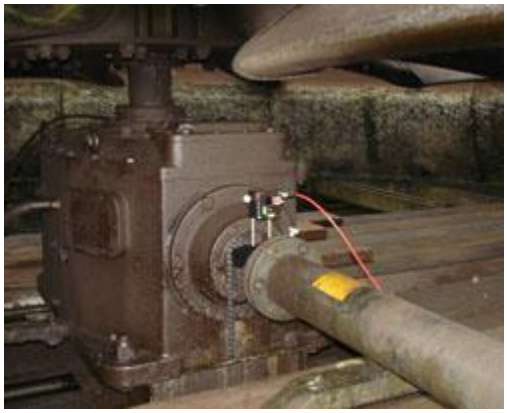
Savings with Easy Laser

Savings example 1

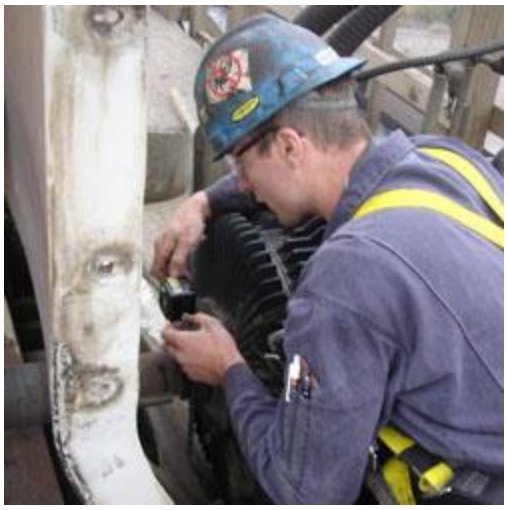
Example cooling tower



Proper Alignment Will Reduce Your Carbon Footprint!

Traditionally, maintenance departments do not sing their own praises. Maybe that should change? In many companies the maintenance departments are still considered to be a necessary expense instead of a profit center. This perception is starting to change as improved maintenance procedures demonstrate cost savings that go directly to the company's bottom line by reducing the energy costs and improving reliability. One example is Lake Erie Steel, a large steel mill in Nanticoke Ontario, who recently purchased an Easy-Laser®, dual beam, shaft alignment system. This system gives them the ability to align the 14 foot long Jack Shafts on their water cooling towers. Spanning the 14 feet coupling to coupling is not a problem for the Easy-Laser® that is capable of shaft alignment over a distance of sixty feet. In the past a contractor had done this work using a single beam system that could not span the required distance of fifteen feet from the motor to gearbox. The procedure for this type of system had been to measure alignment at each coupling on either end of the Jack Shaft and then use both sets of alignment results to calculate the necessary correction in order to align the machine units.

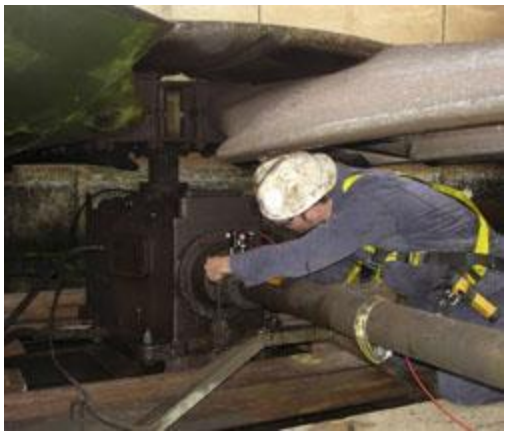
With the Easy-Laser®, Lake Erie's Industrial Mechanic Cliff Dosser, and his crew of apprentices and Coop Students, who work in the Hot Strip Mill Pump Zone, were now able to start the alignment of a jack shaft by mounting one laser/detector on the motor shaft and the other on the gearbox shaft there-by doing true shaft to shaft alignment that was not possible previously. Then by simply using the laser beams which were centered in the closed target at the 9 o'clock position the shaft was then rotated to the 3 o'clock position. This is a very quick and easy procedure that is used when doing rough alignment for jack shafts. It determines immediately if the machine is out of alignment and the proper movements for correction. In this case it showed that the alignment was grossly out so corrective action began.



