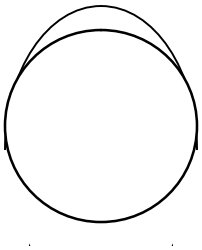
Western Instruments

Established 1965

July 14, 2009

Flash Gauge Calibration Standards

The Flash Gauge provides the Welder Operator with a Graphical Representation or Profile of the Weld. This profile is affected by several different parameters, but the most detrimental is the consistency or the Shape of the outside surface. If the surface is of a constant radius, and reasonably round, then the Weld Profile displayed is very reliable. If the roundness of the two abutting edges is not consistent, then the ultrasonic wave is affected and errors will occur in the displayed profile. This inconsistency can be best described as a Pear Shaped tube, or where the tube is often referred to as a high oval.



The illustration to the left shows a circle to illustrate a tube in a mill. The oval shape in the background would represent a weld shape that is high oval. A weld is typically easier to make when the edges come together 'peaked' or in a high oval. This is a poor practice and eliminates any chance of making a high quality weld. A high quality weld starts with a consistently round weld shape, which allows the operator to make a controlled ID and OD cut to remove weld flash.

A welder operator will normally use the tube in the mill as his calibration standard, so the Flash Gauge will be standardized to the 'warm' steel, at the extremes of the oscillator's (or Probe's) stroke. Using a specially prepared sample, or calibration standard, will only show the operator how nice the displayed profile could be, as the surface on a sized tube is round. However, showing the operator what a round tube will do to his display, will encourage him to weld round.

A second detrimental affect to the displayed profile of the Flash Gauge is the shape of the OD Cut, which is made by the outside trim tool. The simplest way to remove the OD Flash is to used a flat tool, however this produces two sharp edges, on each side of the cut. These edges represent a drastic change in the shape of the surface and will actually cause the ultrasound to refract, and thus produces an error in the profile. Often, people don't consider the detrimental affects of a flat cut, but when the tube is sized, the weld fills out so the OD surface is round. The detrimental affect is from the cold work, that is caused by material from the inside area flowing to fill the outside of the weld. High quality welds are trimmed with a contoured OD tool, with a radius larger than that of the tube being welded.

With the detrimental affects to the Flash Gauge outlined, we can make some considerations for anomalies we can add to a Calibration Standard. Firstly, we won't try to simulate any High Oval, as it is completely impractical to reproduce. However, we can simulate different Flash removal anomalies, but we should start with a tube that is sized, with the ID Flash not removed. This sample, between 60 to 100 cm in length could contain some residual OD Flash, however it would not size to a round condition.

The first step will be to make the Calibration Standard into a segment, that will sit on the tube in the mill. This is done by longitudinally cutting the tube at approximately the 3 and 9 o'clock

positions. There will be residual stress in the tube, that will cause it to open slightly, and the longitudinal cuts may have to be adjusted to ensure the segment does not rock on the tube in the mill. The actual weld centerline of the sample will be used as the artificial weld, which is backward from how a Weld Testing Calibration Standard is made.

The first, and simplest items to add to the standard will be, varying degrees of a simulated flat OD Tool. With the segment of tube mounted in a Universal Milling Machine, a 25mm End Mill is used to take varying depths of cuts that are approximately 230mm long. The OD surface is divided into thirds for; Flush OD (as sized), 10% wt OD cut, & 20% wt OD cut. The length and depth of the divisions can be increased (or decreased), but the maximum depth should never exceed 30% of the wall thickness.

After the OD 'defects' are added to the sample, it can be removed from the Milling Machine, so the longitudinal OD sectors (OD anomalies) can be marked and identified, on both the inside and outside surfaces. The ID Trim conditions can now be made from the residual ID flash. Here, the flash should be left at one end of a sector, then ground or machined down to an undercut (up to 30% wt) at the opposite end of the sector. These reductions in flash height and increased amounts of undercut should be made in steps as opposed to a continuous reduction. Each reduction on each sector, from flash in to maximum undercut, should match on each sector.

This type of calibration standard is an excellent training aid for operators, as well as a good demonstration tool for auditors. Such samples are not necessary for each size or wall thickness, but should be made for a reasonable cross section of Diameter to Wall Thickness Ratios. The product in the mill, while the mill is running, is the best calibration standard as the surface condition is consistent, and the temperature is elevated, neither of which can be simulated on a calibration standard.