

Testing results of the Turtle® Case: Packing case for the transport of art

Climatological tests

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Summary

In assignment of Turtle B.V., E.Co Engineering & Consultancy B.V. investigated the climatological characteristics of the Turtle® Case. The Turtle® Case is used for the transportation of art, in particular paintings.

The climatological tests are carried out by the climatological laboratory of consultant agency Peutz & Associés B.V. The analysis and drawn conclusions are made by E.Co Engineering & Consultancy B.V. and checked by Ing. H. Bruggema from Peutz & Associés B.V..

The temperature inside the case is less than 1°C lower than exterior temperature after 18 hours of cold test followed by 24 hours recovery time.

The humidity inside the case does not exceed 53% during hot/humidity test, which is less than 7% increase compared to starting conditions.

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Table of contents

Summary	2
1. Introduction	4
2. Literature	5
3. Measurement set up	6
4. Results	8
4.1 Results of the cold test	8
4.2 Results of the hot/humidity test.....	9
5. Conclusions and recommendations	11

1. Introduction

In assignment of Turtle B.V. E.Co Engineering & Consultancy B.V. investigates the Turtle® Case. The Turtle® Case is used for the transportation of art (in particular paintings).

To find out three types of characteristics of the Turtle® Case three different types of tests are carried out:

1. vibration test;
2. drop test;
3. climatological test;

This report reflects the results of the climatological tests. The tests are carried out at the climatological laboratory of Peutz & Associés B.V. (Mook, The Netherlands).

In chapter 2 two articles are described, which relate to the field of climatological tests of packing cases for art. In chapter 3 the measurement set up in the laboratory is described.

In chapter 4 the results of the climatological tests are reflected. and in chapter 5 conclusions are presented.

2. Literature

There is an article analysed in the field of climatological testing of packing case for the transport of paintings:

S. Staniforth, 'The testing of packing cases for the transport of paintings', cited in note 1, pp.10-12; T. Green and S. Hackney, 'The Evaluation of a Packing Case for Paintings', *International Council of Museums Committee for Conservation, 7th triennial meeting, Copenhagen 1984, 84-121-6.*

The article of Staniforth described a climatological test for a cold and hot situation, the objective was to determine the change of temperature and relative humidity inside the cases (see figure 1). These measurements bring to light the risk of condensation during transport (change in relative humidity in the closed case) and after unpacking (the end temperature after equilibration period). Tests are performed with starting conditions of 14°C and 45% relative humidity. The cold and hot/humidity test are performed at -10°C respectively 40°C for 18 hours and 24 hours recovery (of inside temperature).

