producingresults

Misguided intentions

Uncontrolled forming forces can ruin a mill

By W.B. "Bud" Graham, Contributing Writer

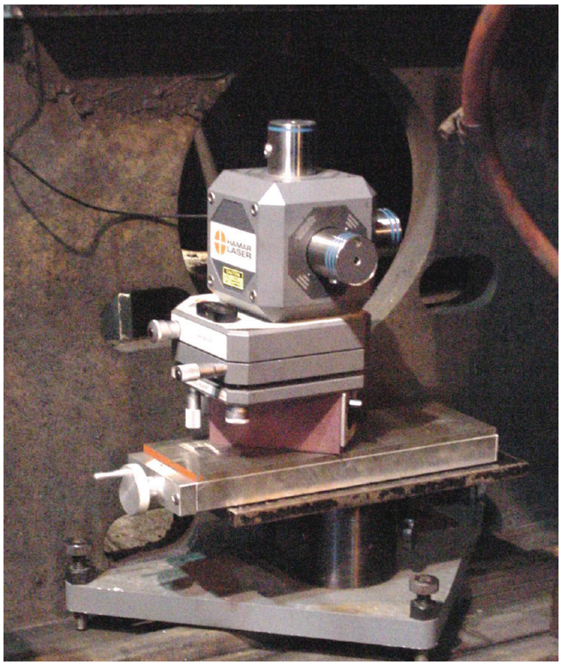

Figure 1
A three-plane laser emitter is installed on a 6-inch pipe mill. The laser base is resting in the keyway mount plate for the weld box.

It's Monday morning and that new set of roll tools has just arrived–you know, the tool set the sales department insisted would make the new best-selling tube. You haven't seen a new roll, let alone a new set, in so long it's like Christmas morning. Later that day the tools are on the mill, they don't work, and the boss is fit to be tied. Where did you go wrong? It has to do with misguided intentions.

What sense does it make, knowing that the tube mill is a toolholder, to spend money to buy the best roll tooling made and put it on a mill that is in poor mechanical shape? The answer is, It makes no sense! Having said this, it seems that money can be found for new tools and regrinds more readily than for maintenance or, dare I say it, alignment. I can hear management's response now: "Why should we align the mill? The manufacturer did that when the thing was made! We don't have money or production time to waste on …" Well, you get the picture.

Running a misaligned mill is a bad habit, and bad habits die hard. The fact of the matter is, if you don't or won't align your mill, you will spend more time and money replacing broken components (such as bearings, shafts, and spacers) and regrinding the tooling. These activities lead to downtime, and in the end you will have gained nothing. In fact, you will have lost production time. Why does a misaligned mill cause all these problems?

The answer is simple: It has no choice. You are trying to process a slit-to-width coil that, thanks to modern technology, is straighter, flatter, and more consistent in its mechanical properties than ever. You are trying to process it with precision-machined roll tools through a straight-line process. Oh, there it is, that misconception. The path through your mill is not a straight line. Misaligned roll shaft shoulders, worn keys, out-of-level shafts, a tipped weld box and Turk's head put that new set of roll tools in places the roll designer never thought of!

Why Align?

Mill alignments are necessary to get the best performance from your tooling. The industry has developed a number of ways to align a mill, including stretched piano wire and scales, an optical transit and scales, and rotating-plane lasers with digital readout. The last method is the quickest and most accurate and can be performed by a single person on small to medium-sized mills (see **Figure 1** and **Figure 2**).

When shoulders are not aligned, the roll tooling can't perform as designed, and more often than not, mill equipment is damaged while you are fighting to make a good weld. To illustrate the effect of misalignment on bearing life, take a look at an alignment report for a typical W-25, universal-driven tube mill. The

Figure 2

The laser target is mounted on the centerline of the last breakdown pass (top). The digital readout shows that the shaft shoulder is –0.006 in. from the centerline. A negative number indicates the thrust is toward the drive side of the mill (bottom).

report is collected by placing laser targets against reference surfaces (shaft shoulders, reference keyways, and horizontal surfaces) and then reading their digital position relative to projected laser planes. The laser projector produces three simultaneous projected planes in space (two vertical planes at 90 degrees to one another and a horizontal plane) by spinning three laser turrets at a high speed. Laser targets positioned in the line of sight to the laser projector intercept the projected plane and produce a readout of the intercept. The accuracy is 0.001 inch over 100 feet in a 360-degree view from the projector.

Interpreting the Data

Figure 3 shows data taken from a typical mill report. Sizing stands 1, 2, and 3 have some of the most severe offsets (see **Figure 4**). Calculations show that these offsets generate excessive forces, such as:

- Sizing stand 2, bottom shaft: a 7,829-pound thrust load toward the drive side of the line
- Sizing stand 3, top shaft: a 4,945-lb. thrust load toward the operator side of the line
- Sizing stand 3, bottom shaft: a 2,060-lb. thrust load toward the drive side of the line

These loadings are created by the roll shaft misalignment and are expressed by a rolled weld seam—poor inside bead scarfing and paste welds.

Thrust loads are adsorbed by only one of the bearing pairs in the inboard bearing blocks (a pair of opposing tapered roller bearings maintains the roll shaft location). In this case, thrust loads are considered additive to radial loading. With proper installation, lubrication, preloading, straight shafts, and minimal shock loading, the normal bearings will have a long life. Assuming a bearing life expectancy associated with 90 percent reliability, the calculated L 10 life (for the projected load) for a typical Timken bearing is 144,619 hours. In the real world this bearing life never occurs because of a variety of factors.

