**Lessons Learned – Hydrant Fuel System Pipe Welding**

**DOD Standard Design 78-24-28, Pressurized Hydrant Fueling System, Type III**

**This lesson learned is to disseminate information about the problems caused by use of flux in-lieu-of purging gas. A contractor used flux coated filler rod instead of backing purge gas with the Gas Tungsten Arc Welding (GTAW) for the field root weld (or first pass) of the butt welded joints. The flux coated filler rods left adhered and loose weld slag inside stainless steel piping that will be difficult or impossible to remove.**

**If backing gas with solid filler rod had been used with the GTAW process for the root pass, weld slag or residue would not have been left inside the piping.**

**<u>Background:</u>**

**This Type III hydrant fuel system delivers the fuel directly to the aircraft without further filtration. It is imperative the fuel piping be free of any debris and water during the construction. Any debris in the hydrant loop piping system can get into the aircraft fuel tanks.**

**Paragraph 3.1 of the standard design specification Section 15060, requires that the root pass of butt (girth) welds made in the field be completed using the GMAW (Gas Metal Arc Welding) or GTAW process in accordance with ASME B31.3. Both processes use "front" shielding gas supplied by the welding torch, but the back purge, or back shielding gas, is optional and should be specified. The GTAW uses a tungsten electrode that the electrical current passes through to provide the heat producing electrical arc. Instead of the tungsten electrode, the GMAW uses a consumable metal electrode that provides the electrical arc and filler metal.**

**The contractor submitted as a welding procedure the use of flux coated filler rod with the GTAW for the root pass that first connects pipe sections. Since the flux provides the "shielding", no back purge was specified in the contractor's weld procedure. Further, the contractor did not identify where this weld procedure would be used.**

**The standard specification Section 15060, Paragraph 2.2.3.d, on weld electrode for stainless steel pipes is incorrect. The referenced AWS A5.4, is not the type used for GTAW or GMAW welding; AWS A5.9, should be referenced.**

**The welding slag issue was discovered on another similar hydrant fuel project built by the same contractor and placed in operation the previous**

**year. Weld slag first jammed a hydrant pit ball valve, and since then small amounts of weld slag were found in the strainers added to the system. It is felt that expansion and contraction of the piping, especially during the change of season, loosens adhered weld slag placing it into suspension.**

**The Government performed a video inspection of the piping to confirm the extent of the weld slag for the project under construction. The video inspections revealed the contractor had used the flux coated rod welding procedure almost exclusively throughout the piping system. Further, the video revealed the contractor didn't comply with the swabbing requirements of Paragraph 3.2.1.e of the standard specs 15060 which requires the pipe be swabbed with a leather or canvas belt disc after the pipe is welded into place, and thereby reducing the amount of adhered and loose slag remaining in the system prior to final flushing of the system.**

**<u>Recommended Action:</u>**

**The standard specification Section 15060, needs to be strengthened to help prevent a similar weld slag problem. The specification must be clear that all root pass welds shall be performed with back purge shielding gas and that flux coated or flux core rods are not allowed. If flux coated or flux core rods must be used, it needs to be clear that it's the contractor's responsibility to clean the pipe internals of all loose and adhered slag and to provide visual (video, etc.) inspection before the flushing/cleaning operation.**

**The standard specifications need to be revised to reference the proper welding electrode, i.e. AWS A5.9. And, the specifications should require that the contractor document on the weld map what weld procedure was used at each location.**

**Only contractors with previous applicable experience should be allowed to bid. The weld procedure submittals should be carefully reviewed by someone knowledgeable in stainless steel pipe welding. The open ends of the pipe should be capped during storage and installation. And, the pipe internals should be carefully inspected for debris.**

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