OPTALIGN®

visible
printer

Operating Instructions
and
Alignment Handbook

Dear Customer,

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

PRÜFTECHNIK AG
Documentation Department
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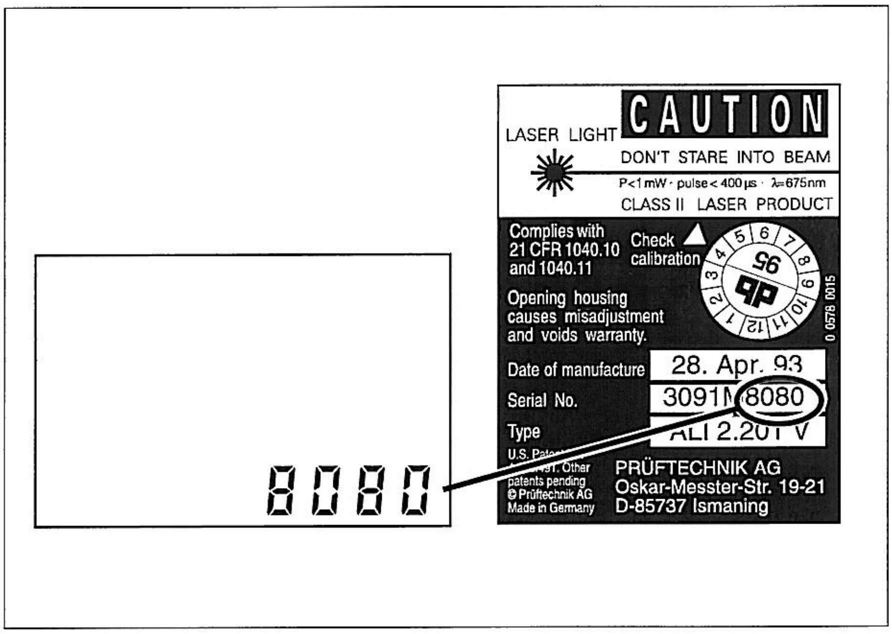
EDITION January 1996
Order Number ALI 2.970 G

Three crucial notes: read these first!

1. Under no circumstances may the visible-beam OPTALIGN V computer (ALI 2.050V) be operated with the infrared OPTALIGN transducer (ALI 2.201)! Otherwise, the invisible laser beam will be emitted at excessive power levels.

2. When first switched on, the computer displays its serial number. Check to ensure that this number matches the last four digits of the serial number on the back of the transducer housing, as these components are uniquely matched and must always be used together! Otherwise, alignment readings may be rendered inaccurate.



3. All OPTALIGN components must be removed from the shafts or coupling before starting the machines! Otherwise, serious injury may result from flying parts.

Please also read 'Important notes and restrictions' (page 12) carefully before using OPTALIGN.

Notice

With any data processing software, data may be lost or altered under certain circumstances. PRÜFTECHNIK AG strongly recommends that you keep separate written 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.

Foreword

Congratulations on your decision to align your machine shafts with OPTALIGN! Since its introduction nine years ago, the OPTALIGN system has become the shaft alignment method of choice in over sixty countries worldwide. Every day, more and more users join the ranks of those who have come to prize OPTALIGN's unprecedented alignment accuracy, speed and operating convenience.

This may seem like a relatively short time for such a revolutionary technology to become well accepted, but the OPTALIGN story is by no means one of overnight success. Thanks to constant feedback received from customers and sales agents, the OPTALIGN has undergone continuous evolution and further refinement based upon their suggestions, comments, and - yes - even complaints. For example, the new VP version of OPTALIGN with printing and data transfer capability was developed specifically in response to increased demand for permanent documentation and data archival of alignment results. So if you should ever encounter a situation where a change or addition would make the system easier to use, faster or more accurate, please share your expertise with us. As in the past, we shall do our best to accommodate your wishes in future developments.

The result of this continuous development policy is the system now before you, with even clearer display graphics, easier-to-use software, and a wide range of specialized accessories to suit even very difficult alignment situations. But the most obvious improvement made in this new generation of OPTALIGN equipment is its visible laser beam, which makes adjustment even quicker and easier than ever.

Just as important as improved operating convenience is the fact that these changes make the new OPTALIGN even easier to learn to use. As a matter of fact, you can learn quite a bit simply by taking the equipment out of its case, placing the transducer flat on its back (on your desk top), putting the prism face down upon it, then turning on the computer and working your way through this manual. But to learn all the capabilities of your new OPTALIGN and many of the finer points of shaft alignment in general, contact your local Prüftechnik agent to register for his in-depth alignment training course. You'll surely find it a few days well spent.

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

January 1996
Ismaning, Germany

PRÜFTECHNIK AG

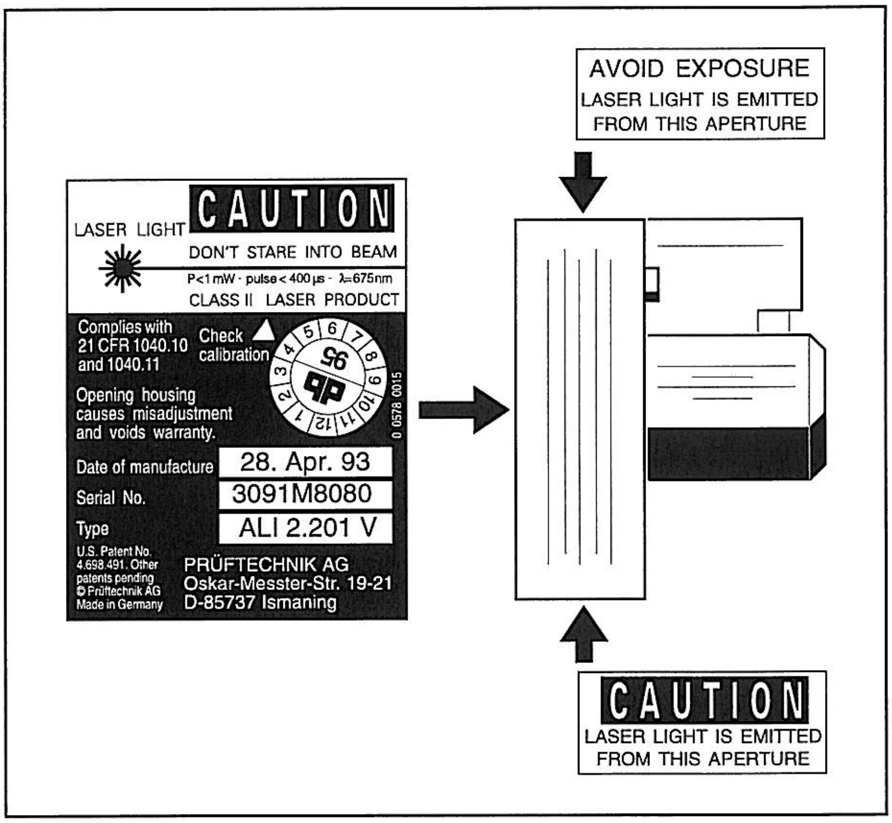
Contents

Laser safety

The OPTALIGN system uses a Class II laser beam. Class II lasers comply with the requirements outlined in the USA's FDA specification 21 CFR Ch. 1, Parts 1040.10 and 1040.11 as well as the ANSI standard. OPTALIGN also fulfills the British standard BS 4803 (Part 1 to Part 3) and the German Industrial Standard DIN JEC 76 (CO) 6. The OPTALIGN Class II laser operates at 675 nm wavelength, with a maximum pulse duration of 400 μsec., maximum radiant power of 0.8 mW and maximum radiant energy per pulse of 0.32 μJ. No maintenance is necessary to keep this product in compliance with the above specifications.

Do not look into the laser beam at any time, including during setup, adjustment or operation.*

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



Caution-use of controls or adjustment or performance of procedures other than those specified herein may result in hazardous radiation exposure.

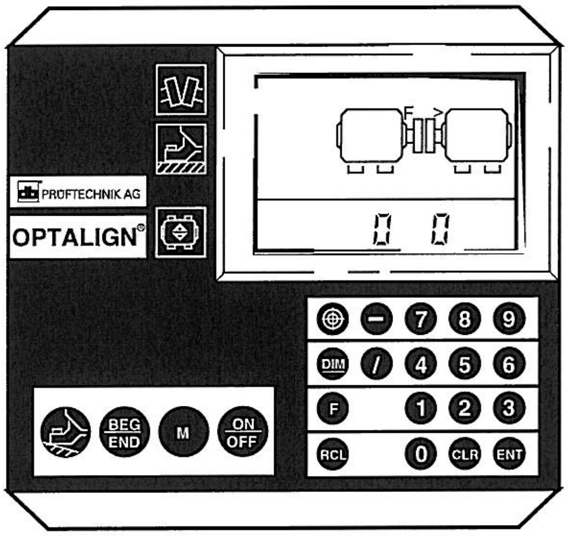
*Since the FDA specification allows maximum exposure of 0.25 seconds, the natural blink reaction of the human eye is normally sufficient to avert any danger, provided that no optical instruments other than ordinary eyeglasses or contact lenses are used.

The OPTALIGN computer at a glance

Coupling key
Displays offset and angularity (gap difference) at the coupling.
(See also page 46.)

Machine foot key
Displays shimming and horizontal corrections required at the machine feet.
(See also page 47.)

MOVE key
Lets you monitor the horizontal move of a machine as you bring it into alignment, guiding you to zero.
(See also page 49.)



Soft foot key
Checks whether all machine feet rest firmly on the foundation and helps determine corrections.
(See also page 64.)

M = Measure
This key is used to activate alignment readings at each selected clock position.
(See also page 45.)

BEG/END key
Allows you to extend the measurement range to handle even severely misaligned machines.
(See also page 61.)

ON/OFF key
(See also page 40.)

Alignment targets
Desired offsets and angularity can be entered to compensate for thermal growth. Correction values are then adjusted automatically. (See also page 51.)

Minus key
For entry of negative values
(See also page 51.)

DIMension key
This key is used for entry of machine dimensions. (See also page 41.)

Slash key
For entry of fractions; also switches computer to inch measurement mode
(See also pages 40 & 41.)

Function key
For special functions such as alignment of vertical machines or entry of machine foot growth.
(See also page 80.)

Clear key
Deletes displayed value of a dimension, target, growth and misalignment reading, but not of a displayed correction or condition of alignment.
(See also page 45.)

Recall key
Recalls previous value into display. (See also pages 46 & 47.)

Enter key
Confirms displayed value and proceeds to next value
(See also pages 41, 45-53.)

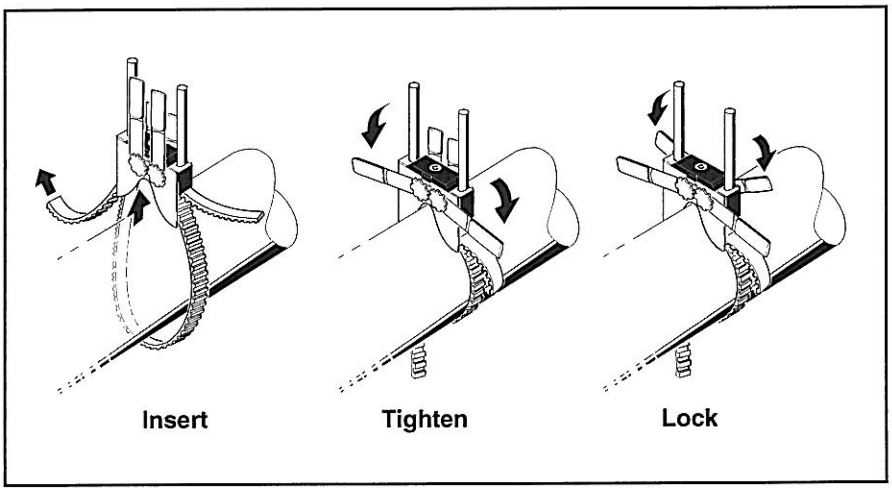
Short instructions for basic alignment

1. Prepare the machine

Perform rough machine alignment with a straightedge.
Eliminate coupling backlash effects (see page 20).
Eliminate soft foot (use Soft Foot Recording Sheet 2; see page 63).

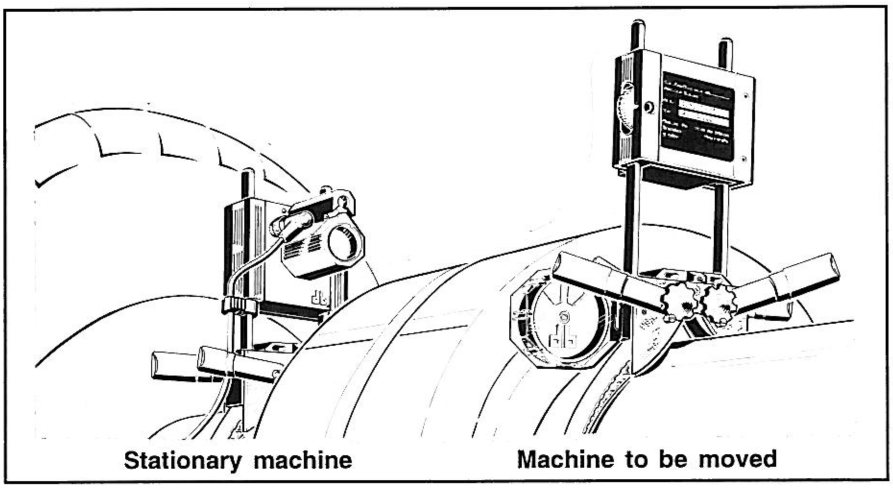
2. Mount the quick-fit brackets

Note:
Your OPTALIGN may be supplied with the compact chain-type bracket (ALI 2.107set) instead of the quick-fit belt bracket. In that case, see page 37 for detailed mounting instructions.



Mount quick-fit belt brackets (or other brackets) on both sides of the coupling, using the shortest possible support rods (see page 26).

3. Mount the transducer and prism

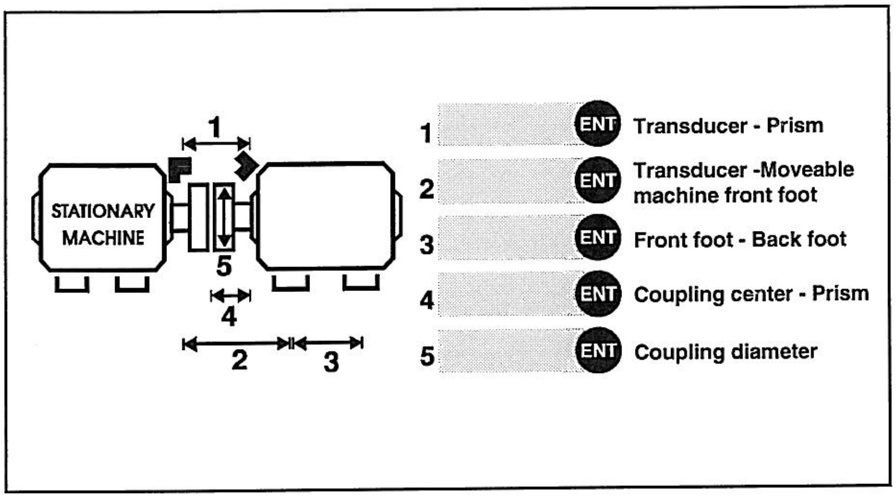


Screw the connector cable into the transducer and computer. Mount the transducer and prism on the support rods: the transducer belongs on the stationary machine side (see pages 38-39).

4. Switch on the computer

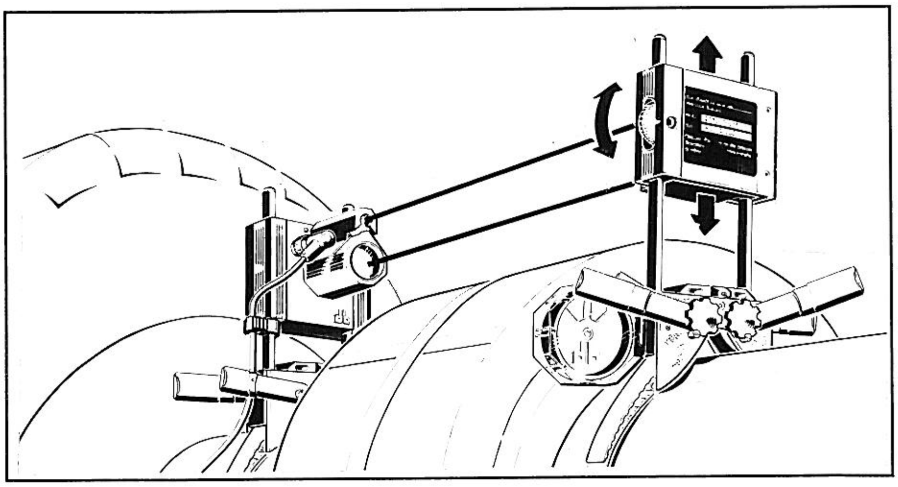
To measure in inches instead of millimeters, press the key marked / at this time. Press the key marked ENT or DIM to proceed.

5. Enter dimensions



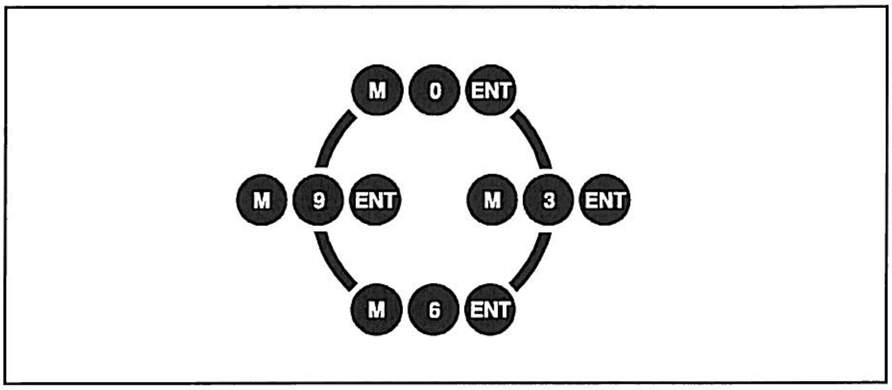
The computer asks for the dimensions shown, one after the other. Press the number keys to enter the first dimension, then the ENT key to confirm the entry and move to the next (see page 41). Note: dimensions 4 and 5 above may be omitted if alignment results at the coupling are not required.

6.1. Measurement: adjust the beam



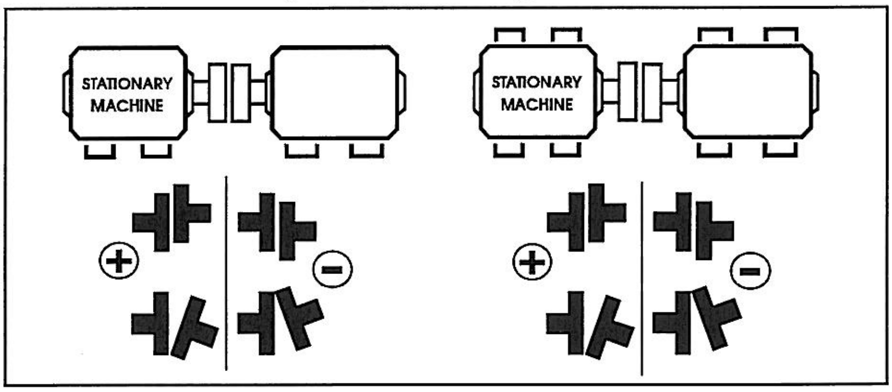
Press the M key to enter the measurement mode, then adjust the transducer and prism so that the initial OFF or END display reaches a value of 0 0 (see page 42).

6.2. Measurement: take alignment readings



Rotate the shafts with transducer/prism to each measurement position (watch the inclinometer), stopping to enter measurements by pressing the keys shown (the numbers correspond to the clock positions as viewed toward the stationary machine). Measurements must be taken in at least three of the four positions (see page 45).

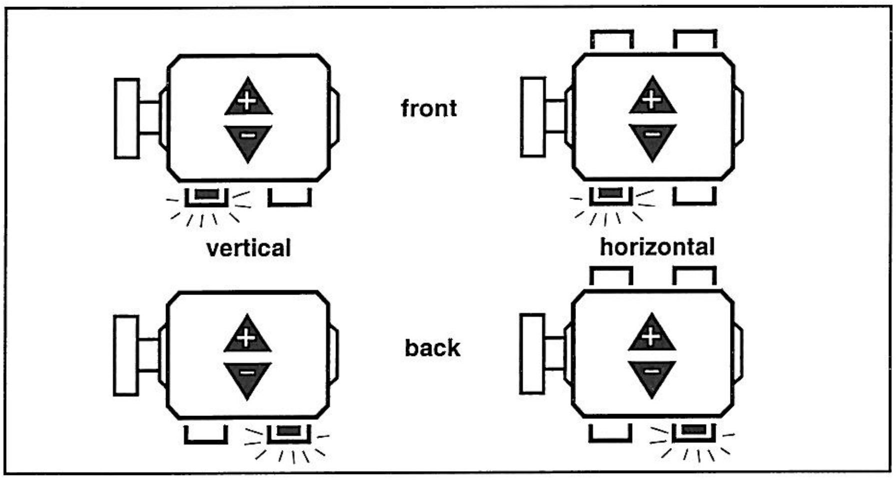
7. Check coupling misalignment



Press the coupling key to display the alignment condition at the coupling (see page 46). Press the ENT key to cycle through the alignment conditions:

Vertical offset	Horizontal offset
Vertical angular gap	Horizontal angular gap

8. Check machine foot corrections

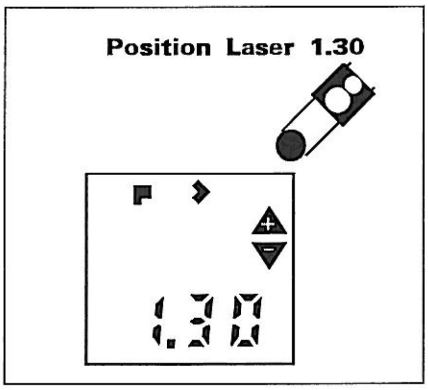


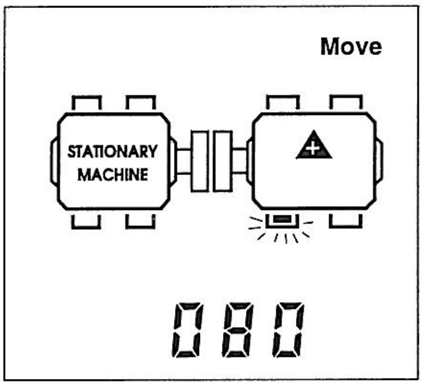
Press the machine foot key to display values for vertical shimming and horizontal positioning at the machine feet (see page 47). Press the ENT key to cycle through all four results:

Front foot shimming	Front foot horizontal positioning
Back foot shimming	Back foot horizontal positioning

9. Shim machine, then position horizontally

(If horizontal corrections are very large it is recommended to rough align horizontally before shimming.)





Note that during shimming the correction values for horizontal moves may have changed. It may be best to repeat steps 6.2 and 7, then once satisfied with the vertical alignment condition, proceed to press MOVE and perform horizontal alignment as described at left.

Press the MOVE key shown at right. Rotate the shafts to the 1:30 o'clock position and press ENT . Readjust the prism as necessary and press ENT again. Follow the display to move front and back feet into position (see page 49).

10. Important: final alignment check

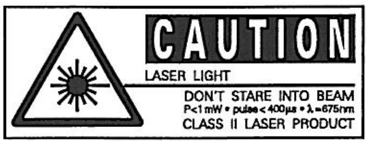
Because the true position of the shaft rotation axes can only be determined by rotating the shafts during measurement, you <u>must</u> take a final set of rotated-shaft readings to confirm the alignment condition. To do so, repeat steps 6.2 and 7 as before.

Important notes, restrictions

Please read this section carefully!

The OPTALIGN system may give many users their first contact with laser measurement technology. The following notes will acquaint you with several of the most important aspects of the system.

Safety



The OPTALIGN system uses a Class II laser beam. Class II lasers fulfill the requirements outlined in the USA's FDA specification 21 CFR Ch. 1, Parts 1040.10 and 1040.11, the British standard BS 4803 (Part 1 to Part 3) as well as the German Industrial Standard DIN JEC 76 (CO) 6.

This means that aside from not staring into the beam, there are no particular protective measures or barriers to be established during its use. (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.)

Under no circumstances may the infrared OPTALIGN transducer (ALI 2.201) be operated using the visible-beam OPTALIGN V computer (ALI 2.050V).

Class I laser safety may be obtained by using an 800 nm infrared (invisible) laser beam, available upon request. No safety precautions whatsoever are necessary for use of Class I laser devices. Operation and parts included in the Class I OPTALIGN vary slightly from those described here (see page 93 for further details).

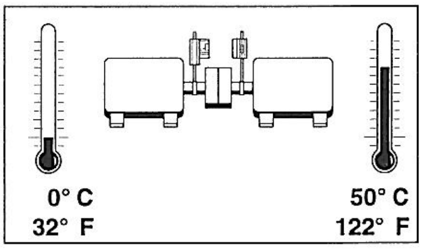
When equipment to be aligned is located in an explosive environment, the intrinsically safe OPTALIGN EX (ALI 2.610 VEx) should be used. Mining safety requirements may be met by the mining version of OPTALIGN (ALI 2.610M).

Please note that the printer interface cable should not be connected to the computer within explosive environments.

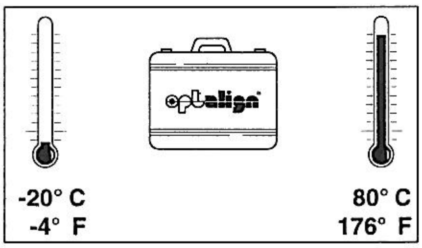
Some versions of OPTALIGN are supplied in a plastic carrying case. If this case is brought into an explosive environment, only a damp cloth may be used to wipe it clean (if at all) to avoid charging the case with static electricity!

Temperature range

The OPTALIGN system may be used at temperatures between 0° and 50° C (32° to 122° F). Otherwise the specified accuracy may not be maintained.



Store your OPTALIGN equipment at temperatures between -20° and 80° C (-4° to 176° F) and consider that on a hot day, the temperature inside a locked car can easily surpass 176° F!



Sudden changes in temperature and humidity (for example, when OPTALIGN is stored in an office but used in hot or cold work areas) can cause the optics to fog over with condensation: the computer then displays OFF and stops measurement. In that case, give the equipment about 10 minutes to reach the work area temperature.

