Test lab

# *CERTIFICATE of QUALITY TEST*

according to DIN 55 350 – 18 – 4.3.4

## Test report-No. 5648.01 / 06

| | |
|---|---|
| Client | **Spectra-Physics GmbH**<br>Ruhlsdorfer Str. 95<br>14532 Stahnsdorf |
| Equipment under test | **Laser Head**<br>**Controller** |
| Purpose | ***Test of the climatic resistance and of the dynamic-mechanical robustness according to the standards as well as to the demands of the client*** |
| Test program | ***Temperature Cycling Test*** ***- test Nb***<br>***Drop Test*** ***- test Ed*** |
| Test period | May 16th to May 23rd 2006 |
| Realization / results | see page 2 to 6 |
| **Test result** | **The tests were realized according to the standards and to the demands of the client.**<br>**During the drop test, all measured accelerations were < 30 g.**<br>**The further evaluation will be done by the client.** |

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Head of test lab / test manager

Dipl.-Ing. M. Rode
Test engineer

Berlin, November 15th 2006

# 1 Purpose

Test of the climatic resistance and of the dynamic-mechanical robustness under defined environmental conditions according to the standards and to the demands of the client.

# 2 Equipment under test (EUT)

| | | |
|---|---|---|
| specimen | **Laser Head,** S/N C50027, C50028 (packed) | - test Nb1 |
| | **Laser Head,** S/N C50025, C50026 (packed) | - test Nb2 |
| | **Laser Head, Controller, and 3 cables in package** | - test Ed |
| manufacturing date | May 2006 | |
| delivery date of the EUT | May 16th 2006 | |
| return date of the EUT | May 23rd 2006 | |

# 3 Basics

## 3.1 Demands of the client

## 3.2 Used standards

**IEC 60068-1**:1988 + **Corr.** 1988 + **A1**:1992 **DIN EN 60068-1**, issue: 1995-03
"Environmental testing - part 1: general and guidance"

**IEC 60068-2-14**:1984 + **A1**:1986 **DIN EN 60068-2-14**, issue: 2000-08
"Environmental testing - part 2: test N: temperature change"

**IEC 60068-2-32**:1975 + **A1**:1982 + **A2**:1990 **DIN EN 60068-2-32**, issue:1995-03
"Environmental testing - part 2: test Ed: free fall"

**ASTM D 5276 - 98**
"Standard Test Method for Drop Test of Load Containers by Free Fall"

# 4 Test program

## 4.1 Temperature Cycling Test
## Temperature change, slow – test Nb
*according to IEC 60068-2-14*

| | |
|---|---|
| specimen-No. | C50027, C50028 |
| EUT | packed, not operating |
| lower test temperature | 0 °C |
| upper test temperature | +50 °C |
| temperature change gradient | 3 K/min |
| dwell time at -20 °C | 2 h |
| dwell time at +50 °C | 2 h |
| cycle duration | ca. 4:34 h |
| number of cycles | 10 |
| test duration | ca. 2 d |

***Visual Inspection***
Before and after the test, the specimens shall be examined visually.

***Functional test***
Before and after the test, a functional test of the specimens shall be performed by the client.

***Failure criteria***
- mechanical and/or thermal damages
- no function or functional failure

***Remark***
The test specimens were examined in 2 constructional variants (test Nb1 and test Nb2).

### 4.2 Drop Test

**Free fall – test Ed**

*according to IEC 60068-2-32 and ASTM D 5276 - 98*

| | |
|---|---|
| specimens | Laser Head, Controller,<br>3 cables in package |
| EUTnot operating | |
| falling height | 1 m |
| underlay | concrete floor |
| test parameters | 1 fall on each side, edge, corner |
| max. permissible acceleration on EUT | 30 g (measured at the Laser Head) |

***Visual inspection***

Before and after the test, the specimens shall be examined visually for any mechanical damages.

***Functional test***

Before and after the test, a functional test of the specimens shall be performed by the client.

***Failure criteria***

- max. permissible acceleration on EUT =< 30 g
- mechanical damages that could lead to a partly or total functional failure
- no function or functional failure

## 5 Realization

The environmental tests were carried out one by one according to the program of testing methods (complex 4.1 and 4.2), according to the standards and to the demands of the client.

