04	-0.01	0.01	-0.00	
-0.04	-0.01	0.01	-0.01	
-0.18	0.09	0.06	-0.06	
Average values of selected measurements				
-0.11	0.04	0.03	-0.03	

OK Page 2 ↑ ↓ ✓ Delete

Page 2      Select measurement      Show links or delete measurement

Select coupling with number key

The measurements are listed with the following details:

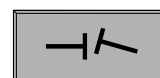
- Page 1: Measurement positions; measurement mode; measurement results (vert. / horiz.)
- Page 2: Measurement positions; measurement mode; date/time; measurement separation; sensor ID.

You can change the measurement separation on page 2 by pressing the EDIT softkey. This is especially practical if you notice after measurement that a template has been used where the separation distance should have been adjusted for the current sensor setup. The results are adjusted accordingly when this entry is corrected.

(Changes made in the dimensions screen affect only later results, not earlier ones.)

Multiple measurement sets can be averaged to achieve more representative results. This feature is particularly useful for uncoupled shafts or when bearing play is considerable.

1. Select a measurement for inclusion in the average and press the 'Select' softkey. Repeat for all other measurements to be included.
2. Press the results key to display the averaged results (see page 2-18).  
Place the measurements in a job sheet for documentation:
3. Press the 'New entry' softkey and select a suitable label (see page 2-22).

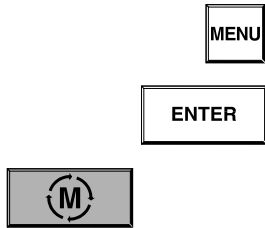


Note

Readings taken before and after a move cannot be averaged together!

**Show history**

If several job records have been saved (e.g. 'as found', 'after soft foot' and 'after alignment'), the corresponding measurement sets in the table can be displayed as follows:



1. Press the Menu key, then select 'Job Sheet'.
2. Select the desired entry (e.g. 'after alignment') and press ENTER.
3. Press the 'M' key to switch to the measurement screen, then press the 'Meas. table' softkey.

The screenshot shows a screen titled "Select Row(s) To Average... (as found)". At the top, it says "1 2". Below is a table with columns for "U/H", "nrad", and "mm". The table contains several rows of data. Below the table are buttons for "OK", "Page 2", up and down arrows, "Exit Hstry", and "Show Links".

U/H	nrad	mm	nrad	mm
✓	0.31	0.09	0.97	0.10
✓	0.16	-0.00	0.67	0.06
	0.00	0.00	0.11	0.03
	-0.09	-0.03	0.00	-0.00
	0.24	0.04	0.82	0.08

Annotations on the right side of the screenshot:

- Job record 'as found'
- Corresponding measurements
- Leave history display

Table entries cannot be selected when recorded measurements are displayed, as that would change the existing job records. You must first press the 'Exit Hstry' softkey.

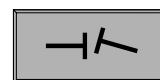
Measurements can be deleted from the table only if they are not linked with any job sheets (page 2-22). In that case, the 'Delete' softkey appears in place of the 'Show links' softkey.

1. To remove a link, first press the 'Show links' softkey.
2. Select the link to be removed, then press the 'Delete' softkey.



## Alignment options

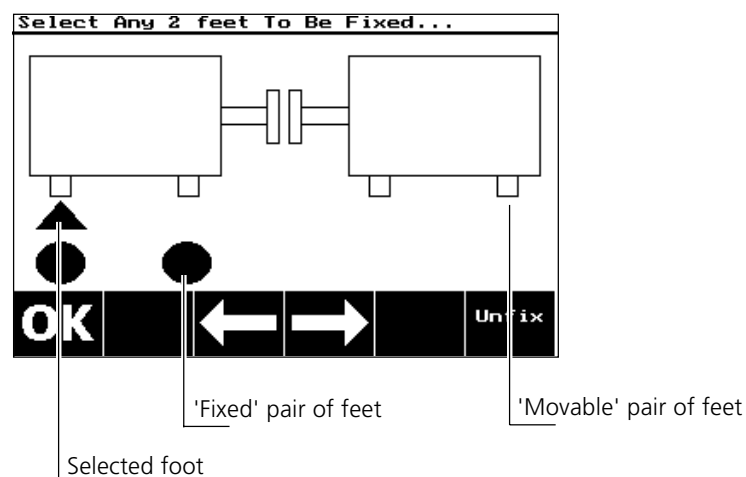
Machine alignment can be optimized in the results screen through selection of appropriate stationary (immovable) feet. If, for example, one pair of machine feet cannot be lowered on the machine to be moved, that pair can be designated fixed and another (previously 'immovable') pair of feet can be redefined to be moved.



### Fixed machine feet

Note that only two pairs of machine feet can be designated fixed. Proceed as follows:

1. Press the 'option' softkey in the results screen.
2. Select the 'Fixed feet' option.



3. Select the fixed pair of machine feet to be redesignated as 'movable'.
4. Press the 'Unfix' softkey.
5. Select the movable machine feet that are to be set 'fixed'.
6. Press the 'Fix' softkey.
7. Press OK; two pairs of machine feet must always be marked as being fixed.

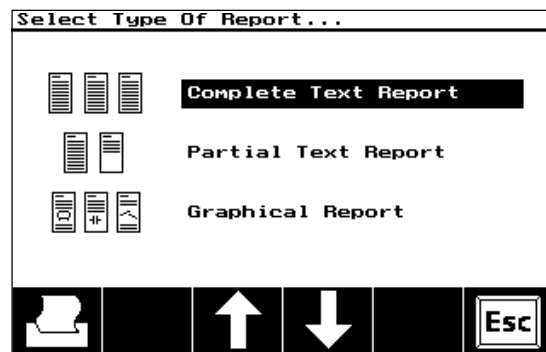


## Printing

### Report



1. Connect the ROTALIGN PRO computer to a printer (see system operating instructions Part 1, Chapter 2).
2. Press the 'Menu' key (page 3-1).
3. Select the 'Device config' option.
4. Check the printer and interface (LPT/COM) settings and change them if necessary (see Part 1, Chapter 3)
5. Select the 'Report' option from the menu:



Three different report formats are available for documenting the current alignment job:

- Complete text report
- Short report (including the most important data)
- Graphic report



6. Select one of the above formats using the arrow keys and then press the 'Print' softkey.

### Screen contents

1. Connect the ROTALIGN PRO computer to a printer and check the printer settings as directed above.
2. Open the screen to be printed.
3. Press the slash key.



The message 'Hardcopy started' appears. When printing is finished, the message ' Hardcopy printed' is displayed.



Do not press any other keys on the ROTALIGN PRO computer until the printing job is finished. Otherwise errors may occur.

## Chapter 4: Aligning special machines

This chapter deals with alignment of machines that require use of special procedures rather than those for the standard case described in Chapter 2. These machines include:

- Machine trains (groups of up to six machines coupled together)
- Cardan drive machines
- Flanged machines (mounted vertically or horizontally)

### Machine train alignment

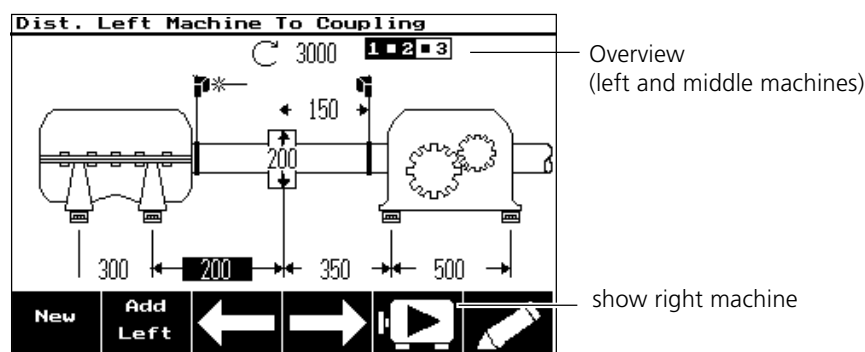
A step-by-step approach is recommended for machine train alignment:

1. Measure alignment at each coupling
2. Display results and optimize corrections (by defining 'stationary' machine feet)
3. Align two machines (remount sensors if necessary)
4. Check alignment results
5. Align the next two machines and repeat alignment check
6. Repeat step 5 until all machines have been aligned.

Before measurement is begun, the machine train must be set up and all dimensions entered.

#### 1. Setup

Since this section resembles the standard case described in Chapter 2 (page 2-10), it is outlined here only briefly:



- a. Press 'New' and select a suitable template.
- b. Check the dimension settings and all machine- and coupling-specific parameters (type, thermal growth, targets etc.); change the settings as necessary.
  - To add another machine to the left or right end of the train, press the 'Add left' or 'Add right' softkey.





- Only the end machines can be deleted:
  - Use the arrow keys to select the corresponding machine diagram in the dimensions screen.
  - Press the CLR key.



**Note**

The distance 'coupling center to receiver' cannot be entered until sensors are mounted around the corresponding coupling. Be sure to mark the mounting locations on the shafts in case the sensors must be remounted, e.g. to monitor alignment corrections.

## 2. Measurement

- Use the brackets to mount the laser emitter and receiver onto the shafts.
  - Depending upon the coupling type and machine conditions, specialized brackets may offer more rigidity or convenience than the standard compact chain-type bracket (see the 'accessories' section of the system operating instructions, Part 1, Chapter 4).
  - The laser emitter is always mounted on the machine shown on the left side in the screen diagram.

b. Adjust the beam onto the receiver (see page 2-15).



c. Press the 'M' key and center the laser beam within the measurement range (page 2-16).

d. Rotate the shafts in order to begin measurement ('sweep' mode, page 2-17).

- Select the most suitable measurement mode for the situation (e.g. limited shaft rotation, page 3-10).
- Be sure to observe the requirements for valid measurement (rotation angle, number of measurement points).



e. Press the STOP softkey to stop measurement.

f. Switch the laser off and place the sensors around the next coupling.



g. Press the 'DIM' key.

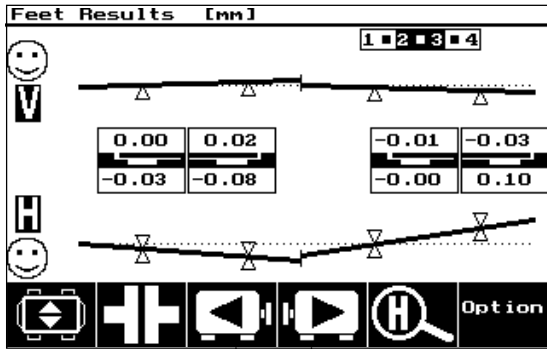
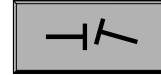


h. Press the machine arrow key to proceed to the next coupling, then enter the separation distance 'coupling center to receiver' (see above).

i. Repeat the measurement procedure (step c through e) until measurements have been taken around all couplings.

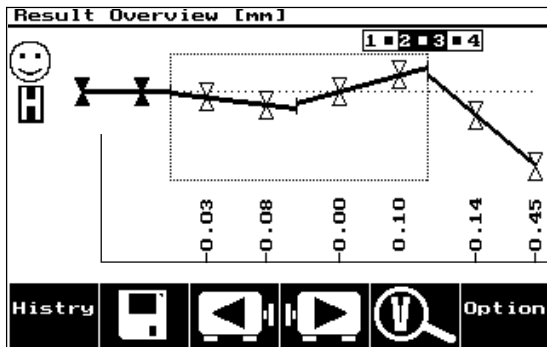
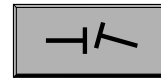
### 3. Evaluation

Press the results key:



Switch to machine pair at left/right

- See page 2-18 for a detailed description of screen contents.
- Press the result key again to obtain an overview of the entire machine train. You may use the 'H' or 'V' key to obtain a zoomed view of the horizontal or vertical alignment condition along with offsets at the feet of the selected machine pair. This selection can be moved using the left- and right-machine softkeys.



'Fixed feet'

Job record  
(page 2-22)

- If all the machines in the train can be moved freely, you can optimize the corrections to reduce machine movements to a minimum by using the 'fixed feet' setting:
  - Press the 'Option' softkey and select 'Fixed feet'.
  - Change the setting for fixed feet (page 3-17).
  - Press the OK softkey to switch to the results screen.
  - Repeat this procedure until necessary corrections can be made with a minimum of effort.



**4. Alignment**

- a. Mount the sensors about the corresponding coupling. Be sure to mount the receiver at the same distance from the coupling center as before initial alignment measurement (see note on page 4-2).
- b. First correct the vertical position of the machine by raising or lowering its feet (page 2-20).
- c. Take a set of alignment readings to check the corrections.
- d. Correct the horizontal position of the machine by moving it laterally (page 2-21).
- e. Take a set of alignment readings to check the corrections.
- f. Repeat the alignment procedure at the next coupling.
- g. Finish with a set of alignment readings taken at each coupling.

**5. Archival**

A job record can be made for every measurement.

- a. Open the overall view in the results screen (by pressing the results key twice).
- b. Press the 'New entry' softkey and enter an appropriate record name (page 2-22).

To save the file:

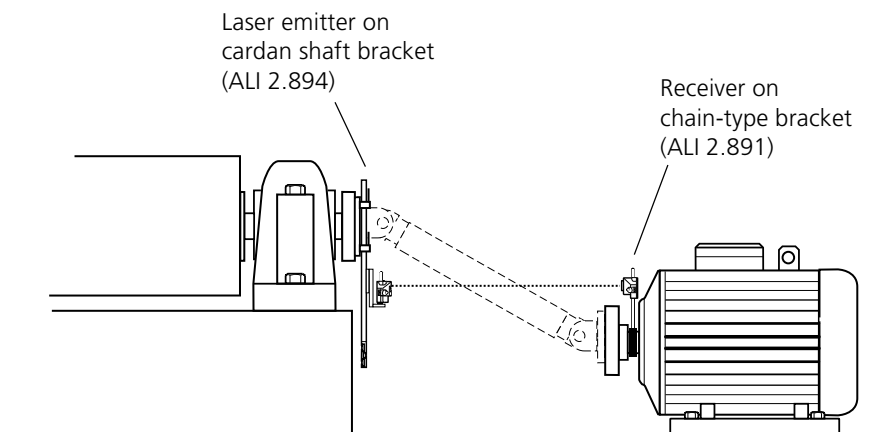


- c. Press the 'Menu' key, then select the 'file' option.
- d. Select 'Save file as', then enter a file name using the text editor (page 2-22).



## Cardan shaft alignment

This section describes alignment of machines joined by a cardan shaft. The optional cardan shaft bracket set ALI 2.894 is used to mount the laser emitter. The receiver can be mounted using the standard chain-type bracket ALI 2.891set (included with ROTALIGN PRO) as shown below.

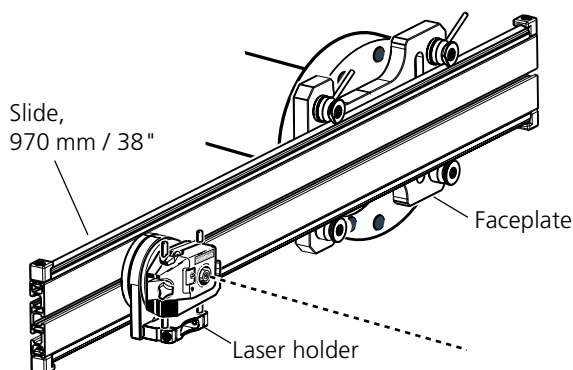


Cardan shafts are normally installed with the spacer shaft set at a considerable angle (usually  $4^\circ$  to  $6^\circ$ ) in order to ensure sufficient lubricant circulation, which in turn prevents the universal joints from seizing. Excessive misalignment of such a configuration leads to rapid fluctuation of the driven shaft RPM during operation, which holds particularly grave consequences for electronically-controlled synchronous and asynchronous AC drive motors.

Precise alignment reduces the rotational irregularities of the cardan shaft to a minimum, so that the uneven bearing loading during cardan shaft rotation is also minimized, the service life of the components is extended and the chance of unexpected machine failure is reduced.

The measurement procedure described here allows precise measurement even when a large amount of offset is present between the two machines – even over great measurement distance (up to 10 m / 33 ft.).

### Cardan shaft bracket (ALI 2.894)

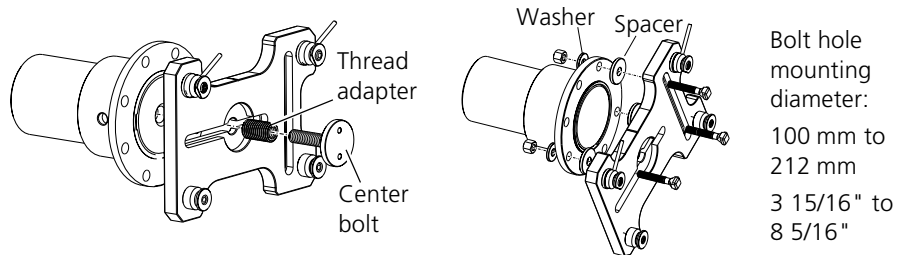


### 1. Mounting

- a. Mount the faceplate on the coupling using the bolts supplied. The bracket is usually mounted on the coupling face of the non-rotatable shaft, for example, the roll in a paper mill.

Two different mounting arrangements are available:

- i. If the shaft end or coupling face has a threaded hole in its center, the easiest and most rigid mounting method is to use the large center bolt as shown below. A thread adapter may be used as shown to fit the center bolt to larger bores.
- ii. The coupling bolt holes may be used for three-point mounting using the square-headed M10 bolts as shown below. If the coupling face has a raised rim, the precision machined spacers are used as shown in order to separate the bracket faceplate from the coupling face. (Without the spacers, there would be no direct contact between the faceplate and the coupling surface surrounding the bolt holes – exactly the location where the faceplate and coupling are being joined.) The washers prevent the nuts from marking the coupling surface when tightened.

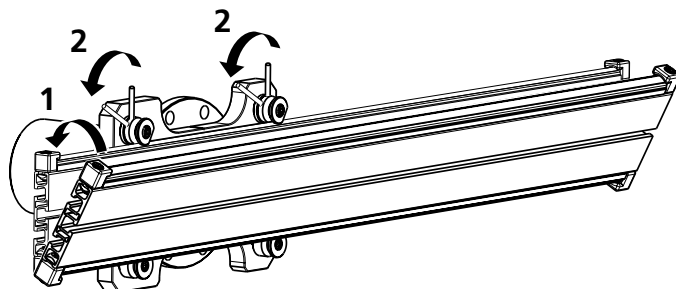


i: Faceplate mounting with center bolt    ii: Faceplate mounting onto coupling flange

- b. Before tightening down the bolts, use an inclinometer or spirit level to position the face plate at the same angle as the cardan shaft when installed (usually horizontal or vertical; see page 4-5). A design drawing from the machine manufacturer can be helpful in determining the intended horizontal and/or vertical offset between the machine coupling halves. The inclination can be calculated from these horizontal and vertical distances as follows:  

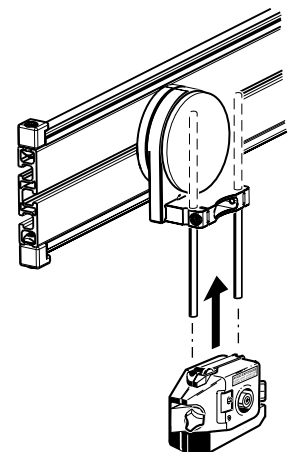
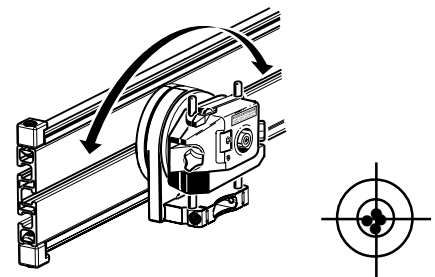
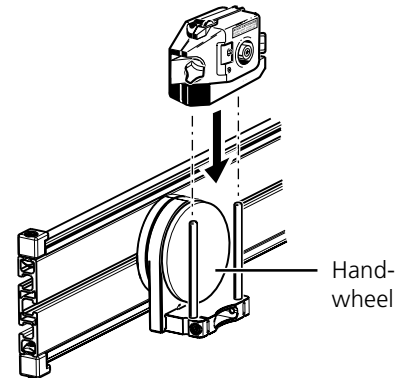
$$\text{Inclination} = \arctan(\text{vertical offset} \div \text{horizontal offset})$$

- c. Place the slide in the faceplate as shown with the center groove facing outward, then use the two levers (top) to tighten the slide into place.



