

## **Digital Radiography Test for the GTAW and FSW Weldments on AA 7075-T651 Aluminium Alloy**

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### **Abstract**

NDT-Non Destructive Testing's are inspections, checks and surveys carried out by means of methods that do not alter the material and do not require the destruction or removal of test samples from the concerned fabrication structure. The main feature of this kind of tests is the possibility to check the concerned parts without interfering with the tested material. On-destructive tests are thus a crucial tool for the product final check. As for safety parts, the check by means of non-destructive test (NDT) also ensures the product conformity. Aluminum and its alloys have been used in recent times due to their light weight, moderate strength and good corrosion resistance aluminum alloy-AA 7075-T6 has been researched upon especially as a potential candidate for aircraft material. This alloy is difficult to weld using conventional welding techniques like FSW and GTAW. An attempt has been made in this paper to weld 7075-T651 alloy using for the Gas Tungsten arc weld (GTAW) with argon as a shielding gas and Friction stir welding (FSW) . The FSW is solid state welding. It is echo free welding process. In the Both welding NDT have been reported. The Digital Radiography is widely used in crack, porosity, tungsten inclusions etc. detection are and other defects inspection. Liquid Penetrate testing, Ultrasonic testing, Eddy current inspection etc. are the various NDT techniques are used in industries for the final inspection. In this experiment we are conducting Digital Radiography by using VIDISCO (fox-Rayzor) Machine for various intensities with time.

**Key words:** AA7075-T651 FSW, GTAW, NDT, Radiography, Defects Detection

**Introduction**

Radiographic Testing (RT), or industrial radiography, is a nondestructive testing (NDT) method of inspecting materials for hidden flaws by using the ability of short wavelength electromagnetic radiation (high energy photons) to penetrate various materials. Either an X-ray machine or a radioactive source (Ir-192, Co-60, or in rare cases Cs-137) can be used as a source of photons. Neutron radiographic testing (NR) is a variant of radiographic testing which uses neutrons instead of photons to penetrate materials. This can see very different things from X-rays, because neutrons can pass with ease through lead and steel but are stopped by plastics, water and oils. Since the amount of radiation emerging from the opposite side of the material can be detected and measured, variations in this amount (or intensity) of radiation are used to determine thickness or composition of material. Penetrating radiations are those restricted to that part of the electromagnetic spectrum of wavelength less than about 10 nanometers. Radiography is one of the most useful of the non-destructive tests which can be applied for assessing the quality of welded joints. Radiography can detect flaws or Discontinuities in welds such as Cold Lap, Porosity, and Slag Inclusions. Incomplete Penetration or Lack of Penetration (LOP), incomplete fusion, internal concavity or Suck Back. Internal & External Undercut Offset or Mismatch, Inadequate & Excess Weld Reinforcement and Cracks. Radiography technique is based upon exposing the components to short wavelength radiations in the form of X-rays of wavelength less than  $0.001 \times 10^{-8}$  cm to about  $40 \times 10^{-8}$  cm from a suitable source. The portion of the Weldments where defects are suspected is exposed to X-rays emitted from the X-ray tube. During exposure, X-rays penetrate the welded object and thus affect the x-ray film.

**Heat-treatable and Non-heat-treatable alloy**

Heat-treatable alloys: 2000, 6000, 7000 & 8000

Non-heat-treatable alloys: 1000, 3000, 4000 & 5000

**Non-Heat-Treatable Alloys**

The initial strength of alloys in this group depends upon the hardening effect of elements such as manganese, silicon, iron, and magnesium, alone or in various combinations. The non-heat-treatable alloys are usually designated as, in 1, 000, 3, 000, 4, 000 or 5, 000 series. Since these alloys are work-hard enable, further strengthening is made possible by various degrees of cold working, denoted by the "H" series of tempers. Alloys containing appreciable amounts of magnesium when supplied in strain-hardened tempers are usually given a final elevated temperature treatment called normalizing to ensure stability of properties. [8]