One Laser/Detector is mounted on the motor shaft which is outside the cooling tower wall.

Now with the laser target doors open, measurements were recorded in as little as forty degrees of shaft rotation. The display showed real time readings in both the horizontal and vertical planes for the moveable machine.

The moveable machine is usually the motor however it is possible to change the configuration of the machine in the laser display if the driven (Gearbox) unit is to be moved or even a combination of different machine feet. The trick is in choosing the correction that requires the least amount of movement. Now all that was needed was to re-position the machine but the real skill was in controlling the movement. At a distance of fifteen feet you don't bump anything; it's a gradual move which is best done with jacking bolts. The work was completed and unit was put back in serviceCliff took an initial amperage reading on the unit before the re-alignment and it was found to be 174 amps. After the work was completed another reading was taken showing 155 amps. That's a whopping 19 amp drop!



There is not much room under the large fan blades for the apprentice, but the other Laser/Detector is mounted on the Gearbox shaft.

Although Lake Erie Steel is running almost 24/7 it was estimated that the cooling tower ran half the year as it is not required in the winter months. That equates to 4,380 running hours so a 19 amp drop works out to a little over 10% in energy reduction which would be 78,735 Kilowatt hours saved. Using the average of 0.07 cents per KW, a savings of $5,511.44 per year is realized.

WOW! I think Cliff and his crew should be quite pleased with themselves as they look at their success in yet another way. They have not only reduced the plant's overall carbon footprint by reducing energy that relates to 54 metric tons of CO_2, or the equivalent of 8.2 cars off the road, but they have also done an excellent job of re-aligning the motor and gearbox which means that, barring unforeseen circumstances, the plant will get the optimum life out of the cooling tower drive. I'd say that was a good days work wouldn't you?

Energy savings pay back the investment

Peter Bengtsson and Peter Lundahl work with preventative maintenance at Akzo Nobel Functional Chemicals AB in Stenungsund. Their objective is that all installation downtime should be planned. To achieve this they use measurement systems for vibration checks and alignment of the machines. Aligning machines using lasers is a given for the majority of larger industries today, but smaller companies have a lot to gain as well. Especially as the costs of current measurement systems are extremely reasonable. Less downtime minimises production losses, a not insignificant cost in many processes. Use of replacement parts is reduced, the working environment is improved with reduced leakage and reduced vibrations. In addition, correctly aligned machines use less energy, something which is soon noticed on the utilities bill, and in the long term even on the environment.

"Together with vibration control, machine alignment is the largest cost saving within maintenance work," explain Peter and Peter.

"One of the foremost reasons that we use Easy-Laser® is the fast support we receive. Something that is, of course, important because we work against the pressure of time when something occurs regardless of whether it is planned or unscheduled"

says Peter Bengtsson.

"I also appreciate that the products are so easy to use, because it allows us to concentrate on the alignment work"

Peter Lundahl adds, and continues:

"I am convinced that an investment in a laser measurement system pays for itself many times over. Which maintenance or operations manager can say no to it?"

Easy-Laser® measurement and alignment systems have frequently paid for themselves within a year through large replacement parts and energy savings. Just one unscheduled stoppage less often means large cost savings.

The department for Functional Chemicals for example has 100 connected machines. They use nearly 7000 kW per hour (6000 hours/year) (2005). The total energy cost is then:
6960 kW x 6000 h x 0.3 SEK = 12,528,000 SEK/year.

If the energy reduction with a good alignment is 1% (125,280 SEK), the investment is repaid within 3–6 months.

In addition, there are 20 sheave/pulleys with an energy consumption of 600 kW per hour (8000 hours /year). Total energy cost for these:

600 kW x 8000 h x 0.3 SEK = 1,440,000 SEK/year.
1% energy reduction corresponds to 14,400 SEK, but for sheave/pulleys this can mean savings as much as 5–10%. Here the repayment period is, in other words, even shorter.

