# National Transportation Safety Board
**Washington, D.C. 20594**

## Hazardous Materials Accident Brief

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| Accident No: | DCA02MZ001 |
| Location: | South Charleston, West Virginia |
| Date of Accident: | January 5, 2002 |
| Time: | 11:36 a.m. eastern standard time |
| Carrier: | Dana Transport, Inc. |
| Vehicle: | MC-307 Cargo Tank |
| Injured: | No injuries |
| Evacuated: | None |
| Property Damage: | In excess of $18,000 |
| Materials Involved: | 5,152 gallons of polypropylene glycol |
| Type of Accident: | Catastrophic structural failure of cargo tank |

## The Accident

About 11:36 a.m., on January 5, 2002, a tractor/cargo tank semitrailer was leaving the Bayer Corporation's South Charleston, West Virginia, chemical plant. (The cargo tank consisted of three independent but connected tanks.[1]) The vehicle had stopped at a traffic signal just beyond the plant, at the intersection of Montrose Drive and MacCorkle Avenue. When the vehicle started to cross McCorkle Avenue, the cargo tank failed catastrophically between the front and center tanks and broke in two. (See figure 1.) The tanks were not breached, and no cargo was released. (The cargo tank contained 5,152 gallons of polypropylene glycol.[2]) No one was killed, injured, or evacuated as a result of the accident. The intersection, however, was closed for 7 hours. Damage, cleanup, and lost revenues were estimated at $18,000.

[1] For the purposes of this brief, *cargo tank* means all three connected tanks; *tank* means any one of the three tanks.

[2] The Department of Transportation (DOT) does not identify polypropylene glycol as a hazardous material; however, the cargo tank semitrailer could have been used to transport DOT-regulated hazardous materials.

**Figure 1.** Accident.

## Cargo Tank Information

At the time of the accident, Dana Transport, Inc., (Dana) of Avenel, New Jersey, owned the vehicle. The Jacob Brenner Company, Inc.,[3] (Brenner) had manufactured the cargo tank semitrailer in 1974. The front tank had a water capacity of 3,000 gallons; the center tank, 1,500 gallons; and the rear tank, 2,000 gallons. In total, the cargo tank had a water capacity of 6,500 gallons.

The tanks were Department of Transportation (DOT) specification MC-307 cargo tanks and were made of T316 stainless steel. The shell material was specified as 12 gauge (nominally 0.105 inches thick), and the head material was specified as 10 gauge (nominally 0.140 inches thick). Each tank had circumferential stainless steel stiffeners (rings) that had been welded around it to provide structural support. (See figures 2 and 3.)

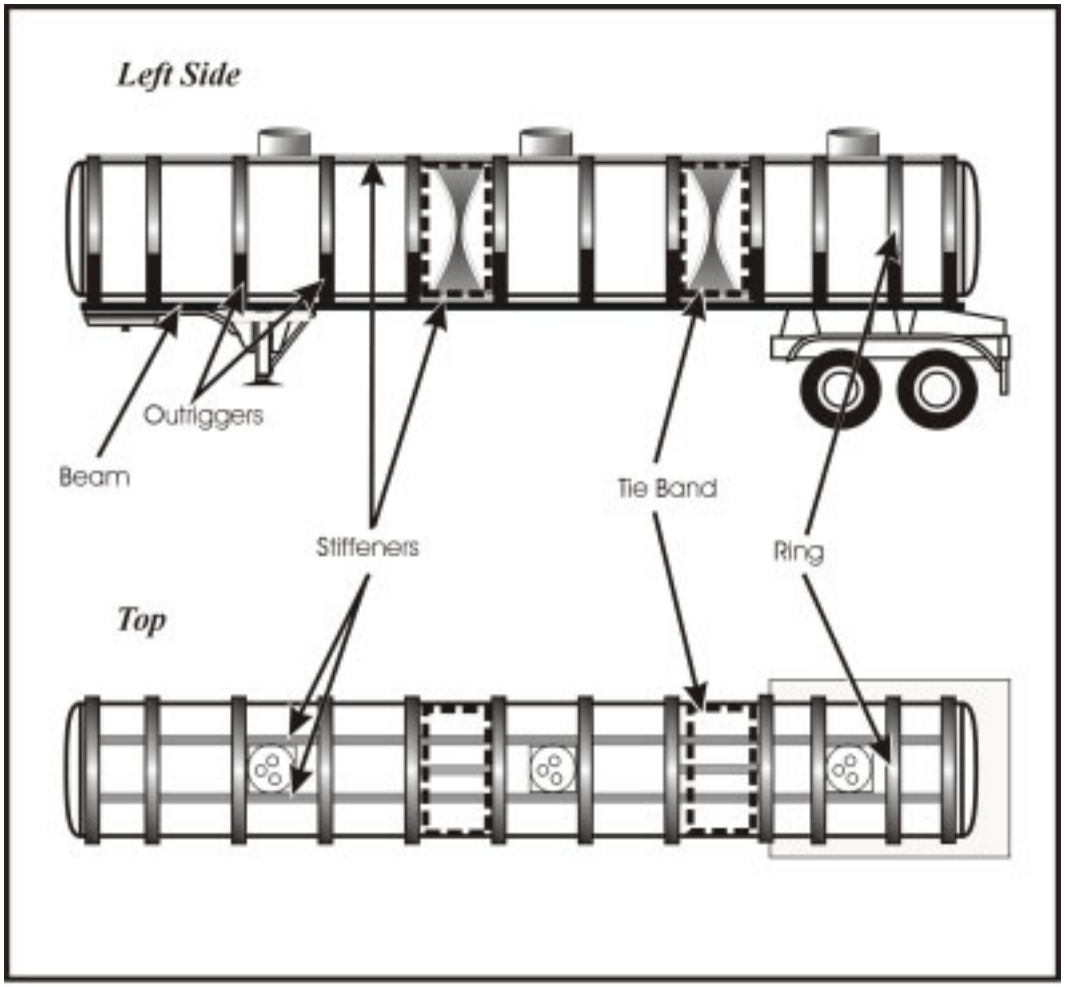


**Figure 2.** Side and top view of cargo tank (without exterior jacket).

[3] Now known as Brenner Tank, LLC, after it was purchased by Peterson Industries, LLC, of Sturgeon Bay, Wisconsin, on September 1, 2001.

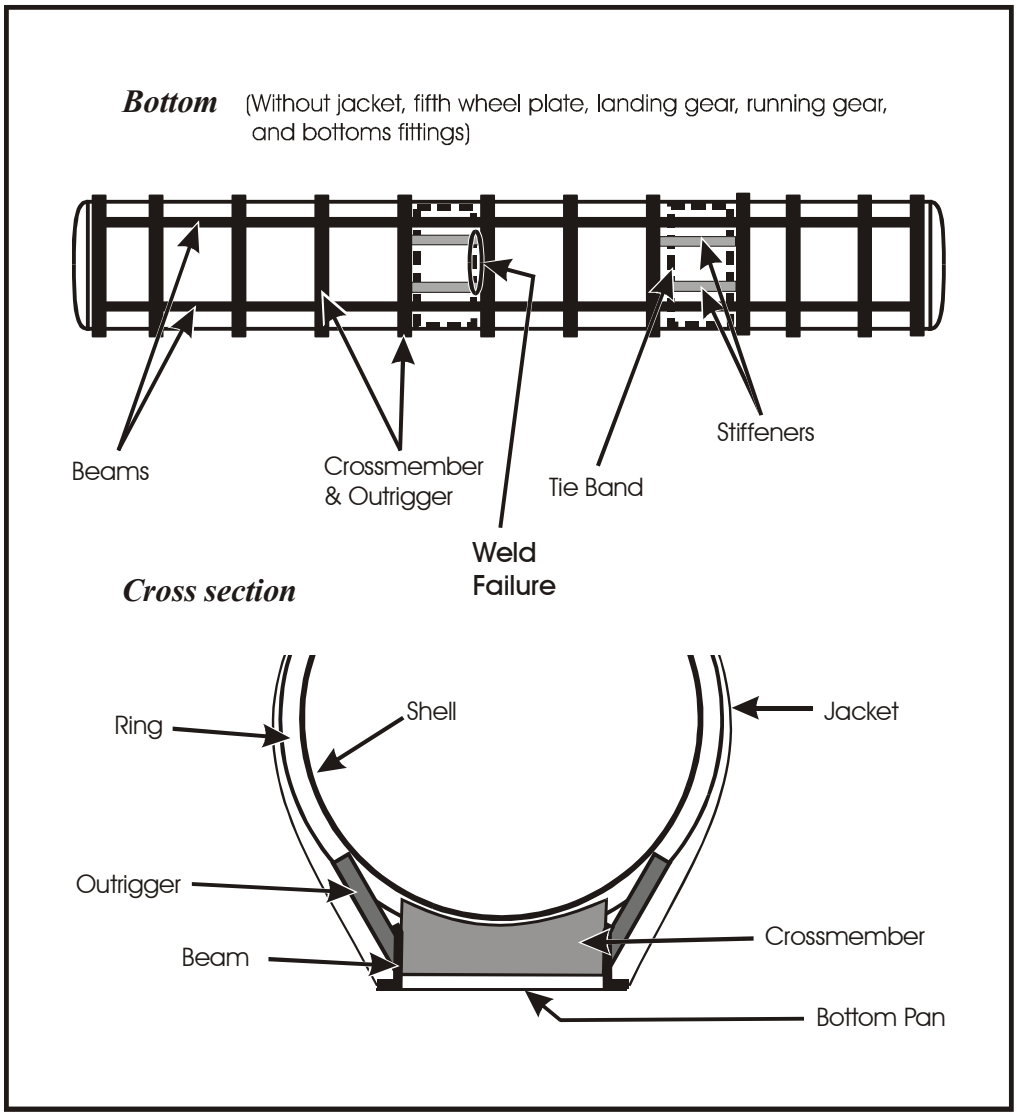


**Figure 3.** Bottom view and cross section of cargo tank.

The three tanks had been made into a unified structure by welding 2-foot-wide stainless steel bands, called "tie bands," over the facing heads of adjacent tanks. (The tie bands were made of the same material as the tank shell: 12-gauge stainless steel.) According to the design specifications, the welds were to have complete penetration and to be fully circumferential. Longitudinal stainless steel stiffeners (stiffeners) had been welded along both sides of the top and bottom of the cargo tank to provide structural support.

The cargo tank was welded to a carbon steel frame that ran the full length of the semitrailer and contained the fifth wheel plate and the attaching points for the landing gear, the running gear, and the rear end protection**.** The cargo tank was covered with flexible fiberglass insulation, which, in turn, was covered by a stainless steel jacket that had been welded to the sides of the frame. The

jacket was 24 gauge (nominally 0.025 inches thick). A stainless steel pan was welded to and covered the bottom of the frame.

The frame consisted of two longitudinal beams that were joined to each other by several cross members. Each beam was welded to each ring on the cargo tank by an outrigger. The frame was visible only where it was attached to the fifth-wheel plate, the landing gear, the running gear, and the rear end protection. Only the visible parts of the frame were painted; those portions of the frame covered by the jacket and pan were not painted.

According to Brenner's quality assurance manager, the cargo tank semitrailers that Brenner now manufactures do not have a frame. Instead, the cargo tank is the sole structural member between the fifth wheel and the frame for the running gear. The manager said that as designed, the cargo tank involved in the accident was strong enough without the frame to maintain its integrity. The frame had been included with the early cargo tanks as an extra measure of structural support.

Since buying the cargo tank semitrailer in 1997, Dana had done the required visual external inspections every year. The inspection records do not indicate any problems with corrosion, the welds, or the structural integrity of the cargo tank. According to the records, the inspections had included the "major appurtenances, -upper coupler assembly, -suspension system attachments [and] -connecting structures." The records also indicate that the vehicle had been inspected for "corroded or abraded areas, distortions, dents, [and] welds." The records do not indicate whether the jacket and the pan had been removed for inspection of the structural members and welds covered by the jacket.

## Postaccident Examination

On-scene Safety Board investigators found that the portion of the frame that had been uncovered by the failure was extensively corroded. The corrosion had penetrated the full thickness of the metal in some areas. (See figure 4.) The investigators removed the jacket to reveal the frame in an area under the tie band between the rear and center tanks. That part of the frame was also extensively corroded.

**Figure 4.** Corrosion of frame.

The Safety Board laboratory examined two portions of a tie band and the associated weld zones to the tank heads. The tie band had been welded to the front head of the center tank and to the back head of the front tank. One portion included the weld at the bottom of the center tank, where the failure had occurred, and the second portion included the weld to the front tank, where small cracks had been observed on the outer surface. Both weld zones had fatigue cracking that progressed from the interior surface of the band to the outer surface. The welds did not have full penetration, and the weld zone occupied 50 percent or less of the thickness of the tie band.

The areas between the unwelded portions of the tie band and the tank heads formed narrow notches. According to Penton Education Division *Basic Course in Failure Analysis,*[4] "A notch … in a part subjected to fatigue loading can be regarded as a factor causing a local increase in stress or as a factor reducing strength."

## DOT Regulations for Cargo Tanks

The *Hazardous Materials Regulations* (Title 49, *Code of Federal Regulations* [CFR], Parts 171 to 180) requires the periodic inspection and testing of DOT specification cargo tanks. According

[4] Lipton, Charles, *Basic Course in Failure Analysis*, Penton Publishing Company, Cleveland, Ohio, 1969 – '70.

to paragraph 180.407(d)(2)(viii), "All major appurtenances and structural attachments on the cargo tank including, but not limited to, suspension system attachments, connecting structures, … must be inspected for any corrosion or damage which might prevent safe operation." Furthermore, in a January 8, 2001, letter interpreting the paragraph to the National Tank Truck Carriers, Inc.,[5] the Research and Special Programs Administration (RSPA) stated, "…even where insulation precludes a visual external inspection of the tank shell, a visual external inspection of a cargo tank's … major appurtenances and structural attachments must be conducted in accordance with §180.407(d)(2)**."**

However, according to RSPA's Office of Hazardous Materials Safety, inspectors can do the inspection required by paragraph 180.407(d)(2)(viii) without removing the insulation and jacket and must inspect only the portions of the cargo tank that they can see.

## Postaccident Actions

As a result of the Board's investigation of this accident, the Truck Trailer Manufacturers Association[6] (TTMA) issued a technical bulletin (TB-121-03), dated April 4, 2003, that states the following:

> [The objective of the bulletin is] to provide guidance for the inspection of the circumferential seam welds within the connecting structure joining multiple cargo tanks, in a self-supporting cargo tank motor vehicle where external visual inspection is precluded by insulation, jacketing, doubler bands, etc.
>
> [The bulletin recommends that these cargo tanks be] initially visually inspected by fully removing any obstruction to visual inspection of the connecting structure. At a minimum the external visual inspection must include inspection for cracks, defects in welds, leakage, corrosion, dents, or distortions that might render the cargo tank unsafe for transportation service…. This is a once in a life time cargo tank inspection requirement.
>
> Thereafter the connecting structure shall be tested annually for leaks in the void area by hydrostatic or pneumatic pressure test, dye penetrant test, etc….
>
> Any cargo tank that has reached or surpassed a 20-year service life and that has not had the required tests performed shall be placed out of service until the required inspections are completed.

[5] The National Tank Truck Carriers is composed of approximately 180 trucking companies that specialize in the nationwide distribution of bulk liquids, industrial gases, and dry products in cargo tank motor vehicles.

[6] The TTMA is an association whose purposes are to establish confidence between manufacturers of truck trailers, cargo tanks, intermodal containers and their suppliers; to bring about a mutual understanding of the problems confronting all manufacturers; to conduct programs and activities which will further the interests of TTMA member companies and the truck trailer industry; and to provide a means of cooperating with the various agencies of the Federal, State, and international governments in any appropriate manner that will best serve both the public and the members' interests.

The initial inspection that the bulletin calls for is intended to yield a thorough assessment of the condition of hidden structural components on cargo tanks that have a design similar to the design of the cargo tank that was involved in the accident. The annual testing that the bulletin requires is intended to ensure that each cargo tank maintains its structural integrity throughout its lifespan.

The Federal Motor Carrier Safety Administration plans to issue a Cargo Tank Safety Advisory Notice (FMCSA-HSMA-01-03) in August 2003 that advises motor carriers and cargo tank manufacturers to take the following steps:

- Identify the cargo tanks manufactured before January 1983 that have designs that are similar to the tank involved in the accident.
- Determine the status of each tank.
- If the tank is no longer in service, get documentation from the owner that explains why.
- Otherwise, inspect the tank in accordance with the TTMA's technical bulletin.
- Make sure the inspection documents identify the tank, what was discovered during the inspection process, and the methods used to repair any defects.
- Send the documents to the Federal Motor Carrier Safety Administration.

Also, the Federal Motor Carrier Safety Administration will stipulate in the advisory notice that all tanks still in service must be inspected no later than December 31, 2003, and that a Federal Register notice will be issued after the December 31 deadline requiring the removal of the remaining uninspected tanks from hazardous materials service until the inspection and necessary repairs are completed.

## Probable Cause

The National Transportation Safety Board determines that the probable cause of this accident was a combination of fatigue failure caused by incomplete welding on the tie bands and of the extensive corrosion of the frame.

**Adopted: August 21, 2003**