

**UNITED STATES DEPARTMENT OF TRANSPORTATION  
FEDERAL RAILROAD ADMINISTRATION  
RAILWORTHINESS DIRECTIVE (RWD)  
RWD No. 2016-01**

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This document is an FRA Railworthiness Directive (Directive) issued under 49 C.F.R. § 180.509(b)(4). FRA is issuing this Directive to all owners of Department of Transportation (DOT) specification 111 general purpose tank cars. FRA is issuing this directive based on its finding that as a result of non-conforming welding practices, DOT-111 tank cars built by American Railcar Industries, Inc. (ARI) and ACF Industries, LLC (ACF) between 2009 and 2015 to the ARI and ACF 300 stub sill design and equipped with a two piece cast sump and bottom outlet valve (BOV) skid may be in an unsafe operating condition and could result in the release of hazardous materials. As a result of non-conforming welding practices, these cars may have substantial weld defects at the sump and BOV skid groove attachment welds, potentially affecting each tank's ability to retain its contents during transportation. Further, the use of tank cars with the defective welds identified violates the requirements of the Federal Hazardous Materials regulations (HMR; 49 CFR parts 171-180).<sup>1</sup> FRA is issuing this Directive to ensure public safety, ensure compliance with the applicable Federal regulations governing the safe movement of hazardous materials by rail, and ensure the railworthiness<sup>2</sup> of the tank cars. This Directive requires owners to: (1) identify tank cars in their fleet covered by this Directive; and (2) ensure appropriate inspection and testing of each tank car's sump and BOV skid groove attachment welds to ensure no flaw exists which could result in the loss of tank integrity.

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<sup>1</sup> See 49 CFR § 179.200-10.

<sup>2</sup> 49 CFR § 180.503.

## **I. BACKGROUND**

On May 9, 2014, Canadian Pacific Railway (CP) notified FRA of tank car CTCX 736177, leaking denatured alcohol (ethanol) in CP's Bensenville Yard in Franklin Park, Illinois. Tank car CTCX 736177 is a 30,000 gallon specification DOT 111A100W-1 non-coiled, non-insulated, general purpose tank car manufactured for the transportation of Class 3 flammable liquids and owned by The CIT Group/Equipment Financing Inc. (CIT). ARI manufactured the tank car in its Marmaduke, Arkansas facility in May 2012, to the company's ARI 300 stub sill design.<sup>3</sup> CP contacted an environmental response company, SUNPRO, Inc., who applied an epoxy patch to stop the leak. On May 10, 2014, FRA personnel inspected the car and found the patched area between the cast sump and BOV skid halves on the bottom of the tank. At CIT's direction, on May 29, 2014, SUNPRO transferred tank car CTCX 736177's lading into another tank car and CP moved tank car CTCX 736177 to the Greenbrier Rail Services' (Greenbrier) Atchison, Kansas, repair facility for further inspection. Greenbrier inspected the sump and BOV skid groove attachment weld joints using liquid penetrant, ultrasonic, and visual inspection nondestructive testing (NDT) methods. During the inspection at Greenbrier's facility, representatives of CIT, ARI, FRA, and Greenbrier identified defects in the groove attachment welds at the sump and BOV skid, including small pinholes (porosity), incomplete joint fusion, incomplete joint penetration, and cracks.

Design drawings require the groove attachment welds joining the tank shell plate, the cast sump, and the cast BOV skid, to be full penetration and full fusion (i.e., the junction between the tank shell plate, skid casting, and BOV flange must be completely

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<sup>3</sup> The 300 designation is a stub sill design style classification the AAR Tank Car Committee assigned to certain ARI and ACF manufactured tank cars.

fused (melted) together, creating a solid barrier capable of holding the contents of the tank). The defects FRA detected ranged from 2-1/2-inches to over 17-1/2-inches long and up to 3/8-inch deep.

Subsequently, CIT sent the tank car to ARI's repair facility in North Kansas City, Missouri. There, ARI removed the segment of the weld containing the defects and additional tank shell material containing the sump casting, the BOV skid casting, and the groove attachment welds, and sent the section to ESI in Aurora, Illinois, for metallurgical analysis.

ESI's analysis identified large pockets of trapped oxides (slag) starting just below the interior weld surface and extending almost completely through the weld thickness. For the failed welds on tank car CTCX 736177, the only way slag pockets (or slag inclusions) could form is if a welder does not follow appropriate welding practices during welding by failing to thoroughly clean and visually inspect every weld pass before depositing the next weld pass as the Hazardous Materials Regulations (HMR; 49 CFR parts 171-180)<sup>4</sup> and AAR's Tank Car Manual<sup>5</sup> require. The slag pockets prevented the complete fusion of the joint between the tank plate and the castings and produced the porosity and lack of fusion observed. Over time, these defects initiated and propagated cracks in the welds resulting in the tank leaking.

The HMR require all weld joints on tank car tanks to be fusion-welded in compliance with the requirements of the Tank Car Manual. For attachment welds to the tank, the Tank Car Manual requires the welder producing the welds to visually inspect the first pass and each layer of multi-pass welds to ensure each pass is free from cracks,

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<sup>4</sup> See 49 CFR § 179.200-10.

