On the Subject of Welding: Weld Preparation

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Welding is an important fabrication technique for joining of the similar and dissimilar metallic materials. Welding techniques are so broad and advancing towards mechanized process and robotic applications. Fundamentally it is a multidisciplinary subject that requires a knowledge of physics, chemistry, metallurgy, electrical and mechanical engineering for a sound outcome. With the advance of the technology the welding equipment are becoming more efficient and complex yielding to the more desirable outcome if practiced adequately and within specifications. Demand for the advanced materials to perform in a specific environment comes with the requirement for the adequate welding technique and process. As our experience and knowledge of materials behavior is growing, so as the control on the welding parameters are getting fine-tuned with more grips on the fundamentals. However, no matter how advanced the welding process may be its full potential can only be realized if the welding preparation has been carried out and pre welding requirement as per Welding Procedure Specification (WPS) has been satisfied.

Welding is usually the last step of a series of operations pertinent to the fabrication of the structure or vessel. If welding preparation is not carried out as per requirements, it can reflect on the quality of the weld and its load bearing capacity; in some case result in the failure of the equipment with possible catastrophic consequences. Moreover, as per Quality Assurance/Quality Control (QA/QC) requirement for the identification and control of process and welder related defects this point is frequently overlooked. This can be misleading as welder can justifiably claim that they have essential qualification and skills for a sound welding and poor preparation are to blame for. This puts an emphasis on the importance of welding workpiece preparation. For a systematic welding approach consider following sequence of operation in a fabricating plant for welding step.

1. Design: Welding preparation shall start on drawing pad. Consultation between designer and floor staff is of most importance and shall be treated as an essential pre-requisite for a good welding outcome.
2. Procurement: Material must be checked against the heat batch and the plates shall be clearly identified. Dimensional tolerance must be checked specifically on pipes as oval pipes or wrapped plates can lead to serious fit up problems. Cleanness of the surface and its condition has an important effect on the welding quality and has to be evaluated for the cost of pre-weld cleaning. At this stage plate defects shall be located with the means of non -destructive examination (NDE).
3. Storage: Material should be protected against external environment and adverse condition to avoid the surface contamination and corrosion. The surface contamination in most cases effect the quality of the weld.
4. Straightening: Straighten of hot rolled plate can avoid difficulties and extra cost during fabrication stage.
5. Cutting: the edge preparation for butt welds must be beveled for complete fusion through the thickness of the plate.
6. Edge Preparation: Plate edge preparation varies however, in all cases the aim is to produce a sound weld with the minimum weld required for the given strength. The choice of the edge preparation is governed by the following threefold; access to the work piece, economics and possible distortion. If access is limited to one side there is always possibility of distortion even when welding a thick plate. Consideration shall be given in the use of double V and U preparation than single V in thick plates. The economy of double V preparation may be justified by the required reduced amount of weld material.
7. Cleaning: Weld to be weld shall be cleaned from contamination to avoid defects such as porosity. There is a misconception that contamination is burnt out by arc. Example of contamination can be grease, paint, dust and rust. It can be demonstrated that if no cleaning prior to welding and in the presence of the contamination the resultant weld is not better than that obtained by a no coated bare wire welding. Sometimes the contamination is drawn not from the surface of the metal but from laminations in steel. So quality of steel is of particular importance.
8. Assembly: Assembly can be regarded as the most difficult problem in fabrication as they may affect fit up in final joints, which in turn effects the amount of required weld material and the control of procedure requirement. However, realistically speaking in some industry e.g. ship building due to shear use of material getting a reasonably flat plate is very challenging. In this case techniques such as usage of clamps, fixtures and tack welds shall be employed to accommodate this inaccuracies. If the tack welds are not planned to be assimilated to the weld shall be planned to be cut out. It should be noted that if the WPS considers pre-heat in the welding this shall be followed for the tack welding as well. Assembly shall follow a procedure that caters for some flexibility in planning the welding sequences. The analogy to the sequence planning is like the tightening of the bolts in car tire or an engine cylinder head. A correct plan sequence even out the applied forces and stresses. However, it should be noted that this approach is labor intensive and shall only be considered if the sequencing is calculated to be cheaper than post weld correction. The sequencing is not common to be applied to the mechanized welding as the advantage of long arc time is lost.

In the next issues of the Materials Mind we will pick up where we left on this article and put our focus on the next steps, which is the actual welding process and the post weld process requirements.

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