## 2. Sensor mounting and adjustment

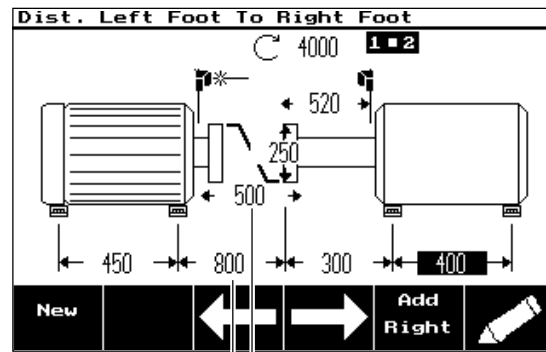
- a. Mount the laser holder onto the rail: ensure that its handwheel is loosened, then slide the holder onto the center groove of the rail.
- b. Mount the laser onto its holder: slide it onto the posts until the beam aperture is approximately in line with the rotation axis of the holder.
- c. Mark a set of target crosshairs on the shaft rotation centerline of the other machine coupling (if the flange has a center hole, a dust cap can be inserted to provide a temporary target surface).
- d. Switch on the laser and adjust the beam to strike the center of the target on the opposite coupling:
  - Rough adjustment: loosen the handwheel and slide the holder along the rail; loosen the yellow locking knobs to adjust the beam height.
  - Fine adjustment: use the thumbwheels on the laser housing to center the laser beam onto the target.
- e. Rotate the laser holder one complete revolution. The laser beam should not drift from its target at any time; if not, repeat the previous step.
- f. Switch off the laser and remove it from its holder.
- g. Loosen the support posts and slide them through the bracket frame so that they protrude from the other side.
- h. Remount the laser onto the support posts.
- i. Use the chain-type bracket to mount the receiver on the opposite machine shaft, then connect it to the ROTALIGN PRO computer.
- j. Switch the laser back on, then adjust the beam onto the receiver (see pages 2-7 and 2-15).



## Cardan shaft alignment

### 3. Setup and measurement

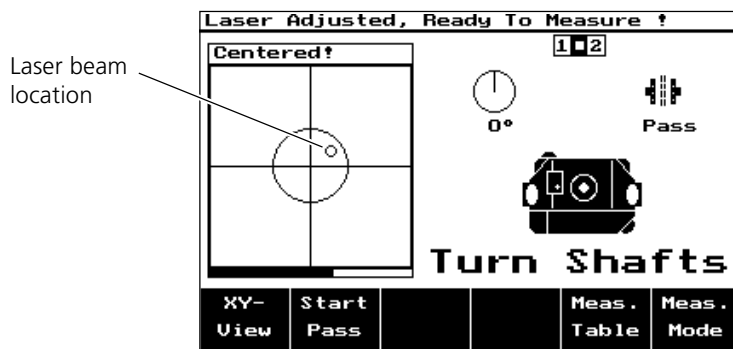
- Switch on the ROTALIGN PRO computer.
- Set up the machines (page 2-10) and select the coupling type 'cardan shaft'.



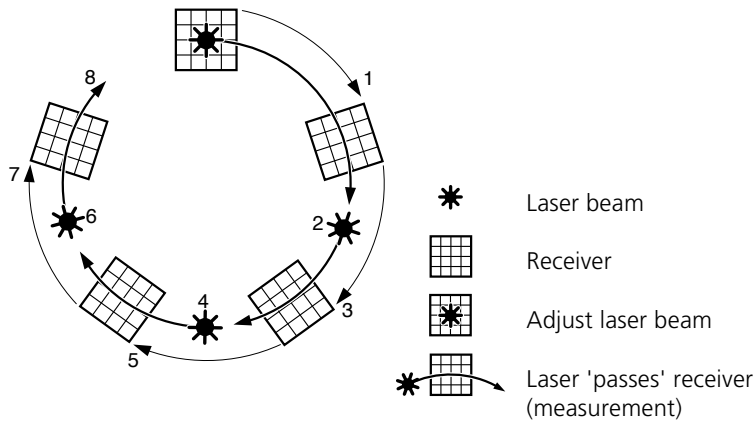
Distances to receiver-side coupling flange



- Remove the receiver dustcap and press the 'M' key. The laser beam location should be apparent in the adjustment screen (page 2-16).
- Select the 'pass' measurement mode (page 3-10).



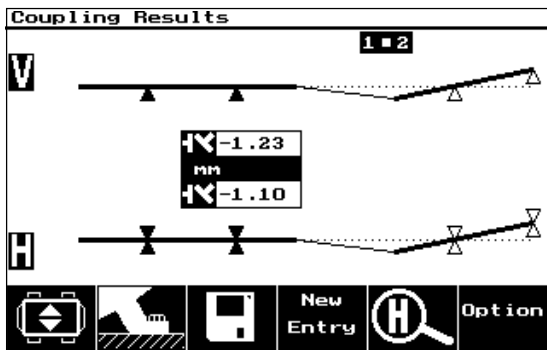
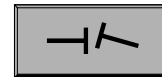
- Press the 'Start Pass' softkey to take the first measurement.
- Rotate the receiver to the next measurement position.
- Slowly rotate the laser past the receiver (see illustration on following page). When the receiver registers the beam position as it passes by, the green LED on the receiver lights for about one second.
- Block the laser beam to prevent inadvertent readings, then rotate the receiver into the next measurement position. Repeat steps g and h to take measurements in at least three positions over at least 75° of rotation. (Five position measurements, however, will yield greater reliability of results.)



**4. Evaluation and alignment**

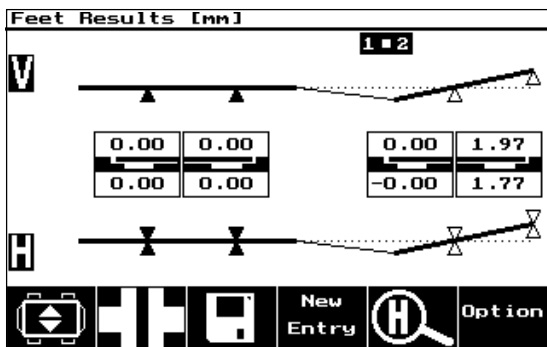
Since offset does not affect the performance of cardan shafts, only angularity must be corrected here.

a. Press the 'result' key following measurement:



Note that the tolerance function should be deactivated as it is not intended for use with cardan shafts and its use will only return 'sad face' indication (out of tolerance).

b. Press the 'Foot values' softkey to display necessary corrections; since only angularity must be corrected, only one foot location must be corrected. Angularity targets (or thermal growth) are not included in these calculations.



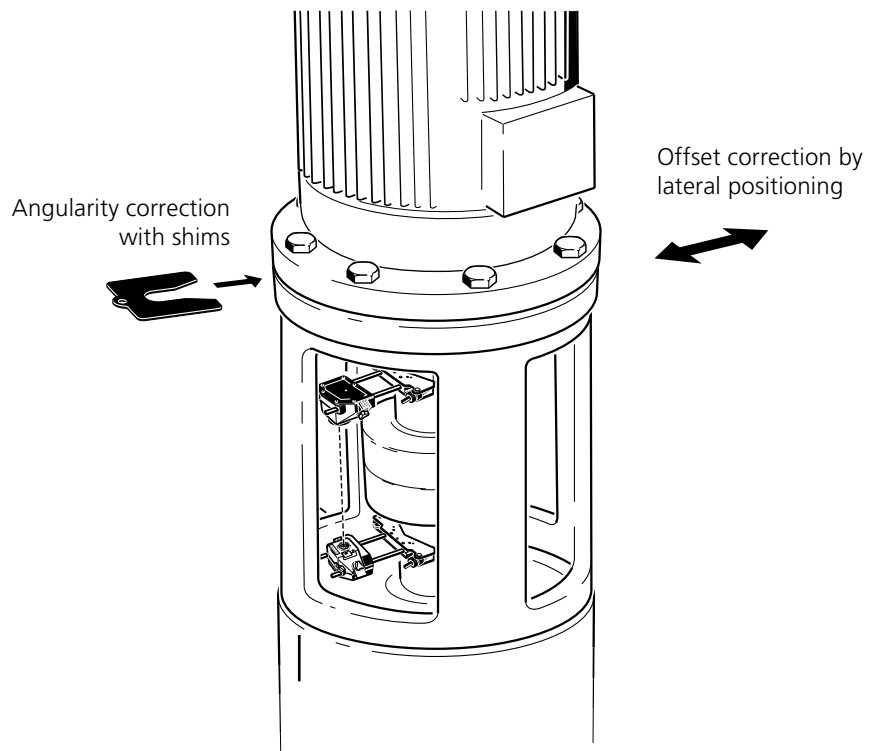
c. Position the machine to be moved with the help of the MOVE function (page 2-20).



### Aligning flanged machines

Flange-mounted machines can be situated vertically or horizontally. In either case, alignment corrections are made directly at the flange.

Angularity is corrected by inserting or removing shims from between the flanges. ROTALIGN PRO calculates the shimming thickness for each flange bolt. Offset is corrected by positioning the flange laterally. A typical situation is shown in the diagram below:



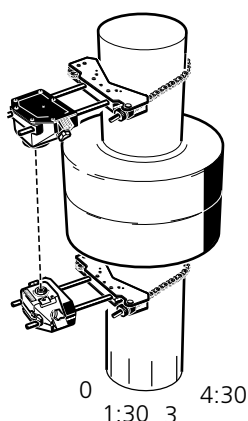
Note regarding setup and measurement:

- The laser emitter is mounted on the shaft of the stationary machine.
- The electronic inclinometer cannot determine the rotation angle of vertical shafts; therefore measurements must be taken on vertical machines in the 'static' mode. The standard 45° measurement positions used with this procedure must be marked accordingly on the machine.

### 1. Mark measurement positions (vertical machines only)

Mark the shaft or housing as follows (e.g. shaft marking):

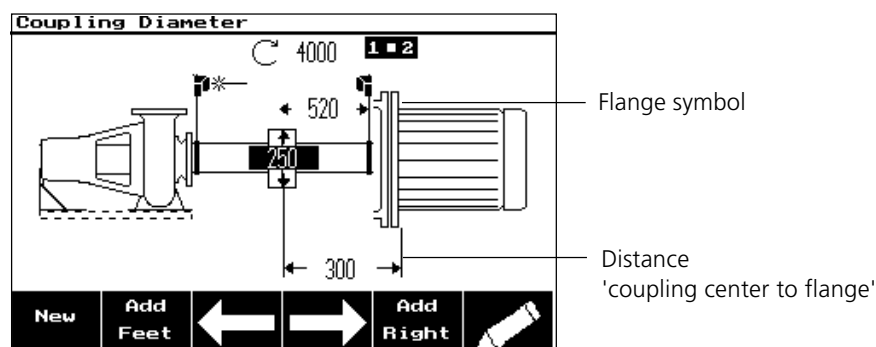
- Mark a reference position on the coupling housing close to the shaft and in line with one of the pillars or bolts. Likewise, mark a starting point on the shaft. This ensures that lateral corrections can be performed with the minimum of effort.
- Measure the circumference of the shaft and divide by eight.
- Use this distance to make seven more evenly-spaced marks on the shaft beginning at your chosen start point. Number the points counterclockwise as seen from receiver to laser, beginning with "0" first, followed by '1:30', '3:00' etc.



Mark measurement positions  
in counterclockwise direction

### 2. Setup

- Mount the laser emitter and receiver onto the shafts (page 2-4).
- Connect the receiver (page 2-7) and switch on ROTALIGN PRO.
- Select a suitable template and enter the required dimensions (page 2-10).
- Set up the right machine (receiver side) for a flange as follows:
  - Use the arrow keys to select the right machine, then press the EDIT softkey.
  - Select 'Fixation', then press EDIT.
  - Select 'Flange left', then press OK twice.
- Enter the flange geometry as follows:
  - Select the flange symbol, then press EDIT.
  - Adjust the required parameters:

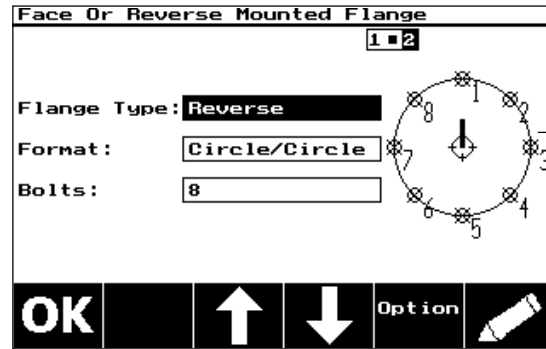




FLANGE TYPE: Face- or reverse-mounted flange .

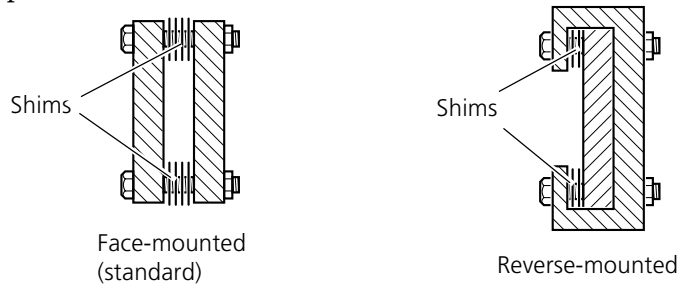
FORMAT: Flange geometry and bolt arrangement (see below)

BOLTS: Number of bolts

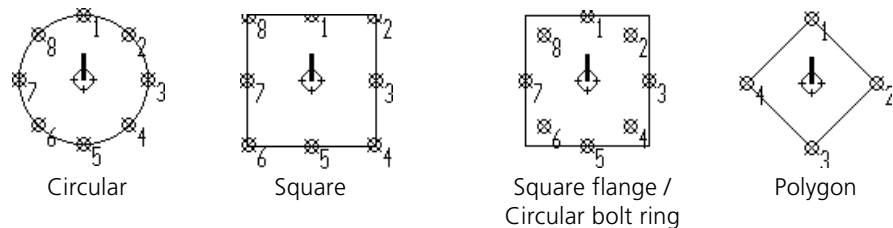


Flange format with bolt numbers

Flange types:



Flange formats:



- Press the 'Option' softkey and enter the flange dimensions; position the flange center if necessary and define additional bolt positions (page 4-16).

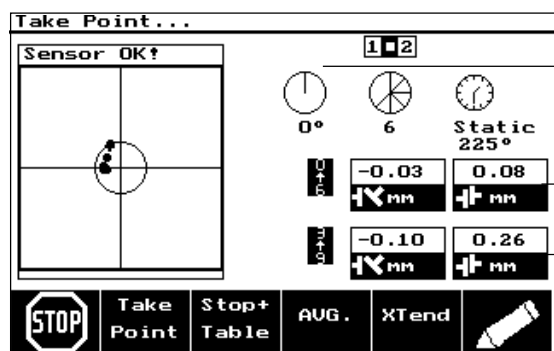
### 3. Measure



- Adjust the laser and press the 'M' key (page 2-15).
- For vertical machines: press the 'Meas. Mode' softkey and select 'static' mode (page 3-12). (Any desired mode may be used for horizontal machines.)
- Rotate the shafts to the first measurement position (with reference mark and measurement position '0' matched up).
- Press the 'Take point' softkey in the measurement screen and enter the first measurement position (0).



- e. Rotate the shafts to the second measurement position (e.g. 1:30) and press the 'Take point' softkey.  
(If the measurement positions are marked counterclockwise, the shafts should be turned clockwise.)
- f. Repeat the measurement procedure until at least three measurements have been taken.



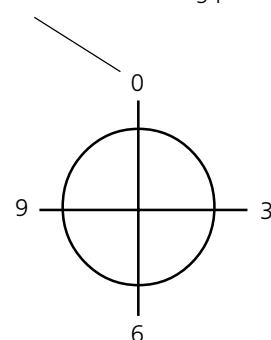
Inclinometer display is inactive for vertical machines

**Alignment condition:**

'0:00 - 6:00' direction

'3:00 - 9:00' direction

0: Reference mark and measurement starting point



Direction of view: from receiver to laser

Stop + view table page 3-15

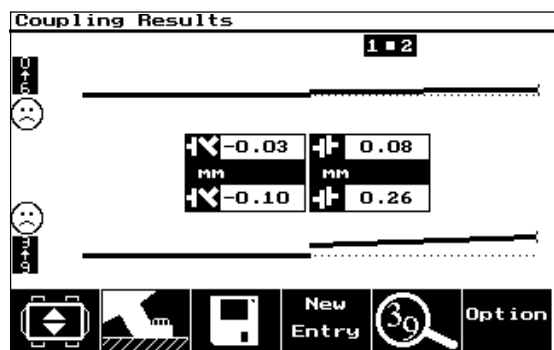
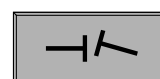
Extend range page 3-14

Averaging setting page 3-12

- Further measurement options are described in Chapter 3 (page 3-10).

**4. Evaluation**

- a. Press the 'result' key and switch the view to 'both directions':



MOVE page 2-20

Foot corrections

Save page 2-22

Display options page 2-19

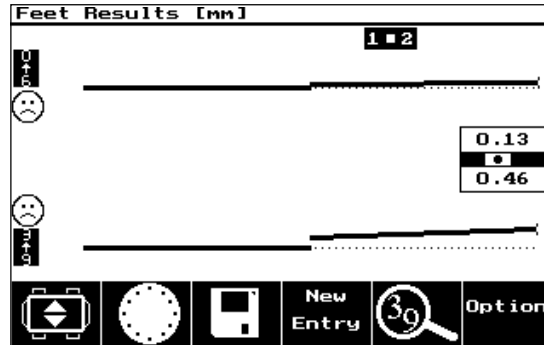
Switch view page 2-19

Job sheet page 2-22



b. Press the 'foot correction' softkey.

- The corrections indicate how far the flange must be positioned laterally in the 0:00 - 6:00 and 3:00 - 9:00 directions.
- Positive sign = move flange toward 6:00 or 9:00.

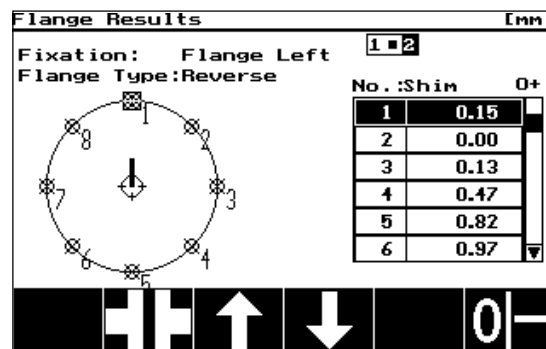


Move flange  
by 0.13 mm toward 6:00  
and  
by 0.46 mm toward 9:00.



c. Press the 'flange value' softkey.

- The required shim corrections are indicated for each flange bolt.
- Positive/negative sign: add/remove shims.
- Bolt Number 1 is normally located at the reference mark and measurement starting point (0:00 position).