Caution

If the system is subjected to strong, uneven heating during measurement (such as when placed in direct sunlight), measurements may be affected by uneven expansion of the transducer housing, which would cause the laser beam to deflect irregularly. Therefore, in that case, allow the OPTALIGN system to reach ambient temperature for several minutes before beginning measurement; in case of doubt, repeat the readings and compare them to establish repeatability.

WARNING:
All components must be removed from the shafts or coupling before starting the machines! Otherwise, serious bodily injury may result from flying parts.

Avoid working with OPTALIGN in the immediate vicinity of strong, hot light sources, and be careful that point light sources do not shine directly into the position detector. Mobile radio communication equipment should not be used near the system, as it may interfere with measurements.

Do not subject the computer to severe impact during alignment, as the resulting momentary electrical interruption could erase the memory of the alignment in progress and require new measurements and readings.

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

Ordering a few spare parts (such as a connector cable, two extra bracket belts and a spare inclinometer) in advance may save time and frustration someday in case of damage.

Please ensure that the laser and sensor brackets fit solidly onto their mounting surfaces! Insufficient surface pressure (especially due to tilted or skewed mounting, dirt beneath magnetic contact surfaces or insufficient tension on belts, chains or other clamping elements) can lead to looseness and hence inavoidably give rise to measurement error. This measurement error can even prove to be quite repeatable, which leads to a false sense of measurement security.
Therefore, never use self-constructed mounting brackets or modify the original bracket configuration supplied by PRÜFTECHNIK AG (for example, even by using longer support posts than those supplied with the bracket for the particular application at hand).

Different models, different functions

Please note that this manual covers all functions built into the various different versions of OPTALIGN available, so some sections may not apply to your particular model. Please consult your PRÜFTECHNIK dealer for information on how to obtain the functions you need.

Measurement separation

Since the OPTALIGN system requires no mechanical connections (such as cantilevered dial indicator brackets) to span over the coupling during measurement, alignment may easily be performed over transducer-prism separations of up to 5 meters (16¼ feet). Alignment over longer distances may be performed using the TURBALIGN system (which also aligns entire machine trains).

CE Conformance

All versions of OPTALIGN conform to all CE requirements as long as data transfer between the measurement receiver and the computer is performed via the two-meter cable ALI 2.260.

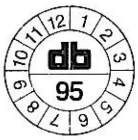
Warranty, service and care

OPTALIGN 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 OPTALIGN laser diode is guaranteed for two years, and all other system components are covered by a one-year warranty.

Service and care



Although the OPTALIGN 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 on the back of the transducer housing. The CALI-CHEK (ALI 2.081) allows simple 'go/no-go' screening of OPTALIGN accuracy, while the CALI-CHEK T (ALI 2.083) may be used to determine percentage error. Both systems may be used locally by agents or customers, eliminating unnecessary returns for checking: the OPTALIGN is then returned to Prüftechnik or an authorized dealer only if poor CALI-CHEK results show that relinearization is required. The ALI 2.083 is also available with certified calibration standards traceable to German or other national standards.

Lenses and prism 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 detergent. The moving parts of the belt-type quick-fit bracket should be lightly oiled from time to time. See page 99 for instructions on bracket tension adjustment.

Annoying delays may often be avoided in case of damage by stocking a few spare parts such as a connector cable, two extra bracket belts and a spare inclinometer.

If any problems are encountered during use, consult the trouble-shooting guide on page 96 for help in locating and correcting the problem.

Batteries

Note for intrinsically safe models: Batteries should be changed only outside the intrinsic safety zone!

If the OPTALIGN system is not to be used for an extended period of time, the batteries should be removed from the computer.

As the batteries grow weak, the message 'battery low' flashes at first in the display, then appears constantly to give sufficient warning in plenty of time to finish the alignment job in progress. Displayed measurements remain correct in any case.

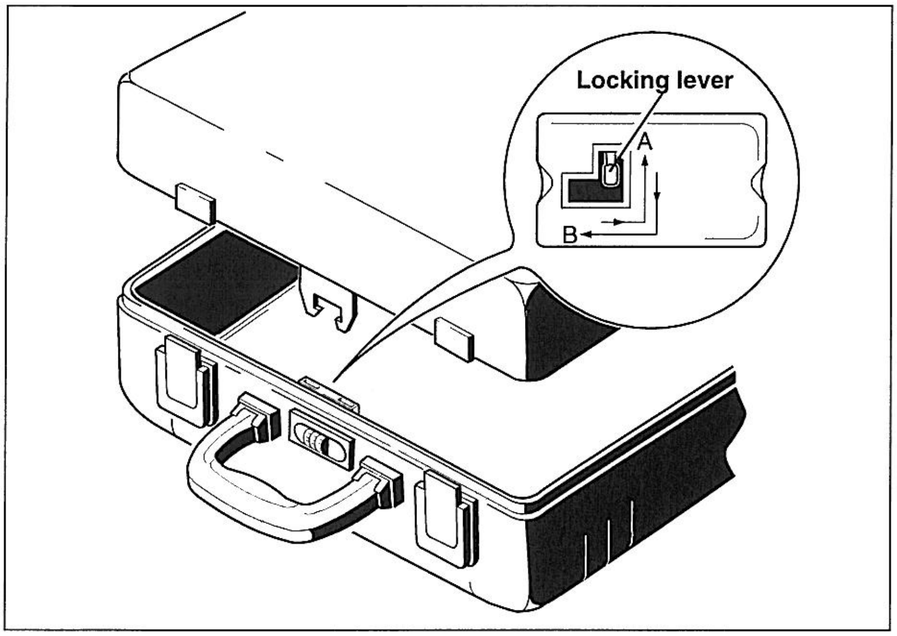
Replace the four 1.5 volt 'C' batteries (IEC LR 14) as soon as possible; NiCad cells should not be used since their voltage drops off quite abruptly when their charge is depleted, giving little or no 'battery low' warning in advance.

Instructions for safety combination lock

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

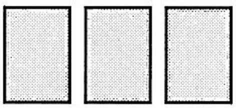
1. Starting point (for example, "000.")

2. Look at the back of the lock inside the case to locate the combination locking lever. Now push this lever from position A to position B (see sketch below).



Note:
Depending upon local market requirements, the OPTALIGN may also be supplied in a plastic case without a combination lock.

3. Now set the three dials to your own secret code. Note this new combination in the boxes at right and keep this note in a secure location in case you should ever forget the combination.



4. Without changing the setting of the dials, push the combination locking lever back to its original position A.

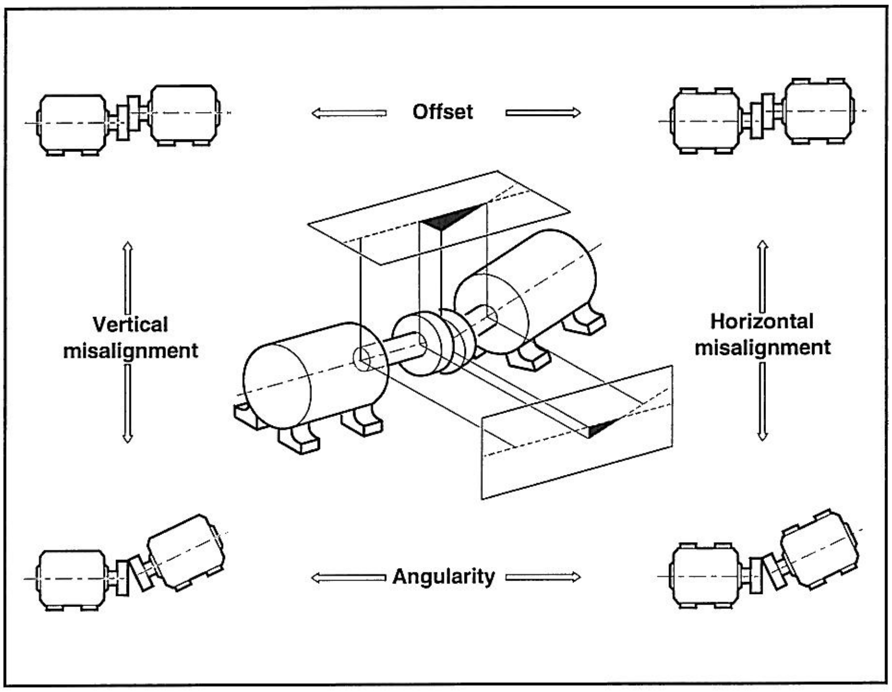
Before closing the case and using the lock, make sure that the above instructions have been correctly followed. Now the lock can be opened only when set to the new combination.

If the case is packed very full, push the two halves of the case together snugly to assure proper functioning of the combination lock.

What is 'alignment?'

Two machines are aligned to 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

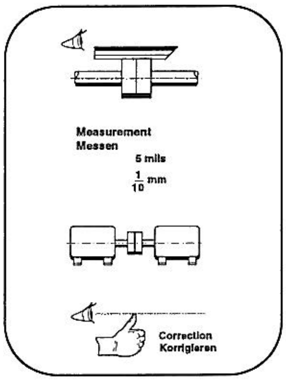
These four degrees of freedom must be measured in order to achieve correct alignment. OPTALIGN displays four values which combine to correct all these parameters simultaneously by

- Raising or lowering the front and back feet of the machine and
- Moving the front and back ends of the machine left or right

Precut shims (available from your OPTALIGN dealer) such as PERMABLOC or LAMIBLOC can greatly reduce the time and effort needed for vertical alignment adjustments, while the MOVE function of the OPTALIGN allows horizontal alignment to be followed directly in the display.

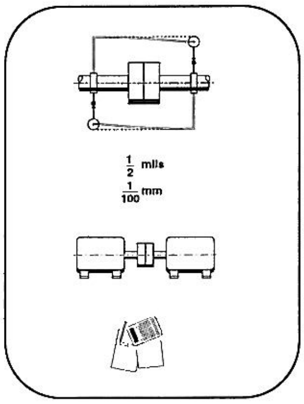
Comparison of alignment methods

Straightedge



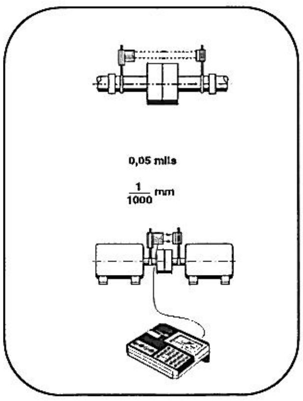
The straightedge is the most well-known and widespread shaft alignment tool. If both the coupling surface and the measuring eye are in good condition, alignment accuracy may approach 1/10 mm (5 mils). This may be sufficient for some machines and couplings. Thanks to its simplicity, the straightedge is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

Laser optics



This approach has the highest accuracy available - and it also gives the user several other distinct advantages. Custom-made brackets are no longer required for each individual machine/coupling arrangement. Instead, since no mechanical linkage across the coupling is involved, just a few universal brackets can be used to mount quickly on nearly every machine. Measurements must no longer be read and written down, and correction values for the machine feet appear automatically in the display.

How accurate should alignment be?

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

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

As an example, a machine running at 1800 rpm has coupling offsets of -1.8 mils vertically and +0.6 mils horizontally: both these values fall within the 'excellent' limit of 2.0 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, so the table lists values for coupling diameters of 100 mm or 10". You may compare results directly by entering this coupling diameter into the OPTALIGN, 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

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

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

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

at either coupling at the ends of the spacer shaft.

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

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

Suggested Shaft Alignment Tolerances

		Tolerance			
	[RPM]	metric [mm]		inch [mils]	
Soft foot	any	0.06 mm		2.0 mils	
Short 'flexible' couplings		Acceptable	Excellent	Acceptable	Excellent
Offset	600			9.0	5.0
	750	0.19	0.09		
	900			6.0	3.0
	1200			4.0	2.5
	1500	0.09	0.06		
	1800			3.0	2.0
	3000	0.06	0.03		
	3600			1.5	1.0
	6000	0.03	0.02		
	7200			1.0	0.5
Angularity	600			15.0	10.0
(gap difference at coupling edge	750	0.13	0.09		
per 100 millimeters diameter	900			10.0	7.0
or per 10 inches diameter)	1200			8.0	5.0
	1500	0.07	0.05		
	1800			5.0	3.0
	3000	0.04	0.03		
	3600			3.0	2.0
	6000	0.03	0.02		
	7200			2.0	1.0
Spacer shafts and membrane (disk) couplings					
Offset	600			3.0	1.8
(per 100 millimeters spacer length	750	0.25	0.15		
or per inch of spacer length)	900			2.0	1.2
	1200			1.5	0.9
	1500	0.12	0.07		
	1800			1.0	0.6
	3000	0.07	0.04		
	3600			0.5	0.3
	6000	0.03	0.02		
	7200			0.25	0.15

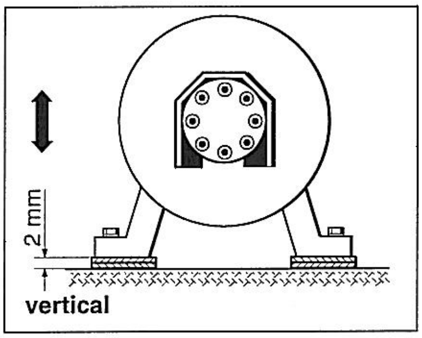
Machine preparation

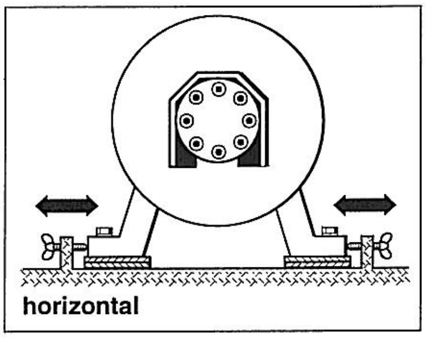
Certain preparations should be made before beginning any alignment to ensure efficient measurement and successful results.

Solid, flat foundation

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

Machine mobility



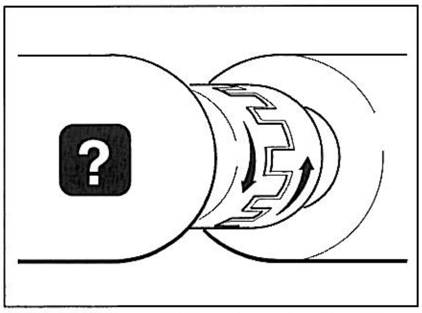


If the machine to be moved stands directly on the foundations, it cannot be lowered for alignment correction. Therefore it is generally advisable to start with about 2 mm (80 mils) of shims beneath the feet of both machines.

Precut shims such as single-thickness PERMABLOC or laminated LAMIBLOC shims, available individually or as complete assortments in carrying cases, should be on hand before beginning alignment. 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).

Coupling play

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



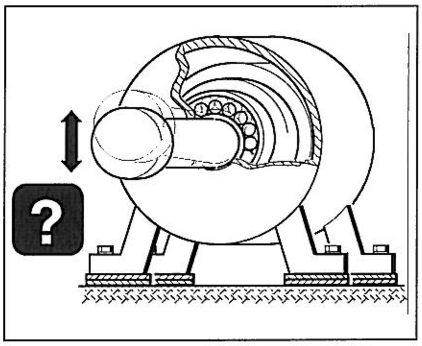
If ignored, excessive coupling torsional play (backlash) can lead to erroneous alignment results, so it must be eliminated before beginning alignment. Just as with uncoupled shafts, however, an Inclinometer may be mounted on each side for accurate positioning.

If at all possible, the shafts should be linked together for easiest and most accurate positioning at the 90° measurement intervals.

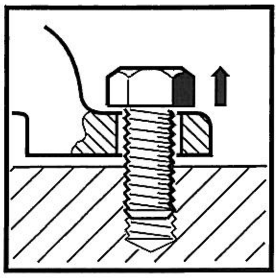
Shaft play

Excessive radial play of the shaft within the bearing will lead to poor alignment results. The OPTALIGN soft foot function can measure radial play when the shafts are lifted.

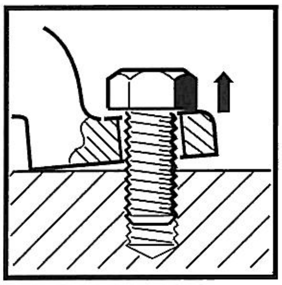
A small amount of axial shaft play (up to 3 mm / 1/8"), however, will have no adverse effect on accuracy.



Measuring and eliminating soft foot



parallel soft foot



angular soft foot

One of the most important prerequisites to 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 non-parallel contact surfaces, can deform the machine feet and housing. Uneven foundations and dirty or corroded machine feet can leave the machine standing on only three feet. If not corrected before alignment, the resulting 'soft foot' allows the machine to tip into a different position every time the bolts are loosened, making proper alignment difficult or impossible.

The OPTALIGN soft foot function is invaluable in checking and correcting this condition. Thanks to its simple operation, there is less temptation to skip this crucial step when alignment must be done quickly. The procedure is described in detail starting on page 63.

Checking alignment with vibration analysis

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

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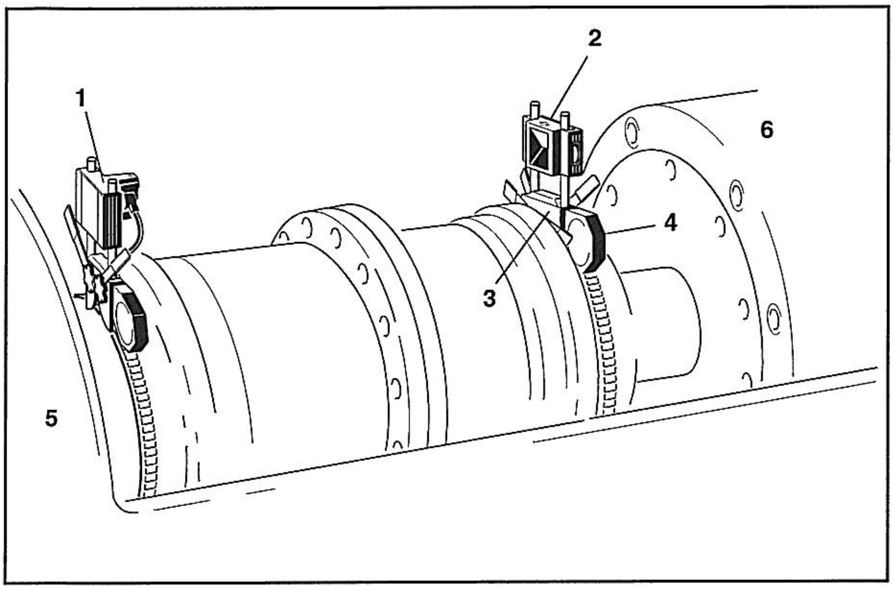
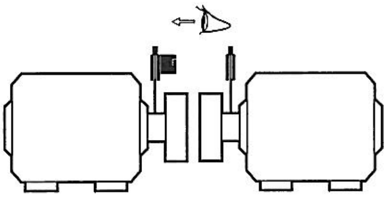
The OPTALIGN measurement principle



1 = Transducer, 2 = Prism, 3 = Belt-type quick fit bracket, 4 = Inclinometer
5 = Stationary machine, 6 = Machine to be moved.

The OPTALIGN transducer is mounted on the shaft of the stationary machine and emits a laser beam over the coupling. The prism mounted on the shaft of the machine to be moved reflects the beam back into the position detector.

When the shafts are rotated, any misalignment causes the reflected beam to change its position on the detector. The exact location of the beam is recorded by registering its coordinates every 90° (or in measurement positions located at 12:00, 3:00, 6:00 and 9:00).



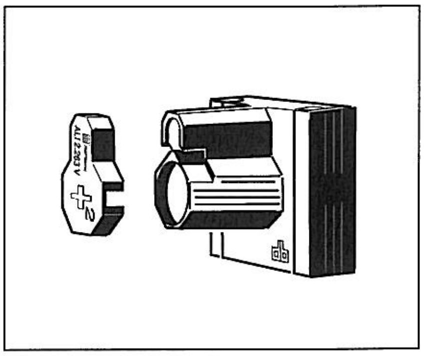
Limited shaft rotation may be compensated by use of a special function (described on page 83) which allows measurement at 45° intervals.

The computer then uses these minute displacements to calculate the current alignment condition and displays the resulting correction values for the machine feet.

Of course, the current alignment condition can be displayed in terms of coupling values as well (see page 46). This allows the operator to compare the situation at hand with prescribed tolerances.

OPTALIGN components

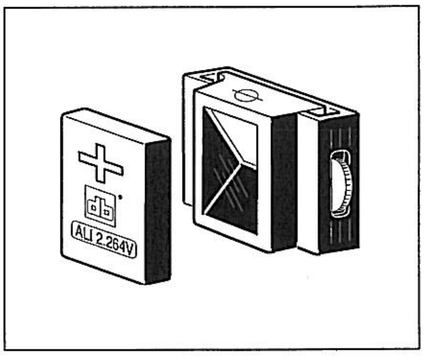
Transducer ALI 2.201V



The semiconductor laser diode, located in the upper portion of the transducer housing, emits a ray of red light (wavelength 670 nm) 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 II safety. (See page 93 for information regarding the Class I transducer.)

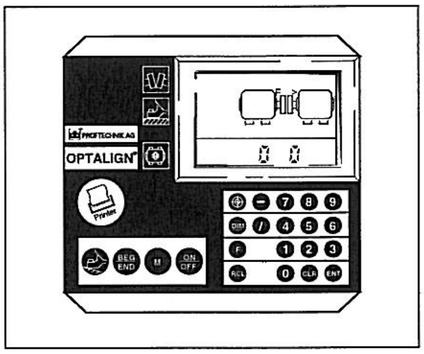
Located in the lower housing portion below the laser, the detector is a biaxial, analog, photoelectric semiconductor position detector with a resolution of 1 μm and a diameter of approx. 6 mm (1/4").

Prism ALI 2.202V



The prism is always mounted on the shaft or coupling side of the machine to be moved. It reflects the laser beam back into the position detector as the shafts are rotated. The prism is adjusted by changing its height and its horizontal angle (using the thumbscrew) so that the beam strikes the position detector.

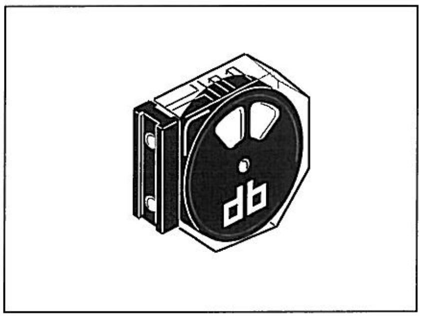
Computer ALI 2.050V



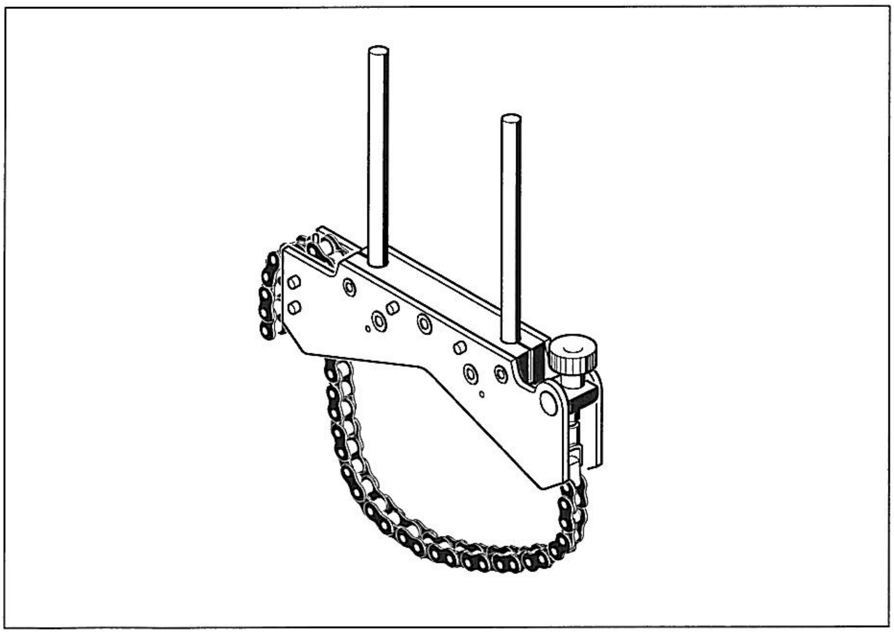
Measurement data pass directly via cable from the position detector to the OPTALIGN computer and are then used to calculate machine foot corrections. Several special software functions allow the computer to handle a range of alignment situations. The computer also powers the entire system using four 'C' batteries (IEC LR 14) located in the back of its housing. Batteries should be replaced whenever the 'battery low' message is displayed.

Inclinometer — ALI 2.207

The Inclinometer indicates measurement positions exactly. If the shafts are uncoupled, two inclinometers can be used to position both sides accurately.



Compact chain-type bracket — ALI 2.107 set



Please note that your particular OPTALIGN set may include the ALI 2.203 belt-type bracket instead of the bracket shown at left.

All components (hardware and software) described herein may vary from country to country. See your original price quotation and packing slip for definitive information regarding your particular system, or ask your local Prüftechnik dealer for further details.

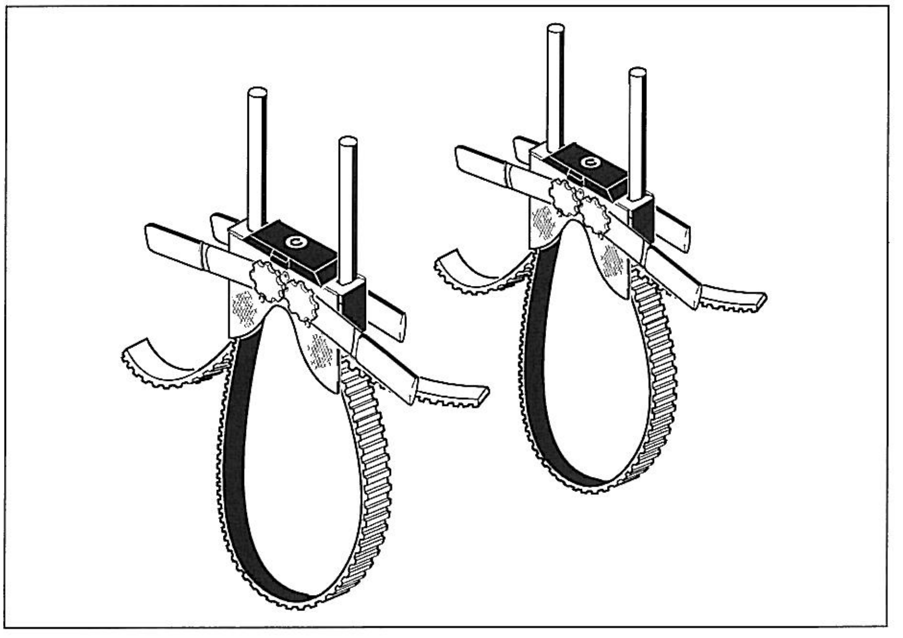
Compact and lightweight, this bracket is designed to provide extremely rigid support for the measurement components with a minimum of mounting time and effort. The compact chain-type bracket fits onto shafts and couplings ranging from 15 to 500 mm (1/2" to 20") in diameter.