Total saving more than 140,000 SEK/year!

Example Belt alignment

Large savings for sheave/pulley driven machines
Stora Enso in Sweden has focused on developing a program for preventative maintenance since 2003. Their previous maintenance manager took the first step towards large savings for all sheave/pulleys.

"We soon realised that an investment in Easy-Laser® BTA would give great savings"

says Jan-Ove Westlund at the department for mechanical maintenance at Stora Fors AB. He continues:

"Since we started using the BTA to align our sheave/pulleys we can safely say that the consumption of belts and pulleys has reduced considerably. This has even meant greater machine availability. If, like we do, one has 250 sheave/pulleys, it is easy to understand what this means. In that the tool is also extremely user friendly, in principle self instructing, means that it is really utilised to its full."

They measured the energy consumption before and after alignment and received savings figures of between 5 and 20 percent. They started work on the their most important machines such as vacuum pumps, pulpers, mixers and sheave/pulley driven filters, with a focus on two main points:
Alignment using Easy-Laser® BTA for sheave/pulleys
Make access to the pulleys easier by replacing fixed guards with guards with hatches that are easy to open for the alignment work
The savings that could be counted:
200 sheave/pulleys x € 535 / year = € 100,700 (average cost for replacement parts such as pulleys, belts and bearings)
10 % energy saving (average) = € 214,000 (200 sheave/pulleys with average 25 kW motor with 8000 operating hours and € 0.054/kWh)
Avoidance of 24 hours paper machine downtime = € 216,000
Several examples
Another company, SSAB in Borlänge, has more than 200 sheave/pulleys in its facilities. A pulley package consisting of pulleys, belts, bearings and seals cost on average approx. 5000 SEK. If the operating times can be extended from one year to two it means a

saving of 2500 SEK per pulley package. If one assumes that each BTA is used to align 50 pulley packages a year it means a saving of 125,000 SEK.)

Transmissions with several wide belts are especially sensitive. It is easy to understand that the difference in belt tension between the inner and outer belts can differ greatly when aligned incorrectly. This reduces efficiency as not all belts are driven optimally. If one belt is worn then all belts must be replaced with new ones at the same time, which adds expense to the entire operation. Even wide belts are affected more as the tension is uneven over the entire width. Extending service life thanks to correct alignment is easy. Large savings can also be made when it comes to the cost of these types of belts and pulleys.

Savings calculation example

Laser alignment justification

It has been proposed that laser alignment equipment should be purchased. It would be used on the connecting shafts between all motors and pumps, mixers, fans, compressors etc on site to ensure they are correctly aligned.

The current system used for shaft alignment is a straight edge. This is relatively inaccurate since it depends on the judgement of the human eye. There are four ways in which the shaft alignment can differ from the ideal situation of being perfectly aligned; horizontal and vertical offset where the rotating axes are parallel but not colinear, and horizontal and vertical angularity, where the two shafts are meeting at an angle. It is extremely difficult to get all 4 within acceptable limits of accuracy when aligning with just a straight edge. Typically the shafts will be misaligned by about 0.5mm using this technique. However, using laser alignment will typically reduce the offset to less than 0.1mm and the angularity to less than 0.1mm/100mm (angularity is measured as a ratio of the gap between the shafts to their diameter).

This report will go on to show that improving these alignments will

lead to savings in the maintenance budget and the power consumption of the plant.

Energy Cost Saving: Secondary Plant

A laser alignment system was tested on pump MP421. The current drawn by the motor was measured at 12.2 Amps. After being re-aligned, this came down to 11.8 Amps, a 3.28% reduction in power, which equates to a saving of 0.288 kW or £77.58 over the course of 1 year (figures as per 2002).

The possible savings that could be made in Secondary are shown below. It has been assumed that the power consumption of all the machinery will reduce by only 1%, as this is likely to be the absolute minimum. As shown above, savings of 3.28% and perhaps higher may be achievable in some cases.

