

## TechNote #27 ROTALIGN®

### Thermal growth compensation with ROTALIGN®

#### Introduction

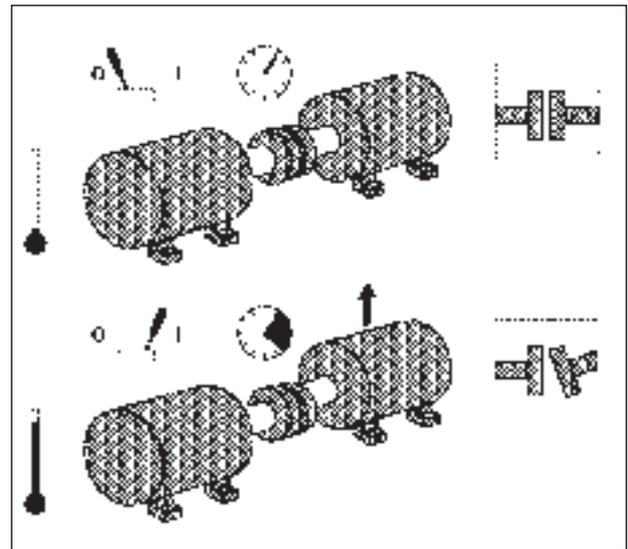
Shaft-coupled machines often operate at temperatures high enough to cause an expansion of the machine housing known as thermal growth, which causes relative displacement of shafts from their 'cold' stationary positions. This in turn results in deterioration of the alignment condition unless proper compensatory measures are taken.

If the direction and extent of growth are known, the machines may be purposely misaligned such that they grow into place, resulting in a good alignment condition during normal operation. The most readily available target specifications for cold alignment are generally obtainable from machine manufacturers; these are usually expressed in terms of dial indicator readings at the coupling which must be converted into ROTALIGN-compatible form (see Technical Note #25 for instructions).

ROTALIGN offers two different methods for entering values for thermal growth compensation: once the 'cold' alignment condition is known in terms of coupling offsets and angularity, it may be entered using the 'coupling targets' function. Alternatively, if expected thermal growth values are known for the machine feet or bearing locations, those amounts may be entered directly into the ROTALIGN computer using a different function. This note explains both methods.

#### Coupling Targets

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



#### Procedure:

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

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

# PRÜFTECHNIK AG - Shaft alignment

## ROTALIGN® TechNote - page 2

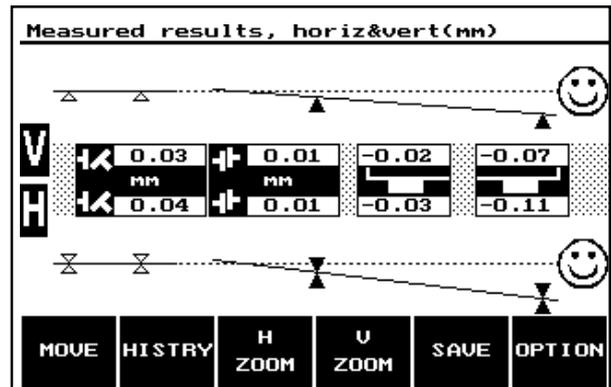
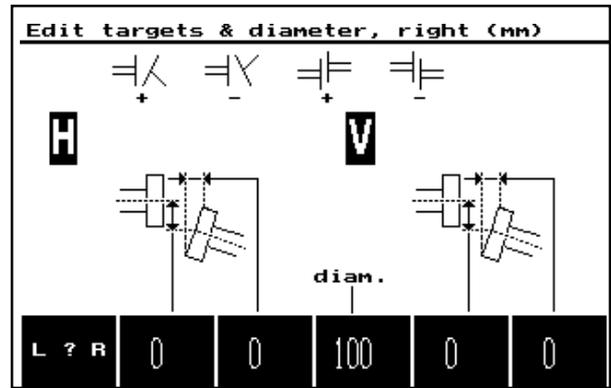
Shown at right is the Coupling Targets screen for Gap/Offset. Depending on the chosen coupling display mode, the softkeys point to the horizontal and vertical parameters; in the middle is the coupling diameter.

