Australian Compliance Laboratory

Specialising in performance testing of dangerous goods packaging

A mock guide to:

Stack testing jerrycans and drums

For those wanting to internally test their dangerous goods packagings before laboratory analysis

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1. Determine the stack load from Appendix A.
2. Fill 3 samples to their maximum capacity with water and seal tightly.
3. Condition the samples to 40°C.
4. Apply the stack load to each of the hot samples in such a way that it engages the stacking feature. Refer to Appendices B and C.
5. Allow the samples to hold the test load for 4 weeks.
6. The samples must not leak. They must support the test load and be in good condition.

1.2 Plastic packagings with a stacking feature, containing solids

1. Determine the stack load from Appendix A.
2. Fill 3 samples to their maximum capacity with polygranules and seal tightly.
3. Condition the samples to 40°C.
4. Apply the stack load to each of the hot samples in such a way that it engages the stacking feature. Refer to Appendices B and C.
5. Allow the samples to hold the test load for 4 weeks.
6. The samples must not leak. They must support the test load and be in good condition.

1.3 Plastic packagings without a stacking feature, containing liquids

1. Determine the stack load from Appendix A.
2. Fill 4 samples to their maximum capacity with water and seal tightly.
3. Set up all the samples under common platen.
4. Condition the samples to 40°C.
5. Apply the stack load (multiplied by 4 samples) to the hot samples. Refer to Appendices B and C.
6. Allow the samples to hold the test load for 4 weeks.
7. The samples must not leak. They must support the test load and be in good condition.

1.4 Plastic packagings without a stacking feature, containing solids

1. Determine the stack load from Appendix A.
2. Fill 4 samples to their maximum capacity with polygranules and seal tightly.
3. Set up all the samples under common platen.
4. Condition the samples to 40°C.
5. Apply the stack load (multiplied by 4 samples) to the hot samples. Refer to Appendices B and C.
6. Allow the samples to hold the test load for 4 weeks.
7. The samples must not leak. They must support the test load and be in good condition.

1.5 Metal containers with a stacking feature, containing liquids

1. Determine the stack load from Appendix A.
2. Fill 3 samples to their maximum capacity with water and seal tightly.
3. Apply the stack load to each sample in such a way that it engages the stacking feature. Refer to Appendices B and C.
4. Allow the samples to hold the test load for 24 hours.
5. The samples must not leak. They must support the test load and be in good condition.

1.6 Metal containers with a stacking feature, containing solids

1. Determine the stack load from Appendix A.
2. Fill 3 samples to their maximum capacity with polygranules and seal tightly.
3. Apply the stack load to each sample in such a way that it engages the stacking feature. Refer to Appendices B and C.
4. Allow the samples to hold the test load for 24 hours.
5. The samples must not leak. They must support the test load and be in good condition.

1.7 Metal containers without a stacking feature, containing liquids

1. Determine the stack load from Appendix A.
2. Fill 4 samples to their maximum capacity with water and seal tightly.
3. Set up all the samples under common platen.
4. Apply the stack load (multiplied by 4 samples). Refer to Appendices B and C.
5. Allow the samples to hold the test load for 24 hours.
6. The samples must not leak. They must support the test load and be in good condition.

1.8 Metal containers without a stacking feature, containing solids

1. Determine the stack load from Appendix A.
2. Fill 4 samples to their maximum capacity with polygranules and seal tightly.
3. Set up all the samples under common platen.
4. Apply the stack load (multiplied by 4 samples). Refer to Appendices B and C.
5. Allow the samples to hold the test load for 24 hours.
6. The samples must not leak. They must support the test load and be in good condition.

2 Appendices

2.1 Appendix A: Calculate the test weight

$$Test\ weight = \left[\frac{3000}{stack\ height\ (mm)} - 1\right]_{RU,1} x\ gross\ mass\ (kg)$$

Where,

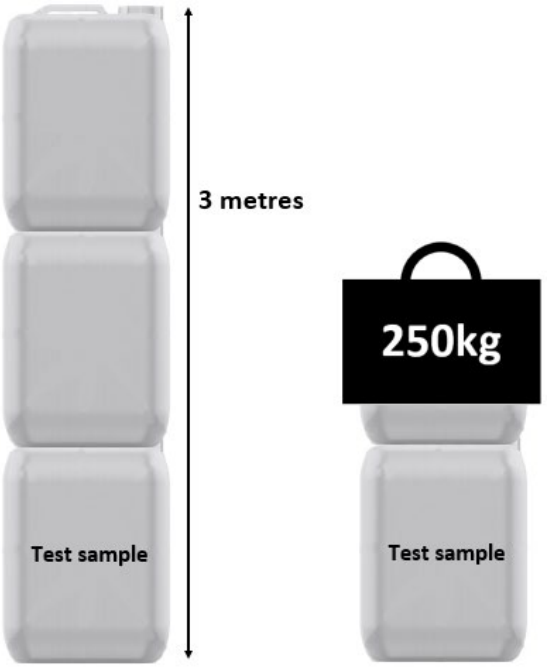
RU,1 means to round up to the nearest integer, and

