NEWTON TECHNICAL ARTICLE

Compressive Load Capabilities of Type C Waterproofing

JN®
NEWTON
WATERPROOFING

Understanding the Data and What it Means

Compressive Load Capabilities

Understanding the Data and What it Means

Contents

Newton House, 17-20 Sovereign Way, Tonbridge, Kent, TN9 1RH
T: +44 (0)1732 360 095 **W:** www.newtonwaterproofing.co.uk **E:** tech@newtonwaterproofing.co.uk

1. Introduction

When designing and specifying a floor build-up, the importance of accurate and reliable compressive load data cannot be underestimated. Especially considering that the consequences of specifying the wrong product without the required compressive load capability can be significant and extremely costly in the long-term.

In this technical article by Newton Waterproofing Systems, we not only present the two prevalent standards that are used to determine a materials' compressive performance, we also consider the key differences between the various test methods and how this can lead to inaccurate and misleading data being presented by manufacturers and suppliers in the UK.

Finally, as a potential resolution to this confusing situation, the article also presents the extensive further testing that has taken place on Newton's cavity drain waterproofing membranes in order to accurately determine the products' resistance to long-term static loads. The individual test results are provided, as well as a comparison to other products in the industry, and a summary of the implications of these results for designing waterproofing.

2. Why is Compressive Load Data Important?

Any element of the build that receives a load should be tested in order to ensure that it is capable of resisting that imposed load.

In Newton's case, during an evaluation of the load capability of our products we noticed that there were often two test standards for the compressive load testing. Generally, one of the standards assesses the capability of the product to resist long-term static loads, whilst the other standard is used to determine the resistance to short-term temporary loads. Naturally, a products' test results when resisting short-term loads is generally much higher than the long-term static load figure.

This was especially noticeable when analysing the test standards for insulation, as many manufacturers will use the much higher temporary load figure in order to advertise the capabilities of their product. For example, insulation advertised as 500 kPa capable under short term loads, is generally only suitable for long term imposed loads of 165 kPa.

Misleading data such as this has the potential to create significant issues in the construction process, with the specification of products that do not possess the necessary load capabilities.

Consequently, this article considers the importance of correctly calculating compressive load data in cavity drain waterproofing systems, and also presents the appropriate compressive load test results that Newton have obtained for their own products.

Newton House, 17-20 Sovereign Way, Tonbridge, Kent, TN9 1RH
T: +44 (0)1732 360 095 **W:** www.newtonwaterproofing.co.uk **E:** tech@newtonwaterproofing.co.uk

3. What is the Compressive Load Data for Newton's Products?

3.1. Using the Right Test Data

BS EN 826 is the European standard that specifies the equipment and procedures to be used when determining the compression behaviour of rigid insulation test specimens. It achieves this by measuring the load that is required to deform the material by 10% - if no failure is reported then the insulation passes the test.

Newton's Fibran XPS 500-C insulation is rated at 500 kPa when tested to BS EN 826 (500 Kilopascals is equivalent to 50 tonnes per square metre). However it is also important note that this is a destructive test and not a test of the capability of the insulation to resist long-term compressive load.

Instead, the meaningful compressive load test for insulation is BS EN 1606, which assesses the compressive creep performance of thermal insulation materials over an extrapolated 50-year period, and therefore determines the maximum safe load that can be applied to the product without reducing the total thickness by more than 2%.

A margin of just 2% is significantly more strict than the 10% deformation limit used in BS EN 826, and clearly the differing results could have a major impact on whether or not a product is correctly specified. As a result, only BS EN 1606 should be considered as a safe assessment of the potential use of the material within a floor build, whilst BS EN 826 is a destructive test only.

