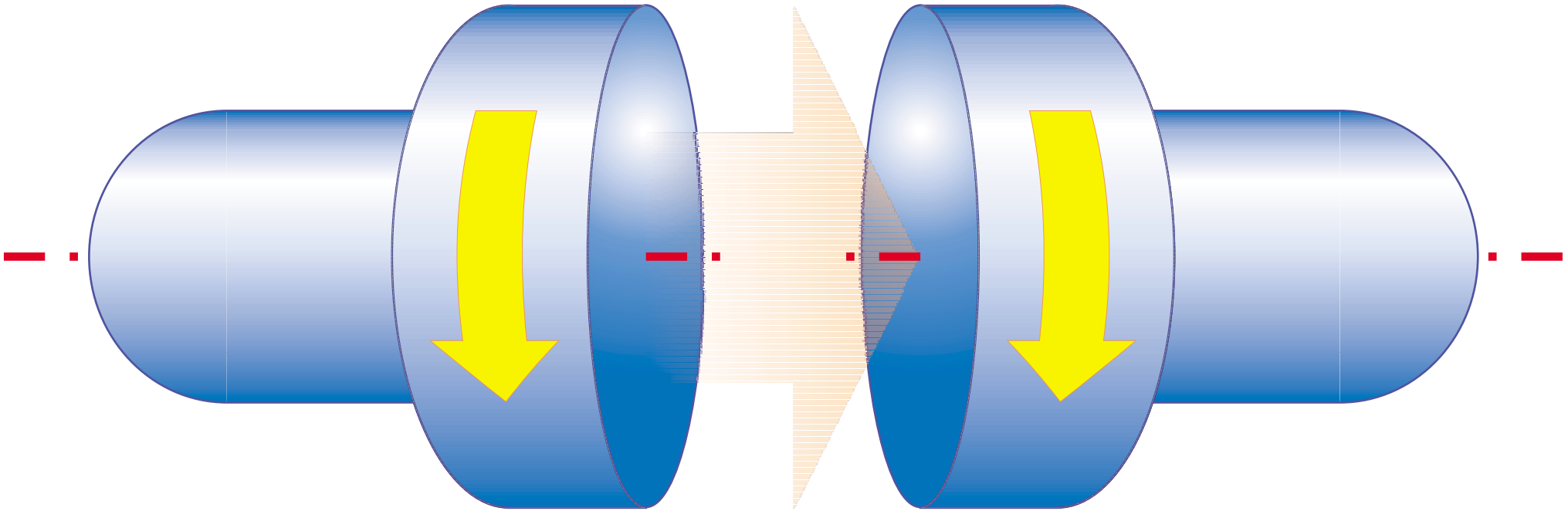
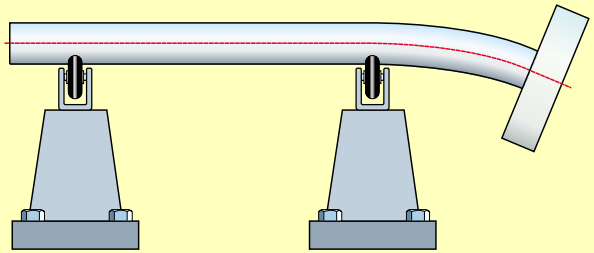
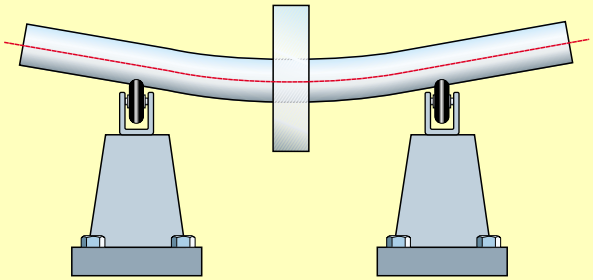
What is shaft alignment?



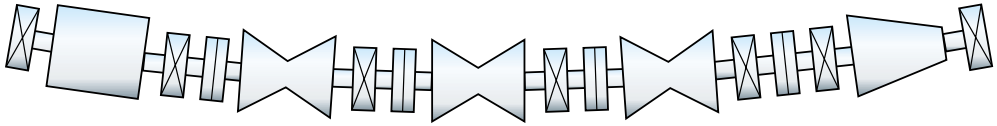
What is catenary?



