

The background of the cover is a vibrant, abstract composition of red and orange tones. It features several large, overlapping, curved shapes that resemble stylized flames or architectural elements. These shapes are filled with a complex, repeating pattern of fine, concentric lines that create a sense of depth and movement. The overall effect is dynamic and modern.

CSR[™]

Gyprock[®]
Fibre Cement

GYP500 October 2004. RRP \$24.95

THE RED BOOK[™]

Fire and Acoustic Design Guide

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42	B11	250	B21	545	D11	768	D7	851	E15	981	E17
050	B10	255	B21	546	D11	769	D7	852	E15	982	E17
051	B10	275	B22	547	D11	770	D7	853	E15	983	E17
055	B10	280	B22	550	C9	771	D7	856	E15	985	E17
60	B24	290	B25	555	C9	772	D7	857	E15	986	E17
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62	B24	292	B25	580	C9	781	D8	859	E15	992	E18
075	B10	293	B25	582	C9	782	D8	860	E16	993	E18
080	B10	294	B26	600	B12	783	D8	862	E14	994	E18
089	B15	295	B26	601	B12	784	D8	863	E14	995	E18
090	B15	296	B27	602	B12	785	D8	864	E14	997	E18
091	B15	297	B26	605	B12	786	D9	865	E16	75PP	D13
092	B15	298	B27	606	B12	787	D9	866	E16	75PP-DC	D13
093	B15	305	C6	610	B13	788	D9	867	E14	75SS	D14
105	B16	310	C6	611	B13	789	D9	868	E14	75SS-DC	D14
110	B16	315	C6	613	B13	790	D9	869	E16	RWS Timber	C18
121	B29	320	C6	614	B13	791	D9	870	E13	RWS Steel	B30
122	B29	325	C6	620	B17	795	D16	871	E13	SF001	E17
125	B16	330	C6	630	B19	796	D16	874	E14	SS01	F4
127	B29	335	C7	631	B17	797	D16	875	E14	SS02	F4
128	B29	350	C7	632	B17	798	D16	876	E14	SS03	F4
130	B16	352	C7	633	B17	800	E7	890	E19	SS04	F4
131	B16	354	C7	640	B22	801	E7	900	C16	SS05	F4
135	B16	355	C7	652	C7	802	E7	901	C16	SS06	F4
150	B18	375	C8	653	C8	803	E7	902	C16	SS07	F4
152	B18	380	C8	654	C8	804	E7	903	C16	SS10	F5
154	B18	390	C15	660	C8	805	E8	911	C17	SS11	F5
155	B18	391	C15	661	C13	806	E8	912	C17	SS12	F5
157	B18	392	C15	662	C13	807	E8	915	C17	SS13	F5
160	B18	393	C15	663	C13	808	E8	916	C17	SS14	F5
161	B19	403	C14	664	C13	809	E8	920	C19	SS15	F5
162	B19	410	C14	665	C8	810	E9	921	C19	SS16	F5
165	B31	411	C14	670	C13	811	E9	923	C19	SS20	F6
167	B31	415	C14	671	C13	812	E9	924	C19	SS21	F6
168	B31	419	C14	672	C13	813	E9	925	C19	SS22	F6
170	B32	425	C12	674	C10	814	E9	927	C19	SS23	F6
171	B32	430	C12	675	C10	815	E9	928	C19	SS24	F6
175	B19	450	C12	677	C9	816	E9	940	B28	SS25	F6
178	B32	455	C12	678	C9	817	E9	940+		SS26	F6
179	B32	475	C12	680	C10	818	E9	ExpressWall	B28	SS27	F6
180	B19	480	C12	681	C10	819	E9	941	B28	SS30	F7
185	B30	493	C22	682	C10	821	E10	942	B28	SS31	F7
186	B30	494	C22	690	C20	822	E10	945	B34	SS32	F7
191	B19	495	C22	693	C20	823	E10	946	B34	SS33	F7
192	B35	496	C22	694	C21	824	E10	947	B34	SS34	F7
193	B35	497	C22	695	C21	825	E10	950	E13	SS35	F7
194	B35	498	C22	696	C20	826	E10	951	E13	SS36	F7
195	B35	500	C11	697	C21	827	E10	952	E13	SS37	F7
196	B35	501	C11	698	C21	829	E10	953	E13	SS40	F8
197	B35	502	C11	722	D15	831	E11	955	E13	SS41	F8
198	B35	503	C11	723	D15	832	E11	960	G5	SS42	F8
205	B20	530	D12	724	D15	833	E11	961	G5		



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Health & Safety.

Information on any known health risks of our products and how to handle them safely is on their package and/or the documentation accompanying them.

Additional information is listed in the Material Safety Data sheet.

To obtain a copy, telephone 1800 807 668.

Guarantee.

CSR Building Products guarantees its Gyprock® products to be free of defects in materials and manufacture.

If a CSR product does not meet our standard, we will, at our option, replace or repair it, supply an equivalent product, or pay for doing one of these.

CSR recommends that only products, components and systems recommended by it be used. If this is not done, CSR will need to be satisfied that any defect in its product is attributable to our failure to meet our standard (and not another cause) before this guarantee applies.

This guarantee excludes all other guarantees and liability for damage or loss in connection with defects in CSR's product, other than those imposed by legislation.

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CSR™, Gyprock®, Supaceil™, Fyrchek™, Soundchek™, Aquachek™, Bracechek™, Impactchek™, FlamechekMR™, Freshstone™, Supatone™, Bradford™, *design*LINK®.

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SECTION 'A'

Introduction

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An Introduction to The Red Book™.

The CSR Gyprock and Fibre Cement Fire & Acoustic Design Guide... 'The Red Book™', provides a ready reference to the performance of an extensive range of CSR Gyprock and Fibre Cement (GFC) fire and acoustic wall, ceiling and column/beam systems.

Over the last 50 years, CSR has developed effective, practical and cost effective fire and acoustic systems for most applications. Fire, acoustic and structural testing has been carried out for all GFC products as well as those of CSR Bradford Insulation and Rondo Building Products. To complement this extensive testing program, CSR GFC has obtained certified assessments from appropriate authorities on the likely performance of some systems. These assessments are based on test results and expert opinion.

CSR GFC fire rated systems have been tested or assessed to AS1530.4 : 1990 or 1997 at approved testing laboratories. Test reports and assessments are available on request.

CSR GFC has developed systems with 'Fire Resistance Levels' (FRL) up to -/180/180 (3 hours). The systems and performance specifications detailed in this manual are guaranteed only for the construction specified. Any variation or substitution of materials or assembly requirements, or any compromise in assembly may result in failure under critical conditions. It is recommended that only accredited plasterboard fixers install fire rated systems.

CSR GFC acoustic rated systems have been assessed by PKA Consulting, acoustic engineers.

CSR is continuously developing its products, which may result in changes to product specifications, range and performance. The systems and products in this Fire and Acoustic Design Guide are current at the publication date.

Components.

CSR GFC manufactures and supplies a diverse range of plasterboard and fibre cement sheets, acoustic panels and accessories to suit a multitude of wall, ceiling and encasement applications.

GYPROCK® Plasterboard CD is machine made sheet composed of a gypsum core encased in a heavy duty linerboard. Available with long edges recessed to assist in producing a smooth, even and continuous surface once jointed, or in square edge. GYPROCK Plasterboard CD is manufactured to AS2588 – 'Gypsum Plasterboard', and incorporates CD (Controlled Density) technology. GYPROCK Plasterboard CD is suitable for internal walls and ceilings.

GYPROCK SUPACEIL™ is a 10mm thick sheet designed to span up to 600mm in ceiling applications. GYPROCK Supaceil™ is machine made sheet composed of a gypsum core encased in a heavy duty linerboard. Long edges are recessed for flush jointing. GYPROCK Supaceil™ is manufactured to AS2588 – 'Gypsum Plasterboard', and incorporates CD (Controlled Density) technology.

GYPROCK SOUNDCEK™ has been designed to provide increased acoustic resistance in wall and ceiling systems. GYPROCK Soundcek™ is machine made sheet composed of a high density gypsum core encased in a heavy duty linerboard. Long edges are recessed to assist in producing a smooth, even and continuous surface once jointed. GYPROCK Soundcek™ is manufactured to AS2588 – 'Gypsum Plasterboard', and is suitable for internal walls and ceilings.

