

Test report no.: 211984/20

Client: R&G Faserverbundwerkstoffe GmbH
Im Meißel 7-13
71111 Waldenbuch
GERMANY

Order: Tests on tubes made of carbon fibre

Letter of: 2020-07-06 **Reference:** ---

Receipt of samples: 2020-07-09 **Date of sampling:** ---

Test period: 2020-07-14 to 2020-07-15

This test report comprises 5 pages.

This test report replaces the test report of 20 July 2020.

Würzburg, 10 August 2020
For/Krü/str/

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i. A.

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The original language of the test report is German. In case of doubt the German version is obligatory.

Die auszugsweise Wiedergabe, Vervielfältigung und Übersetzung dieses Berichtes bedarf der schriftlichen Genehmigung der SKZ - Testing GmbH. Die Ergebnisse beziehen sich auf die geprüften Produkte. Der Akkreditierungsumfang kann im Internet unter www.skz.de eingesehen werden.

1. Order

By letter of 6 July 2020 the company R&G Faserverbundwerkstoffe GmbH, Im Meißel 7-13, 71111 Waldenbuch, GERMANY, placed an order with SKZ - Testing GmbH to carry out tests on tubes made of carbon fibre.

2. Test material

The following test material was sent to SKZ - Testing GmbH by the customer on 9 July 2020:

| Material | Quantity | Denomination ¹⁾ | Dimensions [mm] |
|----------|----------|---|----------------------------|
| 1 | 10 | 7416141 Carbon round tube, wound, 3k-PW (Ø 16 / 14) x 1000 mm | approx. (Ø 16 / 14) x 1000 |
| 2 | 10 | 7316141 Carbon round tube, pultruded, (Ø 16 / 14) x 1000 mm | approx. (Ø 16 / 14) x 1000 |

¹⁾ according to the client

The SKZ - Testing GmbH had no influence on the selection of the test material.

3. Test procedure

Usually, we carry out tests according to standards for which we have an accreditation. The list of all standards for which we are accredited is shown on the homepage at www.skz.de. In case of non-accredited procedures, they are marked with *.

Unless stated otherwise, all the tests were performed at standard atmosphere 23/50 according to DIN EN ISO 291: 2008-08, class 1 "Plastics - Standard atmospheres for conditioning and testing" and after storage for at 24 hours at this atmosphere.

The following tests were carried out:

3.1 Mass per unit length

The mass per unit length was determined on 10 tubes each. For this purpose the length was measured and the weight determined. On the basis of these data the mass per meter was calculated.

3.2 Flexural test

The bending strength was determined according to DIN EN ISO 14125: 2011-05 "Fibre-reinforced plastic composites - Determination of flexural properties".

Number of specimens: 10 each
 Specimens: approx. 1000 mm x (Ø 16 / 14) mm
 Testing speed: 50 mm/min
 Distance between the supports: 640 mm
 Deflection measurement: Traverse
 Load cell: 2 kN

4. Results

4.1 Mass per unit length

| Material | Parameter | Unit | Result | | |
|--|-------------------------|------|--------|-----------|-----|
| | | | SV | \bar{x} | s |
| 1) 7416141 Carbon round tube, wound, 3k-PW (Ø 16 / 14) x 1000 mm | Mass per unit length | g/m | 70.5 | 69.9 | 3.8 |
| | | | 70.7 | | |
| | | | 73.1 | | |
| | | | 71.7 | | |
| | | | 69.8 | | |
| | | | 71.3 | | |
| | | | 70.9 | | |
| | | | 59.4 | | |
| | | | 70.8 | | |
| | | | 70.9 | | |

SV = single value;

\bar{x} = arithmetic mean value;

s = standard deviation

| Material | Parameter | Unit | Result | | |
|---|-------------------------|------|--------|-----------|-----|
| | | | SV | \bar{x} | s |
| 2) 7316141 Carbon round tube, pultruded, (Ø 16 / 14) x 1000 mm | Mass per unit length | g/m | 77.4 | 77.4 | 0.1 |
| | | | 77.5 | | |
| | | | 77.4 | | |
| | | | 77.3 | | |
| | | | 77.3 | | |
| | | | 77.5 | | |
| | | | 77.5 | | |
| | | | 77.3 | | |
| | | | 77.4 | | |
| | | | 77.4 | | |

SV = single value;

 \bar{x} = arithmetic mean value;

s = standard deviation

4.2 Bending strength

| Material | Parameter | Unit | Result | | |
|--|---------------------|------|--------|-----------|----|
| | | | SV | \bar{x} | s |
| 1) 7416141 Carbon round tube, wound, 3k-PW (Ø 16 / 14) x 1000 mm | Bending strength | MPa | 302 | 302 | 23 |
| | | | 290 | | |
| | | | 296 | | |
| | | | 290 | | |
| | | | 268 | | |
| | | | 345 | | |
| | | | 297 | | |
| | | | 328 | | |
| | | | 323 | | |
| | | | 286 | | |

SV = single value;

 \bar{x} = arithmetic mean value;

s = standard deviation

| Material | Parameter | Unit | Result | | |
|---|---------------------|------|--------|-----------|----|
| | | | SV | \bar{x} | s |
| 2) 7316141 Carbon round tube, pultruded, (Ø 16 / 14) x 1000 mm | Bending strength | MPa | 282 | 299 | 26 |
| | | | 298 | | |
| | | | 284 | | |
| | | | 308 | | |
| | | | 326 | | |
| | | | 330 | | |
| | | | 310 | | |
| | | | 267 | | |
| | | | 280 | | |
| | | | 326 | | |

SV = single value;

\bar{x} = arithmetic mean value;

s = standard deviation