Overhang

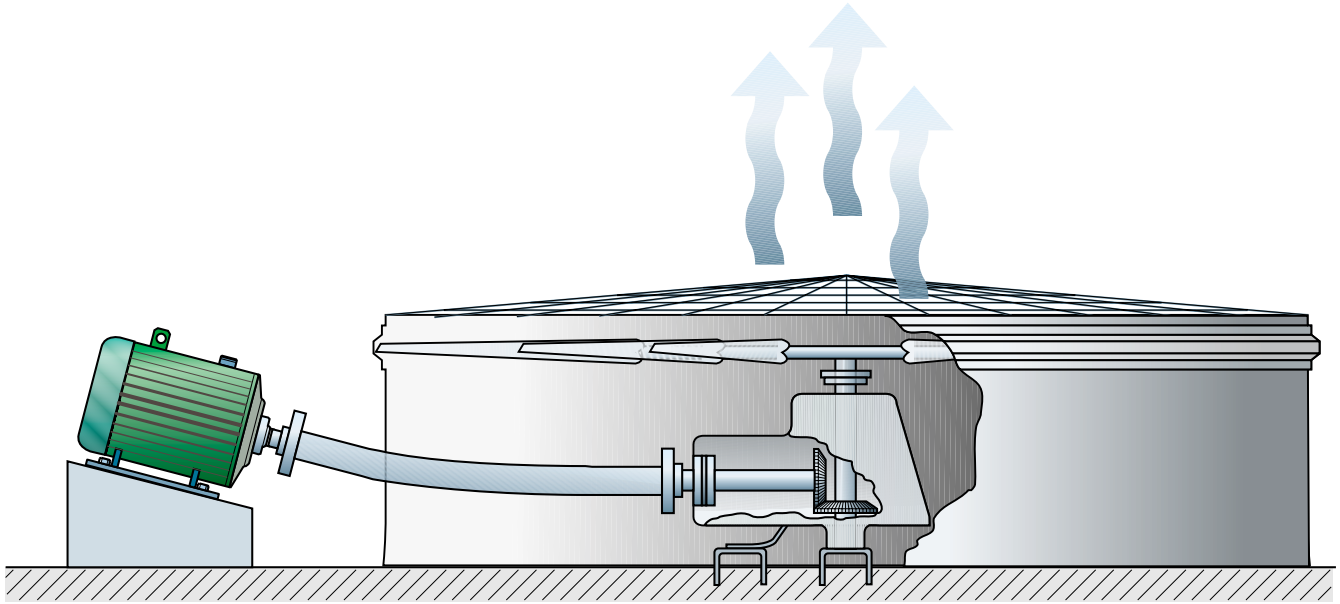


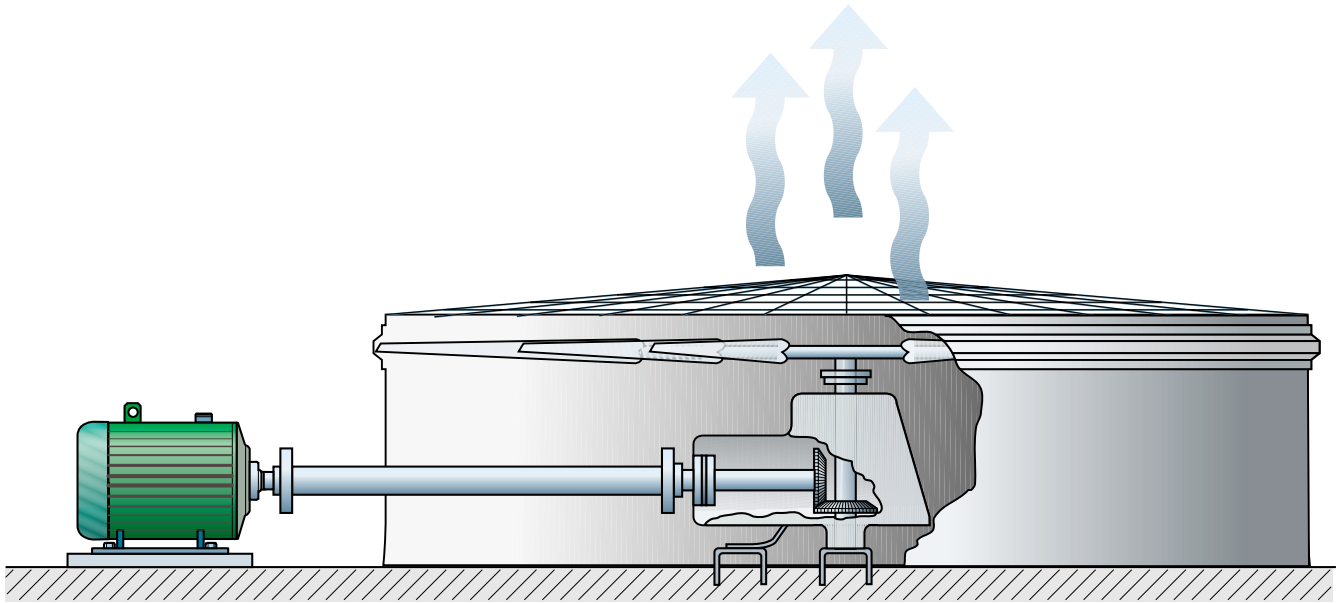
Sag



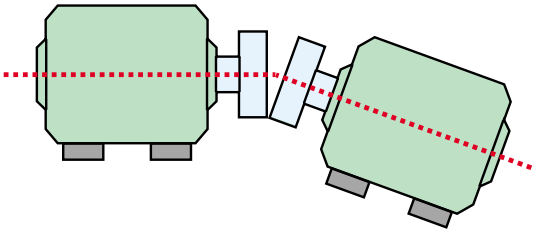
Machine catenary

Operation above critical speed?

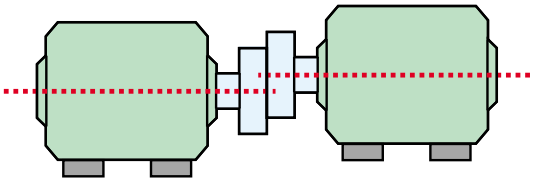




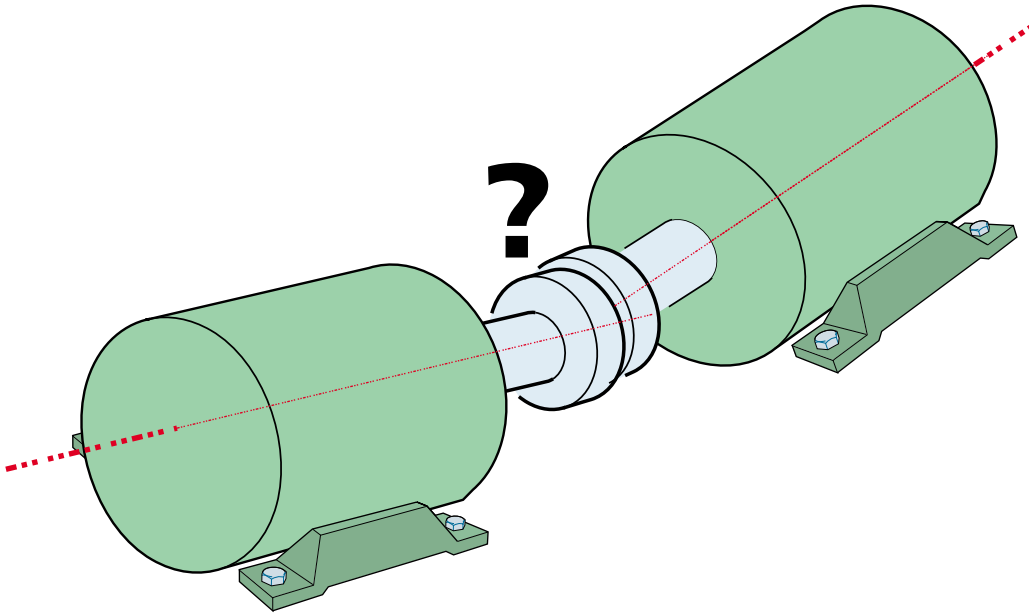
4 parameters

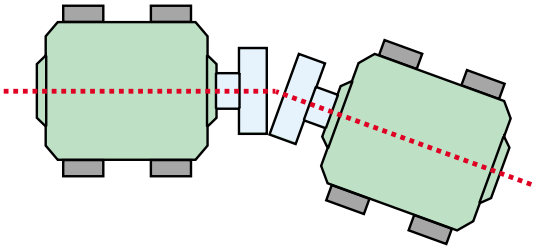


Vertical angularity

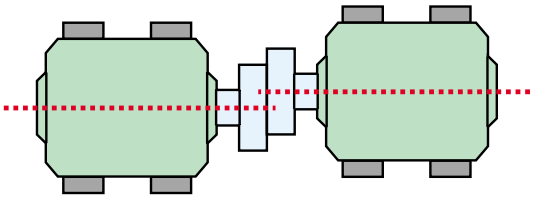


Vertical offset



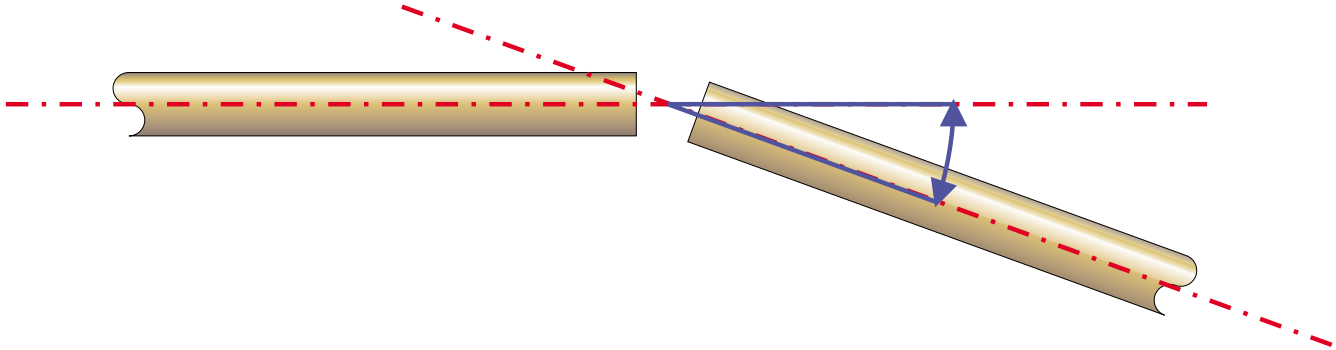


Horizontal angularity



Horizontal offset

Angularity means the angle between two rotation axes



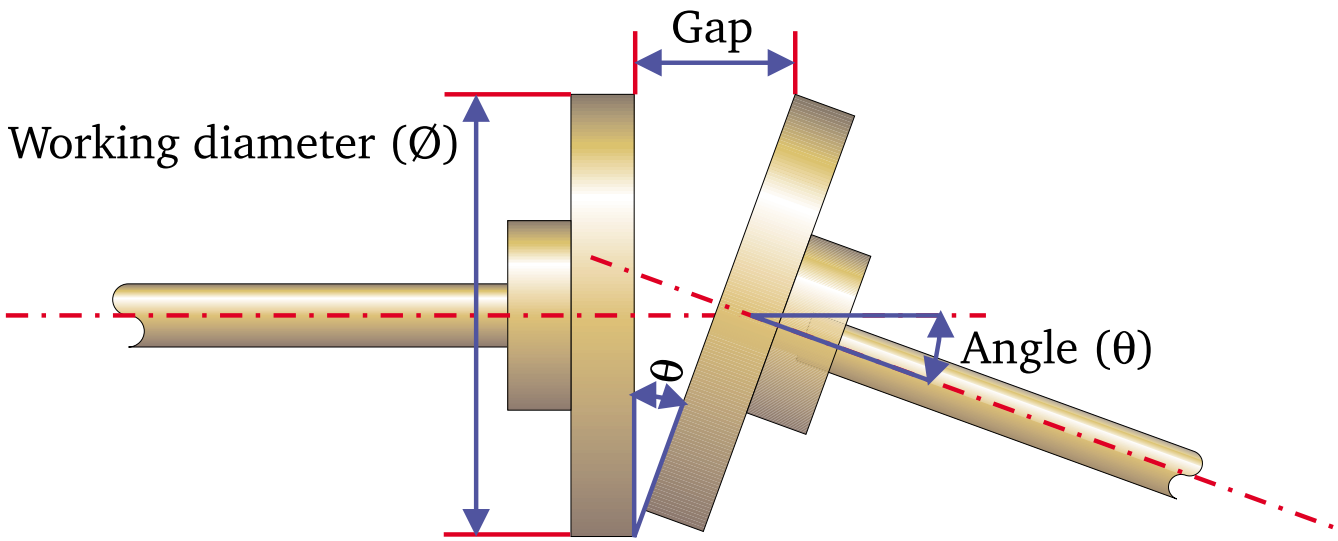
The angle is usually given as a **gap** per **working diameter**.