When thrust loading is added, calculated bearing life drops dramatically. The operator side bearing supporting the bottom shaft at S2 now has only a 0.81 percent life expectancy. Similarly, the top and bottom shafts at S3 have 2.45 percent and 12.83 percent life expectancy, respectively. This illustrates why bearings are falling out of the mill at an alarming rate.

I'm sure that the bearing suppliers would rather you keep operating with large side thrust loads. However, this eats up bearings. The bottom line is that mill alignment pays back every day in increased uptime, reduced maintenance costs, and longer tool life. Quit being a

	Fin 1	Fin 2	Fin 3	Sizing 1	Sizing 2	Sizing 3
Top Shaft	0.002	(0.001)	(0.002)	0.022	0.002	0.012
Bottom Shaft	0.002	0.002	0.000	(0.001)	(0.019)	(0.005)
Center Distance	36	26	26	226	26	26
Force From Offset–Top	310	(412)	(824)	14	824	4,945
Force From Offset–Bottom	310	824	0	(1)	(7,829)	(2,060)
Total Load–Top	2,729	2,831	3,243	2,433	3,243	7,364
Total Load–Bottom	2,729	3,243	2,419	2,420	10,248	4,479
Calculated Bearing Life						
Hours–Top	96,699	85,608	54,425	141,902	54,425	3,537
Hours–Bottom	96,699	54,425	144,619	144,494	1,175	18,548
Percent of Baseline–Top	66.86	59.20	37.63	98.12	37.63	2.45
Percent of Baseline–Bottom	66.86	37.63	100.00	99.91	0.81	12.83

Figure 3

The offsets vary from 0.001 in. (fin pass 2) to 0.022 in. (sizing pass 1). Large offsets can reduce bearing life dramatically. In the case of sizing pass 2, the bearing life is 0.81 percent of its baseline.

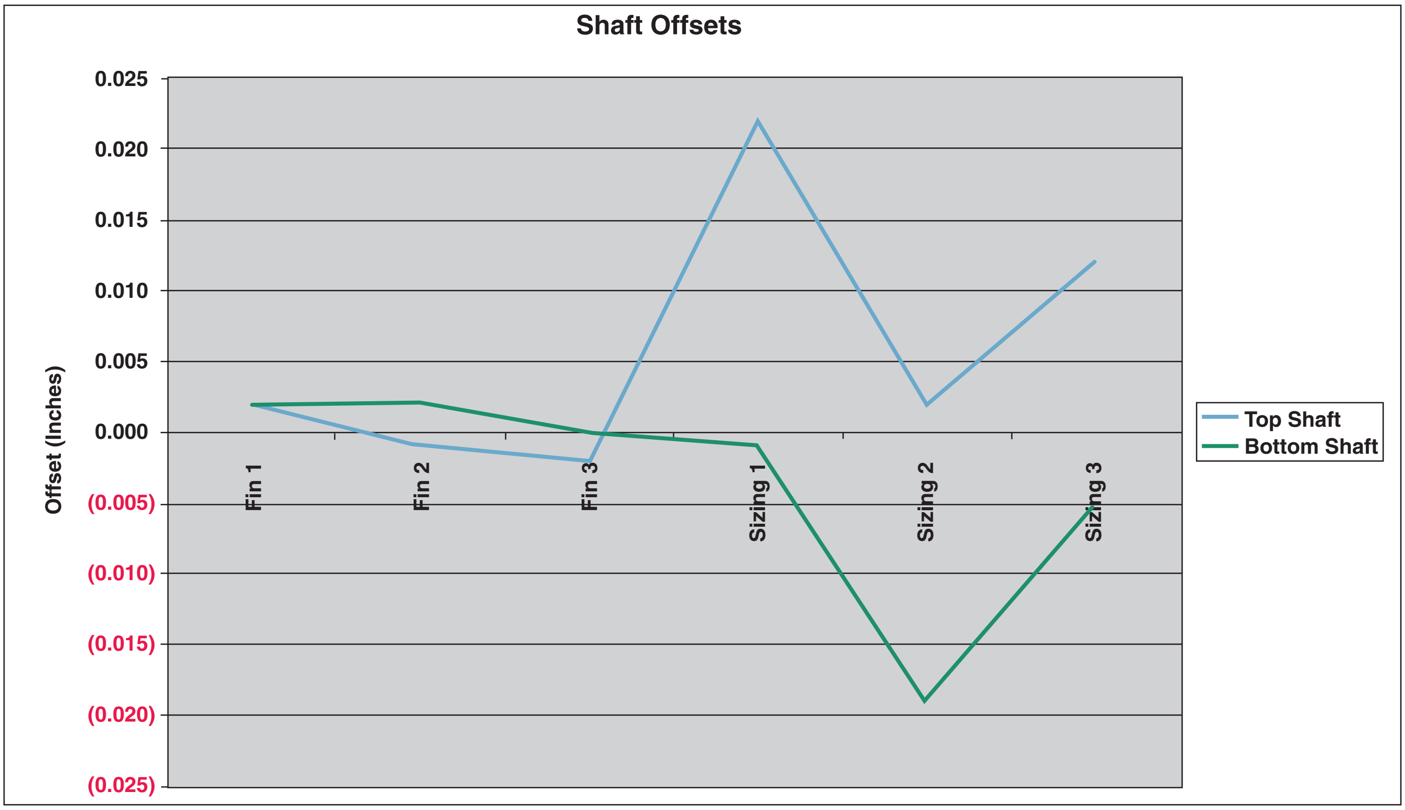

Figure 4

Although an offset of 0.022 in. doesn't sound like much, a graphic representation shows that indeed it is a severe amount of offset.

firefighter and killing production every time something breaks. Perform planned maintenance so outages are on your schedule, not driven by breakdowns. Ditch the bad habit—align the mill for increased reliability (especially in the bearings) and an easier day at work!

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