**Heat-Treatable Aluminium Alloys**

Heat-treatable aluminium alloys are 2000, 6000, 7000 & 8000 in series. The initial strength of alloys in this group is enhanced by the addition of alloying elements such as copper, magnesium, zinc and silicon. Since these elements single or in various combinations show increasing solid solubility in aluminum with increasing temperature, it is possible to subject them to thermal treatments which will impart

pronounced strengthening. Precipitation hardening is commonly used to process copper alloys and other non-ferrous metals for commercial use . The examples of aluminum-copper alloys, copper-beryllium, copper-tin, magnesium-aluminum and some ferrous alloys.

**Table: 1 Base metal AA7075 chemical composition and microstructure investigation**

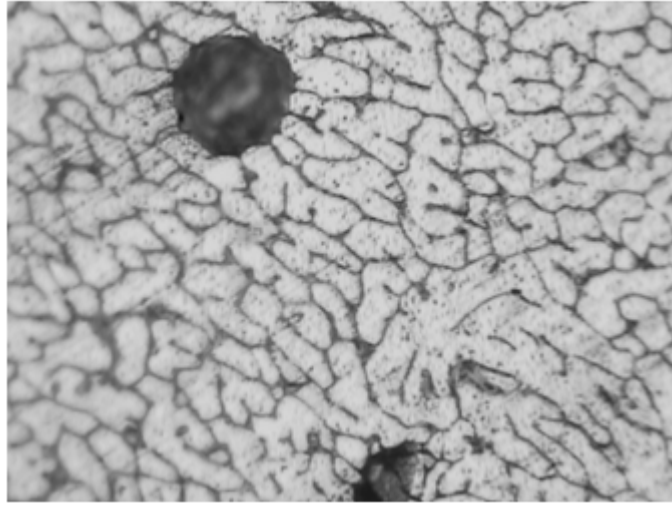
Al	Zn	Mg	Mn	Cr	Cu	Fe	Si	Ti	Ni
87.1 to 91.4	5.1 to 6.1	2.1 to 2.8	0.2 to 0.3	0.18 to 0.28	1.4 to 2.0	0.18	0.4	≤0.029	≤0.029

**Digital Radiography**

Digital image processing involves manipulating one or more digital images. Operations of practical importance on a single image involve artifact suppression, gray-scale manipulations, distortion corrections, and edge enhancement. Important techniques involving two or more images are (time difference) subtraction, dual energy cancellation of bone or soft tissue structures, and the extraction of flow or organ function parameters. The processing of a single image can be classified as a point operation, a local operation or a global operation. A point operation uses a single point (pixel) of the initial or input image to obtain the corresponding point of the final or output image. A local or neighborhood operation uses several pixels in a limited area of the input image to obtain a point in the processed or final image.



**Fig. 1 Base metal microstructure**

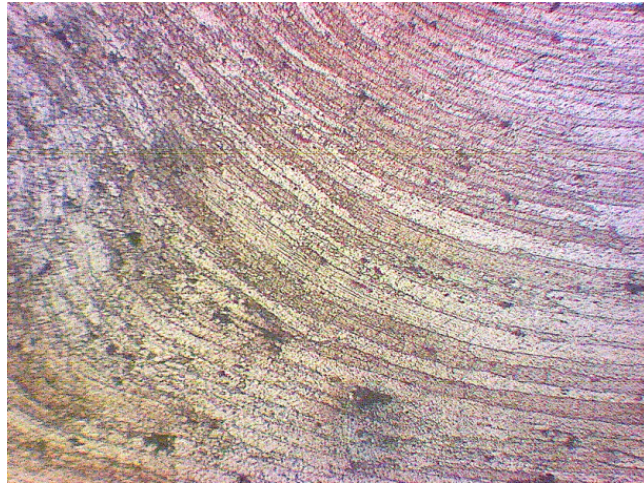


**Fig. 2 welded zone microstructure**

Fig. 1 refers the microstructure which has revealed spheroidal particles of  $Mg^2Zn^2$  (black) and light grey particles of  $FeAl_3$  present in the aluminium solid solution. Fig. 2 shows the Microstructure has revealed Interdendritic eutectic with light grey particles of  $FeAl_3$  present in the solid solution.