Other accessories

The OPTALIGN product catalogue illustrates and describes the complete range of other accessories. It is available free of charge under the order number ALI 9.300.

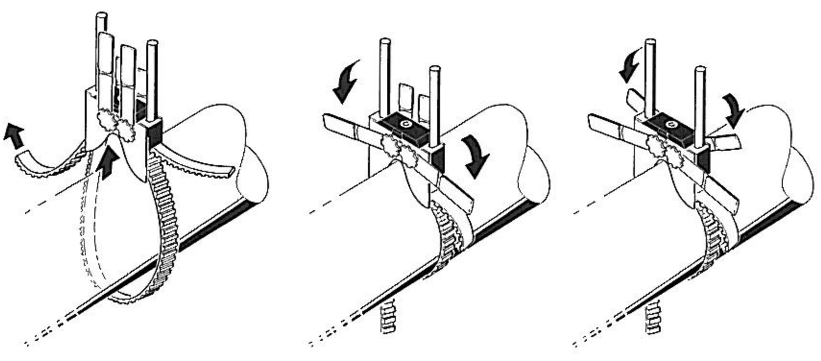
Among the most useful of these accessories are the various brackets specially designed for mounting OPTALIGN on specific machine configurations. These are described in detail on the following pages.

Belt bracket ALI 2.203



The belt bracket is used to mount OPTALIGN components on a wide range of shafts or couplings: it fits onto diameters from 20 to 200 mm (5/8" to 8").

Mounting instructions:
Choose the shortest support posts which will still allow the laser beam to pass over the coupling flange (for best results, unless unavoidable use only the shortest support posts of 115 mm (4-1/2") supplied). Use the anti-torsion bridges (ALI 2.176, see Product Catalog ALI 9.300) to avoid torsional deflections when shafts are rotated to the 3:00 and 9:00 measurement positions. Insert the support posts into the brackets. Insert the belt into the transport mechanism: first flip the belt separator toward the outside, then insert the belt into the exposed slot at the center of the transport mechanism. The smooth side of the belt should contact the shaft or coupling surface.



Note: all levers must point upwards as shown in the far left illustration. In most cases, it will not matter whether the short lever side or the long lever side of the bracket faces the coupling; if the transducer or prism threaten to scrape on machine housings as they are rotated, several additional millimeters of clearance may be had by ensuring that the short levers face the coupling.

Now sling the belt around the shaft and insert it into the transport mechanism on the other side of the bracket. Push it through and pull it snugly around the shaft. Grasp both belt ends with one hand to maintain this snug mounting, and use thumb and index finger of the other hand to spread apart the long tightening levers until moderate resistance is felt (see middle illustration). Do not use too much force on the levers, or the tightening mechanism will slip to the next belt tooth, causing bracket wear and belt damage.

With the long levers barely tightened, the bracket may now be shifted slightly on the shaft using pressure from thumb and index finger in order to align the spirit level in the top of the bracket (or use the inclinometer to position the bracket).

Maintain finger pressure on the long levers, and release the belts from the other hand so that it can tighten the short locking levers one at a time (see illustration above right). These should be tightened down quite firmly, but not so excessively as to damage the levers or bracket.

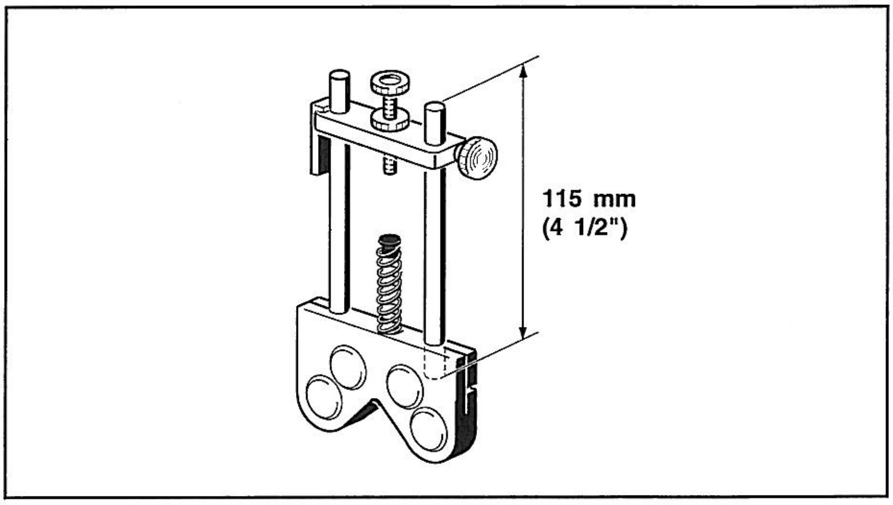
Now the bracket should be tight upon the shaft. Do not push or pull on the bracket to check, since that would only loosen its mounting. (The best confirmation of proper mounting is repeatability of alignment readings!) Should the brackets become loose over time, they may be tightened as directed on page 99.

To remove the brackets, first release the short locking levers, and only then the long tightening levers.

Compact magnetic bracket ALI 2.112 set

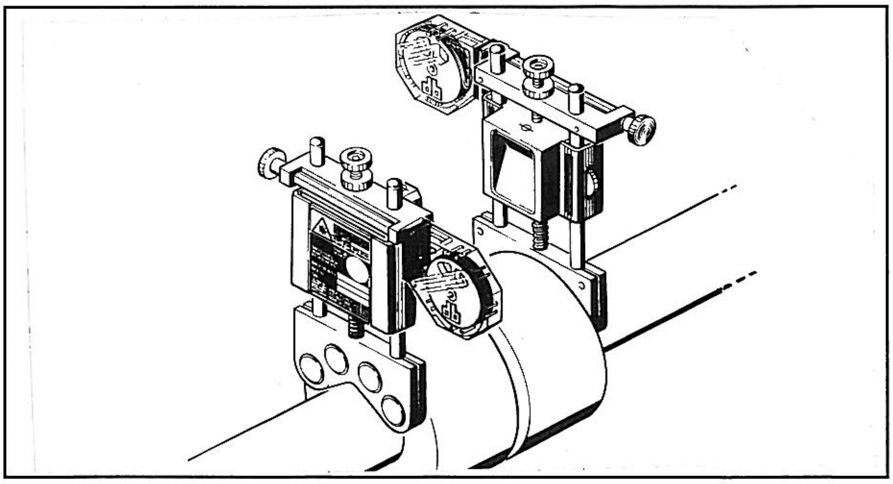
Especially when large machines are to be aligned, the coupling flange may be the most advantageous surface for mounting the OPTALIGN transducer and prism.

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



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.

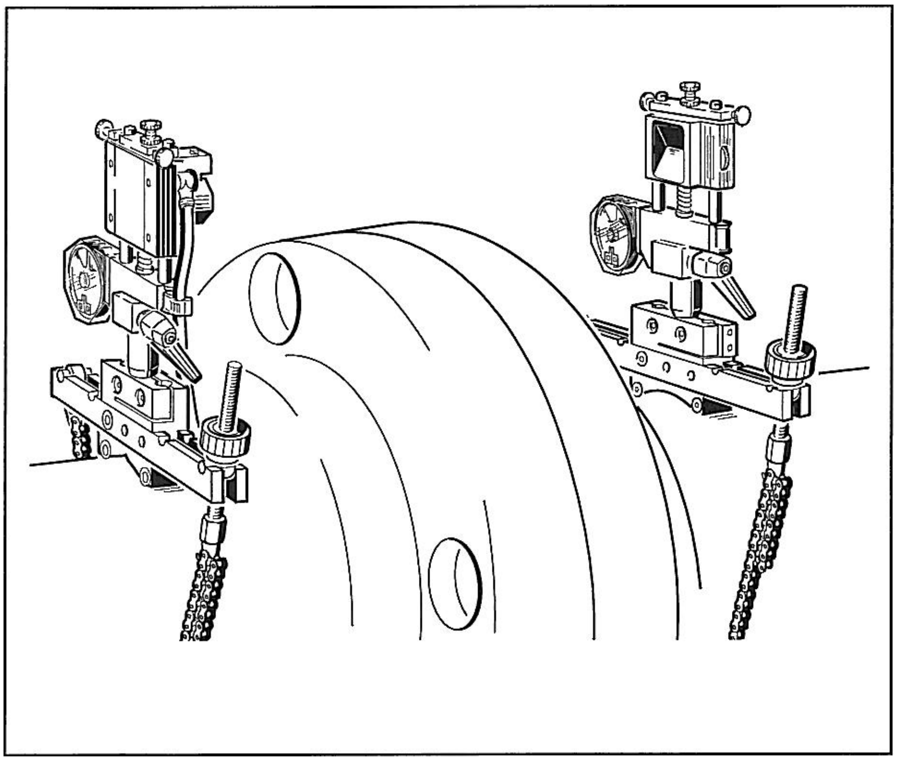


Slide the transducer and prism onto the support posts, then attach the anti-torsion bridge. Attach an inclinometer to the mounting plate on the side of the bridge and use it to position the transducer and prism vertically before performing fine adjustment. The thumbscrew and locking ring on top of the bridge can help adjust the prism vertically.

Chain-type bracket ALI 2.210

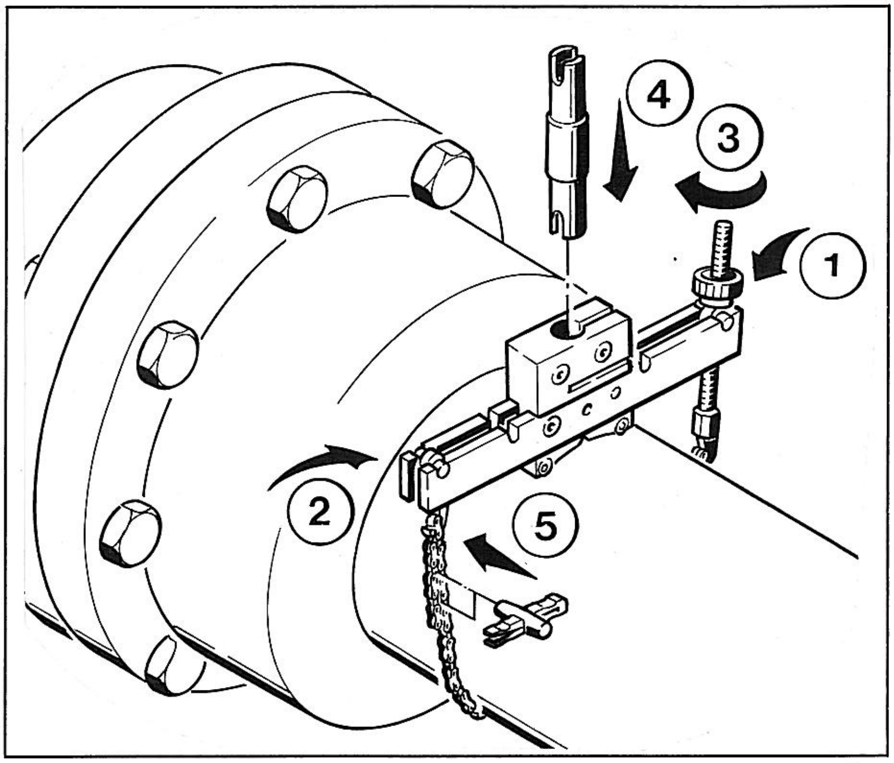
When shafts of large diameter are to be aligned, this rugged chain-type bracket provides very rigid mounting. The bracket is composed of various individual components which store in a contoured case. The many different bracket configurations are shown along with pictorial instructions inside the case lid.

The chain tension bars are supplied in different lengths to accommodate a wide range of shaft diameters from 80 mm to 900 mm (3 1/8" to 35 7/16").

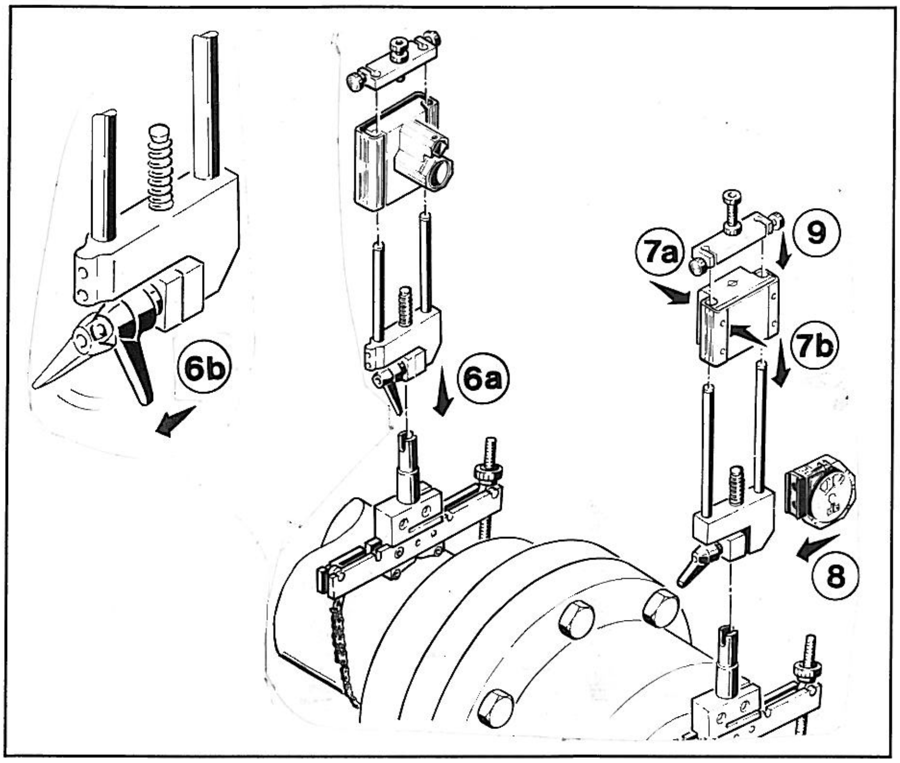


Brief instructions for chain-type bracket

Choose tension bars of appropriate length for the shaft or coupling diameter at hand and fasten them to the tension bar carrier. Slip the swivel joint onto the threaded chain hook, then screw the tension nut onto the threaded end of the hook. The swivel joint fits into the grooves on one side of the tension bar as shown below (1). Place this assembly onto the shaft or coupling of the machine which is to be treated as stationary.



Then attach the chain to the hook, sling it around the shaft, and catch it loosely into the grooves on the other side of the tension bar using the chain holder, so that the chain is barely slack (2). Then tighten the tension nut (3) to clamp the bracket firmly onto the shaft or coupling mounting surface. Insert into the tension bar carrier the shortest support posts which still allow the laser beam to pass over the coupling (4). Insert the red plastic clip into the free end of the chain, then press it into the portion wrapped around the shaft in order to prevent the free end of the chain from swinging around and striking the transducer or prism when the shafts are turned (5).



Mount the system holder onto the support post (6a) and lock it into place by turning the clamping lever (6b). If necessary, the range of lever movement may be extended for further tightening by pulling the lever axially outwards and turning it back to its original position, then releasing it.

Install the prism on the posts of the bracket mounted on the shaft of the machine to be moved, squeezing the prism into its housing (as shown in 7a) and sliding it down onto the posts (7b). Install the laser/detector on the support posts of the other bracket. The dust caps may now be removed from the prism and transducer.

The inclinometer attaches to a steel plate on the side of the system holder (8). If the shafts are uncoupled, two inclinometers may be used (one on each bracket) to align the brackets to each other and position them consistently when rotating the shafts.

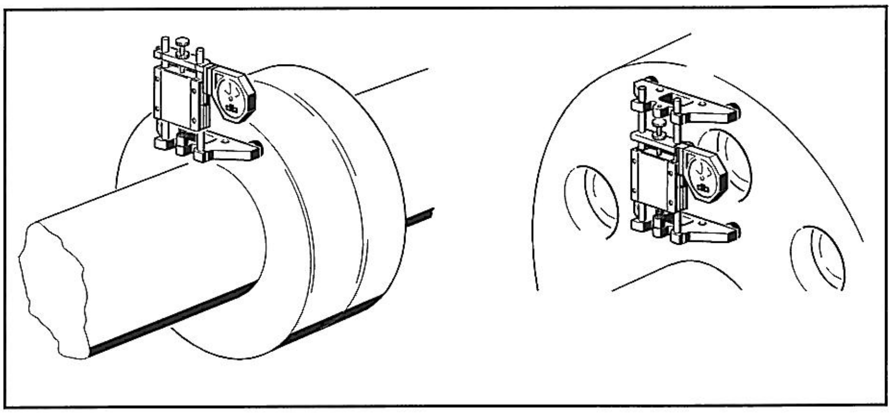
Always slide the prism and laser down as low as possible on the support posts, allowing room for the beam to clear the coupling hubs.

Note: for maximum bracket rigidity and highest measurement accuracy, anti-torsion bridges (order number ALI 2.176) should be attached to the bracket posts as shown (9).

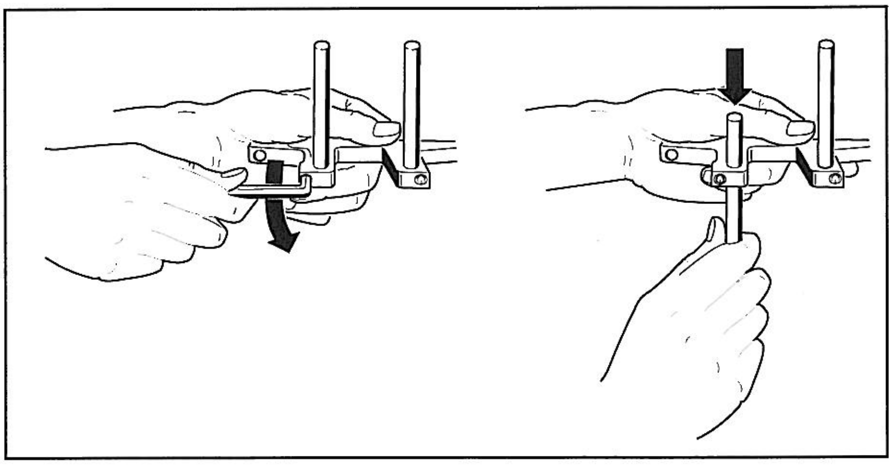
Coupling bolt hole bracket — ALI 2.106 set

This magnetic bracket can serve as a useful substitute for the standard belt-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 TURBALIGN brackets are used. However, once the coupling bolt is removed, this bracket can be placed upon the coupling flanges as shown below. The TURBALIGN emitter 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. Besides supporting the inclinometer, the spring bridge allows easy and precise adjustment of the components and provides additional rigidity for optimum measurement results.



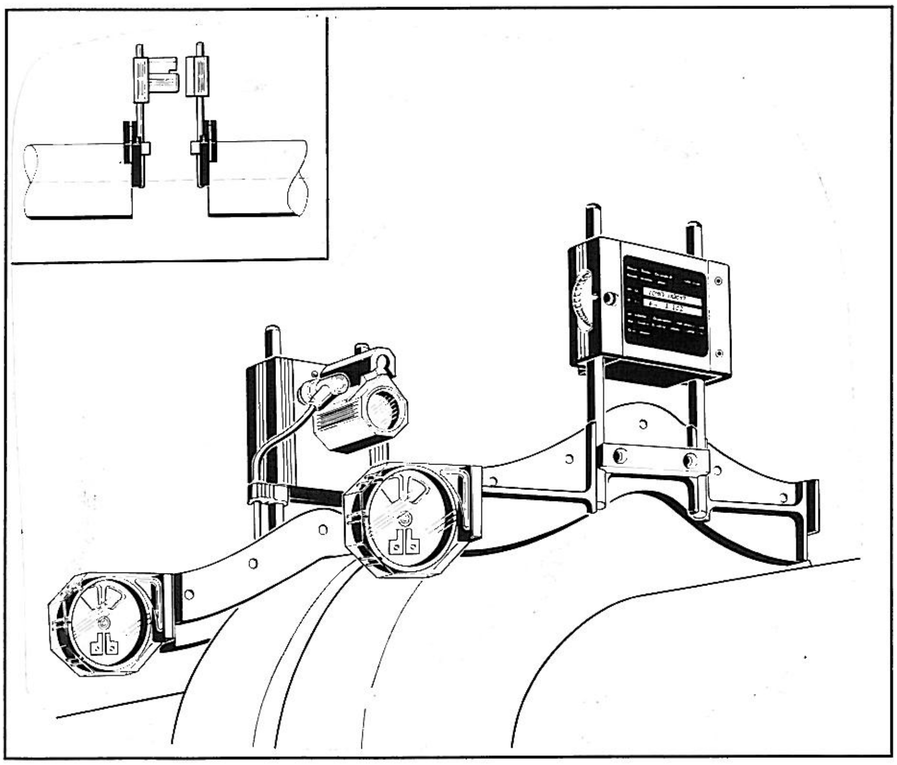
Use only the 115 mm (4½") support rods supplied with the bracket. The position of the support rods may be changed by loosening the hex screws which clamp them in the bracket.



Magnetic sliding bracket ALI 2.230

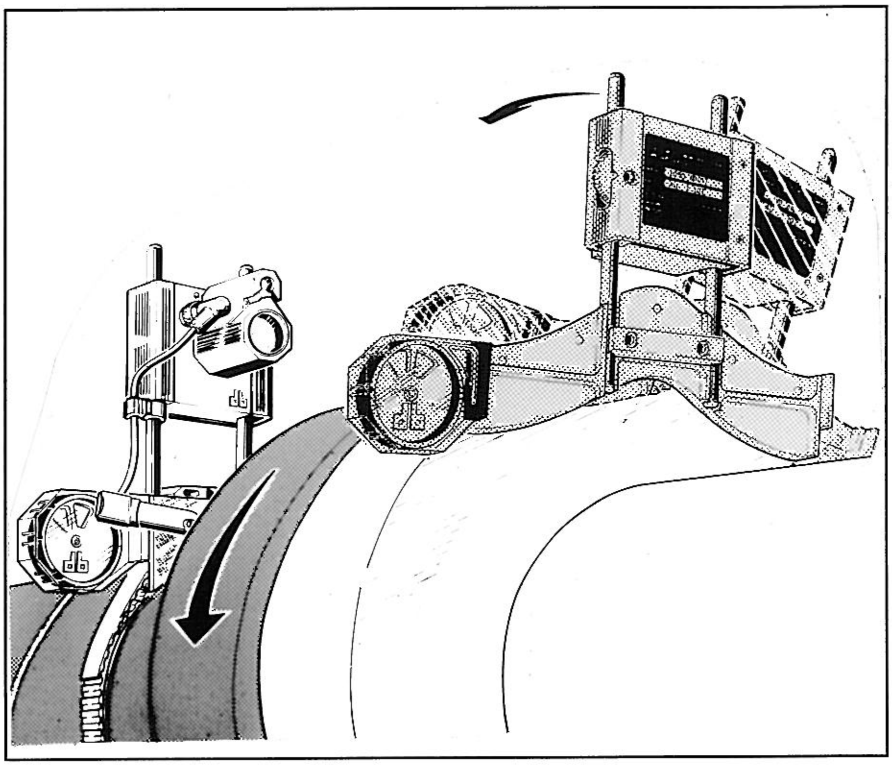
In order to accurately align two machines to each another, the position of their shafts must be measured by measuring radial displacement (such as OPTALIGN does) while the shafts are rotated. Unfortunately, some machines do not fulfill this requirement as their shafts cannot be rotated slowly for measurement.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

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



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

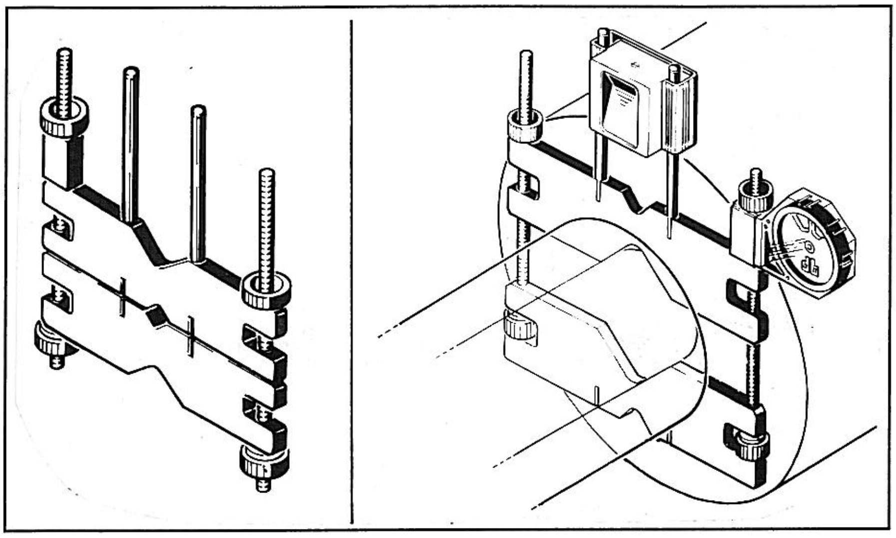
- The flange and perimeter of the coupling or shaft must be surface-finished.
- The coupling or shaft must be made of ferrous material (steel) with a large magnetic contact area provided for the magnets to guide the bracket properly.
- Before mounting the sliding bracket, the coupling or shaft should be cleaned, then lightly lubricated at the appropriate location to allow the bracket to slide around smoothly.
- The laser transducer should always be mounted upon the side with the highest-quality finish.



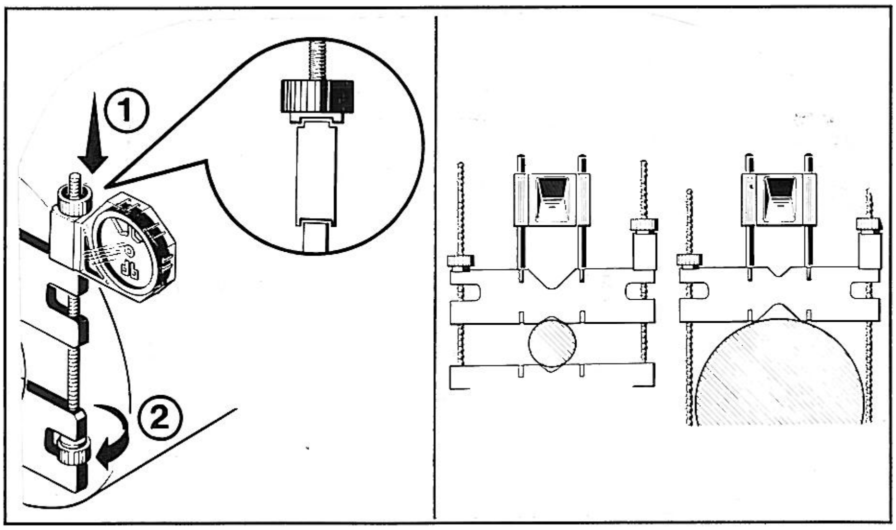
For best possible alignment accuracy, always try to rotate at least one shaft (with the coupling bolts removed). If at all possible, always mount the laser transducer on the shaft that can be rotated (any quick-fit bracket can be used on the rotating side).

Remember:
Accuracy achieved from non-rotating shaft alignment methods is always less than that of the OPTALIGN when both shafts are rotated and the usual belt-type quick-fit brackets or chain-type brackets are used. Therefore, non-rotating measurement should be seen only as a method of last resort.

Extra-thin bracket ALI 2.109L set



In some alignment situations, space along the shaft or coupling may be so tight that the standard quick-fit brackets may be difficult or impossible to mount. In such cases, this extra-thin bracket offers the perfect solution: with a thickness of only 8 mm (less than 3/8"), it fits into virtually any available gap between machine housing and coupling. The ALI 2.109L set extra-thin bracket fits onto any shaft diameter up to 94 mm (3 11/16").



The extra-thin bracket is designed for especially easy mounting: the "slip nut" shown in the adjacent sketch slides onto the threaded rod and is held in place by the bracket lugs as shown. Tightening and loosening are performed by simply turning the thumbwheel located on the lower portion of the threaded rod.

(ALI 2.109L set: screw threaded rods into lower traverse, mount bracket and use thumbwheels to tighten upper traverse onto shaft.)

Operating OPTALIGN

Step by step

The instructions below, when followed in sequence, will help you to perform basic alignment properly. Each individual step is described in detail on the pages that follow.

0. Before using OPTALIGN, make sure the machine is properly prepared for alignment as described on page 20.
   Do not neglect soft foot correction before alignment!

1. Are alignment targets prescribed, for example, to compensate for thermal growth effects? If so, obtain the most reliable values available.

2. Mount the brackets.

3. Attach the transducer and prism.

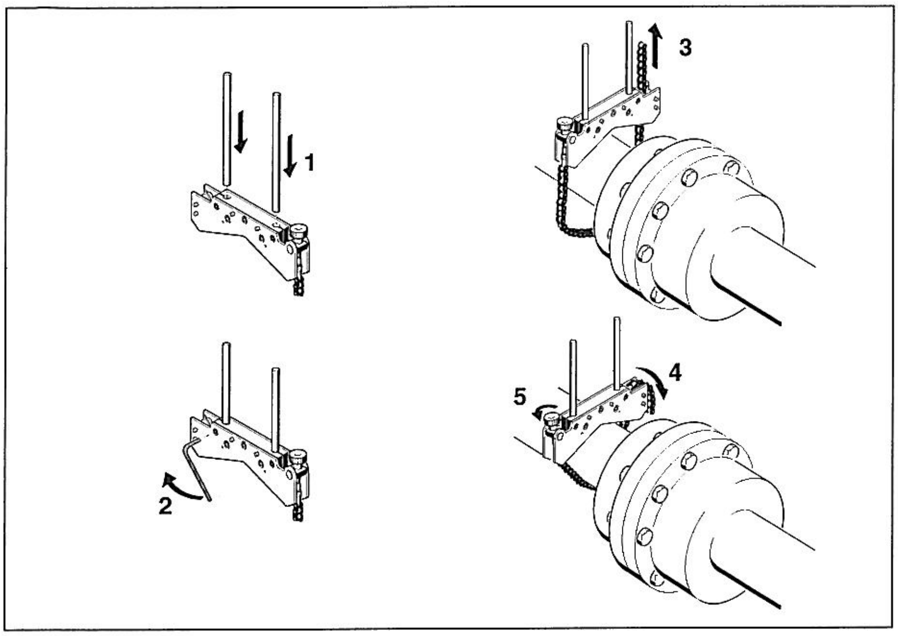
4. Follow Basic Alignment Recording Sheet 1
   a) Measure the five dimensions and enter them.
   b) Enter alignment targets if necessary.
   c) Adjust transducer and prism to one another.
   d) Take alignment readings.
   e) Display alignment condition at coupling.
   f) Display corrections at machine feet.

5. Steps d) and e) can be repeated, if desired, to check that the same coupling values are repeatedly obtained from one measurement set to the next.

6. Shim the machine to be moved according to the displayed corrections, or position the machine horizontally using the MOVE function.

7. Repeat steps 4c to 6 as necessary until shaft alignment falls within prescribed tolerances.

Mounting the compact chain-type bracket



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

Choose the shortest support posts which will still allow the laser beam to pass over the coupling flange. Use the anti-torsion bridges (ALI 2.176, see Product Catalog ALI 9.300) to avoid torsional deflections when shafts are rotated to the 3:00 and 9:00 measurement positions. Insert the support posts into the bracket (1), then fasten them in place by tightening the hex screws on the sides of the bracket frame (2). Then place the bracket on the shaft or coupling, wrap the chain around the shaft (3) and catch it loosely on the anchor peg (4). Turn the bracket thumbscrew to tighten the assembly onto the shaft (5).

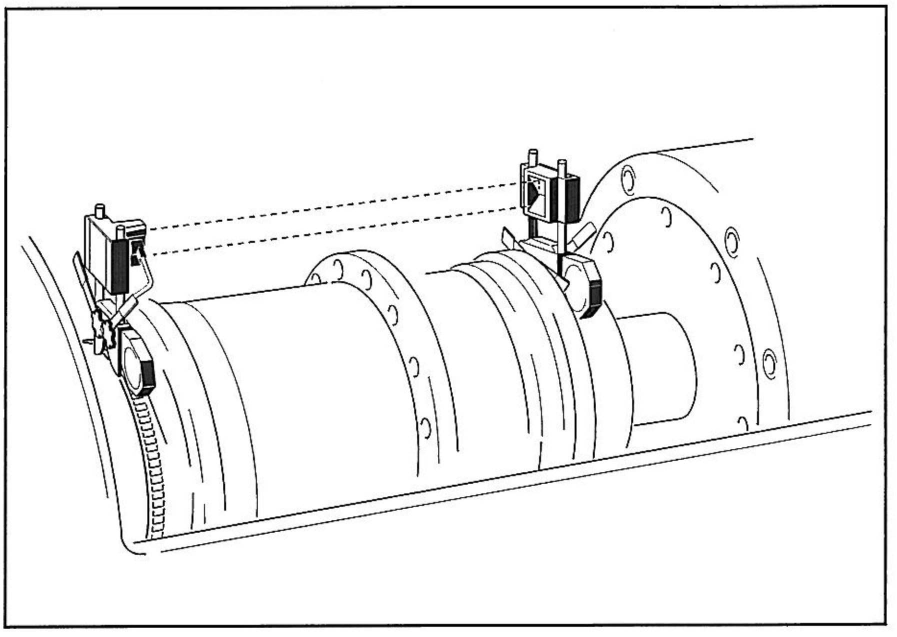
Now the bracket should be tight upon the shaft. Do not push or pull on the bracket to check, since that would only loosen its mounting. (The best confirmation of proper mounting is repeatability of alignment readings!)

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

Mounting transducer and prism

Install the laser/detector on the support posts of the bracket installed on the stationary machine's shaft.

Squeeze the front and back of the housing together and slide the transducer and prism onto the support posts so that both are at the same height just above the coupling flange as shown below. Remove the dust caps from both components.

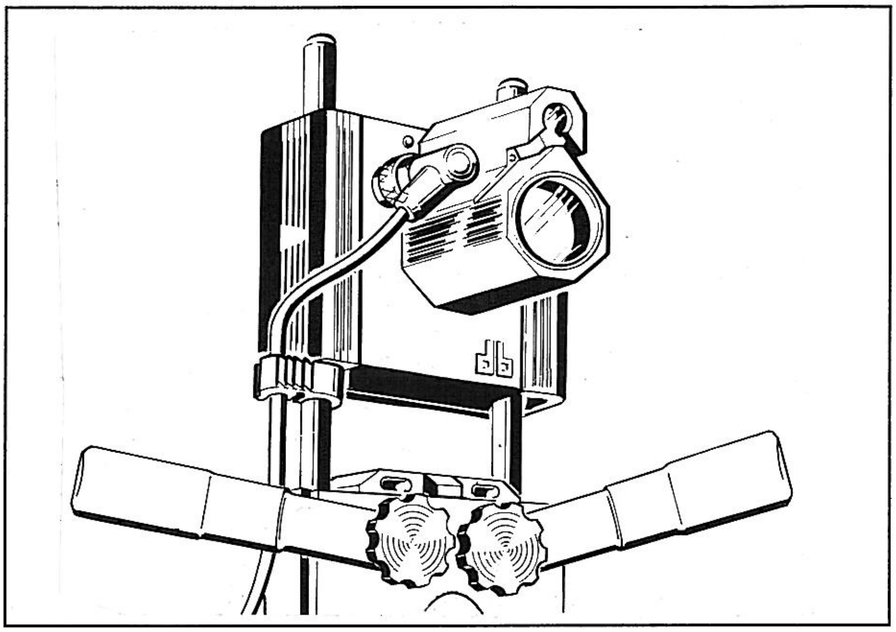


The inclinometer attaches to a steel plate on the side of the bracket. If the shafts are uncoupled, two inclinometers may be used (one on each bracket) to align the brackets to each other and position them consistently when rotating the shafts.

Always slide the prism and laser down as low as possible on the support posts, allowing room for the beam to clear the coupling hubs. Note: for maximum bracket rigidity and highest measurement accuracy, anti-torsion bridges (order number ALI 2.176) should be attached to the bracket posts. Only one bridge is needed to balance the prism, but two bridges should be used on the transducer, one above and one below, due to its greater weight.

Connecting the transducer

The OPTALIGN transducer is connected by screwing the straight-ended cable plug into the computer socket; note the keyway indicating proper plug orientation. The angled socket is screwed into the transducer in the same manner. Leave the cable attached when storing the OPTALIGN computer and transducer in their case, as this will help avoid damage to cable pins, plugs and sockets.



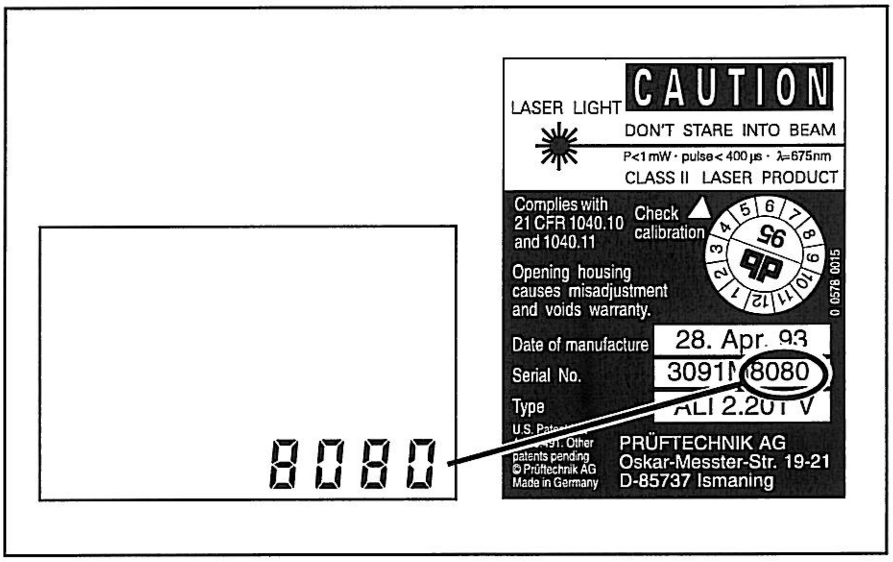
Attach the plastic cable clip to the lower portion of the support post as shown. This helps avoid measurement disturbance and damage to the cable or socket if the cable is pulled.

Since the computer contains data describing the particular transducer to which it is matched, use only the original transducer delivered with the computer in order to maintain accuracy and proper laser beam control. Under no circumstances may an infrared (invisible) laser transducer be attached to a computer with a visible-laser hardware module: this would make the laser operate outside the Class I safety limits!

Alignment using recording sheet 1

Now recording sheet 1 may be used: begin at the upper left corner with the ON/OFF key and simply follow the flow chart guideline. This will lead you through the entire measurement procedure.

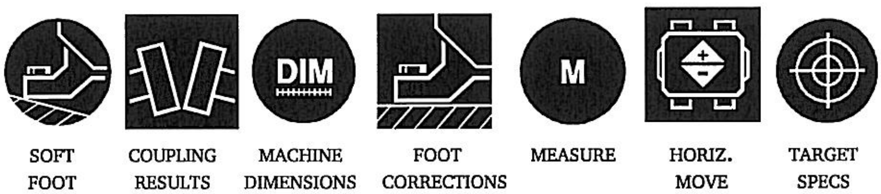
When first switched on, the computer displays its serial number. Check to make sure that this number matches the last four digits of the serial number on the back of the transducer housing, as these components are uniquely matched and must always be used together to maintain measurement accuracy.



To work in inches, press the slash key (/) now; otherwise all entries and results will be displayed in metric units.

Function keys

The function keys are marked



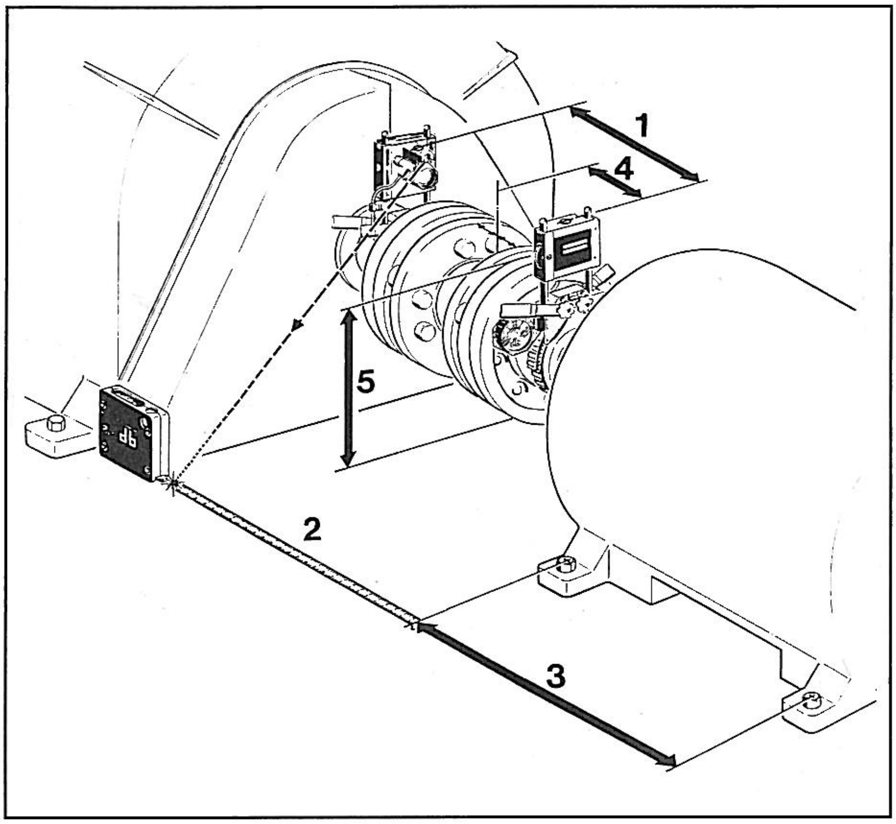
Their respective functions are described in detail on the following pages.

Example: You are viewing the machine foot correction values (as indicated at the bottom of the recording sheet) and want to change the machine dimensions previously entered. To do so, press the DIM key to cycle through machine dimensions and make the desired changes. At any time, the machine foot key may be pressed to show the adjusted correction values.

Machine dimensions

When the DIM key is pressed, the computer prompts for the five machine dimensions shown below. Tape measure readings are perfectly sufficient. In the metric mode, enter the dimensions in millimeters; when working in inches (see p. 23), enter whole inches and fractions to the nearest 1/8". Example: to enter a distance of 3' 8¼" (= 44¼"), just press the keys 4 4 1 / 4 (ENT). The computer display is rounded to the nearest 0.1", but calculations are made internally using the full fractional value.

1. Enter the distance between transducer and prism; press ENT to confirm. The computer display then switches to the next dimension.



2. Enter the distance between transducer and front foot of the machine to be moved: the transducer now provides a location mark on the machine foundation by emitting a laser beam downward as shown above. (See special instructions for invisible Class I laser on page 93.) The transducer-front foot dimension may then be measured easily, especially when large machines are involved. Confirm this distance entry with ENT.

The transducer and prism symbols blink in the display to indicate that the laser beam is being emitted. Do not look into the beam aperture of the transducer.

3. Enter the distance between front foot and back foot of the machine to be moved; confirm with ENT.

4. Enter the distance between coupling center and prism (<u>not</u> transducer); confirm with ENT.

Note: dimensions 4 and 5 may be omitted if alignment results at the coupling are not required.

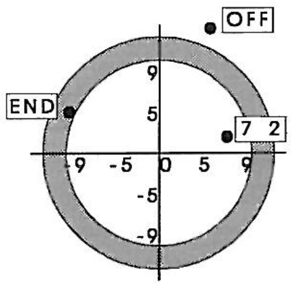
5. Enter the coupling diameter and confirm with ENT. (When working in the inch mode, the computer suggests a default diameter of 10". In most cases, this should be confirmed with ENT.)

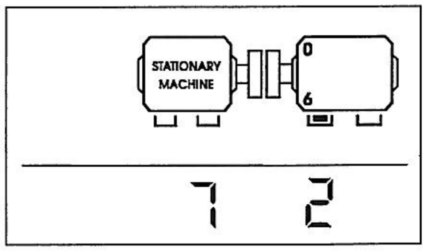
Measurement (1): Adjusting the prism

Now proceed with measurement by pressing the M key. When first mounted, the transducer and prism are usually misadjusted, that is, the laser beam might not be reflected into the measuring range of the position detector. The prism must then be adjusted so that the laser beam reflects into the larger lower aperture in the detector housing. The display will then show two single digits instead of OFF or END: the left-hand digit stands for the horizontal (X) position of the beam, while the right-hand digit tells its vertical (Y) position. Detailed instructions on laser beam adjustment appear on the following pages.

The transducer and prism symbols blink in the display to indicate that the laser beam is being emitted. Do not look into the beam aperture of the transducer.

The detector surface





OFF appears in the computer display when the laser beam is not detected (for example, if it goes completely out of range or is interrupted).
END is displayed when the laser beam strikes the outer, nonlinearized area of the detector (shaded grey above).
When the laser beam strikes the detector anywhere within its linearized measurement range, two digits (X,Y coordinates) are displayed to tell its location within a range of -9 to +9.
The detector measurement range is about 6 mm (¼") in diameter.

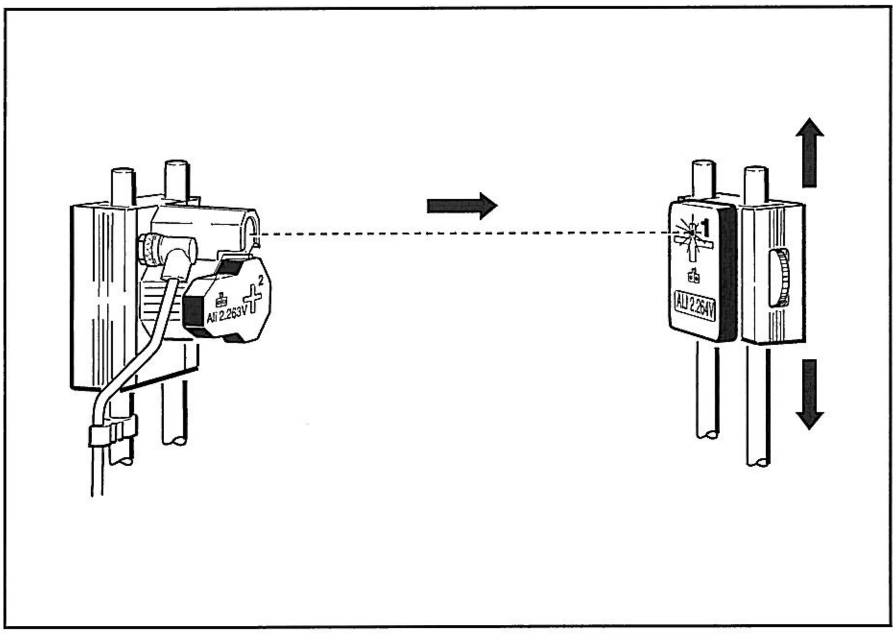
Protection and adjustment caps

Transducer ALI 2.263V
Prism ALI 2.264V

These accessories helps make laser beam adjustment easier: the visible laser beam appears as a very bright spot on the red rubber, while the target symbols show the ideal beam location for perfect adjustment.

Use the caps as follows:

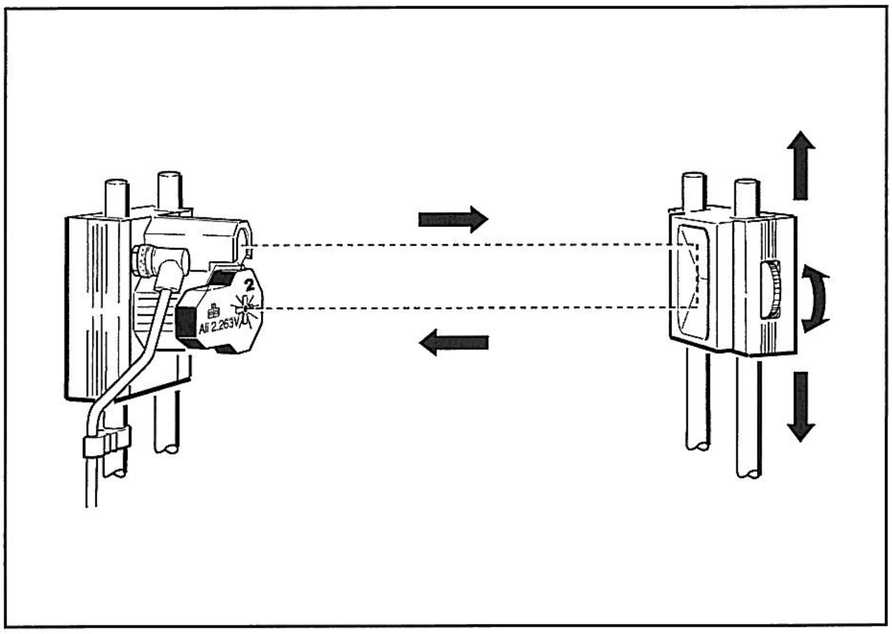
1. Once the brackets are mounted on the shafts or coupling halves, mount the transducer and prism onto the support posts as usual. The prism should be located at the same approximate height as the transducer. Attach the cable to the transducer and computer and proceed as usual to the beam adjustment mode.



2. Remove the transducer cap, turn it 90° so that the slot in the side faces upwards, and slide it onto the lower portion of the transducer as shown above. The laser beam is now directed toward the prism. When the beam strikes the red rubber prism cap, it should be readily visible. If the beam is so far off target that it misses the prism completely, hold a sheet of paper in front of the prism to locate the beam for preliminary adjustment until the beam strikes the red cap on the prism (it may be necessary to reposition the transducer bracket to do so).

3. Adjust the beam in the vertical direction by sliding the prism (and/ or transducer) up and down along their support posts. Fine adjustment may be facilitated by using the ALI 2.176 anti-torsion bridge set, which features a spring-loaded adjustment knob. Center the beam vertically on the raised target of the prism cap. If the beam is completely to one side of the target, loosen the brackets and remount them so that the beam falls within the range of the prism target.

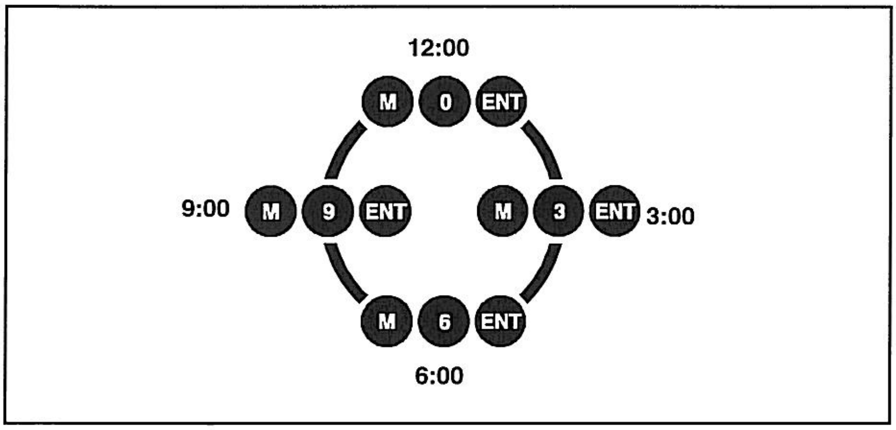
4. Now remove the prism cap. The beam is reflected back toward the transducer cap which still covers the position detector. If the beam misses the detector completely, use a piece of paper to locate the beam (being careful not to block the outgoing beam from the transducer) and adjust the beam onto the cap as directed below.



5. Adjust the beam vertically onto the center of the target by sliding the prism up and down along its support posts. Then adjust the beam horizontally by turning the thumbscrew on the side of the prism housing.

6. When the beam is centered on the detector target markings, remove the transducer cap. The computer display should now confirm proper adjustment by displaying (X,Y) beam coordinates close to 0 . Continue to make fine adjustments of the prism upwards or downwards, and horizontally with the thumbwheel until both coordinates read 0.

Measurement (2): Taking alignment readings



Now measurements are entered from four shaft positions 90 rotational degrees apart, that is, with the OPTALIGN system located at 12:00 (straight up), 3:00, 6:00 (straight down) and 9:00. The horizontal positions are determined as seen from the prism looking toward (but not into) the transducer. Alignment readings are entered into the computer from each of these positions by pressing the keys M, [position], ENT.

The more accurately the shafts are positioned using the Inclinometer, the more accurate the readings will be.

These measurements can be taken in any order desired. Wrong measurements can be corrected (overwritten) by simply taking a new reading in the same position or completely eliminated by pressing the keys M, [position to be erased], CLR.

If the shafts cannot be rotated into all four positions, then take three readings and allow the computer to calculate the fourth reading automatically.

If the beam should leave the detector range during measurement (for example, due to gross misalignment), the coordinates in the display will be replaced by the letters END or OFF. See page 61 for detailed instruction on how to handle this situation by extending the measurement range.

If the machine shafts cannot be rotated 180°, see page 83 for instructions on special function 6, which allows measurement at 45° intervals.

If the machine shafts cannot be easily stopped exactly every 90°, see page 81 for more information on how OPTALIGN can help.

Note:

If for any reason the repeatability of alignment readings should be in doubt (for example, if the machine bearings are worn), a second set of readings may be taken to compare results (see following pages) before performing alignment corrections. Since the computer retains all dimension values until it is turned off, there is no need to enter dimensions again when taking a new set of readings.

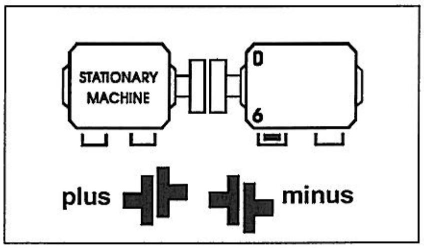
Display misalignment at coupling

How well is the machine aligned? How much misalignment does the coupling have? Is remaining misalignment within prescribed tolerances? These vital questions can now be answered easily using the OPTALIGN coupling key.

To display the alignment condition at more than one location (e.g. for two coupling planes), use the F 7 function as described on page 85.

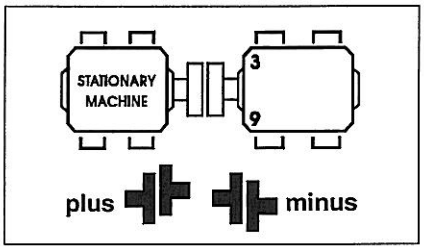
To compare OPTALIGN coupling readings with dial indicator results:
1) The distance 'prism to coupling' must correspond to the distance from the prism to the plane where the radial dial gage takes its readings.
2) The 'coupling diameter' must correspond to the diameter travelled by the axial dial gage.

When the coupling key is pressed, vertical offset is displayed first. The blinking coupling symbol indicates the direction of offset: i.e. whether the shaft centerline of the machine to be moved is higher or lower than that of the stationary machine. Write this value on the recording sheet.



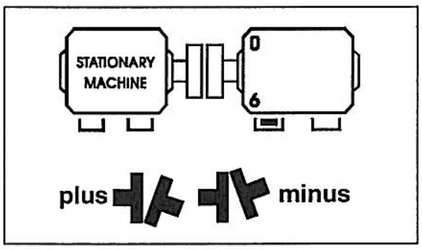
Vertical offset

Press the ENT key to display horizontal offset. Write this value on the recording sheet.



Horizontal offset

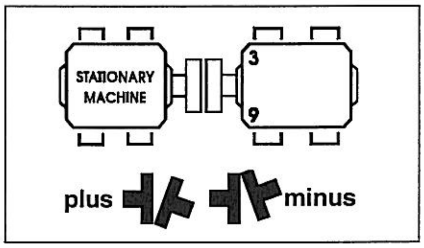
Press ENT once more to show vertical angularity as the gap difference at the coupling diameter entered earlier. The blinking symbol tells whether the gap opens toward the top or bottom. Write this value on the recording sheet.



Vertical angularity

Press ENT again to display horizontal angularity. Write this value on the recording sheet.

Pressing ENT will cycle forwards through these four results, while pressing RCL will cycle backwards through them as desired.



Horizontal angularity

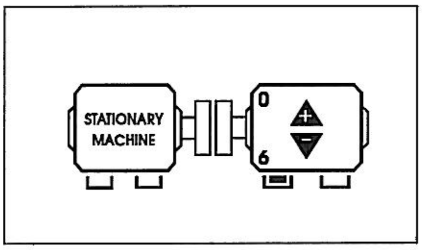
These coupling results always show the actual measured condition, so after alignment, a new set of measurements must be taken to update these results. The values should then lie within the appropriate tolerance. For example, for a large machine running at 3000 rpm, these coupling values should not exceed 3/100 mm (see page 19).

Display foot corrections

If the coupling results show that misalignment exceeds the tolerance, then the machine must be realigned by shimming vertically and/or horizontal repositioning. The OPTALIGN machine foot key is used to display the values of these corrections.

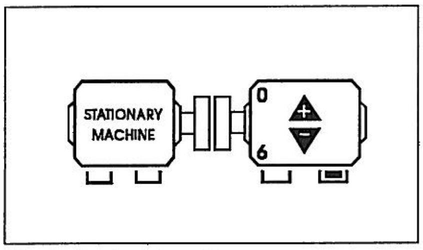
Shim machine feet with PERMABLOC or LAMIBLOC precut shims

When the foot key is pressed, the shimming value for both front feet is displayed first. The arrow appearing within the machine tells whether to insert shims (arrow pointing upwards) or remove them (arrow pointing downwards). Write this value on the recording sheet.



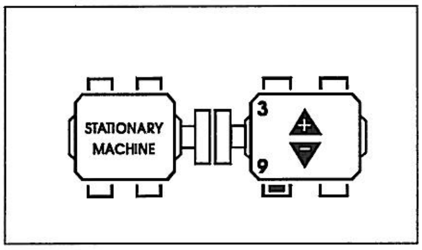
Front foot shimming

Press ENT to display the shimming correction for both back feet. Write this value on the recording sheet.



Back foot shimming

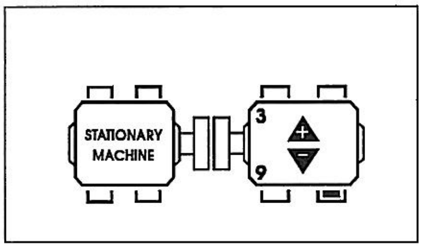
Press ENT to show the necessary amount and direction of horizontal repositioning at the front end of the machine. Write this value on the recording sheet. Note: these moves may be carried out using the OPTALIGN's MOVE feature (see page 49).



Front foot horizontal correction

Position horizontally using the MOVE function

Press ENT again to display the horizontal correction for the back end of the machine. Write this value on the recording sheet.



Back foot horizontal correction

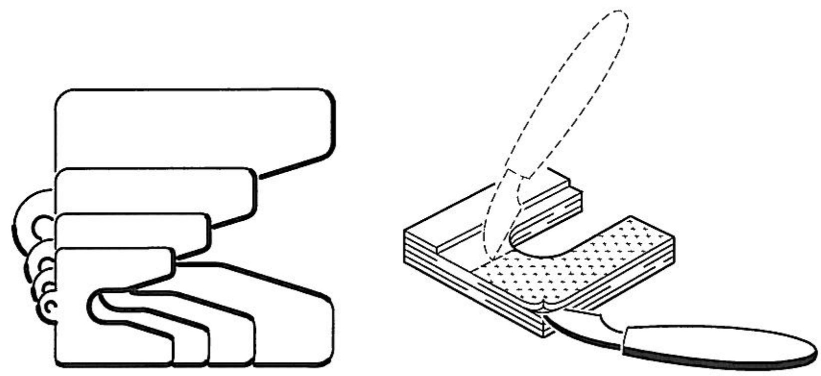
Pressing ENT will cycle forwards through these four results, while pressing RCL will cycle backwards through them as desired.

Vertical alignment corrections

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

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

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



PERMABLOC®　　LAMIBLOC®

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

LAMIBLOC shims are laminated from 12 layers to give a total thickness of 1 mm; the correct shimming amount is obtained simply by peeling off the excess layers, so only a handful of shims are 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.

Horizontal alignment using MOVE

The OPTALIGN MOVE function enables you to follow the progress of horizontal alignment positioning in the computer display.

The MOVE key belongs to the function key group and is denoted by a plan view of the machine to be moved with a double arrowhead as shown at right.

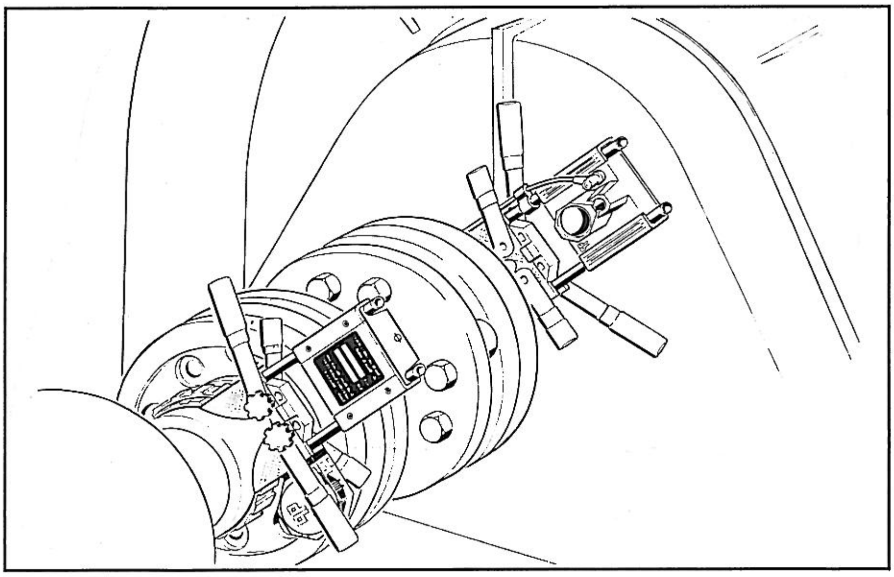
Note: transducer and prism must remain in 1:30 position during the entire MOVE procedure!

Follow these simple steps to carry out the function:

0. If vertical alignment has been carried out first, a new set of alignment readings should be taken because the machines usually move a bit during shimming. However, this second measurement cycle goes quickly since the machine dimensions are already entered (and remain stored until the computer is switched off). If horizontal coupling misalignment values are outside tolerance, then the machine must be repositioned.

1. Press the MOVE key.

2. Turn the shafts so that the OPTALIGN components are located at 1:30 position (note that only this position, 45° to the right of vertical as seen from the prism side, may be used!) Then press the MOVE key again.



The transducer and prism symbols blink in the display to indicate that the laser beam is being emitted. Do not look into the beam aperture of the transducer.

3. Now readjust the prism so that the display reads 0 0.
   Then press the MOVE key once more.

4. Loosen the anchor bolts just enough so that the machine can be moved.

Warning:
Temptation may be great to move the machine with a few hefty blows of a sledgehammer. This can cause not only bearing damage, but also less accurate MOVE results. Jack bolts on the machine feet or other mechanical or hydraulic adjustment methods are therefore recommended.

5. Move the front or back end of the machine in the direction indicated by the computer display. The amount of correction remaining is always shown for whichever end is furthest out of line; this is indicated by the blinking machine foot. At any time, the display may be switched from one machine foot to the other by pressing the ENT key.

   As one end of the machine is brought to within half the remaining correction for the feet at the other end, the computer switches automatically to the other end, beeping and blinking the other machine foot as it does so. Be careful not to overlook these signals when concentrating on the numerical display!

Please pay careful attention to the following points:

- **Which foot is flashing in the display?**
- **When does the display jump to the other foot?**
- **In which direction is the arrow pointing?**

   Proceed with the alignment until correction values for both ends reach zero. The computer should then switch constantly back and forth from front to back feet, displaying 0 all the while.

   If the machine suffers from excessive soft foot, the MOVE function may be hampered by the fact that the machine changes its position on its own every time the anchor bolts are loosened and tightened.

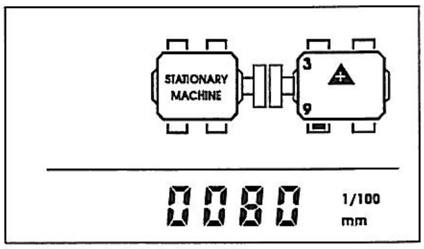
   Therefore, please use the soft foot function and correct the situation before beginning MOVE.

   If severely misaligned machines are positioned using the MOVE function, they may need to be moved so far that the laser beam leaves the position detector and 'END' or 'OFF' appears in the display. In that case, use the measurement interrupt function described on page 61 (note special MOVE instructions on page 62).

6. Tighten the anchor bolts.

7. Exit the MOVE function and start taking a new set of alignment readings by pressing the M key. Since the machine was moved, earlier results are no longer valid, so a new set of alignment readings <u>must</u> be taken after positioning the machine to be moved in order to check coupling misalignment or remaining foot corrections.

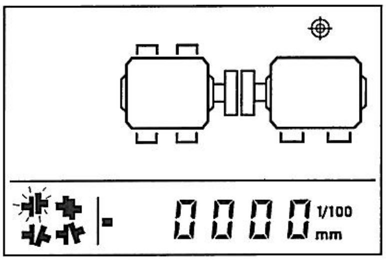
Example:
The front end of the machine to be moved must be moved in the direction shown by 80/100 mm.



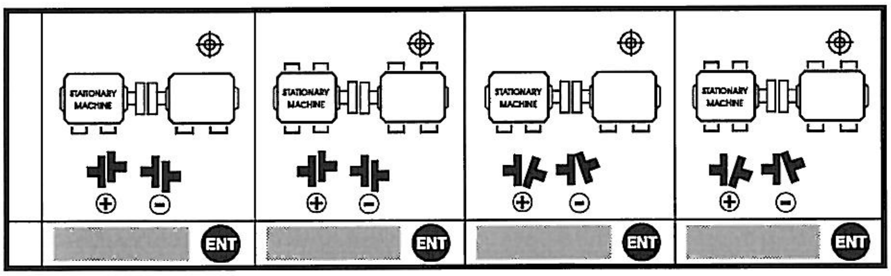
Incorporating target alignment specifications

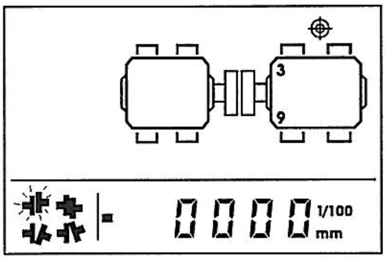
In certain instances, it is desirable to introduce a specific amount of misalignment, for example, to compensate for growth of machines which are aligned when cold, but operate at high temperature. The OPTALIGN 'Target' function key allows you to specify the exact misalignment desired as it would be measured at the coupling center. This information is then automatically calculated into the alignment corrections. The target key may be pressed before or after measurements are taken, but only after all the required dimensions have been entered.

1. Press the target key



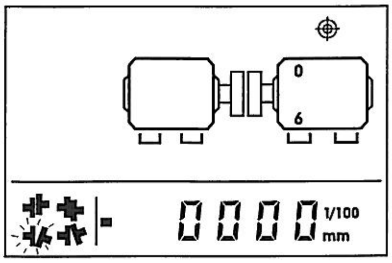
2. Enter the desired amount of vertical offset at the coupling for the machine to be moved during alignment (MTBM): if it should stand higher than the stationary machine, enter the offset as a positive value. Enter the offset as a negative value if the MTBM shaft should be lower than that of the stationary machine. Write this amount in the space provided on the recording sheet. Press ENT to proceed to the next parameter.





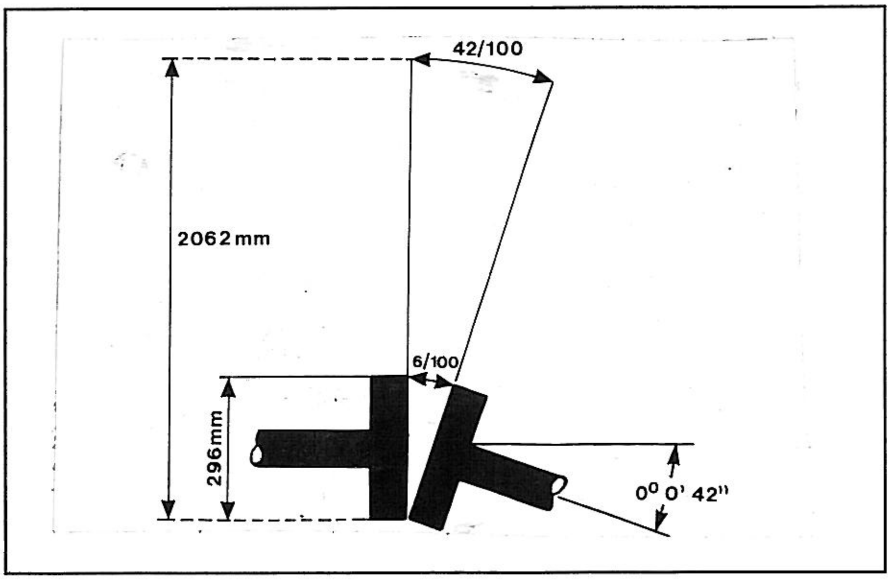
3. Enter the target value for horizontal offset for the MTBM. This amount is entered as a positive number if the MTBM shaft should be positioned further toward 3 o'clock than the stationary machine at the coupling center. It is entered as a negative number if the MTBM shaft is to be positioned further toward 9 o'clock than the stationary machine at the coupling center. Write this amount in the space provided on the recording sheet. Press ENT to proceed to the next parameter.

Incorporating target alignment specifications

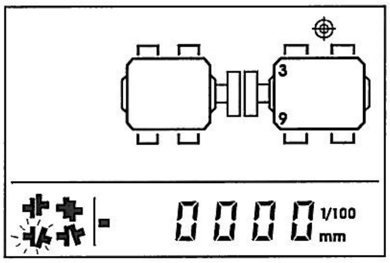


4. Enter vertical angularity by specifying the desired gap difference at the edge of the coupling diameter entered earlier. Enter a gap opening at the top of the coupling as a positive value; if the gap opens toward the bottom of the coupling, enter it as a negative value. Write this amount in the space provided on the recording sheet. Press ENT to proceed to the next parameter.

If shaft angularity is specified in terms of arc seconds (e.g. 0 ° 0' 42"), enter the number of arc seconds in place of the gap width followed by ENT . Now press DIM, then ENT four times and change the coupling diameter to 2062 mm (or 206.2 inches): at this diameter, the gap width increases by precisely 0.01 mm (or 0.001") for every 0° 0' 01" of shaft angularity. Press the target key to return to the coupling spec function, then press ENT three times to proceed to the following step.



Alternatively, if angularity is prescribed for a specific coupling diameter (for example, as a desired gap difference per 10"), enter the angularity (e.g. gap difference) followed by ENT. Now press DIM, then ENT four times and change the coupling diameter accordingly (e.g. to 10"). Press the target key to return to the coupling spec function, then press ENT three times to proceed to the following step.



5. Enter horizontal angularity as a positive value if the gap opens toward the 3 o'clock (far) side of the coupling. If the coupling diameter has already been adjusted as directed in the previous step, enter the corresponding angularity directly at this point. Write this amount in the space provided on the recording sheet. Press ENT to confirm this value and return to the first target parameter. Continue by selecting another function with one of the function keys, or continue with step 6.

6. Proceed with alignment measurement by pressing the key marked M.

Comparing OPTALIGN readings with dial indicator results

To compare OPTALIGN coupling readings with dial indicator results:

1) The distance 'prism to coupling' must correspond to the distance from the prism to the plane where the radial dial gage takes its readings.

2) The 'coupling diameter' must correspond to the diameter travelled by the axial dial gage.

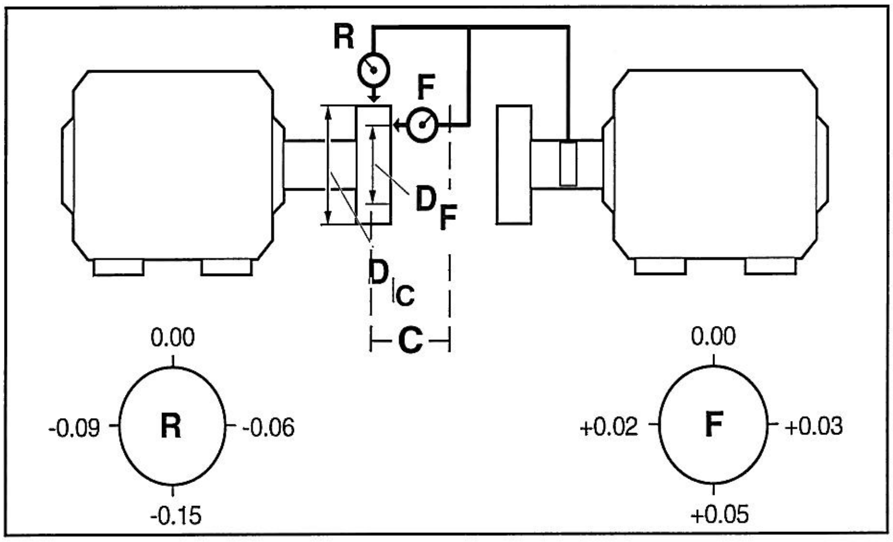
Also be sure to measure and eliminate bracket sag effects from the indicator readings; even then, slight discrepancies may arise due to limited resolution, hysteresis, looseness and other phenomena which tend to reduce the accuracy of dial indicator measurements.

If target alignment is specified differently

Some traditional methods used to incorporate target specs into alignment do not specify the desired misalignment as measured at the coupling. Such specs must be converted first into coupling alignment values to be entered into the OPTALIGN computer.

Rim and face dial indicators

To compare OPTALIGN coupling readings with dial indicator results:
1) The distance 'prism to coupling' must correspond to the distance from the prism to the plane where the radial dial gage takes its readings.
2) The 'coupling diameter' must correspond to the diameter travelled by the axial dial gage.
Most importantly, any bracket sag effects must be measured and used to adjust dial indicator results accordingly! Also please be aware that dial indicators are subject to other effects (such as hysteresis and parallax errors) which may be difficult to quantify, yet still diminish accuracy of results.



If alignment targets specify this measurement setup, first convert the indicator readings into net misalignment values at the coupling center:

Vertical offset

$$V_O = \frac{-(R_0 - R_6 + R_S)}{2} - \frac{C \cdot (F_6 - F_0 - F_S)}{D_F}$$

Horizontal offset

$$H_O = \frac{(R_3 - R_9)}{2} + \frac{C \cdot (F_9 - F_3)}{D_F}$$

Vertical angularity (per unit length)

$$V_A = \frac{(F_6 - F_0 - F_S)}{D_F}$$

Horizontal angularity (per unit length)

$$H_A = \frac{(F_9 - F_3)}{D_F}$$

Indicator bracket sag is measured (as indicated in the small figures at left and right above) by mounting the indicator on a pipe, zeroing the indicator scale at 12:00 position, then rotating the pipe to 6:00 position. The amount of sag is then read from the indicator scale; this amount, which is usually negative, is then inserted directly into the equations above.

Where

R_0 = Rim reading at 12:00
R_3 = Rim reading at 3:00
R_6 = Rim reading at 6:00
R_9 = Rim reading at 9:00
F_0 = Face reading at 12:00
F_3 = Face reading at 3:00
F_6 = Face reading at 6:00
F_9 = Face reading at 9:00
R_S = Bracket sag reading of radial (rim) indicator
F_S = Bracket sag reading of face (axial) indicator
C = Distance from radial (rim) indicator to coupling center (use a negative value here if indicator is to the right of the coupling)
D_F = Diameter travelled by face (axial) dial indicator tip
D_C = Coupling diameter

(Proper clock positions are given when viewing dials from MTBM toward stationary machine.)

Use the OPTALIGN target alignment procedure as described beginning on page 51. At steps 2 - 5, enter the values V_O, H_O, V_A and H_A, respectively.

Example:

Using the indicator values shown on the previous page as an example, the remaining values are

R_S = -0.04 mm F_S = -0.03 mm   C = 10 mm
D_F = 200 mm D_C = 220 mm.

The OPTALIGN coupling function values would then be:

Vertical offset

$$V_O = -\frac{(0.00 + 0.15 + 0.04)}{2} - \frac{10 \cdot (0.05 - 0.00 + 0.03)}{200}$$

= -0.099, or -0.10 mm (right-hand machine sitting lower)

Horizontal offset

$$H_O = \frac{(-0.06 + 0.09)}{2} + \frac{10 \cdot (0.02 - 0.03)}{200}$$

= 0.0145, or +0.01 mm (right-hand machine further away)

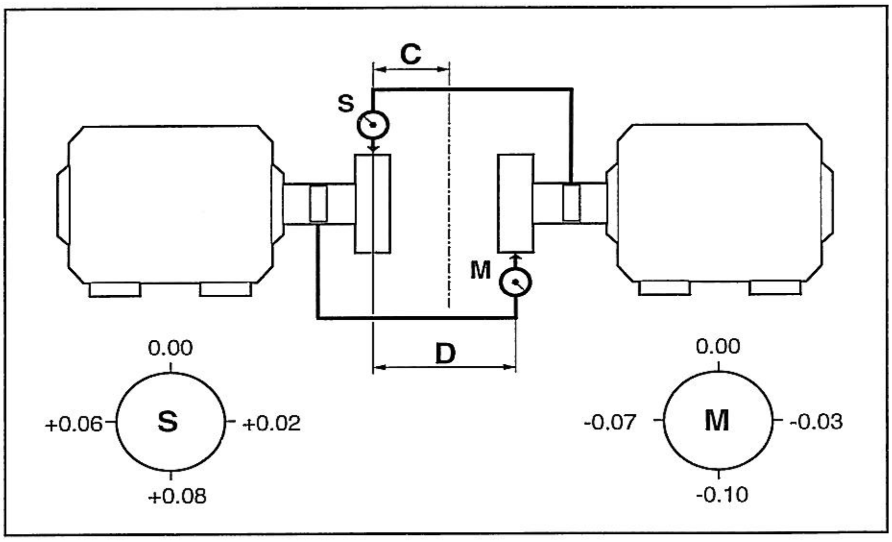
Vertical angularity

$$V_A = \frac{(0.05 - 0.00 + 0.03)}{200} = 0.0004 \text{ mrad}$$ (or 0.04 mm per 100 mm open toward top)

Horizontal angularity

$$H_A = \frac{(0.02 - 0.03)}{200} = -0.00005 \text{ mrad},$$ (or 0.005 mm per 100 mm open toward front)

Reverse dial indicators



If alignment targets specify this measurement setup, first convert the indicator readings into net misalignment values at the coupling center:

Vertical offset

$$V_0 = \frac{C \cdot (S_0 - S_6 + S_s + M_0 - M_6 + M_s)}{2D} - \frac{(S_0 - S_6 + S_s)}{2}$$

Horizontal offset

$$H_0 = \frac{C \cdot (S_3 - S_9 + M_3 - M_9)}{2D} - \frac{(S_3 - S_9)}{2}$$

Vertical gap

$$V_A = \frac{\emptyset \cdot (S_6 - S_0 - S_s + M_6 - M_0 - M_s)}{2D}$$

Horizontal gap

$$H_A = \frac{\emptyset \cdot (S_9 - S_3 + M_9 - M_3)}{2D}$$

Where

S_0 = Reading from indicator S at 12:00
S_3 = Reading from indicator S at 3:00
S_6 = Reading from indicator S at 6:00
S_9 = Reading from indicator S at 9:00
M_0 = Reading from indicator M at 12:00
M_3 = Reading from indicator M at 3:00
M_6 = Reading from indicator M at 6:00
M_9 = Reading from indicator M at 9:00
S_S = Bracket sag of indicator mounted on stationary machine
M_S = Bracket sag of indicator mounted on machine to be moved
D = Distance between indicators
C = Distance from coupling center to location of indicator mounted on stationary machine side
Ø = Coupling diameter

(Proper clock positions are given when viewing dial from MTBM toward stationary machine.)