*Remark (Drop Test)*

The procedure for identifying the members (faces, edges, and corners) of the rectangular containers (big and small one) was as follows (see Fig. A1). One end of the box is facing the manufacturer's joint, where applicable, on the observer's right, the top of the box is designated as 1, the right side as 2, the bottom as 3, the left side as 4, the near end as 5, and the far end as 6. The edges are identified by the numbers of two faces that form that edge; for example, 1 2 identifies the edge formed by the top and the right side. The corners are identified by the three faces that meet to form that corner; for example, 1 2 6 identifies the corner at which the top, right side, and far end meet (see Fig. A2).

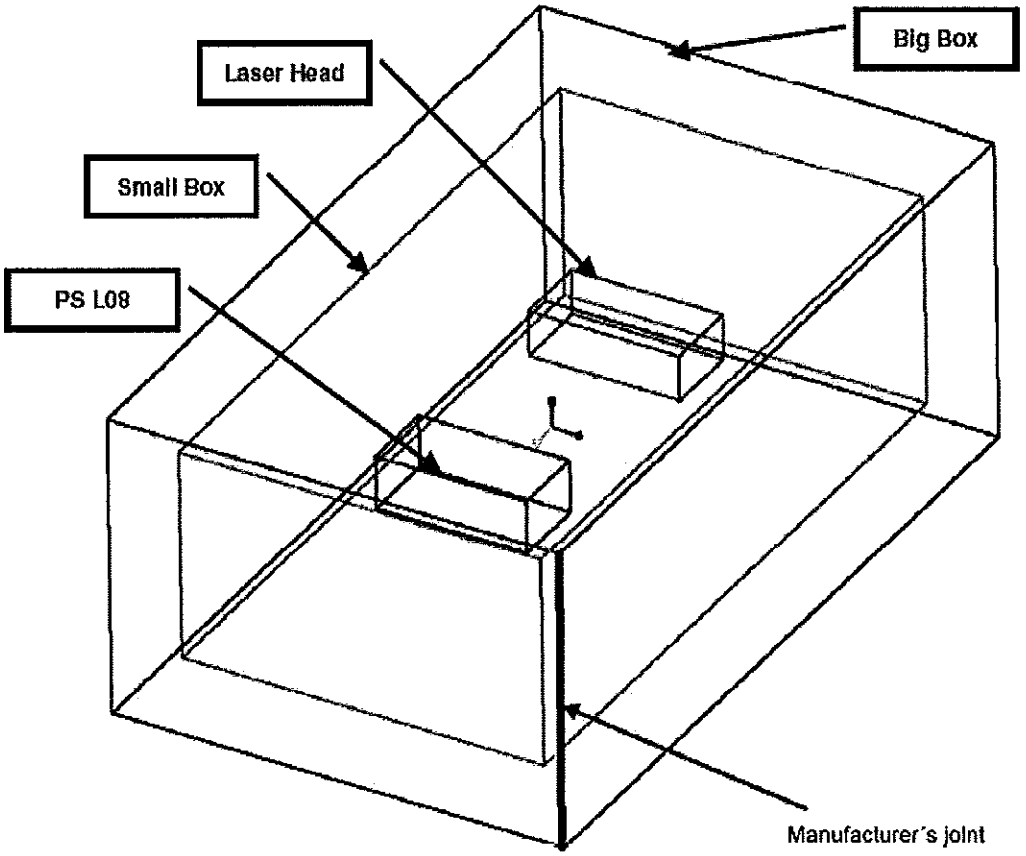

Big Box
Laser Head
Small Box
PS L08
Manufacturer´s joint

Fig. A1

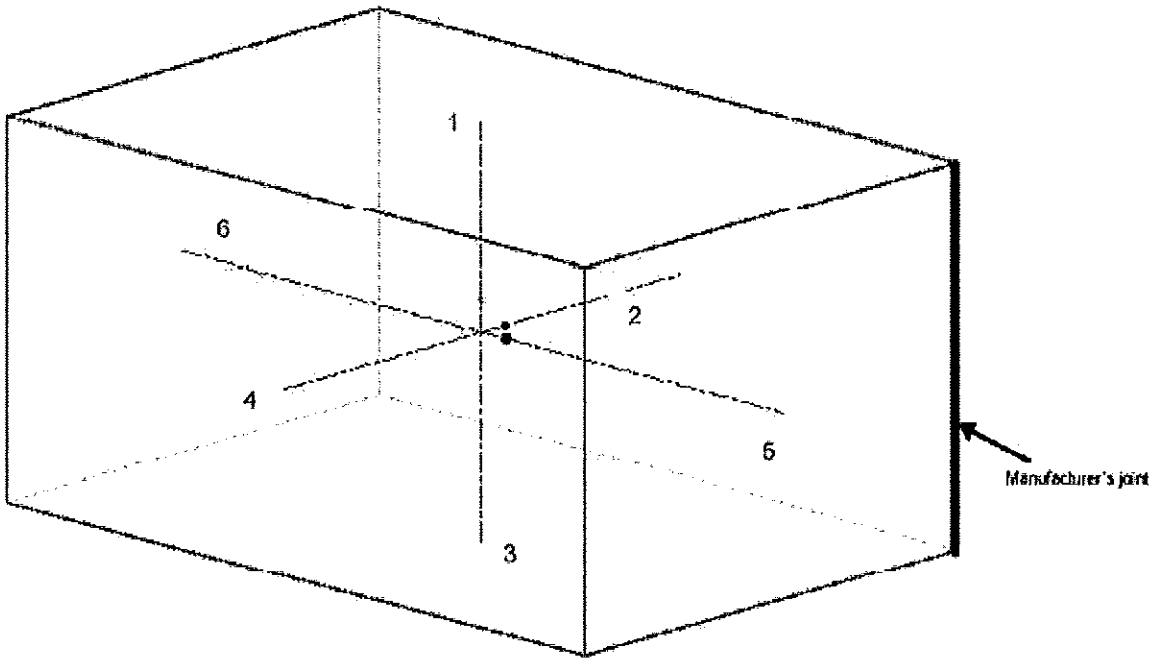

1
6
2
4
5
3
Manufacturer's joint

Fig. A2

***Measuring and test facilities***

| name | type | serial-No. | manufacturer | Calibrated till | remarks |
|---|---|---|---|---|---|
| climatic chamber 17 | KPK 600 | 42871/92 | Heraeus | 23.01.2007 | test Nb |
| | | | | | |
| *provided by the client:* | | | | | |
| notebook with test software | | | | | functional test |
| several interface cables | | | | | functional test |

***Climatic protocols*** see appendix 1

***Drop test protocols*** see appendix 2

***Pictures*** see appendix 3

# 6 Results

## 6.1 Climatic tests

After the

