



WELDING REPAIR AND MAINTENANCE

A quick and comprehensive approach to the importance and relevant details regarding the development of the welding process in manufacturing facilities, users of equipment and welded pipes.

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1. Introduction

It is known to all industry professionals that welding is a very popular and widely used manufacturing process around the world, both for the manufacture of equipment, structures and accessories, as well as in their recovery, repairs in general and maintenance.

This text promotes a practical discussion about the real differences between the welding of equipment and other items, while new, and the welding of repair and maintenance. In fact, these differences should not exist or at least be very few.

2. Development

2.1 Essential Aspects of the Welding Process

Welding is considered a special process and because of this characteristic, it requires the development of qualified procedures and skilled welders or welding operators.

Such qualifications are supported by international construction and qualification standards, such as AWS, ASME and EN ISO standards, determine rigorous tests to evaluate the intrinsic quality of welds performed following previous procedures, instructions and good engineering practices.

Therefore, it can be said that one of the pillars that support the quality of welding are the documents produced by manufacturers that use welding as a construction process.

2.2 Document quality

Welding requires a lot of data for its control and quality assurance. One of the most well-known by the industrial branch is the document called Welding Procedure Specification (EPS) which determines all the variables that must be met so that welding can result in success.

Another document widely used in the welding segment is the RQS, known as the Welders'

Qualification Record. Such documents establish that the professional was tested in a given situation and approved in order to have minimum conditions to perform the welding in situations understood by the standard as similar to the situation tested in the laboratory or through volumetric testing (radiography, for example).

Another important document is the Welding Execution and Inspection Instruction (IEIS), which in addition to determining the essential parameters for the realization of a particular joint or set of joints, also establishes the non-destructive tests that will be performed after its completion.

Several other documents are also part of this document. Among them, we can mention the welding plan, which also establishes the most diverse information regarding the welding execution of a piece of equipment or structure.

2.3 Suitable environment



Figure 1 Example: Exposure to wind

Construction or fabrication welding, through numerous features available in a boiler shop, is performed in an appropriate environment. This suitable environment is characterized by well-lit spaces sheltered from wind and weather, with adequate access to the joint to be welded, good quality of electrical power and availability of several different welding processes, available for quality and productivity gains in your production.

The same situation is sometimes not repeated in repair and maintenance welding, which may need to be done in places of little access, exposed to

the wind, with little energy resources or only with the possibility of using one or another welding process.

Remembering that repair and maintenance welding, in its vast majority, is performed after a certain time of equipment in use, and therefore, the possibility of finding equipment already oxidized is another risk that will cause additional surface preparation processes to be required before the actual execution of the welding.

2.4 Optimized layout

The gain in productivity and consequently the production of welded joints in a fast and reliable way, is also the result of an optimized layout of cutting, assembly, preparation, welding and final inspections. When it comes to welding, repair and maintenance, the same region must be worked by different professionals who will perform these activities of cutting, preparation, welding and inspection in the same region, thus requiring an additional organization for the coordination of all these activities in their correct sequence.

Very commonly, there is the availability of non-destructive testing (NDT) inspectors and also level I and level II inspectors depending on factories and boiler shops so that any discontinuities are evaluated and later repaired if they are considered by the inspectors as defects.

Often in corrective maintenance and repairs that must be done urgently, there is not so much availability of inspectors for this decision-making. This item is dealt with in more depth below.

2.5 Low availability of Weld Inspectors and NDT



Figure 2 The smallest details are important for the life of the equipment, e.g. weld reinforcement height.

It is also observed that there is no immediate availability to hire *Welding Inspectors*, nor non-destructive testing inspectors, such as: *LP Inspectors* or *Ultrasonic Inspectors*, who are essential for the activity of monitoring and evaluating a repair or maintenance that has been necessary as a consequence of an accident or an unexpected equipment breakdown.

This fact also contributes to the fact that repair and maintenance welding unfortunately has a lower final quality standard than the welding standard throughout the construction of equipment in several plants. There are, of course, honorable exceptions that treat such repairs with the same attention as the joints produced in construction.

