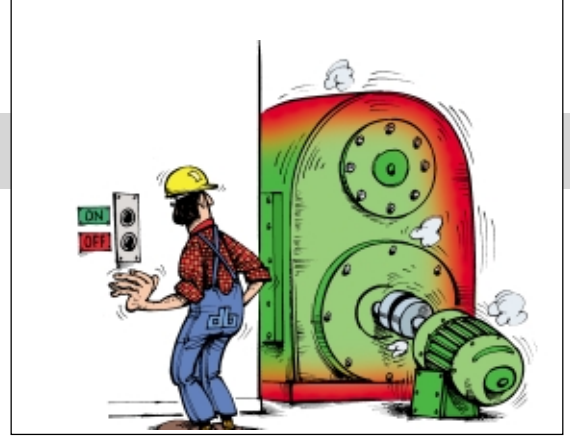
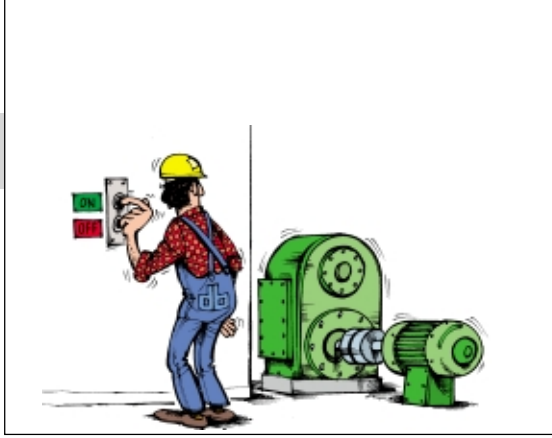


PERMALIGN[®]

Monitoring of Alignment Changes



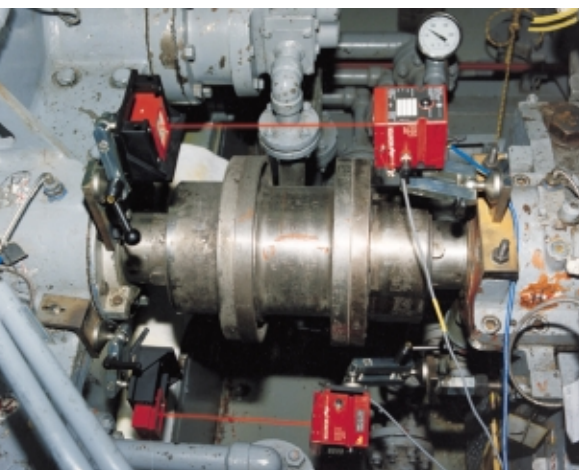
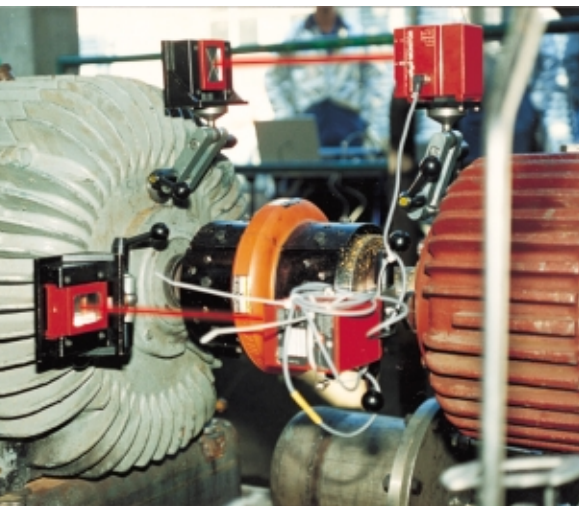
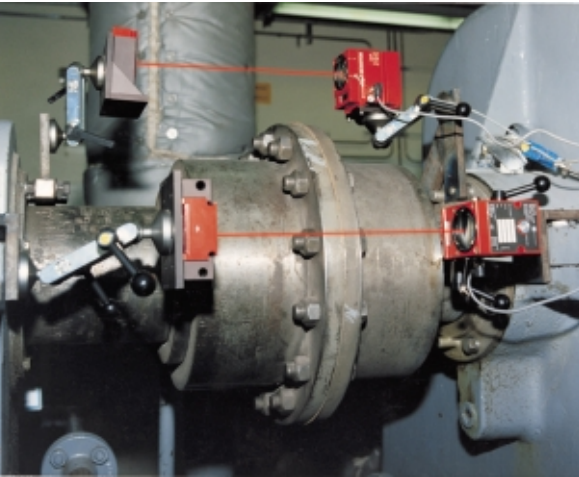