A 6"(152.4 mm) coupling open at the top by 0.005"(0.127 mm) gives an angle between shaft axes of 0.83 mrads.

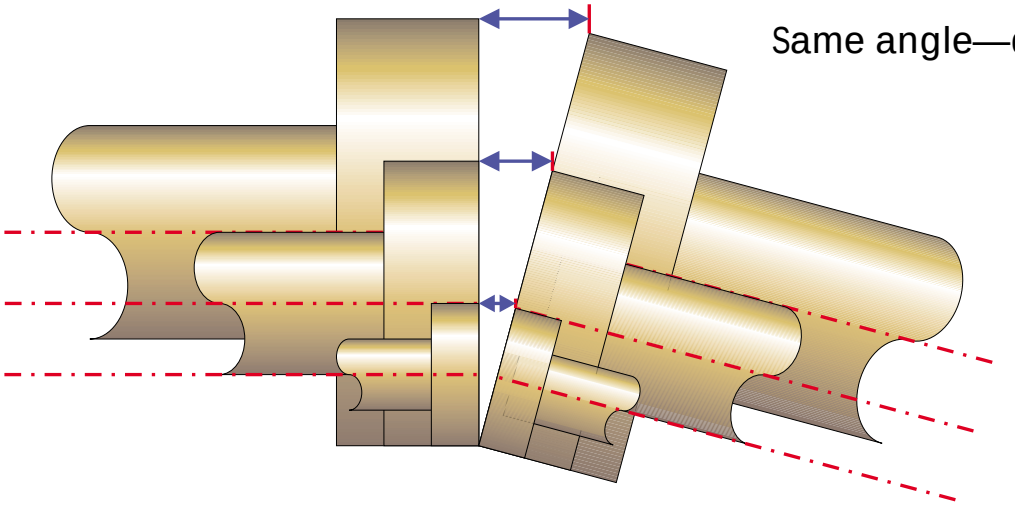
For a 10" working diameter this corresponds to a gap of 0.0083".

For a 100 mm working diameter this corresponds to a gap of 0.083 mm

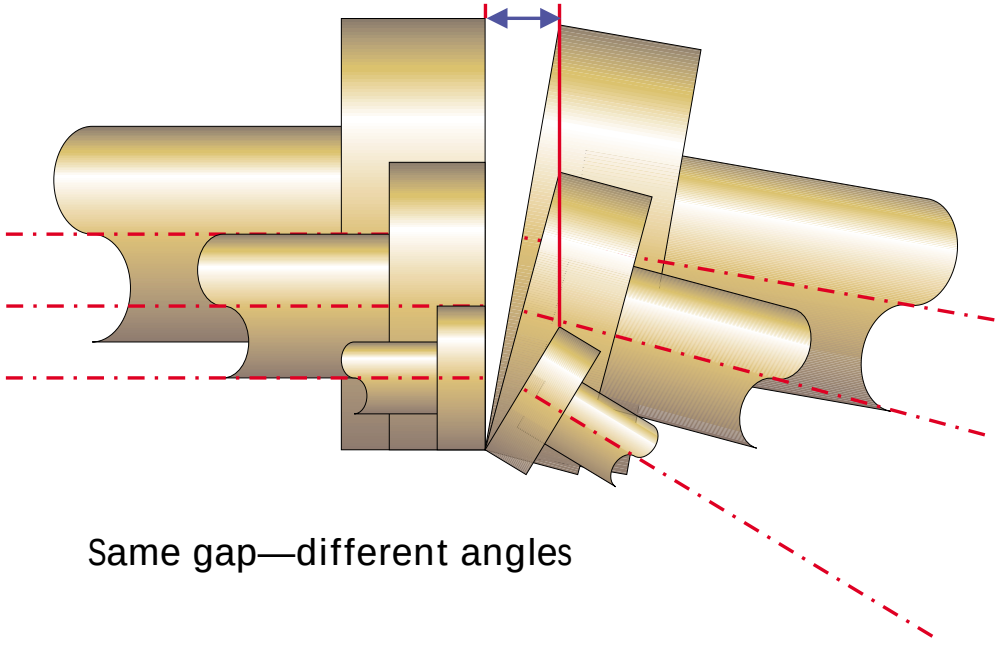
Note:
1 mrad = 1 thousandth of an inch per inch
1 mrad = 1 mm / m



