Big Red Flexi-tank Tests

DATE COMMENCEMENT: 23/07/2007

SUBJECT: 24,000 litre Flexi-bags subjected to mechanical strength tests within 20ft ISO Freight Containers.

TESTS: Tests carried out in accordance with the following standards:

1. DNV 2.7.1 Offshore Containers, paragraph 4.6.4 vertical impact test.
2. EN12079 Offshore Containers, paragraph 7.4 Vertical impact test.
3. ISO 1496-1 Freight Containers, paragraph 6.10 Transverse Rigidity.
4. Non ISO test procedure Torsional Stiffness.
5. Non ISO test 45 degree lift from the horizontal (doors open)
6. Non ISO test 30 degree lift from the vertical (doors closed)

TEST SCOPE:

Marine Container Test Services Ltd, have performed the tests in accordance with the relevant Offshore & ISO standards / non ISO tests to prove the ability of a 24,000ltr flexi-bag whilst fully laden with 24,000ltrs of water & contained inside a standard 20ft ISO Freight Container.

The test loads & findings can be found on the attached test reports.

KEY:

1. MCTS - Marine Container Test Services Ltd
2. MGW - Maximum gross weight.
3. 1DT-2DT-3DT-4DT - MCTS drop test equipment.
4. 3DT. - Highest impact point from drop test equipment.
5. Big Red Flexi-tank. - Durable 24,000ltr bulk liquid storage system.
6. LR. - Lloyds Register of Shipping.
7. DNV 2.7.1 - Offshore container standard.
8. BSEN 12079. - BSI Container Standard.
9. BS ISO 1496-1. - Freight container standard.

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TEST PROCEDURES:

DNV 2.7.1 / BSEN 12079 Vertical impact test 24/07/2007 & 25/07/2007:

- ISO freight container serial numbers WCAU 213107-2 & WCAU 212360-5 where both loaded internally re-installation procedures EPT 1-877-8 with 24,000ltr Flexi-bags (load medium water)
- Note both units MGW 30,480kg & Tare 2,185kg respectively
- Test load = Tare 2,185 + 24,000ltr internal load.
- The units where lifted separately via a mobile crane and positioned onto the drop test equipment serial numbered 1DT-2DT-3DT-4DT. Note position 3DT is the highest drop impact on the equipment.
- Once the unit was positioned onto the drop test equipment, hydraulic rams where positioned at test positions 3DT & 4DT & secured.
- Upon satisfactory survey of the test equipment & unit by MCTS test engineers, the hydraulic force was applied and the unit was subjected to the required drop test.
- First tests where conducted on container WCAU 213107-2 with Flexi bag serial number 070326005c (top discharge) fitted.
- WCAU 213107-2 was subjected to 1off 3DT drop test at the fixed end of the unit & 4off 3DT drop test at the door end of the unit.
- Upon completion of the tests the Flexi-bag serial number 070326005c retained the full load of 24,000ltr of water; no water leakage was evident upon completion of test.
- Second tests where conducted on container WCAU 212360-5 with Flexi bag serial number 070318006c (top discharge) fitted.
- WCAU212360-5 was subjected to 1off 3DT drop test at the door end of the unit.
- Upon completion of tests the Flexi-bag serial number 070318006c retained the full load of 24,000ltr of water; no water leakage was evident upon completion of test.
- Note: Both WCAU containers showed visible signs of structural deformation post tests.
- ISO containers are not designed to be subjected to DNV 2.7.1 / EN 12079 mechanical tests of this nature.

Non ISO 45 degree from the horizontal, tilt test 24/07/2007:

- Upon completion of the drop tests unit WCAU 213107-2 was taken from the drop test equipment & placed in a natural horizontal position.
- The container doors where then opened & upon opening the doors it was noted that the Flexi-bag was still in its natural installation position although 3off of the bulkhead restraining bars had become detached from the internal upright, located on the left hand side of the container internally.
- The doors where secured open and the unit was then lifted by means of a mobile crane via its upper 2off corner fittings located at the fixed end of the unit.
- The unit was held in a 45 degree from the horizontal position allowing the full weight of the Flexi-bag to rest on the bulkhead restraints, the bulkhead restraining bar located second from the bottom completely separated from the bulkhead leaving only the top & bottom restraining bars to support the full weight of the Flexi-bag.
- The unit was then lowered into the horizontal position.
- Upon completion of tests the Flexi-bag serial number 070318005c retained the full load of 24,000ltr of water, and no water leakage was evident upon completion of test.

Non ISO 60 degree from the horizontal, tilt test 24/07/2007:

- Upon completion of the 45 degree lift tests unit WCAU 213107-2 was taken & placed in a natural horizontal position.
- The doors where secured shut with now only 4off bulkhead securing bars in position.
- The unit was then lifted by means of a mobile crane via its upper 2off corner fittings located at the fixed end of the unit.
- The unit was held in a 60 degree from the horizontal position allowing the full weight of the Flexi-bag to rest on the container door bulkhead.
- The crane held the container at the 60degree from the horizontal position for 2 minutes & then the Flexi-tank burst and lost its internal load of 24,000ltr of water.
- Note: The WCAU ISO container showed visible structural signs of deformation post tests.
- ISO containers are not designed to be subjected to non ISO standard tests of this nature.
- Dave Sole & G Rogers where in attendance (Lloyds Register EMEA)

Non ISO Torsional stiffness test 25/07/2007:

- Container WCAU 213089-9 was placed on four level hydraulic rams positioned in the MCTS ISO testing facility.
- The ISO container was loaded internally re-installation procedures EPT 1-877-8 with 24,000ltr Flexi-bag (load medium water)
- MGW 30,480kg & Tare 2,185kg. (ISO container)
- Test load = Tare 2,185 + 24,000ltr internal load plus stacking load of 7,000kg.
- Flexi-bag serial number 070131001b bottom discharge.
- The ISO unit was placed on four level hydraulic rams & raised 6".
- The top four ISO corner castings where bridged to the stacking rams by means of 4off stacking posts.
- A dial test indicator (DTI) was placed directly underneath the bottom rail @ the nearest point to the bottom casting container post A1 & set at 10.00mm.
- The bottom hydraulic ram located to the underside of post A1 was lowered allowing the post A1 to deflect whilst posts B1-C1-D1 where being restrained by the upper stacking posts.
- The upper stacking post / ram was then loaded to a compressive force of 7,000kg and the deflection was recorded (see test sheet)
- Upon completion of the test all external forces where removed & the unit was lowered onto a level base.
- Upon completion of tests the Flexi-bag serial number 070131001b retained the full load of 24,000ltr of water, and no water leakage was evident upon completion of test.
- Note: WCAU containers showed no visible signs of structural deformation post tests.
- ISO containers are not designed to be subjected to non ISO tests of this nature.

ISO transverse racking test at 15,240kg (Door end)

- Container WCAU 213089-9 was placed on four level hydraulic rams positioned in the MCTS ISO test facility.
- The ISO container was loaded internally re-installation procedures EPT 1-877-8 with 24,000ltr Flexi-bag (load medium water)
- MGW 30,480kg & Tare 2,185kg. (ISO container).
- Test load = 15,240kg (as per ISO 1496 regulations).
- Flexi bag serial number 070131001b bottom discharge.
- The ISO container was placed on four level pads & restrained from lateral movement through the bottom side corner casting apertures.
- A hydraulic force of 15,240kg was applied in both a compressive force & a tensile force through the side aperture of the top corner casting of post B.
- Datum / deflections and set where taken during and after the test.
- Upon completion of the test all external forces where removed.
- Upon completion of tests the Flexi-bag serial number 070131001b retained the full load of 24,000ltr of water; no water leakage was evident upon completion of test.
- Note: WCAU containers showed no visible signs of structural deformation post tests.
- Although the transverse racking is an ISO standard test, the standard requires the test to be carried out with the container in the Tare condition.
- The Transverse racking in this instance was carried out with an internal load of 24,000ltrs (non ISO requirement)

CONCLUSSION:

The Flexi-tanks have been submitted to various standard & non standard tests, MCTS note that all the tests carried out in this instance are above the standard requirements laid out in the ISO 1496-1 Freight Containers Specification & tests satisfactory.

IN ATTENDANCE:

- MCTS: Mr Chris Favager MIET Eng Tech & Mr Paul Rowlands TMIET.
- Lloyds Register EMEA: Mr G.Rogers & Mr D.Sole.
- Environmental Packaging Technology: Mr Paul Reynolds, Mr Charles True & Mr Michael Simms.

Signature Valid

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Chris Favager MIET Eng Tech
On behalf of Marine Container Test Services Ltd