Current  
correction mode

Toggle  
correction mode

Since it is not always possible to remove or insert shims, you may use the 'correction mode' softkey to obtain shimming values that accommodate such correction limitations:

- + : Only insert shims
- : Only remove shims
- +/- : Insert and remove shims (minimum correction amounts)
- 0/+ : Set one bolt to zero and add shims to all others
- 0/- : Set one bolt to zero and remove shims from all others

## 5. Alignment

Correct angularity first:

- a. Loosen the flange bolts and lift the upper machine a bit.
- b. Adjust shimming to make angularity corrections:  
For face-mounted flanges (page 4-12) insert the indicated thickness of shims (page 4-14) between the flanges at the respective bolt locations.  
For reverse-mounted flanges (page 4-12) insert the indicated thickness of shims (page 4-14) behind the flanges at the respective bolt locations.
- c. Tighten the bolts back down, then take another set of readings to confirm alignment corrections; repeat shimming if necessary.

Then correct offset misalignment:

- d. Open the 'foot correction' screen for both alignment directions at the same time (page 4-14, b.).
- e. Turn the shafts so that the sensors are located at the first measurement position (0:00).
- f. Press the MOVE softkey.
- g. Loosen the flange bolts.
- h. Position the upper machine laterally in both directions by the amounts indicated.
  - The lateral corrections are updated on screen during positioning.
  - Corrections should be brought as close as possible to zero.
  - Use appropriate tools (e.g. levers) to position the machine.
  - Take care not to let the shims slip out of place during lateral positioning.
- i. Tighten the bolts back down.
- k. Press STOP.
- l. Take a final set of readings to confirm the corrected alignment condition.



**Options for flange geometry setup**

Most flanges and bolt arrangements are symmetric to the shaft. An asymmetrical flange geometry can be produced by moving the axes and changing bolt positions:

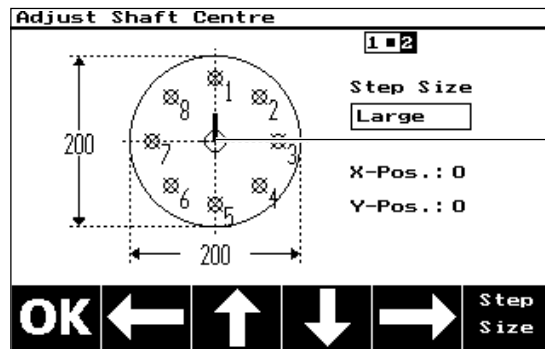


a. Open the 'flange dimensions' screen using the 'option' softkey (page 4-12).



**Positioning the shaft center**

b. Press the 'Adjust center' softkey:



Shaft center

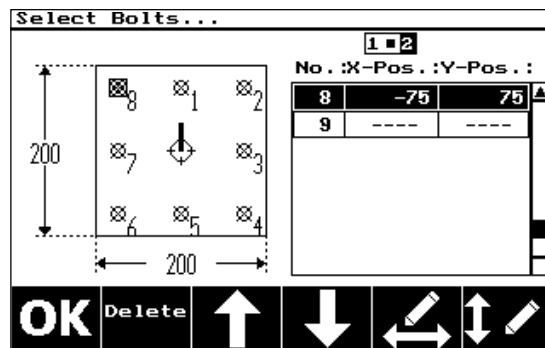
c. Use the arrow keys to position the shaft center:

- Changing 'step size': 'small' = 1 mm (0.1 inch); 'medium' = 10 mm (1 inch); 'large' = 100 mm (10 inch).
- The CLR key returns the shaft center to the middle of the flange.

**Positioning flange bolts**



d. Press the 'User Bolts' softkey in the flange dimensions screen:



Y coordinate

X coordinate

e. Enter the position of a new bolt or change that of an existing one.

- The bolt position is determined by its X and Y coordinates. The middle of the flange is considered to be the origin.
- Entering coordinates: press the corresponding softkey.
- Delete: select a bolt and press the 'DELETE' softkey.

## Chapter 5: Appendix

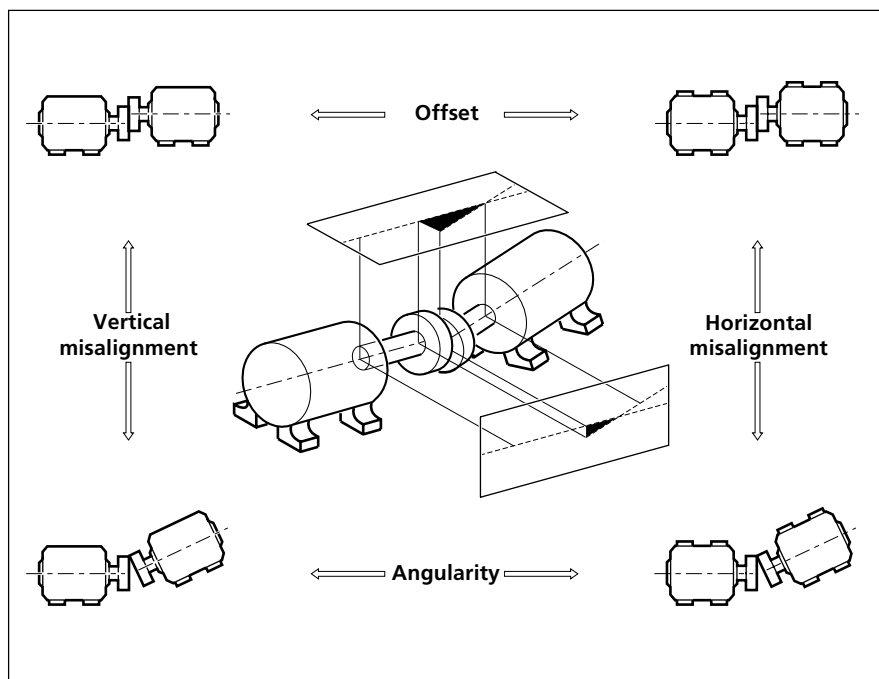
This appendix gives an overview of important aspects of shaft alignment, instructions on handling soft foot, several practical examples and practical tips on alignment problems.

### Shaft alignment basics

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

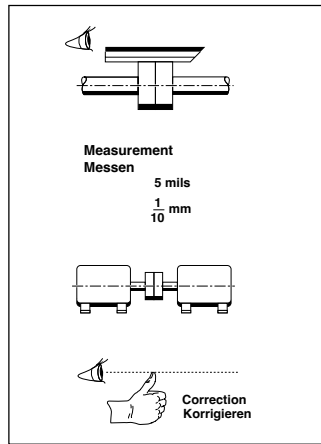


These four degrees of freedom must be measured in order to achieve correct alignment. ROTALIGN displays four values which combine to correct all these parameters simultaneously by

- 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 such as PERMABLOC or LAMIBLOC can greatly reduce the time and effort needed for vertical alignment adjustments. The MOVE function of ROTALIGN PRO allows you to monitor the horizontal and vertical positions simultaneously on screen for quick and reliable alignment.

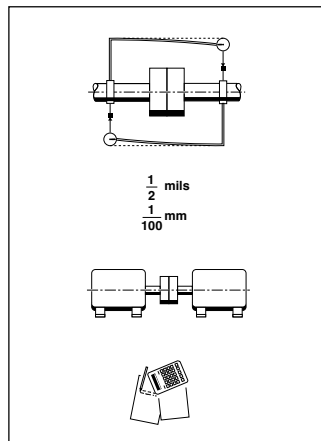
## Comparison of alignment methods



### Straightedge

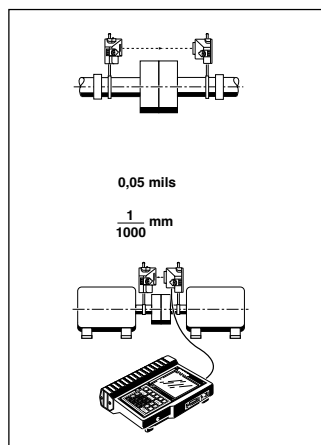
The straightedge is the most well-known and widespread shaft alignment tool. If both the coupling surface and the measuring eye are in good condition, alignment accuracy may approach 1/10 mm (5 mils). This may be sufficient for some machines and couplings.

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 PRO has an actual resolution of 1/1000 mm—better than any other available system (except for our other alignment 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.

## Soft foot

The term 'soft foot' denotes a machine foot that lifts from the frame when its bolt is loosened. Possible causes include:

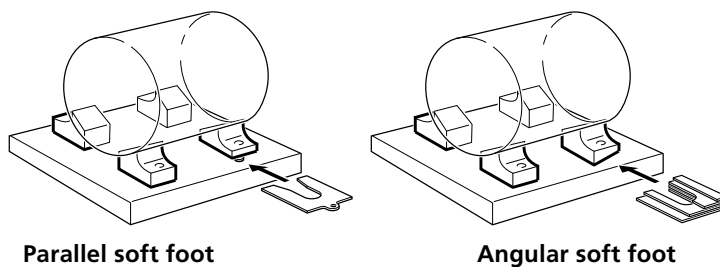
- The contact surfaces of the foot and the frame are not parallel.
- The frame is unstable.
- The machine feet and/or frame are distorted.
- External forces (piping, etc.) are being exerted.
- The undersides of the feet are soiled or corroded.

Possible consequences include elevated vibration, bearing damage from housing distortion and premature machine failure.

Soft foot should always be checked before alignment. ROTALIGN PRO features a 'soft foot wizard' function that reduces this effort to a few minutes. If the foot lifts when its bolt is loosened, the system measures the resulting sensor movement. Soft foot can be corrected using shims.

It is important to distinguish between parallel and angular types of soft foot, since their remedies are vastly different. In some cases, feeler gages must be used to determine the amount and orientation of soft foot.

See page 5-8 for soft foot examples.



### Parallel soft foot

Parallel soft foot is present when the underside of the foot is parallel to the frame but fails to make contact when the bolt is loosened (because the frame drops or the machine foot is shorter than the rest). If only parallel soft foot is present, this condition can often be recognized by a pattern of two similarly elevated readings located diagonally across from one another, since the machine tends to rock back and forth across the diagonal.

### Angular soft foot

Angular soft foot denotes a tilted mounting surface, i.e. the foot and its frame form an angle. All feet can be affected to different degrees, and correction is generally more difficult than with parallel soft foot since the angle of tilt must be measured using feeler gages.

### Squishy soft foot

Corrosion or peeling paint beneath the machine feet can expand to fill considerable rise that ROTALIGN PRO can detect, but feeler gages cannot (since the gap 'appears' to be filled). This condition is known as 'squishy' soft foot, and is best corrected by a thorough cleaning of foot and foundation/frame contact surfaces.

### Background information

Soft foot can severely affect the operating condition and, as a result, the operating lifetime of a machine. This makes the effort of diagnosis and remedy a worthwhile proposition in many cases.

A few simple rules can help you to avoid soft foot:

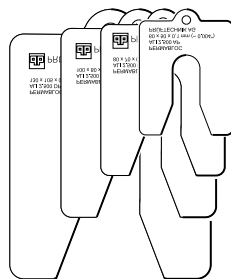
1. Eliminate rust, dirt and contamination from the contact surfaces of the machine feet, shims and frame or foundation.
2. Never insert more than three shims at a time beneath a single machine foot, as more than this can cause a spring effect.
3. Eliminate external forces on the machine such as those from connected piping, auxiliary supports etc.

Once ROTALIGN PRO has calculated the position and amount of the most severely-affected soft foot, feeler gages can be used to determine the type of soft foot involved (see previous page). Possible remedies then include: insertion or removal of shims, insertion of stepped (wedge-shaped) shims, removal of worn or dirty shims, replacement of several thin shims with a single thicker one, or even remachining of contact surfaces.

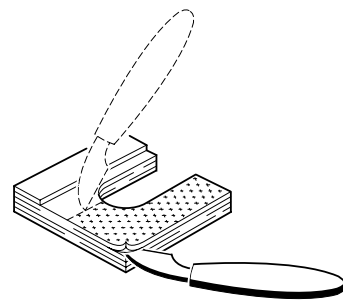
PRÜFTECHNIK AG offers two different types of shims in a wide range of metric thicknesses and sizes to fit most machine feet. Check with your ROTALIGN PRO dealer for inch thicknesses and other custom shims.

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.



PERMABLOC®



LAMIBLOC®



**Measurement**

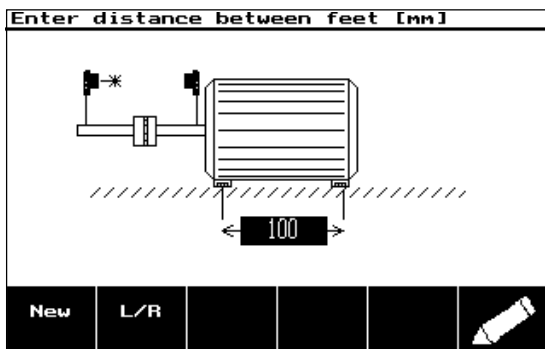
The machine(s) to be measured should be treated first as normal four-footed machines. For six-footed machines, measure the front and rear feet first, then the middle and rear feet in a separate set of readings.



1. Mount the laser emitter and receiver (see page 2-4).
2. Rotate the shafts so that the sensors are oriented vertically (12:00 - 6:00 direction) for the highest possible accuracy.
3. Start the soft foot function by
  - pressing the 'Check soft foot' softkey from the Program Manager or
  - pressing the 'menu' key from within the shaft alignment program and selecting the 'soft foot check' or 'soft foot wizard' option.

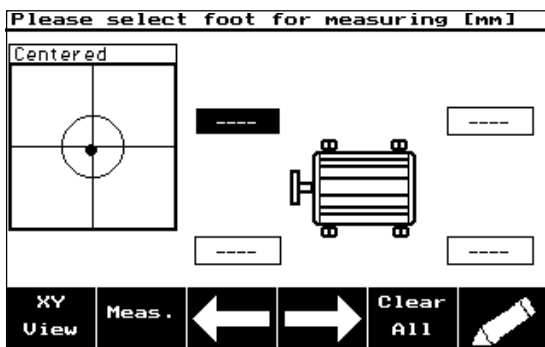


The soft foot check allows experienced users to take a quick set of readings, while the wizard guides the user through setup, measurement and evaluation of results.



Create new measurement file

4. Enter the distance between feet of the machine to be measured; press the 'L/R' softkey to switch between left and right machines if necessary. (This distance may be reset to the default value of 100 mm or 10 in. by pressing the CLR key.)
5. Switch on the laser and adjust the beam onto the receiver cap (page 2-15). Remove the receiver cap.
6. Press the 'M' key.

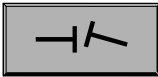


Adjust beam    Start measurement    Select foot    Delete readings    Manual entry

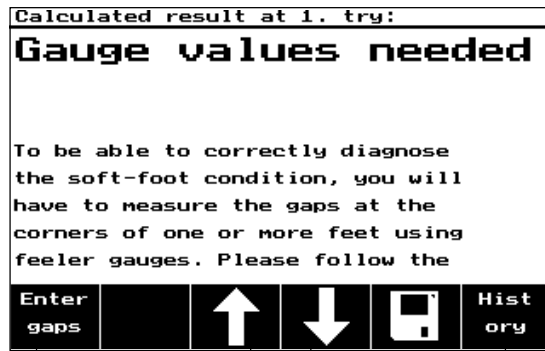
**Soft foot: measurement**



**Wizard only:**  
 You may enter soft foot readings here using the numerical keypad if desired (for training and practice, for example)



7. Check the laser beam adjustment; if necessary, press the 'XY View' softkey, then readjust the beam and change the averaging parameter (page 3-12).
8. Select the foot to be measured and press the 'Meas.' softkey.
9. Loosen the foot bolt.  
 The receiver registers any change in position and passes its measurements on to the ROTALIGN PRO computer for calculation. The display is updated continuously; depending upon the averaging parameter setting made with the AVG. softkey (unavailable with the Wizard), this can take up to several seconds.
10. Press the OK softkey when the displayed value no longer rises, then retighten the foot bolt.
11. Repeat measurement for all remaining feet.
12. Wizard only: press the results key to conclude measurement. Based upon these measurements, the computer offers its advice:

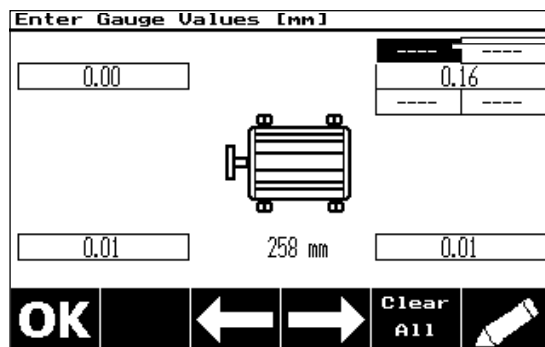


Enter gap width      scroll up / down      Job sheet (page 5-7)

- for clearly interpretable readings, evaluation results are presented with clear instructions on eliminating the soft foot (page 5-7), or
- for readings with more than one possible cause, a message appears instructing you to use feeler gages to measure gap orientation on certain feet.



13. *Wizard option:* Press the 'Enter gaps' softkey.  
 The following screen shows which feet to measure using feeler gages:



Enter feeler gage value here

- 14. Wizard option: Measure the gap widths on the corners of the feet and enter them into the corresponding boxes on the screen.
- 15. Wizard option: Press the OK softkey.



New readings

Measurement results

- 16. Perform soft foot corrections and take a final set of readings to verify results.
  - When all soft feet have been corrected (message: 'No soft foot' appears), you may press the 'Exit' key to leave the soft foot function and proceed with alignment.

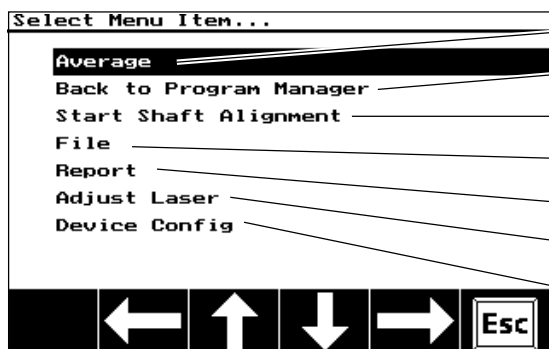
**Job record**

The job record documents all details on soft foot measurement (see also page 3-15). Press the 'History' softkey to access it. 'Page 1' contains the condition evaluation, the number of the soft foot and the averaging parameter setting used. 'Page 2' shows the time of measurement and the distance between machine feet, which can be changed here as well (see page 3-15).



**The menu**

The Menu key opens the following options of the soft foot menu:



- Averaging parameter
- Program Manager
- Shaft alignment application
- File management (open, save, delete)
- Print soft foot report
- Adjust laser beam
- Basic adjustments

## Soft foot: examples

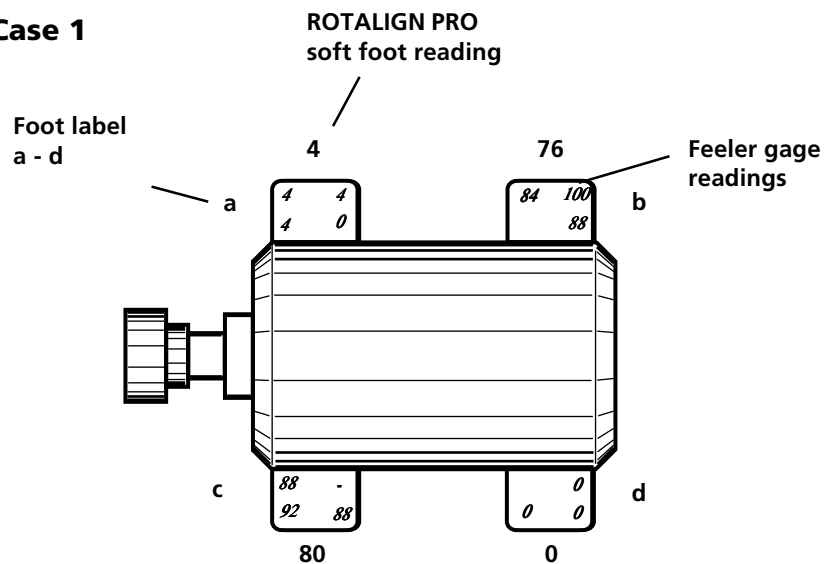
### Soft foot examples

The following examples illustrate typical real-life cases. Of course, all machines and all locations have their own unique characteristics that make it impossible to apply indiscriminately the conclusions presented here. This section is intended to provide positive practical knowledge of how the soft foot function can be used properly to achieve better alignment results in less time.