**Fig. 3 Heat affected zone (HAZ)**



**Fig. 4 Heat affected zone (HAZ)**



**Fig. 5 Irregularly shaped lower density spots randomly located in the weld image**

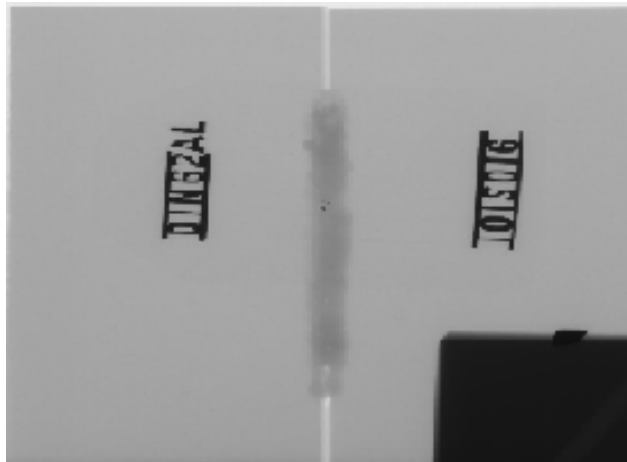
Fig. 3 refers the HAZ microstructure shows the elongated grains with grain boundary eutectic and light grey particles of  $Al_3$  present in the aluminum solid solution. Fig. 4 shows the tungsten inclusions in the micrograph with irregularly shaped lower density spots randomly located in the weld image.

The GTAW & FSW weldments are conducted radiographically test with digital radiography VIDISCO (fox-Rayzor) with different intensity and time.

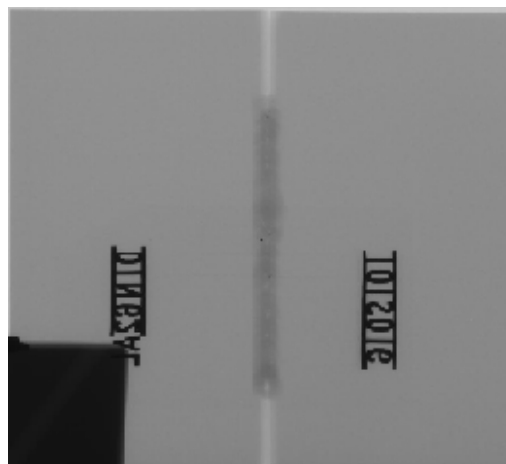
**Fig. 5 Digital Radiography Machine****Fig. 6 Digital Radiography by FSW Weldments****Fig. 7 Digital Radiography by FSW**



**Fig. 8 Digital Radiography Control Unite Weldments**



**Fig. 9 GTAW-X-ray (VIDISCO)**



**Fig. 10 GTAW-X-ray (VIDISCO)**

## CONCLUSION

- (1) The experimental GTAW & FSW Weldments are tested by means of digital radiography VIDISCO (fox-Rayzor) with different intensity and time.
- (2) The observed images are in fig. 5& 6 shows the defect of porosity and cluster porosity in both the Weldments, fig. 7 shows that small tunnel defect and if the experimental parameters are optimized the defect can be nullified.
- (3) The GTAW & FSW Weldments are conducted radio graphically test with VIDISCO (fox-Rayzor) Machine for various intensities and time By using 10-16-AL penatrameter it is low range thickness light weight metal like aluminium alloy we observed 3 wire lines of sensitivity in digital graphs through necked eye.

## 6. 0 REFERENCES

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