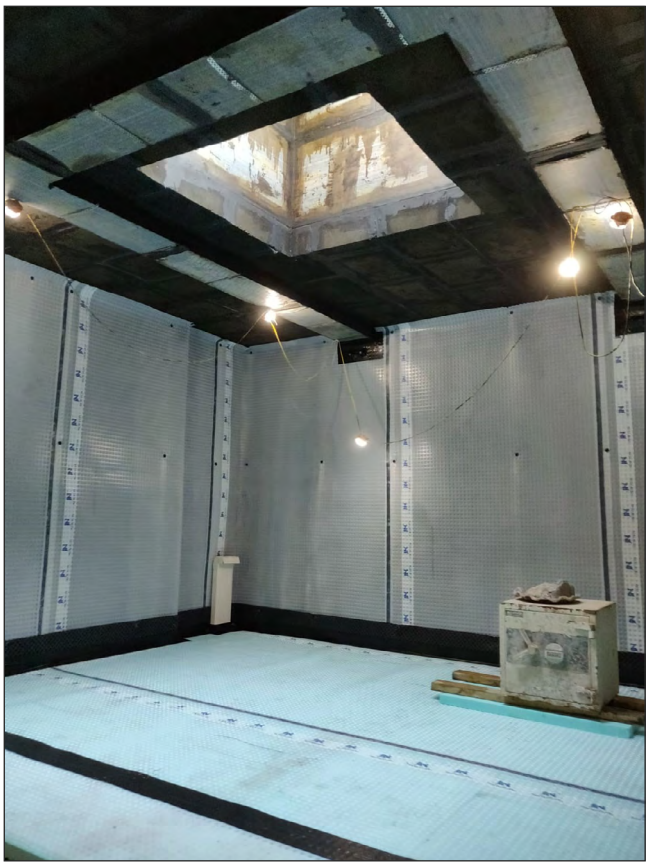
Newton therefore began to consider whether this data confusion might also exist elsewhere, and so we analysed the data used for products in the UK Cavity Drain Membrane (CDM) market.

Our aim was to try and determine whether membrane manufacturers and suppliers in the UK were, like the insulation manufacturers, publishing compressive load results that did not accurately represent the long-term capabilities of the products.

As a result, we found that cavity drain membrane manufacturers were indeed publishing the higher temporary load figure on their product information (not the long term load results) and that UK suppliers of these products were doing the same thing.

Furthermore, there is an existing standard for testing the long term compressive creep of cavity drain membranes, but it seemed that nobody was using it.

Finally, we also discovered that as well as publishing the short-term loading figures, many UK suppliers also published loading figures for when the cavity drain membranes were filled with screed, without also confirming which test method was used. The result is a plethora of confusing and hugely varying data being presented by different companies.



Newton House, 17-20 Sovereign Way, Tonbridge, Kent, TN9 1RH
T: +44 (0)1732 360 095 **W:** www.newtonwaterproofing.co.uk **E:** tech@newtonwaterproofing.co.uk

3.2. Testing the Compressive Load of Cavity Drain Membranes

The standard for testing the load capability of cuspated (studded) membranes is ISO 25619 "Geosynthetics — Determination of compression behaviour", which comes in two parts:

- Part 1 is the determination of compressive behaviour, or in other words the long-term compressive creep properties of the material.
- Part 2 is the determination of short-term compression behaviour. Like BS EN 826, this is a destructive test that is not designed to be used for design purposes.

Much like other products in the UK, Newton's cavity drain membranes that are to be subject to loads as a part of the design have all been tested to ISO 25619-1.

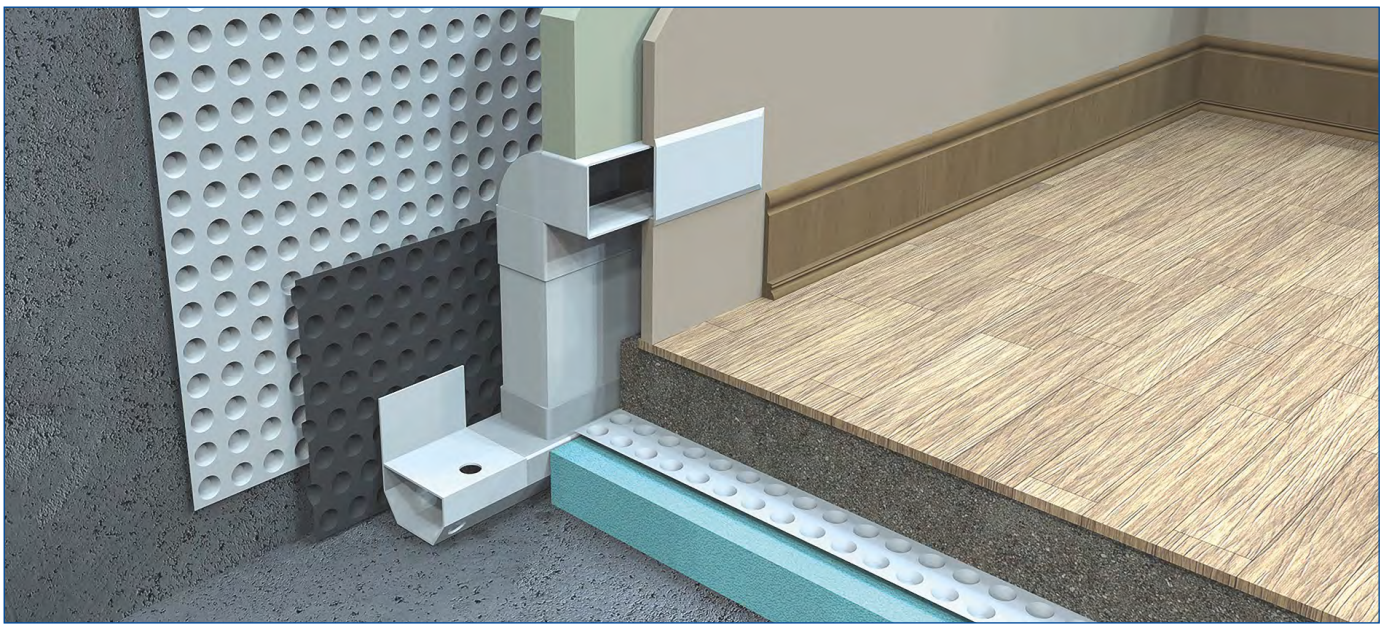
When tested to ISO 25619-1, cavity drain membranes are deemed to have failed if they compress by more than 10% of their nominal thickness - however, because the standard does not confirm an official pass as such, after consultation with Kiwa it was agreed to test Newton's membranes to the same performance level as used by BS EN 1606 for the compressive creep performance of load-bearing insulation. As mentioned in section 3.1, this is 2% compression after 50 years of resisting load.