Alignment monitoring and displacement measurements

The PERMALIGN® laser system measures and monitors alignment changes, commonly referred to as "Thermal Growth", of rotating machinery during operation. It can measure the absolute move of a machine or the relative move between coupled machines. It may be used for permanent monitoring or for just the necessary time to determine positional change from cold to hot or vice versa. The user may obtain printout of numerical data, graphics and plot curves of positional changes over time of any monitored equipment. Contrasting with other monitoring methods, PERMALIGN® allows you to determine what movements have thermal origin and what movements are caused by dynamic influences, pipe strain or load variations, etc. PERMALIGN® is the only linearized laser measuring system with a resolution of one micron throughout the entire detector range of 0.630". The system permits accurate measurement of parallel and angular movement at distances of up to 30 ft. Temperature variations and vibration do not diminish accuracy.

Application photos

Sinngemäß: The three photos are showing temporary operating PERMALIGN applications at ... (temporary because the cabelings are terrible and normally not suitable for printed photos) The three photos are showing PERMALIGN applications The three photos are showing



**PERMALIGN®
Monitor**

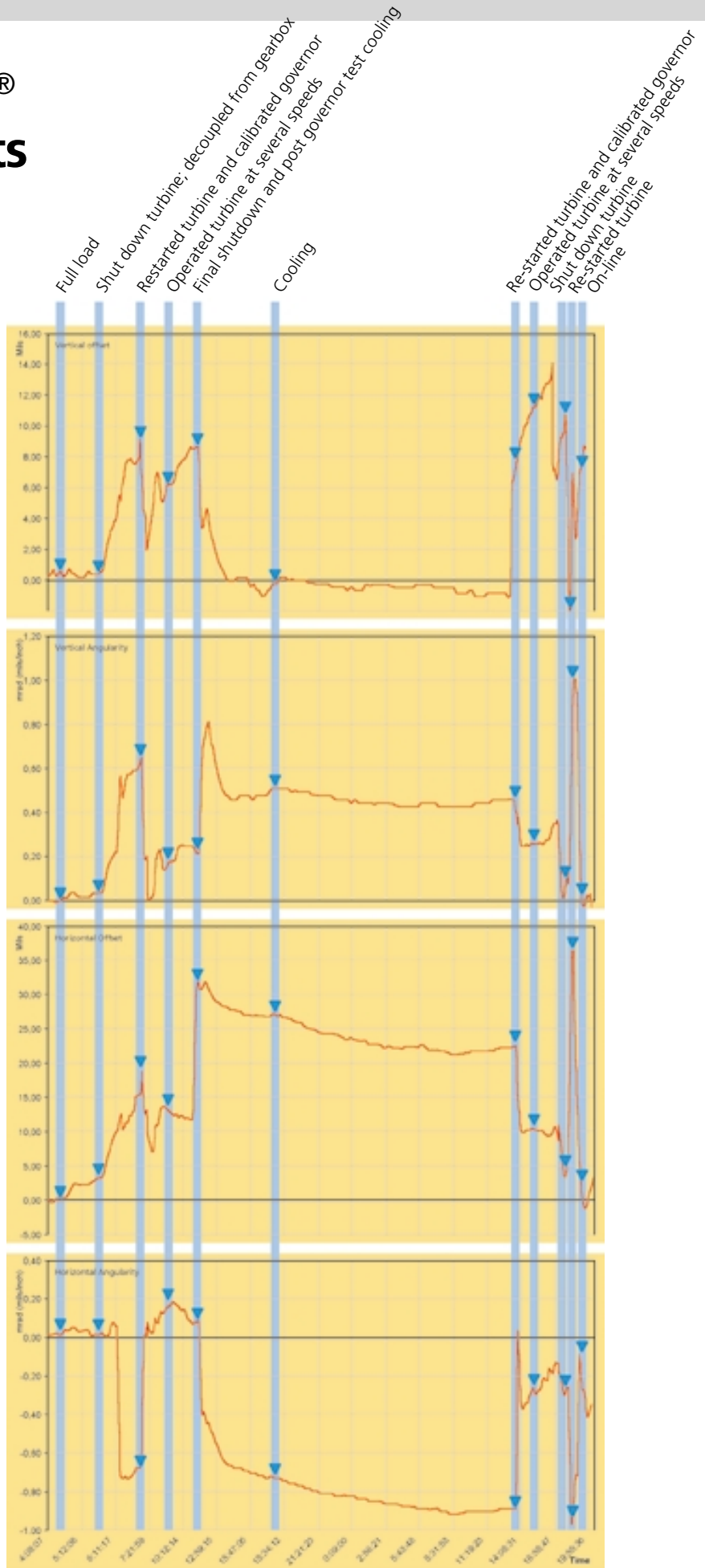
Typical PERMALIGN® measurement results

An example:

A gearbox (Ingersoll Dresser®) driven by a single stage Elliot® turbine exhibited reliability problems for over 15 years. Once every several years, the gearbox would fail. Repair costs typically ranged from 100 to 200K.

It was decided to monitor each coupling with PERMALIGN® to ascertain positional changes between the turbine, gearbox, and fan. Positional changes between the fan and gearbox did not exceed tolerances. However, large changes were discovered to occur between the turbine and gearbox, particularly in the horizontal orientation. These changes were attributed to piping configurations and process parameters (600 psi steam; horizontal inlet/outlet). PERMALIGN® confirmed the customer's suspicions and allowed him to justify a permanent solution.

The customer decided to install expansion joints and continue to use previous alignment targets. The unit has operated problem free since.