Power in kW

Machines		Number	Minimum	Maximum
Pumps	30	5	50	
Fan	5	6	30	
Compressors		4	-	250

Plant size (Secondary) 1180 kW

Cost of power £0.0308

Machine operating time 24 x 365 = 8760 hours per year

Total cost of power in one year 1180 x 0.0308 x 8760 = £318,373.44

Power saving 11.8 kW

Power cost saving £3,183.73

It has also been assumed that all the pumps have a power rating of 5kW. This will be lower than the actual value, since the pumps range from 5-50kW. Similarly, it has been assumed that the fans all have a power rating of 6kW. Making these assumptions has reduced the predicted savings that would be made to the absolute minimum.

N.B. Power saving for MP421 motor above was calculated using:

Power = 3 x Current x Voltage

Repair Cost Saving: Secondary Plant

This is comprised of both the savings made due to a reduction in the amount of spare parts used, and the reduction in labour necessary to carry out repairs. Typically, the lifetime of a bearing can be increased by a factor of eight, and couplings, shafts, and seals all benefit from reduced strain on the shaft.

Using Straight Edge Alignment

Number of machines in Secondary 39
Average repair costs per machine £250
Current MTBF 6 months
Current repair costs £19,500 per year

Using Laser Alignment

Achievable MTBF 20 months
Possible repair costs £5,850 per year

A yearly saving of £19,500 - £5,850 = £13,650

The current and achievable MTBF, and the average repair costs quoted above, are from a report compiled by Pruftechnik Laser Alignment. This may seem to be a fairly large increase on the current 6 months, so again we should assume the worst case scenario. It should be noted that an increase of just one month on the MTBF to 7 months would give yearly repair costs of £16,714, a saving of £2,786.

Labour Cost Saving: Secondary Plant

This is comprised only of the labour savings made due to the reduced time taken to carry out the shaft alignment.

Using Straight Edge Alignment

Time per alignment

1 hour

Number of aligned machines

39

Frequency each machine is aligned per year

1.5 times per year

Total number of alignments per year

58.5

Hours spent on alignment per year

58.5 hours

Average labour cost

£23 per hour

Technicians required per alignment team

2

Cost per team

£46 per hour

Total yearly labour cost for alignment

£2691

Using Laser Alignment

Time per alignment 1 hour

Number of aligned machines 39

Frequency each machine is aligned per year 1 time per year

Total number of alignments per year 39

Hours spent on alignment per year 39 hours

Average labour cost £23 per hour

Technicians required per alignment team 2

Cost per team £46 per hour

Total yearly labour cost for alignment £1794

Total saving made per year £2691 - £1794 = £897

Using Dial Test Indicators (DTIs)

It would seem that DTIs are a viable option, as they are more accurate than using a straight edge and are much cheaper than laser alignment. However, each machine alignment would take 4 hours, so the yearly labour costs for alignment would be £7176. They are also not as accurate as lasers, so would not reap such large savings to the

repair and electricity costs.

Early Savings: Secondary Plant Only

Labour £897
Electricity £3,183.73
Repair £2,786

Total
£6,866.73

This is the bare minimum that would be saved in the secondary plant. The electricity savings could be up to 3 times higher, since it was shown that savings of up to 3.28% could be made, but for the purpose of these calculations a value of 1% was used.

The savings made to the repair costs could be as much as £13,650 if the Mean Time Between Failure increased to the predicted 20 months rather than the 7 months used in these calculations. The Laser Alignment system would also be used on the entire site, and not just the secondary plant. The Secondary plant represented only 41% of the electricity usage across the site between September 2000 and August 2001. If similar savings can be made site-wide, electricity savings would therefore be 2.5 times the above value. Repair and labour savings would also increase accordingly.

Also left out of these calculations is the money saved through increased productivity, since downtime is reduced. The environmental implications of the site reducing its power consumption should also be considered, as all contributions help to keep the company in line with the Climate Change Levy.

Repaid within a year
In light of this, it can safely be stated that the cost of purchasing the Easy-Laser® alignment equipment would easily be repaid within a year, and it would continue to repay itself several times over in the coming years.