GYPROCK IMPACTCEK™ is high strength plasterboard designed for impact areas. It is composed of a glass fibre reinforced gypsum core plus a fibreglass mesh bonded to the inside of the back face. 13mm IMPACTCEK is encased in a violet linerboard and may be used in fire rated applications, and 10mm IMPACTCEK is encased in white linerboard. The long edges of both are recessed for flush jointing.

GYPROCK AQUACHEK™ is designed for use in lining the walls of 'wet areas' of residential and commercial buildings. It is machine made gypsum plasterboard with a core treated to make it resistant to moisture and humidity. It is manufactured to satisfy the requirements of AS2588 – 'Gypsum Plasterboard', and the water resistant requirements of ASTM C630. It is encased with light blue linerboard and the long edges are recessed.

GYPROCK FYRCHEK™ can be used in wall and ceiling systems where an FRL is to be achieved, or where acoustic performance is required. GYPROCK Fyrchek™ is machine made sheet composed of a specially processed glass fibre reinforced gypsum core encased in a heavy duty pink liner board.

GYPROCK FYRCHEK MR™ is primarily intended for walls and ceilings in ‘wet area rooms’ and for soffits and external walls that must achieve fire resistance. GYPROCK Fyrchek MR™ is machine made sheet composed of a specially processed glass fibre reinforced gypsum core which is treated in manufacture to withstand the effects of moisture, and encased in a heavy duty light blue liner board.

GYPROCK FLAMECHEK MR™ is a fire and moisture resistant high performance 10mm thick plasterboard. GYPROCK FlamechekMR™ is a machine made gypsum plasterboard with a treated core to make it resistant to moisture and fire. It is manufactured to satisfy the requirements of AS2588 –‘Gypsum Plasterboard’, and the water resistant requirements of ASTM C630. It is encased with blue linerboard and the long edges are recessed.

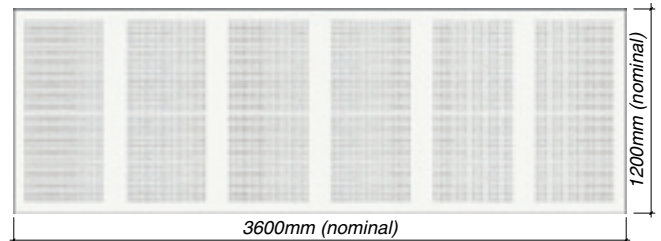
GYPROCK® Shaft Liner Panel is a 25mm thick machine made sheet composed of a glass fibre reinforced gypsum core encased in a heavy duty linerboard. GYPROCK Shaft Liner Panel is used to enclose lift shafts, stairwells and service shafts in multistorey construction. GYPROCK Shaft Liner Panel can be used to achieve fire resistance in wall and ceiling systems.

GYPROCK® Flexible Plasterboard has been designed for curved wall and ceiling systems and has an enhanced core to enable bending to a small radius. It is machine made sheet composed of a gypsum core encased in a heavy duty linerboard. Long edges are recessed to assist in producing a smooth, even and continuous surface once jointed. GYPROCK Flexible Plasterboard is 6.5mm thick and is installed in two layers.

CSR Fibre Cement Wallboard is an autoclaved, cellulose fibre reinforced cement sheet that is immune to permanent water damage and has high impact resistance. CSR Fibre Cement Wallboard is suitable for internal walls as well as internal and external ceiling applications. It has a recess on both long edges so that sheets may be flush jointed, using CSR Gyprock® plasterboard jointing materials.

GYPROCK® Perforated Plasterboard has been designed for use in ceilings where additional sound absorption is required. It is a machine made sheet composed of a gypsum core encased in a heavy duty linerboard and incorporates CD technology. Long edges are recessed for flush jointing. Perforations total 8.2% of the sheet area. For detailed pattern information, refer to Section ‘E’.

FIG A1. PERFORATION PATTERN.

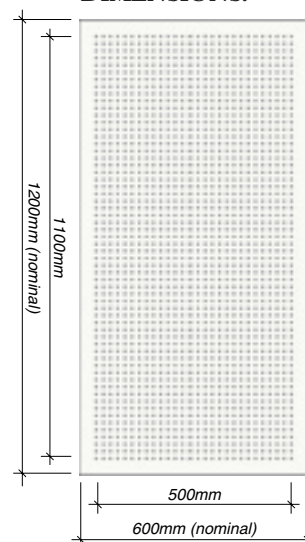


GYPROCK® PLASTERBOARD PANELS.

GYPROCK Plasterboard Panels have a gypsum core and various face treatments. GYPROCK Panels are produced to fit metric grid specifications of (600 x 1200mm nominal).

Perforated Panel has a white vinyl face finish, and a regular grid of 6mm full depth holes. Perforations are approximately 10% of the panel area, and combined with suitable insulation, provide a medium level of acoustic absorption.

FIG A2. GYPROCK PERFORATED PANEL DIMENSIONS.



Supatone™ is a paper faced white ceiling tile suited to basic commercial ceilings. A low maintenance bright white panel, it can be wiped clean with a damp cloth.

Freshtone™ UltraMatt has a low sheen, white vinyl face that can easily be wiped clean. It is ideally suited to large commercial environments, such as supermarkets and shopping centres, where high reflectivity is required.

Freshtone™ Diamond White has a lightly textured vinyl surface which resists fading and mould growth. With a white finish, it is suitable for shopping centres, factories and offices.

Freshtone™ Platinum combines a contemporary metallic look with the simplicity of plasterboard ceiling panels. Appropriate for office foyers, administration areas or any modern space that requires a refined ceiling feature.

CELOTEX™ CEILING PANELS.

Celotex™ ceiling panels have a mineral fibre core and offer a range of attractive textured finishes and acoustic absorption ratings to meet basic requirements. The range includes:

Fine Fissured: 16mm thickness panels with a discrete non-directional pattern. Also available in 19mm thickness with scored bands.

Concorde: 16mm thickness panels with various fissure sizes.

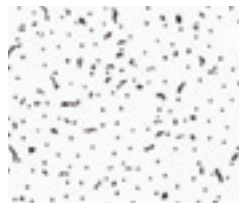
Directional Fissured: 16mm thickness panels with an aligned fissure pattern.

Sand Perforated: 16mm thickness panels with a sand grain-like texture and small round perforations.

For detailed information, please refer to the 'CSR Gyprock® Celotex Acoustic Ceiling Systems' guide.



Fine Fissured



Concorde



Directional Fissured



Sand Perforated

ECOPHON™ CEILING PANELS.

Ecophon™ ceiling panels have a bonded glasswool core for high acoustic absorption performance and the Akutex T finish to provide an attractive easy care surface.

The range includes:

Focus: 20mm thickness panels with a range of edge profiles. Also available for direct fixing to battens or existing ceiling. The Akutex T surface is micro-perforated vinyl paint that can be easily wiped clean.

Advantage: 15mm thickness panels with a glass tissue facing to meet general conditions and good acoustic performance.

Master: 40mm thickness panels with the highest acoustic performance plus Akutex T finish.

Hygiene: 20mm thickness panels with a 'cleanroom' classification. Provides excellent acoustic performance and the Akutex T finish is suitable for pressure wash-down situations. For detailed information, please refer to the 'Ecophon Product Catalogue'.



Akutex T

GYPROCK® CORNICE.

CSR Gyprock manufactures six popular machine made cornice profiles which cater for many styles and applications. Please refer to Table A1 in this section for detailed product size and availability information. It is recommended that cornice be attached with Gyprock® Cornice Cement.

GYPROCK® COVE CORNICE.



GYPROCK® JAZZ CORNICE.



GYPROCK® SYMPHONY CORNICE.



GYPROCK® CONCERTO CORNICE.



GYPROCK® TEMPO CORNICE.



GYPROCK® CLASSIC CORNICE.



TABLE A1. GYPROCK PLASTERBOARD AVAILABILITY.

Colour shading behind each product approximates the colour of the product face liner sheets.

