Transportation Technology Center, Inc.

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SIMULATION TEST REPORT

Flexitank Disposable Bulk Packaging System for Non-Hazardous Liquid in a 20′ Container - COFC – Environmental Packaging Technologies

NOTE: THIS TEST REPORT DOES NOT CONSTITUTE APPROVAL OR DISAPPROVAL OF THE EQUIPMENT, METHOD OR MATERIAL TESTED

TEST REPORT: VL 1-09

August 7, 2009

Report by:
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RAIL SIMULATION TEST REPORT

SUBJECT: **Flexitank Disposable Bulk Packaging System for Non-Hazardous Liquid in a 20′ Container - COFC – Environmental Packaging Technologies.**

SYNOPSIS: A Rail Simulation test was conducted to evaluate a disposable bulk packaging system for shipment of non-hazardous liquid in 20' containers. Environmental Packaging Technologies flexitank type systems have a maximum capacity of 6,340 US gallons and consists of tube constructed multiple ply ultra high tensile ethylene co-polymer membranes (2). A multi-layer secondary containment liner is installed between the container walls and the flexitank and supported by the upper lashing rings. The flexitank is then fitted into a standard 20' ISO marine container and filled with approximately 5,300 US gallons of liquid while being secured with a bulkhead system consisting of a five of steel tubes pre-formed into arcs and a 8 mm plastic fluted dunnage sheet. This method successfully completed Rail Simulation testing.

BACKGROUND: Mr. Michael Sims, Environmental Packaging Technologies, requested a Rail Simulation Test be conducted to evaluate the performance of a disposable bulk packaging system secured inside a 20' container with the Big Red Flexitank™ and a bulkhead system consisting of five steel tubes preformed into arcs and a 8mm plastic fluted dunnage sheet. The same bulkhead system was also used in a previous impact test (see Field Impact Test report FI 3-09).

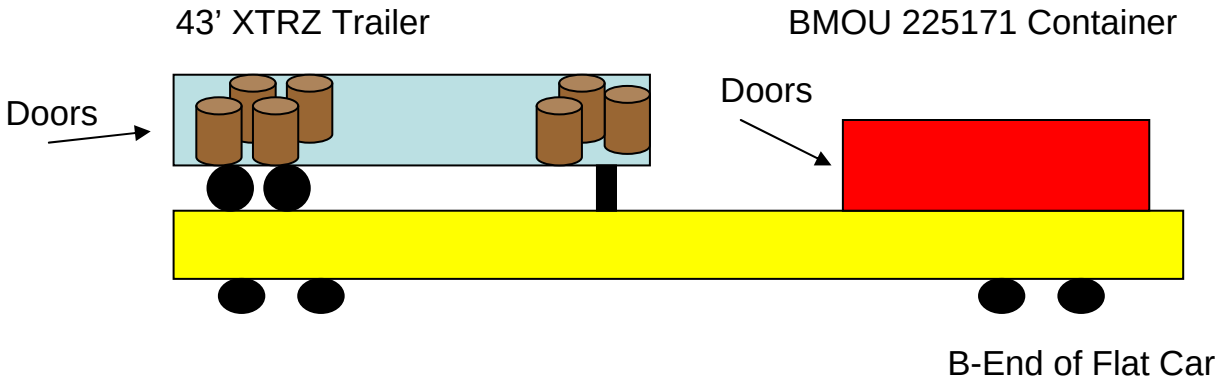
The bottom discharge flexitank is intended as a single trip disposable packaging system for non-hazardous bulk liquids and is fitted into a standard ISO 20' container for a one-way bulk liquid transport system. The flexitank is constructed of 2 plies of ultra high tensile ethylene co-polymer membranes and a woven polyethylene outer. Tank Model # 20CBMBSF having dimensions of ~10'x20' and a maximum capacity of approximately 6,340 US gallons was used during testing. The flexitank is fitted with one 3" filling/discharging PE male cam lock equipped with ball valve.

The Rail Simulation Test was conducted on the Vibration Test Unit (VTU) at the Transportation Technology Center, Pueblo, Colorado during the week of June 27, 2009.

In attendance during testing were:

Mr. Michael Simms, Environmental Packaging Technologies
Mr. Don Reilly, Environmental Packaging Technologies
Mr. Shane Sims, Environmental Packaging Technologies
Mr. Mike Sandoval AAR/TTCI

LOAD DESCRIPTION: The test load was in container BMOU 225171 22G1 having a light weight of 4,900 lbs. and a maximum payload capacity of 67,200 lbs. The test container was loaded on the B-end of flat car TTWX 190074 (light weight 70,100lbs) having 15" end of car cushion units. An additional trailer was loaded for additional weight. The XTRZ trailer was loaded with 58" diameter paper rolls to the Intermodal Loading Guide's E-18 Method. Approximate combined weight of the XTRZ trailer was 40,000lbs.



Load Diagram

The test load consisted of one Environmental Packaging Technologies "Big Red Flexitank™", Tank Model #20CBMBSF having dimensions of ~10'x20' with a nominal capacity of approximately 6,340 US gallons. The 20' container was cleaned and checked for any protruding material that could puncture the flexitank. Each welded seam inside the container was covered with duct tape. The inside of the container was lined with 8mm cardboard with Styrofoam triangles fitted on the inside corners (see Photo #1). The multi layer Barrier Wear Sleeve liner was then installed prior to fitting the flexitank and attached to the upper lashing rings. The flexitank was secured inside the 20' container to the upper corner lashing rings and with a bulkhead consisting of five preformed arched tubular steel bars (manufactured by a proprietary process that rolls and welds 17 gauge steel) with dimensions of approximately 93" wide x 58" high with an 8mm plastic fluted sheet facing the interior of the load. The bulkhead was installed horizontally across the rear of the container and the five steel tubes extending into the recessed container bull board slots on both sides of the container were secured in place with Velcro straps. The flexitank was then filled with 5,300 US gallons of water using a calibrated water meter. Total approximate weight of the water filled "Big Red Flexitank™" and container was 47,250 lbs.

The bulkhead also has an additional flap attached at the front of the tank which is then secured to the upper center lashing rings to prevent the flexitank from surging over the top of the bulkhead system.

Two pneumatic dunnage airbags (3' x 16' @ 1.0 psi) were placed on top of the flexitank to help reduce surging of the liquid in the flexitank.

Total approximate weight of the entire "hammer" load was 157,350 lbs. The system was tested with both doors open with the forward impacts conducted towards the doors and the reverse impact towards the nose wall.

The anvil string consisted of four empty railcars: MP 582911, CR 433432, DRGW 60971 and DRGW 60932 having a combined weight of approximately 269,100 lbs. The airbrakes were set on all cars and the handbrakes were set on the first and last standard draft gear car in the anvil string.

RESULTS:

Impact Target Speed	Actual Speed	#1 Top Bulkhead Tube	#2 Bulkhead Tube	#3 Center Bulkhead Tube	#4 Bulkhead Tube	#5 Bottom Bulkhead Tube	Anvil Movement
Distance to door empty		**12"**	**12 "**	**11 5/8"**	**11 1/2"**	**11 3/8"**	
Distance to door after 5,300 gallons		**11 7/8"**	**11 7/8"**	**11 5/8"**	**11 ½"**	**11 3/8"**	
5.0 mph	**4.9 mph**	**11 7/8"**	**11 7/8"**	**11 5/8"**	**11 ½"**	**11 3/8"**	**16"**
Reverse 5.0 mph	**5.0 mph**	**11 7/8"**	**11 7/8"**	**11 5/8"**	**11 ½"**	**11 3/8"**	**17"**
VTU Cycle 1		**11 7/8"**	**11 7/8"**	**11 5/8"**	**11 ½"**	**11 3/8"**	
6.0 mph	**6.0 mph**	**11 7/8"**	**11 7/8"**	**11 5/8"**	**11 ½"**	**11 3/8"**	**22"**
Reverse 6.0 mph	**6.1 mph**	**11 7/8"**	**11 7/8"**	**11 5/8"**	**11 ½"**	**11 3/8"**	**25"**
VTU Cycle 2		**11 7/8"**	**11 7/8"**	**11 5/8"**	**11 ½"**	**11 3/8"**	

CONCLUSION: The bulkhead securement system and flexitank successfully completed Rail Simulation testing. No movement or deflection of the bulkhead was noted during testing. No permanent deflection was noted to the container walls.

DISCUSSION: The bulkhead system and flexitank performed as intended and restricted the entire flexitank and bulkhead from coming into contact with the doors during impacts. The two pneumatic dunnage bags laid across the top of load seemed to have no influence on reducing the surging effects of the liquid. The pneumatic dunnage bags were askew on top of the tank and were not in contact with the top of the container. The additional flap that is from the secondary liner and secured at the upper center lashing rings performed as intended, keeping the flexitank from surging over the top of the bulkhead.

The flexitank was drained and inspected upon completion of the test. The flexitank had no leaks chaffing or abrasion of materials.

Attachment 1 is the Rail Simulation Procedure.

TTCI would like to thank Environmental Packaging Technologies for their assistance in conducting this test.

Mike Sandoval
Sr. Engineer
Damage Prevention and Loading Services

TEST PHOTOS

Photo #1
Container Preparation

Photo # 2
Flexitank Installation

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Photo #3
Bulkhead Installation

Photo #4
Bulkhead Installation

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Photo #5
Pneumatic Dunnage Installation

Photo #6
Flexitank System Ready for Testing

TEST PHOTOS

Photo #7
Flexitank System Ready for Testing

Attachment 1

PROCEDURES FOR SIMULATION TESTING OF TRAILER ON FLAT CAR (TOFC) OR CONTAINER ON FLAT CAR (COFC) LOADING AND BRACING METHODS OR MATERIALS

Cycle 1

A) 2 Impacts - One at each end of the test car at 5 m.p.h. (± 0.5 m.p.h.)

B) Track data on VTU

1) Cycle 1

Run # / Filename	Duration (minutes)	Speed (mph)	Distance
410ctf12_60ft_70in_19mph_128sps_939sec.rcw	15.4	18.5	4.7
701ctf12_60ft_70in_25mph_128sps_418sec.rcw	6.9	24.8	2.8
403ctf12_60ft_70in_30mph_128sps_693sec.rcw	11.3	29.5	5.5
806ctf12_60ft_70in_40mph_128sps_553sec.rcw	9.0	39.0	5.8
424ctf12_60ft_70in_42mph_128sps_983sec.rcw	16.5	42.1	11.5
424ctf12_60ft_70in_42mph_128sps_983sec.rcw	16.5	42.1	11.5
420ctf12_60ft_70in_47mph_128sps_701sec.rcw	12.7	46.9	9.9
803ctf12_60ft_70in_51mph_128sps_549sec.rcw	8.9	51.0	7.6
605ctf12_60ft_70in_62mph_128sps_800sec.rcw	13.3	61.9	13.7
608ctf12_60ft_70in_62mph_128sps_818sec.rcw	13.5	62.3	14.0
508ctf12_60ft_70in_62mph_128sps_611sec.rcw	9.9	62.3	10.3
420ctf12_60ft_70in_47mph_128sps_701sec.rcw	12.7	46.9	9.9
424ctf12_60ft_70in_42mph_128sps_983sec.rcw	16.5	42.1	11.5
403ctf12_60ft_70in_30mph_128sps_693sec.rcw	11.3	29.5	5.5
403ctf12_60ft_70in_30mph_128sps_693sec.rcw	11.3	29.5	5.5
410ctf12_60ft_70in_19mph_128sps_939sec.rcw	15.4	18.5	4.7
Totals	201.1	40.3	134.4

Cycle 2

A) 2 Impacts at opposite ends of the test car - Each at 6 m.p.h. (± 0.5 m.p.h.)

B) Track data on VTU

1) **Cycle 2**

Run # / Filename	Duration (minutes)	Speed (mph)	Distance
410ctf12_60ft_70in_19mph_128sps_939sec.rcw	15.4	18.5	4.7
701ctf12_60ft_70in_25mph_128sps_418sec.rcw	6.9	24.8	2.8
403ctf12_60ft_70in_30mph_128sps_693sec.rcw	11.3	29.5	5.5
806ctf12_60ft_70in_40mph_128sps_553sec.rcw	9.0	39.0	5.8
424ctf12_60ft_70in_42mph_128sps_983sec.rcw	16.5	42.1	11.5
424ctf12_60ft_70in_42mph_128sps_983sec.rcw	16.5	42.1	11.5
420ctf12_60ft_70in_47mph_128sps_701sec.rcw	12.7	46.9	9.9
803ctf12_60ft_70in_51mph_128sps_549sec.rcw	8.9	51.0	7.6
605ctf12_60ft_70in_62mph_128sps_800sec.rcw	13.3	61.9	13.7
608ctf12_60ft_70in_62mph_128sps_818sec.rcw	13.5	62.3	14.0
508ctf12_60ft_70in_62mph_128sps_611sec.rcw	9.9	62.3	10.3
420ctf12_60ft_70in_47mph_128sps_701sec.rcw	12.7	46.9	9.9
424ctf12_60ft_70in_42mph_128sps_983sec.rcw	16.5	42.1	11.5
403ctf12_60ft_70in_30mph_128sps_693sec.rcw	11.3	29.5	5.5
403ctf12_60ft_70in_30mph_128sps_693sec.rcw	11.3	29.5	5.5
410ctf12_60ft_70in_19mph_128sps_939sec.rcw	15.4	18.5	4.7
Totals	201.1	40.3	134.4

Total Simulated Mileage Cycles 1 & 2: 268.8 miles