3.3. The New Testing Process

With no comparative data available to begin with, the first step of the new testing process was to find a starting point for the tests that had the potential to be successful.

This pre-testing process took place over the course of a number of months, and the purpose was to determine the load to be used for each of the full tests. The pre-testing extrapolated the results of 1000 hours of compression within the testing rig, and after approximately one year the pre-testing was complete and we were able to move on to the full testing to ISO 25619-1 (based on the performance standard used by BS EN 1606).

This series of full tests on multiple Newton cavity drain membranes took approximately one year to complete, which was necessary in order to provide an accurate extrapolation of the result after 50-years of compression.



Newton House, 17-20 Sovereign Way, Tonbridge, Kent, TN9 1RH
T: +44 (0)1732 360 095 **W:** www.newtonwaterproofing.co.uk **E:** tech@newtonwaterproofing.co.uk

3.4. Test Results - Newton Cavity Drain Membranes

The full test results and test certificates can be obtained on request from the Newton Technical Team - call us on 01732 360095 or email us on technical@newtonwaterproofing.co.uk.

To summarise the mean compressive loads of each membrane, with no material filling the studs, the results are:

Product Name	Compressive Strength to ISO 25619-1 (Membrane Only)
Newton 508R	7 kPa (0.71 tonnes per square metre)
Newton 508 eco Floor	21 kPa (2.14 tonnes per square metre)
Newton 520 eco	4 kPa (0.41 tonnes per square metre)
Newton 408 DeckDrain	10 kPa (1.02 tonne per square metre)

3.5. Test Results - Newton Cavity Drain Membranes with Screed

Whilst these figures are useful on their own, as mentioned in section 3.1, other UK suppliers were also publishing compressive load data for cavity drain membranes filled with screed, when in fact there was no test basis for these results.

In terms of the effect on the cavity drain membranes, filling the studs with a non-compressible material such as screed means that the load passes through the screed and the contact patch of membrane to the bottom of the studs where it is in contact with the substrate, thus hugely increases the load capability of the membrane.

Newton therefore had these exact tests performed on our membranes in order to provide a complete set of loading data. The screed used was a standard weak mix of one-part cement to four-parts sand mixed only with clean water, and the test rig used was the same one as used on the membranes on their own. The mean compressive loads for each membrane, filled with screed, were as follows:

Product Name	Compressive Strength to ISO 25619-1 (Membrane & Screed)
Newton 508R	800 kPa (81.58 tonnes per square metre)
Newton 508 eco Floor	800 kPa (81.58 tonnes per square metre)
Newton 520 eco	800 kPa (81.58 tonnes per square metre)

It is important to note that the test rig was only capable of exerting a maximum force of 800 kPa, and all three membranes passed the test with ease, therefore giving us a value of 800 kPa for each.

