

Variable Frequency on Demand – The Ultimate in Flexibility for Today’s Tube and Pipe Producers

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Introduction

In today’s business climate with its ever-changing market conditions, tube and pipe producers the world over are continuing to look for new manufacturing opportunities in order to maintain and, wherever possible, grow their share of the available market for tube and pipe products.

Clearly, one possible strategy is to diversify, by producing a wide variety of products on the same mill in order to win new business and satisfy broader market requirements. This applies to both domestic and export markets. Variable frequency welders can now offer producers the flexibility to achieve this.

As a world leader in tube and pipe technology, Thermatool developed the concept of variable frequency on demand from a solid-state welder. Recently the technology has been further refined making it a powerful addition to the well-established family of CFI series welders using proven solid-state technology.

Variable frequency is now available as an option on new solid-state welders, or as an upgrade for most existing Thermatool solid-state welders.

Why Variable Frequency?

A genuine, selectable variable frequency welder gives the tube and pipe producer the flexibility to select the optimum weld frequency for a given material, right at the operator’s console. Electronic selection of specific welding frequencies within selected bands is available from the widest range of welding frequencies available worldwide.

According to Thermatool *“The tube and pipe industry will benefit from this latest innovation in solid-state welder design. It brings the flexibility of solid-state welding technology right to the operator’s hands.”*

In fact variable frequency offers the capability to successfully weld many different materials on the same mill, including carbon steel, stainless steel and coated materials. In addition to the above, a variable frequency welder will greatly assist the production of tube and pipe where difficult diameter-to-thickness ratios exist.

The welding of high tensile strength materials, complex alloys, galvanised and perforated products can also be achieved on a single mill with the application of Thermatool variable frequency technology.

Introducing the capability to weld some or all of the above materials at specific (optimum) frequencies, all on the same mill, will undoubtedly present new business opportunities to the tube and pipe producer.



Fig 1: A range of materials with considerable variation in profile and thickness

Operating a Variable Frequency Welder

As previously stated, the optimum welding frequency can be selected at the operator’s console and it can be incrementally changed while the welder is in normal operation.

Thermatool’s low voltage, electronic frequency switching provides the benefit of holding the optimum weld frequency which the mill operator selects for each product while eliminating the need for multiple mechanical high voltage switches and capacitor changes that were required with many of the older vacuum tube welders.



Fig 2: A typical Thermatool Variable Frequency Welder

What are the Benefits of Variable Frequency?

In addition to the greatly expanded materials capability previously described, a Thermatool solid-state welder equipped with variable frequency will bring the following benefits when the optimum welding frequency for a specific material is selected:

- Significant reduction in the heat affected zone results in minimal displacement of material from the weld. This increases the life of both ID and OD scarfing tools and impedors, thus reducing production costs and increasing mill uptime
- Production of optimum ID weld beads
- Improved quality in secondary bending or hydroforming applications
- A considerable reduction in the volume of ‘spume’ produced during the welding of stainless steel, aluminium or copper tube

Other Frequency Considerations

Coated materials such as galvanised exhaust tube can be very frequency sensitive due to the relative melting points of the coating and the tube material itself. Selection of the optimum frequency

greatly improves weld quality and significantly reduces the volume of material scrapped due to failures in subsequent operations such as bending and expanding of the tube.

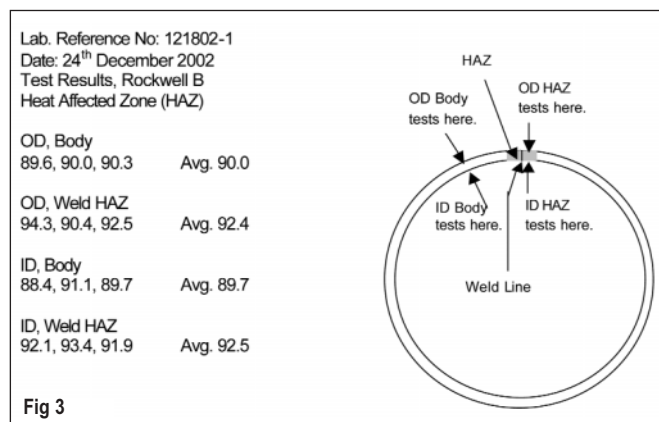
When welding heavy wall tube variable frequency can be used to select the optimum frequency to effectively flatten out the hourglass shape of the weld zone.