Angularity and gap

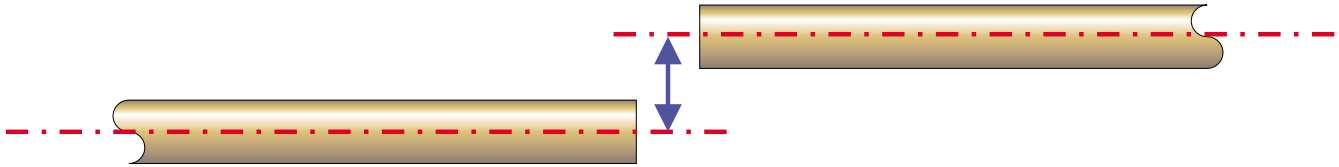


Same angle—different gaps

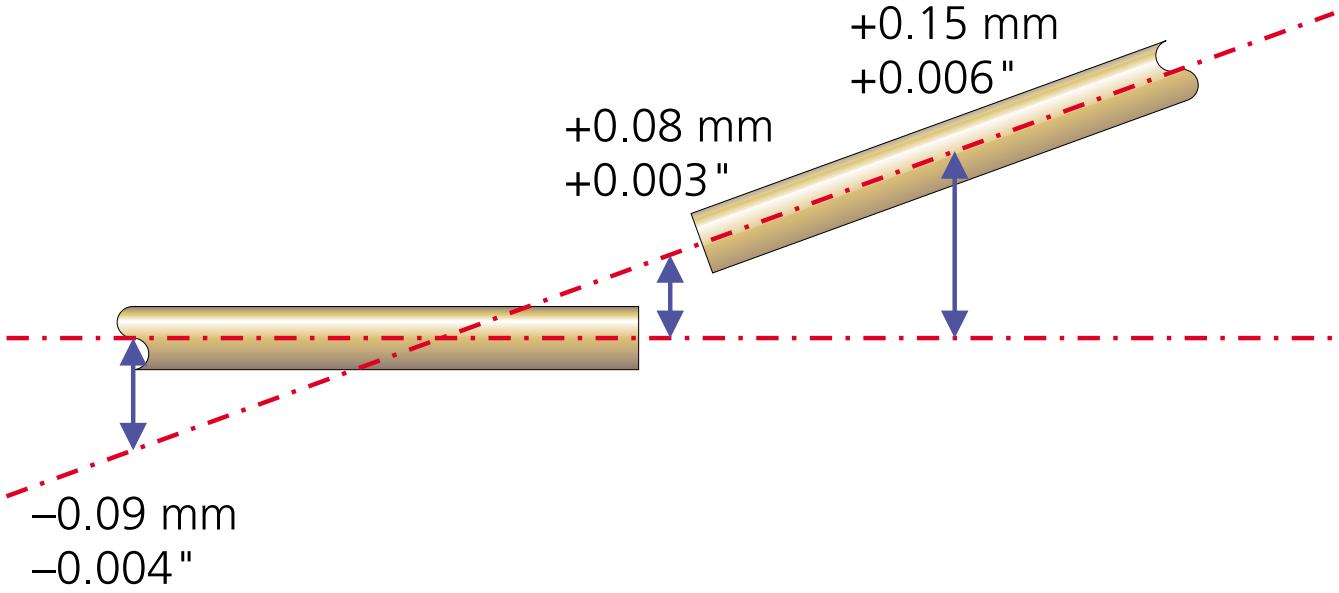


Same gap—different angles

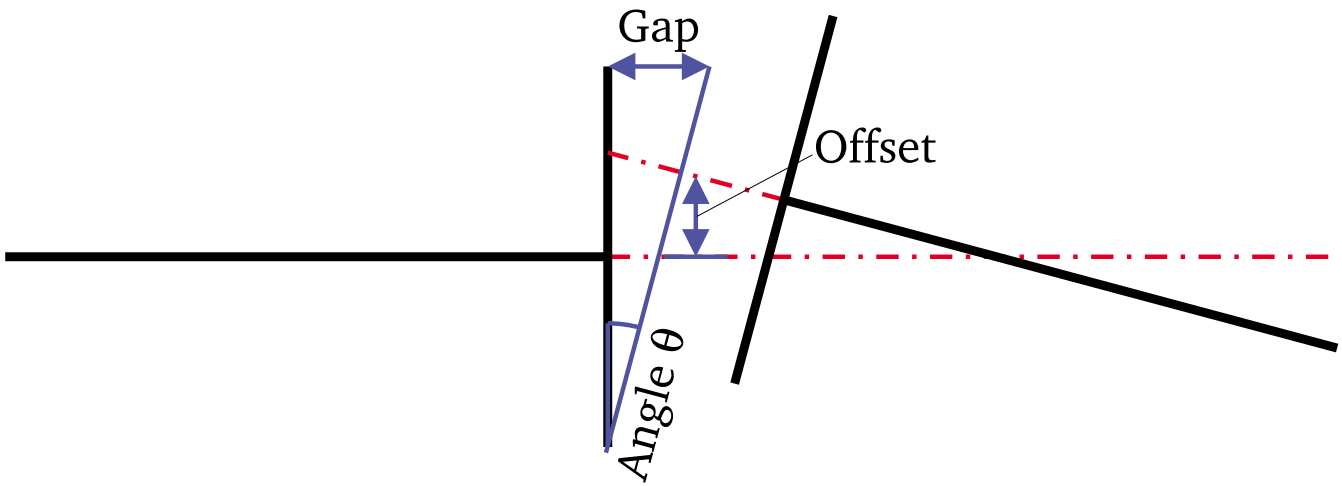
Offset means distance between rotation axes at a given point.

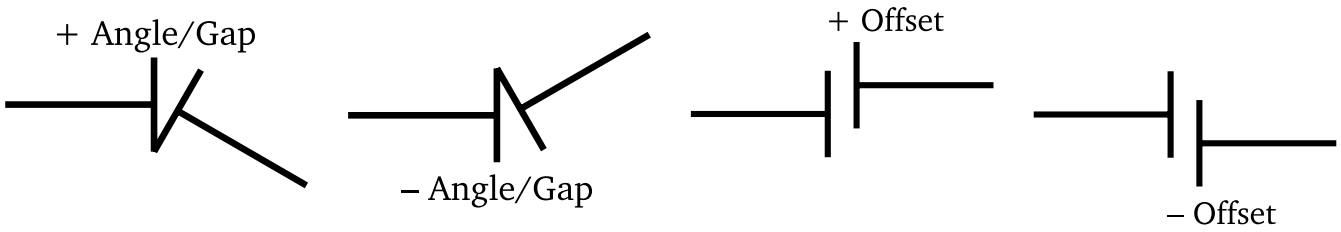


Offset value varies depending upon the location where the distance between two shaft rotation axes is measured.

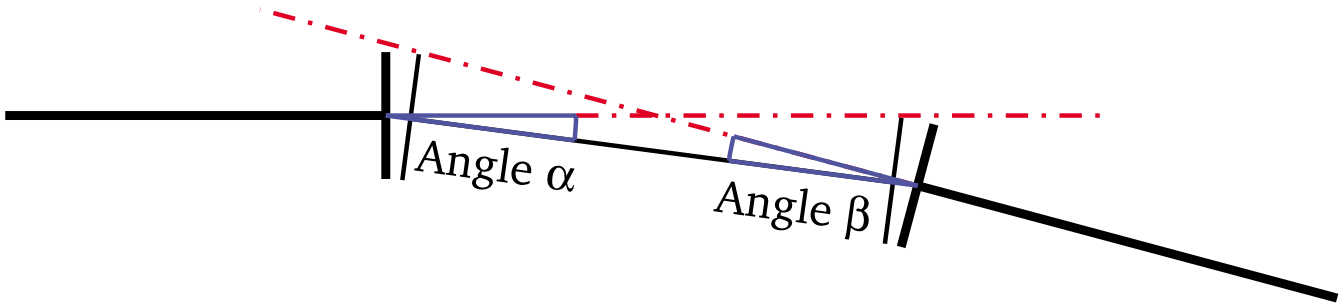


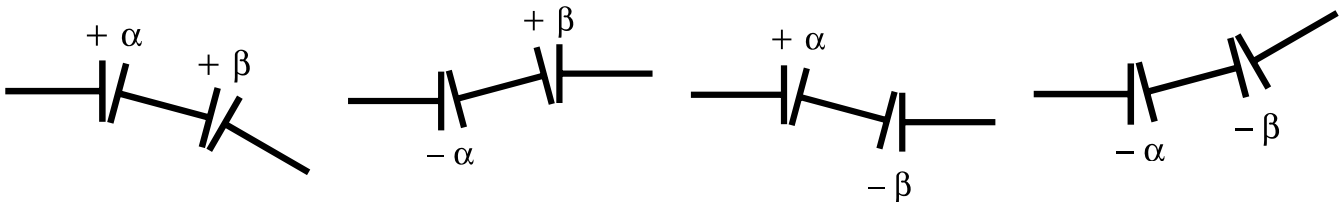
Modern method for short flexible couplings