"L ? R" switches between left and right machine relative to the machine to be aligned. Separate settings for left and right machines may be useful when the machines are supplied by different manufacturers and their targets are therefore specified individually. Separate L/R settings are not needed, however, if the machines are supplied as a complete set from a single manufacturer who supplies combined target values for the set.

Press the softkeys and key in the required values, pressing ENTER after each entry. Note: the diameter shown here applies only to the specification of target alignment values. Here, for example, targets are specified for a 100 mm coupling, even though the diameter of the coupling actually installed (say, 150 mm) has been entered in the machine dimensions screen.

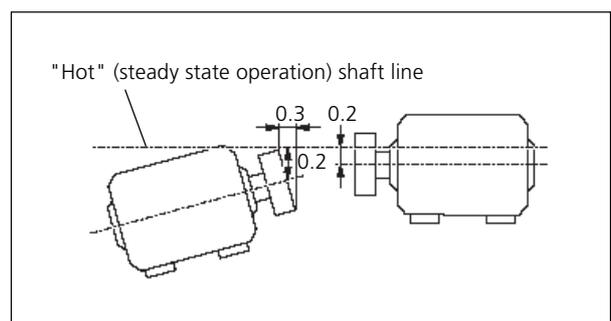
To exit this screen press ENTER. ROTALIGN returns you to the Results Setup Options.

Example:  
The alignment condition measured on a typical pair of machines is shown in the figure at right. At first glance the results appear to be satisfactory and within tolerance:



Consider, however, the following thermal growth specifications for the machines:

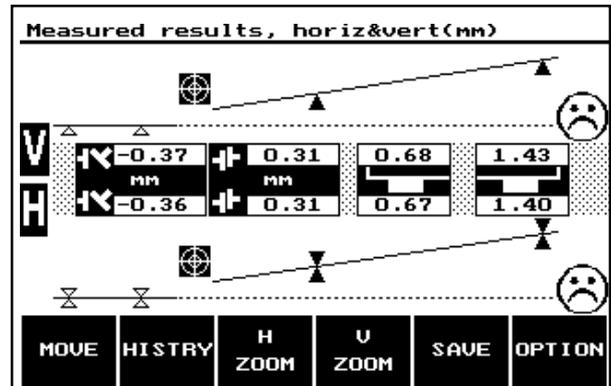
	Left machine	Right machine
vertical gap:	0.2 mm	0.0 mm
vertical offset:	0.3 mm	0.2 mm
horizontal gap:	0.2 mm	0.0 mm
horizontal offset:	0.3 mm	0.2 mm



When these values are entered in the Coupling Targets screen, the results are somewhat different:

Note that the target symbol is now displayed to indicate that thermal growth values have been entered.

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



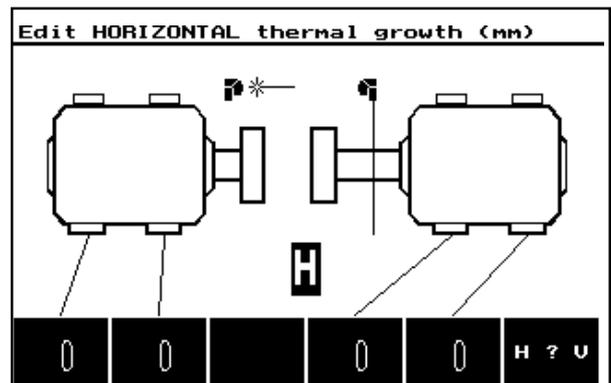
### Thermal growth at machine feet

If target alignment is specified in terms of growth at the machine foot locations, a different function is used to enter the amount of growth expected at each foot location directly into the ROTALIGN computer. The machine foot corrections displayed in the alignment result screen will then be calculated to include the amounts of growth entered. (The coupling results displayed in the measurement screen, however, always display the actual measured alignment condition regardless of targets entered.)