Now use the OPTALIGN target alignment function as described beginning on page 51, with the following change:

- At steps 2 - 5 on page 51, enter the values V_O, H_O, V_A and H_A, respectively.

Example:

Using the indicator values shown on the previous page as an example, the remaining values are

S_S = -0.05 mm M_S = -0.04 mm
C = 15 mm D = 10 mm Ø = 100 mm

The OPTALIGN coupling function values would then be:

Vertical offset

$$V_O = \frac{15 \times (0.00 - 0.08 + 0.05 + 0.00 + 0.10 - 0.04)}{2 \times 10} - \frac{(0.00 - 0.08 - 0.05)}{2} = 0.0875, \text{ or } 0.09 \text{ mm}$$

Horizontal offset

$$H_O = \frac{15 \times (0.02 - 0.06 - 0.03 + 0.07)}{2 \times 10} - \frac{(0.02 - 0.06)}{2}$$

$$= 0.02 \text{ mm}$$

Vertical angularity

$$V_A = \frac{100 \times (0.08 - 0.00 + 0.05 - 0.10 - 0.00 + 0.04)}{2 \times 10}$$

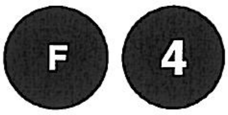
$$= 0.35 \text{ mm}$$

Horizontal angularity

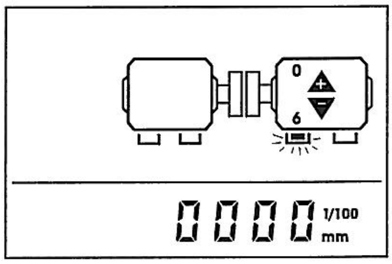
$$H_A = \frac{100 \times (0.06 - 0.02 - 0.07 + 0.03)}{2 \times 10} = 0.00 \text{ mm}$$

Thermal growth at machine feet

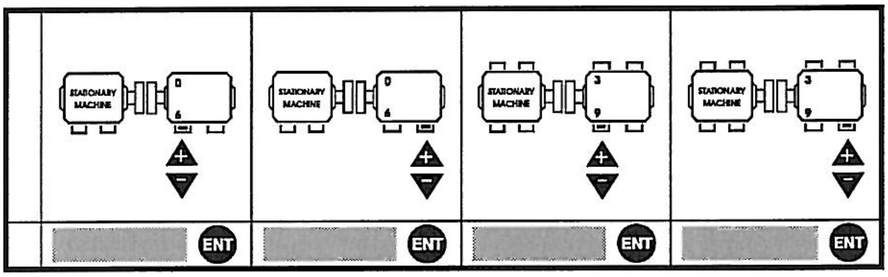
If target alignment is specified in terms of growth at the machine feet, a special function is used to enter the foot growth directly into the OPTALIGN computer.

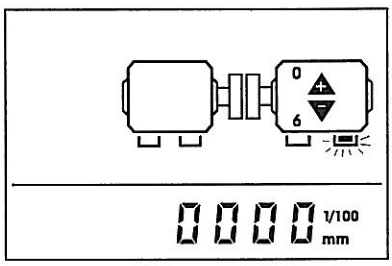


1. Press F 4 before or after taking measurements to start the function; please note, however, that machine dimensions must be entered before the F 4 function can be used. The front foot of the machine to be moved blinks in the display. The double arrowhead indicates that the value displayed is the specified growth, not an alignment correction!



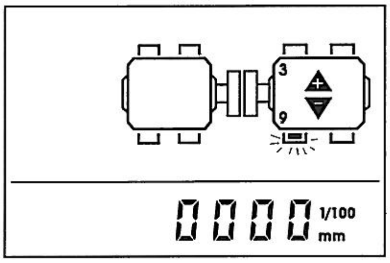
2. Enter the amount by which the front feet will grow with respect to the stationary machine as the machine warms up during operation. The arrows in the display indicate the sign convention (e.g. positive for upward growth). Write this amount in the space provided on the recording sheet. Press ENT to proceed to the next parameter; the rear foot blinks in the display.



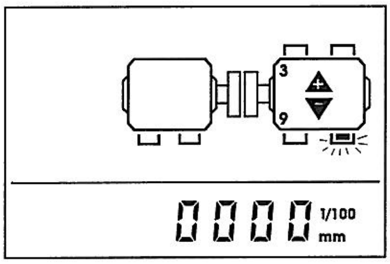


3. Enter the amount by which the rear feet will grow with respect to the stationary machine as the machine warms up during operation. Write this amount in the space provided on the recording sheet. Press ENT to proceed to the next parameter; the display switches to the horizontal depiction (by showing all four machine feet from above) and the front foot blinks in the display again.

4. Enter the amount by which the front feet move horizontally with respect to the stationary machine as the machine warms up during operation. The amount is entered as positive if the machine to be aligned moves toward 3 o'clock and as negative (using the - key) if the machine moves toward 9 o'clock (as seen when viewing from moveable toward stationary machine. Write this amount in the space provided on the recording sheet. Press ENT to proceed to the next parameter; the back foot blinks in the display.



5. Enter the amount by which the back feet move horizontally with respect to the stationary machine as the machine warms up during operation. Write this amount in the space provided on the recording sheet. Press ENT, and the display switches to vertical depiction (side view) and the front foot blinks again.



In this manner, the computer cycles through these four entries in sequence each time the ENT key is pressed. Proceed with alignment as usual. The machine foot corrections displayed will then be calculated to include the machine foot growth as entered above. (The coupling results, however, always display the actual measured alignment condition regardless of targets entered.)

Conversion between desired coupling offsets and machine foot growth

When the desired condition for 'cold' alignment is entered in terms of coupling offsets and angularity with the 'target' key, this alignment condition can easily be converted to expected thermal growth values at the machine feet, if desired: simply press the keys F 4 to call up the machine foot values. These numbers indicate the expected change in foot position from the time of 'cold' alignment to the steady-state operating condition of the machine, so the +/- sign will be opposite of that for the desired 'cold' coupling misalignment. For example, if vertical offset was set to -5/100 mm at the coupling (with no angularity), the machine foot value would be displayed as +5/100 mm, since the OPTALIGN now expects the machine to 'grow' upwards by that amount during operation. Proceed through the remaining foot values by pressing the ENT key.

In the same manner, if the desired alignment condition is entered in terms of machine foot growth values with F 4, the equivalent coupling targets may be called into the display by pressing the 'target' key.

Of course, the machine and coupling dimensions are needed for this calculation, so make sure that all dimensions are correct before converting the desired alignment condition between the coupling and machine feet.

If 'END' or 'OFF' appears in the display during measurement: Extending the measurement range

As explained earlier, OPTALIGN measures shaft alignment by measuring the movement of the laser beam in the position detector as the shafts are rotated. The greater the misalignment, the larger this movement will be. If the machines are severely misaligned, the reflected laser beam may even leave the measurement range of the position detector: the display will show 'END' instead of the detector coordinates. 'OFF' means that the beam is not being received at all.

This situation may be handled during the measurement cycle by stopping to readjust beam into the detector, so that the computer can keep track of the total beam movement from start to finish. This measurement interrupt function is used as follows:

1. Watch the display coordinates as the shafts are turned. If either value should reach ±9, stop rotating the shafts before 'END' or OFF' comes into the display. If you go too far and 'END' or 'OFF' appears, rotate the shafts backwards just until the numbers reappear (or if coupling backlash is present: rotate backwards a bit further, then forward just until torsional play is taken up).

Do not allow the shafts to move from this position - keep them there all the way through to step 5 below!

2. Press the key marked BEG/END.

3. The display now goes blank except for the beam coordinates and a message to readjust the prism. Repeat the beam adjustment procedure to center the reflected beam once more in the position detector; the display should read 0 0 . Note again that the shafts must be held steady during prism readjustment, as any rotation will cause beam movement with corresponding error.

4. Press the key marked BEG/END once more. The computer registers the amount of prism readjustment and adds this to all subsequent measurements.

5. Resume shaft rotation to the next measurement position and proceed as usual.

This function may be used as often as necessary during the same measurement cycle. However, if it must be repeated more than once or twice, it will be faster to use special function F6 (see page 83) taking only 3 readings at 10:30, 12:00 and 1:30 o'clock. If necessary, the BEG/END procedure may also be used with F6. An alternative is to perform a quick rough alignment using feeler gages and a straightedge before using OPTALIGN for the final alignment.

With practice, experience and luck, you may be able to save time and effort in some cases by skipping the position where 'END' or 'OFF' is displayed. For example, it may be possible to take measurements in 12, 9, and 3 o'clock positions if 'OFF' appears only at 6 o'clock.

If severely misaligned machines are measured and then positioned using the MOVE function described earlier, they may need to be moved so far that the laser beam leaves the position detector and 'END' or 'OFF' appears in the display. In that case, use the measurement interrupt function by moving the machine back toward its original, misaligned position just until the correction numbers reappear in the display. Perform steps 2, 3 and 4 above. The computer will resume the MOVE function from where it left off, allowing you to finish machine positioning as usual.

Soft foot

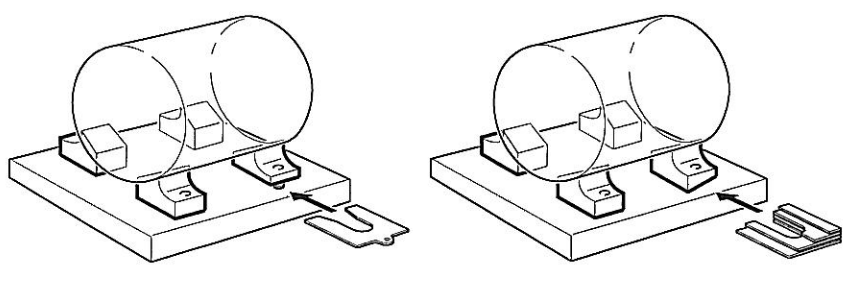
Soft foot is the term used to describe the condition when one or more machine feet do not rest flat on the foundation, but instead must be held down by the force exerted by the foot bolts. There are many possible causes for this, including:

- Non-coplanar machine mounting surfaces
- Deformed machine frame or feet
- External forces (which may be caused by severe misalignment)
- Improper shimming or soiled machine feet

The consequences: deformed machine frames, bent shafts, and distorted bearings, leading to high vibration and premature failure of bearings and shafts.

Therefore, as mentioned previously, every proper alignment job should begin with a soft foot inspection. OPTALIGN makes this checking quick and convenient by measuring the machine movement when each individual machine foot bolt is loosened.

It is important to distinguish between several types of soft foot, among which are 'parallel soft feet' such as short foot and long foot, and angular soft feet. Each particular soft foot situation possesses several behavioral characteristics which serve to diagnose them and to find the most efficient cure or solution for the problem. Feeler gage readings, in combination with the OPTALIGN readings, are often quite helpful in determining the type and cause of a soft foot as well as its optimal solution.



Parallel soft foot — Angular soft foot

Often a machine will exhibit more than one particular type of soft foot condition; these multiple soft feet then act in concert with each other to complicate the situation.

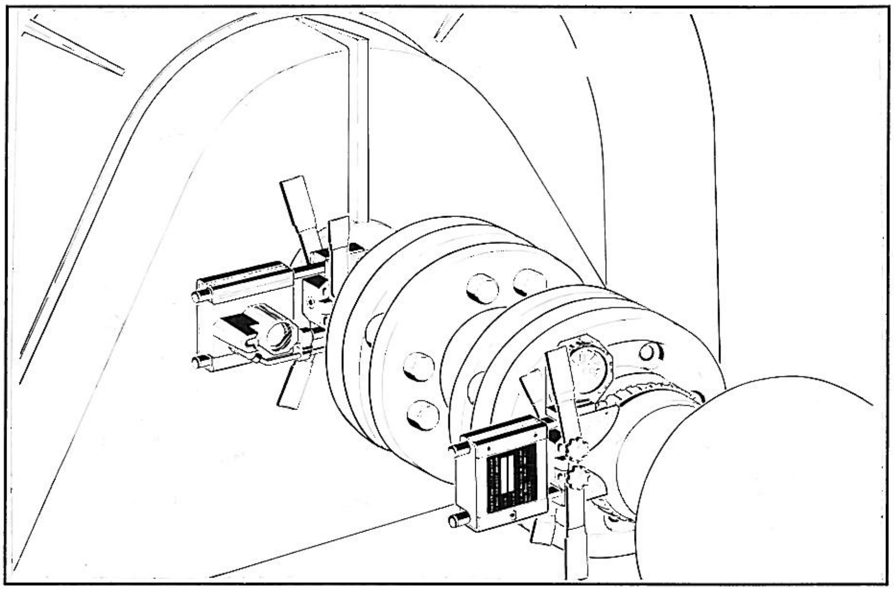
The following description is limited to the soft foot function of the OPTALIGN. As this is intended to be an operating manual and not an in-depth training manual, please contact your distributor for more information on alignment training courses which address this issue as well as many other interesting alignment applications.

Measuring soft foot

Install the OPTALIGN system as usual (see pages 36-38 for installation of brackets and components).

Now consult Soft Foot Recording Sheet 2.

Turn the computer on, then press the slash key, if desired, to switch to the inch measurement mode.

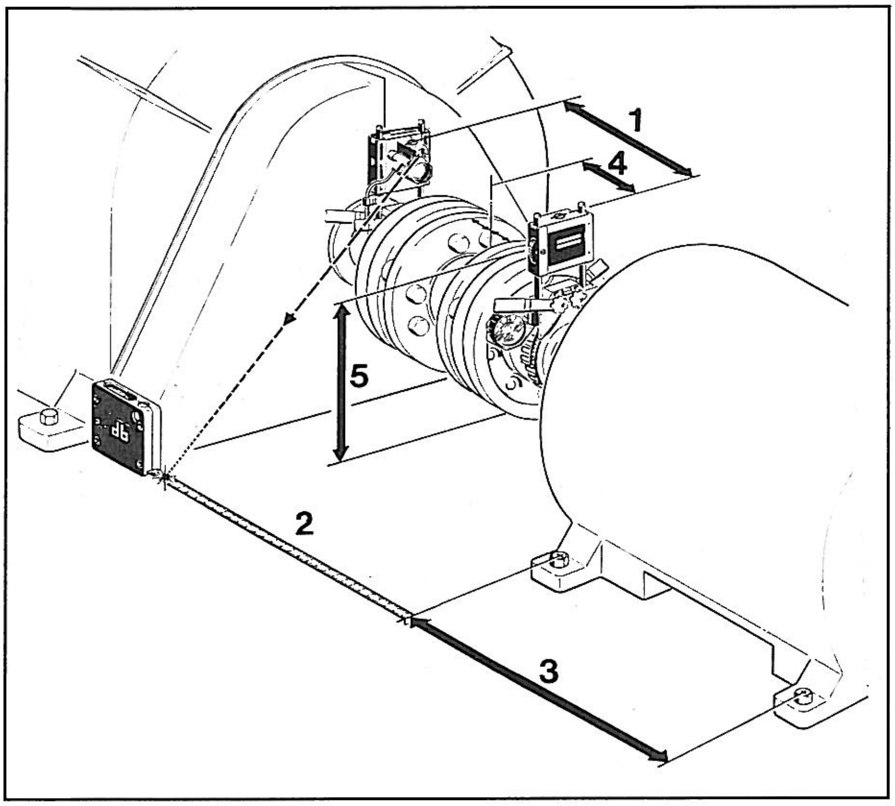


When soft foot is measured by loosening the foot bolts one at a time, any resulting vertical machine movement will be completely angular in nature, so the OPTALIGN prism must be turned sideways to measure this vertical angular movement: rotate the shafts 90° from vertical so that the system is levelled horizontally to the 9:00 position illustrated above. (If 9:00 is not accessible, the 3:00 position may be used instead; the results remain the same, but do not stare into the laser beam which is now also emitted sideways) The shafts remain in this position during the entire measurement procedure.

Press the soft foot key and proceed as described on the following pages.

Machine dimensions

When the soft foot function is initiated by pressing the key shown, the computer now prompts for five machine dimensions in the usual sequence described below. You may wish to leave the laser and prism at 12 o'clock to facilitate measuring and entering these dimensions. Then rotate back to 9 o'clock (or 3 o'clock) and proceed as described on the following page.



The transducer and prism symbols blink in the display to indicate that the laser beam is being emitted. Do not look into the beam aperture of the transducer.

1. Enter the distance between transducer and prism; press ENT to confirm. The computer display then switches to the next dimension to be entered.
2. Enter the distance between transducer and front foot of the machine to be moved: the transducer now provides a location mark on the machine foundation by emitting a laser beam downward as shown above. (See special instructions for invisible Class I laser on page 93.) The transducer-front foot dimension may then be measured easily, especially when large machines are involved. Confirm this distance entry with ENT.
3. Enter the distance between front foot and back foot of the machine to be moved; confirm with ENT.
4. Enter the distance between coupling center and prism (<u>not</u> transducer); confirm with ENT.
5. Enter the coupling diameter and confirm with ENT. (When working in the inch mode, the computer suggests a default diameter of 10". In most cases, this should be confirmed with ENT.)

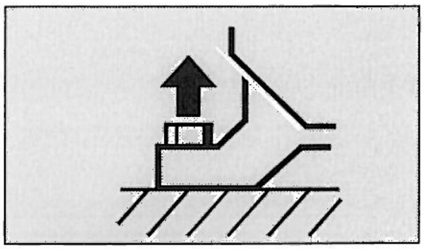
Note: dimensions 4 and 5 may be omitted if alignment results at the coupling are not required.

Recording sheet 2: soft foot

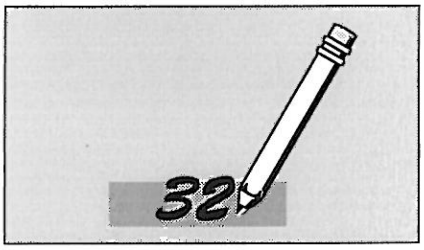
The transducer and prism symbols blink in the display to indicate that the laser beam is being emitted.

Adjust the prism to center the laser beam in the position detector. Follow the (X,Y) coordinates of the beam in the display to achieve exact centering by adjusting them to (0,0). Then press ENT to confirm this initial adjustment. The display now shows 0000, and soft foot measurement can begin.

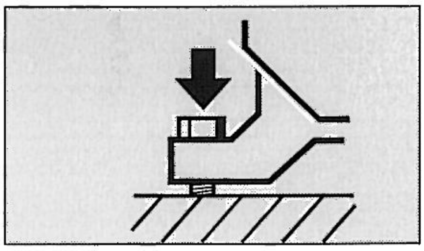
The front foot flashes in the display, so begin by loosening the bolt of one of the front feet (either left or right side). Keep loosening the bolt until the value in the display no longer increases.



Note this soft foot value for the corresponding machine foot on the recording chart.

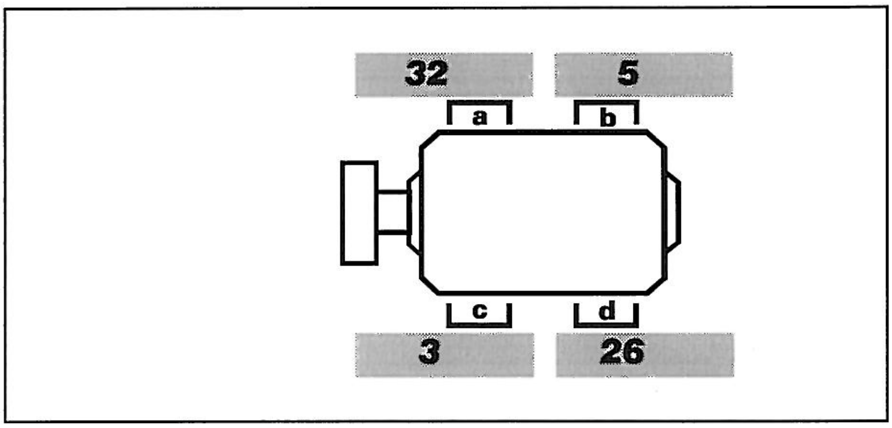


Tighten the foot bolt back down. (The display value may not always return to exactly 0000.)



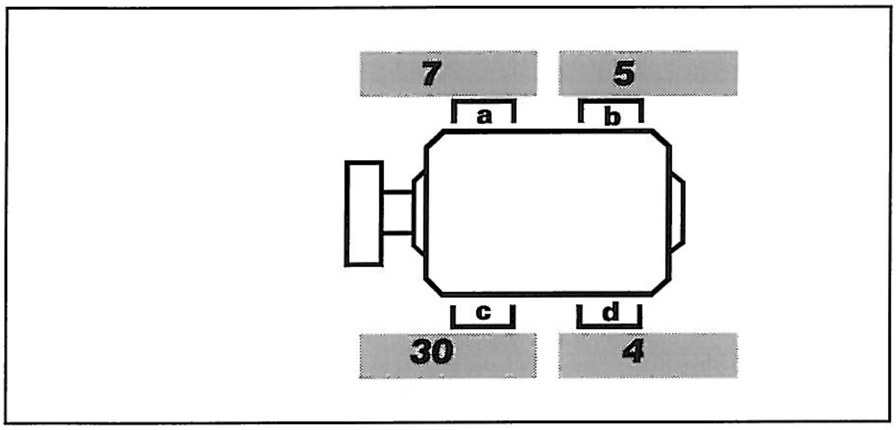
Press the ENT key to switch to the back foot. The display value is automatically reset to 0000 and the back foot can now be measured.

Repeat these steps for each machine foot in sequence to complete the soft foot record as shown in the example below.



Determining soft foot corrections

The pattern of readings on the recording sheet can provide useful information on the type of soft foot at hand. As mentioned earlier, however, soft foot diagnosis can sometimes require further



investigation; the appendix to this manual (page 104) offers more detailed information on advanced techniques for dealing with soft foot. For now, let us consider how to recognize and correct two basic types of soft foot, parallel and angular.

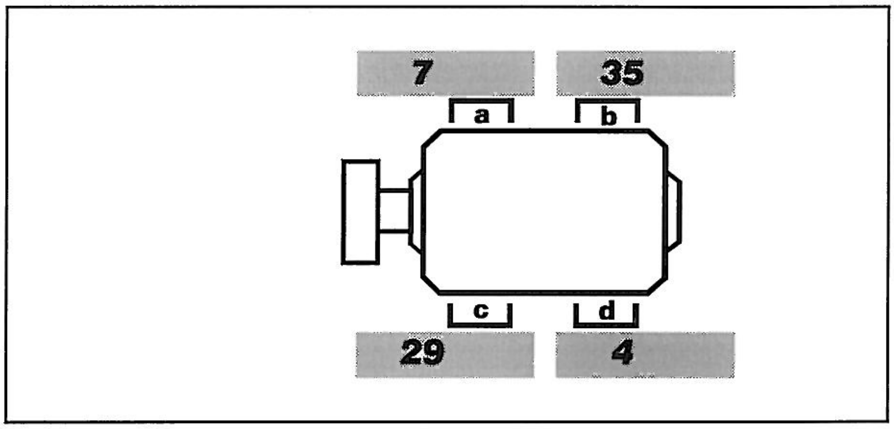
When one foot shows a higher reading than all the others, an angular soft foot should be suspected (see also appendix).

To correct the situation (as illustrated in the above example), loosen the bolt on the offending foot and use feeler gages to find out the angle direction.

Make a stepped shim as shown below (most easily done with LAMIBLOC laminated shims) to fit into the gap according to the feeler gage readings. Check results by taking another set of soft foot readings with OPTALIGN.

Recording sheet 2: soft foot

When parallel soft foot occurs, two elevated readings of nearly the same amount will typically occur diagonally opposed to each other. The two other corners, which act as pivot points as the machine rocks back and forth, show much less soft foot.

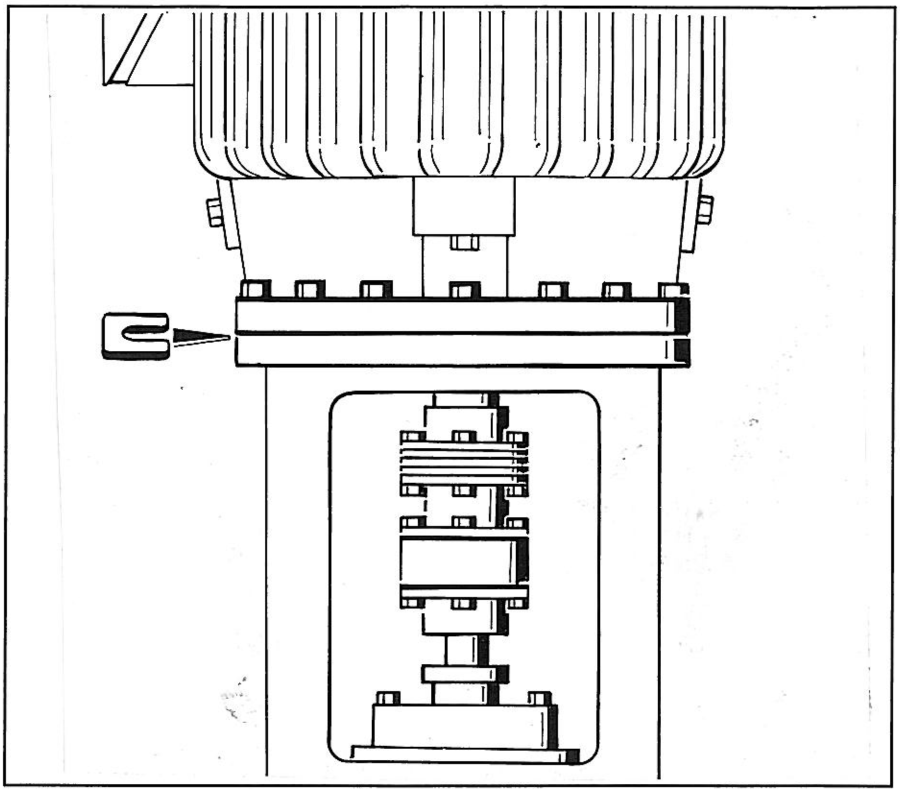


In the (metric) example shown above, the correction would be to insert 35/100 mm of shims under foot 'b.' A final check will confirm whether this correction eliminates the soft foot.