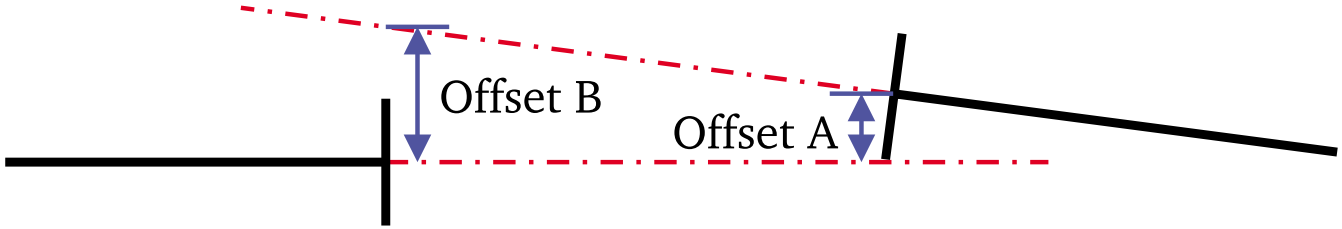


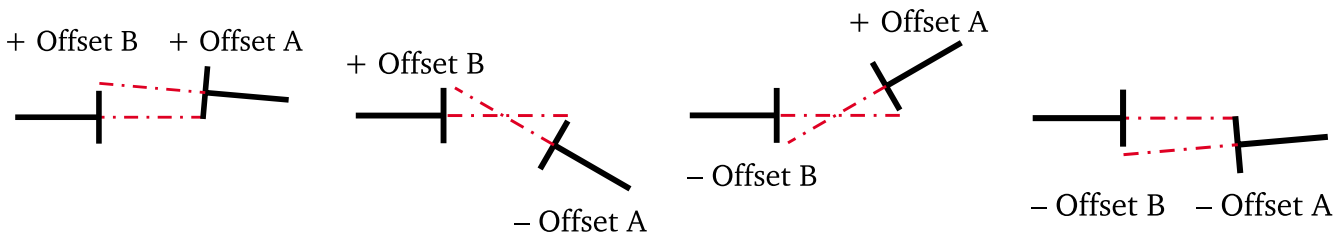


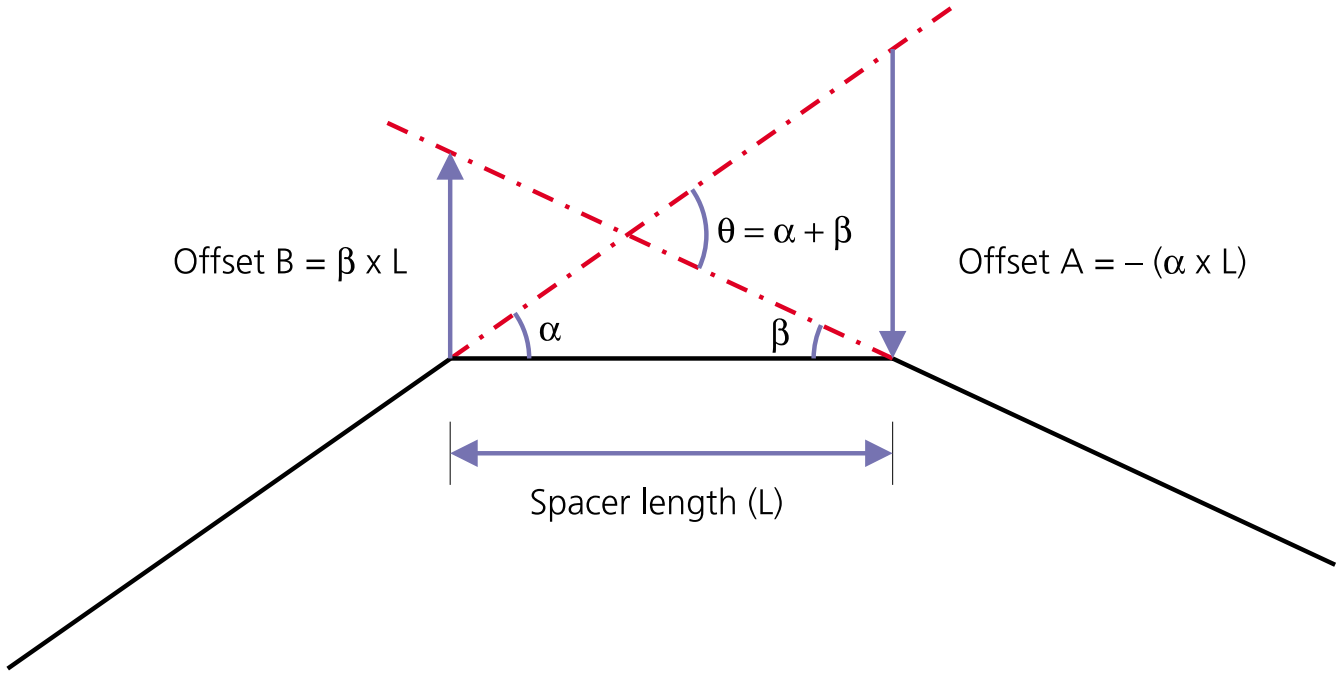
Modern method for spacer shafts 1





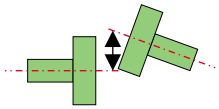


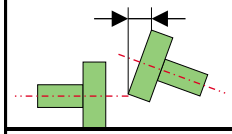


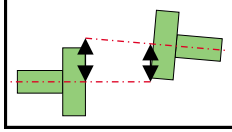


How precise should alignment be?

	RPM	metric (mm)		Inch (mils)	
		Acceptable	Excellent	Acceptable	Excellent
Short "flexible" couplings					
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
Angualrity	600			15.0	10.0
	750	0.13	0.09		
Metric values—Gap difference per 100 mm coupling diameter	900			10.0	7.0
	1200			8.0	5.0
	1500	0.07	0.05		
Inch values—Gap difference per 10 inch coupling diameter	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 (disc) couplings	600			3.0	1.8
	750	0.25	0.15		
	900			2.0	1.2
Metrics values—Offset per 100 mm spacer shaft	1200			1.5	0.9
	1500	0.12	0.07		
Inch values—Offset per inch spacer length	1800			1.0	0.6
	3000	0.07	0.04		
	3600			0.5	0.3
	6000	0.03	0.02		
	7200			0.3	0.2





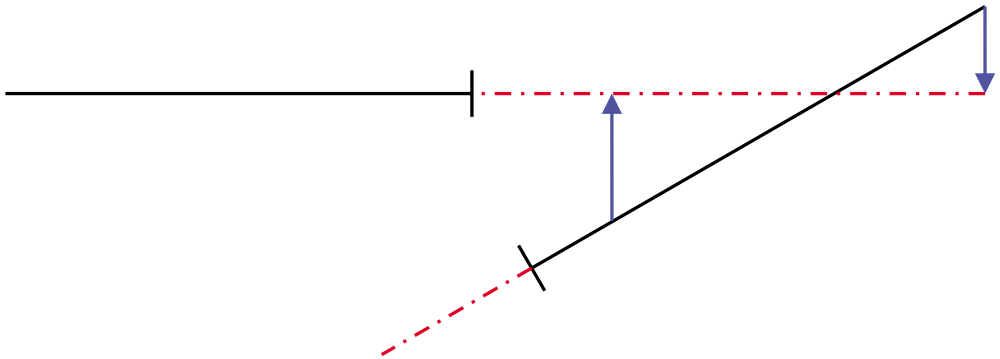


The suggested tolerances shown opposite are general values, based upon over 15 years of shaft alignment experience at PRÜFTECHNIK and should not be exceeded. They are to be used only if no other values are prescribed by existing in-house standards or the machine manufacturer.

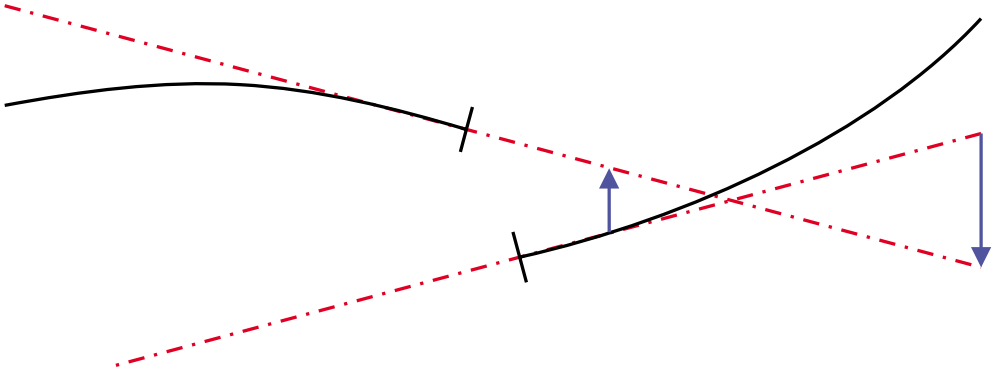
Rigid couplings have no tolerance for misalignment, they should be aligned as accurately as possible.

Coupling strain and shaft deflection

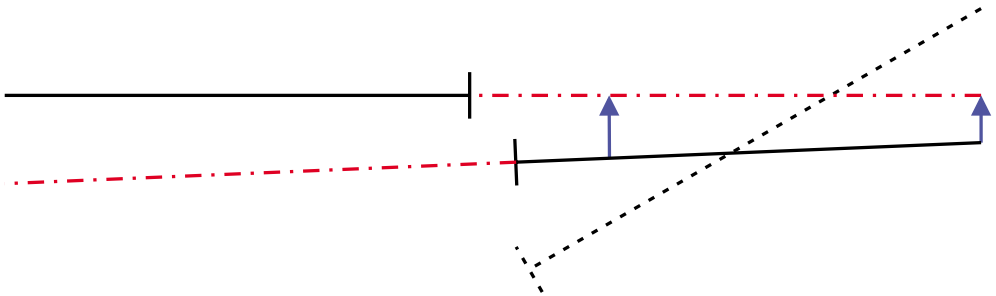
The alignment condition with the shafts uncoupled. Severe misalignment is present.



The projected centrelines of rotation are shown as measured with the shafts coupled.