3. Facts and Challenges of Repair and Maintenance Welding

In view of what has been commented on in the previous lines, it is noted, therefore, a great distance between the favorable environment for welding existing in the companies that manufacture equipment and other welded items, with the users of these equipment and structures, who do not have so many resources for the welding to be performed in the same molds as the original weld was produced.

It should also be considered that an equipment designed and built with high quality welds at its birth also requires the continuity of this same quality in the execution of repairs and maintenance. It is, therefore, essential that users of equipment that may need repairs with the use

of welding know how to do it or know how to hire companies with professionals who have the knowledge to do it with a quality similar to the quality of construction welding.

It is, therefore, a common challenge for users of welded equipment to develop knowledge related to this process so that the user knows how to determine the technical specifications compatible with the criticality of the repair to be performed.

3.1 Lack of knowledge

Unlike the existing culture in companies specialized in the manufacture of welded equipment, the customers of this equipment, that is, food, pharmaceutical and mining industries, among other industries in general, hardly have in-depth knowledge in Welding Engineering.

Since this competence does not belong to the set of expertise understood as essential, this finding leads to a scenario where possible errors may be made as a result of the lack of knowledge about specific aspects, which are quite relevant to the final quality, such as: the need for heat treatment for welding, preheating, adoption of the filleted pass technique, so on.

3.2 Shortages of specific tools and consumables



Figure 3 Photo by Karan Bhatia on Unsplash

It is also necessary to understand that, in certain

special situations, it is essential to use very specific welding tools and consumables, such as:

- Specific abrasives for stainless steel;
- Special gases for welding certain metal materials;
- Electrodes and wires with a specific chemical composition applicable to a particular type of material.
-

This is another difficulty that is encountered when performing repair welding, since many times this welding needs to be done without much time for its planning.

3.3 Areas Possibly Unsuitable for Quality Welding

The execution of a quality welding requires proper preparation, cleaning of oxidation, paints/varnishes and preparation of the cavity through chamfers that have easy access so that proper fusion of materials occurs.

It is not uncommon to observe that recovery and maintenance welding is sometimes done without this detail, since access is sometimes difficult,



poorly lit and subject to constant humidity, factors that will collaborate with a different welding situation than ideal.

3.4 Professional welders who may not be qualified for the situation

The qualification of welders, more than a mere formality on *Figure 4 'Alloyed' steels need specific care*

the subject, is an opportunity for the professional welder himself to measure his competence in executing welded joints of acceptable quality. Therefore, the habit of qualifying welders for repair and maintenance welding develops and maintains a high quality culture of continuous improvement in the welding sector of companies, through tests internationally recognized as appropriate for the evaluation of these professionals in their various processes, positions and different deposition techniques.

Such a culture is not usual in many of the companies that have welders available for repairs in their maintenance departments.

3.5 Miscellany of base materials

It is common in many companies to come across numerous metallic materials being used in the construction of their industrial equipment. In this way, several different types of stainless steel, as well as several types of non-ferrous metals (aluminum and titanium are examples), or low alloy steel, are part of the group of metallic materials that can suffer wear and, therefore, require repairs and maintenance by welding throughout their useful life. This specific feature will require from the maintenance team, knowledge about the weldability of each of them with regard to various peculiarities, which also represents a challenging element for quality welding.

3.6 Absence of welding documentation

The absence of welding documentation is usual, such as: RQPS, EPS and RQS referring to welders. It is important, therefore, to develop a systematic of constant preparation of documents that provide support and precise instruction for the execution of such weld maintenance repairs.

4. Solution system

Numerous material specifications already bring the possibility of weld repairs, such as ASTM A216 materials (WCB...), etc

Therefore, it is noted that the solution is within the reach of the welding professional, including procedural qualification, qualification of welders and interpretation of construction standards, material standards and welding qualification standards. Thus, it is possible to form a robust and intelligent scenario for carrying out activities related to welding repairs within the most varied welding quality systems.

