Designation: C 515 – 95 (Reapproved 2007)

Standard Specification for Chemical-Resistant Ceramic Tower Packings[1]

This standard is issued under the fixed designation C 515; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This specification covers fired ceramic shapes formed from naturally occurring clays and from compounded bodies that are used as packing in tower installations. These ceramic units are designed primarily for use in process equipment for the chemical or allied industries.

1.2 The physical and chemical properties that affect quality of packing materials are covered in this specification. Properties that affect actual operational efficiency or characteristics of processing towers are not covered.

1.3 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are for information only.

1.4 The following precautionary statement pertains to the test method portion only, Section 7, of this standard. *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:* [2]

C 279 Specification for Chemical-Resistant Masonry Units

C 373 Test Method for Water Absorption, Bulk Density, Apparent Porosity, and Apparent Specific Gravity of Fired Whiteware Products

E 4 Practices for Force Verification of Testing Machines

3. Terminology

3.1 *Definitions:*

3.1.1 *tower packing*—a term covering variously shaped ceramic pieces such as spheres, cylindrical rings with either normal or angular ends, rings with included obstructions, perforated cylinders, and curved saddles. These shapes are used within columns or towers to provide inert surfaces for promotion of energy transfer or chemical reaction between liquids and liquids, gases and liquids, and gases and gases.

3.1.1.1 *Discussion—Clay*: An earthy or stony mineral aggregate consisting, essentially of hydrous silicates of alumina, plastic when sufficiently pulverized and wetted, rigid when dry, and vitreous when fired at a sufficiently high temperature.

3.1.2 *chemical stoneware tower packing*—pieces manufactured from specially compounded bodies consisting of clays and other minerals, of natural origin.

3.1.3 *chemical porcelain tower packing*—pieces manufactured from specially compounded bodies, consisting of refined clays and other naturally occurring minerals. These pieces are characteristically smooth-textured, vitreous, and white or light gray in color.

4. Shapes, Sizes, and Quantities

4.1 The number of dumped pieces of cylindrical-type packing per cubic foot shall conform to the requirements for each size of rings, packings, and saddles as specified in Table 1, Table 2, and Table 3.

5. Tolerances for Rings

5.1 *Dimensional Accuracy*—The average outside diameter and average length shall be within ±5 % of specified size for 80 % of a lot, and within ±10 % of specified size for 100 % of a lot.

5.2 Measurement of the ring shall be made with calipers, avoiding flashes, protrusions, and obviously defective areas. The average outside diameter shall be determined as one half the sum of the maximum and minimum outside diameters. The

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

TABLE 1 Requirements For Shapes, Sizes, and Quantities of Rings

Raschig Rings				
Size,[A] in. (mm)		Nominal Wall Thickness, in. (mm)		Approximate Number per Cubic Foot[B] (0.03 m^3)
¼	(6.4)	1/32 to 1/16	(0.8 to 1.6)	79 200
5/16	(7.9)	1/16	(1.6)	36 000
⅜	(9.5)	3/32 to 1/16[C]	(2.4 to 1.6)	22 500
½	(12.7)	3/32	(2.4)	9 960
⅝	(15.9)	3/32 to ⅛[C]	(2.4 to 3.2)	5 360
¾	(19.1)	3/32 to ⅛[C]	(2.4 to 3.2)	2 890
1	(25.4)	⅛	(3.2)	1 260
1¼	(31.8)	3/16	(4.8)	640
1½	(38.1)	¼	(6.4)	360
2	(50.8)	3/16 to ¼ [C]	(4.8 to 6.4)	155
3	(76.2)	⅜	(9.5)	64 to 74
4	(101.6)	½	(12.7)	27 to 31
6	(152.4)	⅝	(15.9)	8 to 9

Lessing Rings				
Size,[A] in. (mm)		Nominal Wall Thickness, in. (mm)		Approximate Number per Cubic Foot[B] (0.03 m^3)
1	(25.4)	⅛	(3.2)	1220
1¼	(31.8)	3/16	(4.8)	620
1½	(38.1)	¼	(6.4)	330
2	(50.8)	¼	(6.4) to (9.5)[C]	142
3		5/16	(7.9) to ⅜ (9.5)[C]	44
4		⅜	(9.5) to ½ (12.7)[C]	22

Cross Partition Rings				
Size,[A] in. (mm)		Nominal Wall Thickness, in. (mm)		Number per Cubic Foot (0.03 m^3)
				Square Set / Stagger Set
3	(76.2)	5/16	(7.9) to ⅜ (9.5)	64 / 74
4	(101.6)	⅜	(9.5) to ½ (12.7)	27 / 31
6	(152.4)	½	(12.7)	8 / 9

[A] This dimension describes both the specified length and the specified outside diameter, and is intended as a guide rather than as an acceptance criterion.
[B] Dumped, except for values assigned to 3 in. (76.2 mm) of larger rings, which are usually stacked in square or stagger set. These numbers are to be considered as guides rather than as acceptance criteria.
[C] Representative of different manufacturers' practices.