<sup>5</sup> AAR Manual of Standards and Recommended Practices, Section C-III, Specifications for Tank Cars (November 2014) (Tank Car Manual), at Appendix W.

overlap, incomplete fusion, and slag inclusions before depositing the next pass. To perform the required visual inspections properly the welder must thoroughly clean and inspect each pass before depositing the next pass. The presence of the slag pockets ESI identified in the groove attachment welds on tank car CTCX 736177 demonstrates the welder who deposited them did not follow these requirements.

Based on this incident, using ultrasonic testing techniques, CIT voluntarily inspected 386 additional tank cars in its fleet constructed to the same ARI 300 and ACF 300 design and equipped with a two-piece cast sump and BOV skid (sister cars). Approximately 15 percent of the sister cars inspected had the same defects as those identified in CTCX 736177, ranging from ½-inch to 22-inches long and from 1/8-inch to 0.39-inches deep. The approved tank car arrangement design drawings require welds to be either 7/16-inch or ½-inch thick at these locations. In other words, the slag pockets in the sump and BOV skid groove attachment welds of some sister cars were almost as deep as the welds were thick, resulting in less than full fusion of the weld joint (and meaning the welds were almost hollow). Welds with such extensive amounts of slag and incomplete fusion are not likely to withstand the design stresses and in-train forces they will encounter. Over time, these conditions will initiate and propagate cracks, either partially or completely through the weld, as occurred with tank car CTCX 736177.

FRA's review of CIT's inspection and test records of the sister cars revealed similar defects to those found in the attachment groove welds of tank car CTCX 736177 in cars welded by six other welders, not just the welder of CTCX 736177. Therefore, FRA concludes other welders assigned to make the attachment groove welds did not properly clean and inspect the welds during the manufacturing process. FRA also believes the single bevel groove weld joint design for these welds that allowed the slag to

accumulate at the root of the welds and along the walls of the tank plate, sump, and BOV skid castings made cleaning and inspecting the welds more difficult, and contributed to the defects in the welds.

Based on information provided by ARI, FRA understands between 2009 and 2015, ARI and ACF together manufactured approximately 14,800 general purpose tank cars to the same 300 stub sill design with the same two-piece cast sump and BOV skid weld design.<sup>6</sup> Accordingly, FRA believes the defects causing the leak in CTCX 736177 are likely to be in many of the 14,800 tank cars produced.

## **II. DIRECTIVE**

Upon the date of issuance of this Directive, tank car owners must:

1. Identify the railroad tank cars in their fleet manufactured by ARI or ACF to the ARI 300 or ACF 300 stub sill design and equipped with a two-piece cast sump and BOV skid and provide to FRA within 30 days of the issuance of this Directive, the reporting mark and number of each car. Before offering a tank car for transportation under the conditions of this Directive, the tank car owner or other offeror of the car, shall ensure there is no visible leak from the BOV saddle and sump weld areas, the car complies with all applicable regulatory requirements, and is in a safe condition for transportation. Each time a car subject to this Directive is offered into transportation, this visual inspection of the BOV saddle and sump weld area must be performed to ensure there is no visible leak from the BOV saddle or sump weld areas. The person performing the inspection must document the inspection and provide a copy of the inspection results

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<sup>6</sup> ARI changed the sump and BOV skid groove attachment weld design in 2015 as a result of the incident with CTCX 736177.

to the tank car owner within 30 days of the inspection. Tank car owners must maintain the records of these inspections for 10 years.

2. Inspect and test the sump and BOV skid groove attachment welds as follows:

a. Facilities. All inspections and tests required by this Directive (other than the visual inspection required by paragraph 1 above) must be performed by tank car facilities (defined at 49 CFR 179.2) certified by the AAR consistent with Appendix B of the Tank Car Manual. (Appendix B provides the requirements for tank car facilities to obtain AAR certification.)

b. Procedures. Due to the subsurface location of the identified slag inclusions and related cracks, volumetric inspection methods (ultrasonic testing), must be used in conjunction with surface inspection methods (liquid penetrant, magnetic particle and visual inspection) to ensure the welds are completely examined.

i. All NDT, including visual inspection, must be performed consistent with written procedures described in Appendix T, paragraph 1.18 of the Tank Car Manual and approved by an individual qualified and certified as a Level III in the NDT method. (Appendix T provides the requirements for qualification and certification of NDT procedures and personnel for tank cars.)

ii. All NDT procedures and techniques used, including procedures for visual inspection, must be capable of locating, interpreting, evaluating, and sizing cracks, incomplete penetration, incomplete fusion, and slag inclusions to a level of sensitivity and reliability of 90% (90% probability of detection).<sup>7</sup> Ultrasonic testing methods and

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<sup>7</sup> Probability of detection is a quantitative measure of the likelihood of finding defects of a specific type and size resulting from statistics-based detection experiments using actual or engineered flaw sets, see *Department of Defense Handbook Nondestructive Evaluation System Reliability Assessment MIL-HDBK-1823A* (2009).

techniques used must allow for clearance around internal attachments adequate to perform longitudinal and transverse wave scanning, including procedures for phased array ultrasonic testing, if used.