GYPROCK Product	Thickness mm	Width mm	Sheet Length (mm)								Mass kg/m ²
			2400	2700	3000	3600	4200	4800	5400	6000	
CD RECESSED EDGE	10	1200	✓ W	✓ W	✓ W	✓ W	✓ W	✓ W	✓ W	✓ W	6.5
		1350	✓ W		✓ W	✓ W	✓ W	✓ W		✓ W	
	13	900		*✓ WSN	W	W					8.5
		1200	✓ SN	✓	✓	✓	✓ W	✓	SN	✓ WSN	
		1350			✓	✓	SN	✓ W			
CD SQUARE EDGE	10	1200	W	SN	WSN	W				6.5	
	13	1200		SN	SN					8.5	
SUPACEIL™	10	900	W		W	W		W		7.2	
		1200	✓ SN	W	✓	✓▲	✓	✓	✓		✓
		1350	W		✓	✓	✓	✓			✓
SOUNDCEK™	10	1350						✓		9.3	
	13	1200			✓					13.0	
AQUACHEK™	10	1200	✓	✓ SN	✓	✓	✓			8.0	
		1350	SN	SN	WSN	✓ SN		✓ WSN			
	13	1200		✓ W	✓	W				10.4	
IMPACTCEK™	13	1200			✓					10.3	
BRACECEK™	10	1200				✓				8.4	
FLEXIBLE	6.5	1200				✓				4.25	
FLAMECEK MR™	10	1350						✓		8.0	
FYRCHEK™	13	1200		✓ W	✓	✓				10.5	
	16	1200	✓ SN	✓ W	✓	✓				12.5	
FYRCHEK™ MR	13	1200		✓ WSN		SN				10.7	
	16	1200		✓ WSN	W	SN				13.5	
PERFORATED SHEET	13	1200				✓				10.0	
SHAFT LINER PANEL	25	600			✓					19.8	
COVE CORNICE	–	55			✓	✓	✓	✓		0.68kg/m	
	–	75			W	W	W	W		0.93kg/m	
	–	90			✓	✓	✓	✓	✓	1.3kg/m	
CLASSIC CORNICE	–	90						✓		1.2kg/m	
TEMPO CORNICE	–	90						✓		1.6kg/m	
CONCERTO CORNICE	–	90						✓		1.4kg/m	
SYMPHONY CORNICE	–	75						✓		0.90kg/m	
JAZZ CORNICE	–	75						✓		1.8kg/m	

Indicates available in: ✓ = Australia wide; W = Western Aust.; S = South Aust.; N = Northern Territory.

Indicates NOT available in: ~~W~~ = Western Aust.; ~~S~~ = South Aust.; ~~N~~ = Northern Territory.

* = Length is 2740. ▲ = 3300 and 3900mm lengths also available in WA only.

In Western Australia only, additional Recessed Edge/Square Edge products are available.

Additional sizes may be available in some products. Call your state office for details.

**TABLE A2.
CSR FIBRE CEMENT WALLBOARD
AVAILABILITY AND MANUFACTURING
TOLERANCES.**

CSR Fibre Cement Wallboard is manufactured in the following sizes and available in all states.

CSR Fibre Cement Wallboard has two long edges recessed to allow seamless jointing.

Thickness (6mm RE = ✓) (9mm RE = ■) (12mm RE = ❖)			
Length mm.	Width mm.		
	900	1200	1350
1800		✓	
2400	✓	✓ ■ ❖	✓
2700		✓ ■ ❖	
3000	✓	✓ ■ ❖	✓
3600	✓	✓	✓
4200		✓	

Mass 6mm thickness (nominal)	9kg/m ²
Mass 9mm thickness (nominal)	13.5kg/m ²
Mass 12mm thickness (nominal)	18.3kg/m ²
Length	+0 to -4mm
Width	+0 to -3mm
Thickness	+0.25 to -0.25mm
Diagonals Difference (max)	3mm

INSULATION.

CSR GFC Fire and Acoustic Systems incorporate CSR Bradford glasswool and rockwool insulation. These products have undergone significant acoustic testing and have a proven track record of performance and durability

in service. Additional information on CSR Bradford Insulation materials is available by telephoning CSR Bradford on (02) 9765 7100.

Although insulation materials are often specified for thermal resistance, they can contribute significantly to the acoustic performance of wall and ceiling systems. CSR GFC only recommends materials that have been tested for fire and acoustic applications, have proven durability, and are supported by their manufacturer for these applications. Should other insulation materials be used, the manufacturer of those materials must verify the performance of the complete system, CSR GFC will not support the performance of substitute materials.

Acoustic Polyester insulation manufactured by Tontine and Autex have been tested in acoustic applications by the manufacturer and are specifically made for that purpose. CSR accepts the use of Tontine and Autex Polyester insulation.

BRADFORD INSULATION.



TABLE A3. SPECIFIED INSULATION AND ABBREVIATIONS.

(Abbreviated names have been used in system tables).

Product	Abbreviation
75mm Bradford SoundScreen™ R2.0 batts (rockwool)	75mm Soundscreen™ 2.0 batts
60mm Bradford SoundScreen™ R1.6 batts (rockwool)	60mm Soundscreen™ 1.6 batts
45mm Bradford Rockwool Fibertex Partition batts, 38kg/m ³	45mm Rockwool Partition batts
75mm Bradford Comfortseal™ R1.5 batts wall (glasswool)	75mm Comfortseal™ R1.5 batts
105mm Bradford Comfortseal™ R2.0 ceiling batts (glasswool)	105mm Comfortseal™ R2.0 batts
50mm Bradford Glasswool Partition batts, 10.8kg/m ²	50mm Glasswool Partition batts
75mm Bradford Glasswool Partition batts, 10.8kg/m ²	75mm Glasswool Partition batts
Autex ASB 2 (50mm) / Tontine TSB 2 (50mm) Polyester Insulation	ASB2/TSB2 Polyester batts
Tontine TSB 3 (65mm) / Autex ASB 3 (60mm) Polyester Insulation	ASB3/TSB3 Polyester batts
Tontine TSB 4 (75mm) / Autex ASB 4 (70mm) Polyester Insulation	ASB4/TSB4 Polyester batts
Tontine TSB 5 (85mm) / Autex ASB 5 (80mm) Polyester Insulation	ASB5/TSB5 Polyester batts
Tontine Blanket (25mm) 10kg/m ³ Polyester Insulation	TBL/1025 Polyester

STEEL COMPONENTS.

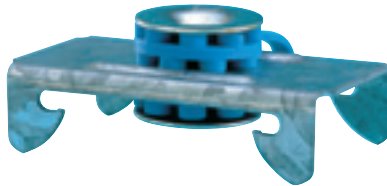
CSR GFC recommends steel building elements manufactured by Rondo Building Services Pty Ltd, for our systems. Top hats manufactured by Stramit, Lysaght and Rhino Steel are also specified in some systems.

General information on Rondo steel building components is provided throughout this manual. Additional information can be obtained from the Rondo Building Services Pty Ltd office in your state, or telephone 1300 367 663.

CSR GFC will not support the performance of substitute materials. It is the responsibility of the manufacturer of the component to substantiate equivalent performance in any particular application.

CSR GYPROCK® RESILIENT MOUNT.

The CSR Gyprock® Resilient Mount is a proprietary component used in conjunction with Rondo steel sections for fastening GYPROCK plasterboard to a supporting structure while simultaneously isolating it from structure borne vibration.



This significantly reduces the amount of impact noise, speech and low frequency sound filtering through to rooms above, below or alongside the noise generating room. The resilient mount has been design for use on ceilings and can be used on walls provided plasterboard with minimum mass of 15kg/m² is fixed on the resilient mount side of the wall. The mount can be used in fire rated and non fire rated systems.

STUD ADHESIVE.

CSR Gyprock® Acrylic Stud Adhesive is coloured blue for easy identification. It can be used on both timber and steel in temperatures not less than 5°C.

Contact surfaces must be free of oil, grease or other foreign materials before application. The adhesive is applied with a broad knife to form 25mm diameter by 15mm high walnuts. This product is suitable for use with pre-painted metal battens and some treated timbers. Always follow directions on packaging when using CSR stud adhesive.



