

Radiographic Testing and Ultrasonic Testing in Stainless Steel Weldment in Tig Welding

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Abstract: Nondestructive testing or Non-destructive testing (NDT) is a wide group of analysis techniques used in science and industry. The terms Nondestructive examination (NDE), Nondestructive inspection (NDI) and Nondestructive evaluation (NDE) are also used to describe this technology. Because NDT does not permanently alter the article being inspected, it is a valuable technique that can save both money and time in product evaluation, troubleshooting and research. Testing methods include ultrasonic, magnetic-particle, liquid penetrant, radiographic, remote visual inspection (RVI), eddy-current testing,^[1] and low coherence interferometry. Nondestructive testing is a tool in forensic engineering, mechanical engineering, electrical engineering, civil engineering, systems engineering, aeronautical engineering, medicine and art.

Key words: NDT test in welding process for stainless steel • Radiographic test and Ultrasonic test to be carried out

INTRODUCTION

Nondestructive testing rely on use of electromagnetic radiation, sound and inherent properties of materials to examine samples. This includes some kinds of microscopy to examine external surfaces in detail, although sample preparation techniques for metallography, optical microscopy and electron microscopy are generally destructive as the surfaces must be made smooth through polishing or the sample must be electron transparent in thickness. Sound waves are utilized in the case of ultrasonic testing. Contrast between a defect and the bulk of the sample may be enhanced for visual examination by the unaided eye by using liquids to penetrate fatigue cracks. One method (liquid penetrant testing) involves using dyes, fluorescent or non-fluorescing, in fluids for non-magnetic materials, usually metals. Another commonly used method for magnetic materials involves using a liquid suspension of fine iron particle applied to a part while it is in an externally applied magnetic field (magnetic-particle testing) [1].

Training: Non-Destructive Testing (NDT) training is provided for people working in many industries. Practically trained persons can apply to write a certifying

exam with one of the few governing bodies. Getting certified to inspect steels is quite a complex and difficult process. [5] Further, NDT Training has recently become available online. WorldSpec.org is one of the innovative companies that helped pioneer this new "era" in NDT Training [2].

Weld Verification:

- Section of material with a surface-breaking crack that is not visible to the naked eye.
- Penetrant is applied to the surface.
- Excess penetrant is removed.
- Developer is applied, rendering the crack visible.

In manufacturing, welds are used to join two or more metal surfaces. Because these connections may encounter loads and fatigue [4].

Welds may be tested using NDT techniques such as industrial radiography using X-rays or gamma rays, ultrasonic testing, liquid penetrant testing or via eddy current. In a proper weld, these tests would indicate a lack of cracks in the radiograph, show clear passage of sound through the weld and back, or indicate a clear surface without penetrant captured in cracks [5].

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Structural Mechanics: Structures can be complex systems that undergo different loads during their lifetime. Engineers will commonly model these structures as coupled second-order systems, approximating dynamic structure components with springs, masses and dampers. These sets of differential equations can be used to derive a transfer function that models the behavior of the system [6].

In Nondestructive testing, the structure undergoes a dynamic input, such as the tap of a hammer or a controlled impulse. Key properties, such as displacement or acceleration at different points of the structure, are measured as the corresponding output. This output is recorded and compared to the corresponding output given by the transfer function and the known input [3].

Welding Technology

Methods: Welding is a process for joining different materials. The large bulk of materials that are welded are metals and their alloys, although the term welding is also applied to the joining of other materials such as thermoplastics. Welding joins different metals/alloys with the help of a number of processes in which heat is supplied either electrically or by means of a gas torch. In order to join two or more pieces of metal together by one of the welding processes, the most essential requirement is Heat. Pressure may also be employed, but this is not, in many processes essential [7].

Fusion welding — including gas tungsten arc welding (GTAW) (Ref. 3), resistance welding (RW) (Ref. 4) and laser beam welding (LBW) (Ref. 5) - is a method that requires a great deal of energy, resulting in chemical reactions that are responsible for a variety of defects, such as oxide films, porosity, cracks and the formation of the inter metallic compound Al_4C_3 (Refs. 6-8). These defects decrease the strength of the weld joint. • The *diffusion bonding* method (Ref.9) requires a high vacuum or heating equipment ; therefore, it is more expensive and has restricted application. • *Mechanical interlocking* or *mechanical fasteners* (Ref. 10) are method that lack ductility; there fore, stress concentration is easily produced in welding points (such as bolt joints or rivets) that may lead to catastrophic fractures. • The *friction welding* (FRW) method (Refs. 1112) is classified as a solid-state welding process in which heat is generated by friction from the relative motion of the parts to be welded. The application of an axial force maintains intimate contact of the parts and causes plastic deformation of the material near the weld interface. Deformation is largely restricted to the volume of material adjacent to the original interface by an adiabatic shear

process (Ref. 13). Friction welding is used with SiC/Al composites because energy is produced in the work piece after opposite friction, resulting in less input energy; the heat-affected zone(HAZ) is more narrow; and hard, brittle inter metallic compounds are not easily produced, thus increasing the welding strength (Ref. 13). The advantages of friction welding are as follows:

CONCLUSION

Welding is the most commonly used process for permanent joining machine parts. Welding is the process in which fusion of metallic parts with heat and with or without pressure. Welding is a fabrication process which joins materials (metals) or thermoplastics, by causing union. It is the process of melting the work pieces and adding a filler material to form a pool of molten material (the weld pool) that cools to become a strong joint.

Gas flame, an electric arc, a laser, an electron beam, friction and ultrasound are used for welding.

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