3.6. Test Results - Newton Cavity Drain Membranes with Insulation

Newton have been using extruded polystyrene (XPS) insulation beneath our floor membranes since the turn of the millennium, and for the past five years we have sold our own closed-cell slotted insulation board, Newton Fibran XPS 500-C. The insulation acts as a spacer to ensure that the floor membrane is at the correct height above the Basedrain drainage system; a range of channels that receive water entering the property at the weakness within the structure, before delivering it to the pumps.

Using insulation as a spacer in this way has sometimes been misunderstood and maligned within the UK waterproofing industry. This is especially the case the when it comes to accurately understanding the compressive capability of the specially strengthened Fibran XPS 500-C insulation board, and its ability to resist the point loads of the cuspated membrane above it.

In order to provide quantifiable data in support of this method, Kiwa also carried out compressive loading tests on the Fibran XPS 500-C insulation with Newton's cavity drain membrane placed above it. Through this test we were therefore able to determine the safe load that can be placed above each of the membranes without impacting on the insulation by more than a 2% compressive creep over 50 years. As before, this performance level is to the standard required by BS EN 1606, which is the same test used by all insulation manufacturers to determine the long term load capability over 50 years.

For this test the membranes were filled with screed so as not to compress the studs of the membrane. The results also represent the maximum depth of the indent into the Fibran XPS 500-C, as created by the point load of the studs of the membranes

The mean results for point load compression of Newton Fibran XPS 500-C below the membrane were:

Product Name*	Compressive Strength to BS EN 1606 (Membrane, Insulation & Screed)
Newton 508R	35 kPa (3.57 tonnes per square metre)
Newton 508 eco Floor	50 kPa (5.10 tonnes per square metre)
Newton 520 eco	45 kPa (4.59 tonnes per square metre)

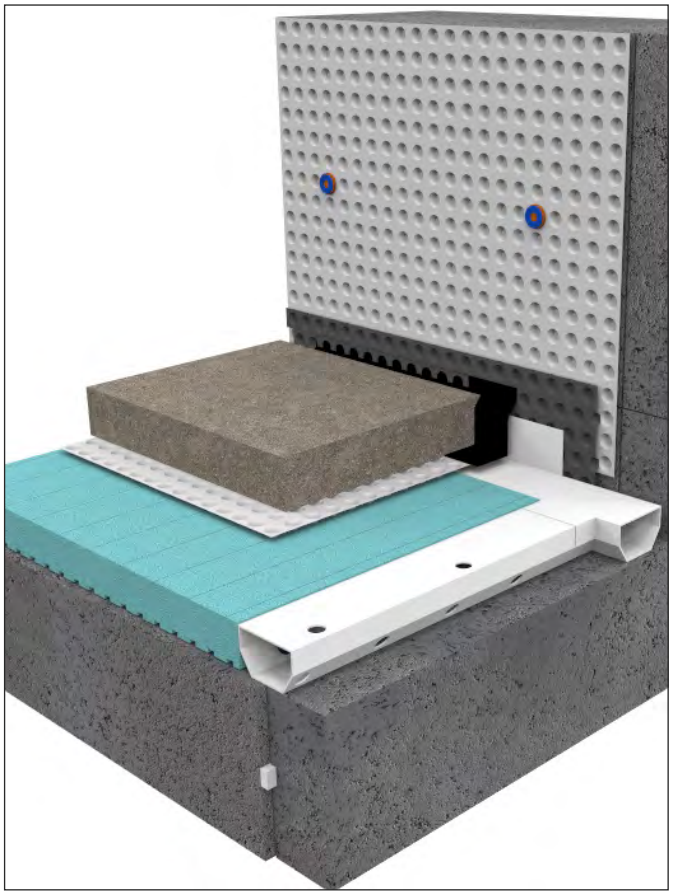
*Newton 408 DeckDrain is rarely specified above insulation, and was therefore omitted from this test.

4. How Does Newton's Data Compare to Other Products?

To our understanding, the Newton cavity drain membranes are the only products currently available that have meaningful test data to support the long-term compressive capability of the membranes under load.

In all other examples that were included in our research, manufacturers and suppliers are only providing the short-term compressive load figures for their products, which are not suitable for design purposes and should not be considered as indicative of the long-term compressive load capabilities.

Furthermore, some suppliers are also using non-applicable testing standards that do not assess the capability of cavity drain membranes to withstand compressive load.



