GRANULITE

GRANULITE LAB TEST SUMMARY

Granulite 300 grade has been tested by DIFK German Institute for Refractory and Ceramics, accredited testing laboratory, according to DIN EN ISO standards (see the Summary Table below). Complete copies of test reports are available for your review attached.

PROPERTY	RESULT	TEST
CHEMICAL ANALYSIS XRF		
SiO_2	58,48 %	DIN EN ISO 12677
Al_2O_3	36,31 %	DIN EN ISO 12677
Fe_2O_3	1,45 %	DIN EN ISO 12677
TiO_2	1,11 %	DIN EN ISO 12677
CaO	0,72%	DIN EN ISO 12677
PHYSICAL PROPERTIES		
Loss on ignition (1025 °C)	0,12 %	DIN EN ISO 12677
True density	0,841 g/cm^3	DIN 66137-2
Loose bulk density	0,404 Mg/m^3	DIN EN 1097-3
Melting Temperature	1748 °C	DIN 51730
Moisture	0,07 %	INTERNAL TEST METOD
PARTICLE SIZE		
0-63 µm	2,38 %	DIN 66165 PART 1+2
63-125 µm	14,68 %	DIN 66165 PART 1+2
125-250 µm	82,94 %	DIN 66165 PART 1+2
250-500 µm	0 %	DIN 66165 PART 1+2

Determination of humidity content

Date of testing: *August 10, 2017*

The results are related to delivered material

Sample	Humidity [wt-%]
Granulite-160	**0,09**
Granulite-300	**0,07**

Chemical analysis of refractory products by XRF

fused cast bead method
determined according DIN EN ISO 12677*

Date of testing: *August 10, 2017*

The results are normalized to 100 wt.-% and related to ignited material

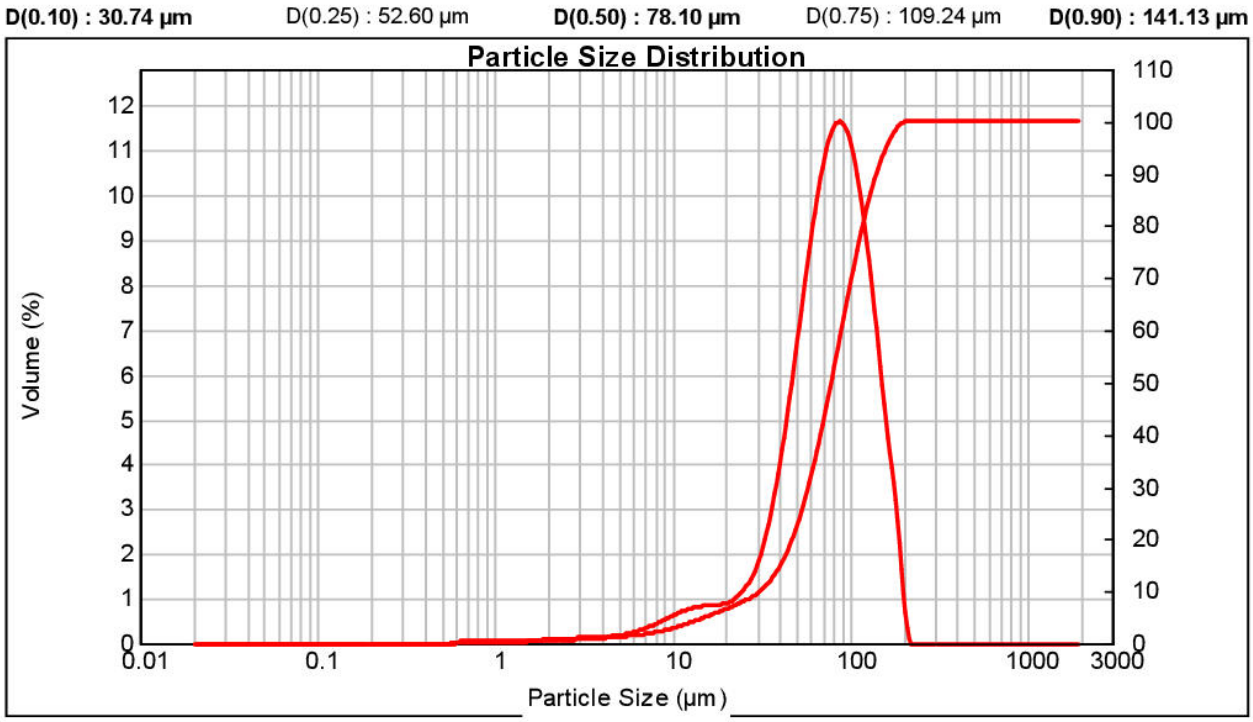
	Granulite-160	**Granulite-300**
Al_2O_3	35,54	36,31
SiO_2	59,54	58,48
Fe_2O_3	1,27	1,45
TiO_2	1,07	1,11
CaO	0,68	0,72
MgO	0,32	0,42
K_2O	0,66	0,61
Na_2O	0,38	0,34
Mn_3O_4	<0,01	<0,01
Cr_2O_3	<0,01	<0,01
P_2O_5	0,31	0,35
ZrO_2	0,03	0,03
SrO	0,05	0,05
BaO	0,15	0,14
change in weight by ignition (1025 °C)	-0,15	-0,12