***- Temperature Cycling Test*** ***- test Nb***

no mechanical or thermal damages of the specimens were determined outside.

The further evaluation of both constructional variants will be done by the client.

## 6.2 Dynamic-mechanical tests

During

***- Drop Test*** ***- test Ed***

the following max. accelerations were measured at the specimen (3D acceleration sensor at the Laser Head):

| 2006/05/23 | | Max. acceleration [g] (absolute) | | | |
|---|---|---|---|---|---|
| time | geometry | X | Y | Z | vector |
| 10:45 | 3 | 3 | 6 | 26 | 26 |
| 10:47 | 1 | <1 | 1 | 5 | 5 |
| 10:53 | 2 | 25 | 9 | 14 | 26 |
| 10:56 | 4 | 23 | 8 | 8 | 24 |
| 10:59 | 6 | 4 | 13 | 17 | 20 |
| 11:03 | 5 | 1 | 3 | 2 | 4 |
| 11:08 | 12 | 1 | 2 | 2 | 3 |
| 11:18 | 14 | 1 | 2 | 2 | 3 |
| 11:22 | 23 | 14 | 10 | 11 | 19 |
| 11:24 | 34 | 13 | 13 | 24 | 29 |
| 11:32 | 16 | 2 | 5 | 2 | 5 |
| 11:35 | 15 | 2 | 8 | 3 | 9 |
| 11:38 | 35 | 4 | 18 | 12 | 19 |
| 11:39 | 36 | 3 | 16 | 12 | 18 |
| 11:45 | 26 | 6 | 25 | 10 | 25 |
| 11:47 | 25 | 2 | 6 | 2 | 7 |
| 11:49 | 46 | 2 | 4 | 1 | 4 |
| 11:51 | 45 | 9 | 18 | 4 | 20 |
| 11:54 | 146 | 2 | 6 | 2 | 6 |
| 12:03 | 345 | 16 | 11 | 6 | 18 |
| 12:06 | 346 | 2 | 5 | 2 | 6 |
| 12:08 | 145 | 1 | 3 | 1 | 3 |
| 12:12 | 236 | 8 | 19 | 6 | 21 |
| 12:14 | 126 | 2 | 5 | 3 | 6 |
| 12:16 | 235 | 6 | 12 | 5 | 12 |
| 12:23 | 125 | 2 | 7 | 2 | 8 |