MASONRY ADHESIVE.

CSR Gyprock® Masonry Adhesive is used to adhere GYPROCK plasterboards to CSR Hebel Aerated Autoclaved Concrete substrates and all masonry substrates.

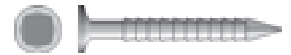
FASTENERS.

CSR Gyprock distributes a comprehensive range of ring shank nails, hot-dip galvanised clouts, and screws for use with timber and steel framing to accommodate most installation applications.

- **GYPROCK Ring Shank Nails.**

Hardwood 25 x 2.8mm.

Softwood 30 x 2.8mm.



- **GYPROCK Clouts.**

(Hot-dip galvanised).

30, 40 and 50mm x 2.8mm.



- **GYPROCK Plasterboard Screws.**

N°6 Type 'W'

for timber framing.



N°6 Type 'S' Needle Point

for lightweight steel studs and furring channel up to 0.8mm thickness



N°6 Type 'S' Drill Point

for steel framing 0.8mm to 1.2mm thickness.



GYPROCK Plasterboard Laminating Screws.

40mm x N°10.

for laminating

layers of plasterboard together at butt joints and control joints (where permitted).



CSR Fibre Cement Nails: Galvanised 2.0mm x

30mm for softwood and

2.0mm x 25mm for

hardwood.



CSR Fibre Cement Screws: For 6mm thickness sheets only.

N° 8 x 20mm self

embedding head, needle point for light gauge steel frames up to 0.8mm.



N° 8 x 25mm self

embedding head, drill point for heavy gauge steel frames from 0.8mm to 1.2mm.



TABLE A4. FIXING PLASTERBOARD TO SOFTWOOD.

Plasterboard Thickness	1st Layer	2nd Layer	3rd Layer
10mm Plasterboard	2.8x40mm Gal Nail or N°6-18 x 25mm Bugle, NP or 2.8x30mm Ring Shank Nail	2.8x50mm Gal Nail or N°6-18 x 40mm Bugle, NP	
13mm Plasterboard	2.8x40mm Gal Nail or N°6-18 x 32mm Bugle, NP or 2.8x30mm Ring Shank Nail	2.8x50mm Gal Nail or N°6-18 x 45mm Bugle, NP	3.75x75mm Gal Nail or N°8-15 x 65mm Bugle, NP or N°10-40 Laminating
16mm Plasterboard	2.8x50mm Gal Nail or N°6-18 x 32mm Bugle, NP	3.15x65mm Gal Nail or N°6-18 x 50mm Bugle, NP	3.75x75mm Gal Nail or N°8-15 x 65mm Bugle, NP or N°10-40 Laminating
2x6.5mm Plasterboard	2.8x40mm Gal Nail or N°6-18 x 25mm Bugle, NP or 2.8x25mm Ring Shank Nail	2.8x40mm Gal Nail or N°6-18 x 32mm Bugle, NP or 2.8x30mm Ring Shank Nail	
13mm+16mm Plasterboard	2.8x40mm Gal Nail or N°6-18 x 32mm Bugle, NP or 2.8x30mm Ring Shank Nail	2.8x50mm Gal Nail or N°6-18 x 45mm Bugle, NP	

TABLE A5. FIXING PLASTERBOARD TO HARDWOOD.

Plasterboard Thickness	1st Layer	2nd Layer	3rd Layer
1 x 10mm Plasterboard	2.8x30mm Gal Nail or #6-18 x 30mm Bugle, NP or 2.8x25mm Ring Shank Nail		
2 x 10mm Plasterboard	2.8x30mm Gal Nail or #6-18 x 25mm Bugle, NP or 2.8x25mm Ring Shank Nail	2.8x40mm Gal Nail or #6-18 x 32mm Bugle, NP	
1 x 13mm Plasterboard	2.8x30mm Gal Nail or #6-18 x 30mm Bugle, NP or 2.8x25mm Ring Shank Nail		
2 x 13mm Plasterboard	2.8x30mm Gal Nail or #6-18 x 32mm Bugle, NP or 2.8x25mm Ring Shank Nail	2.8x40mm Gal Nail or #6-18 x 40mm Bugle, NP	
3 x 13mm Plasterboard	2.8x30mm Gal Nail or #6-18 x 32mm Bugle, NP or 2.8x25mm Ring Shank Nail	2.8x40mm Gal Nail or #6-18 x 45mm Bugle, NP	3.15x65mm Gal Nail or #8-15 x 65mm Bugle, NP or #10-40 Laminating
1, 2 or 3 x 16mm Plasterboard	2.8x40mm Gal Nail or #6-18 x 32mm Bugle, NP	2.8x50mm Gal Nail or #6-18 x 45mm Bugle, NP	3.15x65mm Gal Nail or #8-15 x 65mm Bugle, NP or #10-40 Laminating
2 x 6.5mm Plasterboard	2.8x30mm Gal Nail or #6-18 x 25mm Bugle, NP or 2.8x25mm Ring Shank Nail	2.8x30mm Gal Nail or #6-18 x 32mm Bugle, NP or 2.8x25mm Ring Shank Nail	
13mm+16mm Plasterboard	2.8x30mm Gal Nail or #6-18 x 32mm Bugle, NP or 2.8x25mm Ring Shank Nail	2.8x50mm Gal Nail or #6-18 x 45mm Bugle, NP	

TABLE A6. FIXING FIBRE CEMENT AND PLASTERBOARD TO TIMBER.

Fibre Cement Thickness	1st Layer	2nd Layer
6mm Wallboard	N°8-15 x 20 CSK NP or 2.8x40mm Gal nail	
9mm Wallboard	N°8-15 x 30 CSK NP or 2.8x40mm Gal nail	
6/9mm Wallboard over 13mm Plasterboard	2.8x40mm Gal Nail or N°6-18 x 32mm Bugle, NP or 2.8x30mm Ring Shank Nail	2.8x50mm Gal Nail or N°8-15x40mm CSK, NP
6/9mm Wallboard over 16mm Plasterboard	2.8x50mm Gal Nail or N°6-18 x 32mm Bugle, NP	2.8x50mm Gal Nail or N°8-15x40mm CSK, NP
13/16mm Plasterboard over 6mm Wallboard	N°8-15 x 20 CSK NP or 2.8x40mm Gal nail	2.8x50mm Gal Nail or N°6-18 x 45mm Bugle, NP
13/16mm Plasterboard over 9mm Wallboard	N°8-15 x 30 CSK NP or 2.8x40mm Gal nail	2.8x50mm Gal Nail or N°6-18 x 45mm Bugle, NP

NOTES:

Predrill 9mm and 12mm Wallboard for easier fixing.

Fixings are suitable for internal applications only.

Type 'W' screws of equivalent length may be used as an alternative to 'NP'.

NP = Needle Point Screws.

DP = Dill Point Screws.

Bugle = Bugle Head Screws.

CSK = Countersunk Head Screws.

GAL = Galvanised.

TABLE A7. FIXING TO STEEL 0.5-0.8mm BMT.

Plasterboard Thickness	1st Layer	2nd Layer	3rd Layer
1 or 2 x 6.5mm Plasterboard	#6-18 x 25mm Bugle, NP	#6-18 x 25mm Bugle, NP	
1 or 2 x 10mm Plasterboard	#6-18 x 25mm Bugle, NP	#6-18 x 40mm Bugle, NP	
1, 2 or 3 x 13mm Plasterboard	#6-18 x 25mm Bugle, NP	#6-18 x 40mm Bugle, NP	#10-40 Laminating
1, 2 or 3 x 16mm Plasterboard	#6-18 x 30mm Bugle, NP	#6-18 x 45mm Bugle, NP	#10-40 Laminating
13mm + 16mm Plasterboard	#6-18 x 25mm Bugle, NP	#6-18 x 45mm Bugle, NP	

TABLE A8. FIXING TO STEEL 0.8-2.0mm BMT.