$Gross\ mass_{solid\ contents} = the\ packaging's\ rated\ gross\ mass\ (kg)$, or

$$Gross\ mass_{liquid\ contents} = [maximum\ capacity\ (L)\ x\ specific\ gravity\ (kg/\mathrm{L})] + tare\ mass\ of\ all\ components\ (kg)$$

2.2 Appendix B: Engaging the stack feature

The stack load must engage the stack feature of the packaging. This can be achieved by using another packaging and placing it on top of the test sample. Alternatively, you can cut out the base of a similar sample and fill it with sand to create a flat surface to apply a stack load.



2.3 Appendix C: Applying the stack load

2.3.1 Method 1: Dynamic application

This method is particularly useful as it is very quick and provides lots of performance information. This method does not account for viscoelastic creep of plastic packages and so the test load must be scaled appropriately.

1. Consider the notes in Appendix D to scale your test load.
2. Subject the sample to a compressive load of 10mm/min until failure is observed.
3. Record the maximum achievable load before failure was observed.

2.3.2 Method 2: Static application

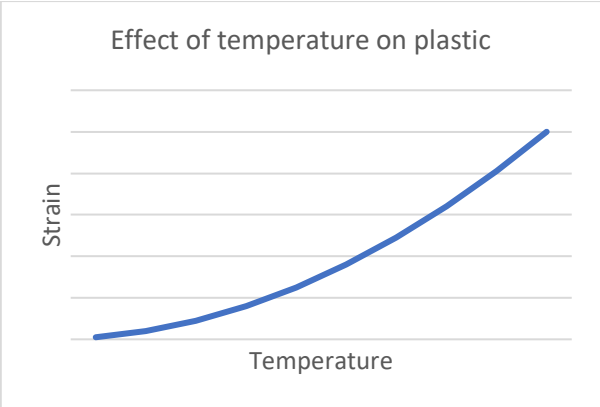
This method is useful as accurate, cheap, and almost anyone can do it. This method does not properly account for the weakening of plastic material with temperature. Neither does it account for accelerated creep with increased temperature. The test load must therefore be scaled appropriately.

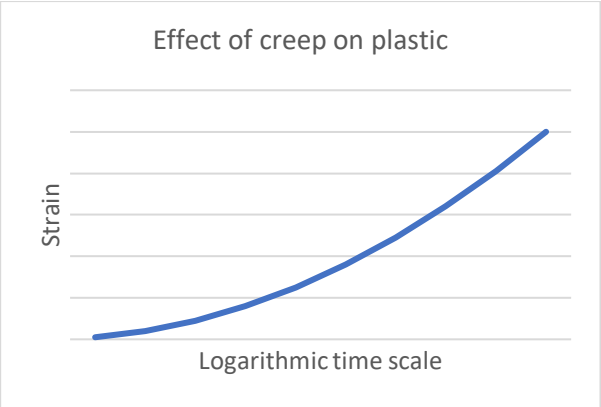
1. Consider the notes in Appendix D to scale your test load.
2. Apply the stack load to the test samples.
3. Set up a failure prevention system that will catch the falling weight in the event that the samples fail. Example: a cage or a crane catch.
4. Leave the apparatus in the corner for the test duration.

2.4 Appendix D: A note about scaling the test load

A plastic packaging's resistance to compressive load is affected by temperature and viscoelastic creep (time). The degree of this non-linear property depends greatly on the physical properties of the plastic and the geometry of the packaging. For these reasons, the compressive stack load when mock testing must be scaled appropriately to consider these influences.

However, for an accurate scaling, more research needs to be done. Having said this, a scaling factor of 25% for temperature and 10% for creep may be considered as conservative. This deduction is based on the general information available within Plastics Engineering, Third Edition by R.J. Crawford.





3 Document information

3.1 General guidance

1. Mock testing on one package means nothing as it may give an out-lying result. You need to test on many samples to create reliable data. The more samples you test, the more reliable your data.
2. It's prudent to over-test your package before submitting. This can be achieved by exceeding the test requirements and/or performing many tests on one package.
3. The more measurement, control, and repeatability of your tests, the better.
4. The closer to laboratory conditions of your tests, the better.

3.2 The codes

The mock test methods in this document are modelled on those in the Australian Code for the Transport of Dangerous Goods by Road and Rail (ADG Code) and the United Nations Recommendations on the Transport of Dangerous Goods (UNRDG), Chapter 6.1.5.

3.3 ACL contact information

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3.4 Revision

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3.5 Disclaimer

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