Inspecting Rail Tank Cars

Union Tank Cars' new plant in Alexandria, La., makes use of the latest inspection technologies

BY MARY RUTH JOHNSEN

When you visit the new UTLX Manufacturing, Inc., plant in Alexandria, La., you'll see rows of gleaming ebony tank cars awaiting delivery (Fig. 1) and a massive manufacturing space filled with workers, equipment, and dozens of tanks in various stages of assembly. However, you won't see any vats of chemicals awaiting use or containers of spent chemicals. That's because this new plant only uses digital x-ray equipment, with its resultant benefits of real-time, easier-to-analyze results, fewer environmental issues, and space savings.

UTLX Manufacturing, Inc., is a wholly owned subsidiary of Union Tank Car Co., Chicago, Ill. The company's goal with Plant 08 in Alexandria was to build the most advanced and automated tank car manufacturing facility in the world. Several states competed for the opportunity before the company selected the Louisiana site. Construction began at the 122-acre greenfield site, a former cotton field, in December 2004. Although Alexandria is in the middle of the state, far enough from the Gulf Coast to avoid the worst hurricane effects, 400,000 yards of soil were brought to the site to raise the elevation above the 100-year flood plain. In addition, 1000 pilings were driven in to help support the more than 900,000 sq ft (20.7) acres of manufacturing space, and the buildings were designed and constructed to withstand 90-mph winds.

The facility consists of three manufacturing buildings and an administration building. There are four miles of embedded rail inside the plant, three miles outside. It employs an Lean Manufacturing process (four lines, each divided into seven manufacturing cells). The multiple lines prevent easier-to-assemble tank cars from being held up by more complicated orders ahead of them. The first tank car was completed June 2, 2006, and when it reaches full production on two shifts, it will produce 70 tank cars per week. Currently, it assembles 60 cars per week. The plant employs Lean Manufacturing concepts, including self-directed work teams and visual signals for material replenishment.

Compared to the company's plant in Sheldon, Tex., the design of the new plant reduces car travel during manufacturing from more than 4 miles to 1 mile. Normal cycle time will be 8 to 12 days as compared to 40 days, and value added/nonvalue added time is 80/20 compared to the typical 50/50. Material is all located at point of use; there is no traditional warehouse at the site. The goal is to be able to move a car to each new work cell within an average of four hours. Overhead cranes are used at only five points throughout the plant, everywhere else the tank cars are moved by self-propelled carts.

Fig. 1 — Completed tank cars awaiting delivery.

Fig. 2 — A tub being loaded onto the fluoroscope.

Quality Assurance

The tank cars are built and inspected according to the requirements of Association of American Railroads (AAR) M-1002, *Manual of Standards and Recommended Practices Specifications for Tank Cars*, and AWS D15.1, *Railroad Welding Specification — Cars and Locomotives*. Inspection processes used include visual inspection; digital radiography using a fluoroscope, CMOS (complementary metal oxide semiconductor) scanner, and spot x-ray

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Fig. 3 — Inspector Jason Couvillion operates the fluoroscope and interprets the x-ray images. Porosity, slag, and incomplete fusion are the more common discontinuities he'll locate with the equipment.

Fig. 4 — Inspector Spencer Scallan examines a CMOS image. The CMOS equipment is used to inspect the closure weld that joins the two tubs together to form a tank.

Fig. 5 — Kenneth Leblanc, an ASNT Level II Certified UT inspector and Level III inspector in radiography, checks the quality of a nozzle weld.

system using phosphorus panels; phased array ultrasonic testing; liquid penetrant testing; bubble leak testing; and hydrostatic testing.

The 32-member Quality Assurance Department includes five AWS CWIs; other members have been tested to the requirements of AAR M-1002, Section C3, Appendix T, which is patterned after the CWI exam. Other Plant 08 staff members, including Plant Production Manager Thomas S. Malo, are also CWIs, but inspection isn't part of their regular duties. While training of most of the plant's welding workforce began literally with teaching them to put on a welding helmet, the QA staff consists of experienced inspectors, although that experience wasn't necessarily in rail car manufacturing. Most had their initial training in the Nondestructive Testing Technology Program at the T. H. Harris campus of Louisiana Technical College, Opelousas, La., and then worked in a variety of fields before joining the UTLX staff. UTLX provided additional on-the-job training after they were hired.

The inspection process starts, however, with the welders. They are expected to critique and be accountable for their own welds. Additional visual inspection by the CWIs and other inspectors is required throughout the manufacturing process.

Digital X-Ray

"There is no (x-ray) film or chemicals on the premises," said Doug Edgel, director of quality assurance. "We should save about $100,000 per year on film and chemicals. I can't stress enough how great it is not to have chemicals to deal with." Issues involving film processing chemicals include safety, costs, and maintenance of the processors, he explained.

