

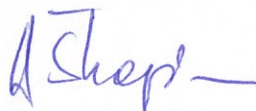
Ljubljana, 21. 5. 2004

TRANSLATION OF THE TEST REPORT**No. P 296/04-460-1****TESTING OF KERROCK PLATES**

Applicant: KOLPA d.d., Rosalnice 5, 8330 Metlika, Slovenia**Order Form:** No. 231/BL from 11. 3. 2004

Task Carrier:

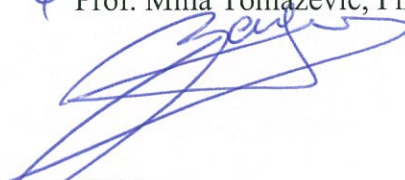
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Prof. Miha Tomaževič, Ph.D.



Translation prepared: 24. 6. 2004

INTRODUCTION

Applicant:	KOLPA d.d., Rosalnice 5, 8330 Metlika, Slovenia
Samples: name (number of colour) quantity and dimensions	<p>1.) KERROCK SINGLE-COLOURED (2063) 1 plate: 1,3m x 1,5m x 12mm 8 plates: 1,5m x 0,19m x 12mm 1 plate: 1,5m x 0,19m x 10mm</p> <p>2.) KERROCK GRANIT (4092) 1 plate: 1,3m x 1,5m x 12mm 8 plates: 1,5m x 0,19m x 12mm 1 plate: 1,5m x 0,19m x 10mm</p> <p>3.) KERROCK TERACO (5055) 1 plate: 1,3m x 1,5m x 12mm 8 plates: 1,5m x 0,19m x 12mm 1 plate: 1,5m x 0,19m x 10mm</p>
Manufacturer:	KOLPA d.d., Rosalnice 5, 8330 Metlika, Slovenia
Internal sample designation:	KERROCK SINGLE-COLOURED ZAG D4-22/1 KERROCK GRANIT ZAG D4-22/2 KERROCK TERACO ZAG D4-22/3
Date and manner of sample receipt:	06. 02. 2004, delivered by applicant
Beginning of testing:	10. 03. 2004
End of testing:	06. 05. 2004
Dates of measurements and tests:	
- Density	10. 03. 2004
- Flexural properties (flexural strength and modulus)	11. 03. 2004
- Tensile properties (tensile strength and strain at break)	12. 03. 2004 - 16. 03. 2004
- Charpy impact strength	15. 03. 2004
- Water absorption	16. 03. 2004 – 23. 03. 2004
- Resistance to dry heat	18. 03. 2004
- Resistance to steam	18. 03. 2004
- Resistance to surface wear	18. 03. 2004
- Resistance to cigarette burns	18. 03. 2004
- Linear expansion coefficient	26. 03. 2004 – 06. 05. 2004
- Hardness by means of a Barcol impressor	15. 04. 2004
- Compressive properties	20. 05. 2004



In agreement with the applicant, the following properties of Kerrock plates were determined:

1. DENSITY / *SIST EN ISO 1183-1 :2004*
2. FLEXURAL PROPERTIES (FLEXURAL STRESS AND MODULUS)
/ *SIST EN ISO 178 :2003*
3. TENSILE PROPERTIES (TENSILE STRENGTH AND STRAIN AT BREAK)
/ *SIST EN ISO 527-1 :2000*
4. CHARPY IMPACT STRENGTH / *SIST EN ISO 179-1 :2001*
5. WATER ABSORPTION / *SIST EN ISO – 62 :2000*
6. RESISTANCE TO STEAM / *SIST EN 438-2:1999*
7. RESISTANCE TO DRY HEAT / *SIST EN 438-2:1999*
8. RESISTANCE TO SURFACE WEAR / *SIST EN 438-2:1999*
9. RESISTANCE TO CIGARETTE BURNS / *SIST EN 438-2:1999*
10. LINEAR EXPANSION COEFFICIENT
11. HARDNESS BY MEANS OF A BARCOL IMPRESSOR / *SIST EN 59:1999*
12. COMPRESSIVE PROPERTIES / *SIST EN ISO 604:2003*

COURSE OF MEASUREMENTS AND TESTS

1. DENSITY

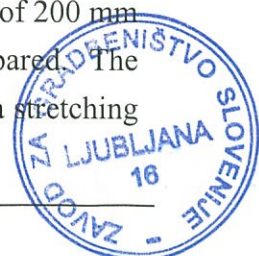
Density of all three samples was determined according to *SIST EN ISO 1183-1 :2004 – METHOD A*. Density was determined gravimetrically based on the Archimedes' principle.