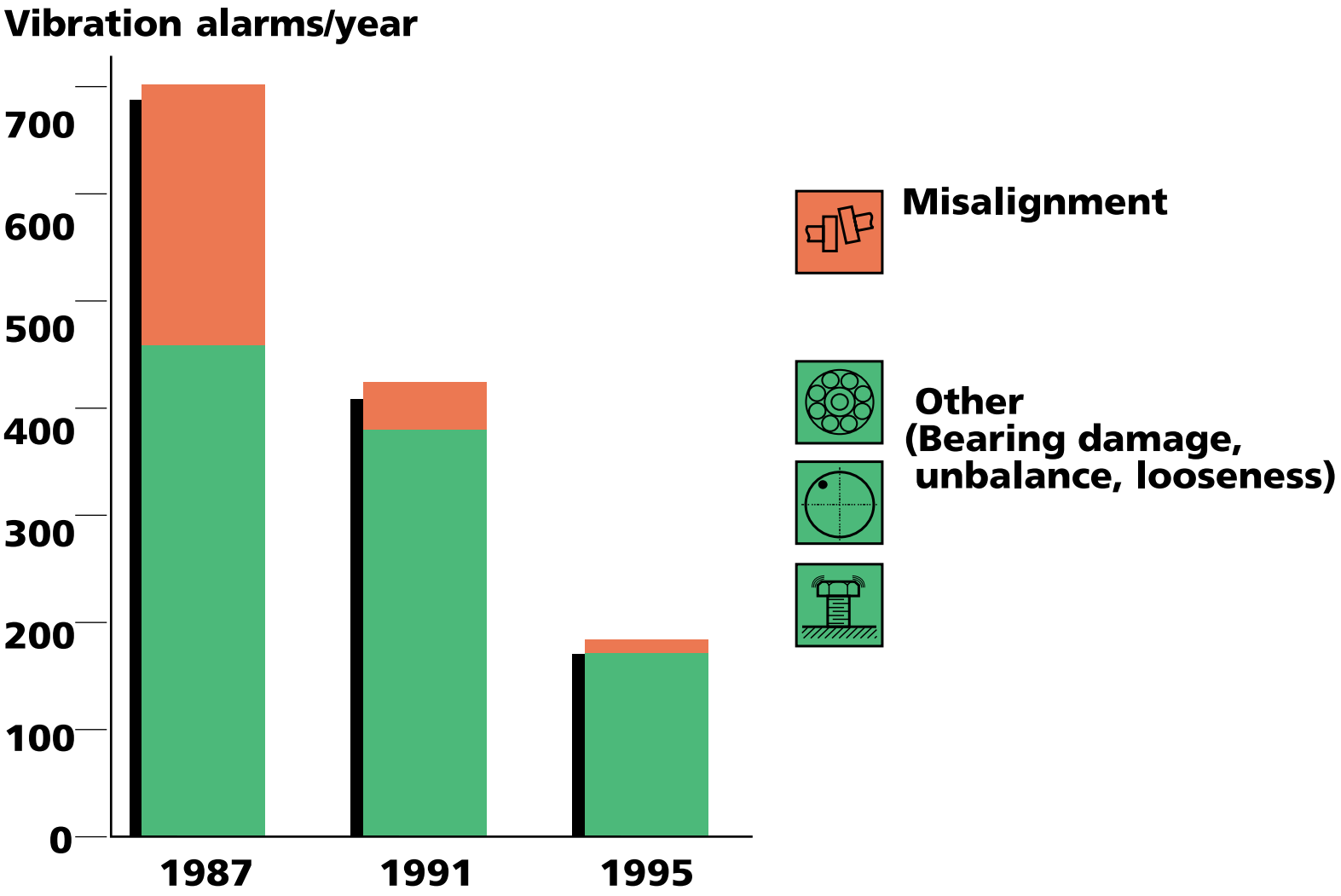
The right shaft is moved according to the measured values. The alignment situation has improved but the shafts are still not aligned.