The tank car bodies are constructed in two sections called tubs that are later joined together with a girth weld. The Alexandria plant builds nonpressure tank cars. The company's Sheldon, Tex., and East Chicago plants build pressure tank cars. Pressure cars are those rated at 300 lb/in.^{2} or greater. The welds making up the tubs for those cars must undergo 100% x-ray testing. Requirements for nonpressure tanks require the company to qualify three tanks in a row. If no defects are found in those three tanks, then x-ray is required for junctures only. A juncture is the spot where the horizontal welds and the girth welds meet. Edgel explained any time the welding process or the type of tank car being assembled changes, they must requalify with radiographic testing.

The tubs are transported into the two bays for the fluoroscope — Fig. 2. A real-time, 100% scan takes approximately 40

minutes; checking the junctures of the long horizontal joint, girth joint, and head joint takes approximately 8 minutes. Speed is the primary benefit of the fluoroscope, Edgel explained. If they used traditional, film-based radiography, it would take a three-person crew from 3 to 4 hours to shoot one tub.

Inspector Jason Couvillion had 12 years of experience before joining UTLX — Fig. 3. "With this machine, you are x-raying and interpreting the x-rays simultaneously," he explained. "Porosity, slag, and incomplete fusion are the three most common defects we'll find with the fluoroscope."

Somewhat later in the construction process, CMOS technology is used to inspect the closure weld that joins the two tubs together to create the tank — Fig. 4. Requirements for the closure weld are the same as for the welds inspected using the fluoroscope. The Alexandria plant is not the first UTLX plant to utilize this technology. "We developed this about two years ago in the Chicago plant," Edgel explained. "It has proven to be durable in this type of environment."

The company uses CMOS equipment from Envision Product Design LLC, Anchorage, Alaska. The scanner is on a tractor situated below the tank, and moves at the same speed as the tank as it rotates. Compared to film, the company saves about a half hour per tank, Edgel said.

Before joining UTLX, inspector Spencer Scallan performed ultrasonic thickness testing for Dow Chemical and also had worked as an aircraft inspector. He said setup for a CMOS inspection takes about 15 min with the x-ray itself requiring another 35 min.

CMOS technology has proven to be durable in a rail car manufacturing environment.

Inspectors also utilize a Dynamix Industrial X-Ray machine from FujiFilm for miscellaneous x-ray tasks and if they need to shoot junctures only.

Plant Production Manager Malo cited another benefit of digital x-ray technology that might not immediately come to mind — space savings. By law, tank cars can be used a maximum of 50 years, then must be removed from service. They then, however, can run on a privately held line, for instance, at a historical site. Manufacturing records must be maintained for those 50 years plus an additional 10, Malo explained, so having the x-rays stored electronically rather than on film saves a tremendous amount of warehouse space.

Additional Inspections

Once the tank bodies are completed, the company begins cutting the openings and then welding the manways, nozzles, and other items that are inserted into the tank. The company uses Omniscan MX UT phased array equipment to examine all inserted nozzle welds (Fig. 5); this is a company standard, not a code requirement. This is not 100% inspection, but a sampling of one in every five welds. Again, they're mostly looking for excessive slag, porosity, and incomplete fusion. "We don't see cracks often, but we also look for them," Edgel said. "This inspection is done behind every welder, not every car. We're checking the quality of the welder."

Fig. 6 — Once all the fittings have been attached, the inside of the car is checked for cleanliness, all openings are closed, and the car pressurized to determine there are no leaks at any of the fittings.

At the point in production when the cars come out of the stress relief ovens, they are given an all-over visual inspection followed by hydrostatic testing. Each car is filled with a metered amount of water (the gallonage the tank should hold, which is later stenciled onto the completed tank car) and then pressurized. Nonpressure rated cars are pressurized to 165 lb/in.^{2} and pressure cars to 400 lb/in.^{2}. The pressure is held for 10 min and then the whole car is tested for leaks.

"The hydrostatic system is a closed-loop system so the water is recycled," explained Bill Casey, manager – weld engineering. "This is done in conjunction with state and local authorities to ensure that only uncontaminated water is released."

The company builds both jacketed and unjacketed tank cars. Jacketed cars are insulated and have a series of coils attached to them through which steam or hot water travel to help liquefy the product inside. The coils are all subjected to bubble tests to ensure there are no leaks prior to welding on the 9-gauge sheet metal jacket material.

As the tank cars near completion, fittings such as manways, air vents, and safety valves are added. Inspection Manager Dan Glad explained inspectors check each fitting to make sure the correct parts such as valves have been added, determine the interior of the car is clean, close all the manways and valves, and then pressurize the car to 30 lb/in.^{2}. Bubble tests are conducted to determine whether there are any leaks in the fittings — Fig. 6.

Conclusion

Welding, and the resultant necessary inspections, of the tank cars are completed once the ladders, platforms, and other safety gear have been added.

Weld Engineering Manager Casey said the goal this year was for the welders to achieve zero defects, and Inspector Couvillion said they are closing in on that goal. "They (the welders) are doing very well," he said, "especially when you think that this is a new plant and where these people came from in terms of experience."

Although tank cars can vary in length, those currently being assembled in Alexandria are 54 ft long. They contain many more feet than that of welds. Casey explained that, by definition, a defect is 3 in. long or less (anything longer is considered more than one defect). During the week *Inspection Trends* visited the plant, they had recorded six defects.❖