After the drop test, no external damages of the specimens like cracks, breaks, distortions or any other mechanical damages were determined.

The operability of the specimens was ensured.

The further evaluation will be done by the client.

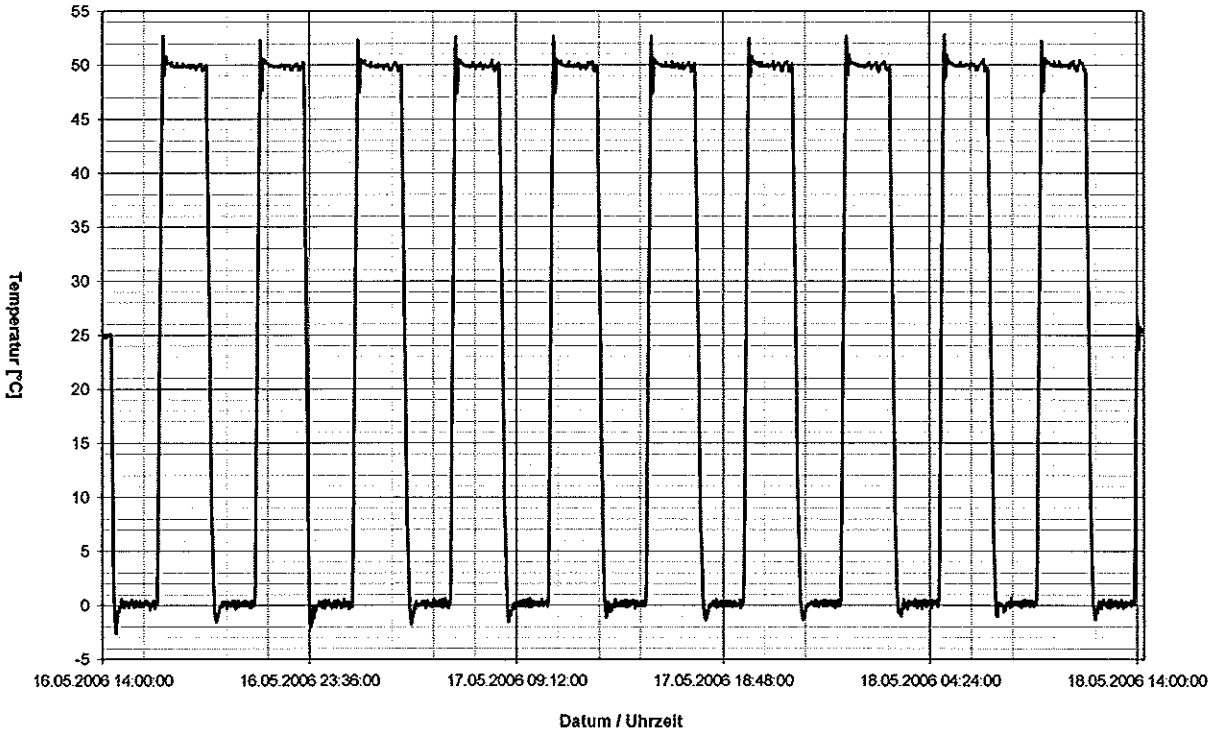
**The tests were realized according to the standards and to the demands of the client.**

**During the drop test, all measured accelerations were < 30 g.**

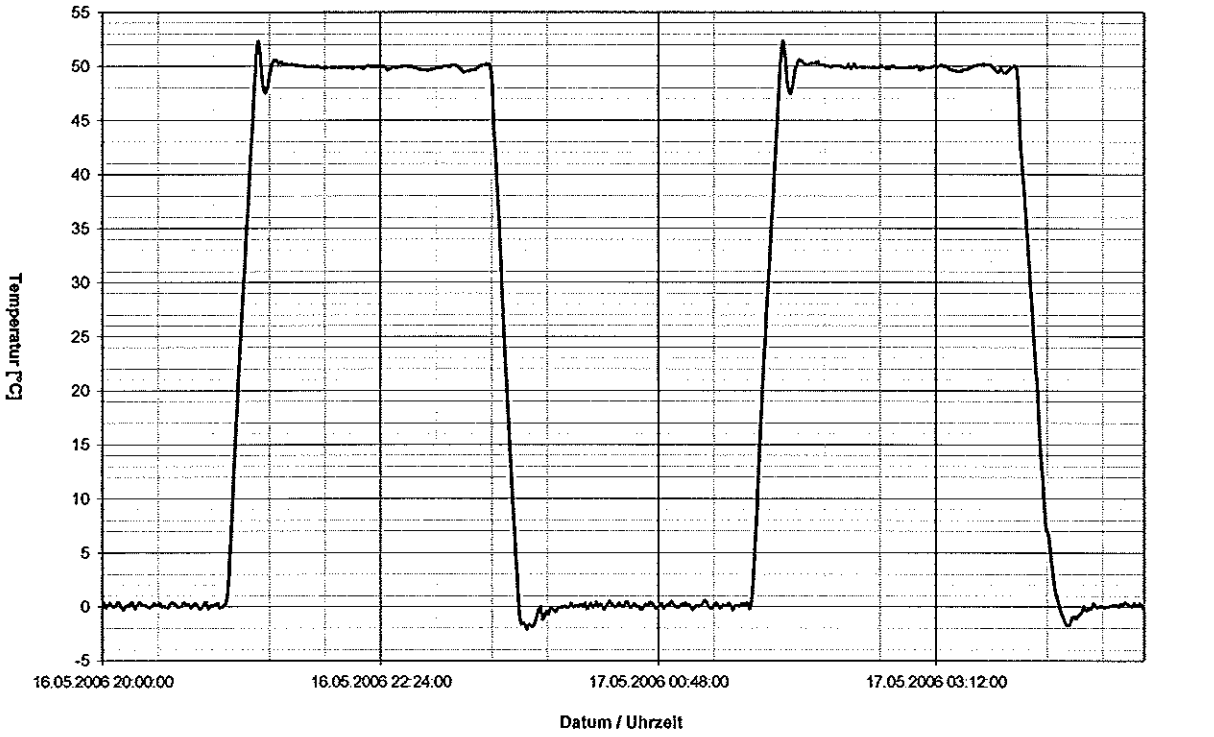
**The further evaluation will be done by the client**


This test report-No. 5648.01 / 06 includes 6 pages and appendix 1 to 3.