c. Personnel. All personnel, including subcontractors, reviewing and approving NDT procedures and reports, including visual inspections, must be qualified and certified to Level II or Level III consistent with Appendix T of the Tank Car Manual and the tank car facility's written practice.

i. In addition to the requirements of Paragraph c. above, all personnel performing NDT on these welds, and reviewing procedures and reports, including subcontractor personnel, must be trained and tested on the procedures to be used and samples representing the welds to be inspected consistent with 49 CFR part 172, subpart H, and Appendix T of the Tank Car Manual.

d. Acceptance Criteria. Interpretations and evaluations of inspections and tests shall comply with Appendix W of the Tank Car Manual.

e. Records. All inspection and test results must be documented, including re-inspections of repairs. The documentation must include the information described in Appendix T, paragraph 1.20 of the Tank Car Manual including the additional reporting requirements of Appendix T for the applicable NDT methods(s) chosen.

i. A separate record must be completed for each inspection and test performed on each tank car.

ii. The results of ultrasonic testing inspections must be recorded digitally and maintained with the inspection and test record.

iii. In addition to the record retention periods required by Chapter 1 of the Tank Car Manual for tank car facilities, the tank car owner must retain all records and

documentation required by this Directive for 10 years following the completion of the inspections and tests.

f. Schedule. The inspections and tests required by this Directive must be performed according to the following schedule:

i. Within 12 months from the date of issuance of this Directive for tank cars in hazardous materials service;

ii. Within 18 months from the date of issuance of this Directive for tank cars in non-hazardous materials service;

iii. Within 24 months from the date of issuance of this Directive for tank cars returning to service or withdrawn from storage and placed in hazardous or non-hazardous materials service prior to loading;

iv. Tank cars not inspected and tested according to this Directive may not be loaded and/or offered into transportation until they are inspected and tested in accordance with this Directive;

v. Tank car owners must include the results of the inspections and tests required by this Directive in the analysis of its qualification and maintenance program at the intervals required by 49 CFR 180.501 and 180.509;

vi. Within 60 days of the issuance of this Directive, each owner of a tank car subject to this Directive must notify all parties under contract to the car owner, including its lessees and/or sub-lessees, using the cars covered by the Directive of the terms of this Directive and the inspection and testing schedule.

g. Reports. Owners of tank cars subject to this Directive must report the inspection, test, and repair information to FRA as follows:



- i. Tank car reporting mark(s) and number(s) of tank cars in an owner's fleet identified under paragraph (1) of this Directive;
- ii. Planned inspection and test schedule for each tank car identified under paragraph (1) of this Directive, by reporting mark and number;
- iii. Tank car facility (station stencil) that performed the inspection(s) and test(s);
- iv. Date(s) the inspection(s) and test(s) were performed;
- v. Inspection and test method(s) and procedure number(s) used;
- vi. Name(s) of inspector(s) performing the inspection(s) and test(s), level(s) of certification(s), and method(s) certified;
- vii. Inspection and test results;
- viii. Corrective (repair) action(s) taken; and
- ix. The type and date of any accidents, incidents, or releases from the tank car related to the welds that are the subject of this Directive.

The information may be submitted in written hardcopy format or sent electronically to: Larry Strouse, General Engineer, Hazardous Materials Division, Office of Technical Oversight, FRA, 200 W. Adams Street, Suite 310, Chicago, Illinois, 60606, (312) 353-6203, email: Larry.Strouse@dot.gov. FRA must receive initial reports by October 30, 2016 and subsequent status updates every 90 days thereafter.

h. Repairs. Prior to initiating any repairs, a tank car facility must obtain the tank car owner's written permission and approval of the qualification and maintenance program the tank car facility will use consistent with Appendices D, R, and W of the Tank Car Manual and 49 CFR § 180.513. A tank car facility must report all work

performed and all observed damage, deterioration, failed components, or noncompliant parts to the owner under 49 CFR § 180.513.

FRA will continue to monitor the performance of the tank cars subject to this Directive in hazardous materials service and will take all necessary regulatory or enforcement action to ensure the highest level of safety on the Nation's railroads is maintained. Regardless of any entity's compliance with this Directive, FRA reserves the right to seek civil penalties or to take any other appropriate enforcement action for violations of the HMR that have occurred.

### **III. Paperwork Reduction Act**

The Paperwork Reduction Act of 1995 (44 U.S.C. 3507(d)) requires FRA to consider the impact of paperwork and other information collection burdens imposed on the public. FRA has determined that this Railworthiness Directive imposes new information collection requirements. FRA will be publishing a Paperwork Reduction Act notice for comment, following publication of this Directive.

### **IV. Agency Contact For Questions**

If you have any questions concerning this Directive, contact Larry Strouse, General Engineer, Hazardous Materials Division, Office of Technical Oversight, FRA, 200 W. Adams Street, Suite 310, Chicago, Illinois 60606, (312) 353-6203, Larry.Strouse@dot.gov.

Dated:



*for* Robert C. Lauby,  
Associate Administrator for Railroad Safety  
Chief Safety Officer