Vertical Offset

Positive vertical offset indicates turbine shaft centerline at coupling center is shifted to 12:00 relative to gearbox shaft centerline

Vertical Angularity

Positive vertical angle denotes open to top of the coupling

Horizontal Offset

Positive horizontal offset indicates turbine shaft centerline at coupling center is shifted to 3:00 (away from wall) relative to gearbox shaft centerline.

Horizontal Angularity

Negative horizontal angularity denotes coupling open to 9:00 (wall)



Measure machine growth with PERMALIGN® in 3 easy steps:



PERMALIGN system

bestehend aus Monitor und Reflektor. Mit je einem System können Lageveränderungen von zwei Achsen beobachtet werden. Zwei Systeme sind also notwendig, um die bei einem Maschinensatz interessanten vier Freiheitsgrade beobachten zu können (Winkelversatz und Parallelversatz jeweils horizontal und vertikal).

1. The laser-optical measurement system PERMALIGN® is mounted on the faces of the coupled machines and adjusted once the machines have reached their "steady state" operating conditions.

2. The machines are then shut down and begin to cool off.

3. The measurements tell the exact displacement occurring between the machines as they cool off, including coupling offsets. (Alternatively, growth could also be measured during start-up.)

When connected to a PC, the PERMALIGN® system utilizes its own special program (entitled "SHAFT") to record and display the entire cool-down phase continuously. Horizontal and vertical displacements shown graphically can then be correlated to machine temperature

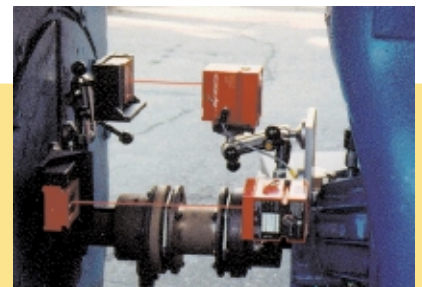


The measurement values can then be entered directly as target specifications during subsequent OPTALIGN® or ROTALIGN® laser shaft alignment.

The same PERMALIGN® equipment also lets you measure other types of displacement quickly, accurately and without contact.

PERMALIGN® technical data

Resolution	internal: 1 µm, external: 1/100 mm (1/1000")
Accuracy	better than 2%
Measurement range	16 x 16 mm (5/8" x 5/8"), 2 displacement axes
Max. separation	10 m (30 ft.)
Laser safety class	Class 1 (no protection necessary)
Protection	IP 65
Temperature range	10° C - 50° C (50° F - 122° F)
Dimensions	65 x 90 x 90 mm (B x H x T)
Weight	750 g (Monitor); xxx g (Reflector)



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