Variable Frequency and Improved Weld Quality

A correctly installed ThermoTool solid-state welder equipped with the variable frequency option will always bring about improved weld quality. This has been supported by a growing number of installations worldwide where very significant results have been reported. Improved weld quality, increased yield rates, lower production costs and improved uptime have all been linked to the ability to weld at the optimum weld frequency.

What defines the 'Optimum' Weld Frequency?

One of the most talked about aspects surrounding the concept of what defines the optimum weld frequency is the very issue of what constitutes the perfect weld. ThermoTool CFI welders equipped with variable frequency can certainly guide a tube and pipe producer towards the perfect weld. That is, if the perfect weld is defined by its apparent absence! The almost total disappearance of the so-called hourglass area of the weld zone appears to point to the creation of a homogenous weld, one where resultant hardness across the weld zone is also uniform.



Recently, a stainless steel tube producer who operates a ThermoTool CFI solid-state welder fitted with variable frequency asked for a sample of welded stainless steel tube to be sent for laboratory analysis and micro-hardness testing across the weld area. See results above (Fig 3).

Hardness Tests (per Fig 3) were conducted on a Wilson-Instron Series 2000 Automatic Hardness tester, Serial Number P5087, Calibrated 7-9-02. Calibration block used #C50378, 81.18 HRB.

As a further illustration, another tube sample was also cut through the weld, mounted, polished and etched. The micrograph (Fig 4) shows the structure to be entirely ferritic. Locating the bond plane proved to be very difficult as the sample shows uniform heating with no flow lines to indicate the weld area. At high magnification, some evidence of dissolution of high-melting point nitrides was found, suggesting that this point had been subjected to very high heat intensity. This was assumed to be the bond line.

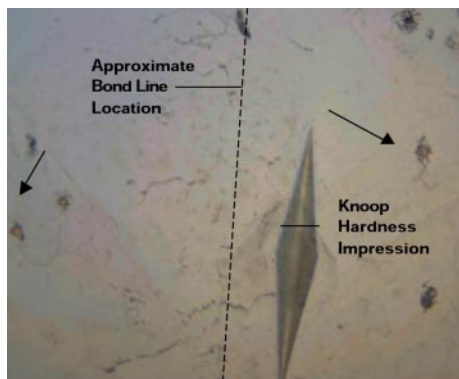
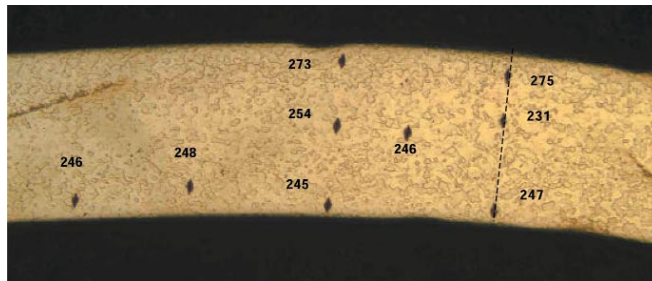


Fig 4: Sample bond plane as evidenced by partial dissolution of nitride inclusions (see spider web precipitates around nitrides at arrows). 320X, Aqua Regia Etch

Fig 5: Test impressions on sample, 12.8X. Dashed line indicates bond plane. Hardnesses are very uniform through the HAZ and parent metal



In contrast to the above micrograph (Fig 5) where the bond plane is somewhat difficult to locate, the micrograph (Fig 6) shows the typical hourglass shape to the heat affected zone in an HF welded carbon steel sample.



Fig 6

Conclusion

In conclusion, genuine selectable Variable Frequency on demand is something new and exciting – worthy of consideration by any producer of tube and pipe. It offers tube mill operators the potential to expand their current welding capabilities providing a very controlled and proven route through to new products and hence new markets.

Selectable Variable Frequency on demand optimises the welding process by providing the ability to weld at the optimum frequency for a given material – not at the frequency that suits the welder best!

By welding a given material at its optimum frequency a ThermoTool solid-state welder can therefore become a pivotal element in the control of weld quality. It can also be a key factor in contributing towards future profitability, especially where welding at the optimum frequency brings about a significant reduction in downtime and scrap material on a tube and pipe mill.

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