Causes of machine breakdown

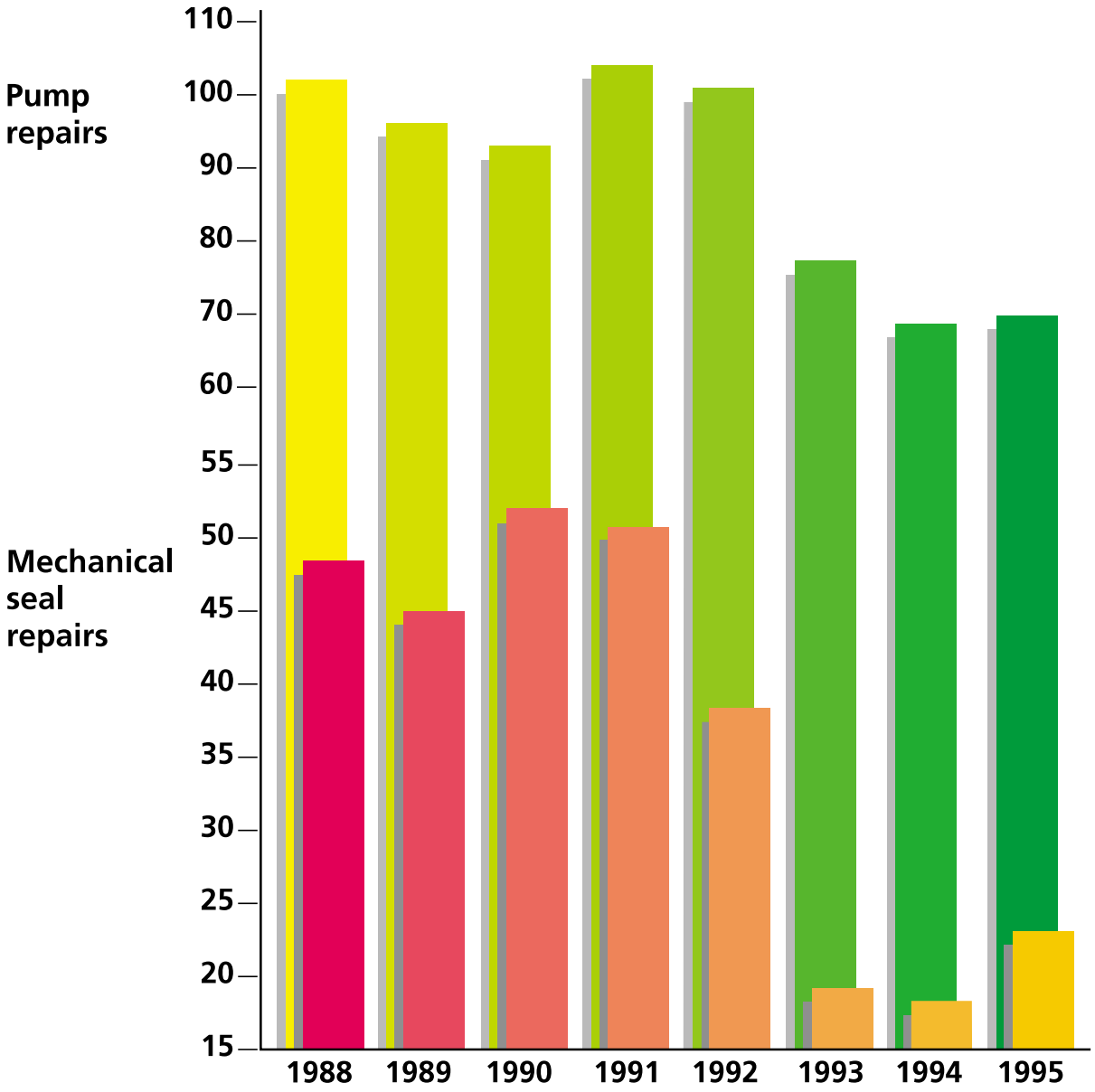
Symptoms of misalignment

Laser shaft alignment cuts vibration alarms



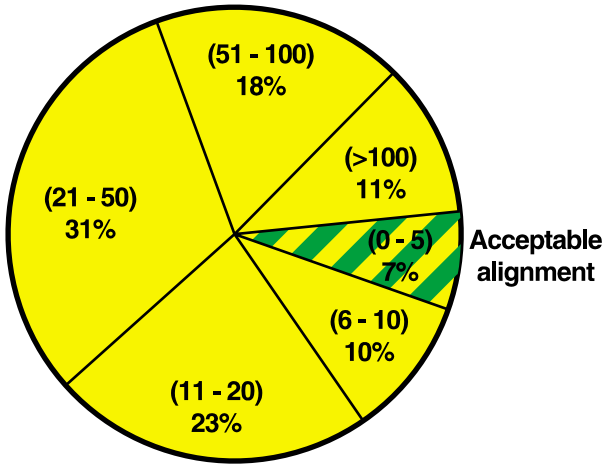
Source: Shell Petroleum, Stanlow, UK

Laser shaft alignment reduces repair incidence

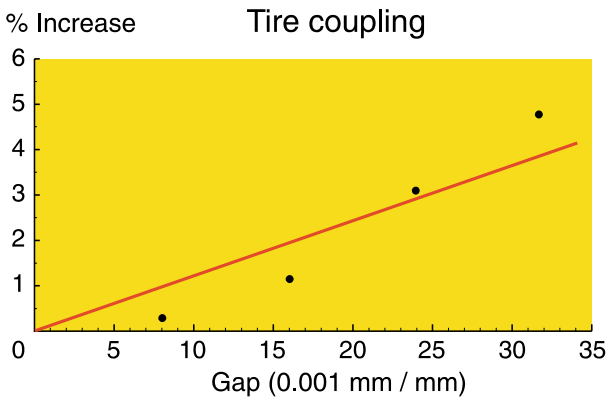


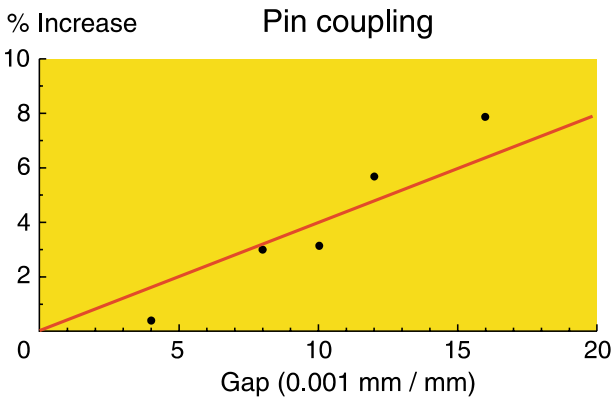
Source: Hoechst AG, Gendorf/Germany

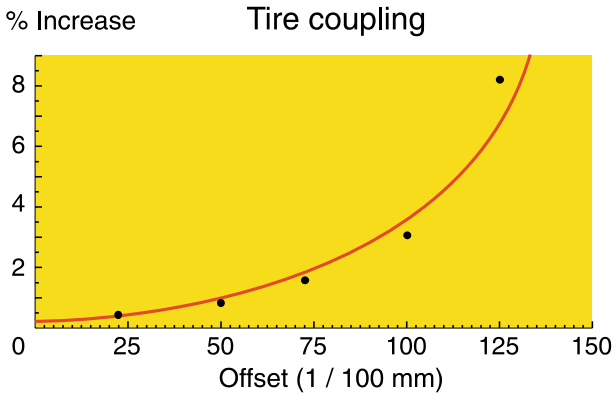
Laser shaft alignment cuts energy costs

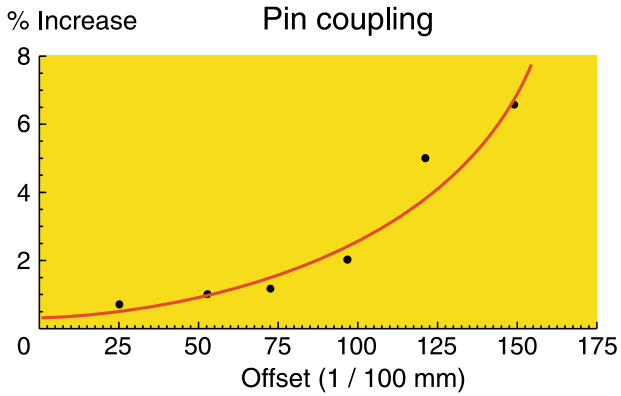


Misalignment versus power consumption, 3000 rpm









Source: ICI Rocksavage Site, Runcorn, UK

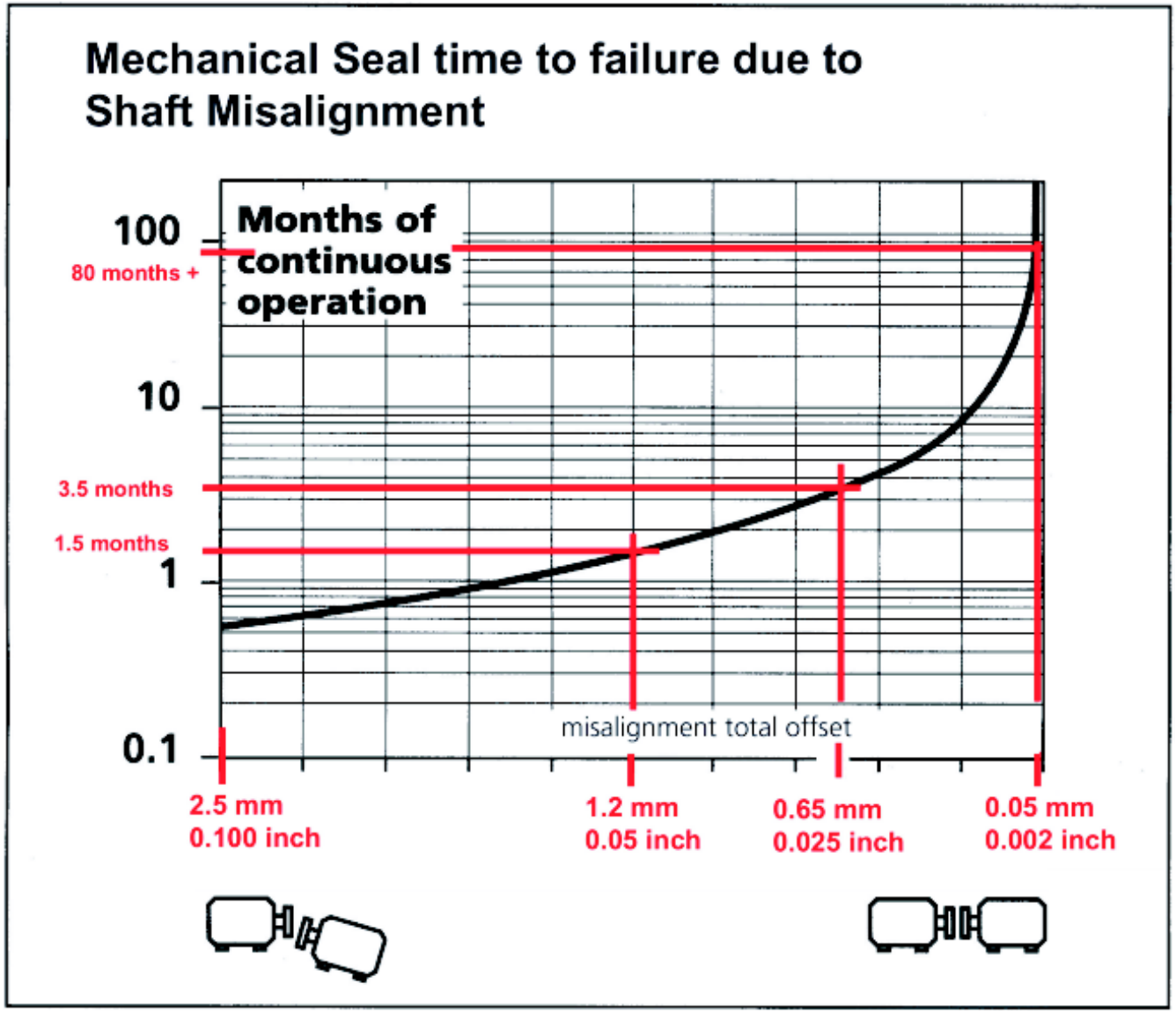
Laser shaft alignment improves pump reliability

A comprehensive pump alignment and monitoring programme at Acordis Acetate Chemicals' Plant in Derbyshire, UK increases MTBF from 10 months to 46 months.