2. DETERMINATION OF FLEXURAL PROPERTIES (FLEXURAL STRESS AND MODULUS)

The testings were carried out on all three samples according to *SIST EN ISO 178:2003*. At least five specimens of dimensions of 24 cm x 2 cm x 1,2 cm were cut out from the delivered plates using a diamond circular saw. The measurements of flexural properties were carried out at 23°C and 50 % relative humidity using a test machine ZWICK Z 100 (A1). The supports were separated by 19,2 cm, the speed of loading was 2 mm/min.

3. DETERMINATION OF TENSILE PROPERTIES (TENSILE STRENGTH AND STRAIN AT BREAK)

The testings were carried out on all three samples according to *SIST EN ISO 527-1:2000*. Using the milling procedure, at least five paddle-shaped specimens of a length of 200 mm and a cross-section of 10 mm x 12 mm in the thinnest central part, were prepared. The tensile properties were measured using a ZWICK Z 100 (A1) test machine at a stretching



rate of 1 mm/min, a temperature of 23°C and at 50 % relative humidity. The pressure of gripping jaws was 80 bar. The direction of testing was irrelevant.

4. CHARPY IMPACT STRENGTH (WITHOUT NOTCH)

Toughness according to *SIST EN ISO 179-1/1fU:2001* was determined for all three samples. At least 10 specimens of dimensions of 80 mm x 10 mm x 10 mm were cut out from the delivered plates using a diamond circular saw. The measurements were carried out at 23°C and 50 % rel. humidity using a ZWICK D-7900 pendulum impact testing machine. A pendulum with a nominal energy of 1 J was used. The speed of hammer was 3 m/s, the specimens were fixed on supports separated by 62 mm. The pendulum was selected based on preliminary testings in which it had been required that the specimen break upon first strike of pendulum. In all specimens complete fractures occurred (type C).

5. WATER ABSORPTION

Water absorption testing was only carried out on the KERROCK SINGLE-COLOURED sample, according to *SIST EN ISO – 62:2000*, METHOD 1. Three specimens of dimensions of 60 mm x 60 mm x 12 mm, cut out from the original plates using a diamond circular saw, were weighed and immersed into the required amount of deionized water at a temperature of 23°C. Water absorption was determined by immersing the specimens into water and measuring gravimetrically the water uptake in equal time intervals (24 h). Before weighing, the specimens were wiped up with a dry cloth. The procedure was repeated until the specimens were soaked for 192 h.

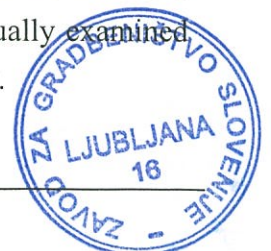
6. RESISTANCE TO STEAM

The testing was only carried out on the KERROCK SINGLE-COLOURED sample, according to *SIST EN 438-2:1999 – pt. 24*. The sample was exposed to the steam from the boiling water for a period of 1 h. After 24 h the exposed surface was visually examined using a magnifying glass. The effect on the surface of the specimen were expressed in accordance with the rating scale: ratings or degrees from 1 to 5, 1 being the worst and 5 the best result.

The same evaluation procedure was used in the following testings: resistance to dry heat, resistance to cigarette burns.

7. RESISTANCE TO DRY HEAT

The testing was only carried out on the KERROCK SINGLE-COLOURED sample, according to *SIST EN 438-2:1999 – pt. 8*. The sample was exposed for 20 min to a silicone oil having a temperature of 180°C. The exposed surface was visually examined and evaluated as described in the second paragraph of point 6 of this report.



8. RESISTANCE TO SURFACE WEAR

This testing was carried out on all samples according to requirements given in *SIST EN 438-2:1999 – pt. 6* with modifications. A specimen of dimensions 100 mm x 100 mm was placed into an apparatus for wear determination: ABRASER - MODEL 503. Using a calibrated abrasive paper and a prescribed load we measured the degree of wear after 100 revolutions. The degree of wear was determined gravimetrically.

9. RESISTANCE TO CIGARETTE BURNS

The testing was only carried out on the KERROCK SINGLE-COLOURED sample, according to *SIST EN 438-2:1999 – pt. 18*. The following brands of cigarettes were used: Chesterfield, Kim and Gauloises. The exposed surface was visually examined and evaluated as described in the second paragraph of point 6 of this report.