ESPECIFICAÇÃO DO PROCEDIMENTO DE SOLDAGEM (EPS) WELDING PROCEDURE SPECIFICATION (WPS) QW-200.1								WPS Nº 075	
TÍTULO Tipo de EPS: S2-0220 Objeto do Documento: METAL BASE Descrição: METAL BASE Escopo de Aplicação: METAL BASE					Processo: GTAW / SMAW Norma Técnica: S2-0220-02		Tipo de Trabalho: S2-0220-02 Norma Técnica: S2-0220-02		
PARÂMETROS DE SOLDAGEM Tipo de Trabalho: S2-0220-02 Objeto do Documento: METAL BASE Descrição: METAL BASE Escopo de Aplicação: METAL BASE								Tipo de Trabalho: S2-0220-02 Norma Técnica: S2-0220-02	
ESPECIFICAÇÃO DE MATERIAIS Tipo de Trabalho: S2-0220-02 Objeto do Documento: METAL BASE Descrição: METAL BASE Escopo de Aplicação: METAL BASE								Tipo de Trabalho: S2-0220-02 Norma Técnica: S2-0220-02	
ESPECIFICAÇÃO DE CONDIÇÕES DE SOLDAGEM Tipo de Trabalho: S2-0220-02 Objeto do Documento: METAL BASE Descrição: METAL BASE Escopo de Aplicação: METAL BASE								Tipo de Trabalho: S2-0220-02 Norma Técnica: S2-0220-02	
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Figure 5 EPS Example

The welding procedures and qualification of welders are standardized by several standards in the Brazilian market, the best known being:

- ASME-IX – qualification for professionals and procedures aimed at pressurized reservoirs, boilers, valve bodies and all those that are subject to the ASME code.
- ASTM A488 - Qualification of welding procedures for molten materials.
- AWS D1.1 – Structural Welding Code

As usual, in the form of questions and answers from the FBTS Technical Department, there are important clarifications about the attributions, advantages and details about the functions of welding inspectors.

1. It is common in industrial societies around the world to qualify and intensively use welding inspectors both in the manufacture and repair of welded equipment. How does this system work in Brazil?

FBTS Answer: In Brazil we have the SNQC-IS, conducted by FBTS which aims to evaluate the compliance of the professional – Welding Inspector, attesting to the competence of these professionals to exercise the duties and responsibilities established in NBR 14842.

FBTS has been accredited by INMETRO, according to the NBR 17024 standard, since April/92 to certify Welding Inspectors.

2. Where are the main advantages of working with the support of N1 welding inspectors

FBTS Answer: The use of Level 1 Welding Inspectors aims to ensure, through on-site monitoring, that only welding procedures and qualified welders will be used in the projects, thus minimizing the risk of failures or even rework during welding operations. The activities related to the control and handling of welding consumables and the performance of heat treatment after welding, complemented by the final visual inspection of the weld strongly contribute to the achievement of compliance in

welded products.

3. What about the advantages of partnering with N2 Welding Inspectors?

FBTS Answer: The performance of the Level 2 Welding Inspectors aims to ensure the repeatability of defect-free welding, through the preparation of technical documentation as well as the qualification of welding procedures and welders/operators. This qualification aims to reduce the cost of rework and thus increase the productivity and quality of welded products.

5. Conclusions and recommendations

From what has been described throughout each paragraph of this text, it is possible to identify the important need to approach the topic of Repair and Maintenance Welding with the same criticality and care as that adopted in manufacturing welding.

In this sense, it is recommended that the process begin by sharing this and other study materials that motivate the change of repair systems, for others that are more detailed and complete.

Next steps should be taken in the search for training and leveling of knowledge on the subject and the creation of new procedures and internal instructions that are adherent to the needs and requirements determined by standards on the subject and best engineering practices.

Certainly, these actions are proven to be very economical in view of the expenses and costs of not using the solutions proposed above.

Always look for experienced and qualified professionals as well as reputable organizations



such as FBTS.

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We would like to thank the Technical Staff and Board of Directors of FBTS for their participation in important clarifications