Cost-effective abuse solutions that put the right product in the right place

CGC A USG COMPANY

Abuse-Resistant Assemblies SA-929

Durability is one of the most basic design considerations in any building. Interior partitions are always vulnerable to both incidental and intentional surface and impact damage, especially in institutional applications such as schools and hospitals.

Understanding at the onset the type of abuse likely for different applications is an important factor in controlling lifecycle costs. For example, embassies and bank vaults require walls that cannot be breached, while the walls of a middle school might deal with nothing more serious than incidental abrasion and indentation from cleaning equipment, furniture and the occasional malicious behavior.

Walls That Work

User's Guide

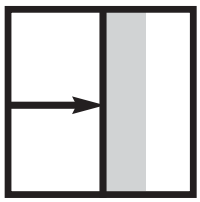
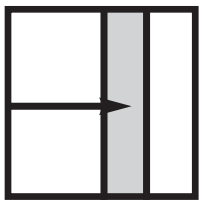
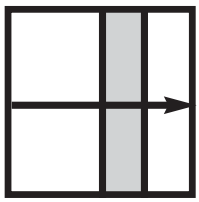
The information in this brochure can help you:

– Determine the level of abuse your application is likely to experience
– Maintain the relevance of your design throughout its lifecycle
– Create a cost-effective building by using the right product in the right place
– Pursue sustainable building product selection

Overview

At the most fundamental level, abuse resistance can be defined as the ability of a partition system to resist three primary types of damage.

Industry Standards

Surface Damage		Abrasion and indentation, which include surface damage caused by ordinary contact with people and furniture, as well as contact with objects such as mail carts, hospital gurneys and cleaning equipment
Penetration		Hard-body (tools or hard objects) and soft-body (human) impact, which include impacts that can penetrate through the partition into the wall cavity, causing damage that is both costly to repair and potentially dangerous
Security		Forced entry and ballistic assaults, which include gun fire and deliberate attempts to break through a partition

Applications

CGC has defined five categories of abuse resistance to help building owners and design professionals determine the type and amount of durability needed for specific building applications. Each category is described below. All categories shown represent an improvement over standard interior drywall partition construction.

Levels of Abuse

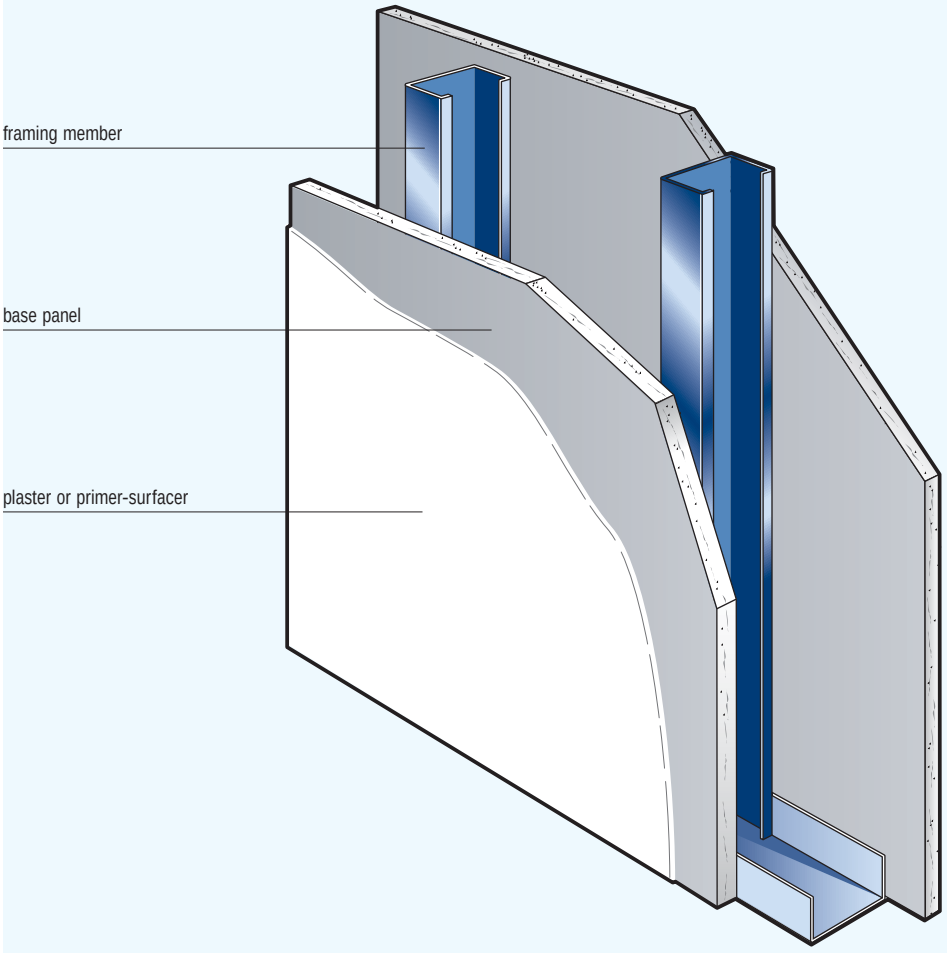
Use abuse-resistant systems for applications where damage from abuse is likely to occur. Different types of applications require different levels of abuse-resistant systems. For example, a family kitchen will not require as much abuse resistance as a school corridor or a detention center. Identifying the probable level of abuse during the design phase, rather than after the building is in use, is a key factor in keeping building lifecycle maintenance costs as low as possible.

1: Light Duty	 For areas requiring a basic upgrade to standard drywall, with improved resistance to incidental surface and indentation damage	**Single-family residential stairways** **family rooms, children's rooms** **primary grade classrooms** **public spaces in healthcare facilities**
2: Moderate Duty	 For areas requiring a moderate resistance to incidental surface, indentation and penetration damage from people and objects (usually unintentional abuse)	**Multifamily stairways, entries and common areas** **middle/high school classrooms** **college lecture halls** **mailrooms** **retail corridors/public areas**
3: Heavy Duty	 For areas requiring resistance to heavy surface, indentation and penetration damage from people and objects (often intentional abuse)	**High-risk multifamily entries** **stairways/common areas** **school corridors, gyms, college dorms** **healthcare or commercial corridors** **payroll, loading areas**
4: Extreme Duty	 For areas requiring resistance to extreme levels of surface, indentation and penetration damage from hard objects	**Court detention facilities** **psychiatric wards** **payroll rooms/shipping/receiving areas** **government/military facilities** **embassies/consulates** **bank vaults, data storage facilities** **pharmaceutical dispensing areas**
5: Security	 For areas requiring resistance to forced entry and ballistics	**Government/military facilities** **embassies/consulates** **high-detention facilities**

System

An abuse-resistant assembly consists of a substrate that provides more abuse resistance than conventional gypsum panels and either a primer-surfacer or a plaster finish. A primer-surfacer, which is used in lieu of a skim coat and paint primer, provides increased abrasion resistance. A plaster finish provides a monolithic surface and increased abrasion and impact resistance, achieving the highest-quality interior panel finish.

Abuse-Resistant Components



Components

Abuse-resistant systems have been comprehensively tested for fire resistance and impact resistance ratings only when all of the system components are used together. Substitutions of any of the components are not recommended and are not supported by CGC. Refer to the appropriate product material safety data sheet for complete health and safety information.

Base Panels

FIBEROCK® AQUA-TOUGH™ Interior Panels

– Engineered for increased resistance to abrasion and indentation
– Outperform paper-faced and glass mat faced gypsum panels
– Designed for wall assemblies in high-traffic areas where moisture, mold and fire resistance are especially important
– Refer to data sheet EWB-W118 for more information

FIBEROCK® VHI Abuse-Resistant Panels

– Higher level of abuse resistance (Very High Impact) is ideal for institutional applications
– Embedded fiberglass mesh in the back of the panel
– Installed over conventional framing, so it offers reduced labor and increased flexibility when compared with masonry construction
– Refer to data sheet EWB-0W25 for more information

DUROCK® Cement Board

– Water-durable, mold-resistant substrate for use in high-moisture areas
– Use in abuse-resistance systems in combination with IMPERIAL® Basecoat Plaster or IMPERIAL® Finish Plaster or ceramic tile
– Refer to data sheet EDR-6295 for more information

STRUCTOCORE™ Security Wall Metal Lath Sheets

– Not available in all geographic areas. Contact your CGC Sales Representative for details.
– Patented steel security sheet reinforcement for use in extreme duty applications
– Resists forced entry for up to 15 minutes and gunfire when used with STRUCTO-BASE® Gypsum Plaster
– Finish with IMPERIAL Finish Plaster for maximum durability
– Available in 2.5 mm (12 gauge) and 1.1 mm (18 gauge)
– Ideal for use in place of reinforced concrete and concrete block to reduce weight
– Refer to CGC Data Sheet SA1119, *Security Wall Systems*, for more information

Components

Plasters

DIAMOND® Interior Finish Plaster

– Provides quality walls and ceilings for residential or commercial construction where the superior strength of IMPERIAL Finish Plaster is not required
– Ideal for applications requiring fast completion as well as durability
– Use as a one-coat system or as the finish coat in two-coat systems
– Refer to data sheet EPL-1061 for more information

IMPERIAL Basecoat Plaster

– High-strength veneer basecoat plaster for use in two-coat applications
– Refer to data sheet EPL-1080 for more information

IMPERIAL Finish Plaster

– Particularly suited to hard-wear locations requiring the ultimate in strength, abrasion resistance and durability
– High-strength finish plaster
– Use as a one-coat system or as the finish coat in two-coat systems
– Refer to data sheet EPL-1078 for more information

STRUCTO-BASE Gypsum Plaster

– Available on special import basis only. Contact your CGC Sales Representative for further information.
– Develops higher strengths than conventional plasters
– Use with STRUCTOCORE Security Wall Lath Sheets wherever the ultimate compressive-strength plaster is needed
– Requires the addition of aggregate
– Refer to USG data sheet P753 for more information

Primer-Surfacer

TUFF-HIDE™ Primer-Surfacer

– Use in lieu of a skim coat of joint compound and paint primer to provide the highest quality interior panel finish
– Greatly increases abrasion resistance
– Refer to data sheet EJC-0J56 for more information

Related Products

DURABOND® Joint Compound

– General purpose setting compound that permits quick finishing and decorating
– Use for finishing walls and ceiling joints; ideal for heavy fills and for patching
– Essential for bed coat on FIBEROCK products
– Refer to data sheet EJC-1507 for more information

Paper-Faced Metal Bead and Trim

– Made with a strong paper tape laminated to a sturdy, rust-resistant metal form, warranted to resist edge-cracking and chipping
– Variety of styles permits design flexibility
– Refer to data sheet ETR-00T9 for more information

Performance Testing

Selection of the right abuse-resistant assembly is an important factor in keeping building lifecycle costs down.

Depending on the application, CGC offers various abuse-resistant assemblies that address the most common abuse issues. If abrasion is a primary concern, for example, the addition of TUFF-HIDE Primer-Surfacer to FIBEROCK AQUA-TOUGH Interior Panels can raise abrasion cycles from 30 to 1000.

Extensive third-party testing allows you to precisely identify the abuse-resistant assembly that is most appropriate for your application.

Performance Tests

CGC has been testing products for abuse resistance since the 1940s. This extensive testing ensures the value and performance of the abuse-resistant system you select.

Testing Methods

Abuse-resistant assemblies are tested to ensure long-term performance in real-world applications.

Independent testing of abuse-resistant assemblies is performed by H.P. White Laboratory, Inc., a ballistic research and development facility that specializes in forced entry testing. H.P. White Laboratory developed the first set of comprehensive test procedures and standards for the evaluation of the physical security of structures and structural subassemblies. Although originally designed for government and military organizations, these procedures have evolved to include commercial applications such as banks, currency exchanges and prisons.

Products and systems are tested in accordance with ASTM standards. ASTM International is one of the largest voluntary standards development organizations in the world, and is a trusted source for technical standards for materials, products, systems, and services.

Performance Testing

Surface Damage

Abrasion Resistance

CGC has developed a modified test method to measure the relative abrasion resistance of wall surfaces. In this test, the sample material is placed under a moving weighted wire brush. The values reported for the test reflect the number of cycles to which the partition can be exposed prior to failure (test apparatus specified in ASTM D4977).

Indentation Resistance

CGC uses the Gardner impact apparatus to measure the relative indentation resistance of partition materials. A 0.9 kg (2-pound) weight is raised to a 900 mm (36-inch) height and dropped onto a 16 mm (5/8″) hemispherical die which strikes the sample. The values reported reflect the depth of the indentation (test apparatus specified in ASTM D5420).

Penetration

Hard-Body Impact Resistance

CGC has developed the first vertical-panel impact test method for determining the relative penetration resistance of partition designs. This method employs a weighted swinging ram fitted with a 50 mm (2-inch) pipe cap (resembling a sledgehammer). Increasing the weight of the ram increases the amount of impact energy, measured in Joules/foot-pounds, that impinges the partition assembly. The value reported is the energy required to cause penetration into the partition cavity with a single blow (defined as failure of the system).

Soft-Body Impact Resistance

CGC evaluates soft-body impact resistance using a 27 kg (60-pound) leather bag which is pulled away from the sample (in 150 mm (6-inch) increments) and released. The values reported represent the Joules/foot-pounds of energy required to produce failure of the partition. CGC has tested for three different types of failure resulting from soft-body impact: surface creasing, partition deformation, and structural failure (ASTM E695).

Security

Forced-Entry Resistance

Forced entry resistance is evaluated by the U.S. Department of State, and is measured in terms of the number of minutes taken by a team of armed men to penetrate the partition system being tested.

Ballistic Resistance

The U.S. Department of State evaluates resistance to ballistic attack in terms of weapon caliber, and presents its results in the form of levels of resistance.

Summary of Testing Methods

Performance Tests	Type of Abuse	Test Method	Measurement
Surface Damage	Abrasion	Modified ASTM D4977	Cycles to failure
	Indentation	Modified ASTM D5420	Depth
Penetration	Hard-body impact	CGC impact test	Joules (ft.-lbs.) to failure
	Soft-body impact	ASTM E695	Joules (ft.-lbs.) to failure
Security	Forced entry	Std. SD-STD-01.01	Time to penetration
	Ballistics	Std. SD-STD-01.01	Caliber of weapon

Testing Results

To qualify for one of the CGC-defined categories of abuse resistance, certain minimum performance levels must be met.

Minimum Performance Levels

	Abrasion	Indentation	Hard-Body Impact	Soft-Body Impact
Category 1	15 cycles	3.8 mm (0.15 in.)	40 J (30 ft.-lbs.)	161 J (120 ft.-lbs.)
Category 2	30 cycles	3.3 mm (0.13 in.)	54 J (40 ft.-lbs.)	244 J (180 ft.-lbs.)
Category 3	100 cycles	2.5 mm (0.10 in.)	108 J (80 ft.-lbs.)	284 J (210 ft.-lbs.)
Category 4	500 cycles	2 mm (0.08 in.)	149 J (110 ft.-lbs.)	406 J (300 ft.-lbs.)
Category 5	1000 cycles	N/A	N/A	N/A

Performance Testing

Sustainability

The LEED® (Leadership in Energy and Environmental Design) program is a guideline for building solutions established by the U.S. Green Building Council (USGBC) and endorsed by the Canada Green Building Council (CaGBC). LEED's mission is to transform the building industry by establishing a common standard of measurement to define what constitutes a "green building." To this end, LEED provides a framework for assessing building performance and meeting sustainability goals. This framework assigns points for certain sustainability criteria, such as sustainable site development, water savings, energy efficiency, materials selection and indoor environmental quality.

Specific products cannot be LEED-certified, because there are many contingent factors on each project that must be considered. However, certain products may assist you in obtaining LEED points for your design solution. For example:

CaGBC LEED Credits	MR 2	
Construction Waste Management	2.1	Divert 50% of project waste (by weight or volume) from landfill (1 point)
	2.2	Divert another 25% of project waste (by weight or volume) from landfill (1 point)
Recycled Content	**MR 4**	
	4.1	If sum of project materials by value have 7.5% post-consumer or 15% post-industrial (1 point)
	4.2	If sum of project materials by value have 15% post-consumer or 30% post-industrial (1 point)
Local/Regional Materials	**MR 5**	
	5.1	If 10% of project materials are shipped less than 800 km (500 miles) by truck, or less than 2400 km (1500 miles) by rail (1 point)
	5.2	If 20% of project materials are shipped less than 800 km (500 miles) by truck, or less than 2400 km (1500 miles) by rail (1 point)
Low-Emitting Materials	**EQ .4**	
	4.2	Drywall installation (less than 50g/L per CSCAQM, Table 1) (1 point)

The following chart lists the products in CGC abuse-resistant systems that may be eligible for LEED points. But using products with a high recycled content is only one part of the equation. Another key measure of sustainability is embodied energy, or the total energy required to produce a particular material or building component and get it to a building site. For example, if you use wallboard with a high recycled content but need to ship it across the country, the embodied energy costs of transportation may outweigh the environmental advantage of using a recycled product. It may be more environmentally sound to ship natural gypsum wallboard products from a plant close to a job site.

CaGBC LEED Credits	MR 4.1 and 4.2				EQ 4		MR 5.2
Product Family	**Post-Consumer**	**Post Industrial**	**Embodied Energy[a,b]**	**Density lb/cu. ft.**	**VOCs[c]**	**Mfg. Efficiency**	**Raw Materials (% by weight)**
FIBEROCK Panels[d]	10%	85%	5 MJ/kg	55	none	95%	85% FGD gypsum (barged 400 km (250 miles)), 10% cellulose (local), and 1% starch (local)
DUROCK Cement Board	0	20%	10 MJ/kg	72			Portland cement and fly ash
Veneer Plasters	0	0	3 MJ/kg	105	none	98%	Plaster of paris and lime (DIAMOND), plaster of paris and sand (IMPERIAL)
Joint Compound—Setting Type	0	0	3 MJ/kg	100	none	98%	Plaster of paris, limestone and mica
SHEETROCK Paper-Faced Bead	0	25%	40.8 MJ/kg		none		Steel, paper, and non-solvent organic adhesive
SHEETROCK Metal Bead	0	25%	34.8 MJ/kg		none		Steel

For more information on USGBC, CaGBC and LEED, visit the following web sites:
U.S. Green Building Council: www.usgbc.org
Canada Green Building Council: www.cagbc.org
Leadership in Energy & Environmental Design: www.usgbc.org/leed/leed_main.asp

Notes
(a) Megajoules per kilogram. (b) Transportation of gypsum board accounts for over 10% of the board's embodied energy, while mining accounts for less than 1%.
(c) Section 01350 of the Material Specifications adopted by the Collaborative for High Performance Schools (CHPS) for VOC emissions. All FIBEROCK panels use FGD gypsum, but the FGD gypsum content of SHEETROCK panels changes from plant to plant and even day to day at any one plant, due to availability. The recycled contents above are approximate. While FGD gypsum is not available everywhere in Canada, CGC does have plants strategically located to meet your needs. Evaluation should be made for each job on the benefits of using FGD instead of natural gypsum.

Assembly Selector

The assemblies shown in the following tables are listed according to the five categories of abuse resistance explained in the Applications section. They incorporate different combinations of CGC's abuse-resistant products (including gypsum fibre panels and plaster systems) to meet various levels of required abuse resistance.

Category 1: Light Duty

Basic upgrade to standard drywall; provides some resistance to surface abuse and impact

Assembly		Surface Damage		Penetration[a]		System Thickness[f] mm (in.)	System Weight[f] kg/m² (psf)	Cost Index[g]
Substrate	Finish	Abrasion[b] cycles	Indentation[c] mm (in.)	Hard-Body[d] J (ft.-lbs.)	Soft-Body[e] J (ft.-lbs.)			
15.9 mm (5/8″) FIBEROCK AQUA-TOUGH Interior Panel	Joint treatment only	30	2.8 (0.11)	115 (85)	244 (180)	124 (4-7/8)	31 (6.4)	118

Notes

(a) Minimum 92 mm (3-5/8″), 0.8 mm (20-gauge) steel framing at 400 mm (16″) o.c. is recommended for abuse-resistant assemblies, and was used for the hard-body, soft-body and acoustical testing shown here. Framing space of 610 mm (24″) o.c. will likely reduce the impact resistance of an assembly, while framing of 300 mm (12″) or 200 mm (8″) o.c. will likely improve the impact resistance. (b) Values reflect the average number of cycles to failure. Testing performed using the abrasion test apparatus specified in ASTM D4977 with a 11 kg (25 lb.) added weight. Independent testing performed by H. P. White Laboratory, Inc. Three identical specimens were tested for each product. (c) Values reflect the average measured depth of indentation. Testing performance using the Gardner test apparatus specified in ASTM D5420, with 16 mm (5/8″) die at 8 J (72 in.-lb.) drop energy. Independent testing performed by H.P. White Laboratory, Inc. Three identical specimens were tested for each product. (d) Values reflect the minimum impact energy required for a 50 mm (2″) steel pipe cap to completely penetrate the panel when supported by 400 mm (16″) o.c. framing. Independent testing performed by H.P. White Laboratory, Inc. Three identical specimens were tested for each product. (e) No failure observed up to apparatus capacity of 406 J (300 ft.-lbs.) Values reflect the minimum impact energy required for the following: "Surface Failure"—First evidence of creasing or other damage at panel surface. "Structural Failure"—Complete penetration through panel. Testing performed in accordance with ASTM E695 using a 27 kg (60 lb.) leather bag. Panels supported by 400 mm (16″) o.c. framing. Independent testing performed by H.P. White Laboratory, Inc. Three identical specimens were used for each product. (f) Weights and thicknesses are based on completed systems (panels on both flanges of studs). (g) Based on R S Means®, *Means Square Foot Costs,* published by R.S. Means Co., Inc. (h) Two-coat IMPERIAL veneer consists of IMPERIAL Basecoat Plaster and IMPERIAL Finish Plaster. (i) Two-coat veneer consists of DIAMOND Veneer Basecoat Plaster and IMPERIAL Finish Plaster.

Assembly Selector

Category 2: Moderate Duty

Provides moderate resistance to incidental impact and abrasion from people and objects

Assembly		Surface Damage		Penetration[a]		System Thickness[f] mm (in.)	System Weight[f] kg/m² (psf)	Cost Index[g]
Substrate	**Finish**	**Abrasion[b] cycles**	**Indentation[c] mm (in.)**	**Hard-Body[d] J (ft.-lbs.)**	**Soft-Body[e] J (ft.-lbs.)**			
15.9 mm (5/8″) Fiberock Aqua-Tough Interior Panel	Tuff-Hide Primer-Surfacer	1000	2.8 (0.11)	115 (85)	244 (180)	124 (4-7/8)	34 (6.9)	149
15.9 mm (5/8″) Fiberock Aqua-Tough Interior Panel	2-coat Imperial veneer plaster[h]	1000	1.5 (0.06)	115 (85)	244 (180)	130 (5-1/8)	41 (8.4)	184
15.9 mm (5/8″) Fiberock VHI Abuse-Resistant Interior Panel	Joint treatment only	30	2.8 (0.11)	237 (175)	>650 (>480)	124 (4-7/8)	31 (6.4)	127
15.9 mm (5/8″) Durock Cement Board	2-coat veneer plaster[i] or tile	1000	2.8 (0.11)	87 (64.5)	244 (180)	130 (5-1/8)	49 (10)	202

Category 3: Heavy Duty

Provides resistance to intentional and heavy surface and impact abuse from people and objects

Assembly		Surface Damage		Penetration[a]		System Thickness[f] mm (in.)	System Weight[f] kg/m² (psf)	Cost Index[g]
Substrate	**Finish**	**Abrasion[b] cycles**	**Indentation[c] mm (in.)**	**Hard-Body[d] J (ft.-lbs.)**	**Soft-Body[e] J (ft.-lbs.)**			
15.9 mm (5/8″) Fiberock VHI Abuse-Resistant Interior Panel	Tuff-Hide Primer-Surfacer	1000	2.8 (0.11)	237 (175)	>650 (>480)	124 (4-7/8)	34 (6.9)	158
15.9 mm (5/8″) Fiberock VHI Abuse-Resistant Interior Panel	2-coat veneer plaster[g]	1000	1.5 (0.06)	237 (175)	>650 (>480)	130 (5-1/8)	41 (8.4)	190
3.4#/sq. yd. Lath	Structo-Base Gypsum Plaster and Imperial Finish Plaster	1000	2 (0.08)	122 (90)	N/A	137 (5-3/8)	67 (13.8)	226

Notes

(a) Minimum 92 mm (3-5/8″), 0.8 mm (20-gauge) steel framing at 400 mm (16″) o.c. is recommended for abuse-resistant assemblies, and was used for the hard-body, soft-body and acoustical testing shown here. Framing space of 610 mm (24″) o.c. will likely reduce the impact resistance of an assembly, while framing of 300 mm (12″) or 200 mm (8″) o.c. will likely improve the impact resistance. (b) Values reflect the average number of cycles to failure. Testing performed using the abrasion test apparatus specified in ASTM D4977 with a 11 kg (25 lb.) added weight. Independent testing performed by H. P. White Laboratory, Inc. Three identical specimens were tested for each product. (c) Values reflect the average measured depth of indentation. Testing performance using the Gardner test apparatus specified in ASTM D5420, with 16 mm (5/8″) die at 8 J (72 in.-lb.) drop energy. Independent testing performed by H.P. White Laboratory, Inc. Three identical specimens were tested for each product. (d) Values reflect the minimum impact energy required for a 50 mm (2″) steel pipe cap to completely penetrate the panel when supported by 400 mm (16″) o.c. framing. Independent testing performed by H.P. White Laboratory, Inc. Three identical specimens were tested for each product. (e) No failure observed up to apparatus capacity of 406 J (300 ft.-lbs.) Values reflect the minimum impact energy required for the following: "Surface Failure"—First evidence of creasing or other damage at panel surface. "Structural Failure"—Complete penetration through panel. Testing performed in accordance with ASTM E695 using a 27 kg (60 lb.) leather bag. Panels supported by 400 mm (16″) o.c. framing. Independent testing performed by H.P. White Laboratory, Inc. Three identical specimens were used for each product. (f) Weights and thicknesses are based on completed systems (panels on both flanges of studs). (g) Based on R S Means®, *Means Square Foot Costs,* published by R.S. Means Co., Inc. (h) Two-coat Imperial veneer consists of Imperial Basecoat Plaster and Imperial Finish Plaster. (i) Two-coat veneer consists of Diamond Veneer Basecoat Plaster and Imperial Finish Plaster.

Category 4: Extreme Duty

Provides resistance to extreme levels of damage from hard objects

Assembly		Surface Damage		Penetration[a]		System Thickness[f] mm (in.)	System Weight[f] kg/m² (psf)	Cost Index[g]
Substrate	**Finish**	**Abrasion[b] cycles**	**Indentation[c] mm (in.)**	**Hard-Body[d] J (ft.-lbs.)**	**Soft-Body[e] J (ft.-lbs.)**			
15.9 mm (5/8″) FIBEROCK VHI Abuse-Resistant Interior Panel	TUFF-HIDE Primer-Surfacer	1000	2.8 (0.11)	237 (175)	>650 (>480)	124 (4-7/8)	34 (6.9)	158
15.9 mm (5/8″) FIBEROCK VHI Abuse-Resistant Interior Panel	2-coat veneer plaster[g]	1000	1.5 (0.06)	237 (175)	>650 (>480)	130 (5-1/8)	41 (8.4)	192
15.9 mm (5/8″) FIBEROCK VHI Abuse-Resistant Interior Panel (2 layers)	2-coat IMPERIAL veneer plaster[h]	1000	1.5 (0.06)	>271 (>200)	>650 (>480)	130 (5-1/8)	41 (8.4)	238
STRUCTOCORE Metal Lath Sheets	STRUCTO-BASE Gypsum Plaster and IMPERIAL Finish Plaster	>1000	1.5 (0.06)	N/A	N/A	114 (4-1/2)	220 (45)	287

Category 5: Security

For areas requiring forced-entry and ballistic resistance

Assembly		Surface Damage		Penetration[a]		System Thickness[f] mm (in.)	System Weight[f] kg/m² (psf)	Cost Index[g]
Substrate	**Finish**	**Abrasion[b] cycles**	**Indentation[c] mm (in.)**	**Time to Penetration minutes**	**Ballistic Calibre of Weapon**			
1.1 mm (18 gauge) STRUCTOCORE Metal Lath Sheets	STRUCTO-BASE Gypsum Plaster and IMPERIAL Finish Plaster	>1000	1.5 (0.06)	5	sub-machine gun level	114 (4-1/2)	220 (45)	287
2.5 mm (12 gauge) STRUCTOCORE Metal Lath Sheets	STRUCTO-BASE Gypsum Plaster and IMPERIAL Finish Plaster	>1000	1.5 (0.06)	15	rifle level	114 (4-1/2)	220 (45)	287

Notes

(a) Minimum 92 mm (3-5/8″), 0.8 mm (20-gauge) steel framing at 400 mm (16″) o.c. is recommended for abuse-resistant assemblies, and was used for the hard-body, soft-body and acoustical testing shown here. Framing space of 610 mm (24″) o.c. will likely reduce the impact resistance of an assembly, while framing of 300 mm (12″) or 200 mm (8″) o.c. will likely improve the impact resistance. (b) Values reflect the average number of cycles to failure. Testing performed using the abrasion test apparatus specified in ASTM D4977 with a 11 kg (25 lb.) added weight. Independent testing performed by H. P. White Laboratory, Inc. Three identical specimens were tested for each product. (c) Values reflect the average measured depth of indentation. Testing performance using the Gardner test apparatus specified in ASTM D5420, with 16 mm (5/8″) die at 8 J (72 in.-lb.) drop energy. Independent testing performed by H.P. White Laboratory, Inc. Three identical specimens were tested for each product. (d) Values reflect the minimum impact energy required for a 50 mm (2″) steel pipe cap to completely penetrate the panel when supported by 400 mm (16″) o.c. framing. Independent testing performed by H.P. White Laboratory, Inc. Three identical specimens were tested for each product. (e) No failure observed up to apparatus capacity of 406 J (300 ft.-lbs.) Values reflect the minimum impact energy required for the following: "Surface Failure"—First evidence of creasing or other damage at panel surface. "Structural Failure"—Complete penetration through panel. Testing performed in accordance with ASTM E695 using a 27 kg (60 lb.) leather bag. Panels supported by 400 mm (16″) o.c. framing. Independent testing performed by H.P. White Laboratory, Inc. Three identical specimens were used for each product. (f) Weights and thicknesses are based on completed systems (panels on both flanges of studs). (g) Based on R S Means®, *Means Square Foot Costs,* published by R.S. Means Co., Inc. (h) Two-coat IMPERIAL veneer consists of IMPERIAL Basecoat Plaster and IMPERIAL Finish Plaster. (i) Two-coat veneer consists of DIAMOND Veneer Basecoat Plaster and IMPERIAL Finish Plaster.

Good Design Practices

This section is an overview of design, application, installation and safety concerns that should be addressed when CGC's products and systems are used at professional constructions sites or at home in do-it-yourself projects. This section is not intended to be a comprehensive review but instead to outline some major issues. No attempt is made at completeness.

We recommend that architects and contractors seek the assistance of safety professionals, especially at the professional construction site, because there are many factors to be considered that are not included here. For more detailed information on safety considerations and material handling, refer to Chapter 13 of *The Gypsum Construction Handbook, Centennial Edition.*

1	**System**	CGC will provide test certification for published fire, sound, and structural data covering systems designed and constructed according to its published specifications. Tests are conducted on company products assembled to meet performance requirements of established test procedures specified by various agencies. System performance following substitution of materials or compromise in assembly design cannot be certified; failure may result under critical conditions. Using components as specified is essential to achieving the performance ratings specified. Thicknesses, weights, framing spaces and designs are integral to achieving assembly performance.
2	**References**	Refer to SA920, *Plaster Systems;* and SA100, *Fire-Resistant Assemblies,* for typical details, good design practices, limitations, and additional information. Typical detailing and practices may not be appropriate or adequate for higher levels of abuse-resistant construction. Final detailing should be determined by the design professional of record.

3	**Control Joints**	Location and design of control joints is the responsibility of the design professional/architect. Gypsum panel surfaces should be isolated with control joints or by other means where: A. Dissimilar wall and ceiling materials abut; B. Partition, furring, or column fireproofing abuts a structural element; C. Ceiling or soffit abuts a structural element, dissimilar wall or partition, or other vertical penetration; D. Construction changes within the plane of the partition or ceiling; E. Partition or furring run exceeds 9 m (30′); F. Ceiling dimensions exceed 15 m (50′) in either direction with perimeter relief, 9 m (30′) without relief; G. Exterior soffits exceed 9 m (30′) in either direction; H. Wings of L-, U-, and T-shaped ceiling areas are joined; I. Expansion or control joints occur throughout the building itself. Less-than-ceiling-height frames should have control joints extending to the ceiling from both corners. Ceiling height door frames may be used as control joints. Treat window openings in the same manner as doors. Zinc Control Joints, when properly insulated and backed by gypsum panels, have been fire-endurance tested and are certified for use in one- and two-hour fire-rated walls
4	**Metal Door and Borrowed Light Frames**	Metal door and borrowed light frames should be at least 1.1 mm (18-gauge) steel, shop-primed, and have throats accurately formed to the overall thickness of the partition. They should be anchored at floor with 1.4 mm (16-gauge) steel plates welded to trim flanges, with provision for two power-driven anchors or equal per plate. Jamb anchors should be 1.1 mm (18-gauge) steel welded in each jamb. Stud reinforcing described below is screw-attached to jamb anchors. Three-piece frames may also be used with these partitions provided end of partition floor runner is anchored with two suitable fasteners. For standard doors up to 900 mm (3′0″) wide and weighing not more than 45 kg (100 lbs.), 0.5 mm (25-gauge) steel studs and runners may be used for framing the opening. For doors 800 mm (2′8″) to 1200 mm (4′0″) wide (90 kg (200 lb.) max.), rough framing should be 0.8 mm (20-gauge) studs (92 mm (3-5/8″) min.) and runners. For heavy doors up to 1200 mm (4′0″) wide (135 kg (300 lb.) max.), two 0.8 mm (20-gauge) studs should be used. For doors over 1200 mm (4′0″) wide, double doors, and extra-heavy doors (over 135 kg (300 lbs.)), framing should be specially designed to meet load conditions. For added door frame restraint, spot-grouting at the jamb anchor is suggested but not required. Apply DURABOND Setting-Type Joint Compound just before inserting board into frame; do not terminate gypsum panel against trim return. Consult with door frame manufacturer for other requirements.
5	**Fixture Attachment**	Lightweight fixtures should be installed with toggle bolts or hollow wall anchors inserted in the panel and, preferably, also through the stud. Wood or metal mounting strips for cabinets and shelving should be bolted to the stud framing.
6	**Sound Tests**	Sound tests are conducted under controlled laboratory conditions per ASTM procedures. Comparable field performance depends on building design and careful attention to detailing and workmanship. Where these partitions are used for sound control, seal the partition perimeter with a 6 mm (1/4″) minimum round bead of Acoustical Sealant. Seal around all cutouts for lights, cabinets, pipes and plumbing, ducts, and electrical boxes. Back-to-back penetrations of the diaphragm, flanking paths, and borrowed light openings within doors and walls should be avoided.

7	**Corner Reinforcement**	SHEETROCK Paper-Faced Metal Bead and Trim resists edge-cracking and -chipping, and is backed by a limited 30-year warranty. The coated paper tape covering ensures excellent adhesion of joint compound for a strong, smooth finish.
8	**Joint Treatment**	For partition assemblies using FIBEROCK board products, it is essential that DURABOND setting-type compounds be used for the bed coat. Further cosmetic treatment of the joints may use conventional all-purpose joint compounds.
9	**Additional Information**	For additional information and product limitations, see technical publications in this series: SA100, *Fire-Resistant Assemblies*, for fire- and sound-rated systems; SA933, *Aesthetic Assemblies,* for finishing product specifications; SA920, *Plaster Systems,* for information on veneer finish products; and SA934, *Moisture-Resistant Assemblies,* for data on ceramic tile base.

About the cover:

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Texas Children's Hospital Clinical Care Center

Houston, TX

Recipient of the 2003 AIA Honor Award

Architects

FKP Architects

Houston, TX

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Metric Specifications
CGC Inc., through its operating subsidiaries, will provide metric conversions on its products and systems to help specifiers match metric design sizes. In addition, some products are available in metric dimensions from selected manufacturing plants. Refer to SA100, *Fire-Resistant Assemblies,* for additional information and a Table of Metric Equivalents.

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All products described here may not be available in all geographic markets. Consult your local sales office or representative for information.

Safety First!
Follow good safety and industrial hygiene practices during handling and installation of all products and systems. Take necessary precautions and wear the appropriate personal protective equipment as needed. Read material safety data sheets and related literature on products before specification and/or installation.

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