Note that quite often, several feet may show different amounts of angular soft foot (which may even be combined with parallel soft foot) at the same time. Use feeler gages at the corners of each foot to diagnose this situation as directed in the appendix.

Alignment of vertical machines

One of the most difficult alignments to perform using conventional methods is that of vertical machines such as the one shown below.



OPTALIGN automatically calculates the necessary shimming (angularity) corrections for the bolt flange and the lateral corrections to be performed by sliding the upper machine back and forth and from side to side. The shimming corrections are calculated to yield only positive amounts, so shims must never be removed (to save headaches if no shims are already in place).

Since the OPTALIGN roof prism monitors parallel movement in only one direction at a time (namely, along its vertical axis), the lateral corrections can be carried out in both directions at the same time most easily through the use of additional displacement monitors such as mechanical dial indicators (see page 78 for more on this).

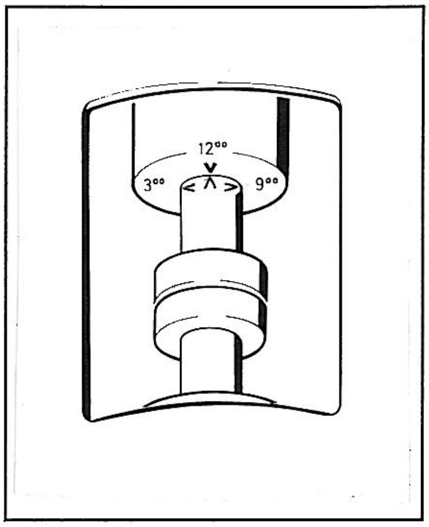
On vertical machines, there is no fixed 12:00 direction, so this can be chosen to be any convenient location. It will help, however, to designate this starting point so that the resulting 12:00 - 6:00 and 3:00 - 9:00 axes will easily line up later with the adjustment points used for horizontal positioning.

Since the Inclinometer cannot be used to indicate the measurement positions on vertical machines, a different positioning scheme must be used. The procedure runs as follows:

Setup

1. Select the 12:00 measuring position and make a mark on the machine housing where the shaft enters it.

2. Measure the shaft circumference and divide by four. Use this distance to make four evenly-spaced marks on the shaft near the housing entrance.

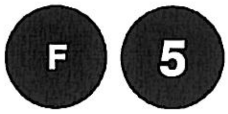


3. Mount the OPTALIGN brackets around the coupling so that they are lined up with one of the shaft markings.

4. Slide the prism onto the upper bracket (or whichever is attached to the machine to be moved). As always, the transducer goes on the shaft or coupling of the stationary machine.

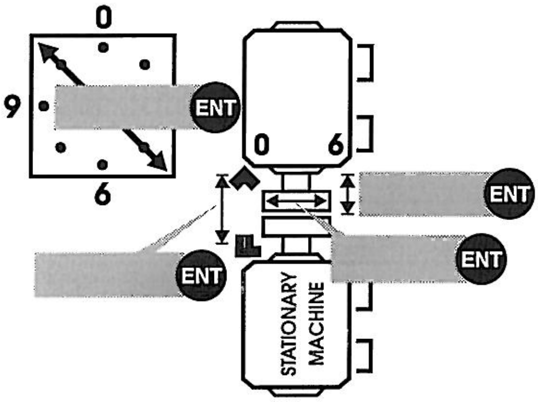
5. Attach the cable to computer and transducer and clip it onto the transducer bracket. Now follow the procedure on Vertical Alignment Recording Chart 3.

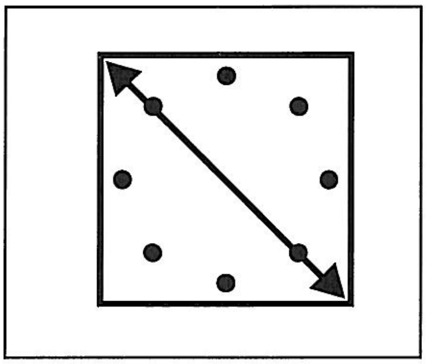
Entering dimensions



Switch on the computer and press the slash key if working in inches. Press F then 5 to begin the vertical alignment routine.

The computer prompts for input of the required machine dimensions in the order shown below. Tape measurements are perfectly sufficient for these.





1. Measure and enter the maximum diameter across the bolt flange (from edge to edge or corner to corner, <u>not</u> the bolt circle diameter!) on the machine to be moved. Press ENT to confirm this value and proceed to the next dimension.

2. Measure and enter the distance between housing markings on the transducer and prism (Distance Laser to Prism). Press ENT to confirm this value and proceed to the next dimension.

3. Measure and enter the distance from the prism housing marking to the coupling center. Press ENT to confirm this value and proceed to the next dimension.

4. Measure the coupling diameter and enter it, pressing ENT to confirm. A default value of 100 mm (or in the inch mode, 10") will be used if you do not change it.

Proceed with measurement as follows.

The transducer and prism symbols blink in the display to indicate that the laser beam is being emitted.

Adjusting the beam, taking measurements

Now press M to go into the measurement mode.

Line up the shaft marking where the brackets are mounted with the housing marking at the previously-chosen 12:00 position. Adjust the prism as usual to center the reflected laser beam in the position detector. The display should read 0 0 before proceeding further.

Make sure that the shafts are positioned at the 12:00 housing marking, then enter the measurement as usual by pressing M 0 ENT.

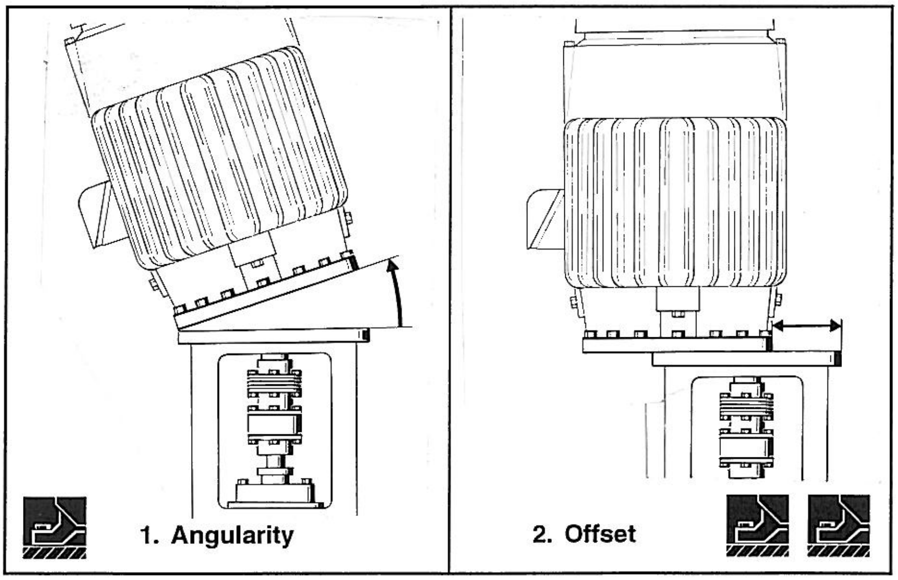
Rotate the shafts 90° in clockwise direction as viewed toward the transducer and enter the measurement as usual by pressing M 3 ENT.

In the same manner, rotate the shafts 90° at a time and enter the measurements from the 6:00 and 9:00 positions. Just as with the normal alignment procedure, three position measurements suffice for alignment calculation.

Alignment correction

The coupling key may now be pressed to find out whether coupling alignment is already within tolerance. If so, then alignment corrections are unnecessary; if not, the systematic approach described below will help make corrections as quick and painless as possible.

When 'ordinary' horizontal machines are aligned, shaft offset and angularity are corrected at the same time by using just the right combination of shims (or lateral movements) at the front and rear feet of the machine to be moved. Alignment correction of vertical machines is quite different from this: the shaft angularity is controlled solely by the shim thickness at each flange bolt. Therefore, as shown (exaggerated for clarity) in the diagram below, the OPTALIGN computer calculates just the right combination of shims to correct the tilt of the upper machine. These angular corrections are obtained by pressing the machine foot key once.



1. Angularity

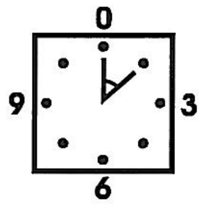
2. Offset

This shimming correction leaves the shafts perfectly parallel, but offset from each other to some degree. The solution here is to simply shove the machine to be moved into line with the stationary machine, but this requires a combination of movements in both side to side and front-to-back directions. The OPTALIGN computer calculates the correct amount of movement in each direction; more later on how these are then carried out.

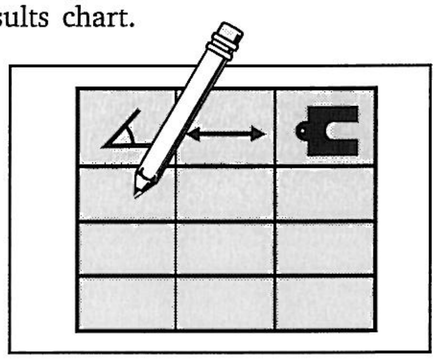
Because the machine will move sideways when shims are being inserted to correct for angularity, it makes sense to take care of angularity first, then take a new set of alignment readings to determine the actual shaft offset (by pressing the machine foot key twice) before moving the machine laterally. The repeat readings go quickly, however, since the machine dimensions remain in memory until the computer is switched off.

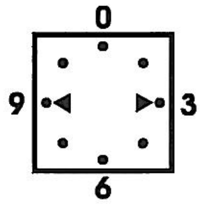
Angularity adjustment

Once alignment measurements are taken, the shimming corrections for angularity may be called into the display by pressing the machine foot key. (Alternatively, the coupling key may be pressed to check whether coupling alignment is already within tolerance before making corrections.)

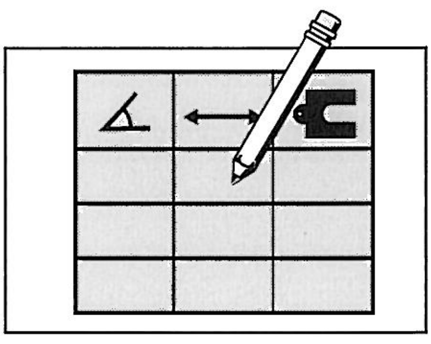


Now the display flashes an angle symbol within a plan view of the bolt flange to request the location of the first bolt. To find out the shimming amount for the 12:00 bolt, simply confirm the suggested starting value of 000.0° by pressing ENT . (Alternatively, you could begin with any other bolt by entering its angular location.) Note that one decimal place is provided for entering the exact value. Record the angle entered in the left-hand column of the recording sheet results chart.

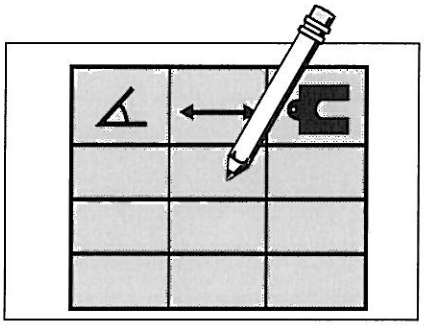




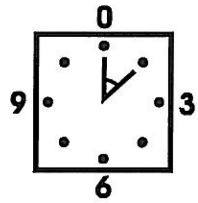
Next, the display flashes arrowheads across the bolt flange to request the bolt circle diameter at the first bolt where the shimming correction is to be calculated. Enter this diameter and record it in the middle column of the shimming chart and press ENT to proceed.



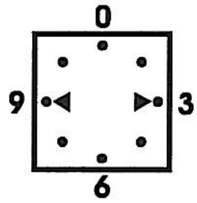
The required shimming amount is now displayed for the first bolt location. Record this value in the right-hand column of the shimming chart and press ENT to proceed.

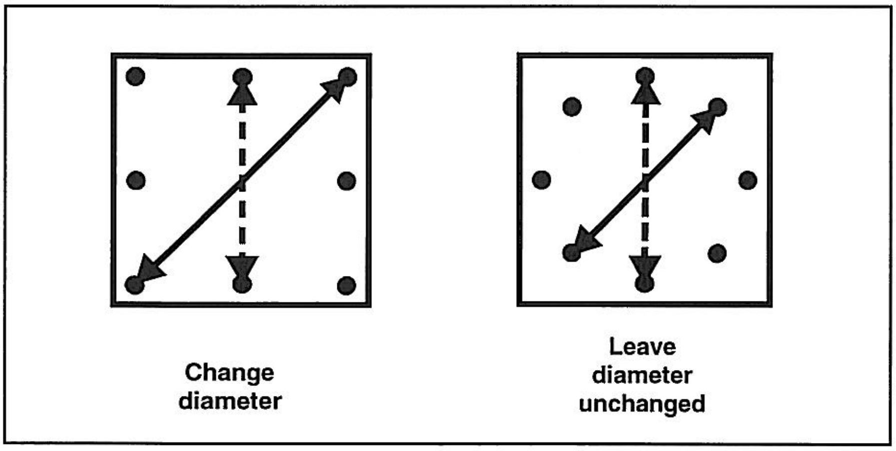


The display cycles to the bolt location angle. Enter the angle from the first bolt to the second. Note that one decimal place is already built in. Simply enter the current angle in decimal degrees without using fractions; e.g. 22-1/2° is entered as 2 2 5 ENT (= 22.5°). Record this amount on the chart, and press ENT.



The display cycles to the bolt diameter. If the bolts are arranged in a circle around the flange, the diameter remains the same from one bolt to the next, so no change is necessary. However, if the bolts are not in a circular arrangement, the diameter may now be changed for the second bolt (either by pressing CLR to erase the previous value or by overwriting it directly with the new value). Record the proper diameter entered for the second bolt and press ENT.

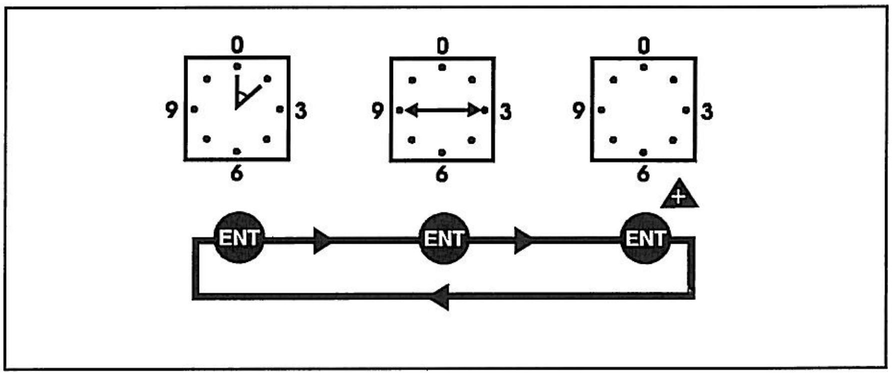




Now the display shows the shimming necessary at the second bolt. Record this amount in the shimming column of the chart and press ENT.

The computer automatically adds on the same angular amount as that last entered and retains the same diameter from one bolt reading to the next, so that ordinarily no further keystrokes are required other than pressing ENT repeatedly to progress around the entire flange. (Of course, the display allows you to adjust the angle or diameter at any time.) Record all angles, diameters and shimming corrections for the all the bolts around the flange.

The RCL key allows you to step backwards from shimming to diameter to angle for the bolt currently under consideration.



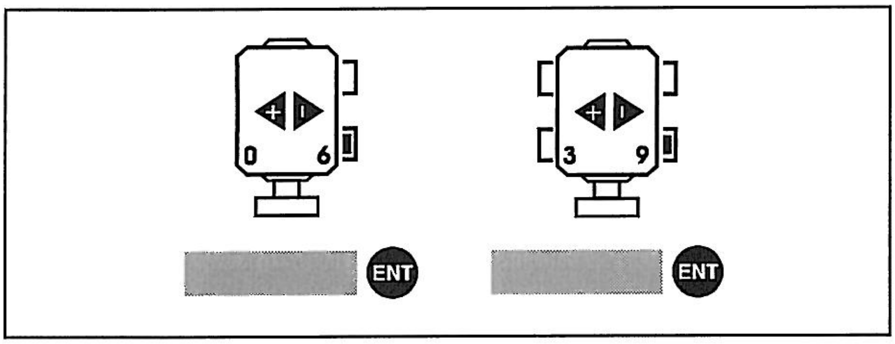
You cannot return to the previous bolt's results with RCL. You must instead go forward around the flange by pressing ENT repeatedly to arrive once more at the correction for the desired angle. Or alternatively, you may input the desired angle directly when the computer asks for it and then confirm the diameter and correction for that location by pressing ENT.

By examining the pattern of shimming values, you can easily imagine the direction in which the machine to be moved is tilted. Note again that shimming amounts are always calculated to be positive so that no shims must be removed. This allows you to begin measurement with all shims removed, guaranteeing that the machine is aligned with a minimum of shimming.

Offset adjustment

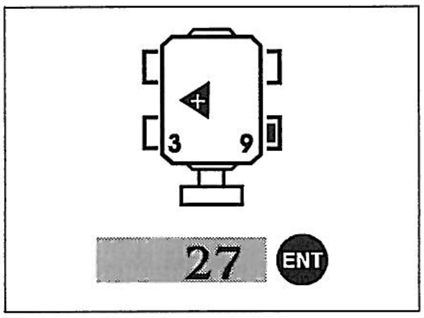
After repeating the position measurement cycle (M 0 ENT, M 3 ENT, etc.) press the machine foot key. Vertical shimming results may now be checked using the procedure described on the previous pages. Press the machine foot key again to display the necessary alignment corrections for offset adjustment.

The display shows the bolt flange (plan view) as a reminder that the amount shown applies to vertical alignment. The amount of offset adjustment required is displayed numerically, and the 0 - 6 symbols and +/- arrow inside the machine to be aligned show the direction of offset correction necessary along the 12:00 - 6:00 axis: a positive result tells you to move the machine toward 12:00, while a negative result would require movement toward 6:00. Record this amount in the space provided on the recording sheet.



Press the ENT key to see lateral correction in the 3:00 - 9:00 direction: positive results indicate movement toward 3:00, and negative amounts require that the machine be moved toward 9:00. Record this amount in the space provided on the recording sheet.

For example, the display shown at right indicates that the machine to be moved must go 27/100 mm toward the 3:00 measurement position.



Because these adjustments require that the machine be moved parallel in both 12:00 - 6:00 and 3:00 - 9:00 directions at the same time, the OPTALIGN MOVE function cannot be used here, as the prism allows measurement of parallel movement only along the Y axis of the position detector.

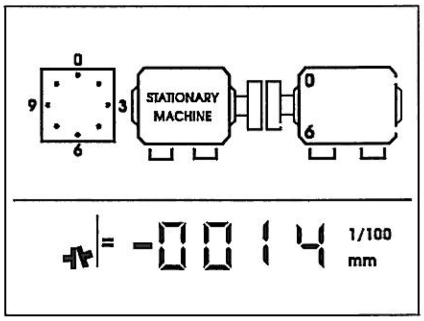
The transducer and prism symbols blink in the display to indicate that the laser beam is being emitted.

If machine movement can be controlled to make adjustment in only one direction at a time (i.e. positioning the machine along the detector Y axis without moving in the X direction), the OPTALIGN special function F 1 can be used to monitor these lateral corrections: position the transducer at 12:00, then press F , 1 , and ENT to monitor the position detector Y coordinate as the machine is moved along the 12:00 - 6:00 axis (whereby the machine is not allowed to move along the 3:00 - 9:00 axis, or else new readings would be required to register the changed position). Then rotate the shafts to put the transducer at 3:00. Now follow the 3:00 - 6:00 positioning by watching the Y coordinate display with the F 1 function - this time without moving along the 12:00 - 6:00 axis. This function allows you to accurately monitor the machine's movement to the nearest micron in the metric mode, or to the nearest ten thousandth (0.0001") in the inch mode.

Alternatively, some other form of horizontal positioning monitor (such as mechanical dial indicators) may be used to carry out both horizontal corrections simultaneously. Be sure to mount the indicators in such a way that positive deflection results when the machine is moved toward the 12:00 or 3:00 measurement positions.

As a final check, another repeat set of alignment readings should be taken and then the coupling misalignment may be checked by pressing the coupling key. When displaying coupling results for vertical machines, positive offset means at the coupling, the machine to be moved is offset toward 12:00 or 3:00, while positive angularity indicates a gap opening toward 12:00 or 3:00. (You will note that this is the same sign convention as that used with lateral corrections described on the previous page.)

For example, the display at right shows that at the coupling diameter entered previously for this vertical machine, the gap difference is (-)14/100 mm, open toward the 6:00 measurement position.



Target alignment specifications may be entered so that corrections will include a prescribed amount of desired misalignment: press the target key and use the same sign convention as described above.

Description of keys


Display misalignment at coupling (see also page 46)


Display machine foot corrections (see also page 47)


MOVE function: follow horizontal alignment in display (see also page 49)


Soft foot measurement (see also page 64)

BEG/END Measurement interrupt function (see also page 61)

M Enter alignment measurement mode and use to take alignment readings (see also page 45)


Enter alignment target specifications (see also page 51)

DIM Enter machine dimensions (see also page 41)

F Special functions (see also page 80)

RCL Recall previous value (see also page 46 & 47)

− Change sign of value to be entered (see also page 51)

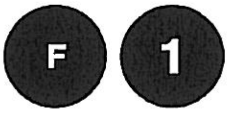
/ Switch to inch mode, or enter fractions (see also pages 40-41)

CLR Erase value displayed (other than results; see also page 45)

ENT Enter data and advance to the next screen (see pages 41, 45-53)

Special functions

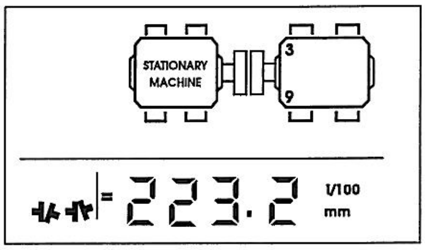
F 1: Displaying detector coordinates



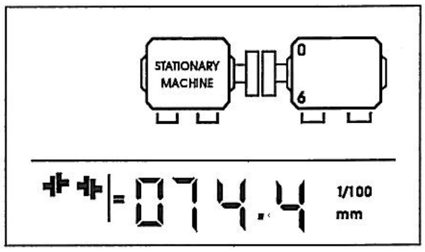
Turn on the computer, then press the keys F 1 to display the exact coordinates of the reflected laser beam received by the position detector to the nearest μm (0.001 mm). To display the coordinates in 1/10 mils (0.0001"), switch the display into its inch mode by pressing the slash key (/) immediately after turning on the computer.

The transducer and prism symbols blink in the display to indicate that the laser beam is being emitted.

Since four digits are displayed in this mode, the computer first shows the horizontal coordinate as indicated by the plan view of the machines. The coupling gap symbol serves as a reminder that when the prism and transducer are at 12:00 position, this coordinate changes as the horizontal <u>angle</u> of the machines changes.

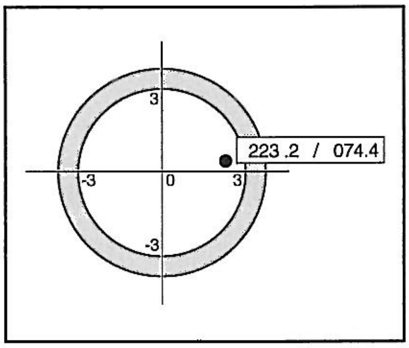


Press ENT and the display gives the vertical coordinate value as indicated by the side view of the machines. The offset symbol means that with the prism and transducer located at 12:00 vertical position, this coordinate changes as the machines move vertically relative to each other.



The illustration at right shows the actual beam position represented by the displays above.

Note: The small coupling symbol will change to reflect the actual position of the beam (positive or negative).



IMPORTANT:
The coordinate values displayed in this measurement mode may be used only for relative observation over short periods of time, because OPTALIGN is not designed for absolute measurement or for long-term stability of measurement values. Continuous measurement over long periods of time may be performed with PERMALIGN equipment.

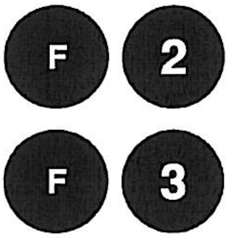
F 2 and F 3: Measuring continuously rotating shafts

Especially when massive machine shafts must be rotated using auxiliary motors or manual lever hoists, it can become difficult to stop the shafts at the exact 90° measurement intervals required by OPTALIGN. In such cases, the F 2 or F 3 function allows continuous, slow shaft rotation during entry of alignment readings.

Some users prefer to use these function for routine measurements as well, to reduce the number of keystrokes required.

When using this feature, the operator follows the same standard alignment procedure as shown on the recording sheet but specifies only the starting measurement position; then one has only to press the ENT key when the OPTALIGN system passes each remaining position.

The procedure runs as described on the following page.

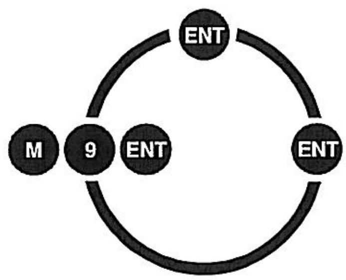


1. Activate the continuous rotation mode:
   - for clockwise rotation press F 2
   - for counterclockwise rotation press F 3

The transducer and prism symbols blink in the display to indicate that the laser beam is being emitted.

2. Enter the starting measurement position:
   Press M (position) ENT
   (For example, press M 9 ENT to begin at 9:00 position.)

3. Begin rotating the shafts clockwise (F2) or counterclockwise (F3) as viewed toward the transducer. Watch the inclinometer closely and press ENT at the exact moment when the system passes any of the four measuring positions.



After the first measurement position, the computer registers all subsequent positions automatically, including repeat measurements. Press the coupling or machine foot key as usual to obtain results. The computer will automatically prompt for any missing machine dimensions not yet entered.

