Welding Quality in Kenya: Application of Radiography

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Abstract

In Kenya, welding services are extensively employed in both the formal and informal sectors. The needs continue to increase with increasing population, infrastructure and vehicle fleet, and economic development. Welding need is even currently very important in support of Kenya Vision 2030. This study reports some examples on the role of radiography in assessing quality of welds in Kenya in accordance with Article 2 and 22 of ASME V. Samples were acquired from both informal and formal sectors and tested for volumetric flaws using radiography method. During the sample acquisition visual inspection were carried out before and after welding, and professional Non Destructive Testing investigators witnessed the welding process on site. The study observed a wide variation in welding competency, especially in the informal sector and this has provoked efforts to widen the study with an aim of developing a comprehensive advisory report for Kenyan policy makers.

Key words: Radiographic films, visual inspection, informal sector, welders, Kenya Vision 2030

1.0 Introduction

Radiography is a nondestructive method that has been used for many decades in inspecting welding joints of structures and vessels such as boilers, pipelines, nuclear reactors and ships among others *[1]*. This method makes use of ionizing radiation to detect volumetric discontinuities such as voids and inclusions in a material. Its main application is inspection of structures and vessels. However it can also be used as a means of random quality assessment of industrial welds and deterioration, and certifying skills and competency of welders.

In Kenya welding services are extensively employed in both the formal and informal sectors. While in the formal sector the services are regulated, the same is not the case in the informal sector. The formal sector employers are bound by law to be responsible of their products safety and employees competency in services delivery. The employees are also annually assessed through welders retesting and license renewal. Their licenses specify the range of material thickness and type, welding positions and applicable welding procedure. However, independent monitoring of product safety is not carried out. The informal sector on the other hand is highly unregulated despite being the largest employer in Kenya. It employs over 80 % of the working population of which 20 % are engaged in manufacturing *[2]*. The services of the welders in the sector are extensively utilized in the construction industry, fabrication of domestic products, repairs of machinery and in transport industry *[3]*. The sector is also a major source of welding manpower in Kenya and it is expanding very fast with the population growth, demand for cheap

domestic and farming products and high increase of reconditioned vehicles in a fast growing transport industry. The current economic development trend in Kenya and the long-term strategic plan under Kenya Vision 2030 *[4]* will demand enhanced skills and competency, and independent monitoring for purposes of sustainable safety policies. In this study we report the first independent monitoring of the welding services in Kenya, which is aimed to support the Government efforts towards achieving sustainable development.

2.0 Methodology

2.1 Test samples acquisition

Test samples were randomly acquired from selected towns in Kenya, which were representative of major industrial, transport and farming activities. The towns were Mlolongo (12 samples), City Stadium (12), Mombasa (10), Kisumu (10), Kitale (10) and Meru (10). The samples were selected on accounts of thickness range and welding orientation from both the informal and formal sectors. For all the acquired samples the field investigators witnessed the welding processes on site and performed visual inspection before and after the process. Inspection and process observations were recorded and from the formal sector copies of the welding procedures were taken. Sixty-four samples of 3 mm thickness were acquired from the informal sector while a total of 92 plates and18 pipes of 10 mm and 8 mm thickness, respectively, were acquired from the formal sector. The samples were preserved and securely transported to radiography laboratories for testing and further examination.

2.2 Examination and Testing

Visual inspection involves not only inspecting the samples visually but also studying the radiographic films. These helps in identifying and sizing any obvious discontinuities open to the surface and film interpretation of images. The main items required to perform the inspections included a measuring tape, vernier caliper, magnifying lens, film viewer and weld gauge. Visual testing was done in accordance with Article 9 of ASME V *[5]* taking into account the minimum luminance requirements.

Each of the samples was subjected to radiographic inspection to determine volumetric flaws. The source of radiation was a 300 KV, 6 mA X-ray tube and Kenya radiation protection regulations and procedures were followed in taking the sample radiographs. The obtained radiographic films were processed and viewed in accordance with Article 2 and 22 of ASME V *[5]* and interpretation was in accordance with ASME VIII *[6]* and ASME IX *[7]*. The standards give codes that specify the acceptance levels of imperfections detected in welds. The films were first evaluated for artifacts and false indications that are formed prior to film processing, during film processing and after processing. The radiograph was then evaluated for true discontinuities and to assess the quality level, the sizes of imperfections permitted by the standard were compared with the dimensions of indications revealed by radiographs. These tests were repeated for all specimen and joints of interest.

3.0 Results and Discussions

Defects present in plates from both the informal and formal sectors, and formal sector pipes are shown in percentages tested samples (Table 1). The defects in the formal sector welds were significantly lower than in the informal sector by approximately a factor of 3. However, the percentage of defects, although different between the sectors, portrayed unacceptable percentage of failure as reflected in the figures of total discontinuities. This difference was attributed to the fact that welders in the formal sector are subjected to annual assessment through testing and subsequent licensing. We observed that defects that were recorded in the formal sector welds were mostly from welders taking the test for the first time. The welding in the formal sector was also done following written welding procedures and specifications and this was not the case in the Informal sector. The welders in the informal sector were also not annually assessed and licensed thus causing the high failure of the tested welds. We further observed that the welders who were subjected to retraining, mainly in the informal sector, gave better services than those who were not retrained.

Table 1: Results of defects in percentages of tested samples from both informal and formal sectors

Welds	Type of Discontinuity					Total Discontinuities
	Undercut	Porosity	Cracks (C)	Lack of Fusion (LOF)	Incomplete Penetration (IP)	
Informal Sector Plate Welds	16 %	6 %	3 %	34 %	33 %	92 %
Formal Sector Plate Welds	5 %	15 %	0 %	8 %	10 %	38 %
Formal Sector Pipe Welds	0 %	0 %	0 %	0 %	6 %	6 %

Note: The % indicated represents the percentage of total samples tested having the given defect.

4.0 Conclusion

This study investigated the application of radiography in inspecting the quality of welding services in Kenya. It revealed the wide deficiencies in the quality of welds services given by the both formal and informal sectors. Re-training of welders and annual assessment through testing and licensing was found to be an important aspect in the two sectors and governmental policy to that effect is required. The study also affirmed the importance of radiography as an important tool in industrial services/products inspection and support for Kenya towards realization of its long-term strategic plan towards Vision 2030. However, expanded studies were seen to be necessary to strengthen what has been achieved under the current work.

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