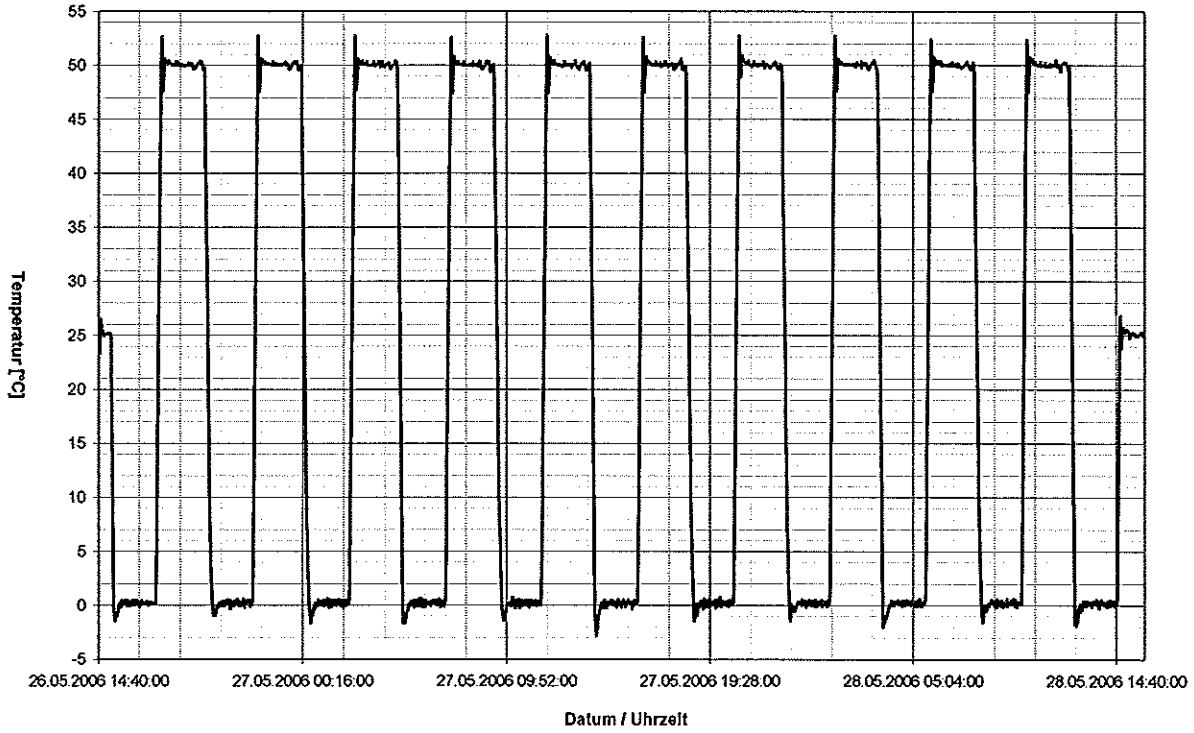
appendix 1 – climatic protocols
appendix 2 – drop test protocols
appendix 3 – pictures