The following notation is used for these examples:

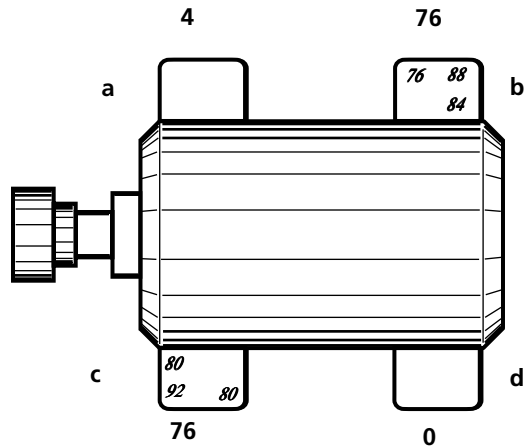
- ◆ ROTALIGN PRO readings appear outside the foot contours.
- ◆ Feeler gauge readings appear inside the foot contours.
- ◆ Blank spaces mean the reading is not available.
- ◆ Feet are labeled clockwise a to d.

#### Case 1



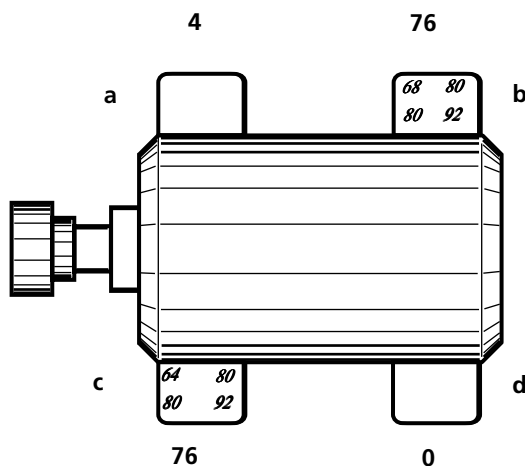
ROTALIGN PRO readings show near perfect rock, tempting the inexperienced aligner to shim feet B and D. In this case, that would be a mistake. The 4/100 mm difference diagonally, with near zero readings on the other diagonal, prompts feeler gauge examination of feet B and D. The feeler gauge results show 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.

**Case 2**

Identical and opposing ROTALIGN PRO 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.

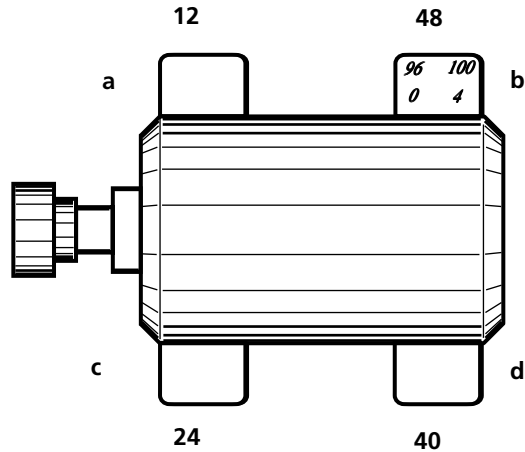
Conclusion: Shim both feet B and D about 50-60% of the feeler gauge amount and recheck all four feet.

**Case 3**

Identical ROTALIGN PRO 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.

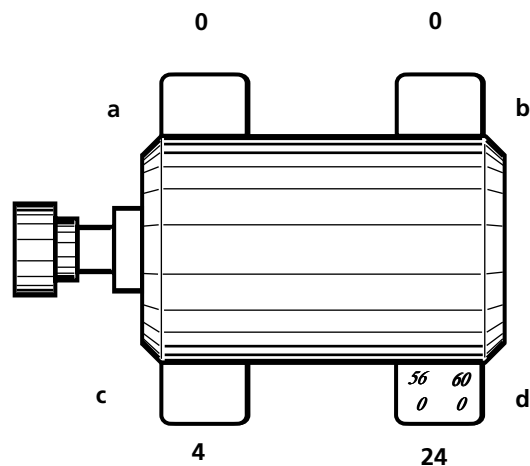
## Case 4



One foot having high ROTALIGN PRO 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.

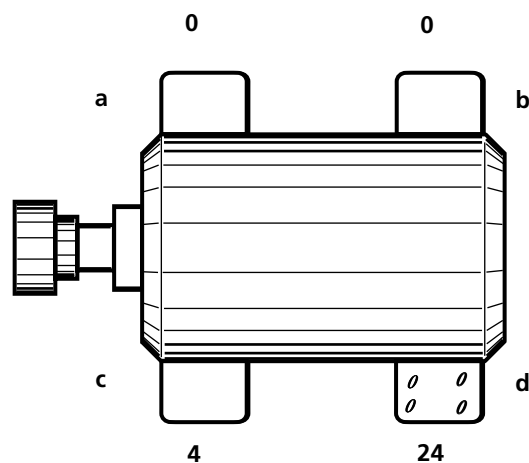
## Case 5



Feeler gauge readings are taken to examine the foot with the high ROTALIGN PRO 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.

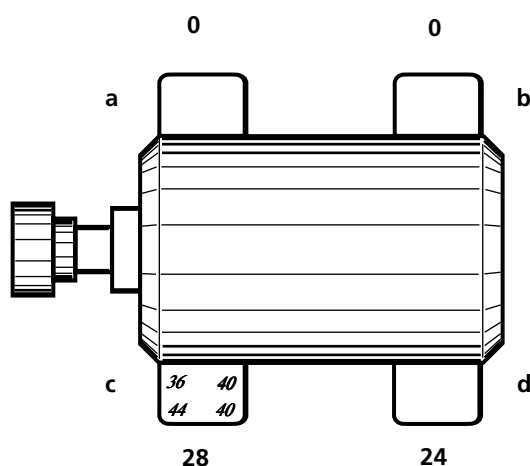
## Case 6



Feeler gauges are used to examine the foot with the largest ROTALIGN PRO 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.

## Case 7



Two large ROTALIGN PRO 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 PRO 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).

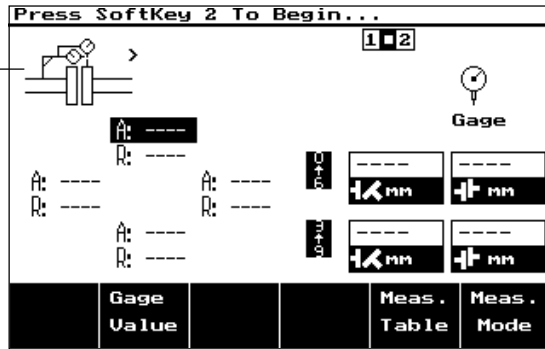
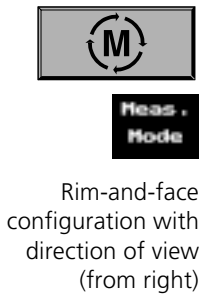
**Dial indicator measurement**

If dial indicators were previously used to align the machines, those readings can be entered into ROTALIGN PRO for verifying calculation and comparison with laser-optical measurement results.

Conversely, ROTALIGN PRO may be used to convert its own readings into dial gage values.

**1. Converting dial gage readings into ROTALIGN PRO values**

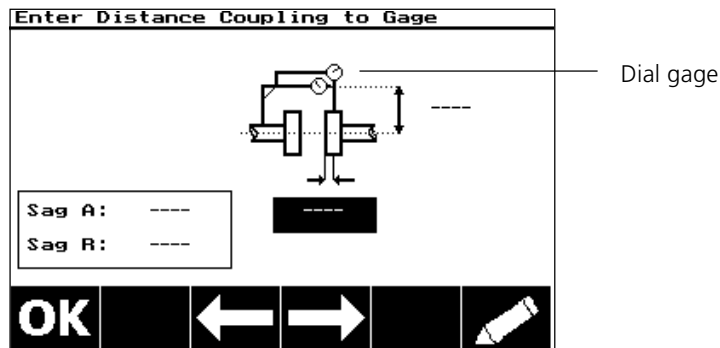
- a. Press the 'M' softkey.
- b. Press the 'Meas. Mode' softkey and select 'Dial gages':



- The left portion of the screen shows the dial gage configuration and contains areas for entering dial gage readings.
- ROTALIGN PRO equivalent values are displayed in the boxes on the right side of the screen.



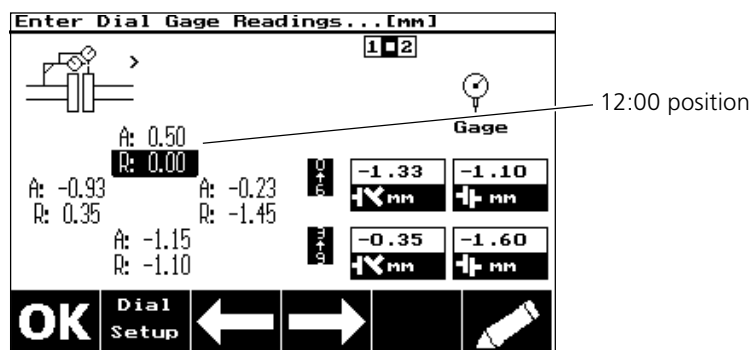
- c. Press the 'Gage value' softkey; if the dial gage setup has not yet been specified, press the 'Dial setup' softkey to display the following screen:



- d. Use the arrow keys to select the dial gage diagram, then press the EDIT softkey. A selection screen appears for you to choose the appropriate configuration (rim-and-face or indicator-reverse).
- e. Enter the required dimensions and, if known, the amount of bracket sag.



- f. Enter the dial gage values into each of the entry boxes; the direction of view is indicated by the 'eye' symbol next to the dial gage depiction (i.e. viewed from the right in the example below):



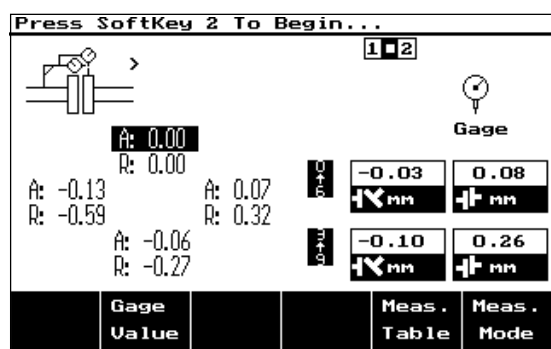
- The computer calculates the coupling gap and offsets from the gage readings, including any bracket sag amounts entered.
- Press the OK softkey to normalize the gage readings to the 12:00 position and place them into the measurement table (page 3-15).

## 2. Converting ROTALIGN PRO values into dial gage readings

- Open the measurement table (page 3-15).
- Select the measurement set(s) to be converted to dial gage readings, then press the OK softkey.
- Set the measurement mode to 'Dial Gage'.
- If the dial gage setup has not yet been specified, press the 'Gage value' softkey, then 'Dial setup' and enter the required dimensions (see step 1c above).

Table

Meas.  
Mode



- The computer automatically converts the ROTALIGN PRO measurements into normalized dial gage readings.
- These gage readings can be changed by pressing the 'Gage value' softkey, selecting the desired reading, then entering the new reading via the keyboard. The gap and offset values are automatically adjusted for the new reading. Press OK to normalize the dial gage readings to 12:00 position and enter them into the measurement table.

## Troubleshooting

### Poor repeatability

- Incorrect bracket mounting:  
Are they slipping or mounted skewed? Have they been bumped accidentally?
- Preparation errors:  
Is bearing play excessive? The soft foot function can be used to determine bearing play (page 5-5).  
Are the foundation and machine frame stable? If so, remove the coupling bolts measure using 'pass' mode (page 3-11).  
Are the machines joined by a rigid (fixed) coupling? Read page 2-2 for further details.
- Are the receiver and emitter lenses clean?
- Check the machine for soft foot (page 5-5).
- Are corrections being carried out in the proper direction? Check the +/- sign convention on page 2-19 to be sure.

### Error messages:

During measurement:

- *Invalid measurement*: Measurements cannot be evaluated because too few points have been measured or the shafts were not rotated far enough. Check the requirements for the respective measurement modes starting on page 3-10.
- *Error: End 'sweep' mode*: Measurement was started in 'sweep' mode although the laser beam was not adjusted into measurement range (Laser Off). Readjust the beam before beginning measurement.

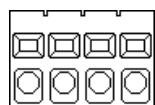
The following can appear in the 'receiver' status line (page 2-16):

- *Sensor...*: Measurement program is attempting to address the receiver sensor and to begin measurement. This message appears even when the receiver is not connected.
- *Laser Off*: The laser beam is not striking the receiver detector: readjust the beam and make sure the receiver cap is removed.
- *Laser End*: The laser beam is striking the edge of the detector: readjust the beam; during measurement: extend the measurement range (page 3-14).
- *Sensor OK*: The laser beam is in the outer measurement range; measurement can be started.
- *Centered*: The laser beam is centered in the inner measurement range. Start measurement.
- *Temperature*: If the receiver temperature rises above 60°C / 140°F or falls below 0°C / 32°F, then this message appears and measurement stops.
- *Inclinometer*: The electronic inclinometer has failed. Contact your PRÜFTECHNIK AG distributor for service assistance.
- *Ambient Light* or *Laser bright*: The position detector is overloaded by excessive ambient light or the more intense laser beam emitted just after switching on (in order to facilitate beam location). Shade the receiver or wait for the beam to switch to normal power.
- *Clean lens*: Insufficient laser beam intensity due to lens contamination. Clean the receiver and emitter lenses using the optical cloth included with ROTALIGN PRO.

### Machine symbols



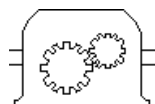
Electric motor with or without a fan; the fan can be located on the left or on the right.



Reciprocating machine such as diesel motor or reciprocating compressor.



Generator



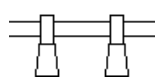
Gearbox



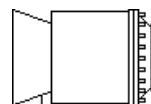
Pump



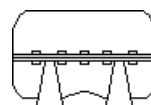
Blower, fan



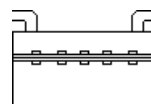
One- or two-bearing shaft



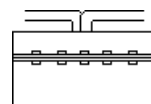
Gas turbine



Compressor



Steam turbine (high-pressure)



Steam turbine (low-pressure)



Standard symbol for other machines not shown here



Flange symbol  
(treated separately from rest of machine)

### Suggested alignment tolerances

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. Or, in inches: 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

$$(0.07 \text{ mm}) \times 75/100 = 0.0525 \text{ mm (or } 5/100 \text{ mm)}$$

Or, in inches: e.g. at 1800 rpm, diameter = 20":

$$5 \text{ mils} \times 20"/10" = 10 \text{ mils gap}$$

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

$$(0.03 \text{ mm}) \times 300/100 = 0.09 \text{ mm (or } 9/100 \text{ mm)}$$

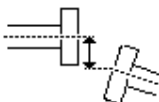
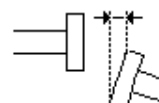
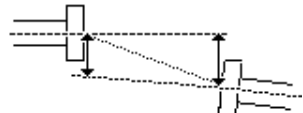
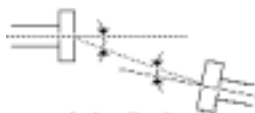
at either coupling at the ends of the spacer shaft.

In inches: e.g. 7200 rpm, with length = 10":

$$0.25 \text{ mils} \times 10"/1" = 2.5 \text{ mils offset}$$

"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 (fixed) couplings have no tolerance for misalignment, they should be aligned as accurately as possible.

### Suggested Shaft Alignment Tolerances

	[RPM]	Tolerance			
		metric [mm]		inch [mils]	
<b>Soft foot</b>	any	0.06 mm		2.0 mils	
<b>Short "flexible" couplings</b>		Acceptable	Excellent	Acceptable	Excellent
<b>Offset</b>	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	
<b>Angularity</b> (gap difference at coupling edge per 100 millimeters diameter or per 10" diameter)	600			15.0	10.0
	750	0.13	0.09		
	900			10.0	7.0
	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	
<b>Spacer shafts and membrane (disk) couplings</b>					
<b>Offset</b> (per 100 millimeters spacer length or per inch of spacer length)	600			3.0	1.8
 offsB/offsA	750	0.25	0.15		
	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	
<b>Angularity (mrad)</b> (angle between spacer and shaft)	600			3.0	1.8
 alpha/beta	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 50 Hz supply running at multiples/fractions of 3000 RPM.

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

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**Productive  
maintenance  
technology**

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# ROTALIGN® PRO

## Straightness & Flatness

### Operating Instructions

#### Overview:

##### Part 1

ROTALIGN® PRO  
System operating instructions

##### Part 2

ROTALIGN® PRO  
Shaft alignment  
operating instructions

##### Part 3

ROTALIGN® PRO  
Straightness & flatness  
operating instructions

##### Part 4

BORALIGN®  
Operating instructions

**A printed copy of this manual in book form  
can be obtained from PRÜFTECHNIK Alignment**

#### Dear Customer,

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



Edition April 2000  
Straightness firmware v.1.6x  
ALI 9.648G

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Documentation Department  
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eMail: info@pruftechnik.com

## Foreword

Welcome to STRAIGHTNESS & FLATNESS, the latest additions to the ROTALIGN PRO range of laser-optical applications for machine alignment and measurement. This manual is a supplement to the main ROTALIGN PRO operating instructions, and discusses only the details specific to straightness and flatness measurement. Please acquaint yourself with the main instructions first!

The original ROTALIGN computer concept started back in 1995 primarily for laser shaft alignment, but also with flexibility in mind for the future development of other laser-optical applications. ROTALIGN has now become ROTALIGN PRO, with increased computing power and functionality so that several applications can be loaded at once, and more complex programs can be considered.

The first new application was BORALIGN for the alignment of machine bores. This was followed by STRAIGHTNESS and most recently FLATNESS.

STRAIGHTNESS measures machine beds, slides, ways and even paper machine rolls with the same ease and accuracy as for laser-optical shaft alignment.

FLATNESS allows the user, in conjunction with a standard PC, to combine several straightness measurements to build up a surface contour map of a rectangular machine base, a test bed, or across a series of machine runways.

Please let us know of your ideas and suggestions for development – by mail, fax or over the Internet at [www.pruftechnik.com](http://www.pruftechnik.com). We will try to include them in future product versions!

Ismaning, Germany  
April 2000  
PRÜFTECHNIK AG

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## **Chapter 1: Introduction**

This manual is a supplement to the main ROTALIGN PRO instructions, and deals exclusively with straightness and flatness measurement. Please consult the ROTALIGN PRO main manual, ALI 9.645G, which discusses the computer unit and other components. For the ROTALIGN PRO shaft alignment application, please consult manual ALI 9.646G.

### **Before you begin**

#### **About this manual**

This instruction manual is divided into four sections:

- Chapter 1. Introduction
- Chapter 2. Straightness measurement
- Chapter 3. Flatness measurement
- Appendix

#### **Everyone**

Please acquaint yourself first with the operating and safety notes given in the main ROTALIGN PRO manual, page 1-9.

#### **Beginners**

Read through the sections on the ROTALIGN PRO components (main manual, Chapter 2). Then try an actual measurement, following these instructions.