Plasterboard Thickness	1st Layer	2nd Layer	3rd Layer
1 or 2 x 6.5mm Plasterboard	#6-18 x 25mm Bugle, DP	#6-18 x 25mm Bugle, DP	
1 or 2 x 10mm Plasterboard	#6-18 x 25mm Bugle, DP	#6-18 x 40mm Bugle, DP	
1, 2 or 3 x 13mm Plasterboard	#6-18 x 25mm Bugle, DP	#6-18 x 40mm Bugle, DP	#10-40 Laminating
1, 2 or 3 x 16mm Plasterboard	#6-18 x 30mm Bugle, DP	#6-18 x 45mm Bugle, DP	#10-40 Laminating
13mm + 16mm Plasterboard	#6-18 x 25mm Bugle, DP	#6-18 x 45mm Bugle, DP	

TABLE A9. FIXING TO STEEL 0.5-0.8mm BMT.

Fibre Cement Thickness	1st Layer	2nd Layer
6mm Wallboard	#8-15 x 20 CSK NP or 9-18x20 Fibretek	
9mm Wallboard	#8-15 x 30 CSK NP or 9-18x30 Fibretek	
6/9mm Wallboard over 13mm Plasterboard	#6-18 x 25mm Bugle, NP	#8-15x40mm CSK NP
6/9mm Wallboard over 16mm Plasterboard	#6-18 x 30mm Bugle, NP	#8-15x40mm CSK NP
13/16mm Plasterboard over 6mm Wallboard	#8-15 x 20 CSK NP or 9-18x20 Fibretek	#6-18 x 40mm Bugle, NP
13/16mm Plasterboard over 9mm Wallboard	#8-15 x 30 CSK NP or 9-18x30 Fibretek	#6-18 x 40mm Bugle, NP

TABLE A10. FIXING TO STEEL 0.8-2.0mm BMT.

Fibre Cement Thickness	1st Layer	2nd Layer
6mm Wallboard	#8-15 x 20 CSK DP	
9mm Wallboard	#8-15 x 30 CSK DP	
6/9mm Wallboard over 13mm Plasterboard	#6-18 x 25mm Bugle, DP	#8-15x40mm CSK DP
6/9mm Wallboard over 16mm Plasterboard	#6-18 x 30mm Bugle, DP	#8-15x40mm CSK DP
13/16mm Plasterboard over 6mm Wallboard	#8-15 x 20mm CSK DP	#6-18 x 40mm Bugle, DP
13/16mm Plasterboard over 9mm Wallboard	#8-15 x 30mm CSK DP	#6-18 x 40mm Bugle, DP

Notes:

Predrill 9mm and 12mm Wallboard for easier fixing.

Fixings are suitable for internal applications only.

NP = Needle Point Screws.

DP = Dill Point Screws.

Bugle = Bugle Head Screws.

CSK = Countersunk Head Screws.

GAL = Galvanised.



JOINTING ACCESSORIES AND COMPOUNDS.

CSR GFC has a wide range of compounds, cements and accessories for finishing plasterboard installations.

Refer to the Gyprock® Residential Installation Guide, N°GYP547 for detailed jointing and finishing information.

CSR GFC MASTICS AND SEALANTS.

CSR Gyprock® Fire Mastic must be used in fire rated systems where caulking is indicated and is recommended for caulking acoustic systems.

CSR Gyprock® Wet Area Acrylic Sealant is recommended for sealing non fire rated wet area systems.

Physical Properties.

THERMAL AND MOISTURE STABILITY.

CSR GFC plasterboard and fibre cement products are stable building materials when subjected to the normal range of interior temperature and humidity conditions.

Thermal coefficient of Linear Expansion (α).

- Plasterboard: $\alpha = 16.2 \times 10^{-6}$ mm (mm/°C) in the temperature range 4°C to 38°C.
- Fibre cement: $\alpha = 7.5 \times 10^{-6}/^{\circ}\text{C}$.
- Final length is calculated as follows:
 $L_f = L_i (1 + \alpha \Delta T)$.

The hygrometric coefficient of expansion (δ).

- Plasterboard: $\delta = 7.2 \times 10^{-6}$ mm/mm/% R.H. (5% – 90% R.H.). Final length is calculated as follows:
 $L_f = L_i (1 + \delta \Delta \text{RH})$.
- Fibre cement: $\delta = 0.18\%$ (expansion from equilibrium to saturated). Final length is calculated $L_f = L_i \times \delta \times$ (% of saturation).

INTERNAL MOISTURE.

GYPROCK plasterboard must not be used where it will be in contact with liquid water or constant relative humidity above 90%.

GYPROCK Plasterboard CD, GYPROCK SUPACEIL and GYPROCK SOUNDCEK are designed for use in dry areas only.

For wet area walls and external ceilings subject to intermittent high humidity where plasterboard is specified, GYPROCK AQUACHEK or GYPROCK FYRCHEK MR or CSR Fibre Cement Wallboard must be used. In all cases follow product installation brochures.

THERMAL PERFORMANCE.

The 'R' values for GYPROCK plasterboards are:

- 10mm thickness = 0.062 m²k/w.
- 13mm thickness = 0.074 m²k/w.
- 16mm thickness = 0.086 m²k/w.

The 'R' values for CSR Fibre Cement are:

- 6mm thickness = 0.02 m²k/w.
- 7.5mm thickness = 0.025 m²k/w.
- 8mm thickness = 0.027 m²k/w.
- 9mm thickness = 0.03 m²k/w.



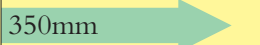
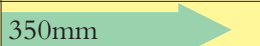






STRUCTURAL PROPERTIES.

CSR Fibre Cement Wallboard properties at EMC*/Saturated.

- Density (kg/m³) 1350/–.
- Compressive Strength.
 - Parallel to sheet length (MPa) 20/15.
 - Parallel to sheet width (MPa) –/50.
- Flexural Strength.
 - Parallel to sheet length.
 - ultimate (MPa) 13/9.
 - yield (MPa) 10/6.
 - Parallel to sheet width.
 - ultimate (MPa) 16/11.
 - yield (MPa) 12/8.
- Modulus of Elasticity (GPa) 6/4.

NOTE: *EMC = Equilibrium Moisture Content.

TABLE A11. IMPACT AND UDL RESISTANCE FOR STUD SPACING AND LINING MATERIAL COMBINATIONS.

Typical Wall Application	Wall Lining Material	Stud Spacing	Soft Body Impact Resistance	UDL Resistance
Public corridor, stair shaft and fire isolated exit in a spectator stand, sports stadium, cinema, theatre, railway station, bus or airport terminal. (Some Class 9 Buildings)	1 x 13mm GYPROCK Impactchek	600mm	400mm 	≥ 1.0 kPa
	1 x 13mm GYPROCK Impactchek + 1 x 13mm GYPROCK Fyrchek	600mm	400mm 	≥ 1.0 kPa
	1 x 13mm GYPROCK Fyrchek + 1 x 6mm CSR Fibre Cement Wallboard	600mm	350mm 	≥ 1.0 kPa
	1 x 9mm CSR Fibre Cement Wallboard	600mm	350mm 	≥ 1.0 kPa
	2 x 16mm GYPROCK Fyrchek	400mm	350mm 	≥ 1.0 kPa
Walls of stairways and service shafts and fire isolated exits generally.	2 x 13mm GYPROCK Fyrchek	600mm	175mm 	≥ 0.35 kPa
	1 x 16mm GYPROCK Fyrchek	600mm	150mm 	≥ 0.35 kPa
Fire resisting walls generally.	1 x 13mm GYPROCK Fyrchek	600mm	125mm 	≥ 0.25 kPa
Walls generally.	1 x 10mm GYPROCK Impactchek	600mm	300mm 	≥ 0.25 kPa
	1 x 6mm CSR Fibre Cement Wallboard	600mm	250mm 	≥ 0.25 kPa

IMPACT RESISTANCE.

GYPROCK plasterboard of 10mm and 13mm thickness provide adequate resistance to soft body impacts likely in domestic or light commercial use respectively.

Walls lined with Gyprock Fyrchek™, Impactchek™ and CSR Fibre Cement Wallboard can meet various requirements of Specification C1.8 of the Building Code of Australia 2004. This clause specifies resistance to Uniform Distributed Loads (UDLs), surface indentation and impact from a weighted sand bag that is dropped from a specified height. Refer to Table A11 for performance details.