Key factors in achieving the improved reliability included:

- Engineers commitment to the programme
- Patience!
- Laser Alignment
- Condition based maintenance
- Training
- Root cause analysis
- mechanical seal selection
- Bearing selection
- Partnership with suppliers
- Improved piping arrangements
- Pump selection
- Advanced lubrication systems selection

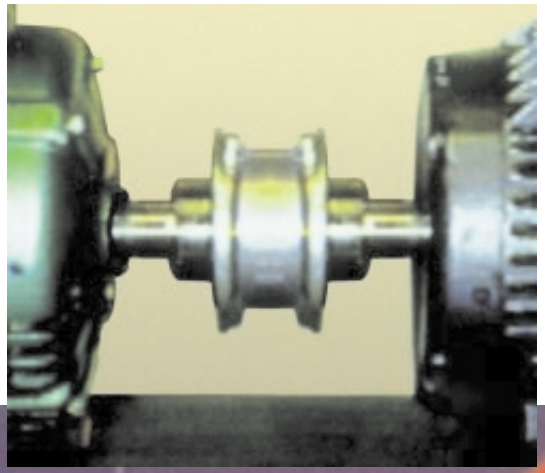
Laser shaft alignment increses seal life



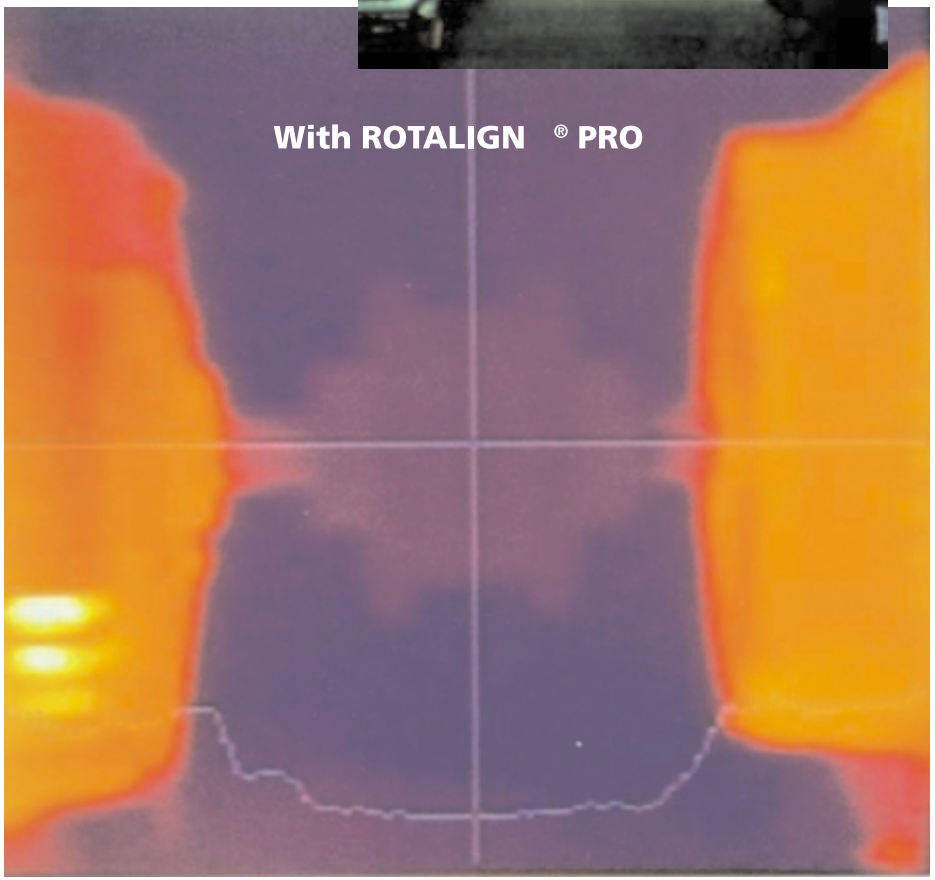
Source: INTECH Training Department of DURAMETALLIC Sealing Systems Worldwide handbook, “Shaft Alignment Techniques”

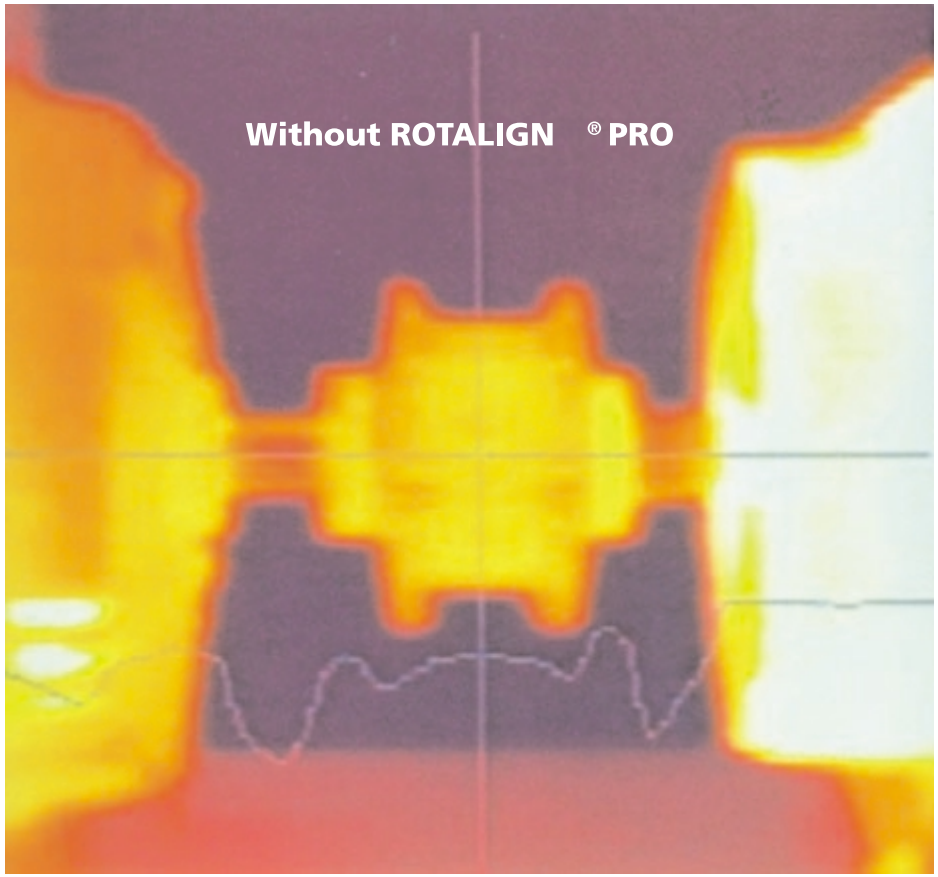
Misalignment increases coupling load

Normal view of coupling as installed



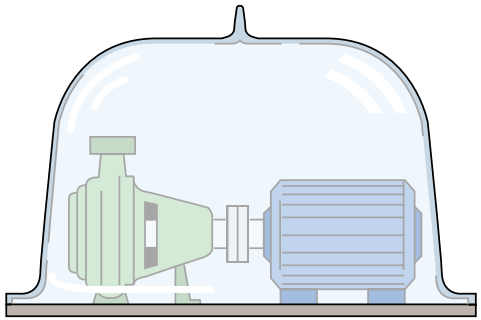
Infrared photos of thermal radiation





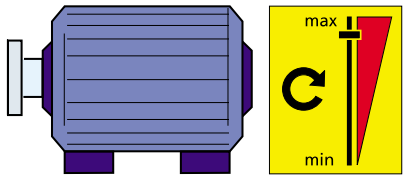
Infrared thermograms courtesy of Infraspection Institute®

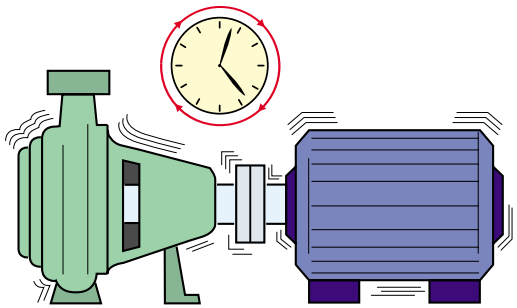
Benefits of laser-optical shaft alignment



- Prevention of catastrophic failures, better maintenance planning

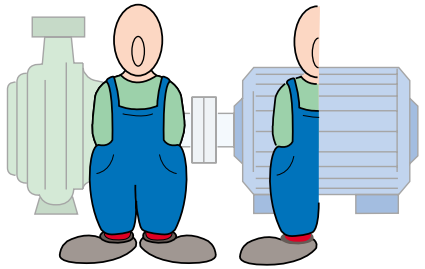
- Higher productivity: higher operating speed, greater power

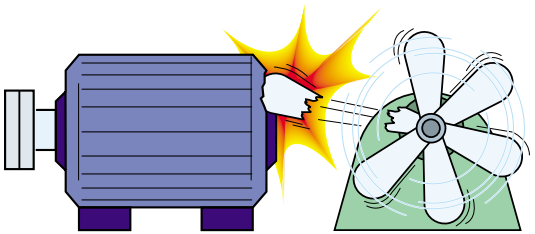




- Extended MTBF (Mean Time Between Failures) = avoidance of downtime, reduced production loss

- Lower labor costs, reduced dependence on specialists, greater manpower reserves





- Avoidance of consequential damage to equipment = reduced spare parts costs

- Reduced spare parts inventory requirements