#### **Experts**

Observe the new procedures described in the system configuration and data handling sections (main manual, Chapter 3). Then run Straightness and follow the on-screen commands and messages.

## Intended use

ROTALIGN PRO to be used exclusively in industrial environments for the purposes specified in the respective application instructions published by PRÜFTECHNIK AG. The device and its accessories must be operated only by specially trained personnel.

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

## 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 PRO.



**WARNING!**

This symbol warns of potential hazards.



**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 PRO.

**Straightness parts list**

The ROTALIGN PRO Straightness Measurement package ALI 3.631SET includes the following individual parts:

- ALI 4.501 Magnetic laser emitter bracket (see appendix)
- ALI 3.198 Sliding receiver bracket (see appendix)
- ALI 3.474 ROTALIGN PRO Straightness & flatness CD for PCs (see below, and pages 2-17, 3-4)
- ALI 9.552 Straightness firmware registration card
- ALI 9.648G Straightness operating instructions (this manual)
- ALI 3.197 Carrying case with foam insert

The ROTALIGN PRO Alignment Commander registration ALI 3.531ZL which is not included in the package, is necessary to view measurements on a PC and to access the flatness options. This registration must be ordered separately.

Several optional accessories are also available for ROTALIGN PRO straightness measurement: see appendix for details.

**Installing Straightness Firmware into ROTALIGN PRO**

When you purchase the above Straightness package, you first need to install the Straightness 'firmware' into your ROTALIGN PRO computer. For this you require:

- PC running under Windows 95/98/NT
- Serial 9-pin cable SYS 2.711
- Straightness & Flatness CD supplied in the package
- ROTALIGN PRO with mains adapter or fully charged batteries.

Proceed as follows:

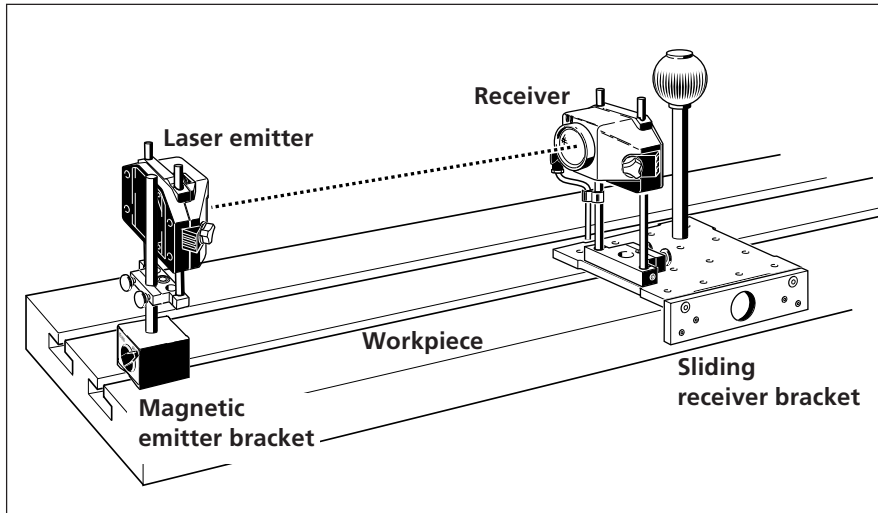
1. Insert the Straightness & Flatness CD in the PC. After a few seconds a menu should appear. If not then run START.EXE from the Windows Explorer CD listing.
2. In the menu select "Install Straightness Upgrade Manager". Follow the on-screen instructions to load the Upgrade Manager, SYS1UPD.EXE onto your PC.
3. Run the Upgrade Manager and again follow the on-screen instructions. You will need to connect the cable between the ROTALIGN PRO 9-pin serial port (top right side) and a spare 9-pin serial port on your PC. If you only have one port, and the mouse is connected to it, you will have to work temporarily without the mouse, and use the keyboard.

Once the installation is complete, the Straightness Program icon should appear in the ROTALIGN PRO Program Manager (page 2-4). You may also at this point wish to install the ROTALIGN PRO Straightness and Flatness software onto your PC, see page 2-18.

## Chapter 2: Straightness

This chapter describes straightness measurement procedures with ROTALIGN PRO and comprises the main part of this manual.

### Operating principle



The ROTALIGN PRO alignment system uses a visible laser beam to determine the straightness of linear workpieces. The laser emitter is mounted at one end of the workpiece and is aimed at the laser receiver, which travels the length of the workpiece during measurement.

The receiver uses a semiconductor position detector to precisely measure the position of the beam. As the receiver is moved along the workpiece, the laser beam changes its position in the receiver according to the degree of straightness deviation.

The ROTALIGN PRO computer uses the laser beam coordinates from the receiver to display the straightness diagram showing the deviation at each measurement position.

Different brackets allow this principle to be used on a wide variety of applications, including straightness measurement of rolls on paper machines and rolling mills.

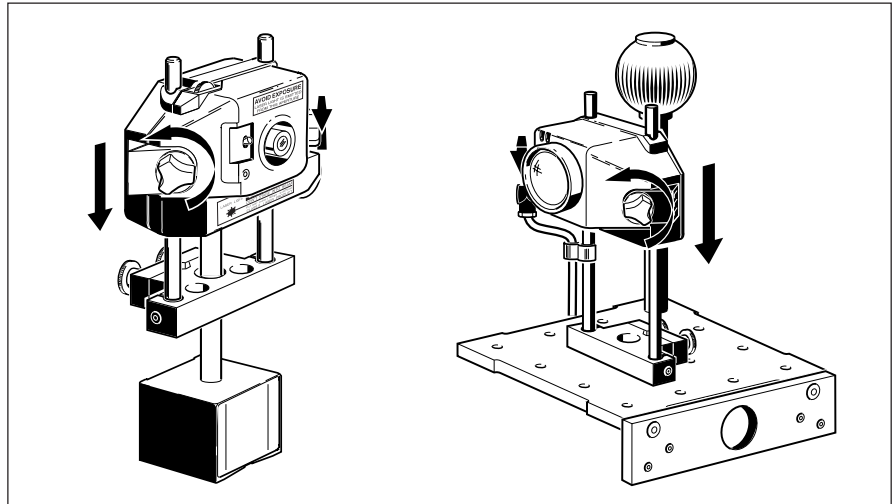
Custom-made brackets can also be used in conjunction with the ALI 3.199 adapter (see appendix)

## Setup

### Mounting laser and receiver

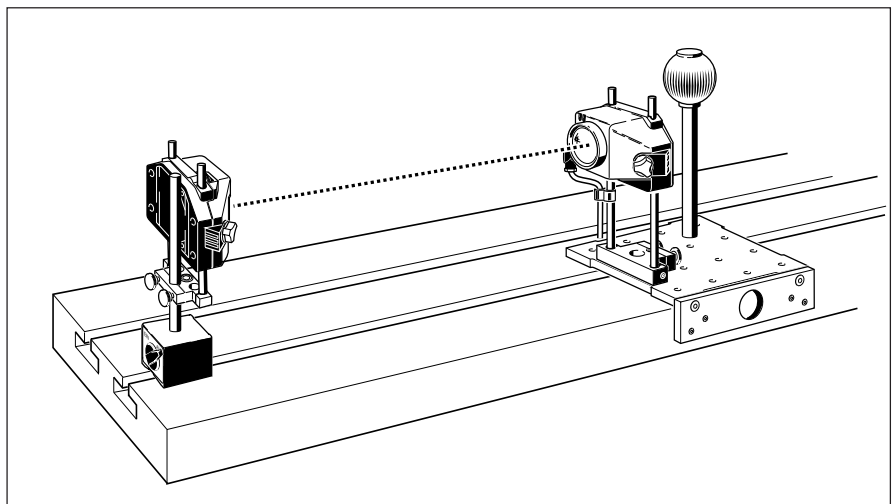
The laser emitter mounts on a simple magnetic fixture (ALI 4.501) at one end of the workpiece. The receiver is mounted onto the ALI 3.198 receiver bracket, which travels along the workpiece from one measurement location to the next.

1. Ensure that the yellow knobs on both components are loosened enough to let you slide the housings onto the support posts.
2. Tighten the yellow knobs to lock the components onto the posts, then remove the dust cap from the laser.



### Bracket mounting

4. Place the receiver bracket onto the machine as shown below. Ensure that all three of the support studs on the bottom of the bracket plate rest firmly on the surface to be measured.
5. Then place the laser bracket at least 500 mm / 20" beyond the nearest measurement location and positioned such that the beam strikes the dustcap of the receiver at the other end of the measurement path.





### Connecting the receiver

6. Plug the receiver cable (ALI 3.581-2) into the ROTALIGN PRO computer: note the keyway indicating proper plug orientation. A gentle push is required until the plug clicks into place.
7. Insert the angled cable end into the receiver socket, noting the keyway orientation, and screw the plug fitting into place.

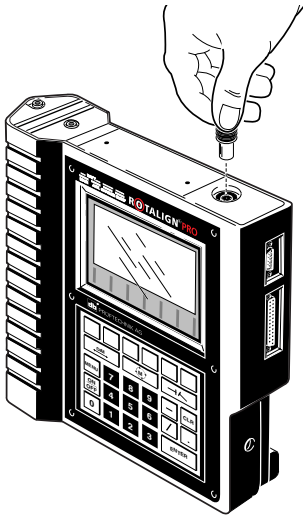
Do not twist the cable when disconnecting it! Otherwise, damage to the conductor pins may result.

The angled plug should be permanently left connected to the receiver, even during storage in its case, as this will help avoid damage to cable pins, plugs and sockets.

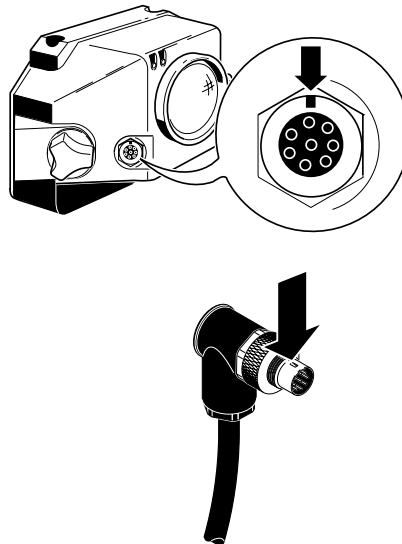


8. Attach the plastic cable clip to the lower portion of the support post as shown in the illustration on the previous page. This helps avoid measurement disturbance and damage to the cable or socket if the cable is pulled.

6.



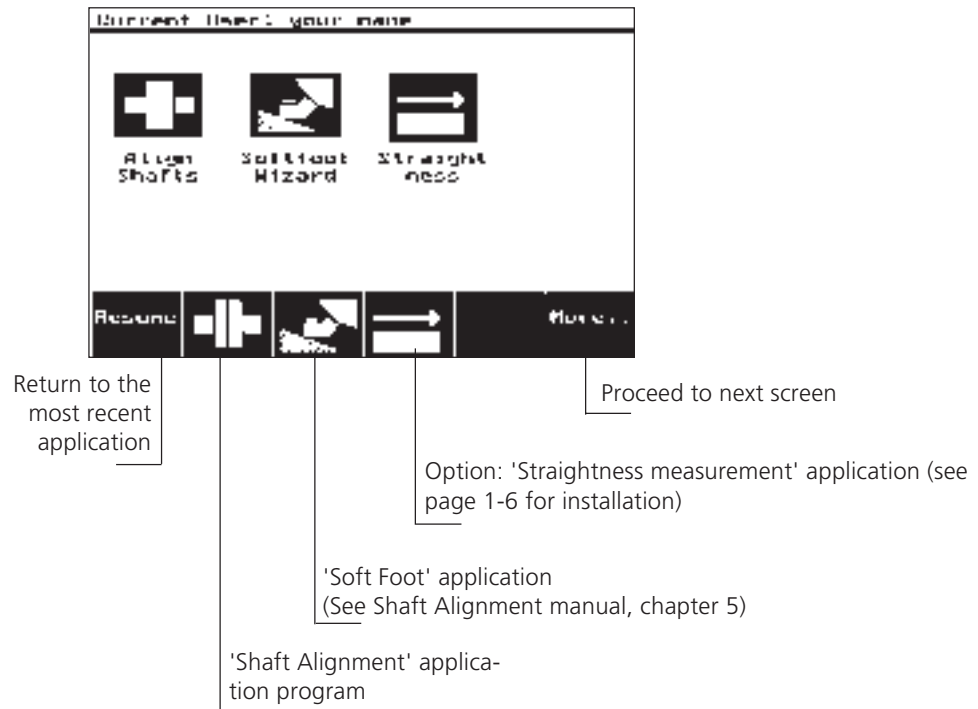
7.



### Switching on



Press the ON/OFF key to switch on the ROTALIGN PRO computer. The operating software ('firmware') loads in approx. 10 seconds, and then the opening screen appears:



This screen is the main display of the 'Program Manager', which takes precedence over the individual measurement applications and handles global functions such as file management, PC communication and administration of the computer system. Chapter 3 of the main ROTALIGN PRO manual (ALI 9.645G) contains detailed information on the Program Manager.

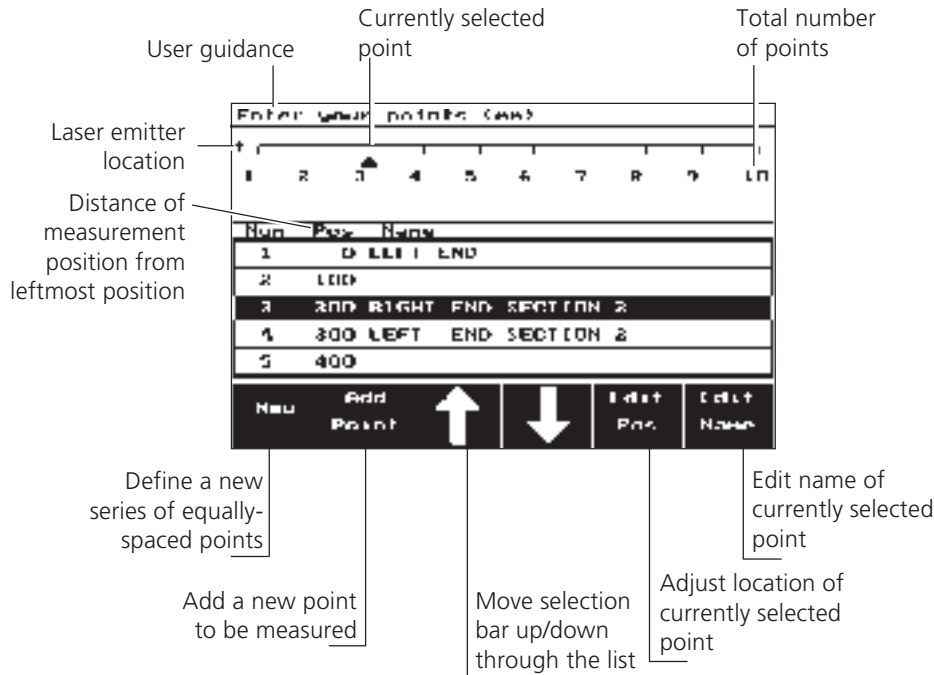
- The six softkeys below the display are used to operate the program. The labels for each of these softkeys appears in the bottom of the screen, so that the function of each key is defined precisely according to the situation at hand (or the screen context; see also the main ROTALIGN PRO manual).
- The program manager can be accessed at any time by pressing the MENU key and selecting the 'Program Manager' option (main manual, page 3-1).
- Screen contrast can be adjusted from the opening screen using the keys '0' and '1'.
- The 'Resume' softkey lets you return to the most recent display before the computer was switched off.
- Press the 'Straightness measurement' softkey to enter the application program. If it is not present then see page 1-6 for installation.



### Set up measurement locations

The next step is to enter the measurement locations.

A line at the top of the 'dimensions' screen shows the locations to be measured as the receiver is moved along the workpiece. The laser emitter is symbolized by the star at the left end of the line.



Measurement locations (or 'points') can be added to the line individually by pressing the 'Add Point' softkey. The easiest way to set up a new measurement series, however, is to press the 'New' softkey:

1. Press the softkey marked 'New'.
2. Enter the total length over which measurements are to be made on the workpiece, then press the 'Enter' key to confirm.
3. Press the down-arrow key, then enter the number of points to be measured along the total length. Press the 'Enter' key to confirm.

The computer calculates the interval between points. Either of the entries made here may be changed by using the arrow keys to mark the line to be changed, then pressing 'Select'.

Press 'OK' to return to the measurement dimensions screen.

Previously-stored dimensions can be loaded by pressing the 'Menu' key, then selecting 'File' and 'Open'. Individual locations and their labels can then be changed if necessary by pressing the 'Edit Pos' and 'Edit Name' keys as directed on the following page.

Setups can also be defined in advance using the ROTALIGN PRO Commander program for PC, then downloaded to the ROTALIGN PRO computer.

**Alternatively, 'length and interval' or 'interval and number of points' may be entered: the computer calculates the missing dimension from the two other entries.**



**Note**

This 'dimensions' screen can also be accessed at any time by pressing the 'DIM' key.



The following steps are to be performed only when necessary. If, for example, the dimensions loaded from a file already matches that of your aggregate, you can skip the following section.

### **1. Adding new measurement points**

- a. Press the 'Add Point' softkey.
- b. Enter the distance from the leftmost measurement position to the one being added. The arrow softkeys can be used to move the cursor back and forth through this number.
- c. Press 'Enter' to confirm the new position. The point list now appears with the new position inserted in the correct order.

### **2. Changing individual positions**

- a. Use the arrow softkeys to highlight the desired position line in the display.
- b. Press the 'Edit Pos' softkey. The corresponding position box opens for editing.
- c. Enter the correct distance from the leftmost measurement position to that being edited. The arrow softkeys can be used to move the cursor back and forth through this number.
- d. Press 'Enter' to confirm the new position. The point list now appears with the changed position in correct order.

### **3. Changing names of points**

- a. Use the arrow softkeys to highlight the desired position line in the display.
- b. Press the 'Edit Name' softkey. The text editor opens with the current name entered for changing.
- c. Use the text editor to change this entry as desired (see main ROTALIGN PRO manual, Chapter 3)
- d. Press 'OK' to confirm the new name. The point list now appears with the new name of the edited point.

### **4. Deleting points**

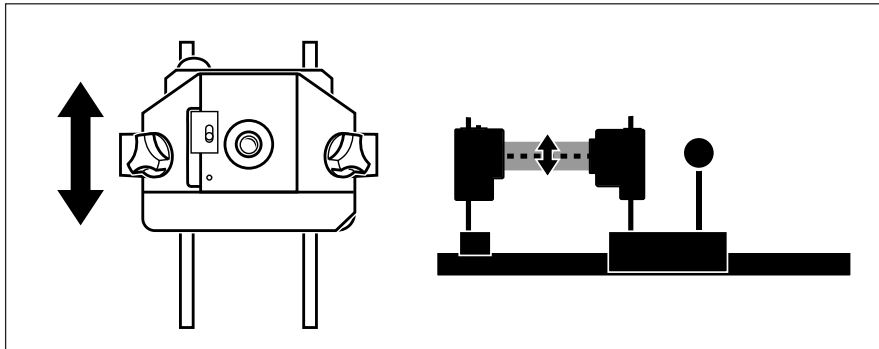
- a. Use the arrow softkeys to highlight the desired position line in the display.
- b. Press the 'CLR' key to delete the marked position.

