



National Transportation Safety Board
Washington, D.C. 20594

Hazardous Materials Accident Brief

Accident No.: DCA-96-SZ-003
Transportation Mode: Rail
Type of Accident: Tank car structural failure with the release and ignition of propane
Location: Consolidated Rail Corporation Selkirk Yard, Selkirk, New York
Date and Time: March 6, 1996, about 11:37 a.m.
Tank Car Number: UTLX 803627
Tank Car Specification: DOT 105J300W
Tank Car Manufacturer: Richmond Tank Car Company
Injured: 1
Evacuated: None
Material Released: Propane (flammable gas)
Type of Failure: Circumferential fracture and separation

The Accident

About 11:40 a.m. eastern standard time on March 6, 1996, tank car UTLX 803627, containing 31,409 gallons of liquefied propane, catastrophically failed about 3 minutes after the tank car had been switched at the Consolidated Rail Corporation (Conrail) classification yard in Selkirk, New York. The propane was released and ignited to create a large fireball. One minor injury was reported; however, there were no fatalities. Damages to freight cars on adjacent tracks and the loss of UTLX 803627 were estimated at about \$63,000. Lading losses from the damaged freight cars totaled \$256,600. At the time of the accident, the weather was overcast, and the temperature was between 32 and 40 °F.

The tank car had been loaded in Sarnia, Ontario, on March 3, and arrived at the Selkirk yard¹ at 9:17 a.m. on March 6 in Conrail train COSE5 from Buffalo, New York. Two car inspectors conducted a rolling inspection of the cars from train COSE5 before the cars were moved from the receiving yard to the classification yard about 11:00 a.m. Neither inspector saw or heard anything unusual during their inspection of the freight cars, and no discrepancies were noted for UTLX 803627. UTLX 803627 was uncoupled and released over the yard hump about 11:37 a.m. The retarder² operator stated that, as gravity propelled the car toward track 69 in the classification yard, he attempted to slow the car by manually applying the group retarder. Data

¹The Selkirk yard covers 1,250 acres and consists of the receiving yard with 11 tracks and a capacity of approximately 1,700 cars, the classification yard with 70 tracks and a capacity of approximately 3,700 cars, north and south departure yards, and servicing facilities for locomotives, car cleaning, and repair. The hump connects the receiving and classification yards. The classification yard, where new trains are made up, is east of the receiving yard.

²A *retarder* is a braking device installed at track level that is designed to slow or retard freight cars as they leave the hump and enter the classification yard.

provided by Conrail indicated that UTLX 803627 should have exited the group retarder at 9.4 mph, but instead exited at 13 mph. The car entered track 69 and coupled with a covered hopper car and three flat cars.

About 11:40 a.m., the tank car separated in half circumferentially near the manway and released its load of propane. The propane ignited almost instantaneously, creating a large fireball. When the tank car separated, the B-end of the tank car and the four other freight cars coupled to it were propelled almost 1 mile eastward along the tracks in the classification yard. The other half of the tank car remained near the separation point.

Tank Car Information

Design and Modifications — UTLX 803627 was one of 85 tank cars built by the Richmond Tank Car Company in 1977 as a Department of Transportation (DOT) specification 105A300W tank car. The tank cars, with a 34,000-gallon nominal capacity, were designed for carriage of liquefied petroleum gas, anhydrous ammonia, and butadiene. The tank shell and heads were constructed of Association of American Railroads (AAR) specification TC-128 grade B steel. The thickness of the tank shell and heads was 9/16 inch (0.5625 inch). The tank was originally insulated with 2 1/2 inches of urethane foam under a welded jacket.

In 1987, the Union Tank Car Company (Union) purchased 811 Richmond-built DOT 105A and 105S tank cars, including UTLX 803627, and converted them to DOT 105J tank cars. All the cars, which had been built under 12 different certificates of construction, were converted at the Union tank car shop in Cleveland, Texas, in 1987 and 1988. As part of this conversion, the original insulation systems (either urethane foam or a urethane foam/ceramic fiber combination) were removed and replaced with 1 inch of mineral wool and 4 inches of fiberglass insulation to meet DOT requirements for thermal protection. During the conversion, the external surfaces of the tanks were also inspected for corrosion. Exterior weld overlays³ were applied to those areas where, because of corrosion induced from moisture collecting in the void spaces of the urethane foam and/or the absence of a protective coating on the exterior of the tank, the tank thickness did not meet the minimum thickness of 9/16 inch.

Weld overlays were applied to 98 square feet of the total 2,027 square feet exterior surface area of UTLX 803627. Most of the areas where weld overlays were applied were located on the top and bottom of the tank, including areas around the manway at the top center of the tank and adjacent to where the tank failed and separated. All of the areas with weld overlays had had post-weld heat treatments to relieve residual stresses.