Determination of particle size distribution

Date of testing: *August 09, 2017*

Determination of grain size with Malvern Mastersizer 2000

	Granulite-160
D10 – value [µm]	**30,74**
D25 – value [µm]	**52,60**
D50 – value [µm]	**78,10**
D75 – value [µm]	**109,24**
D90 – value [µm]	**141,13**

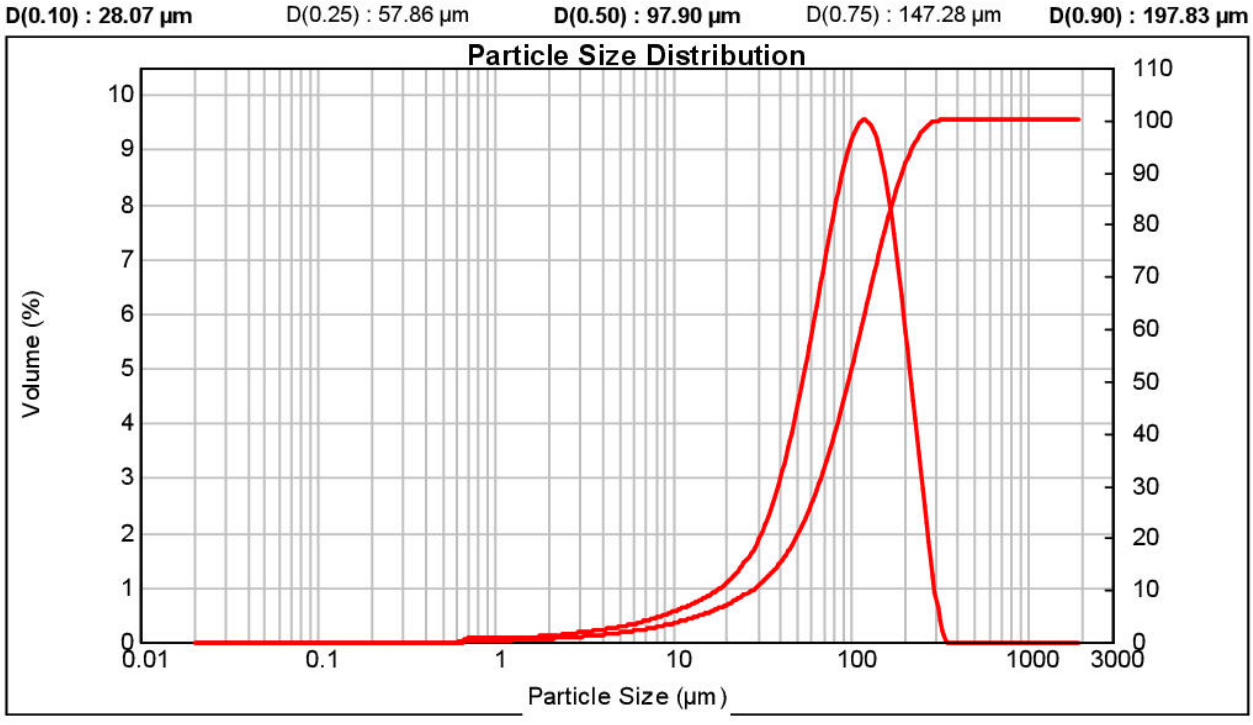


Determination of particle size distribution

Date of testing: *August 09, 2017*

Determination of grain size with Malvern Mastersizer 2000

	Granulite-300
D10 – value [µm]	**28,07**
D25 – value [µm]	**57,86**
D50 – value [µm]	**97,90**
D75 – value [µm]	**147,28**
D90 – value [µm]	**197,83**



Determination of loose bulk density

determined according to DIN EN 1097-3

Date of testing: *August 14, 2017*

Sample	Loose bulk density [Mg/m3]	Average loose bulk density [Mg/m^3]
Granulite-160	**0,402** **0,399** **0,403**	**0,402**
Granulite-300	**0,404** **0,403** **0,405**	**0,404**

Determination of solid state density by Gaspycnometry with Helium gas

determined according to DIN 66137-2

Date of testing: *until August 15, 2017*

True density [g/cm³]				
Sample	**Single value 1 [g/cm³]**	**Single value 2 [g/cm³]**	**Single value 3 [g/cm³]**	**Mean value [g/cm³]**
Granulite-160	0,827	0,825	0,824	**0,825**
Granulite-300	0,837	0,845	0,842	**0,841**

Particle size analysis (dry)

Determined according to DIN 66165 part 1+2

Date of testing: *August 14, 2017*

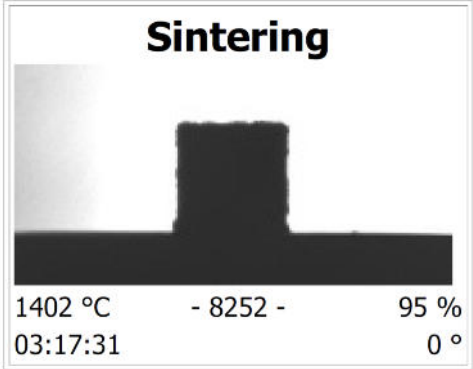
		Granulite-160	Granulite-300
dried sample:	[g]	100,07	100,02
> 0,5 mm	**[%]**	**-**	**-**
0,5 – 0,25 mm	**[%]**	**-**	**-**
0,25 – 0,125 mm	**[%]**	**65,68**	**82,94**
0,125 – 0,063 mm	**[%]**	**29,19**	**14,68**
< 0,063 mm	**[%]**	**5,13**	**2,38**

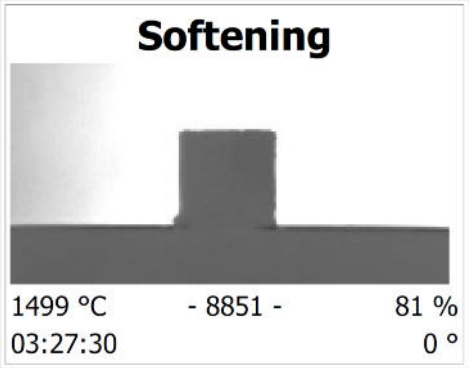
Hot stage microscopy
determined according DIN 51730

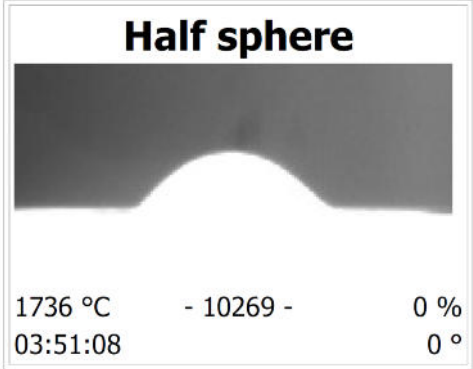
Date of testing: *August 14, 2017*

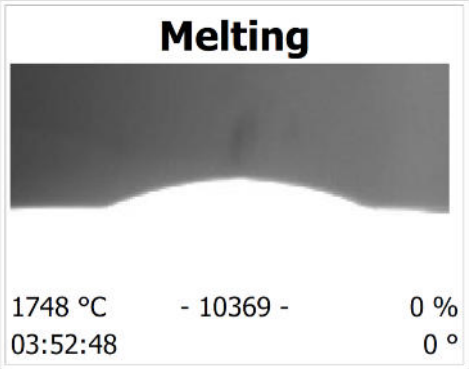
Code		Granulite-160
A	Softening temperature [°C]	**1499**
C	Hemisphere temperature [°C]	**1736**
D	Flow temperature [°C]	**1748**

Remark: without platinum







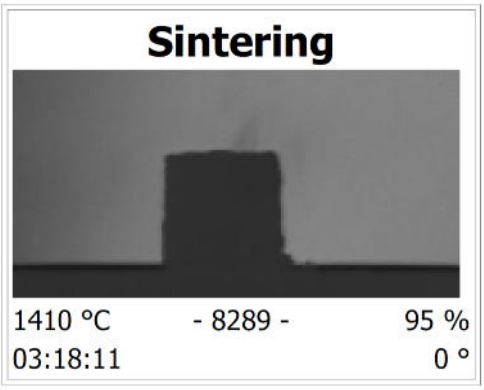


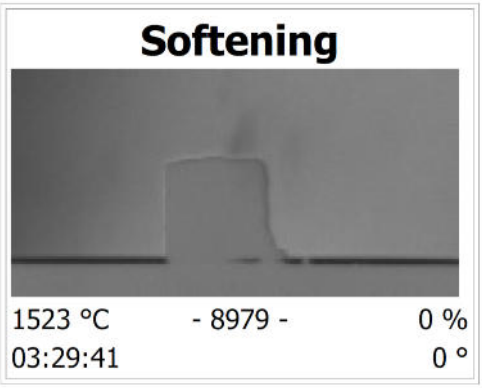
Hot stage microscopy
determined according DIN 51730

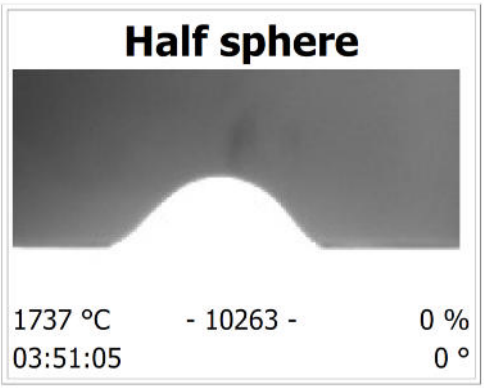
Date of testing: *August 15, 2017*

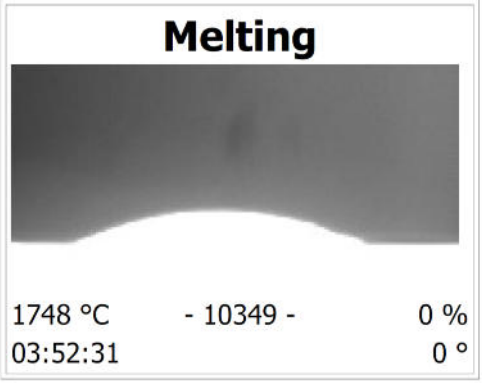
Code		Granulite-300
A	Softening temperature [°C]	**1523**
C	Hemisphere temperature [°C]	**1737**
D	Flow temperature [°C]	**1748**

Remark: without platinum









Sinker
internal test method

Date of testing: *August 25, 2017*

Scope
This test method covers measurement of the relative resistance of granulates to absorption of water

Significance and use
This test method allows to differ the floating and sinking amount of the granulates

Apparatus
Graduated separating funnel 1000 ml
800 ml H_2O
100 g of the sample

Procedure
Weigh in the 100 g of the sample in the measuring cylinder.
Fill in 800 ml of H_2O.
Pivot the separating funnel to horizontal, hold it 10 seconds, then decline it 180° in the other direction. Repeat 20 times.
Wait the settling time of 1 hour.
Let the lower phase out by the plug valve, dry the lower phase 24 h by 110°C
Weigh the amount of the dried sediment.

Sample	Total Amount [g]	Sediment [g]	Sediment [%]
Granulite-160	**100**	**4,8**	**4,8**
Granulite-300	**100**	**2,7**	**2,7**