10. LINEAR EXPANSION COEFFICIENT

For all three samples the linear expansion coefficient was determined in a chamber where the temperature was varied from -20°C to 70°C . Each sample was cycled three times in the whole temperature range. Dilatation and contraction of specimens were measured using an inductive extensometer.

11. HARDNESS BY MEANS OF A BARCOL IMPRESSOR

The testing was carried out in accordance with *SIST EN 59:1999*. A BARCOL GYZJ 934-1 Impressor with a flat-tip indenter having a diameter of 0,157 mm was used. For each sample 7 repetitions at 23°C and 50 % rel. humidity were carried out.



12. DETERMINATION OF COMPRESSIVE PROPERTIES

The testing was only carried out on the KERROCK SINGLE-COLOURED sample, according to *SIST EN ISO 604:2003*. For determination of modulus, at least five specimens of the following dimensions: length x width x thickness = 50 mm x 10 mm x 4 mm were prepared. For determination of strength, the respective dimensions were: 10 mm x 10 mm x 4 mm. The specimens were cut out from the original plates using a diamond circular saw. The compression properties were measured using a ZWICK Z 100 (A1) test machine. The compression speed was 1 mm/min and 5 mm/min for modulus and strength determination, respectively. In both cases the temperature was 23°C while the relative humidity was 50 %. A ZWICK MULTISENZ (066607) extensometer was used. As compression supports, ground steel plates were utilized.




RESULTS


Table 1: Summary of the results for all three samples.

Tested property (unit) / testing method	Measured values	
	sample: individual values	Mean value ± stand. deviation
1. Density - DENSITY (kg / m ³) / SIST EN ISO 1183-1 :2004 – METHOD A	D4-22-1: 1684,7 1686,0 1685,5 1686,3 1685,7 D4-22-2: 1704,8 1706,6 1705,5 1704,0 1707,2 D4-22-3: 1687,1 1690,2 1688,1 1690,4 1688,8	1685,6 ± 0,6 1705,6 ± 1,3 1688,9 ± 1,4
2. Flexural properties - FLEXURAL STRESS (MPa) - MODULUS (MPa) / SIST EN ISO 178:2003 “accredited”  <small>SIST EN ISO/IEC 17025 L-013</small>	D4-22-1: <u>Flexural modulus</u> 8938 9066 9172 9443 8718 9081 <u>Flexural stress</u> 64,8 72,0 66,3 70,4 63,1 68,8 D4-22-2: <u>Flexural modulus</u> 9531 9308 9356 9185 9429 <u>Flexural stress</u> 62,1 67,3 70,3 63,5 61,0 D4-22-3: <u>Flexural modulus</u> 9284 9510 9615 9373 8770 <u>Flexural stress</u> 48,5 55,2 55,1 57,5 56,4	9070 ± 241 67,6 ± 3,4 9362 ± 130 64,8 ± 3,9 9310 ± 327 54,5 ± 3,5
3. Tensile properties - TENSILE STRENGTH (MPa) - STRAIN AT BREAK (%) / SIST EN ISO 527-1:2000 “accredited”  <small>SIST EN ISO/IEC 17025 L-013</small>	D4-22-1: <u>Tensile strength</u> 51,4 50,2 52,8 52,7 50,7 51,5 <u>Strain at break</u> 0,79 0,76 0,82 0,82 0,74 0,78 D4-22-2: <u>Tensile strength</u> 49,9 49,3 51,6 50,9 50,5 51,5 <u>Strain at break</u> 0,71 0,71 0,79 0,77 0,73 0,81 D4-22-3: <u>Tensile strength</u> 41,4 40,3 40,1 40,0 40,0 38,3 <u>Strain at break</u> 0,60 0,58 0,57 0,55 0,57 0,52	51,5 ± 1,1 0,78 ± 0,03 50,6 ± 0,9 0,76 ± 0,04 40,0 ± 11,0 0,57 ± 0,03



<p>4. Charpy impact strength</p> <p>CHARPY WITHOUT NOTCH (KJ/m²)</p> <p>/ <i>SIST EN ISO 179-1/1fU:2001</i></p> <p>“accredited”</p> 	<p>D4-22-1: 5,44 5,04 5,37 5,41 5,28 5,30 5,11 5,36 5,05 5,31 5,42 5,88 5,38</p> <p>D4-22-2: 5,03 5,13 5,24 5,10 5,09 5,12 4,98 4,90 5,18 5,21</p> <p>D4-22-3: 3,71 3,58 3,49 4,21 3,70 3,35 3,35 3,52 3,55 3,44 3,53 3,42</p>	<p>5,33 ± 0,21</p> <p>5,10 ± 0,10</p> <p>3,57 ± 0,23</p>
<p>5. Water absorption</p> <p>- WATER ABSORPTION AFTER 24h - WATER ABSORPTION AT SATURATION – c_s (g) - DIFFUSION COEFFICIENT –D (/)</p> <p>/ <i>SIST EN ISO – 62:2000, METHOD 1</i></p>	<p>D4-22-1: see Table 2</p>	<p>0,03</p> <p>0,12</p> <p>2,81 x 10⁻⁵</p>
<p>6. Resistance to dry heat (degree 1-5)</p> <p>/ <i>SIST EN 438-2:1999</i></p>	<p>D4-22-1: Slight change of gloss and/or colour, only visible at certain viewing angles</p>	<p>4</p>
<p>7. Resistance to steam (rating 1-5)</p> <p>/ <i>SIST EN 438-2:1999</i></p>	<p>D4-22-1: Slight change of gloss and/or colour, only visible at certain viewing angles</p>	<p>4</p>
<p>8. Resistance to surface wear</p> <p>- RESISTANCE TO SURFACE WEAR (mg /100 revolutions)</p> <p>/ <i>SIST EN 438-2:1999</i></p>	<p>D4-22-1: 1389 1279 1281</p> <p>D4-22-2: 1405 1403 1378</p> <p>D4-22-3: 1464 1518 1442</p>	<p>1316 ± 63</p> <p>1395 ± 15</p> <p>1475 ± 39</p>
<p>9. Resistance to cigarette burns (rating 1-5)</p> <p>/ <i>SIST EN 438-2:1999</i></p>	<p>D4-22-1: Slight change of gloss only visible at certain viewing angles.</p>	<p>4</p>



<p>10. Linear expansion coefficient</p> <p>- α (/)</p>	<p>D4-22-1: α (-20°C to 5°C) = $2,8 \times 10^{-5}$ α (5°C to 23°C) = $4,0 \times 10^{-5}$ α (23°C to 50°C) = $4,5 \times 10^{-5}$</p> <p>D4-22-2: α (-20°C to 5°C) = $3,1 \times 10^{-5}$ α (5°C to 23°C) = $3,7 \times 10^{-5}$ α (23°C to 50°C) = $4,2 \times 10^{-5}$</p> <p>D4-22-3: α (-20°C to 5°C) = $3,2 \times 10^{-5}$ α (5°C to 23°C) = $3,7 \times 10^{-5}$ α (23°C to 50°C) = $4,5 \times 10^{-5}$</p>	<p>α (-20°C to 50°C) = $3,7 \times 10^{-5}$</p> <p>α (-20°C to 50°C) = $3,7 \times 10^{-5}$</p> <p>α (-20°C to 50°C) = $3,7 \times 10^{-5}$</p>
<p>11. Hardness by means of a Barcol impressor</p> <p>- HARDNESS (/)</p> <p>/ SIST EN 59:1999</p>	<p>D4-22-1: 61 61 60 60 61 62 62</p> <p>D4-22-2: 62 63 62 63 63 62 63</p> <p>D4-22-3: 61 60 61 62 62 63 62</p>	<p>$61 \pm 0,8$</p> <p>$63 \pm 0,5$</p> <p>$62 \pm 1,0$</p>
<p>12. Compressive properties</p> <p>- COMPRESSIVE STRESS AT YIELD (MPa)</p> <p>- NOMINAL COMPRESSIVE YIELD STRAIN (%)</p> <p>/ SIST EN ISO 604/B/5:2003</p> <p>- COMPRESSIVE MODULUS (MPa)</p> <p>/ SIST EN ISO 604/A/1:2003</p> <p>"accredited"</p> 	<p>D4-22-1: <u>Compressive stress at yield</u> 125,4 125,6 126,9 125,8 127,4 <u>Nominal compressive yield strain</u> 6,42 6,49 6,34 6,47 6,35</p> <p><u>Compressive modulus</u> 9604 9522 9201 9126 9445 9434 9008</p>	<p>$126,2 \pm 0,9$</p> <p>$6,41 \pm 0,07$</p> <p>9334 ± 223</p>

NOTE 1:

Activities designated as **"accredited"** in this report are within the scope of accreditation by SA.



Table 2: Water absorption.

Time (h)	Mass of absorbed water (mg)	Percentage of absorbed water (%)
24	22,6	0,0305
48	35,6	0,0481
72	45,3	0,0612
96	54,0	0,0730
168	71,9	0,0972
192	76,1	0,1029

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