TECHNICAL BULLETIN

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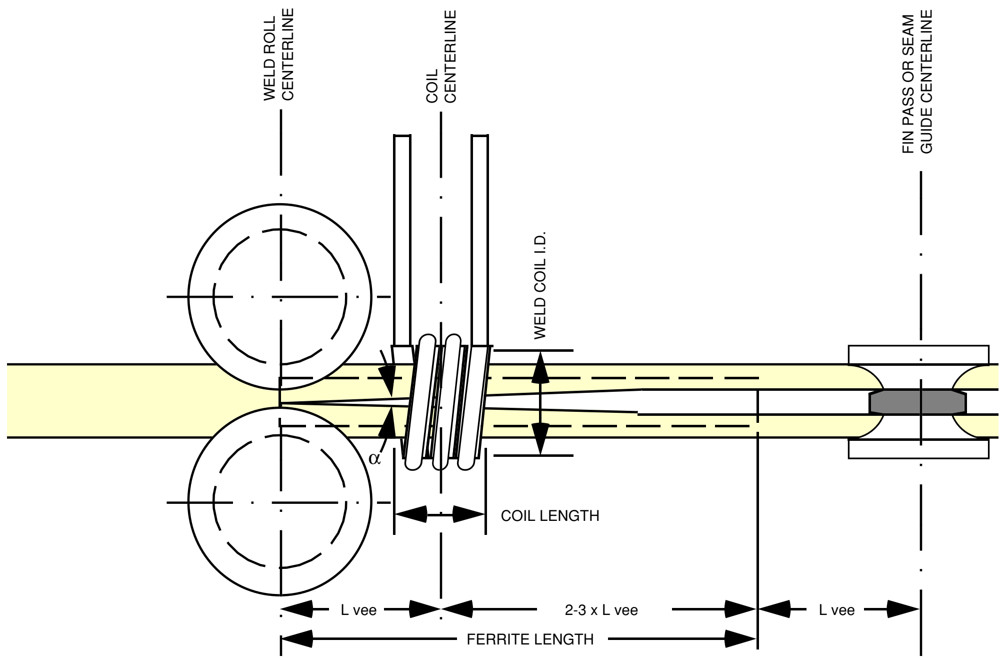
COIL & IMPEDER POSITION FOR INDUCTION WELDING

The placement of the work coil & impeder have more effect on the efficiency of the induction welding process than any other factor. The key to efficient operation lies in keeping the distance from the center of the coil to the weld point as short as possible. This distance is often referred to as the "vee" length, shown as L (vee) in the diagram below.



Vee length

In general, L (vee) should not exceed the welded tube diameter, although exceptions must be made if the wall thickness exceeds 10% of the tube diameter, or if the weld rolls are large in relation to the tube diameter. Shortening the vee by as little as 10% can decrease weld power requirements by 25%!

Coil Length

A coil has its highest "Q" (Electrical quality factor) when its I.D. is equal to its length. In most electrical circuits, this results in maximum efficiency, however this is not usually the case with induction welding. A shorter coil results in a shorter effective vee length, which increases the efficiency of the welding process as a whole. The coil must also match theoutput impedance of the welder in order for maximum output power to be realized. Since coil length, diameter & number of turns all affect impedance, care must be taken when changing the coil length. In general, the recommendations of the welder manufacturers should be followed.

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Coil Diameter

The coil I.D. should be such that there is sufficient clearance with the welded tube to avoid electrical flashovers or coil damage due to broken coil end welds. For tubing from 25mm to 250mm, a radial clearance of 10-15% of the tube diameter is recommended. This clearance may need to be increased for tubing below 25mm & may be reduced for tubing over 250mm. Excessive coil clearance requires higher coil current, which wastes energy and may cause overheating of the coil itself.

Ferrite Position & Length

Ferrite within the impeder should extend from a point at least 2 vee lengths ahead of the coil, to the weld point itself. The actual weld point occurs ahead of the centerline of the weld rolls. With larger sizes of tubing (250mm & up), it may not be possible to extend the ferrite 2 vee lengths ahead of the coil, due to the presence of internal tooling, seam guides, or the proximity of the last fin pass rolls. If the impeder length has to be reduced, there will some loss in welding efficiency.

Under no circumstances should the ferrite extend back through the centerline of the last fin pass, or any rotary seam guide that may be present. Doing so will create a second “vee” ahead of the coil. Current flowing in this vee will cause arcing & preheating of the strip edges.

Impeder Diameter

For tubing under 100mm in diameter, we recommend using the largest impeder possible. From a practical point of view, there must be reasonable clearance between the impeder & the inside of the tube, in order to minimize damage to the impeder. For smaller tubing, we recommend an impeder diameter equal to tube O.D. minus 4 times the wall thickness. For a 25mm tube with a 1.5mm wall thickness, this results in an impeder diameter of 19mm. For larger tubing, the impeder should be 70-80% of the tube I.D.

Larger diameter tubing often uses impeders that cover two arcs under the edges of the strip, rather than extending all the way around the I.D. of the tube. This reduces the cost of the impeder assembly with only a small loss in efficiency. In the case of very large tube mills in the 400 - 600mm diameter range, impeders may only occupy 30% of the inside circumference of the tube.

Approach Angle (a)

This is the angle between the two strip edges as they approach the weld point. It is difficult to define because the edges curve in toward each other, so they do not really form a triangle. The efficiency of the high frequency welding process is partly due to the “proximity effect”, which causes a concentration of current on adjacent surfaces. As the edges are brought closer together, their inductance is reduced, requiring less voltage to drive the current required to heat them. The situation is somewhat complex because the voltage & current are not in phase with one another, but reducing the approach angle will reduce weld power requirements.

There are limits to how narrow this angle can be made. A smaller angle will accentuate any mechanical instability in the strip edges, & may result in variations in weld temperature. Too small an angle may also cause pre-arcing. An angle of 2-4° is generally best for ferritic steel (including stainless). Austenitic stainless & most non ferrous materials are generally welded at 4-8°.

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