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Review of new EN-1090 Standard and edge hardness

White paper

Background and Introduction

The cutting of structural steel with thermal processes, including plasma, is governed by numerous international and local regulations. In Europe, a new standard EN-1090, which is derived from earlier DIN and BSCA standards, is creating a lot of questions. In particular, a tighter requirement on edge hardness of thermally cut surfaces has end users and cutting machine manufacturers asking if plasma will still be a suitable process for this application.

Before providing some specifics on the new edge hardness standard and plasma cut edge results, it is important to note a few key things:

- Plasma is currently used successfully around the globe in many structural steel applications – for general shape cutting, weld surface preparation, coping, and hole cutting for bolted construction. While there are code limitations relating to thermal cutting of holes in some fatigue bearing members (e.g. primary bridge surfaces), most building and structural codes allow for plasma along with other thermal processes (laser, oxyfuel) as long as the resulting cut surface meets all physical requirements specified by the local or national code.

- The responsibility to certify that the cut parts fully meet the required standards is the sole responsibility of the end user and/or the professional engineer who is responsible for the project. No plasma manufacturer can "certify" that their products fully meet the required codes. While data has shown that if properly setup with particular grades of steel the resulting plasma cut can meet requirements, the responsibility to setup the process properly and ensure parts meet requirements is the sole responsibility of the end user. With the large variety of equipment, processes, material thicknesses, and material types it is not possible to guarantee full compliance under all potential conditions. Even variations of a particular grade due to normal process differences from multiple steel mills can result in variations that need to be assessed by the end user.

- As with any welding or cutting process, the end user needs to develop a written cutting/welding process for the steel specified by the design engineers which details the equipment, materials, techniques and quality tests to be used to ensure the final product meets the design and code specifications.

Edge hardness requirements of EN-1090 – thermally cut surfaces must have a hardness less than 350 VHN

Edge hardness limits were tightened in the new EN-1090 European norm specification by adopting without question the British Standard BS 5400 Part 6 (57) which has a maximum hardness specification of 350 VHN.

Research studies with plasma demonstrate compliance of cut surfaces to EN-1090 hardness specifications is possible

In 1997, Ian Harris of the Edison Welding Institute conducted a very extensive study in the United States comparing air, nitrogen, and oxygen plasma with oxy-fuel cutting of structural bridge steels. This report is able to be ordered online at the link provided below. In general, it found that plasma cutting offers significant advantages over oxyfuel, resulting in heat affected zones (HAZ) that can be up to 90% less, with significantly less hardening and depth of hardening due to less heating, faster cool-down rates, and no carbon take-up in the steel.

Based on the EWI study, both air and oxygen plasma processes demonstrated the ability to produce cut edges that would meet the tighter EN-1090 specification. A few excerpts from the study:

- Oxygen plasmas showed the lowest range of hardness values with most values less than the requirement, ranging from 250 to 350 VHN.

- Air plasmas also showed edges that met requirements, ranging from 280 to 540 VHN.

- For all cuts, including those with nitrogen plasma, removal of the surface by grinding up to 0.3 mm resulted in edge hardness values that were below the 350 VHN requirement.

- Variations in grade of plate showed large variations in the edge hardness results. Plate types that had high carbon content (Grade 50) showed the largest increase in edge hardness due to both material chemistry and slow cutting speeds that were used to complete the cutting process. This shows that the interaction of process amperage, gas choice, cut speed, and material chemistry needs to be evaluated for each application to ensure regulations are satisfied.

Note: Plasma cutting has evolved substantially since this 1997 study, with faster cut speeds achievable with lower amperage oxygen and air processes. This should mean that systems are even more likely to meet the standard with no subsequent treatment of the edge required.

Summary

In summary, there is solid evidence in scientific literature that plasma cutting should remain an optimal process for structural steel processing even with the tighter surface requirements of EN-1090. While it remains the responsibility of the end user to verify that their particular choice of machinery, cutting tool, and material thickness and type results in a part that meets regulations, this information shows that the choice of plasma as a cutting process should have a high likelihood of success.

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Order information for the EWI Bridge Steel Study:
http://books.trbbookstore.org/search.aspx?find=plasma

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