Note that alignment accuracy depends on the exact measuring position while pressing the ENT key, so do not try to save a few seconds by rotating the shafts too fast.

It is not allowed to skip over any position, but three measuring positions are sufficient to obtain a result.

If torsion play (backlash) is present, be sure that the transducer and prism have rotated enough to take up the play before they pass the first measurement position. (For example, if F 2 is used, mount and adjust the components at 12:00, but press M 3 and start rotating shafts so that the first alignment reading is taken (with ENT) at 3:00 position).

F 4 : Thermal growth at machine feet

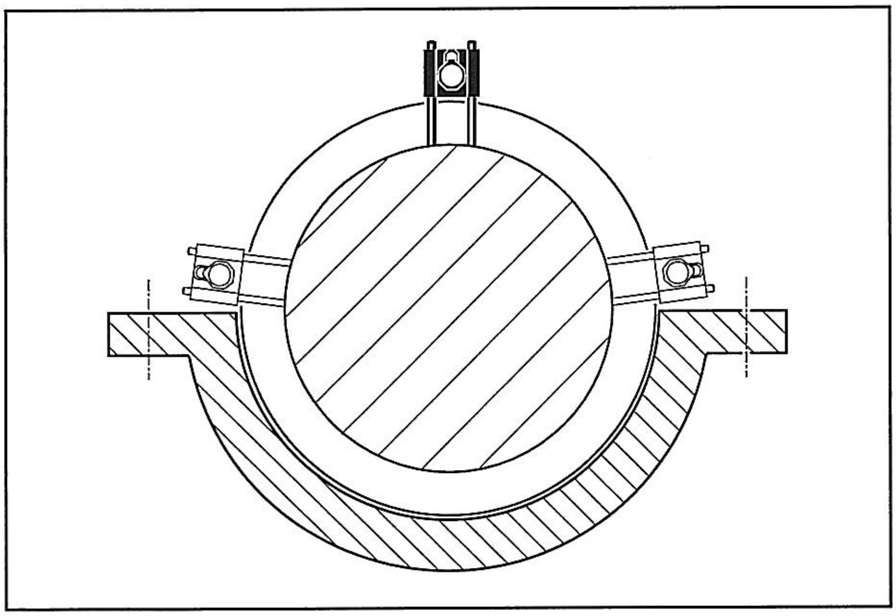
This special function simplifies entry of alignment targets to compensate for thermal growth when specified at the machine feet. See page 58 for detailed instructions on the entire procedure.

F 5 : Alignment of vertical machines

This special function offers a straightforward procedure for this alignment situation, which is difficult to handle by any other means. See page 69 for detailed instructions.

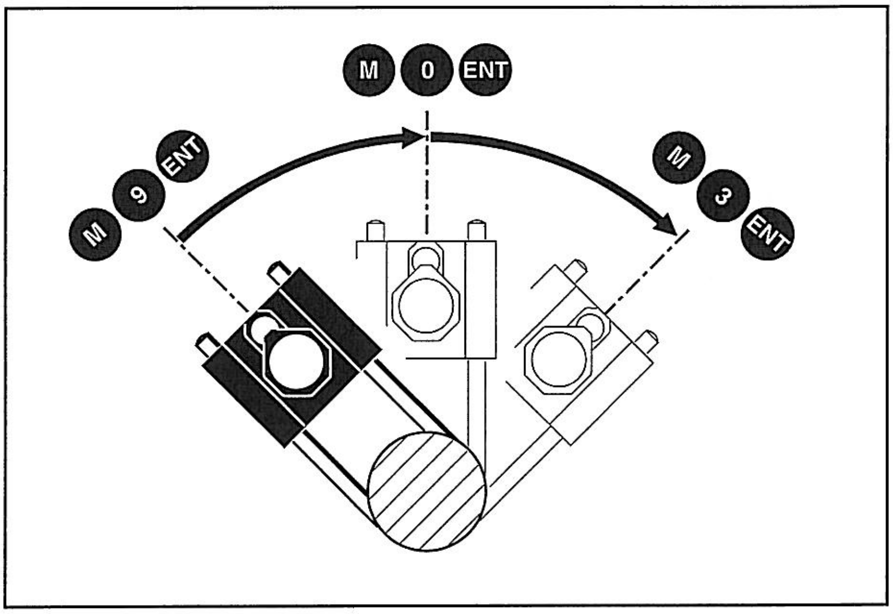
F 6 : Measurement with 90° shaft rotation

OPTALIGN normally requires that the machine shafts be rotated by at least 180° in order to measure their alignment. However, shaft rotation may be limited, for example, when radial clearance is limited and coupling guards or machine case flanges block the horizontal measurement positions. In the diagram below, only about 170° of shaft rotation is possible with the measurement sensors mounted.



In other cases, misalignment may be so severe that the laser beam leaves the position detector before the shafts are turned a full 180° for measurement. The same thing can also occur when long separation distances must be bridged by the laser beam. In all these circumstances, however, the F 6 function can offer a simple, yet effective solution.

This special function allows OPTALIGN to measure alignment with only 90° of shaft rotation. Three fixed positions are still used, but they are only 45° apart from one another (instead of the usual 90°). Even though measurement accuracy may not be quite as high as that obtainable when shafts may be completely rotated, results should still be completely satisfactory in the vast majority of cases. The function is used as follows:

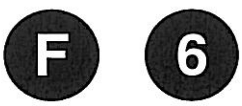


Note:

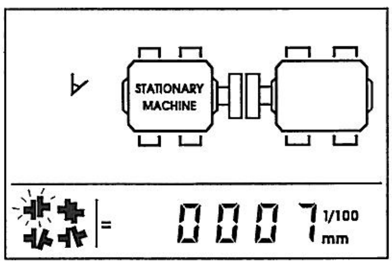
Readings may also be taken centered around the 6:00 position.

Readings may be taken in any order, but these three measurements must be centered around the vertical position of 12:00 or 6:00. No other positions may be used with special function F 6.

- Rotate the shafts so that the measurement components are positioned at a 45° angle halfway between the usual 9:00 and 12:00 positions (i.e. at 10:30); only these 'halfway' positions may be used (i.e. it is not allowed to start at, say, 11:00 position and end at 2:00)! As always, these positions are determined as seen when looking along the shafts toward the stationary machine (transducer).
- Use the inclinometer to determine the exact position.
- Begin taking measurements in this first position (10:30) by pressing: **M 9 ENT**
- Rotate the shafts 45° further to the 12:00 position. Now press: **M 0 ENT**
- Rotate the shafts 45° further to the 1:30 position. Now press: **M 3 ENT**



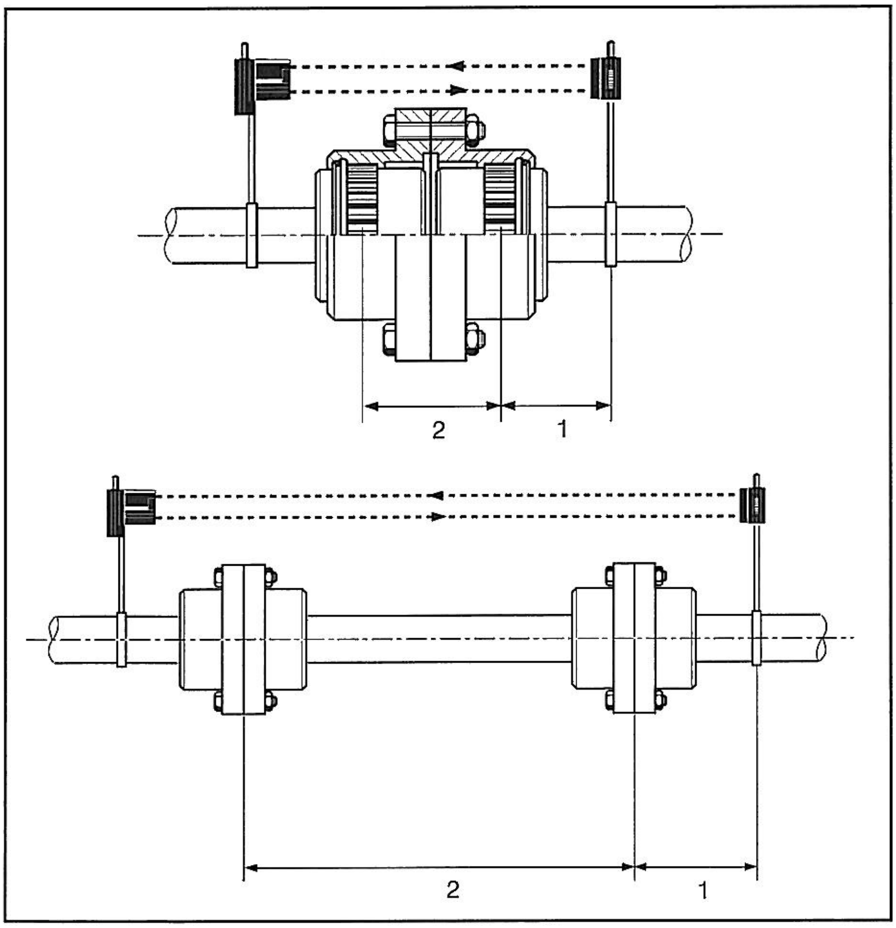
- Now activate the special function for measurements taken over 90° by pressing: **F 6**
- Press the coupling key or foot key to display results. The computer now shows the results. The F 6 function is indicated by the angle symbol which appears in the upper left portion of the display.



- If the results are already displayed before F 6 is pressed, the appropriate results key must be pressed again to update the display.
- To cancel the F6 function, press F6 again. Note that the angle symbol now disappears from the screen. You must, however, update your results again by pressing any results key (foot corrections or coupling results). Also, displayed results for readings taken at 10:30, 12:00, 1:30 will not be accurate unless the F6 function was activated (angle symbol showing) before the results key was pressed. If in doubt, press the results key again after the F6 angle symbol is showing in the screen.

F 7 : Alignment condition in two planes

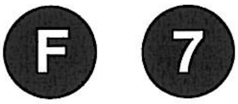
The F 7 function calculates the measured deviation of the shaft axes from the optimum alignment in two different coupling planes. This can be very important, especially for jackshafts or gear or membrane couplings where the coupling planes are separated by a considerable distance. In such cases, alignment results are more meaningful when expressed for each coupling plane instead of at a single 'coupling center' location. All alignment parameters should then lie within tolerance for each coupling.
This function can be activated after measurements are taken.



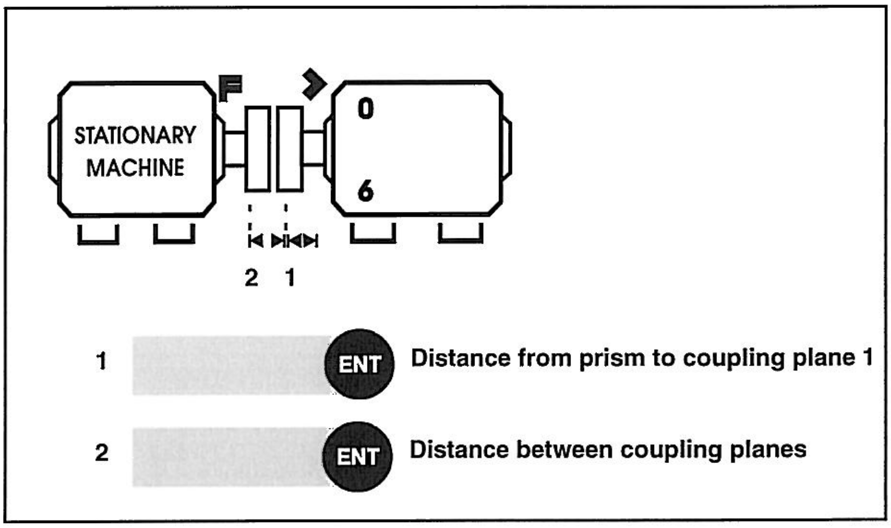
Note:

This is also called the offset-offset function since it displays offsets at two planes rather than the normal offset and angle.

Procedure:

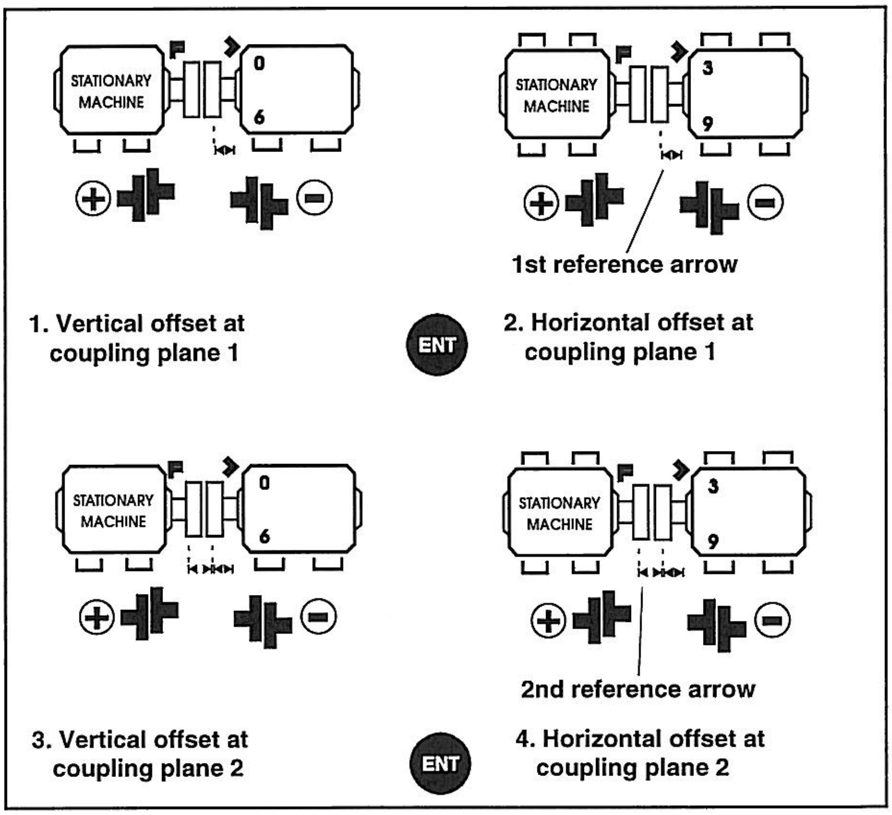


- Press F 7. Observe the diagram in the display.



- Enter the first distance, **from prism to coupling plane 1**. The corresponding reference arrow flashes in the display.
- Press ENT - now the second reference arrow flashes - and enter the **distance between coupling planes.**

- Press ENT to confirm this entry. The results are now displayed; switch from one result to the next by pressing ENT again.



- The F 7 function may be ended by pressing any other function key (e.g. the foot key). The reference arrow then disappears from the display. The offsets at the second coupling plane may be displayed again by pressing F 7 once more.

- The F 7 function can also be used simultaneously with the F 6 function. Both the angle symbol and the reference arrow appear in the display at the same time.

- These additional functions may also be used in conjunction with the F 5 function for vertical machines. In that case, the corresponding symbol appears in the display as always.

F 8: Alignment condition evaluation

The F 8 function allows direct comparison of measured alignment results with generally accepted tolerances (as shown in the 'acceptable' column of the table on page 19.) Satisfactory alignment is indicated by the 'O.K.' symbol in the upper right portion of the display.
Proceed as follows:

- Enter the machine dimensions and take alignment measurements as usual.
- Now press **F 8**. Now RPM appears in the Display.
- Enter the machine speed in RPM and press ENT to confirm this.

Note: The RPM value must be entered as a value between 0 and 7200. Values greater than 7200 RPM cannot be entered. If attempted, the computer will beep twice and the value displayed will return to 0000 RPM. The tolerance table built into the computer is the 'acceptable' standard. If you desire 'excellent' alignment, you must view your actual alignment conditions with the coupling key and compare these values against your 'excellent' tolerance values.

- If the measured alignment condition lies within tolerance, the O.K. symbol flashes in the display to indicate satisfactory alignment.
- If measured alignment falls outside the tolerance, the computer beeps twice and the O.K. symbol does not appear.

- This function may also be used in conjunction with the F 5 function for alignment of vertical machines.

F 90 - 95: Printing with OPTALIGN VP

The OPTALIGN VP computer version (order number ALI 2.050VP) lets you

- temporarily store up to five sets of measurement data
- print out all data via serial interface
- transfer all data to a PC
- carry out a test of the RS-232 interface

Please note that the cables, connectors and software needed to print and transfer data to a PC must be ordered separately as described below.

OPTALIGN Printer Accessory Package ALI 2.615P

The OPTALIGN Printer Accessory Package includes the following parts:

- the ALI 2.041 OPTALIGN VP PC software (for directing alignment results to an ASCII printer or a file),
- the ALI 2.255 serial cable with which to connect the OPTALIGN VP computer to the serial interface of a standard personal computer,
- the ALI 3.267 plug adapter (25 female to 25 female) and
- the ALI 3.266 cable adapter (25 female to 9 female).

If you would like to have your OPTALIGN converted to the printer-compatible OPTALIGN VP, please consult your local distributor or contact PRÜFTECHNIK AG directly.

Printer recommendations

Please consult your printer manual for further instructions on printer setup.

PRÜFTECHNIK AG recommends the KODAK Diconix 180 si printer or any other printer compatible with the Epson FX-80 with serial interface in conjunction with the ALI 2.255 interface cable. PRÜFTECHNIK, however, assumes no responsibility for proper function with any printer other than the KODAK model mentioned above.

The printer interface should be configured as follows:

- 1200 Baud
- 7 data bits
- Parity=even
- 1 Stopbit
- Handshake=Xon/Xoff

F 9 0 : Storing measurement data

Measurements must be stored into the memory of the OPTALIGN computer before data can be transferred to the PC and printer.

After taking measurements as usual, simply press the keys F 9 0. When the 0 key is pressed, the display flashes once to confirm proper entry and the 'OK' symbol appears momentarily.

F 9 0

You can store up to five sets of measurement data in sequence, but no more than that: after that, the computer no longer accepts the '9' key when pressed.

The stored values remain in the computer's memory until either

1. The computer is switched off (by pressing the ON/OFF key twice) or
2. Memory contents are printed, then a new set of measurements is taken and stored. This erases the entire series of previously-stored measurements and replaces it with the current set.

Switching off the OPTALIGN

If measurement data have been stored, the computer does not switch off immediately when the ON/OFF key is pressed. Instead, the computer beeps twice and displays 'F 90' to remind you that stored values are still in memory. In this manner, the OPTALIGN VP protects you from accidental data loss. Press the ON/OFF key a second time in order to switch the computer off.

If all stored data have been printed out at least once, the ON/OFF key functions normally, i.e. only one press of the ON/OFF key is required to switch off the computer.

F 91 - F 94: Data transfer with OPTALIGN VP

The OPTALIGN VP lets you print out all stored data via serial interface to an external printer or to an output file. These data include:

- all machine dimensions,
- coupling alignment target values,
- thermal growth values entered for machine feet,
- alignment results at the coupling and
- alignment correction values at the machine feet.

The printout lists not only the measured alignment condition, but also the necessary correction values. At the top, spaces are provided for the user to fill in additional information regarding the machine type, etc. The printout or output file is produced as follows:

1. Enter the machine dimensions as usual into the OPTALIGN VP and take alignment measurements.
2. Press the coupling key or machine foot key to display the alignment condition or machine foot corrections.

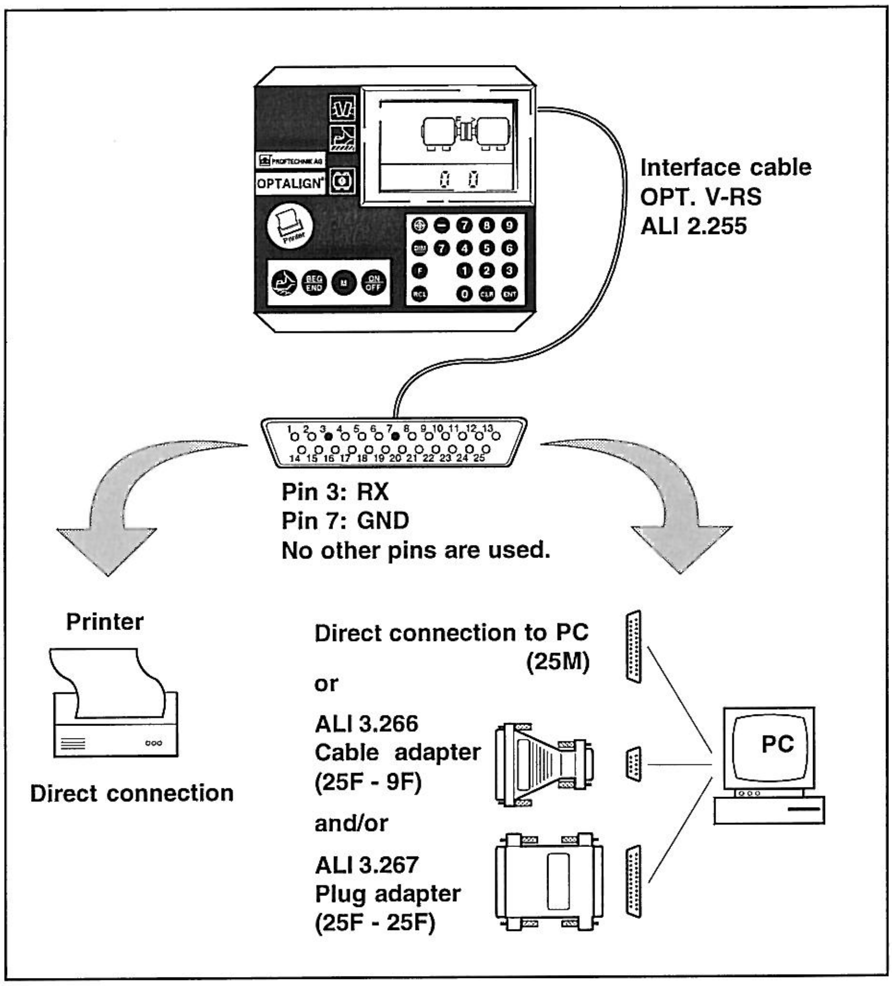
Do not skip this step, or else the computer will display the error message 'Err'.

F 9 0

3. Use the F 90 function as directed on the previous page to store the measurement results.
4. Disconnect the transducer cable from the OPTALIGN VP computer. Attach the round end of the serial cable to this same socket and the other end to the printer or the serial interface socket of the PC as shown in the diagram below.

Please note that the interface cable should not be connected to the computer within explosive environments.

If F 9 1 (- F 9 4) is pressed before the interface cable is connected, the OPTALIGN computer will no longer respond: in that case, press the ON/OFF key ONCE and return to step 4.



5. Switch on the PC and enter OPTAVPRT at the DOS operating level to run the transfer program (advanced users may wish to set up a PIF file to run the program under Microsoft® Windows™*; see the Windows™* manual for instructions). Answer the prompts to specify the interface and printer or output file name.

*Windows is a registered trademark of Microsoft, Inc.

If printed output is desired, switch on the printer and make sure the printer is switched 'online.' (See printer instructions for details.)

6. To transfer an English-language report of the alignment measurement stored first in the OPTALIGN computer, press the keys F 9 2 (see side note for other languages.) Upon completion, the next stored measurement set may be sent by pressing the ENT key.
   To transfer the entire memory contents of the OPTALIGN VP computer (up to five measurement sets), press the keys F 9 4 (see side note for other languages).

7. The alignment report is transferred to the printer or PC as a string of standard ASCII characters for printout or file storage.

Other languages

You may use the key combinations listed below to produce reports in languages other than English:

I. First alignment measurement only

German	press	F 9 1 1
French		F 9 1 2
Dutch		F 9 1 3
Swedish		F 9 1 4
Spanish		F 9 1 5

II. Entire memory contents

German	press	F 9 3 1
French		F 9 3 2
Dutch		F 9 3 3
Swedish		F 9 3 4
Spanish		F 9 3 5

F 95: RS-232 test

The F 95 function may be used to check the RS-232 interface immediately after switching on the computer.

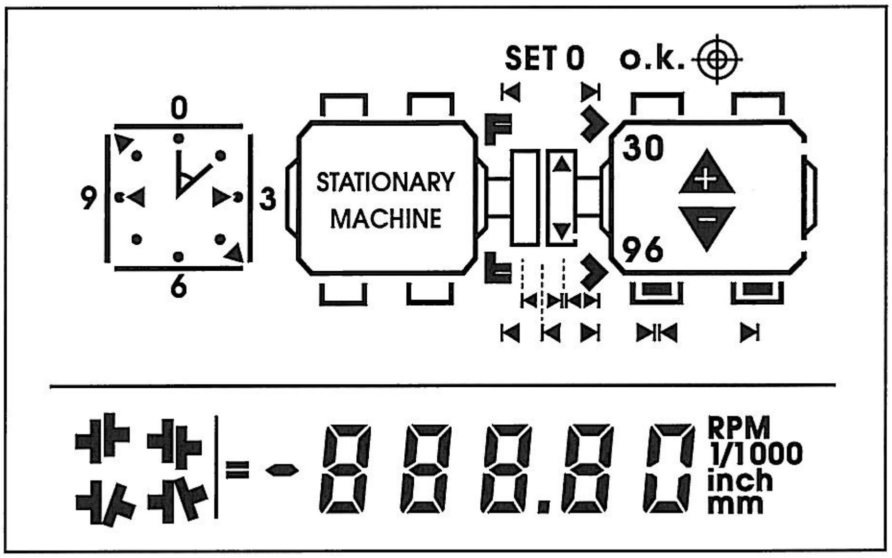
1. Connect the OPTALIGN VP computer to the printer.
2. Switch on the computer.
3. Switch on the printer.
4. Make sure the printer paper supply is adequate.
5. Press the keys F 9 5.
6. The printer should now print out the alphabet. This printout may be interrupted at the printer at any time.

LCD display tests

These special functions have been incorporated into the OPTALIGN software in order to facilitate checking each segment of the LCD display and proper keyboard function. If any segments are missing, contact your authorized Prüftechnik representative for service information.

Testing the entire display

By pressing the keys ON, F, 0 and 1, the user activates all segments of the LCD display simultaneously. The resulting display should match that pictured below.



Testing individual display segments

Press ON, F, 0 and 2 to activate the LCD segments one at a time, beginning with the decimal point of the far right digit. Proceed from one segment to the next by pressing any key (except OFF/ON).

Testing the keyboard

Press ON, F, 0 and 3 to activate this test mode. Then, as each key is pressed, its function is shown in the display (or as nearly so as possible given the LCD graphic limitations). For example, when the MOVE key is pressed, the following display results: