Rollie's Dad's Method of Lathe Alignment

http://www.John-Wasser.com/NEMES/RDMLatheAlignment.html

What you need

- A round bar
  - The bar length should be about 1/3 to 2/3 the bed length.
  - The bar should be of one diameter along most or all of its length. If it is not you will need a micrometer to accurately measure its diameters.
  - The bar does **not** have to be completely straight.

  Since Rollie has a car repair shop, he uses the shafts from junked shocks and struts.
- A dial indicator
  - The end of the measuring rod should be flat.
- A means of mounting the indicator on the cross-slide at lathe center height.
  - To do a vertical alignment: A means to mount the indicator on the cross slide so it is directly above (or below) the lathe axis.
- A chuck of any type to hold the bar.
  - Runout in the chuck is not a problem (for the same reason that a slight bend in the bar is not a problem).

What you DON'T need

A tailstock, perfectly straight bar, a collet or precision chuck or any tool bits.

Applying the method (Horizontal Alignment)

1. Put the bar in the chuck.
2. Mount the dial indicator on the cross-slide at the center height of the lathe.
3. Pull the indicator's measuring rod back by hand (to avoid damage to the indicator) and move the carrige so the indicator is near the chuck end.
4. Release the indicator rod and, turning the lathe by hand, note the highest and lowest measurements on the indicator.
5. Average the high an low readings (add together and divide by two) to get the "near end average distance". If you suspect the bar of not being a single diameter along its length, measure the diameter and subtract half the diameter from the average to get a corrected "near end average distance"
6. Pull the indicator's measuring rod back by hand to clear any irregularities and move the carrige to the end of the bar away from the chuck.
7. Release the indicator rod and again, turning the lathe by hand, note the highest and lowest measurements on the indicator.
8. Average the new high an low readings (add together and divide by two) to get the "far end average distance". If you suspect the bar of not being a single diameter along its length, measure the diameter and subtract half the diameter from the average to get a corrected "far end average distance".
9. **The difference between the "near end average distance" and "far end average distance" is a measure of the misalignment of the spindle axis with the ways.**
10. To correct the problem, put a piece of paper under the near-side foot at the headstock end of the lathe (the feet at the tailstock end are sometimes pivoted to act as a single foot). Re-do the measurements

starting at step 3. If the alignment gets better, add more sheets of paper until the alignment is perfect. If the alignment gets worse, put the paper under the far-side foot at the head end until alignment is achieved.

Applying the method (Vertical Alignment)

1. Put the bar in the chuck.
2. Mount the dial indicator on the carridge so that it is directly above the center line of the spindle.
3. Pull the indicator's measuring rod back by hand (to avoid damage to the indicator) and move the carrige so the indicator is near the chuck end.
4. Release the indicator rod and, turning the lathe by hand, note the highest and lowest measurements on the indicator.
5. Average the high an low readings (add together and divide by two) to get the "near end average distance". If you suspect the bar of not being a single diameter along its length, measure the diameter and subtract half the diameter from the average to get a corrected "near end average distance".
6. Pull the indicator's measuring rod back by hand to clear any irregularities and move the carrige to the end of the bar away from the chuck.
7. Release the indicator rod and again, turning the lathe by hand, note the highest and lowest measurements on the indicator.
8. Average the new high an low readings (add together and divide by two) to get the "far end average distance". If you suspect the bar of not being a single diameter along its length, measure the diameter and subtract half the diameter from the average to get a corrected "far end average distance".
9. **The difference between the "near end average distance" and "far end average distance" is a measure of the misalignment of the spindle axis with the ways.**
10. To correct the problem, put a piece of paper under both feet at the tailstock end of the lathe. Re-do the measurements starting at step 3. If the alignment gets better, add more sheets of paper until the alignment is perfect. If the alignment gets worse, put the paper under both feet at the headstock end until alignment is achieved.

Why This Method Works

The bar acts as a circular cam. With a perfectly straight bar in a perfect chuck the bar is concentric with the spindle axis. Since we don't live in a perfect world there is almost always a slight offset between the center of the bar and the spindle axis. This offset varies from place to place along the bar due to slight bends and/or imperfect mounting.

At any place you pick along the bar the center of the "cam" is some unknown distance from the spindle axis. We'll call this unknown distance 'X'. As you turn the spindle axis the high measurement will be "Bar_radius + X" and the low measurement will be "Bar_radius - X". Their average will be:

- ((Bar_radius + X) + (Bar_radius - X)) / 2 =
- ((Bar_radius + Bar_radius) + (X - X)) / 2 =
- (2 * Bar_radius) / 2 =
- **Bar_radius**

As you can see, the value and direction of the deviation have no influence on the final result. That is why it doesn't mater if the chuck is accurate or the bar has one or more slight bends.

If the bar is not the same diameter at both places we need to measure the diameters and adjust the readings. Averaging the high and low readings gives us a reading for the local bar radius. We convert that to a reading for the bar center by measuring the bar diameter and subtracting half the diameter (a.k.a. The Radius).

Common Error

Some people will find the near-end average distance, turn the lathe till it reads that distance and then move the carridge down the ways with that mistaken assumption that the reading shouldn't change. **That method will only work if your bar is known to be perfectly straight and the chuck is known to hold the bar in perfect alignment with the spindle axis.** Do not confuse that method with this one.

I learned all this from a fellow member of the New England Model Engineering Society. Join us the first Thursday of every month at the Charles River Museum of Industry in Waltham, Mass.