FIRE HAZARD PROPERTIES.

The BCA limits the materials used in Class 2 to 9 buildings by controlling the Fire Hazard properties of linings. These properties may be assessed by two methods.

AS/NZS1530.3 (Simultaneous determination of, ignitability, flame propagation, heat release and smoke release) known as Early Fire Hazard Indices. This method is expected to be phased out for wall and ceiling lining materials.

AS ISO9705 room burn test or AS/NZS3837 the cone calorimeter test. The room burn test is a large scale test to determine SMOGRARC, and the cone calorimeter is a small scale test to determine a Group Number.

Please refer to Table A12 for Gyprock® plasterboard and CSR Fibre Cement product performance details.

TABLE A12. FIRE HAZARD PROPERTIES.

GYPROCK Product	EFHI	SMOGRARC	Group Number
10 – 13mm Plasterboard CD	13/0/1/2	0	1
10mm SUPACEIL™	14/0/1/1	0	1
10mm SOUNDCHek™	0/0/0/3	0	1
10 – 13mm AQUACHEK	13/0/2/3	0	1
6.5mm FLEXIBLE	13/0/1/2	0	1
13mm Perforated Sheet	0/0/0/3	0	1
13 – 16mm FYRCHEK™	0/0/0/3	0	1
13 – 16mm FYRCHEK MR™	13/0/2/2	0	1
25mm SHAFT LINER	0/0/0/3	0	1
10mm FLAMECHEK MR™	13/0/2/2	0	1
13mm IMPACTCHEK™	0/0/0/3	0	1
13mm Perforated Panels	0/0/0/4	0	1
10mm FRESHTONE™ Diamond White	0/0/0/3	0	1
10mm FRESHTONE™ UltraMatt & Platinum	0/0/0/3	0	1
10mm SUPATONE™	13/0/2/3	0	1
10 – 13mm Unpainted Panel	13/0/1/3	0	1
Celotex	0/0/0/2	0	2
Ecophon ADVANTAGE	0/0/0/2	0	1
Ecophon FOCUS	0/0/0/3	0	1
Fibre Cement Wallboard	0/0/0/0	0	1

NOTES: EFHI = Early Fire Hazard Indices (Ignitability/Spread of Flame/Heat Evolved/Smoke Developed). SMOGRARC = Smoke Growth Rate Index

Material & Construction Standards.

All materials and procedures shall comply with the following standards where applicable, and all additional details contained in CSR Gyprock and CSR Fibre Cement Technical Literature.

Plasterboard Manufacture.

AS/NZS2588 : 1998 'Gypsum plasterboard'.

Plasterboard Installation.

AS/NZS2589 : 1997 'Gypsum linings in residential and light commercial construction – Application and Finishing'.

Plasterboard in Wet Areas.

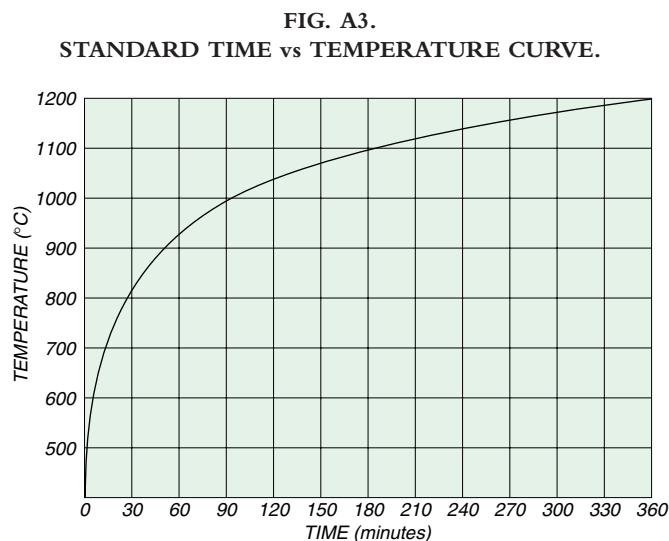
AS3740 : 2004 'Waterproofing of Wet Areas Within Residential Buildings'.

Fire Testing.

Fire resistance testing is conducted to the Australian Standard AS1530 – part 4 'Fire Resistance Tests of Elements of Building Construction'.

This standard gives the test method and criteria of failure for the various elements of construction such as partition walls, floor/ceilings and roof/ceilings.

The specimen assemblies are built into the test furnace and subjected to furnace temperatures in accordance with AS1530.4 'Standard Time vs Temperature Curve'.



HOW IS THE SPECIMEN ASSESSED?

The test specimen is heated in the prescribed manner until the failure criteria has been reached, or is terminated by agreement between parties.

Assessment criteria are represented by three performance measurements known as 'Fire Resistance Levels' (FRL).

Structural Adequacy.

Failure occurs when the specimen collapses under load.

Integrity.

Failure occurs when the specimen develops cracks or openings through which flames or hot gases can pass.

Insulation.

Failure occurs when the average temperature of the unexposed surface of the specimen increases by more than 140°C above the initial temperature, or the temperature at any point of the unexposed surface increases by more than 180°C above the initial temperature.

The test performance of the specimen is expressed as a 'Fire Resistance Level', which indicates the number of minutes for which the specimen fulfils the requirements of the three fire test criteria.

These numbers are then rounded down to the nearest regulatory requirement.

The common regulatory 'FRL' requirements are:

Non Loadbearing	Loadbearing
– /30/30	30/30/30
– /60/60	60/60/60
– /90/90	90/90/90
– /120/120	120/120/120
– /180/180	180/180/180

For Example: – /120/120.

- The dash indicates no requirement for 'Structural Adequacy', which applies to all non loadbearing systems.
- The first 120 indicates 'Integrity' for 120 minutes.
- The second 120 indicates 'Insulation' for 120 minutes.

For any specified FRL, a system having equal or higher respective criteria may be used. Some systems have multiple FRLs stated. FRLs expressed as –/y/z relate to non-loadbearing walls; FRLs expressed as x/y/z relate to loadbearing walls; or FRLs expressed as x/y/z* relate to walls with additional design limits.

WHAT IS RESISTANCE TO THE INCIPIENT SPREAD OF FIRE?

Ceiling systems may be required to achieve a 'Resistance to the Incipient Spread of Fire'.

This requires the ceiling to provide adequate thermal insulation to prevent combustibles in a roof/ceiling or floor/ceiling cavity from igniting for the specified time.

The Building Code of Australia requirement for some ceiling systems is to provide 'Resistance to the Incipient Spread of Fire (RISF), into the space above itself, for not less than 60 minutes'. Systems that meet this requirement are indicated in the system tables.

FIRE HAZARD PROPERTIES.

Fire hazard properties of wall and ceiling linings in some classes of building are specified by the BCA. Refer to Table A12 for fire hazard properties of CSR GFC products.

SMOKE PROOF WALLS.

Smoke proof walls are required in some Class 9a buildings, and they must be built from non-combustible materials.

Where smoke proof walls do not require an FRL, steel framed wall systems clad with GYPROCK Plasterboard CD (eg. CSR 010) may be used.

Fire rated smoke proof walls should be selected from the steel framed systems (refer to Section 'B') with an appropriate FRL.

Building Acoustics.

Building acoustics can be separated into sound absorption and sound transmission.

Sound absorption relates to control of sound that is generated within a room and how it affects people in that room.

Sound transmission relates to sound that passes through a dividing element (direct sound, controlled by the element's sound insulation), and through the surrounding structure (indirect or flanking transmission).

Methods of controlling noise in buildings can be based on systems, structure and lining materials and their absorption and transmission properties.

FLANKING TRANSMISSION.

Flanking sounds reach adjoining areas by indirect paths, rather than through the dividing element. The walls, floors and ceilings that surround the dividing element are the main paths for flanking transmission.

Other paths are via open windows, ducts, doorways and suspended ceilings. Noise sources that have a high degree of low frequency noise such as traffic, aircraft and DVD sound systems have more potential for flanking transmission through the building structure.

Transmission of this type of noise follows structural load paths and can be controlled by breaking these load paths or providing complete separation of the structure.

