



International Standards for Properties and Performance of Advanced Ceramics – Entering 4 Decades of Quality & Rigor

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Introduction

Mechanical and physical properties/performance of brittle bodies (e.g., advanced ceramics and glasses) can be difficult to measure correctly unless the proper techniques are used. For over three decades, ASTM Committee C28 on Advanced Ceramics, has developed numerous full-consensus standards (e.g., test methods, practices, guides, terminology) to measure various properties and performance of monolithic and composite ceramics and coatings that, in some cases, may be applicable to glasses. These standards give the “low-down” for determining many mechanical, physical, and thermal properties and performance thereby providing accurate, reliable, repeatable and complete data. Involvement in ASTM Committee C28 includes users, producers, researchers, designers, academicians, etc. who write, continually update, and validate through round robin test programmes, nearly 50 standards as the Committee enters the fourth decade since its inception in 1986. Included in this poster is a pictogram of the ASTM Committee C28 standards and how to obtain them either as i) individual copies (physical or digital) with full details or ii) a complete collection in one volume. A listing of other ASTM committees of interest is included. In addition, some examples of the tangible benefits of standards for advanced ceramics demonstrate their practical application.

For further information

Committee C28 and Standards for Ceramics
ASTM C28 Committee Page – <http://www.astm.org/COMMITTEE/C28.htm>

List of C28 Subcommittees and Links to Standards – <http://www.astm.org/COMMITTEE/SUBCOMMITTEE/C28.htm>

ASTM C28 Advanced Ceramic Standards by Subject – http://www.astm.org/COMMITTEE/C28_StandBySubject.doc

Chart showing ASTM C28 Advanced Ceramic Standards – http://www.astm.org/COMMITTEE/C28StandardsGraphic_2015a_StandardsChart.pdf

ASTM Standards for Advanced Ceramics, Whitewares, Glass, and Ceramic Tile – <http://www.astm.org/Standards/glass-and-ceramic-standards.html>

Acknowledgments

We thank the more than 90 industry, government, and academic committee members from many countries (~25% non-USA) who have volunteered many hours to develop these standards via work in six technical and four administrative subcommittees.

Committee C28 Advanced Ceramic Standards

Visit the C28 website (<http://www.astm.org/COMMITTEE/C28.htm>) to purchase C28 standards or join Committee C28.

<h3>Monolithics</h3> <ul style="list-style-type: none"> C 1161 Flexural Strength (RT) C 1211 Flexural Strength (HT) C 1368 Slow Crack Growth (RT, Dyn Fatigue) C 1465 Slow Crack Growth (HT, Dyn Fatigue) C 1576 Slow Crack Growth (RT, Stress Rupture) C 1684 Flexural Strength (Rods) C 1834 Slow Crack Growth (HT, Stress Rupture) C 1421 RT Fracture Toughness C 1322 Fractography C 1678 Fracture Mirror C 1326 Knoop Hardness C 1327 Vickers Hardness C 1424 Compression Strength (RT) C 1273 Tensile Strength (RT) C 1291 Creep, Creep Rupture C 1366 Tensile Strength (HT) C 1361 Cyclic Fatigue C 1499 Biaxial Strength (RT) C 1198 Elastic Modulus - continuous C 1259 Elastic Modulus - impulse C 1470 Thermal Guide C 1323 C-ring Strength C 1495 Grinding C 1525 Thermal Shock 	<h3>Composites, Coatings, Porous Ceramics</h3> <ul style="list-style-type: none"> C 1275 CMC Tensile Strength (RT) C 1337 Creep, Creep Rupture C 1359 CMC Tensile Strength (HT) C 1360 Cyclic Fatigue C 1773 CMC Tube Axial Tensile (RT) C 1358 CMC Compression Strength C 1819 Hoop Tensile Strength of CMC tubes (elastomer insert) C 1468 CMC Tensile Strength Trans Thickness C 1557 Filament Strength & Stiffness C 1469 Joint Strength C 1341 CMC Flexure Strength C 1674 Honeycomb Flex Strength C 1835 Classification for SiC/SiC C 1836 Classification for C/C C 1292 CMC Shear Strength (RT) C 1425 Shear Strength (HT) C 1624 Coatings – Scratch Adhesion
<h3>Powders</h3> <ul style="list-style-type: none"> C 1070 Particle Size, Laser Light C 1274 Particle Size, BET C 1282 Particle Size, Centrifugal Sed. C 1494 C, N, O in silicon nitride 	<h3>NDE and Design</h3> <ul style="list-style-type: none"> C 1239 Weibull C 1683 Weibull Scaling C 1175 NDE Guide C 1331 Ultrasonic Velocity C 1332 Ultrasonic Attenuation C 1212 Seeded Voids C 1338 Seeded Inclusions
<h3>Terms, Workshops, Education</h3> <ul style="list-style-type: none"> Subcommittees: C28.01 Mech. Prop. + Reliability; C28.03 Physical Prop. + NDE; C28.04 Applications; C28.07 Ceramic Matrix Composites; C28.91 Terminology STP 1201 Life Prediction; STP 1309 Composites; STP 1392 Composites; STP 1409 Fracture C 1145 Terminology 	

ASTM C28 standards are found in Vol. 15.01 of the Annual Book of ASTM Standards 08-2016

Collaborating ASTM Committees: C08 Refractories; C21 Ceramic Whitewares and Related Products; C26 Nuclear Fuel Cycle; D30 Composite Materials; E07 Nondestructive Testing; E08 Fatigue and Fracture; E10 Nuclear Technology and Applications; E28 Mechanical Testing; F04 Medical and Surgical Materials and Devices; F34 Rolling Element Bearings; G02 Wear and Erosion
Collaborating International Organizations: ISO TC206 Fine/Technical/Adv Ceramics; CEN TC184 Technical Ceramics

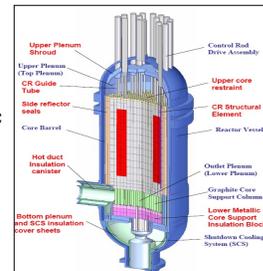
Design Codes

ASME Boiler and Pressure Vessel Section III Nuclear Components, Division 5 references C28 standards. In addition, Composite Materials Handbook, CMH-17, Volume 5 Ceramic Matrix Composite Materials, Part C Testing, references and summarizes C28 standards.

ASME BPV Section III, Div 5, WG on Graphite and CMCs

References:
Classifications C1835 and C1836
Test Methods C1773 and C1819

CMH-17, Vol 5, Part C
References and summarizes:
Test Methods C1275 and C1359
Test Methods C1360
Test Methods C1292 and C1425
Test Method C1358
Test Method C1468

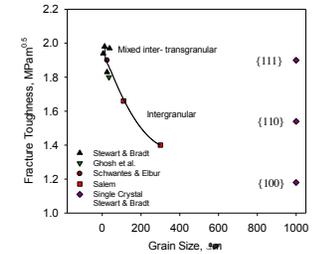


Standardization: Tangible Benefits

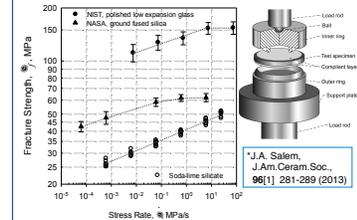
Comparisons Among Authors and Helping to Interpret Data

The Problem: Transparent Armor Ceramics as Spacecraft Windows*

1) Standardized fracture toughness tests using Test Method C1421 ensure correct comparisons of different authors' results



2) Standard-sized circular disks could be used to determine Poisson's ratio and Young's modulus via Test Method C1259 and biaxial strength via Test Method C1499 as well as the slow crack growth parameters, n and A, via Test Method C1368.



Standardization: Tangible Benefits

ASTM F2094 / F2094M – 14 Standard Specification for Silicon Nitride Bearing Balls

ASTM Committee F34 Rolling Element Bearings used C28 standards in this specification

- Minimum average flexural strength in accordance with Test Method C1161
- Minimum fracture toughness in accordance with Test Method C1421