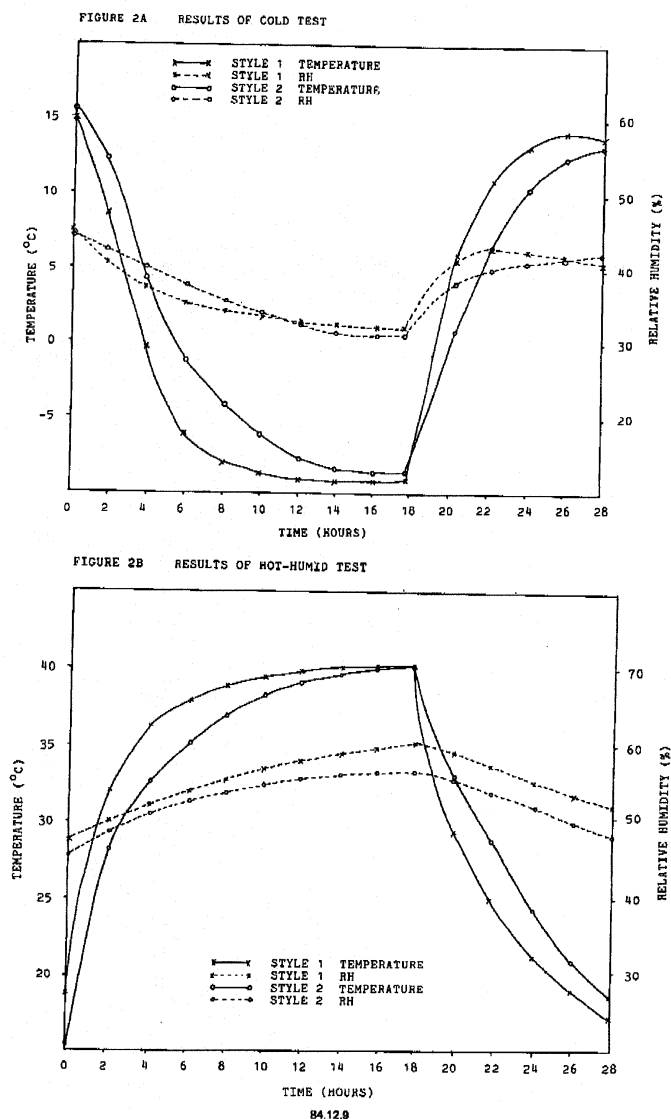


figure 1: Results of cold and hot test described in the article of Staniforth.

3. Measurement set up

In the climatological laboratory of Peutz & Associés B.V. a medium large Turtle® is subjected to climatological tests. The weight of the case is 90 kg.



figure 2: testing environment

The performed climatological tests are:

Cold test:

The case with frame is placed in an environment with a temperature of 14°C and a relative humidity of 45%. After an adaptation period of 72 hours, the inside temperature and relative humidity are measured (starting conditions).

The cold test starts after the adaptation period: a rapid drop in exterior temperature to -10°C for a period of 18 hours. After the cold period, the temperature is rapidly recovered to 14°C and the test runs for another 24 hours in order to monitor the changes in the case.

During adaptation, the cold period and the temperature recovery, the humidity and temperature inside the case are monitored at the bottom and at the top.

Hot/humidity test:

The case with frame is placed in an environment with a temperature of 14°C and a relative humidity of 45%. After an adaptation period of 72 hours, the inside temperature and relative humidity are measured (starting conditions).

The hot/humidity test starts after the adaptation period: a rapid increase in exterior temperature to 40°C for a period of 18 hours. After the hot period, the temperature is rapidly recovered to 14°C and the test runs for another 24 hours in order to monitor the changes in the case.

During adaptation, the hot period and the temperature recovery, the humidity and temperature inside the case are monitored at the bottom and at the top.

Remarks:

In the article of S. Staniforth (Scientific Department National Gallery) the preceding method was also described. In this article the temperature drop and rise were indicated by the time it takes to equilibrate with the changed exterior temperature. This is however not a useful measure because in theory this does not happen before infinity. It merely indicates when the temperature difference is smaller than the sum of measurement accuracies and temperature drift. Therefore it is heavily dependant on measurement conditions.

Better performance indicators are the temperature half-life (time for the interior temperature to cover half of the exterior temperature step) and the end temperature after a defined period of time.

4. Results

In this chapter the results of the tests (cold test and hot/humidity test) are presented.

4.1 Results of the cold test

Starting conditions after 72 hours adaptation at 14°C:

- Inside humidity top: 34.0%
- Inside humidity bottom: 33.5%
- Inside temperature top: 13.9°C
- Inside temperature bottom: 13.9°C

Note: During the adaptation period, humidity inside the case has dropped from 45% to 34% at constant temperature.

Cold period conditions:

- running from 5:35 hours until 23:25 hours after start point
- average outside temperature: -10.8°C
- end outside temperature: -11.6°C

Recovery conditions:

- running from 23:25 hours until 47:20 hours after start point
- average outside temperature: 13.3°C
- end outside temperature: 13.8°C

Temperature inside the case during 18 hours cold period and 24 hours temperature recovery:

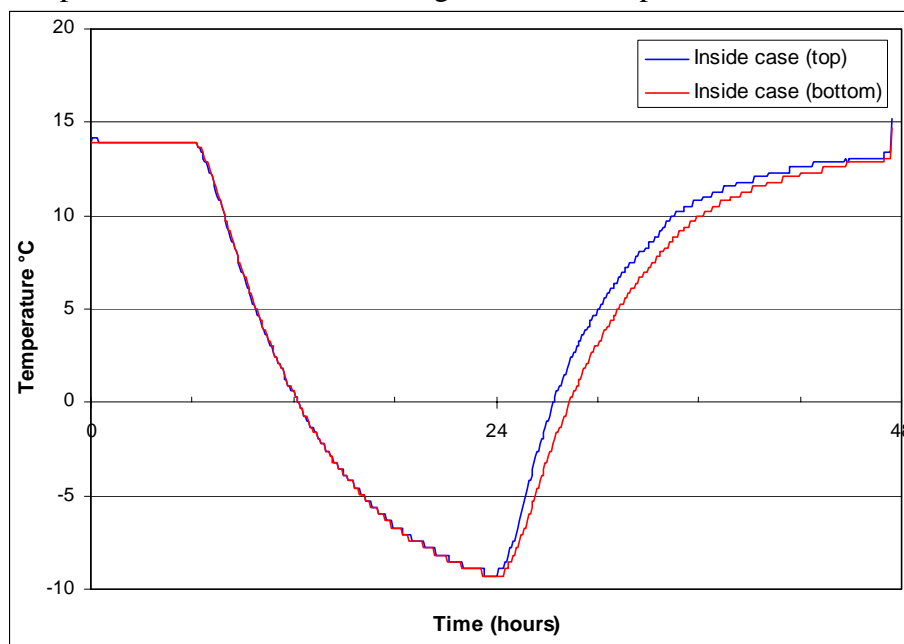


figure 3: Temperature inside the case during the cold-test

Temperature drops to -9.3°C after 18 hours in -10.8...-11.6°C environment (half-life ≈ 6.0 hours).

Temperature recovers to 13.2°C after 24 hours in 13.3...13.8°C environment.

Humidity inside the case during 18 hours cold period and 24 hours temperature recovery:

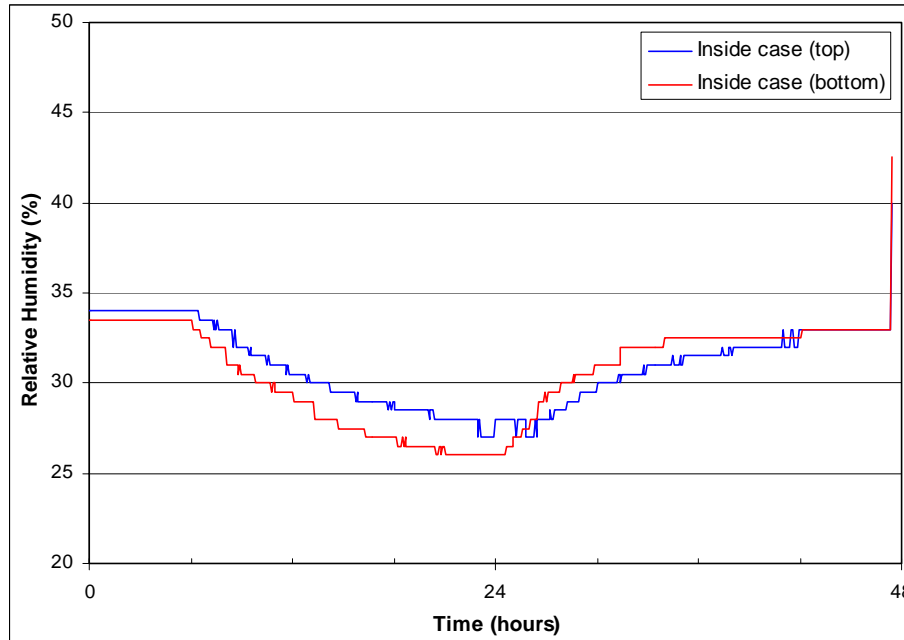


figure 4: Relative humidity inside the case during the cold-test

Humidity drops to 26.5% after 18 hours in -10.8...-11.6°C environment.

Humidity recovers to 33% after 24 hours in 13.3...13.8°C environment.

4.2 Results of the hot/humidity test

Starting conditions after 72 hours adaptation at 14°C:

- Inside humidity top: 46.0%
- Inside humidity bottom: 46.5%
- Inside temperature top: 14.2°C
- Inside temperature bottom: 14.2°C

Hot period conditions:

- running from 5:15 hours until 24:05 hours after start point
- average outside temperature: 40.2°C
- end outside temperature: 40.8°C

Recovery conditions:

- running from 24:05 hours until 48:00 hours after start point
- average outside temperature: 14.8°C
- end outside temperature: 14.6°C

Temperature inside the case during 19 hours hot period and 24 hours temperature recovery:

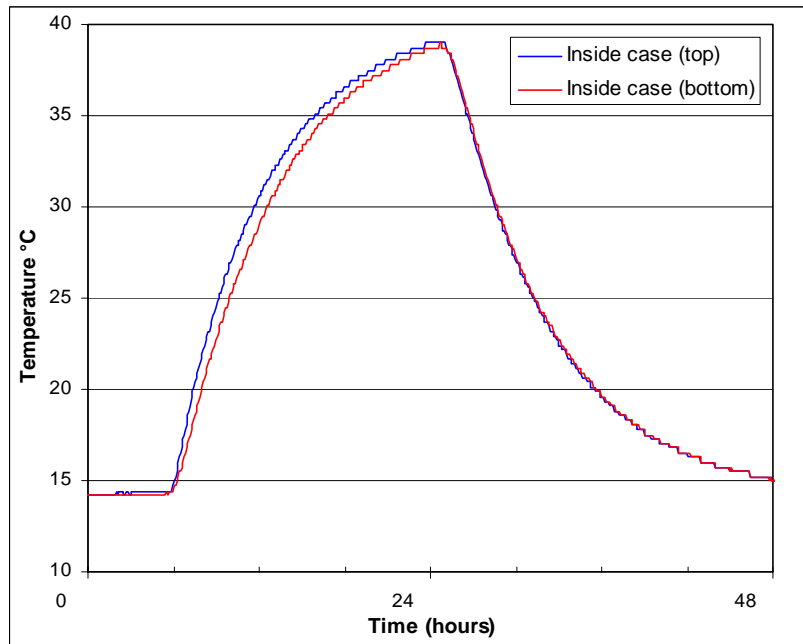


figure 5: Temperature inside the case during the hot-test

Temperature rises to 38.9°C after 19 hours in 40.2...40.8°C environment (half-life \approx 5.4 hours).

Temperature recovers to 15.0°C after 24 hours in 14.6...14.8°C environment.

Humidity inside the case during 18 hours cold period and 24 hours temperature recovery:

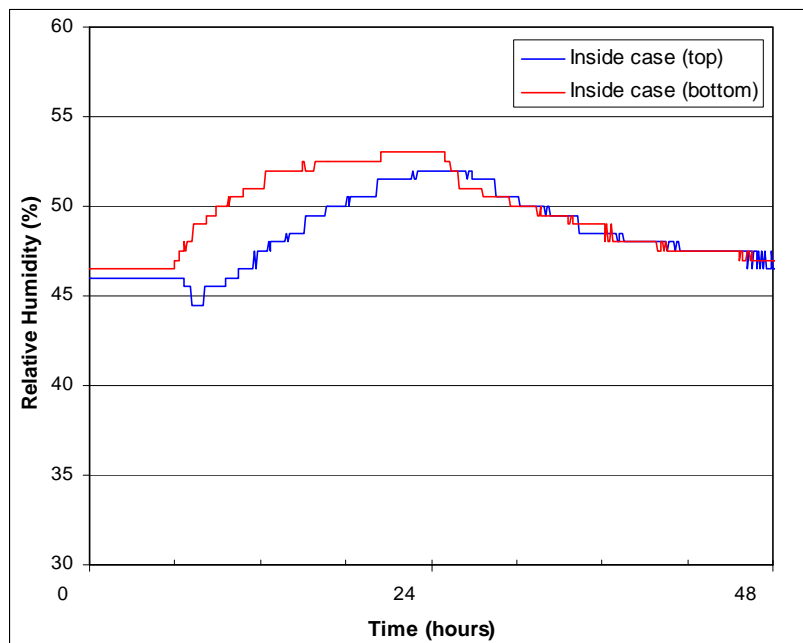


figure 6: Relative Humidity inside the case during the hot-test

Humidity rises to 52.5% after 19 hours in 40.2...40.8°C environment.

Humidity recovers to 47% after 24 hours in 14.6...14.8°C environment.

5. Conclusions and recommendations

On basis of the climatological tests of the Turtle® Case, the following summary of results can be described:

- The turtle case is well thermally isolated, compared to the cases described in the article of Stantiforth (based on the temperature half-life).
- The end temperature of the cold test after recovery, is less than 1°C below the exterior temperature.
- During the hot/humidity test, the humidity does not exceed 53%, which is an increase of less than 7%.

The following comments should be made:

- The tests were carried out with one type of size of the Turtle® Case. Former mentioned results should not have to be valid for all Turtle ® Case-sizes.
- Investigation should be made, which standards are known for humidity and temperature resistance of art, in particular for paintings. If there are no standards on this matter, comparison with other (art) packing cases would be advisable.