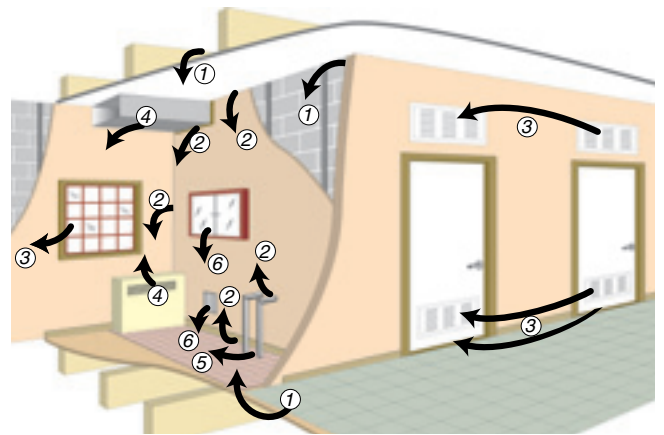
Noise sources that generate a high amount of mid and high frequency noise, such as services and speech, tend to transmit via air paths and direct transmission in lightweight construction.

Typical problem areas for this type of transmission include doors and door frames, glazing, suspended ceiling cavities and ductwork. Practical methods for addressing common situations within buildings can be seen in Section 'Z'.

FIG A4.

COMMON FLANKING TRANSMISSION PATHS.

1. Ceiling plenums, floors, walls.
2. Poor seals between structural elements and around service penetrations.
3. External air-borne paths.
4. Heating and ventilation ducting.
5. Rigid plumbing connections and penetrations.
6. Back-to-back cabinets and switches/power outlets.



SOUND IMPACT RATINGS.

The BCA has performance requirements relating to sound impact for floors and some walls.

For floors, this is specified as a maximum value such as: $L_{nw} + C_I = 62$. Note that lower values of $L_{nw} + C_I$ indicates better acoustic impact performance.

Walls required to have an impact rating must meet the definition of 'Discontinuous Construction'. This means that wall leaves must be separated by at least 20mm and no mechanical connection is permitted, except that masonry may have resilient ties.

Systems that meet this specification are noted in the appropriate system specifications.

Building Acoustics in Practice.

SYSTEM PERFORMANCE.

The R_w , $R_w + C_{tr}$ and $L_{n,w}+C_I$ values in this manual refer to expected results of a laboratory test on an element.

The mathematical model used to make the predictions has been verified statistically on a large body of test data. The accuracy of the prediction is generally within measurement tolerance of results from different acoustic laboratories, that is 2dB.

All care has been taken with preparation of these predictions and it is assumed that construction is strictly in accordance with this manual and relevant Gyprock and Fibre Cement installation guides.

CSR GFC recommends that an acoustic engineer be consulted for all projects where acoustics are important.

SITE PERFORMANCE vs. LABORATORY PERFORMANCE.

As houses are not built like laboratories, it is unlikely that performance measured in ideal test conditions will be achieved in a building. Designers should take care to select systems compatible with the support structure to provide the desired level of insulation.

Field performance is typically 10% less than laboratory performance. Additionally, some forms of surrounding construction have upper limits unrelated to the rating of the element. In these cases, the difference between laboratory and site performance could be larger.


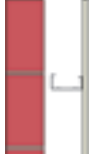



ACOUSTIC INTEGRITY.

The acoustic integrity of a system can be influenced by the combination of elements that make up the system. Single leaf and uninsulated systems are more dependant on high quality installation, as relatively minor defects can cause major degradation of the system performance.

Building systems that allow defects to be hidden from view have a higher chance of gaps being left unsealed, making them more vulnerable to performance degradation.

The likelihood and effect of defects occurring with typical systems is shown in Table A13.

TABLE A13. ACOUSTIC INTEGRITY.

Wall System	Chance of Gaps Being Left Unsealed	Effect of Defects on Performance
 Single skin masonry wall	High	High Degradation
 Masonry with stud uninsulated	High	High Degradation
 Single stud, uninsulated	Low	High Degradation
 Single stud, insulated	Low	Low Degradation
 Double stud, insulated	Low	Low Degradation

BACKGROUND NOISE.

Low levels of noise transmitted from other areas can be partially obscured by background noise.

Where the background noise level is low, such as in remote areas, consideration should be given to providing a higher than standard level of sound insulation.

VARIATION IN OCCUPANT PERCEPTION OF NOISE.

Tolerance for noise varies greatly between people, and variations of up to 15dB can be considered acceptable. This means consideration should be given to the occupant's expectation of the internal acoustic environment. Users of concert halls and practice rooms may have higher acoustic expectations than guests of inner city hotels.

DESIGNING FOR OPTIMUM SOUND INSULATION.

Acoustic design issues are different for every building, and for internal and external noise sources.

When designing apartments and townhouses, reference can be made to the Association of Australian Acoustical Consultants (AAAC) 'Acoustical Star Ratings for Apartments and Townhouses' (www.aaac.org.au), a rating system that considers both internal and external sound transmission. It provides a graded rating system for the acoustic quality of apartments, from 2 Star to 6 Star, and is intended to provide assurance that an occupant's expectations of quality are met.

Where expectations are not met, remedial measures can be expensive and inconvenient.

Some local government areas have adopted the AAAC 4 Star level as a minimum. This exceeds the current BCA requirements in some respects.

MINIMUM PERFORMANCE LEVELS FOR INTERNAL WALLS AND CEILINGS.

The BCA sets out minimum performance levels for internal walls and ceilings based on acceptable standards for affordable housing. The performance requirements are in terms of R_w , R_w+C_{tr} and $L_{n,w}+C_I$.

These levels may need to be increased for:

- Variation in occupant perceptions of noise, e.g. high, medium or low cost housing.
- Local authorities have higher requirements such as the AAAC Star rating system.
- Background noise levels are low.
- Flanking transmission of the surrounding structure. Lightweight structures can be more prone to low frequency flanking.
- The presence of services will vary which BCA provisions are applicable, and could mean separate construction is required.
- The lack of simplicity in construction could reduce actual performance.

MINIMUM PERFORMANCE LEVELS FOR SERVICES.

The BCA sets out minimum performance levels for isolation of noise from services based on acceptable standards for affordable housing. The performance levels are in terms of R_w and R_w+C_{tr} .

These levels may need to be increased for:

- The nature of the noise source and adjacent occupant activity. Some noises are particularly annoying to occupants.

- Systems that meet the new BCA minimum R_w+C_{tr} requirements may have lower performance than systems that meet the corresponding R_w requirements.
- Variation in occupant perceptions of noise, e.g. high, medium or low cost housing.
- Background noise levels may be very low.
- The lack of simplicity in construction could reduce actual performance.

MINIMUM PERFORMANCE LEVELS FOR EXTERNAL WALLS.

The BCA does not set minimum performance levels of transmission for external walls. Guidance should be sought from an acoustic consultant or local authority for setting the design requirements of these elements, as they may be affected by road or aircraft noise.

Issues that may affect the design levels for external walls are:

- Variation in occupant perceptions of noise, e.g. high, medium or low cost housing.
- Background noise levels are low.
- Flanking transmission of the surrounding structure, particularly at windows and doors.
- The lack of simplicity in construction could reduce actual performance.

Detailing for Acoustics.

GAPS, CRACK AND HOLES.

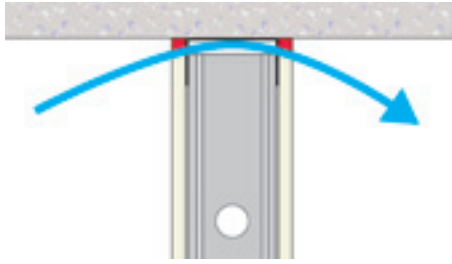
Small openings allow airborne sound to pass through an element and can significantly reduce sound insulation performance. For optimum sound insulation, the element must be airtight.

Perimeters and penetrations for services can be sealed with CSR Gyprock Fire Mastic. It is a dense, flexible compound capable of accommodating minor building movement. Where major movement is expected, use a polyurethane fire and acoustic rated sealant.