### Laser beam adjustment principle

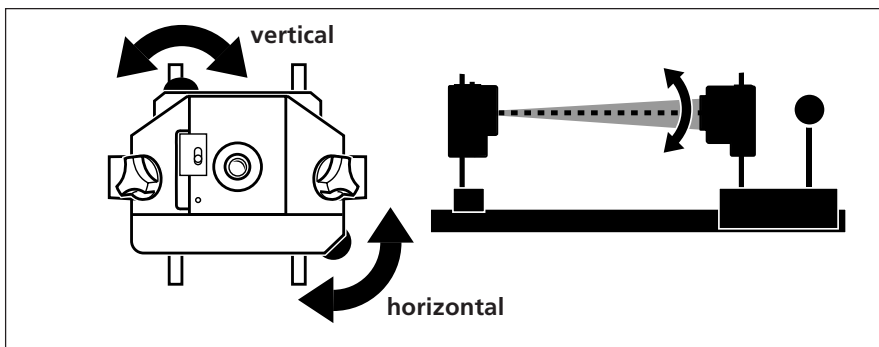
Before measurement can begin, the laser beam must be positioned such that it strikes the approximate center of the receiver lens over the entire measurement path. Actual measurements then reflect the exact deviation from this initial beam position. The emitter bracket assembly and beam adjustment thumbwheels allow beam positioning by changing the emitter position (offset) and the beam angle in both horizontal and vertical directions. The procedure described here is the fastest and easiest method of proper beam adjustment.

Starting with the receiver located at the near end of the measurement path, the beam is brought onto target by adjusting the emitter position. Then the receiver is moved to the far end of the measurement path for angular adjustment of the beam. These two steps are repeated as necessary until the beam remains on target at both ends of the measurement path.

1) Offset adjustment with the receiver located in 'near' position: The entire laser bracket frame can be loosened on the magnetic bracket post (a), then moved up or down for rough adjustment. The laser emitter itself can be loosened on its support posts, then moved up or down for fine vertical adjustment. Horizontal adjustment can be made by moving the entire emitter bracket.

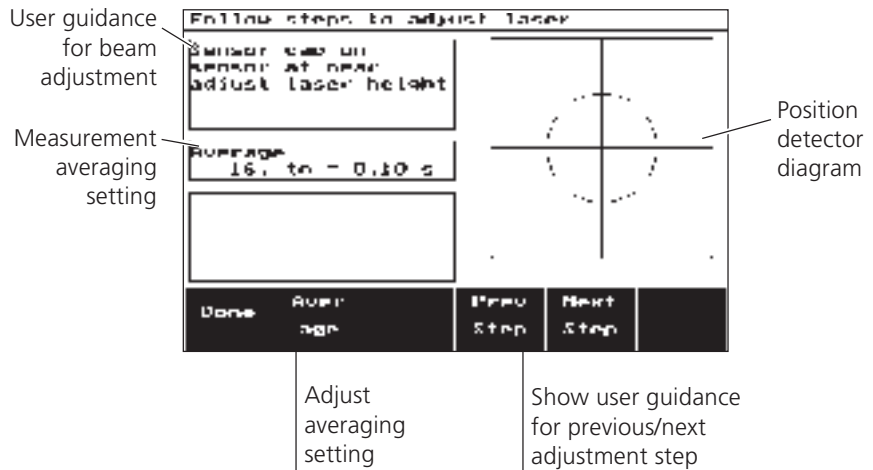


2) Angular adjustment at the 'far' position: The laser bracket frame can be loosened on the magnetic bracket post (a), then swiveled horizontally for rough horizontal angle adjustment. The yellow thumbwheels on the laser housing allow fine adjustment of horizontal and vertical beam angularity.



**Adjustment procedure**

1. Press the 'M' key (or the 'Menu' key, then select 'Laser Setup') to enter beam adjustment mode.



2. The computer now directs you through the following adjustment steps with short texts that appear in a box in the upper left-hand portion of the display. Proceed from one step to the next by pressing the 'Next Step' softkey, following the display prompts:
  - i. Leave the dustcap on the receiver for the moment.
  - ii. Place the receiver at the closest measurement position.
  - iii. Remove the protective cap from the laser emitter and switch it on.

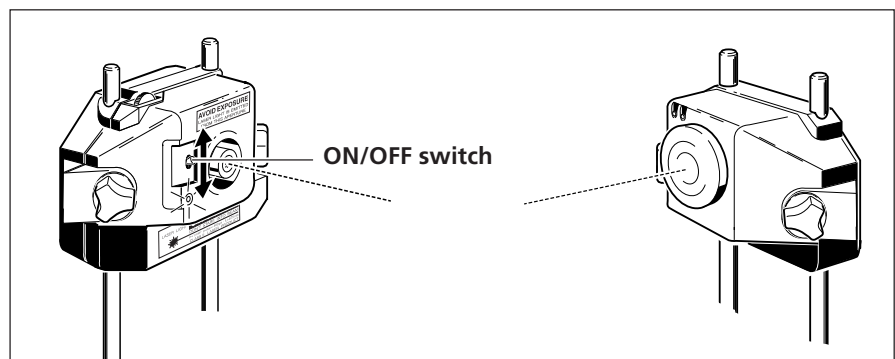


Do not stare into the laser beam!



Maximum measurement stability can be ensured by switching on the laser and computer/receiver at least 30 minutes before beginning beam adjustment and measurement.

Adjust the height of the beam to center it vertically on the receiver cap. If the laser emitter and receiver have been roughly positioned to each other during mounting (see page 2-2), the laser beam should strike the red cap of the receiver. If not, use a white piece of paper to locate the beam and readjust it onto the receiver.



3. Offset adjustment: with the receiver at the near end of the measurement path, adjust the position of the emitter to center the beam onto the receiver cap.

*Vertical adjustment*

- i) Rough: loosen the support post assembly to allow it to slide up and down on the magnetic bracket post.
- ii) Fine: Loosen the locking knobs, then slide the emitter along its support posts.

*Horizontal adjustment*

Deactivate the magnetic bracket clamp, then position the entire emitter bracket assembly laterally.

4. Angle adjustment: press the 'Next Step' key to proceed to the next adjustment step; follow the display prompts.
  - i) Place the receiver at the far end of the measurement path.
  - ii) Adjust the angle of the beam to center it onto the receiver cap.

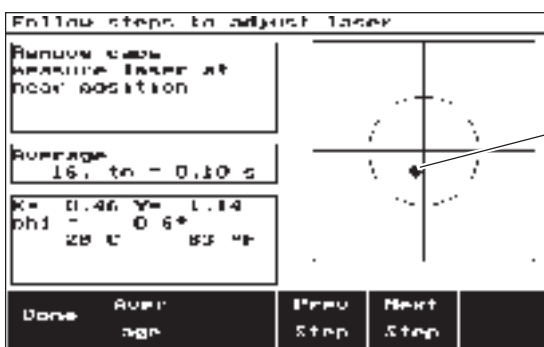
*Horizontal adjustment*

- i) Rough: Loosen the locking knobs, then swivel the emitter support assembly horizontally on the magnetic bracket. (Avoid letting the assembly move vertically to retain the previous adjustment.)
- ii) Fine: Turn the yellow thumbwheel on the bottom corner of the laser housing to adjust the exact horizontal angle of the beam.

*Vertical adjustment*

Turn the yellow thumbwheel on the top of the laser housing to adjust the exact vertical angle of the beam.

5. Repeat steps 3 and 4 as necessary until the beam remains centered on the receiver cap, pressing 'Next step' each time before you move the receiver.
6. Remove the receiver dustcap. Place the receiver at the closest measurement position. The beam position should appear in the displayed detector diagram as a black dot within the target circle, remaining with the circle when the receiver is moved to the far end of the measurement path. If not, repeat adjustment steps 3 and 4 as necessary.



Laser beam position  
on receiver  
(viewed from emitter  
toward receiver)

7. Press the 'Next Step' key to obtain confirmation that the laser is now properly adjusted. Press the 'Done' softkey to confirm adjustment and proceed with actual measurement.

### Taking measurements



Note

To ensure maximum measurement stability, place the receiver assembly at the most distant position for the first measurement and work successively toward the closest position to the laser.

1. Once beam has been confirmed, the display automatically switches over to measurement mode:

Press the up-arrow to move the cursor line to the most distant measurement position (i.e. the bottom of the list).

Laser Beam position (viewed from receiver toward laser emitter)

Measurement parameters: X/Y coordinates, angle, temperature

Measured (x,y) beam coordinates

Cursor line

Num	Pos	Dist	x	y
1	0 LEFT	---	---	---
2	100	.	.	.
3	200 RIGHT	.	.	.
4	300 LEFT	---	---	---
5	400	---	---	---
6	500	---	---	---
7	600	.	.	.
8	700	.	.	.

Take Point    Measure table    Adjust meas. average    Automatic measurement sequence

2. Take the first measurement by pressing the 'Take Point' key. The (x,y) beam coordinates appear in the cursor line.
3. Press the up-arrow key to proceed to the next position in the list and move the receiver to the corresponding measurement position.

Num	Pos	Dist	x	y
9	800	---	---	---
10	900	---	0.46	1.14

4. Take the measurement for this point by pressing the 'Take Point' key. The display is updated to include this new set of readings.
5. Repeat steps 3 and 4 for each remaining measurement point in turn, moving successively closer to the laser emitter.
6. Any measurement may be deleted by using the arrow keys to mark it, then pressing the 'CLR' key.

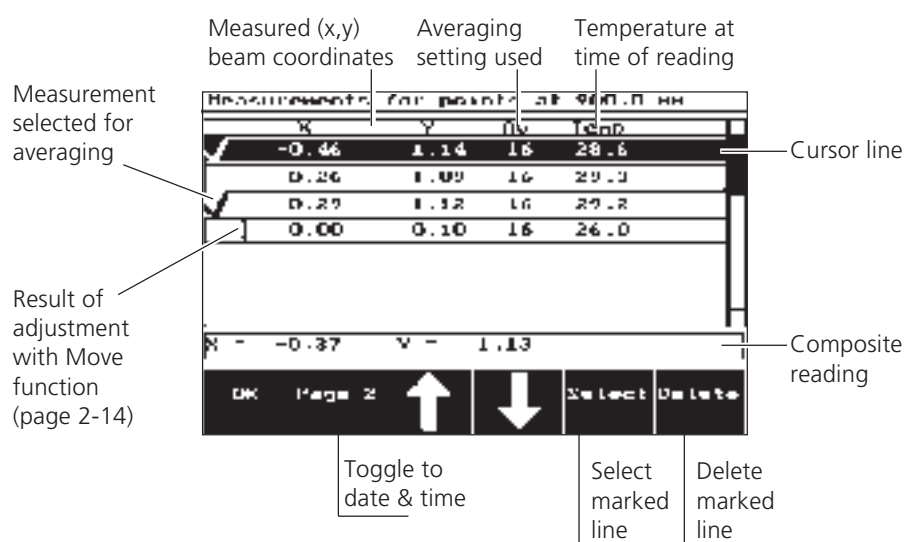


### Measurement options

The measurement display offers a number of softkeys for selection and adjustment of additional options:

### Measurement table

The computer maintains a detailed history of measurements for each individual measurement position. Press the 'Meas Table' key to view all measurements taken at the position currently marked by the cursor line.



This display also allows you to average any desired measurements into a composite reading for graphic depiction and recording in the Results display: use the up/down arrow keys to mark the desired measurement line, then press the 'Select' softkey to place (or remove) a checkmark on that line.

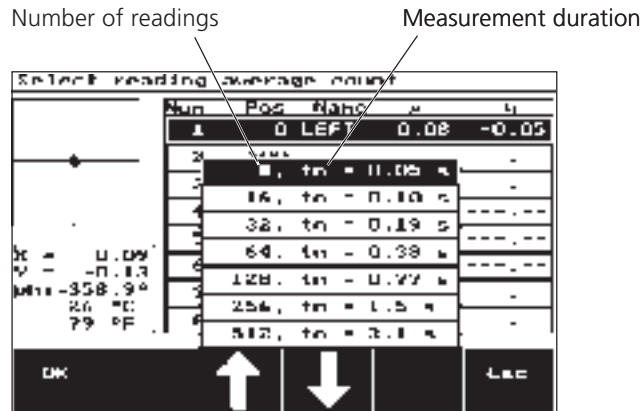
To delete any single measurement, use the up/down arrow keys to mark it, then press the 'Delete' key.

The 'Page 2' softkey toggles the display to show the time and date of measurement and the last four digits of the respective sensor serial number.

Press 'OK' to return to the measurement screen.

### Average

Press this key to adjust the number of individual detector readings for averaging into a single measurement. The greater the number of readings, the longer each measurement takes: this duration is indicated in seconds next to each setting. Use the up/down arrow keys to select the desired setting, then confirm with the 'OK' softkey (or press the 'Esc' softkey to exit without making changes).

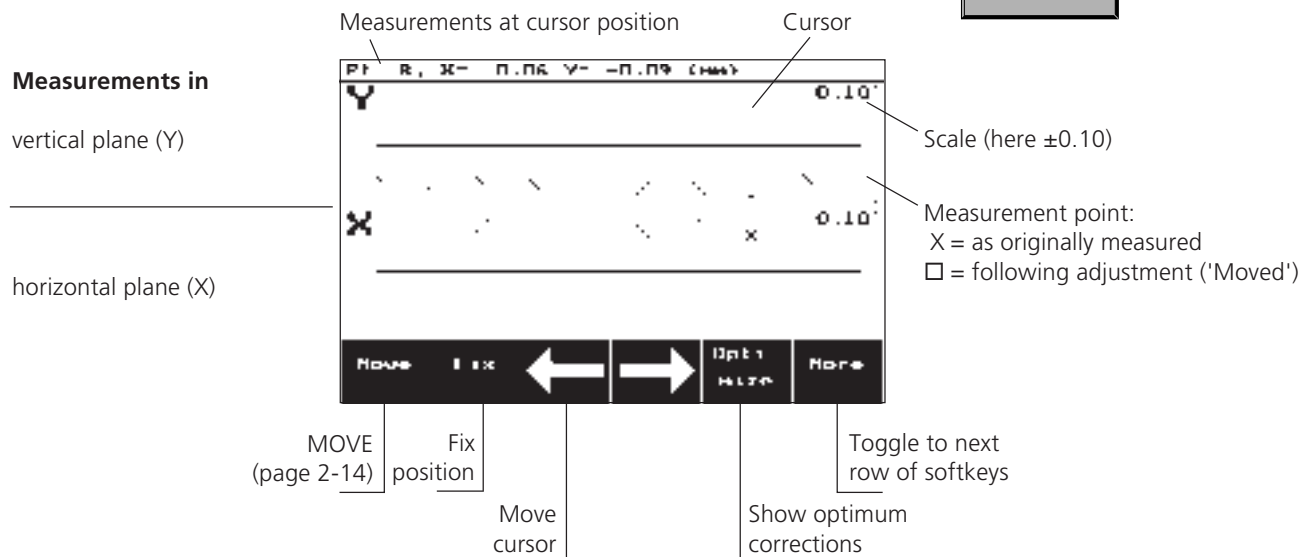
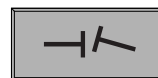


### Automatic measurement sequencing

Press the 'Auto Mode' key to let the computer advance from one position to the next following each measurement. Use the up/down arrow keys to set this progression through the list forwards or backwards, or select 'Off' to disable this feature, then confirm with the 'OK' softkey (or press the 'Esc' softkey to exit without making changes).

### Evaluating results

Press the 'results' key to switch to the results screen:



The straightness condition is shown here as measured, i.e. the detector readings are plotted directly as they appear in the measurement point list. The cursor line marks the current position whose exact values appear in the top line of the display.

### Optimized display

Press the 'Optimize' softkey to have the computer automatically recalculate the diagram such that necessary corrections are minimized. '<opt>' appears in the top line to indicate that displayed measurements have been optimized.



The original unoptimized display can be restored at any time by pressing the 'Laser Line' softkey.

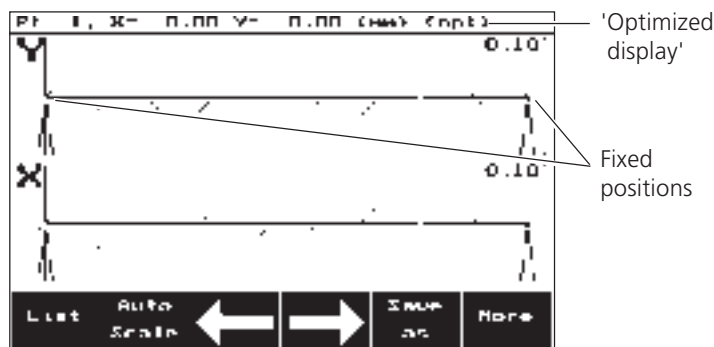


### Fix positions

Any two positions or, if desired, only one position – anywhere along the measurement path – can be designated as fixed in place to define the reference line, which is optimized through these 'fixed' points.



Use the arrow keys to mark the desired position, then press 'Fix' to fix the current cursor position in place. This fixation can be undone at any time by marking the position, then pressing the 'Unfix' key.

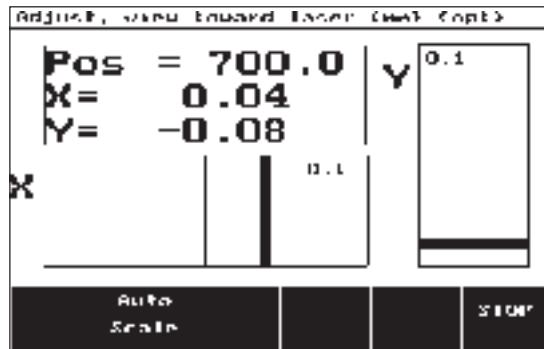


**The Move function**

ROTALIGN PRO allows you to monitor measurements at individual positions with a 'live' on-screen display during adjustment.



1. Use the arrow keys to mark the desired position for correction.
2. Press the Move key. The display resembles that shown below:



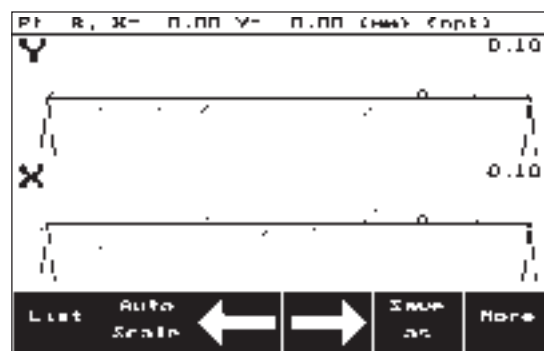
Both X and Y coordinates are continuously updated to reflect the momentary measurement. The bar diagrams are scaled automatically according to the initial results display.



3. Follow vertical (Y) and lateral (X) adjustments in the display while performing them. The 'Auto Scale' key can be pressed at any time to rescale the display (for example, if corrections overshoot the display scale entirely).



4. When the displayed values reach 0.00 (or fall within tolerance for your application), press the 'Stop' key to exit the Move function.



The display now reflects the newly-adjusted position following 'Move'. The moved position is now marked with a square.



During subsequent measurement, the measurement table screen includes the moved results clearly marked as such (see page 2-11).

Press the 'More' key to access additional results display options:



### 'List' results

This softkey displays the entire list of measurement positions along with measured results. This list is always based upon the current display: when results are displayed in unoptimized mode (page 2-13), this list appears similar to that shown during measurement. When the display has been optimized, however, the list shows deviations from the optimized correction line.



### 'Auto Scale' display

This softkey automatically adjusts the display scaling so that all measurements fit into the screen.



### 'Save as' file

Before concluding straightness measurement and adjustment, you should save the results so that they remain available for future use.



Press the 'Save as' softkey in the results screen and enter the file name using the text editor.

The same file name can be used more than once without overwriting the older file, since the file system uses its own identification. However, files with identical names can be distinguished only by their detailed information such as creation date, last measurement, etc.



Note

Always make a copy of important files on data storage medium (using the ROTALIGN PRO Commander program for PC) and on paper. PRÜFTECHNIK AG can assume no liability for lost or altered data!