Newton House, 17-20 Sovereign Way, Tonbridge, Kent, TN9 1RH
T: +44 (0)1732 360 095 **W:** www.newtonwaterproofing.co.uk **E:** tech@newtonwaterproofing.co.uk

4.1. What Does This Mean for Type C Waterproofing Systems?

Thanks to Newton's extensive product testing, designers and specifiers are now able to accurately understand the impact of long-term compressive load on cavity drain waterproofing membranes.

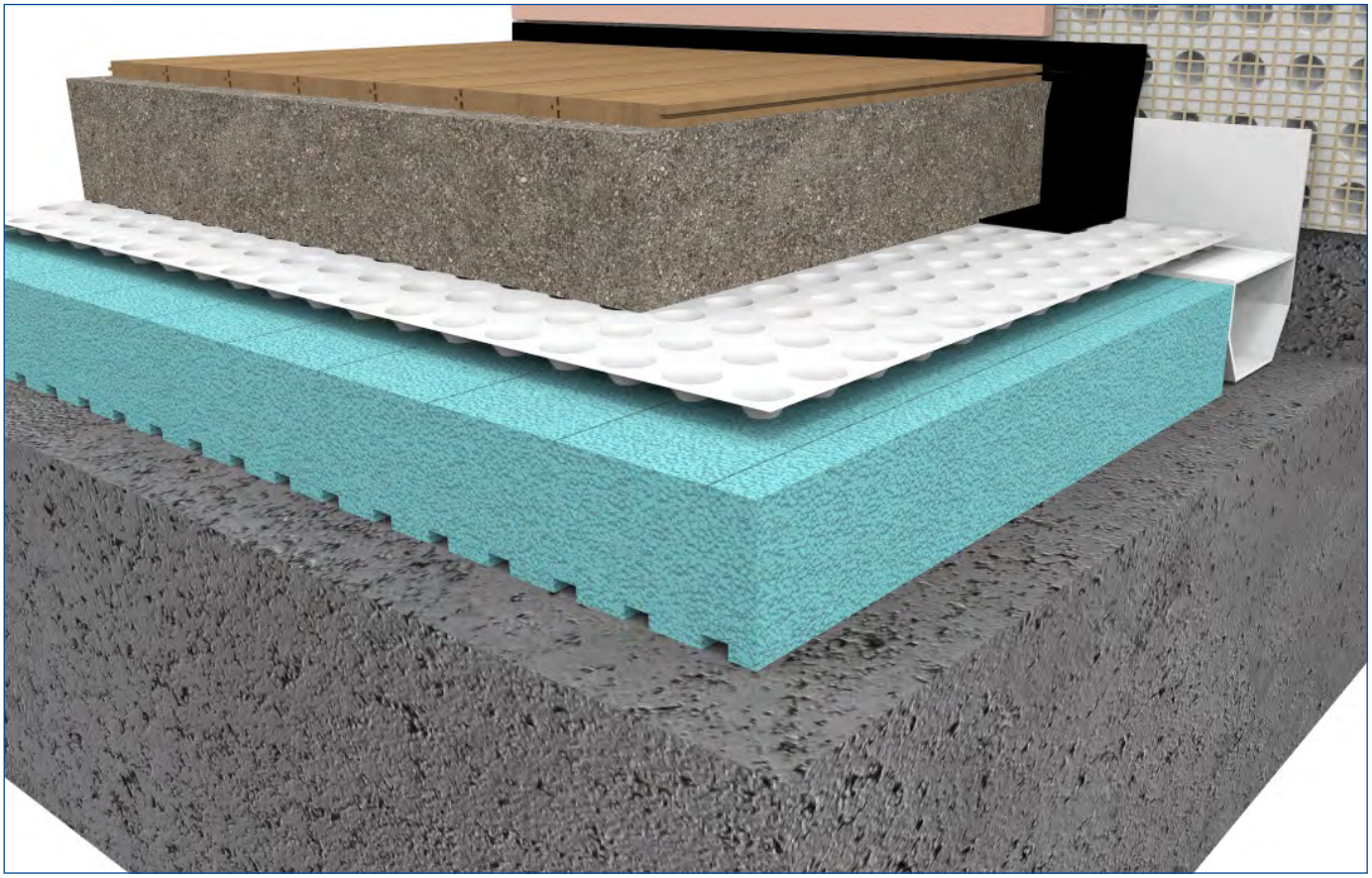
The loads are represented on the test certificates for each individual product in kilo Pascals (kPa) which are equivalent to:

- 1 kPa = 101.97 kg of force per square metre.
- 10 kPa = 1019.7 kg of force per square metre or 1.0197 metric tonnes of force per square metre.