TABLE 2 Requirements for Sizes and Quantities of Saddles

Saddles	
Saddle Designation	Approximate Number per Cubic Foot[A] (0.03 m^3)[B]
¼	115 000
⅜	50 000
½	17 000
¾	6 200
1	2 100
1½	650
2	240
3	50

[A] As randomly dumped.
[B] 1 in. = 25.4 mm.

average length shall be determined as one half the sum of the maximum and minimum lengths.

5.3 *Ovalness*—The difference between maximum and minimum outside diameters of any ring in a lot shall not exceed 10 % of the specified size.

TABLE 3 Requirements for Shapes, Sizes, and Quantities of Saddles[A]

Berl Saddles		Intalox Saddles	
Size, in. (mm)[B]	Minimum Number per Cubic Foot[C] (0.03 m^3)	Size, in. (mm)[B]	Minimum Number per Cubic Foot[C] (0.03 m^3)
1-4	96 050	¼	99 450
½	15 840	½	18 630
¾	4 700	¾	6 110
1	2 070	1	2 240
1½	630	1½	675
2	238	2	257

[A] Saddle shapes shall conform to samples previously approved by the consumer.
[B] 1 in. = 25.4 mm.
[C] See Footnote *B* to Table 1.

5.4 *Inspection*—The sample plan and procedure shall be as agreed upon by the supplier and purchaser at time of purchase.

NOTE 1—See Table 2 for piece size counts of saddles which define size tolerances.

6. Chemical Composition

6.1 The appearance of iron or other leachable impurities on the surfaces may be cause for rejection if this is a matter of concern to the purchaser.

6.2 The presence of undesirable trace elements such as boron is to be considered as a special case and will be treated as such by the purchaser and the manufacturer.

7. Test Methods

7.1 *Crushing Tests*—Make crushing tests on any standard machine conforming to the requirements of Practice E 4. Break ten or more specimens between ⅛-in. (3.2-mm) thick squares of a metal that is oil-hardened to HR C60, with cushions of 0.022-in. (0.56-mm) blotting paper between the hardened plate and the specimen as shown in Fig. 1. The loading rate shall be between 0.2 to 1.0 in. (5 to 25 mm)/min, or between 100 to 500 lbf/min (445 to 2224 N/min). The report shall include the average load causing failure, calculated in pounds-force per linear inch (or newtons per metre) and the loading rate used.

8. Physical Requirements

8.1 *Crushing Strength*—Ceramic tower packing in the form of rings must withstand a load of at least 25 lbf/linear in. (4.4 kN) when the load is applied (distributed) along a full element of the cylinder which lies in a longitudinal plane containing the cylinder axis. In the case of cross-partition rings, the load must be distributed along an element in a longitudinal plane containing the cylinder axis and midway between the partitions.

8.2 *Water Absorption*:

8.2.1 Porcelain packing shall absorb no more than 0.5 weight percent water as determined in accordance with Test Method C 373.

8.2.2 Stoneware packing shall absorb no more than 3 weight percent water as determined in accordance with Test Method C 373.

8.3 *Acid-Resisting Properties*.

NOTE 2—Ceramic tower packings are used in acidic or chemically

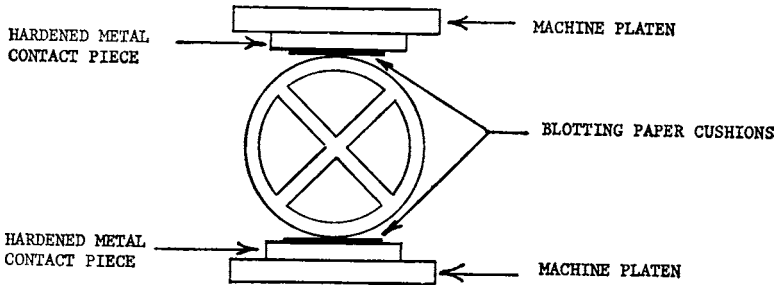

FIG. 1 Arrangement of Apparatus for Crushing Test

neutral solutions and as heat transfer media.

8.3.1 Porcelain packing shall lose no more than 4 % of its original weight when determined in accordance with Section 77 of Specification C 279.

8.3.2 Stoneware packing shall lose no more than 10 % of its original weight as determined in accordance with Specification C 279.

NOTE 3—In preparing samples no attempt shall be made to remove the skin surface of the units and a significant random sample should be taken for use in Specification C 279.

9. Precision and Bias

9.1 The determination of water absorption by Test Method C 373 is accurate to ±0.2 % water absorption in interlaboratory testing when the average value recorded by all laboratories is assumed to be the true water absorption. The precision is approximately ±0.1 % water absorption on measurements made by a single experienced operator.

9.2 The original data on acid weight loss on eight (8) different types of cross partition rings run by four different labs in accordance with Specification C 279 gave the following standard deviations:

Type of Ring	Standard Deviation
1-in. porcelain	0.36
3-in. porcelain	0.42
1-in. Stoneware	0.48
3-in. Stoneware	0.92
3-in. Clay	3.22

10. Keywords

10.1 acid resistance; ceramic; chemical-resistant; crushing strength; low absorption; porcelain; rings; saddles; stoneware; tower packing