Procedure:

When you select THERMAL GROWTH from the Menu, the Result Setup Options appears. Press the THERM GROWTH softkey which allows you to enter the expected thermal movements for the movable machine. Note that for a 6-foot machine, thermal growth values can be entered only for the front and rear feet.

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



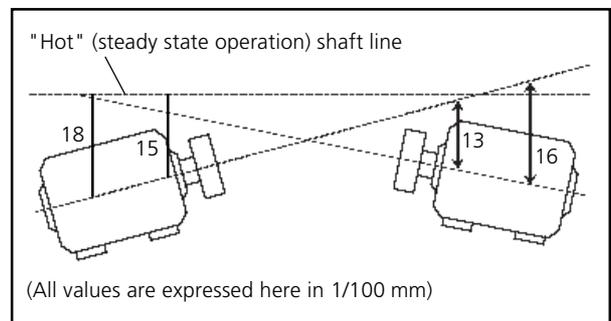
# PRÜFTECHNIK AG - Shaft alignment

## ROTALIGN® TechNote - page 4

Select either horizontal or vertical movement with the "H ? V" key and key in the expected movement at each machine foot location with the indicated soft-keys; press ENTER after each entry. To exit this screen, press ENTER to return to Results Setup Options.

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

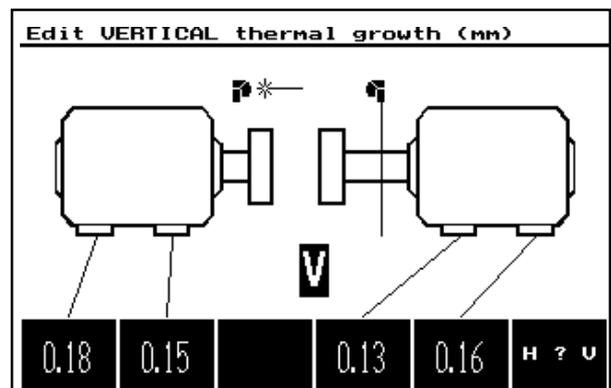
Example:  
Consider the following diagram of "cold" alignment condition, i.e. before the machines are started:



The individual values for entry into the ROTALIGN computer are simply read from the diagram: the distance between the "cold" shaft line to the "hot" shaft line is read for each machine foot location as shown above. These amounts are entered via softkeys as follows into the thermal growth screen:

Sign convention:

- + Machine moves upwards as it warms up
- Machine moves downwards as it warms up



### Thermal growth entry for the stationary machine

If one of the machines cannot be moved during alignment, yet exhibits thermal growth, the following procedure is used:

The stationary machine is first defined under the ROTALIGN menu item "Machine type" to be a "normal 4-foot machine." The machine dimensions of foot separation and distance from front foot to receiver must then be entered into the dimension screen.

The menu item "static feet" is used next to designate the front and rear feet of the stationary machine as immovable.

Expected thermal growth values for the stationary machine feet are then entered as usual (see above).

The computer calculates the alignment corrections such that only the moveable machine is adjusted to compensate for all thermal growth entries, including those made for the stationary machine.

### Special case: parallel growth

Pumps, in particular, often present the special situation in which they must be handled as stationary machines, yet exhibit thermal growth of a pure parallel nature (i.e. both front and back feet rise by the same amount as the machine warms up).

The motor (right) is unaffected by thermal growth, but must be positioned during "cold" alignment such that it compensates the expected parallel offset due to thermal growth of the pump.

Contrary to the standard procedure described on the previous page, the desired offset could also be attained in this special case by using the thermal growth function and entering a negative expected "growth" of -0.17 mm for both front and rear feet of the right machine; i.e. the motor on the right "sinks" by 17/100 mm relative to the pump on the left:

