TRIUMF – Pail Testing for ISAC Waste Shipment to CNL

Subject: Pail Testing (*current design*) Results

Attention: CNL (Michael Horne, Godwin Thambithurai)

Authors/Testers: Adam Newsome, Chad Fisher

Date: 2023-06-09

Test Purpose

The purpose of this test is to confirm that the as-built pail assembly for the *current* design (as of June 9, 2023) of TRIUMF's waste pails (IRH1589 REV C) is satisfactory for shipping and subsequent handling by CNL via crane. Multiple pails of this design have already been packaged into F-308s. After packaging, the pails were modified to add a ~3" loop on the end of the open wire to facilitate lifting.

If the testing of 10 units which were fabricated in the same fashion as the existing pails (including the new loop feature) is successful, CNL will accept these units as part of their waste stream with a noted acceptable deviation from their recently updated requirements.

In the future, the design of the pails will be modified slightly as per recent requirements provided by CNL (via memo "Acceptance Requirements for Intermediate Level Waste Storage at CNL" – May 30, 2023), and a similar batch of testing will be performed for that pail design (i.e. REV D of IRH1589) – this is not included in the scope of this test report. A separate test procedure and report will be produced.

The following image (Figure 1) of the pail assembly (IRH1589 REV C) shows the scope of what is considered to be the "lifting features" for the pails, which is referred to in this document as these features will be inspected prior to load testing to check for issues.

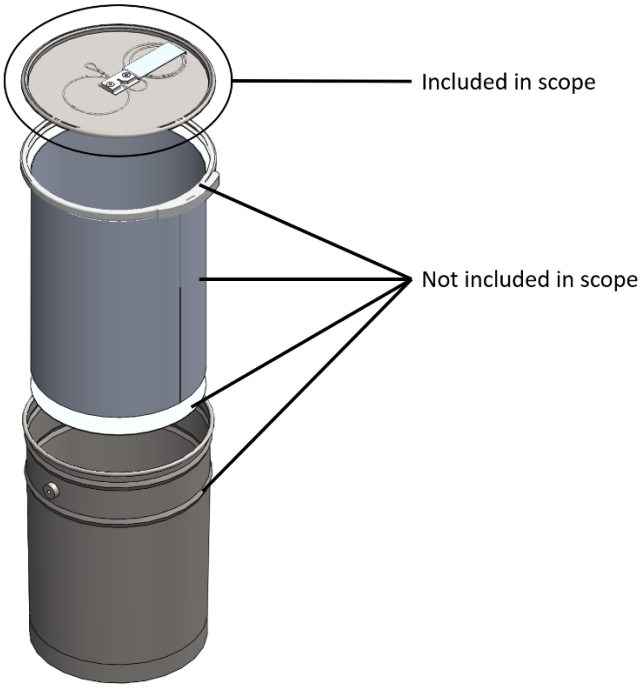

Figure 1: Pail assembly exploded view, showing scope of testing

Test Procedure

Proof testing of 10 articles of waste pails was performed according to the following instructions.

First, fabricate and inspect 10 entire pail assemblies as per IRH1589 REV C, with the addition of a 3” crimped loop on the end of the open wire (see Figure 1). Ensure each pail’s assembly matches the assembly drawing, and also ensure that the crimped loop at the end is identical to that which was performed on the already packaged pails in F-308s. Note: for the purposes of testing, the wire rope length does not need to be 30 ft long as is specified in the design as this is impractical – use ~3 ft length to conserve material and still get an accurate representation of expected use.

For each pail:

1. Fill the pail with a 45 kg [100 lb] load (steel block(s)). This is referred to as “the load” in subsequent steps. Note: 45 kg was chosen based on requirements for proof testing from ASME B30.9 – 2021 Slings, *Section 9-2.6.2 Proof Load Requirements*.
2. Using the wire rope’s loop feature, connect the pail assembly to an overhead crane via standardly available chain with a latching mechanism. On the first test – include an in-line scale to show the applied load. See Figure 3.

3. Hoist the load a sufficient distance off the ground (> 2”) to ensure the load is supported by the lifter (i.e. it is not resting on the ground or another surface). See Figures 4 – 7.
4. Leave the load suspended for 2 minutes.
5. Lower the load to the ground.
6. Visually inspect the lifting features for deformation, cracks, or other defects. Note any deficiencies and take photographs (see Figure 7). Complete the test summary table attached to this document.

Test Observations and Recommendations

Testing was successfully completed for all 10 pails (see Appendix I). After each test each of the lifting features were inspected to determine if there was any deformation, cracking, bending, or other evidence of potential failure. The following observations were made:

- In each case, the components remained in satisfactory condition after loading. There were no areas of major concern which showed evidence of failure occurring.
- During loading, the pail lids elastically deformed slightly, but returned to their original form when unloaded – there appeared to be no plastic deformation of the lids.
- The pail body itself, as well as the clamping ring, showed no signs of elastic deformation.
- The wire rope became kinked after loading at the point at which it bent over the attachment block, as would be expected (see Figure 7 for an example – each cable looked similar to this). While the kink was visible, it was not so significant that it resulted in damage to the rope strands which would compromise its ability to carry the load. This was therefore not deemed to be a concern, especially considering:
    - These lifting features are designed for one-time use so there will be no repetitive cycling at the bend area
    - The test load was 2.25 times that of the rated load, so the actual bending would be less significant
    - There is a history associated with using these components which does not indicate any evidence of failures

  It is worth noting that this wire rope bending observation resulted in some further investigation and a design change for the next revision of the Pail Lifter Device, which is currently underway. It was suspected that this area would be the weakest link in the entire system, so destructive testing was performed on one sample by intentionally lifting up the pail with the full 45 kg load inside and dropping it. The failure point occurred exactly where the sharp 90 degree bend was located as the rope ran around the corner of the attachment block (note: this was not a fresh cable but rather one which already had a kink in it). The failure mechanism was the cable breaking (see Figure 9). While this is not an expected condition to actually occur, the destructive testing was helpful in understanding where the weak point in the design is. Although the design is still satisfactory and meets relevant standards, it is worth the effort to implement a relatively easy design improvement here.

  A fillet will be added in place of the sharp 90 degree bend, which will result in less bending of the wire rope. This was tested in a proof-of-concept fashion by using

a file to modify one of the attachment blocks and loading a new wire with the same test load to determine if there was an observed difference in bending. There was a significant improvement (see Figure 10).

The proof testing of these 10 pails is deemed **successful** by the testers. This means that existing pails packaged in F-308s can be modified with the same type of 3” crimped loop. These pails can be shipped to CNL and there is confidence that failure will not occur during lowering into the ground via crane.

Furthermore, the testing was beneficial to TRIUMF in that it inspired future design changes which will be implemented before the next batch of pails is sent to CNL. Proof testing will be performed for the updated design as well.

TRIUMF

Appendix I – Test Summary (Scanned from Print)

Date of test performance: 2023-06-09
Tester(s) names: Adam Newsome, Chad Fisher

Test load applied: 45 kg [100 lb]
Test assembly: IRGH1589 REV C with added 3" lifting loop on wire rope

Test Pail Number	Pass/Fail	Observations
1	Pass	See Section 3 of this document
2	Pass	See Section 3 of this document
3	Pass	See Section 3 of this document
4	Pass	See Section 3 of this document
5	Pass	See Section 3 of this document
6	Pass	See Section 3 of this document
7	Pass	See Section 3 of this document
8	Pass	See Section 3 of this document
9	Pass	See Section 3 of this document
10	Pass	See Section 3 of this document

Tester(s) signatures:

Adam Newsome. 2023-06-09

Chad Fisher 2023-06-09

Appendix II – Test Photos

Figure 2: Crimped loop which was added to wire rope (3")

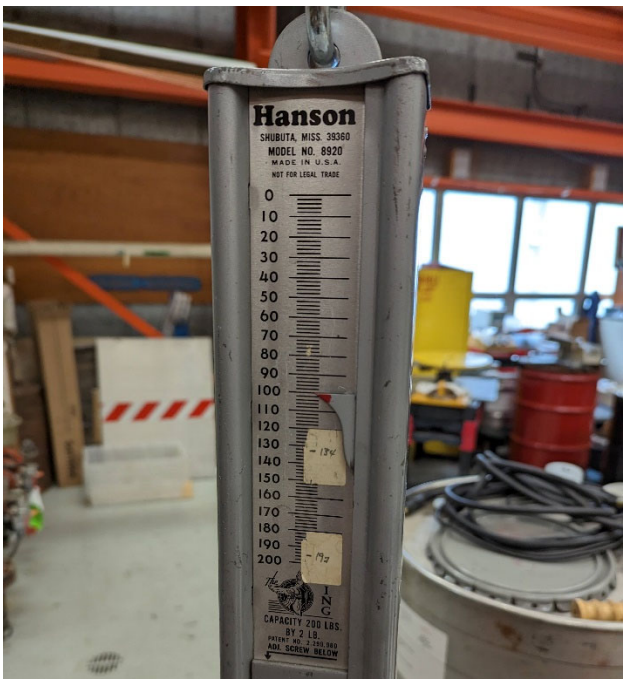

Figure 3: In-line scale on the crane showing 100 lb applied load

Figure 4: Pail shown suspended by wire rope

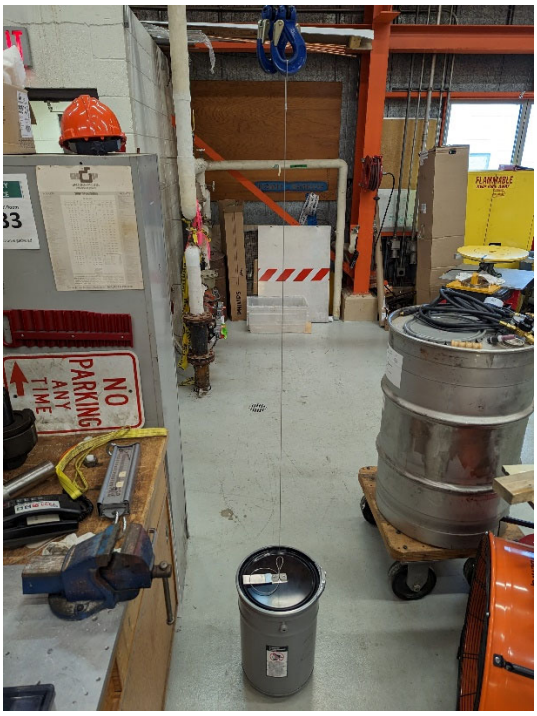

Figure 5: Pail shown suspended by wire rope

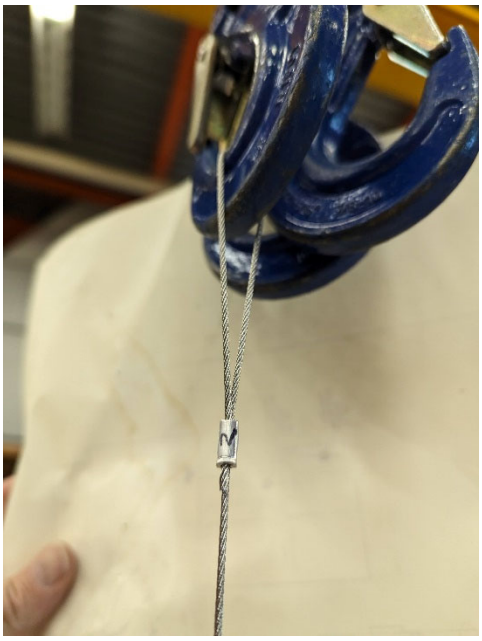

Figure 6: Pail shown suspended by wire rope - closeup of crane hook side

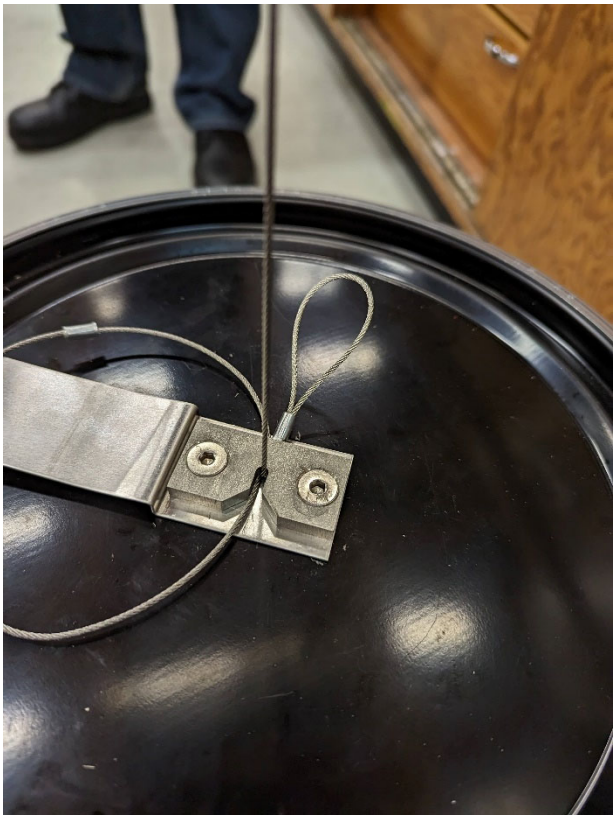

Figure 7: Pail shown suspended by wire rope - closeup of pail side

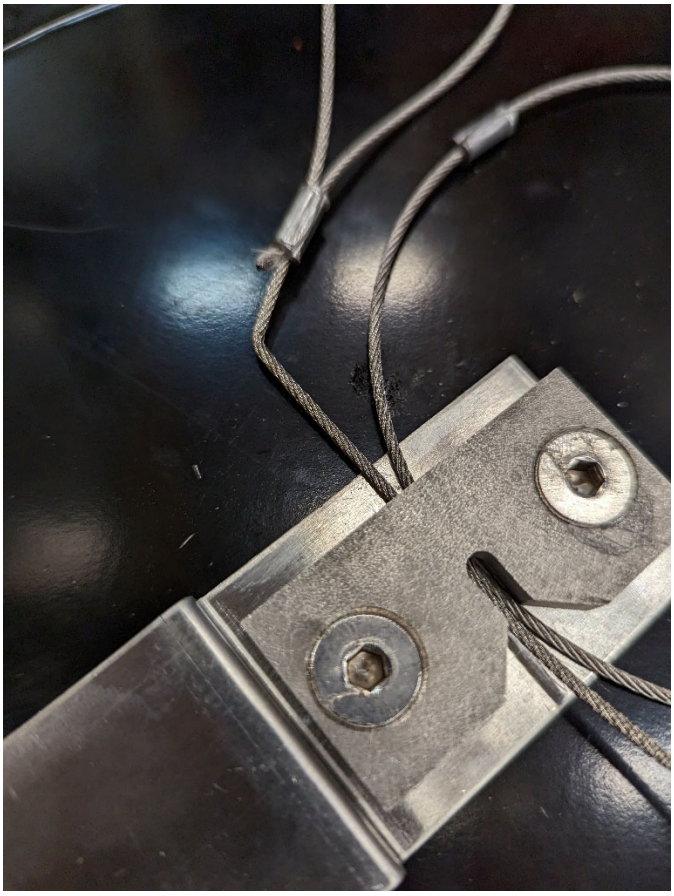

Figure 8: Lifting features shown after load test - note the kinked wire rope

Figure 9: Failure point during intentional destructive testing (beyond what is required for the purposes of this test)

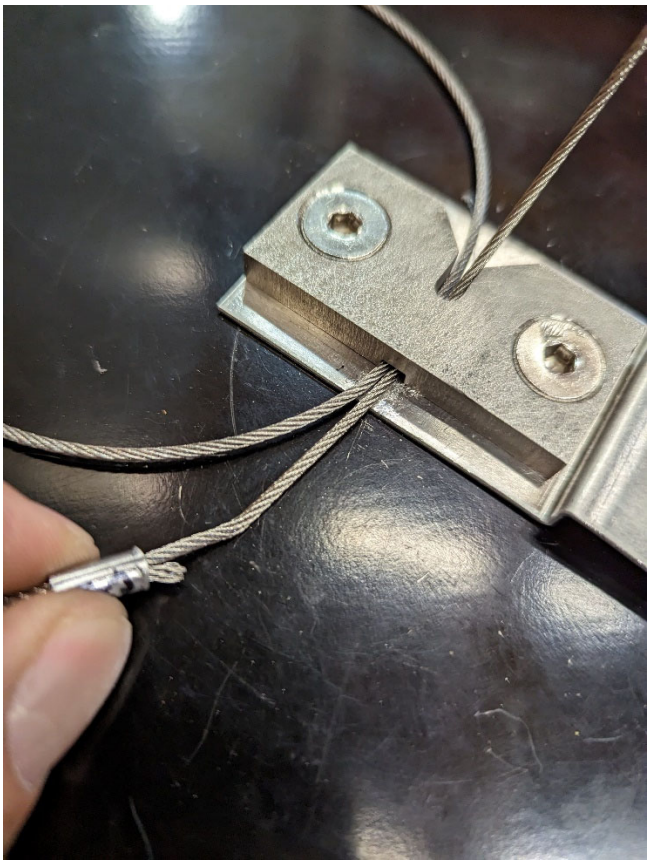

Figure 10: Improvement made to wire rope kinking after prototyping a suggested design change. Compare to Figure 8.