Pre-Accident History — UTLX 803627 was received at the Union tank car shop in El Dorado, Kansas, on November 30, 1995, for cleaning, modification of the manway cylinder, and routine maintenance. Union indicated that the manway modification project had been initiated after the jackets buckled and shifted at the manway on a small percentage of Union's tank cars. The modification consisted of removing the existing manway flashing, then welding a new 3/8-inch-thick cylinder and flashing to the top of the manway reinforcement pad and to the outside of the nozzle flange ring. Because no welding was done to the tank shell, post-weld heat stress treatment was not required or performed. Union indicated that no other repairs or modifications had been made to the top of the tank or around the manway.

³ A series of welds applied in a side-by-side manner in areas that had been thinned through corrosion in order to restore the thickness of the tank to the minimum required by the DOT.

On December 7, 1995, the tank car tank and its safety relief valve were successfully pressure tested in accordance with DOT requirements. The final inspection sheet, dated December 20, 1995, (the date the tank car was released from the repair shop) indicates that all valves and fittings, couplers, trucks, brakes, and safety appliances were in good condition and operational. Between its release from the El Dorado repair shop and the accident, the tank car had transported one load of propane from Windsor, Ontario, to Phoenix, New York, in January 1996.

Failure of UTLX 803627

Initial examination of the fracture surface disclosed that the majority of the fracture contained chevron markings. The orientation of these markings indicated that the origin of the fracture was on the exterior surface of the shell approximately 6 inches circumferentially from the top centerline of the tank car. The apparent origin was immediately adjacent to an area with weld overlay on the tank shell. Sections containing the fracture origins on the mating fracture faces were removed with a cutting torch and sent the Safety Board's materials laboratory for metallurgical examination.

Examination of the fracture surfaces revealed regions of incomplete fusion at the toes of the weld beads in the weld overlay near the manway. The regions of incomplete fusion created voids and cavities where the effective wall thickness of the tank ranged from 0.437 inch to 0.487 inch. Inspection also revealed cracks at the root of the area of incomplete fusion and numerous large voids in the weld metal and at the fusion line in the area immediately adjacent to the fracture initiation. Metallurgical examination also found features on the fracture surfaces that were typical of brittle fracture in metals.⁴

Postaccident Tests and Inspections

Inspection of Union-Owned Tank Cars — On March 12, 1996, the AAR issued Early Warning Letter 144 directing that the 80 tank cars still in service that were built under the same certificate of construction as UTLX 803627 be held out of transportation service pending inspection. Union was to report the inspection results to the Federal Railroad Administration (FRA). Of the 80 tank cars, 78 were inspected, and 2 were in storage. According to the FRA, poor workmanship, weld porosity, lack of weld fusion, and cracking were found in the weld overlay of "several" of the tank cars inspected.

On May 14, 1996, the AAR sent Union a letter expressing AAR and FRA concerns about weld overlay repairs in "highly stressed areas of the tank that may exhibit undesirable characteristics." The AAR proposed that a sample of 10 tank cars from the remaining 731 converted tank cars be examined and an inspection protocol developed. Based on the results of acoustic emissions tests for these 10 tank cars, the FRA, the AAR, and Union developed testing and inspection protocols for the remaining 721 cars. According to Union, as of January 2, 1998, 561 of these tank cars had been inspected, and the inspections revealed no pattern of significant defects in weld overlay areas and no unchecked corrosion. The remaining tank cars are to be inspected by December 31, 1998.

Inspections of Other Richmond-Built Tank Cars — The FRA was concerned that similar Richmond-built tank cars owned by companies other than Union may have been in service with extensive corrosion and areas of the tank shell that fell below the specified minimum thickness. On

⁴At temperatures below the tank metal's ductile-to-brittle transition point, the metal will exhibit brittle rather than ductile properties.

July 2, 1996, the AAR provided the FRA with a list of owners, other than Union, of more than 2,000 Richmond-built tank cars. On September 28, 1996, the FRA sent letters to 23 of these owners informing them of the possible existence of corrosion. The FRA requested that each owner provide information about corrosion, repairs, and retirement of these tank cars. Based on information the owners provided, the FRA estimated that about 19 percent of the inspected tank cars had weld overlay repairs that covered more than 25 square feet of the exterior tank shell.

Consequently, the FRA is preparing, under the provisions of 49 CFR 180.509(b)(4), a letter requiring tank car owners to recall and inspect all Richmond-built tank cars with foam-in-place insulation. The car owners will be required to remove the existing jacket and foam insulation, inspect the external tank shell for corrosion, remove any existing corrosion, measure the tank wall thickness, and repair areas that are below the minimum wall thickness. Any repairs, including weld overlays, will have to be in accordance with approved AAR practices for welding and repair. The letter will also require tank car owners to submit an inspection plan for approval, and to report the results of their inspections to the FRA.

Probable Cause

The National Transportation Safety Board determines that the probable cause of the failure of tank car UTLX 803627 was a defective weld overlay repair adjacent to the manway that resulted in an overstress fracture near the manway. Contributing to the severity of the failure was the brittleness of the tank steel, which promoted the rapid propagation of the overstress fracture and led to complete separation of the tank.

Adopted: April 20, 1998