Most Newton waterproofing designs will specify that the membrane studs should be filled with screed, and as a result the membrane load capability is always 800 kPa (or 81.58 tonnes per square metre). The primary weakness in the floor build is therefore the Fibran XPS 500-C insulation spacer, so it is the long-term compressive load capabilities of this product that should be the main consideration.

If the membrane studs are not filled with a screed or similar non-compressible material, we would recommend using Newton 508 eco Floor only, as it has the highest compressive strength of any of the floor membranes on their own. However, always ensure that attention is paid to the long term load that will be installed above.

Where high loads are needed above the waterproofing membrane, for example with internal walls, plant and machinery, columns or swimming pools, these loads should not be transferred through the insulation and other forms of spacer should be used instead. Please contact the Newton Technical Department by email or phone on 01732 360 095 for assistance with such specifications.



Newton House, 17-20 Sovereign Way, Tonbridge, Kent, TN9 1RH
T: +44 (0)1732 360 095 **W:** www.newtonwaterproofing.co.uk **E:** tech@newtonwaterproofing.co.uk

5. Summary

Overall, the extensive research and testing that has been carried out by Newton Waterproofing Systems has led to three clear takeaway points regarding product performance under long-term compressive loads:

1. Newton are the only supplier of cavity drain membranes that have accurate and meaningful test data for the capability of cuspated (studded) membranes to resist long term compressive load and not deform more than 2% over 50-years, as per the performance standard of ISO 25619-1.

2. Likewise, Newton are also the only supplier of Type C cavity drain membrane systems that have accurate data on the capability of the insulation used below the floor membranes to resist the point loads that are exerted by the cuspated membranes. This is in accordance with the performance standard of BS EN 826.

3. Lastly, Newton Fibran XPS 500-C is the only insulation available that has test data for the ability of the insulation to resist long term compressive point load from Newton's cavity drain membranes and not deform more than 2% over 50-years. Again, this is as per the performance standard of BS EN 826.

Contrastingly, and unlike Newton's tests, the data that is often supplied by other companies to the standard ISO 25619-2 is actually the determination of the short-term compressive behaviour of a material and is the test standard used to confirm changes to the product after exposure to chemicals, other stresses and UV light. Such a test is not intended to be used for design purposes and is not a true representation of the capability of the membranes to resist long term compressive load.

Finally, it is worth stating that if you encounter test data for cavity drain membranes that has been published as per the withdrawn performance standard DIN 53454, this is a standard for the testing of solid plastics and is therefore not suitable for the testing of cuspated membranes.

6. References

- British Standards Institution. (2013). BS EN 826:2013 Thermal insulating products for building applications. Determination of compression behaviour. Available: https://shop.bsigroup.com/ProductDetail/?pid=000000000030259106. Last accessed 5th February 2020.

- British Standards Institution. (2013). BS EN 1606:2013 Thermal insulating products for building applications. Determination of compressive creep. Available: https://shop.bsigroup.com/ProductDetail/?pid=000000000030259119. Last accessed 5th February 2020.

- British Standards Institution. (2008). BS EN ISO 25619-1:2008 Geosynthetics. Determination of compression behaviour. Compressive creep properties. Available: https://shop.bsigroup.com/ProductDetail/?pid=000000000030156786. Last accessed 5th February 2020.

- British Standards Institution. (2015). BS EN ISO 25619-2:2015 Geosynthetics. Determination of compression behaviour. Determination of short-term compression behaviour. Available: https://shop.bsigroup.com/ProductDetail/?pid=000000000030295088. Last accessed 5th February 2020.

- Deutsches Institut für Normung. (2004). DIN 53454:1971-04 Testing of Plastics; Compression Test. Available: https://www.beuth.de/en/standard/din-53454/2157491. Last accessed 10th February 2020.

Newton House, 17-20 Sovereign Way, Tonbridge, Kent, TN9 1RH
T: +44 (0)1732 360 095 **W:** www.newtonwaterproofing.co.uk **E:** tech@newtonwaterproofing.co.uk

JN®

NEWTON

WATERPROOFING

Newton Waterproofing Systems
Newton House,
17-20 Sovereign Way,
Tonbridge, Kent TN9 1RH
United Kingdom

T: +44 (0)1732 360 095
E: info@newtonwaterproofing.co.uk
tech@newtonwaterproofing.co.uk
W: www.newtonwaterproofing.co.uk