OPTOFORM® 40 - Spindle Balance Procedure

The SP-75L Spindle used on the Optoform Machine is balanced to very precise levels at the factory using standard collets. To maintain this degree of balance in the field requires that any collets or part holding devices or parts be made symmetrical with no unbalanced artifacts introduced. These non-symmetrical artifacts may be slots, pins, non-concentric parts, or anything that introduces an unbalanced load. Due to the relatively light-weigth spindle shaft, even small unbalanced loads may have an undesirable affect. These unbalanced loads introduce a vibration into the machine, which may result in parts with a "once per revolution" error machined into them. The amplitude of this error is directly related to the level of imbalance introduced into the machine. When measured on an interferometer this error shows a step at the center of the part commonly referred to as "once per rev. error". Using a radiuscope this error may show up by viewing the projected image. If excessive "once per rev." is present there will be a significant difference in focus between the horizontal and vertical lines. If this vibration is severe enough (i.e. you can feel the vibration by putting your hand on the spindle) damage to the machine may occur if not corrected. Ideally the vibration should be measured using a balancing instrument in conjunction with an accelerometer in 2 planes and corrected by adding set screws in the holes provided at the front and rear of the spindle. Normally, the imbalance introduced in the field occurs at the front of the spindle due to collets or parts that are not symmetrical. This can be corrected by adding or subtracting weight from the front side of the spindle only. Another way of observing the amplitude of this "once per rev. error" is by using the data gathering capabilities of the Optoform Machine. If you go to the maintenance screen and select pmac utility, then servo tests and perform a Z axis 30 second data gather at zero slide speed with the spindle running @ 800RPM, the amplitude of the imbalance may be observed. The resulting chart is automatically scaled with the bandwidth expressed in counts. Each count represents 8.6nm. Typically, the amplitude of this error is under +/-12 counts when balanced at the factory. A baseline for the machine can be established by doing a data gather when the machine is first set up using the dummy collet. The amount of imbalance allowable may be different for each user, depending upon their tolerance, post polish requirements, etc. To prevent damage to the lathe, Precitech recommends this value be kept below +/-30 counts as measured using the data gather referred to above.

It is possible to compensate for unbalanced loads by adding set screws in the holes provided at the front of the spindle and observing the change in the amplitude of the data gather*. The preferred method would be to use collets or part holders which are designed symmetrically. This can be achieved by putting opposed slots, set screws or any artifact which creates symmetry of the rotating mass (i.e. if your have a slit at 0 degrees, you should have an opposing slot at 180degrees etc.).

*To use this technique, label the balance holes on the collet holder OD with a marking pencil 1 thru n. Older spindles have six holes, newer ones 12. Establish a base line data gather with no weight, then place a small setscrew in hole #1. Do a data gather with the weight at this location, then move the weight every 90 degrees around the spindle and

repeat the data gathers at each location. Select the location with the lowest amplitude and move the weight to the holes nearest this point to find the exact location of the desired weight. When the hole with the lowest amplitude data gather is located (even if this value is higher than the data gather with no weight) this will be the hole where additional weight is needed. If the value with the screw is higher than the value with no weight, use a smaller screw or grind material off the existing screw. If this is still too much weight, place 1 screw flush in the desired hole and a second screw 180° from the first, but bottomed out in the hole. Moving the screw in and out will allow the balance to be fine-tuned. If the amplitude of the data gather is lower than the no-weight value, use a larger screw in an attempt to reduce the imbalance further. Moving the weight from flush to bottom of the hole will determine whether more or less weight is required. If moving the screw from the bottom of the hole to flush reduces the amplitude, then more weight is required and vice versa.