ATTENTION



### Switch off

- Press the ON/OFF key to switch off the ROTALIGN PRO computer. If results have not been saved, the following query appears:

'Save data as  
*filename?*'

You now have approx. 10 seconds to decide whether to 'save', 'save as' (under a different file name), 'don't save' or 'cancel' (i.e. do not switch off) before the computer saves all changes to the suggested file name and switches off.

The current measurement data remains in the working memory and can be loaded directly after the computer is restarted; press the 'Resume' softkey to do so (see page 2-4).

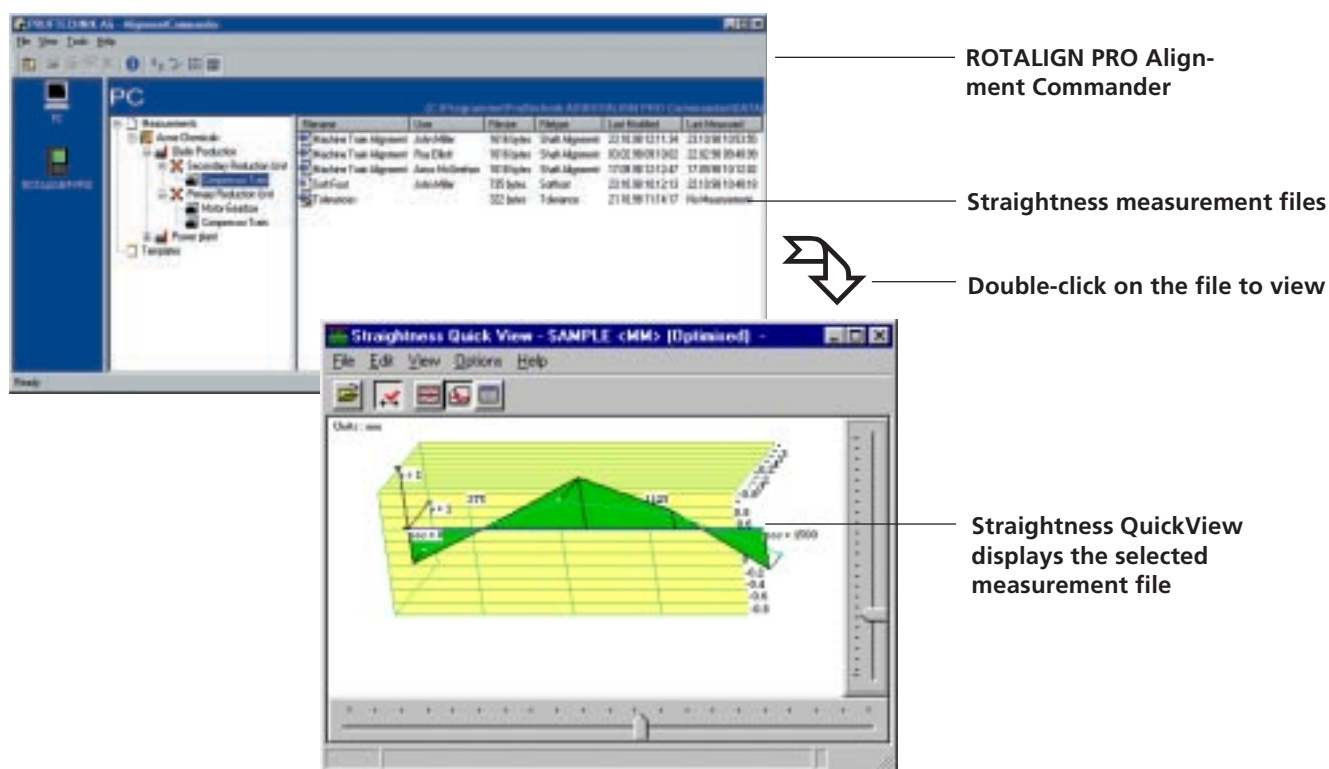
- Switch the laser off and replace the caps on the laser emitter and receiver.
- Remove the components from the machine.

Leave the receiver connected to the computer when you store the system in its case. If an extended period of nonuse is anticipated, remove the batteries from the computer and the laser emitter.

## Viewing straightness on a PC

The Straightness Measurement Package ALI 3.631SET (page 1-6) includes software to transfer straightness measurements from the ROTALIGN PRO computer to a PC under Windows 95/98 or NT. There it lists the data in tabular form or as a two- or three-dimensional display for evaluation. The procedure is summarised as follows:

- 1) Install and setup software on PC
- 2) Setup password for ROTALIGN PRO Alignment Commander.
- 3) Connect ROTALIGN PRO to PC
- 4) Use ROTALIGN PRO Alignment Commander to transfer files.
- 5) View measurements with Straightness QuickView.



To transfer files to a PC you will require your copy of the ROTALIGN PRO Alignment Commander to be registered. This requires the ROTALIGN PRO Alignment Commander registration ALI 3.531ZL which is not included in the Straightness package and must be ordered separately.



**Note**

### **1. Install the programs**

If you haven't already installed the ROTALIGN PRO Straightness and Flatness software onto your PC then proceed as follows:

1. Insert the ROTALIGN PRO Straightness & Flatness CD in the drive and the installation menu should automatically appear after a few seconds. If not, then double-click on START.EXE from the Windows Explorer CD listing.
2. Select the ROTALIGN PRO Straightness & Flatness installation option and follow the instructions as they appear on the screen.
3. When finished, exit the installation program, and remove the CD.

Several programs are installed on your PC, and for the purposes of Straightness you will need to use:

**ROALIGN PRO Alignment Commander:** Reads and copies measurement files from the ROTALIGN PRO computer to the PC. This program must first be setup with a password as described below.

**Straightness QuickView:** Displays the straightness data in various formats.

### **2. Setup ROTALIGN PRO Alignment Commander**

Before you can proceed you will require the correct ROTALIGN PRO Alignment Commander registration certificate ALI 3.531ZL. The full details of registration are described in the ROTALIGN PRO Alignment Commander Online Help, but here is a summary:

1. Have the registration password ready. You will also need the eight digit ID number of your ROTALIGN PRO computer(s), displayed in the ROTALIGN PRO Program Manager under "About this ROTALIGN" (press 'More..' twice to reach this option).
2. Run ROTALIGN PRO Alignment Commander, select 'Tools' and 'Communication Settings'.
3. Under 'Comport' select the COM port on your PC that will be connected to your ROTALIGN PRO.
4. Select 'ROALIGN PRO v.x.x', select 'Add' and enter the ID and the password. Select OK and the Commander will be ready to communicate with your ROTALIGN PRO.



### 3. Connect ROTALIGN PRO to PC

1. Connect serial cable SYS 2.711 between the serial port on the ROTALIGN PRO computer and the PC (see the main ROTALIGN PRO computer manual).
2. Switch on the ROTALIGN PRO computer.
3. From the Program Manager press the 'More..' softkey and the 'PC-Comm' softkey. The display will show 'Standby'.

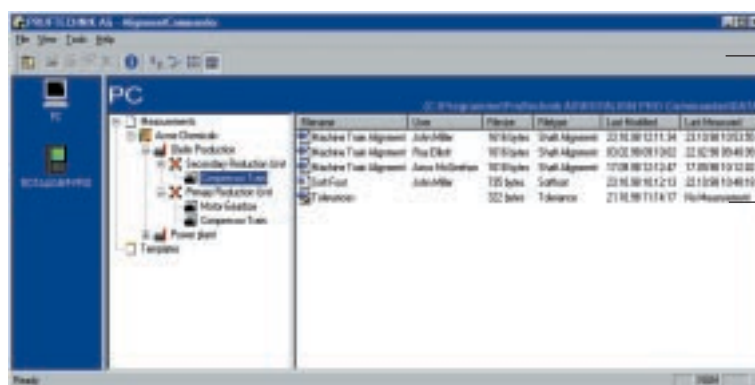
### 4. Transfer files with ROTALIGN PRO Alignment Commander

1. Run the ROTALIGN PRO Alignment Commander program. For full details of its operation please refer to its Online Help.
2. Click on the ROTALIGN PRO icon. The program takes a few seconds to obtain a listing of the measurement files on the ROTALIGN PRO.



To view a file it must first be copied to the PC. To transfer a file or files to the PC first make sure the correct working directory on the PC is selected:

3. Click on the PC icon, the working directory path is displayed above the listing. To change this select 'File' and 'Set Working Folder'. Browse to select the new directory.
4. With the correct working directory, click again on the ROTALIGN PRO icon to list its files.
5. Highlight the file(s) to copy, by clicking on them and holding down the SHIFT or CTRL keys to select multiple files.
6. Drag and drop the highlighted files onto the PC icon. The files will now be copied from the ROTALIGN PRO to the PC.
7. Click on the PC icon to list the copied files:



Please consult the Alignment Commander Online Help for full details of this program

Files copied to PC

8. Now you can double-click on any straightness file to call up the Straightness QuickView program and display the file. The following page describes the options available to you.

Viewing straightness on a PC

**Straightness QuickView**

When you double-click on a straightness file in the ROTALIGN PRO Alignment Commander display, the Straightness QuickView program is launched and the measurements are displayed. Select the desired display icon:

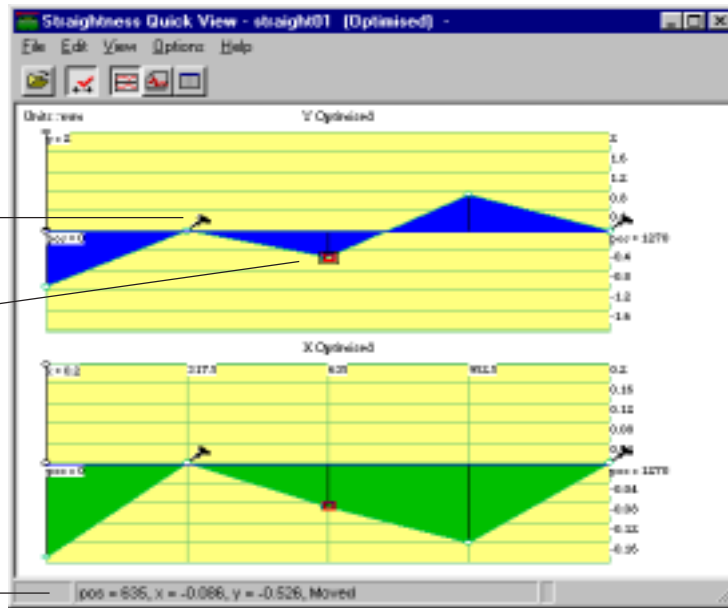


**2D Graph** (default): Two diagrams are displayed to show the projection of measurement points onto the Y-Z and X-Z planes.

Fixed point  
page 2-13

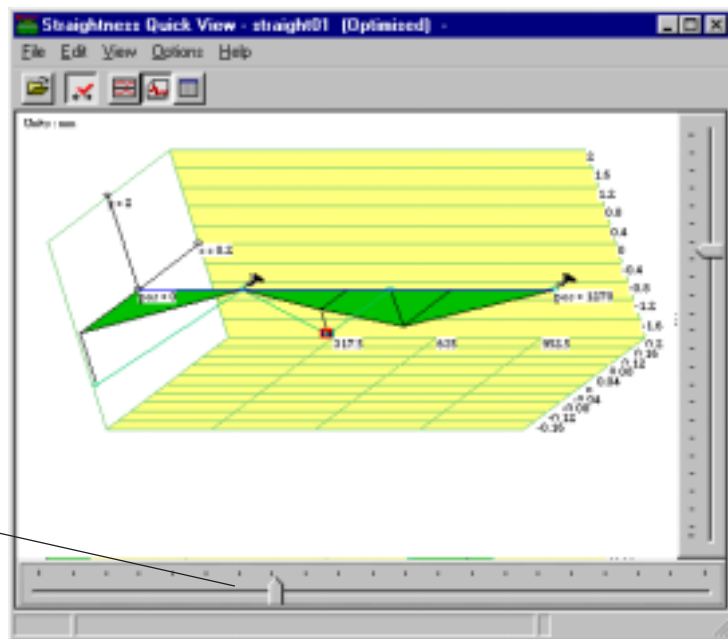
'Moved'  
measurement point  
page 2-14

Measurement point  
coordinates



**3D Graph:** Shows the spatial position of measurement points. The two position pointers on the edge of the window can be used to rotate the view about the Y or Z axis as desired.

Use these pointers  
to rotate the view



**Information View:** Measurement points and supplementary data (e.g. temperature, time etc.) are listed in tabular form. A second window gives information regarding the measurement location and operator.



### Further options

**Measurement point coordinates:** place the mouse cursor onto a measurement point in the Y-Z plane. Its coordinates appear in the status line.

**Fixed point:** click onto a measurement point in the Z plane to set it as the 'zero' reference line and mark it with a nail symbol.



**Optimize measurement points:** select 'View'- 'Optimized'. The raw measurements are optimized relative to the reference line in order to minimise adjustment effort.



**'Moved':** When the machine bed is adjusted following measurement, the corresponding measurement point is marked with a red square.



**Units:** Change between millimeters and inches in the Options Menu.

### Data export to spreadsheet

Select 'File' and 'Export as \*.csv spreadsheet file' to create a file in '\*.csv' data format. Select the desired filename and location and select Save to create the file.

If a spreadsheet program which can read the \*.csv file format (such as Microsoft™ Excel) has been installed on the PC, it is started automatically and loaded with the new \*.csv data file.

End the program by selecting 'File' - 'Exit'.

#### Note regarding data loss

With any data processing software, data may be lost or altered under certain circumstances. PRÜFTECHNIK strongly recommends that you make backup copies of all important data on a regular basis



**Note**

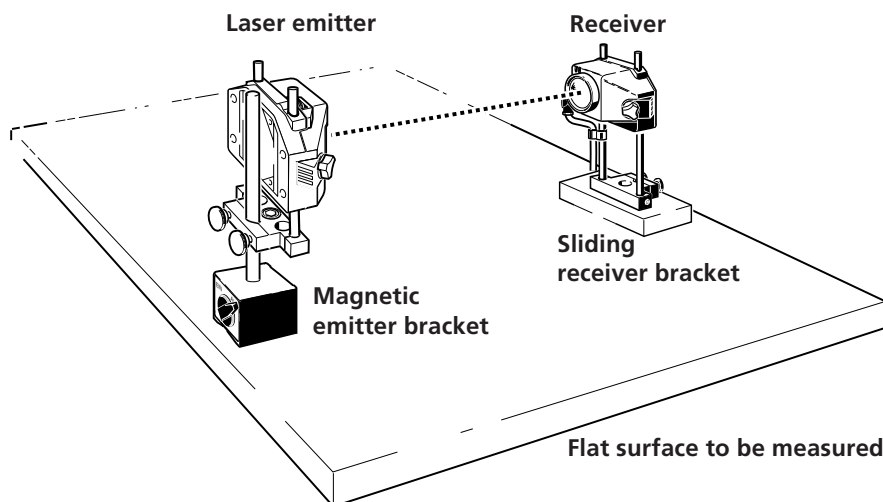


## Chapter 3: Flatness

This chapter describes flatness measurement procedures with ROTALIGN PRO. Please acquaint yourself fully with the straightness measurement procedure in the previous chapter first!

### Operating principle

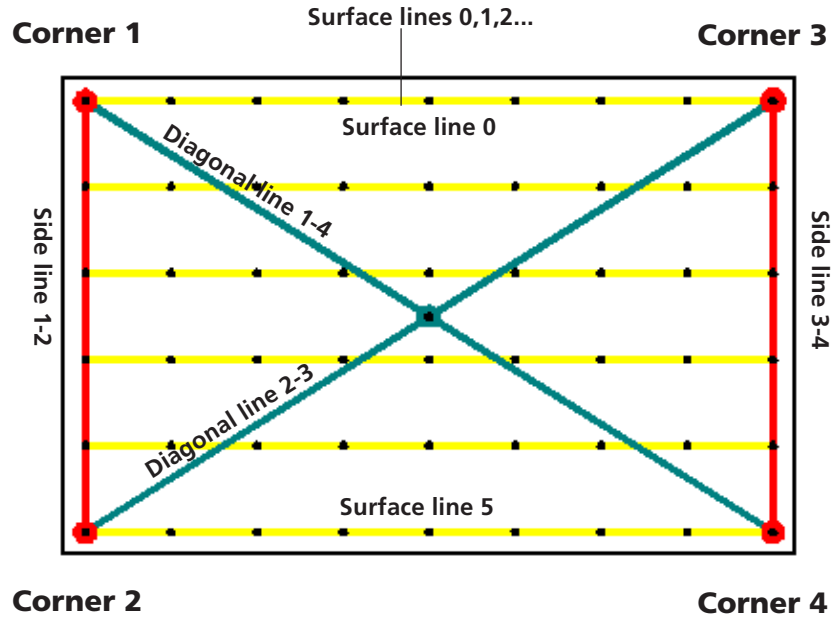
We saw in the previous chapter how series measurements can be made along a single line to build up a picture of its straightness. The principle is essentially the same for measuring the flatness of a whole surface - only lots more points!!



To measure flatness over an area a series straightness measurements are made at various positions across the surface. These sets of measurements are then 'spliced' together by the computer to give an overall surface flatness graph.

The measurements are made according to a grid pattern as shown on the following page.

Flatness measurement example made up of 10 straightness measurements



Arrows indicate direction of laser beam and the order of individual measurements

. . . black points indicate the measurement positions along the side lines & surface lines

This grid pattern is the basis for the straightness measurements used to generate the flatness graph. The corners are numbered 1-4, there are two diagonals, two side lines, and a series of parallel surface lines. These are listed in detail opposite.

Note the following:

- a. The number of surface lines and points along them depends on how detailed you require the flatness graph. You require at least three lines with three points on each.
- b. The laser needs to be at least 500mm (20") from the nearest measurement, so it must be either mounted outside the flat surface, or you measure over a smaller rectangle.

Here is a list of the required straightness measurements:

1. **DIAGONAL from 1 to 4** : Consisting of 3 points - one at each end, and the third where it crosses the other diagonal. The laser must be positioned beyond corner 1.
2. **DIAGONAL from 2 to 3** : As above, with the laser positioned beyond corner 2.
3. **SIDE LINE from 1 to 2** : With laser beyond corner 1. A measurement is made at each of the positions where the surface lines will be.
4. **SIDE LINE from 3 to 4** : With laser beyond corner 3, and a measurement at each position of a surface line.
5. **SURFACE LINE 0** : With laser beyond the left hand side, and a measurement at an equal number of points for each surface line. The surface lines are numbered starting with zero.
6. **SURFACE LINE 1** : at the next position.
7. **SURFACE LINE 2** : at the next position.
8. **SURFACE LINE 3** : at the next position

... and so on.

On the following page is the measurement procedure in detail.

### Flatness measurement procedure

The previous notes give the general idea of which straightness measurements to make. Here is the step by step procedure, to obtain a complete flatness measurement:

1. Determine and mark out the rectangular area you wish to measure. Note that the laser must be at least 500mm (20") from the nearest measurement, so, you may need to construct a base to mount the laser on beyond the edges of the surface to be measured. Alternatively measure over a smaller rectangle.
2. Decide how detailed you require the flatness measurement, and therefore how many surface lines and how many points along them you want to measure. You require at least 3 of each. Aim to have the points in a roughly square grid pattern. The grid diagram on the previous pages gives an idea of the number of points required for a basic measurement. It may seem quite daunting to make all these measurements, but if you are trying to trace a flatness problem, all the time spent now is transformed in an instant into a 3D graph which can reveal the most subtle defects!
3. Mark out the ends of the surface lines and the points along them. Mark out also the center point where the diagonals cross. Number the corners.
4. Starting with Diagonal measurement 1-4, mount the laser on the diagonal line at least 500mm (20") beyond corner 1, following the procedures in chapter 2.
5. The receiver must be repeatably positionable at both corners and at the center point. If it is not repeatable, then your measurements will be less accurate, and the initial laser alignment will be more difficult. It may be helpful to clamp a straight bar onto surface which the receiver base can slide along.

