

t-ceramics

Advanced Technical Ceramics

FULLY STABILIZED ZIRCONIA (8YSZ) CRUCIBLES

(8% by mole Yttria), Max. Usable Temperature 1800 °C

Description.

Pure Zirconium dioxide undergoes a phase transformation from monoclinic to tetragonal at about 1173 °C. The large volume change accompanying this transition (about 9%) lead to cracking when concerning structural monolithic ceramics like crucibles. Stabilization of the tetragonal structure of Zirconia over wider range of temperatures is accomplished by substitution of some of the Zr⁴⁺ ions within the crystal lattice with slightly larger ions, like those of Y³⁺. The resulting doped Zirconia materials are termed Yttria Stabilized Zirconia (YSZ) or Yttria-stabilized Tetragonal Zirconia Polycrystal (Y-TZP). Polycrystalline materials such as YSZ, own their excellent mechanical properties the tetragonal crystal structure.

Fully Yttria Stabilized Zirconia, 8YSZ (8% by mole Yttria) ceramics are used when an application requires a crucible that is exceptionally strong, wear-resistant and chemically inert at extremely elevated temperature. Also is the material that preferred for most biocompatible applications. Fully Yttria Stabilized Zirconia (8YSZ) is the material with the higher strength from the materials we offer and exhibits a Flexural strength that is higher than Nitrides and can approach the value of Carbides. This property significantly extends the reliability and lifetime of crucibles made with stabilized Zirconia.

Fully Yttria Stabilized Zirconia (8YSZ) technical ceramics offers some advantages over Alumina. Namely, Fully Yttria Stabilized Zirconia 8YSZ crucibles compared to Alumina crucibles are more refractory and have much lower thermal conductivity, have higher quality surface finish, are denser and are even 4 times superior in terms of strength (this property degrades when temperature exhibits 1000 C). However, are considerably more expensive even than purest grades of Alumina and are less thermal shock resistant. The main reason for 8YSZ high cost is that both Zirconia and Yttria raw material are rare compared with Alumina and thus expensive.

Thermansys is producing a broad range of analytical grade, dense Fully stabilized Zirconia crucibles in various sizes and forms. Custom solutions available upon request.

Applications.

Analytical applications, metals melting, ceramic powders heat treatment, material acid treatment even at elevated temperature. Zirconia crucibles are ideal for the melting or sintering of precious metals and super-alloys. Other common applications are dental restorations sintering, crystal growing, crucibles for extremely corrosive environments, like plasma etching etc.



Available shapes:

- Boats
- Dishes (Round Shallow)
- Conical (Tapered Wall)
- Classic Form
- Cylindrical
- Rectangular
- Lids
- Custom Shapes

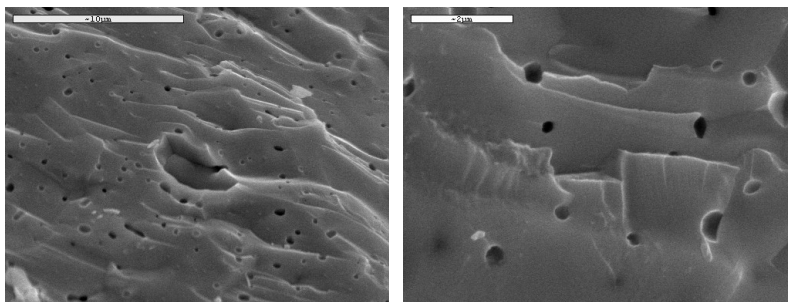
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Chemical Composition.

• Y ₂ O ₃ % wt.	13.3
• Al ₂ O ₃ % wt.	Max. 0.005
• Fe ₂ O ₃ % wt.	Max. 0.002
• SiO ₂ % wt.	0.003
• Na ₂ O % wt.	0.060
• ZrO ₂ % wt.	Balance



Properties.

• Max. Operating Temperature, °C (no load)....	1800-2300	• Dielectric Strength, AC-KV/mm.....	9.0
• Open Porosity, % vol.	0	• Dielectric Constant, 1 MHz.....	-
• Density, gr/cm ³	6.0	• Compressive Strength, MPa.....	2500
• Color.....	White	• Flexural Strength, MPa.....	1200
• Thermal Conductivity at 20°C, W/mK.....	2.2	• Elastic Modulus, GPa.....	30
• Coefficient of Thermal Expansion, 10 ⁻⁶ /°C...	10.5	• Hardness, kg/mm ²	1250

NOTE: The values listed on properties table above are intended to illustrate typical material properties. Property values vary with size, and shape of part. The material properties values contained herein should not be construed as absolute or engineering data and does not constitute a representation or warranty for which Thermansys assumes legal responsibility.

An interesting property of Fully Yttria Stabilized Zirconia (8YSZ) ceramics is that the addition of Yttria to pure zirconia replaces some of the Zr⁴⁺ ions in the zirconia lattice with Y³⁺ ions. This produces oxygen vacancies and permits YSZ to conduct O²⁻ ions (and thus conduct an electric current), provided there is sufficient vacancy site mobility, a property that increases with temperature. The ionic conductivity of the stabilized Zirconias increases with increasing Yttria concentration then saturates, and then starts to decrease. The maximum ionic conductivity is obtained with Yttria concentration of about 8% at 1000 C.

Heating and Cooling Suggestions.

Fully Stabilized Zirconia crucibles are highly sensitive to thermal shock.

Heat up: Warm up the furnace chamber gradually. A maximum heating rate of 5°C per minute is recommended but special precaution should be given for two temperature ranges where the heat up rate should be retained to 3°C per minute. The first “sensitive” temperature range is between 100-300 °C (especially in the presence of water molecules) and the second is between 1100-1250 °C. During these two temperature ranges it is strongly recommended to use a maximum heat up rate of 3°C per minute.

Cool down: Lower the temperature as gradually as possible. Recommended cooling down rate is more severe than corresponding heating rate and should be retained below 5 °C per minute. It is better to remove the crucibles from the hot zone only if the temperature drops below 100 °C. When taking the crucibles out of furnace and bring them into room temperature to pour the melted material try to make the process as gradual as possible. A better practice is after pouring the melted metal to restore the crucible back into the furnace and leave it cool down inside the furnace.

Atmosphere - Chemical Compatibility - Corrosion.

Fully Stabilized Zirconia can be used at high temperature under oxidizing (air), reduced, or inert (Nitrogen, Argon) conditions with no restriction. It is stable chemically in contact with acidic or metal fusions and has been used for containers for melting fused silica. It is not easily reduced except that it may form a carbide when in contact with carbon at 1800 to 1900°C in an inert atmosphere and at 1500°C in a vacuum. It is highly corrosion resistant against molten metals such Fe, Ni, Bi, Pt, Mo, Hf, V, Pu but attacked by Na, K, Be, Li, Si, Ti and Zr.

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Fully Stabilized Zirconia crucibles have very good chemical resistance against diluted or concentrated Acids with the exception of HF. Fully Stabilized Zirconia is insoluble in water and has negligible solubility in HCl and HNO₃. It is however soluble in concentrated boiling H₂SO₄ and alkali hydroxides. The low chemical solubility of YSZ ceramics components makes them highly resistant to chemical corrosion. The almost zero porosity and excellent smoothness of Thermansys crucibles surface prevents chemical attack.

Chemical erosion of ceramic materials is not easy to be measured and determined in a way that will lead to accurate and represented scientific data for all shapes and sizes.

Application Limitations.

Zirconia can be vulnerable to chemisorption in the presence of water molecules, thus YSZ properties degrade rapidly when exposed to water vapor at 200 - 300° C.

Strength and toughness degrade with increasing temperature.

Zirconias generally are conductors of electricity above 1600°C and should not be used in contact with electrical alive heating elements at these temperatures.

YSZ ceramics react above 1500 C with fibrous Alumina insulation that usually high temperature furnaces have. Do not use YSZ crucibles in direct contact with such insulation above 1500 C. Use a plate of crystallized Alumina plate in between.

Health and Safety.

Our ceramic materials, as it is delivered, do not contain substances dangerous to health, or create them during use. They are produced using natural inert raw materials. Any organic binder or other substances used during manufacturing are burned through production firing. Thermansys however cannot guarantee that ceramic crucibles exposed to conditions that could produce residual material or create material transformations retain its health and safety properties upon reuse.

The product at its final delivery form is fully dense and do not produce dust during normal handling and operation. However, if the customer desire to proceed with further product processes like cutting or drilling inert dust might be created. Workers therefor should be provided with suitable dust protection equipment.

Standard Crucible Delivery Forms and Dimensions Tables.

Tables below are listing dimensions and capacity data for all standard shapes and sizes that are available from Thermansys. All data quoted are nominal values. Dimensional tolerances in the order of ±3% are apply to all our products.

Special shape or size of Fully Yttria Stabilized Zirconia ceramics are available upon request. Thermansys can provide a detailed quote even for low volume order. Please send as a detailed drawing of the desired product and we will provide you with a quote.

Conical Form

t-ceramics Fully Yttria Stabilized Zirconia Conical crucibles are available in three forms:

- Tall Form with *Top I.D. $\cong 0.6 \times$ Internal Height*
- Balanced Form with *Top I.D. \cong Internal Height*
- Short Form with *Top I.D. $\cong 2 \times$ Internal Height*

Custom sizes available upon request



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Conical Tall Form

Capacity (ml)	Top O.D. (mm)	Top I.D. (mm)	Wall Th. (mm)	Height Int. (mm)	Part No.	Price (Euro)
0.4	10	8	1	13	CYSZ-CO-T 0.4	15.3
1.0	12	10	1	16	CYSZ-CO-T 1.0	21.6
1.8	14	12	1	20	CYSZ-CO-T 1.8	27.1
4.2	19	16	1.5	26	CYSZ-CO-T 4.2	38.0
8.2	23	20	1.5	33	CYSZ-CO-T 8.2	49.9
16	28	25	1.5	42	CYSZ-CO-T 16	65.7
28	33	30	1.5	50	CYSZ-CO-T 28	82.9
48	40	36	2	60	CYSZ-CO-T 48	103.8
76	48	42	3	70	CYSZ-CO-T 76	126.0
130	56	50	3	84	CYSZ-CO-T 130	158.1
196	64	58	3	94	CYSZ-CO-T 196	188.2
268	70	64	3	106	CYSZ-CO-T 268	214.9
350	76	70	3	116	CYSZ-CO-T 350	240.8
488	84	78	3	130	CYSZ-CO-T 488	277.4

Conical Balanced Form

Capacity (ml)	Top O.D. (mm)	Top I.D. (mm)	Wall Th. (mm)	Height Int. (mm)	Part No.	Price (Euro)
0.3	10	8	1	8	CYSZ-CO-B 0.3	13.8
0.7	12	10	1	10	CYSZ-CO-B 0.7	18.9
1.2	14	12	1	12	CYSZ-CO-B 1.2	23.2
2.8	19	16	1.5	16	CYSZ-CO-B 2.8	32.3
5.5	23	20	1.5	20	CYSZ-CO-B 5.5	42.4
11	28	25	1.5	25	CYSZ-CO-B 11	55.4
18	33	30	1.5	30	CYSZ-CO-B 18	69.6
32	40	36	2	36	CYSZ-CO-B 32	87.4
50	48	42	3	42	CYSZ-CO-B 50	105.6
85	56	50	3	50	CYSZ-CO-B 85	132.1
133	64	58	3	58	CYSZ-CO-B 133	159.6
178	70	64	3	64	CYSZ-CO-B 178	180.6
234	76	70	3	70	CYSZ-CO-B 234	202.9
299	84	78	3	78	CYSZ-CO-B 299	225.2
375	89	82	3.5	82	CYSZ-CO-B 375	247.9
496	97	90	3.5	90	CYSZ-CO-B 496	279.3

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Conical Short Form

Capacity (ml)	Top O.D. (mm)	Top I.D. (mm)	Wall Th. (mm)	Height Int. (mm)	Part No.	Price (Euro)
0.8	19	16	1.5	8	CYSZ-CO-S 0.8	19.8
3.0	23	20	1.5	10	CYSZ-CO-S 3.0	33.2
5.0	27	24	1.5	12	CYSZ-CO-S 5.0	40.8
12	36	32	2	16	CYSZ-CO-S 12	58.3
24	46	40	3	20	CYSZ-CO-S 24	77.7
46	56	50	3	25	CYSZ-CO-S 46	102.0
79	66	60	3	30	CYSZ-CO-S 79	128.1
136	78	72	3	36	CYSZ-CO-S 136	161.2
216	90	84	3	42	CYSZ-CO-S 216	196.1
366	107	100	3.5	50	CYSZ-CO-S 366	245.4
571	124	116	4	58	CYSZ-CO-S 571	296.6

Cylindrical Form

t-ceramics Fully Yttria Stabilized Zirconia Cylindrical crucibles are available in three forms:

- Tall Form with $I.D. \cong 0.6 \times \text{Internal Height}$
- Balanced Form with $I.D. \cong \text{Internal Height}$
- Short Form with $I.D. \cong 2 \times \text{Internal Height}$

Custom sizes available upon request

**Cylindrical Tall Form**

Capacity (ml)	O.D. (mm)	I.D. (mm)	Wall Th. (mm)	Height Int. (mm)	Part No.	Price (Euro)
0.7	10	8	1	13	CYSZ-CY-T 0.7	18.6
1.3	12	10	1	17	CYSZ-CY-T 1.3	24.0
2.3	14	12	1	20	CYSZ-CY-T 2.3	29.7
5.4	19	16	1.5	27	CYSZ-CY-T 5.4	41.9
10.5	23	20	1.5	33	CYSZ-CY-T 10.5	55.1
20	28	25	1.5	42	CYSZ-CY-T 20	72.7
35	33	30	1.5	50	CYSZ-CY-T 35	91.3
61	40	36	2	60	CYSZ-CY-T 61	114.9
97	48	42	3	70	CYSZ-CY-T 97	139.6
164	56	50	3	83	CYSZ-CY-T 164	174.3
255	64	58	3	97	CYSZ-CY-T 255	210.5
343	70	64	3	107	CYSZ-CY-T 343	238.7
449	76	70	3	117	CYSZ-CY-T 449	267.7
621	84	78	3	130	CYSZ-CY-T 621	307.4

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Cylindrical Balanced Form

Capacity (ml)	O.D. (mm)	I.D. (mm)	Wall Th. (mm)	Height Int. (mm)	Part No.	Price (Euro)
0.4	10	8	1	8	CYSZ-CY-B 0.4	15.4
0.8	12	10	1	10	CYSZ-CY-B 0.8	19.7
1.4	14	12	1	12	CYSZ-CY-B 1.4	24.3
3.2	19	16	1.5	16	CYSZ-CY-B 3.2	34.1
6.3	23	20	1.5	20	CYSZ-CY-B 6.3	44.7
12	28	25	1.5	25	CYSZ-CY-B 12	58.8
21	33	30	1.5	30	CYSZ-CY-B 21	73.8
37	40	36	2	36	CYSZ-CY-B 37	92.7
58	48	42	3	42	CYSZ-CY-B 58	112.6
98	56	50	3	50	CYSZ-CY-B 98	140.4
153	64	58	3	58	CYSZ-CY-B 153	169.5
206	70	64	3	64	CYSZ-CY-B 206	192.1
269	76	70	3	70	CYSZ-CY-B 269	215.3
373	84	78	3	78	CYSZ-CY-B 373	247.2
433	89	82	3.5	82	CYSZ-CY-B 433	263.6
572	97	90	3.5	90	CYSZ-CY-B 572	296.9

Cylindrical Short Form

Capacity (ml)	O.D. (mm)	I.D. (mm)	Wall Th. (mm)	Height Int. (mm)	Part No.	Price (Euro)
1.6	19	16	1.5	8	CYSZ-CY-S 1.6	25.9
3.1	23	20	1.5	10	CYSZ-CY-S 3.1	33.8
5.4	27	24	1.5	12	CYSZ-CY-S 5.4	42.1
13	36	32	2	16	CYSZ-CY-S 13	60.0
25	46	40	3	20	CYSZ-CY-S 25	79.2
49	56	50	3	25	CYSZ-CY-S 49	104.8
85	66	60	3	30	CYSZ-CY-S 85	132.0
146	78	72	3	36	CYSZ-CY-S 146	166.3
233	90	84	3	42	CYSZ-CY-S 233	202.4
393	107	100	3.5	50	CYSZ-CY-S 393	252.8
613	124	116	4	58	CYSZ-CY-S 613	305.7

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Classic Form

t-ceramics Fully Yttria Stabilized Zirconia Classic Form crucibles are available in two forms:

- Balanced Form with $I.D. \cong 1.04 \times \text{Internal Height}$
- Short Form with $I.D. \cong 0.55 \times \text{Internal Height}$

Custom sizes available upon request



Classic Balanced Form

Capacity (ml)	Top O.D. (mm)	Top I.D. (mm)	Wall Th. (mm)	Height Int. (mm)	Part No.	Price (Euro)
5.5	23	20	1.5	21	CYSZ-HF-B 5.5	42.4
12	29	25	2	26	CYSZ-HF-B 12	58.3
17	34	30	2	31	CYSZ-HF-B 17	67.3
27	40	35	2.5	36	CYSZ-HF-B 27	81.6
45	45	40	2.5	42	CYSZ-HF-B 45	101.1
80	56	50	3	52	CYSZ-HF-B 80	128.8
132	66	60	3	63	CYSZ-HF-B 132	159.1
210	76	70	3	73	CYSZ-HF-B 210	193.8
310	86	80	3	83	CYSZ-HF-B 310	228.6
440	97	90	3.5	94	CYSZ-HF-B 440	265.4
600	107	100	3.5	104	CYSZ-HF-B 600	302.9

Classic Short Form

Capacity (ml)	Top O.D. (mm)	Top I.D. (mm)	Wall Th. (mm)	Height Int. (mm)	Part No.	Price (Euro)
22	45	40	2.5	22	CYSZ-HF-S 22	74.9
46	56	50	3	28	CYSZ-HF-S 46	102.0
78	66	60	3	33	CYSZ-HF-S 78	127.4
125	76	70	3	39	CYSZ-HF-S 125	155.5
184	86	80	3	44	CYSZ-HF-S 184	183.2
262	97	90	3.5	50	CYSZ-HF-S 262	212.9
356	107	100	3.5	55	CYSZ-HF-S 356	242.5
476	118	110	4	61	CYSZ-HF-S 476	274.5
625	128	120	4	66	CYSZ-HF-S 625	308.3

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Dishes (Round Shallow Form)

t-ceramics Fully Yttria Stabilized Zirconia Dishes are available in one form:

- Round shallow crucibles with $I.D. \cong (3 \text{ to } 5) \times \text{Internal Height}$

Custom sizes available upon request



Dishes

Capacity (ml)	O.D. (mm)	I.D. (mm)	Wall Th. (mm)	Height Int. (mm)	Part No.	Price (Euro)
1.9	23	20	1.5	6	CYSZ-DH- 1.9	27.6
5.7	33	30	1.5	8	CYSZ-DH- 5.7	42.8
13	44	40	2	10	CYSZ-DH- 13	59.4
24	56	50	3	12	CYSZ-DH- 24	77.1
40	66	60	3	14	CYSZ-DH- 40	95.8
62	76	70	3	16	CYSZ-DH- 62	115.3
90	86	80	3	18	CYSZ-DH- 90	135.6
127	96	90	3	20	CYSZ-DH- 127	156.6
173	107	100	3.5	22	CYSZ-DH- 173	178.3
228	117	110	3.5	24	CYSZ-DH- 228	200.6
294	128	120	4	26	CYSZ-DH- 294	223.5

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Rectangular Form

t-ceramics Fully Yttria Stabilized Zirconia rectangular crucibles are available in two forms:

- Square Form with *Length. \cong Width*
- Oblong Form with *Length. \cong 1.5 x Width*

Custom sizes available upon request



Rectangular Square Form

Capacity (ml)	Length Int. (mm)	Width Int. (mm)	Wall Th. (mm)	Height Int. (mm)	Part No.	Price (Euro)
4.0	20	20	2	10	CYSZ-RC-S 4.0	30.0
22	40	40	2	14	CYSZ-RC-S 22.4	79.9
65	60	60	2	18	CYSZ-RC-S 65	149.0
141	80	80	3	22	CYSZ-RC-S 141	235.9
260	100	100	3	26	CYSZ-RC-S 260	339.8
432	120	120	3	30	CYSZ-RC-S 432	460.0

Rectangular Oblong Form

Capacity (ml)	Length Int. (mm)	Width Int. (mm)	Wall Th. (mm)	Height Int. (mm)	Part No.	Price (Euro)
2.7	20	13	1.5	10	CYSZ-RC-O 2.7	24.0
13	40	24	1.5	14	CYSZ-RC-O 13.4	59.4
39	60	36	2	18	CYSZ-RC-O 39	110.3
84	80	48	3	22	CYSZ-RC-O 84	174.3
156	100	60	3	26	CYSZ-RC-O 156	250.7
259	120	72	3	30	CYSZ-RC-O 259	339.2
400	140	84	3	34	CYSZ-RC-O 400	439.2

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Boats

t-ceramics Fully Yttria Stabilized Zirconia boats are available in two forms:

- With tail and hole
- Without tail and hole

Custom sizes available upon request



Boats with Tail and Hole

Capacity (ml)	Length Int. (mm)	Width Int. (mm)	Height Int. (mm)	Wall Th. (mm)	Part No.	Price (Euro)
4.5	40	14	8	2	CYSZ-BT-T 4.5	35.7
6.7	60	14	8	2	CYSZ-BT-T 6.7	46.2
9.0	80	14	8	2	CYSZ-BT-T 9	55.7
11	100	14	8	2	CYSZ-BT-T 11	64.4
12	110	14	8	2	CYSZ-BT-T 12	68.6
10	60	14	12	2	CYSZ-BT-T 10	60.1
13	80	14	12	2	CYSZ-BT-T 13	72.6
17	100	14	12	2	CYSZ-BT-T 17	84.1
18	110	14	12	2	CYSZ-BT-T 18	89.6
20	120	14	12	2	CYSZ-BT-T 20	94.9
32	100	20	16	2	CYSZ-BT-T 32	129.1
38	120	20	16	2	CYSZ-BT-T 38	145.8
45	140	20	16	2	CYSZ-BT-T 45	161.6
62	120	26	20	3	CYSZ-BT-T 62	201.9
73	140	26	20	3	CYSZ-BT-T 73	223.9

Boats without Tail and Hole

Capacity (ml)	Length Int. (mm)	Width Int. (mm)	Height Int. (mm)	Wall Th. (mm)	Part No.	Price (Euro)
4.5	40	14	8	2	CYSZ-BT 4.5	31.9
6.7	60	14	8	2	CYSZ-BT 6.7	40.0
9.0	80	14	8	2	CYSZ-BT 9	47.1
11	100	14	8	2	CYSZ-BT 11	53.5
12	110	14	8	2	CYSZ-BT 12	56.5
10	60	14	12	2	CYSZ-BT 10	50.4
13	80	14	12	2	CYSZ-BT 13	59.4
17	100	14	12	2	CYSZ-BT 17	67.6
18	110	14	12	2	CYSZ-BT 18	71.5
20	120	14	12	2	CYSZ-BT 20	75.2
32	100	20	16	2	CYSZ-BT 32	98.4
38	120	20	16	2	CYSZ-BT 38	109.5
45	140	20	16	2	CYSZ-BT 45	119.9
62	120	26	20	3	CYSZ-BT 62	145.7
73	140	26	20	3	CYSZ-BT 73	159.6

Contact details:

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Lids

t-ceramics YSZ Lids are available for Conical, Cylindrical and Classic Form Crucibles.

Match the Crucible's Top I.D. value with Lid Fit Diameter.
For example: Lid with Part No. **CYSZ-LD-C70** having Fit diameter 70mm is suitable for use with crucibles with I.D. 70mm, e.g. **CYSZ-CY-T 449**

Custom sizes available upon request



Lids (For Conical, Cylindrical and Classic Form Crucibles)

Fit Diameter (mm)	Outside Diameter (mm)	Height Int. (mm)	Part No.	Price (Euro)
8	10	2.0	CYSZ-LD-C 8	31.9
10	12	2.0	CYSZ-LD-C 10	40.0
12	14	2.0	CYSZ-LD-C 12	47.1
16	19	2.0	CYSZ-LD-C 16	53.5
20	23	2.0	CYSZ-LD-C 20	56.5
25	28	2.0	CYSZ-LD-C 25	50.4
30	33	2.0	CYSZ-LD-C 30	59.4
32	36	3.0	CYSZ-LD-C 32	67.6
36	40	3.0	CYSZ-LD-C 36	71.5
40	46	3.0	CYSZ-LD-C 40	75.2
42	48	3.0	CYSZ-LD-C 42	98.4
50	56	3.0	CYSZ-LD-C 50	109.5
58	64	3.0	CYSZ-LD-C 58	119.9
60	66	3.0	CYSZ-LD-C 60	145.7
64	70	3.0	CYSZ-LD-C 64	159.6
70	76	3.0	CYSZ-LD-C 70	31.9
72	78	3.0	CYSZ-LD-C 72	40.0
78	84	3.0	CYSZ-LD-C 78	47.1
80	86	3.0	CYSZ-LD-C 80	53.5
82	88	3.0	CYSZ-LD-C 82	56.5
84	90	3.5	CYSZ-LD-C 84	50.4
90	97	3.5	CYSZ-LD-C 90	59.4
100	108	3.5	CYSZ-LD-C 100	67.6
110	120	3.5	CYSZ-LD-C 110	71.5
116	124	4.0	CYSZ-LD-C 116	75.2
120	128	4.0	CYSZ-LD-C 120	98.4

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Thermansys is a producer of High Temperature Electrical Furnaces, Vacuum Ovens, Precision
Vacuum Hot Plates and Refractory Technical Ceramics.

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