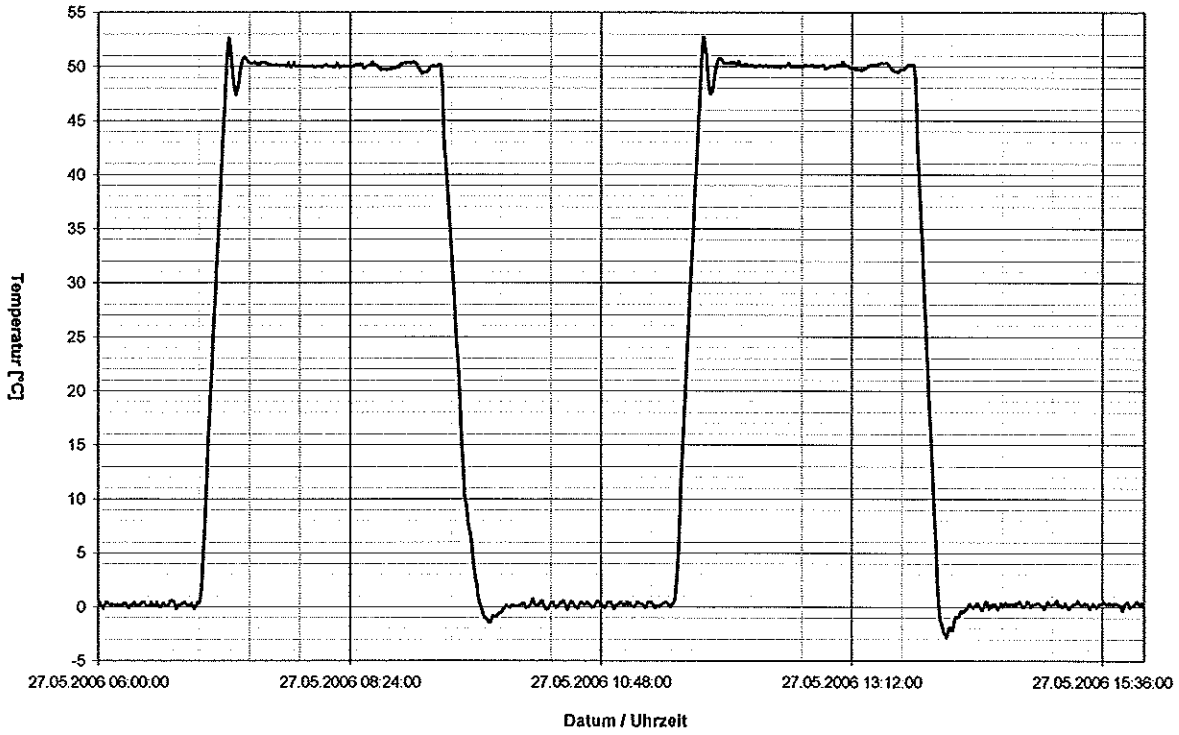

**Temperature behavior in the temperature test chamber TPK 17 – test Nb1 (0°C/+50°C, 10 cycles)**



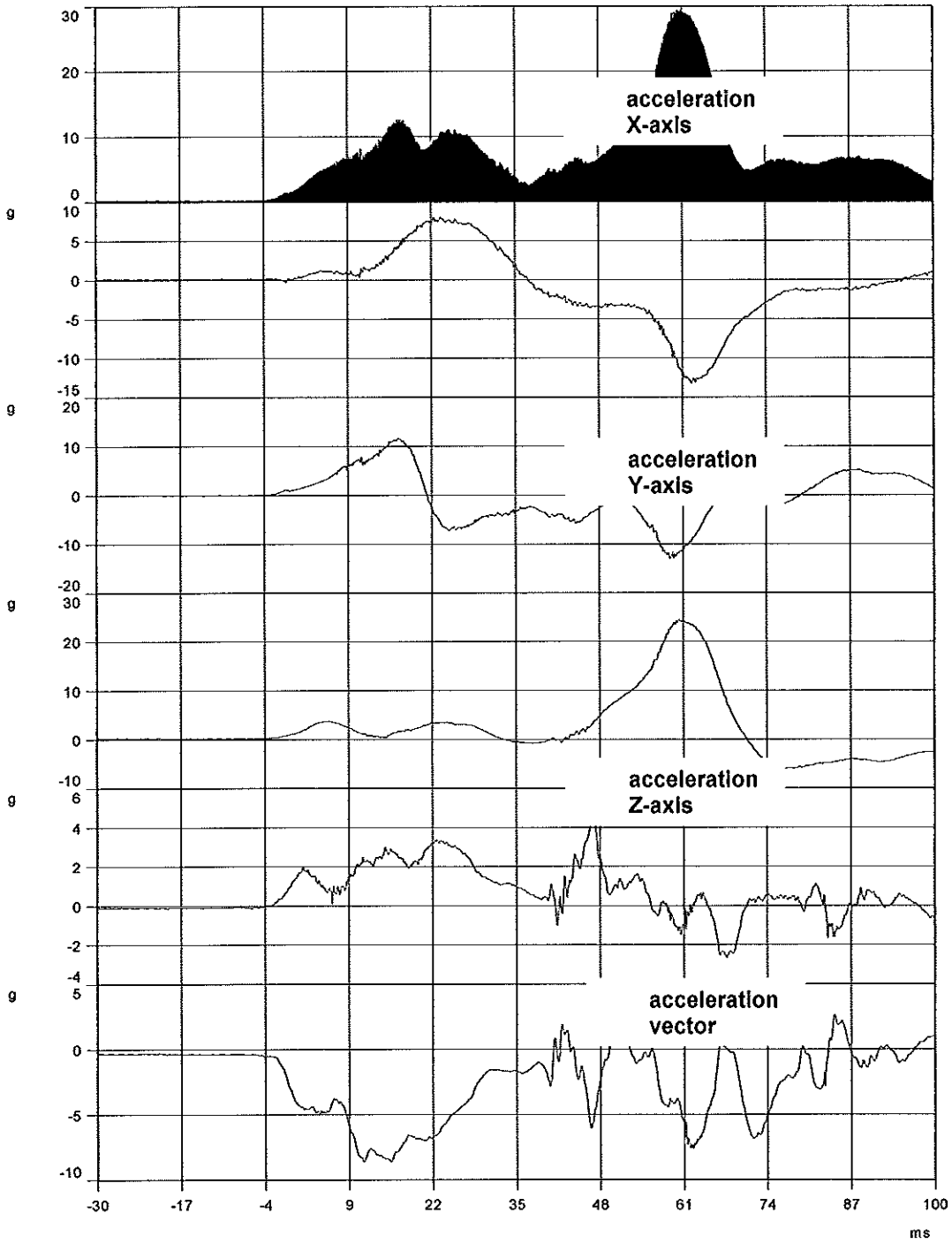

**Temperature behavior in the temperature test chamber TPK 17 – test Nb1 (0°C/+50°C, 2 cycles)**




**Temperature behavior in the temperature test chamber TPK 17 – test Nb2 (0°C/+50°C, 10 cycles)**

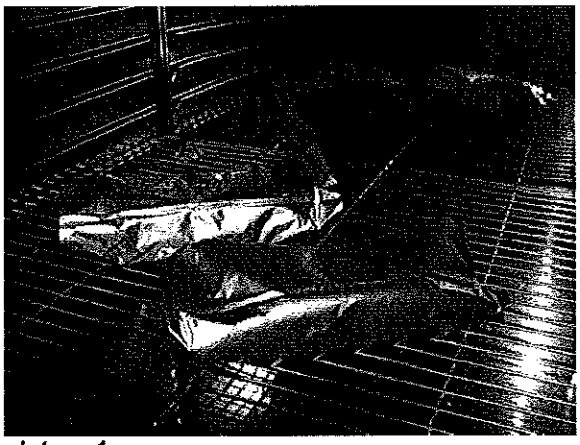



**Temperature behavior in the temperature test chamber TPK 17 – test Nb2 (0°C/+50°C, 2 cycles)**



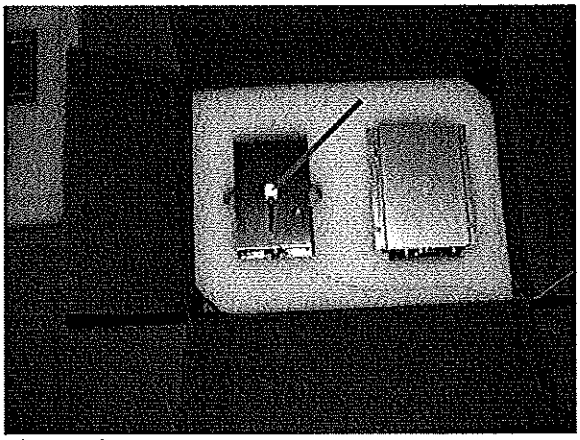

**Maximally measured acceleration during Drop Test on edge 34**

## Pictures



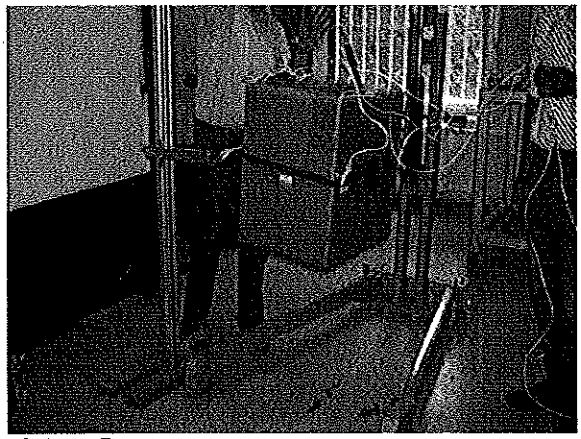
**picture 1**
**Laser Heads C50027, C50028**
**in temperature test chamber 17**
*during test – Nb (0°C/+50°C) – 1st test*

**picture 2**
**Laser Heads C50027, C50028**
**in temperature test chamber 17**
*during test – Nb (0°C/+50°C) – 2nd test (repetition)*



**picture 3**
**Laser Head and Controller in package**
**with 3D acceleration sensor (arrow)**
*before Drop Test*

**picture 4**
**Specimens in package -**
**falling**
*during Drop Test*



**picture 5**
**Specimens in package -**
**falling**
*during Drop Test*

**picture 6**
**Specimens in package**
**on bottom**
*after Drop Test*