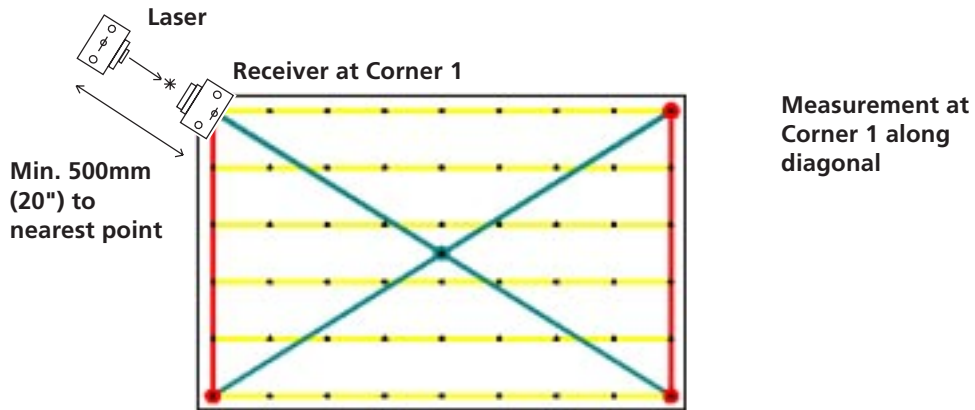
**Note**

Note: for flatness measurements, only the laser y-coordinates are important. The x-coordinates are not used in the flatness calculation, therefore the positioning of the receiver in the x-axis is not as critical as for standard straightness measurements.

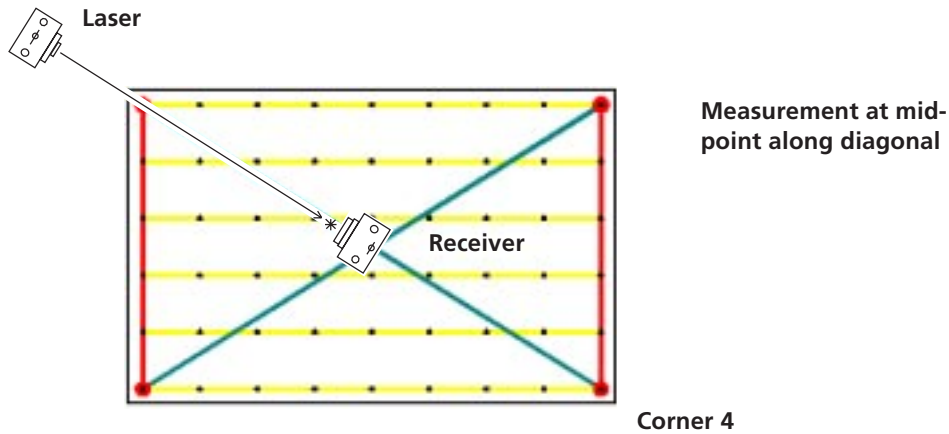
6. Once the laser is aligned, position the receiver at Corner 1. The centerline marking on top of the receiver should be above the measurement point. Take a measurement:



7. Move the receiver to the mid-point and take the second measurement:



8. Finally measure at corner 4. Save the complete straightness measurement as e.g. "DIAG14"
9. Repeat for Diagonal 2-3, mounting the laser diagonally beyond corner 2. Save as "DIAG23".



10. Repeat for the two side lines, measuring at each point along each line. Save as "SIDE12" and "SIDE34"
11. Measure the surface lines, saving as "LINE0", "LINE1"..

This completes the flatness measurement procedure! The following pages describe how to convert all the straightness measurements into one flatness measurement, and display it.

### Transfer files to PC

Using the ROTALIGN PRO Alignment Commander as described at the end of chapter 2, copy all the straightness files for the flatness measurement to your PC. Remember to set the ROTALIGN PRO computer to "PC Comm" mode before transfer.

### Flatness software

When you installed the Straightness QuickView program described at the end of the last chapter, you should also have installed two other programs:

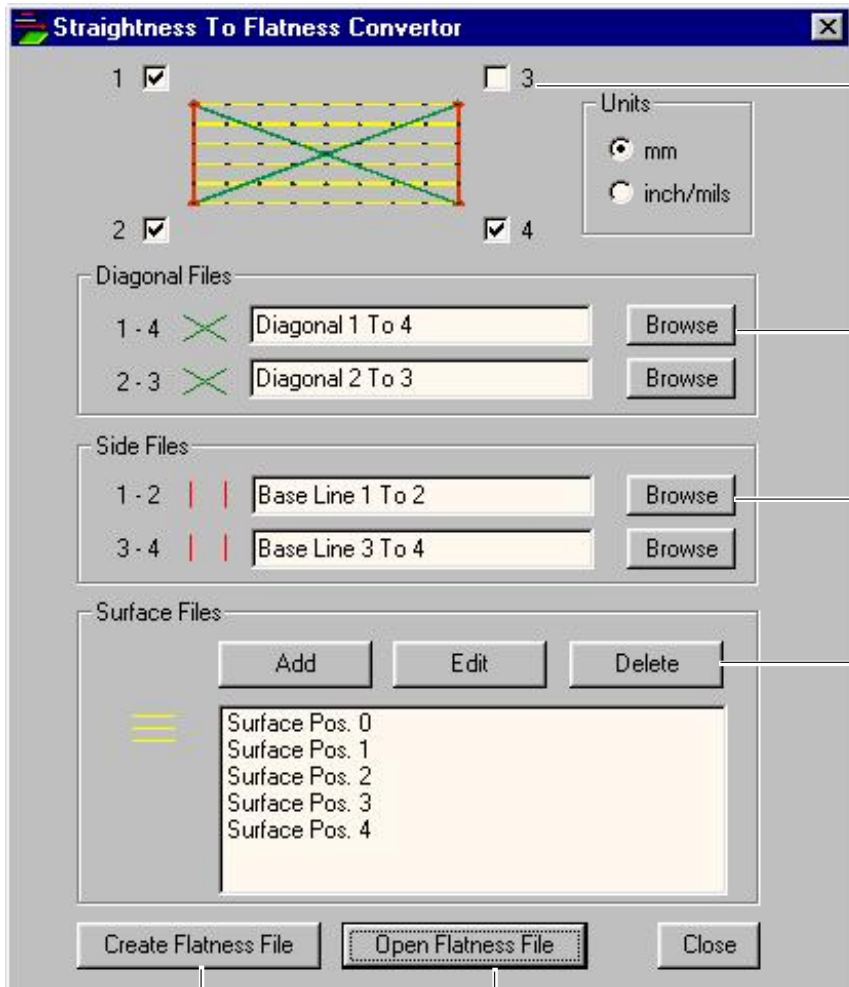
**Straightness to Flatness Converter** : converts all the straightness files into one flatness file.

**Flatness QuickView** : displays the flatness file graphically.

### Straightness to Flatness converter

To create the flatness file follow the proceed as follows:

1. Run the Straightness to Flatness converter, as shown opposite.
2. Click on three of the four corner boxes to fix them. The flatness measurement procedure gives relative values only, and therefore requires the user to essentially 'fix' X and Y axes in space.
3. Use the 'Browse' button to find the two diagonal files e.g. DIAG14 and DIAG23.
4. Use the 'Browse' button to find the two side files e.g. SIDE12 and SIDE 34.
5. Use the 'Add' button to find the surface line files. Select each file to correspond to the line number i.e. LINE0 is number 0, LINE1 is number 1 and so on.
6. The moment of truth - click on the 'Create Flatness File' button. The file is generated, and its location displayed. If there is a gross inconsistency in the data then you may get an error message. Check that the right files are in the right places. If all else fails you may need to inspect each straightness file with the Straightness QuickView program to check that each file has the correct dimensions and appears to have sensible measurements.
7. Click on the 'Open Flatness File' button to launch the Flatness QuickView and display the graph. See overleaf for details.



Click on 3 of the 4 corners to fix them

Enter the diagonal files here

Enter the side line files here

Enter the surface line files here

Click here to create the flatness file

Once the file is created, click here to view the flatness graph, see following page.

**Note regarding data loss**

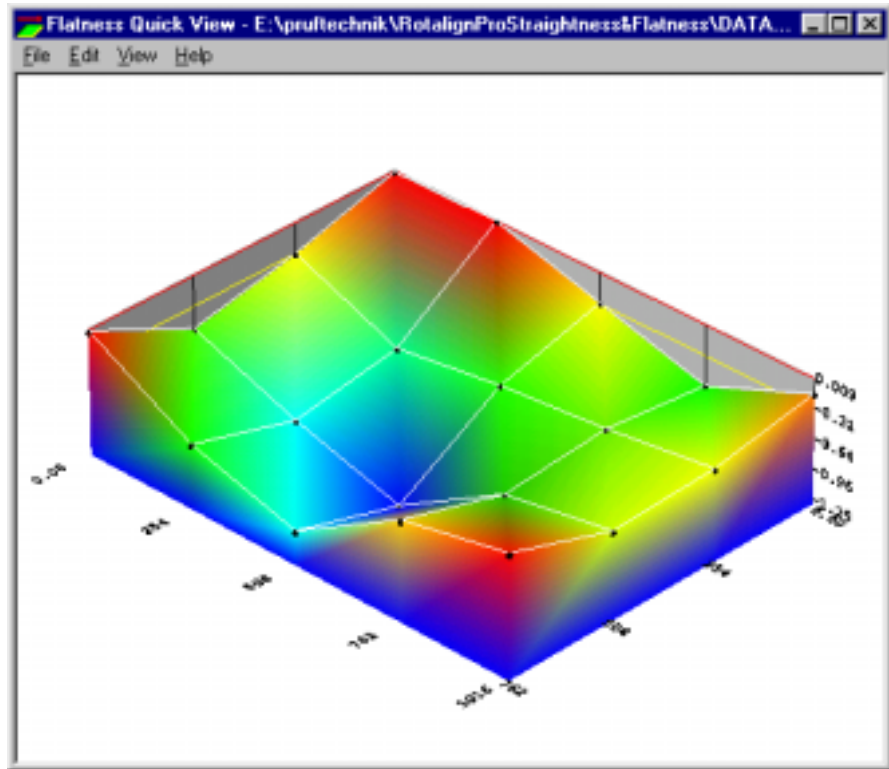
With any data processing software, data may be lost or altered under certain circumstances. PRÜFTECHNIK strongly recommends that you make backup copies of all important data on a regular basis.



**Note**

### Flatness Quick View

Flatness QuickView displays here a simple 5x4 flatness measurement



When you click on 'Open Flatness File' in the Straightness to Flatness converter, the Flatness QuickView is launched, and a 3D graph similar to above is displayed. You can also select 'File' and 'Open' to view another graph.

This graph shows very clearly the surface profile, and allows the engineer to pinpoint the high spots or worn areas. Our programmer has rung the bells and blown the whistles and presents us with some extra features:

**'View' options:** 'Plan View' displays the graph from above with the height values. There are also four different display options to suit your mood!

**Keyboard options:** Click on 'Help' and 'About..' to list some keys to change the view. The arrow keys move it up and down and around. Pressing simultaneously the CTRL key slows things down. The 'A' key makes it bigger and the 'Z' key smaller.

#### View .csv file with Microsoft Excel

The flatness file .csv format is compatible with some spreadsheet programs e.g. Microsoft Excel. If you load it, you can see a listing of all the measurement data which can then be used in a spreadsheet macro e.g. for statistical or QA purposes, or to calculate some form of machine correction.

## Appendix

### Troubleshooting

#### Poor repeatability

- Incorrect bracket mounting:  
Are they slipping or mounted skewed? Have they been bumped accidentally?
- Are the receiver and emitter lenses clean?
- Are corrections being carried out in the proper direction? The straightness display always shows the actual condition, not correction values!

#### Error messages:

The following can appear in the display during measurement:

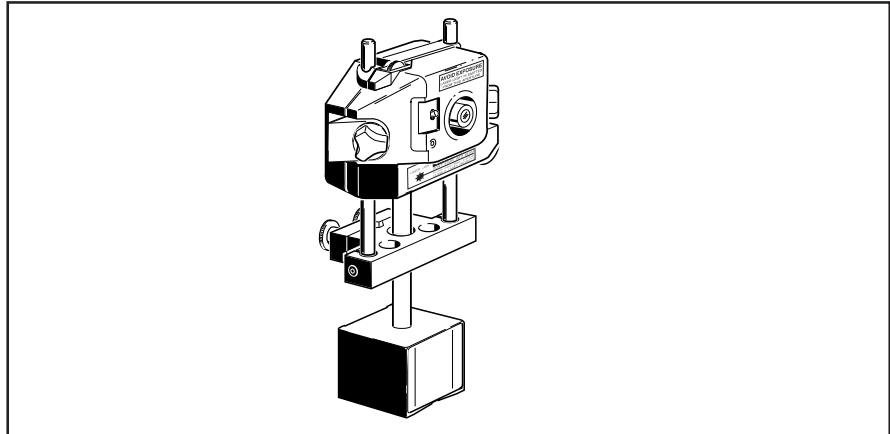
- *Laser Off*: The laser beam is not striking the receiver detector: readjust the beam and make sure the receiver cap is removed; remove any obstructions from the beam path.
- *Laser End*: The laser beam is striking the edge of the detector: press the Menu key, then select 'Laser Setup' and readjust the beam. Measurement must then be repeated from the beginning.
- *Temperature*: If the receiver temperature rises above 60°C / 140°F or falls below 0°C / 32°F, then this message appears. Necessary steps should be taken to prevent prolonged exposure of ROTALIGN PRO components to temperature extremes.
- *Ambient Light* or *Laser bright*: The position detector is overloaded by excessive ambient light or the more intense laser beam emitted just after switching on (in order to facilitate beam location). Shade the receiver or wait for the beam to switch to normal power.
- *Clean lens*: Insufficient laser beam intensity due to lens contamination. Clean the receiver and emitter lenses using the optical cloth included with ROTALIGN PRO.

## Components

This section describes the components unique to the straightness measurement module of ROTALIGN PRO.

### Magnetic laser emitter bracket

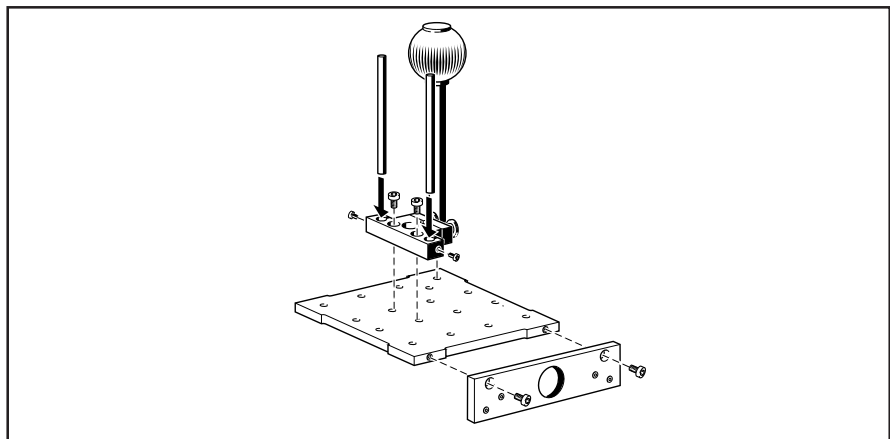
**ALI 4.501**



This versatile, easy-to-use bracket mounts in seconds on any ferromagnetic surface: simply place it onto the surface, then flip the locking lever to activate its powerful magnet. A central support post allows the entire laser emitter carriage to slide vertically and swivel horizontally for easy rough adjustment of the beam position.

### Sliding receiver bracket

**ALI 3.198**



This bracket consists of a plate supporting the receiver carriage. When placed upon the workpiece, the plate rests upon three contact studs. A smaller plate on one side ensures consistent lateral positioning from one measurement location to the next. The knurled grip lets the user avoid touching the receiver assembly during the entire measurement procedure.



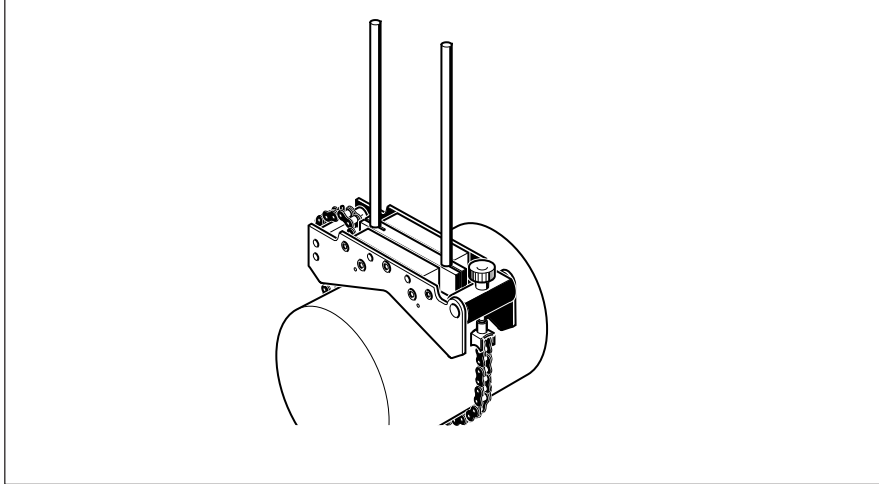
All components may be screwed together in a wide variety of configurations to fit most measurement surfaces. However, for maximum measurement accuracy the two front contact studs must always be positioned in a line with the receiver support posts.

## Accessories

Several useful accessories are available that allow you to ROTALIGN PRO to measure straightness with unsurpassed convenience on special machines.

### Roll straightness bracket

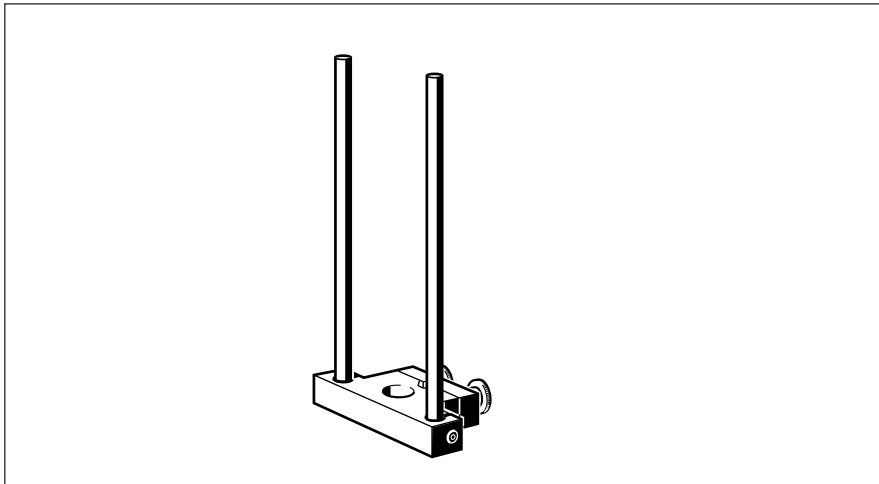
**ALI 3.196**



This bracket is specially designed to fit onto a wide range of rolls such as those found on paper machines and rolling mills. The chain allows convenient mounting at any desired angle (e.g. sideways).

### Bracket adapter

**ALI 3.199**



This adapter allows the laser or receiver to be mounted on the sliding bracket ALI 3.198, the magnetic bracket ALI 4.501 or onto custom-made bracket constructions.

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**Productive  
maintenance  
technology**

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