For systems that are multi-layered, such as masonry composite systems, each layer must be air tight, as services such as power points and switches can act as airborne flanking paths. To remedy this, consider using acoustic rated power boxes, the Gyprock® Silencer, and insulation in the cavity. Refer to flanking details, Section 'Z'.

SOUND FLANKING VIA HEAD & BASE.

Particular attention should be paid to sealing the joints at the top and base of walls with flexible sealant. Such joints are usually required to accommodate some building movement.

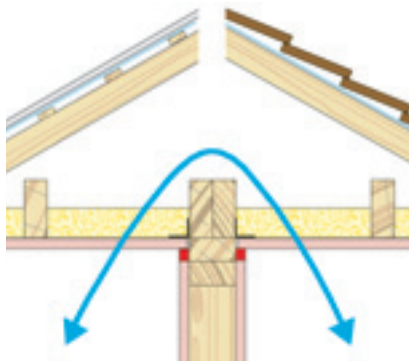


SOUND FLANKING VIA THE CEILING.

This is a common source of sound transmission, particularly where the ceiling has low sound insulation.

It is recommended that, wherever possible, walls pass through the ceiling and be sealed to the floor or roof. This can maintain the desired sound rating of the wall.

Details to treat sound flanking in this situation are given in Section 'Z' for a range of plasterboard and acoustic panel linings.

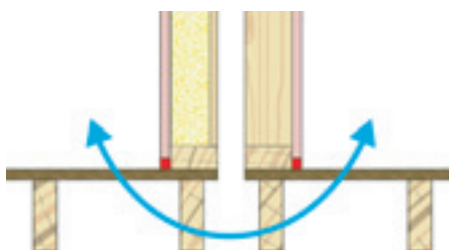


SOUND FLANKING VIA THE FLOOR.

This is also a common source of sound transmission, particularly where the floor is lightweight and continues under the wall.

High flanking transmission performance can be achieved if there is a break in construction, or floor slabs are thick enough.

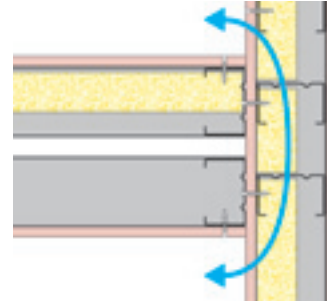
Refer to Section 'Z' for potential performance of various construction details.



SOUND FLANKING VIA PERIMETER WALLS.

This is similar to flanking via the ceiling. The recommended detail is for the partition wall to continue through the perimeter wall.

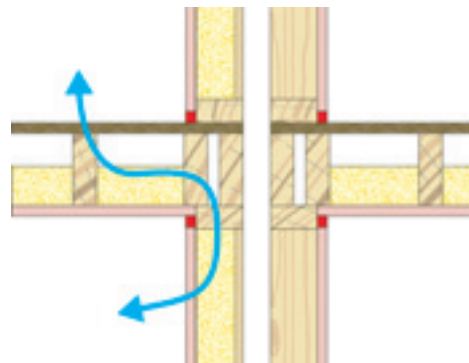
Details to treat sound flanking in this situation are given in Section 'Z' for a range of plasterboard panel linings.



SOUND FLANKING A FLOOR VIA THE PARTITION BELOW.

This source of sound transmission particularly affects lightweight floors and walls. Both impact and airborne sound can travel through the floor and support walls.

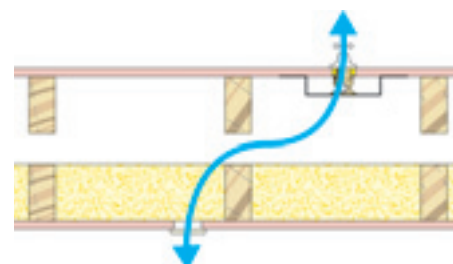
Refer to Section 'Z' for potential performance of various construction details.



SOUND FLANKING VIA ELECTRICAL AND SERVICE PENETRATIONS.

Electrical power outlets, switch boxes and similar penetrations produce areas of low sound insulation in a partition. These should not be placed back to back as they could limit the acoustic rating of the wall.

Penetrations should be avoided where sound insulation is important. Treatment options include using acoustic rated power boxes, the Gyprock® Silencer, and insulation in the cavity. Refer to Section 'Z' for potential performance of various construction details



SOUND FLANKING VIA DOWNLIGHTS.

Downlights installed in ceilings penetrate the linings and create a path through which sound can pass. Insulation may be ineffective as it must be clear of the light fitting and transformer to reduce the likelihood of the light overheating.

When ceiling downlights are required in acoustically sensitive (non fire rated) locations, fire and sound rated lights can be used. Refer to manufacturer's information for limitations.

Refer to Service Systems Section 'F' for performance details for various combinations of linings and downlights in selected systems.

Definitions.

R_w – Weighted Sound Reduction Index. A measure of the sound insulation performance of a building element. R_w is a laboratory measurement similar to STC.

All BCA references to STC have been removed and upgraded to refer to either R_w or R_w+C_{tr} . R_w is measured and calculated using the procedures from AS1276 and AS1191. The related field measurement is abbreviated as $D_{nT,w}$.

The higher the number the better the insulation performance.

$D_{nT,w}$ – Weighted Standardised Field Level Difference. A measurement of the sound insulation performance of a building element. It describes the difference in noise level on each side of a wall or floor, and indicates the level of speech privacy between spaces. It is measured in the field and is therefore subject to the inherent inaccuracies involved in such a measurement.

The higher the number the better the insulation performance.

C_{tr} – A spectrum adaptation value used to modify the sound insulation performance of a wall or floor. Sound insulation performance can be described by R_w or the $D_{nT,w}$ but these are not accurate for all noises, especially for low frequency bass noise from modern stereo systems. C_{tr} values are negative value which is added to either the R_w or $D_{nT,w}$. AS/NZS1276 – sets out testing methodologies for the sound insulation properties of building elements and incorporates these factors and explains their use.

Smaller negative C_{tr} values are more favourable than large negative values.

dB(A) – The 'A'-scale and dB(A) noise level are used to degrade the performance of a sound level meter to simulate what humans hear. The human ear is not a perfect listening device, it is poor at hearing low frequency noise. dB(A) is used to compare measured sound with perceived sound.

A number of noise criteria refer to, and are measured in dB(A). The larger the dB(A) level the louder the noise.

$L_{n,w}$ – Weighted Normalised Impact Sound Pressure Level. A measure of the noise impact performance of a floor/ceiling. It is measured in very controlled conditions in a laboratory and is characterised by how much impact sound reaches the receiving room via the ceiling/floor from a standard tapping machine test.

The lower the number the better the performance.

$L'_{nT,w}$ – Weighted Standardised Field Impact Sound Pressure Level. A measure of the noise impact performance of a floor/ceiling. It is similar to $L_{n,w}$ except it is measured in the field and is therefore subject to the inherent inaccuracies involved in such a measurement.

The lower the number the better the performance.

CI – A spectrum adaptation term used to modify the measured impact sound pressure level, $L_{n,w}$ or $L'_{nT,w}$.

Impact sound is generated by a laboratory grade tapping machine placed on the floor to be tested. This tapping machine does not accurately simulate the noise of a person's foot steps on the floor above, so the CI term was developed to more closely simulate foot step noise.

The term is defined in ISO717-2. The $L_{n,w}$ or $L'_{nT,w}$ alone is sufficient to characterise concrete floors covered with carpet. Other types of floors such as timber joist floors, bare concrete floors or polished timber or tiles laid on concrete floors require the CI term to properly characterise footstep noise.

Timber joist floors can have a CI value slightly positive. Concrete floors with an effective covering such as carpet have CI terms approximately equal to 0dB. Concrete floors with a hard, or less effective covering, can have CI terms varying between -15dB and 0dB.

NRC – Noise Reduction Coefficient. A measure of the ability of a material to absorb sound.

NRC is generally a number between 0 and 1. A material with an NRC rating of 1 absorbs 100 % of incoming sound, that is, no sound is reflected back from the material.

STC – Sound Transmission Class. A measure of the sound insulation performance of a building element. It is measured in very controlled conditions in a laboratory.

STC is an old term and is now obsolete. The BCA has replaced all references to STC with R_w .

NOTE: Source Building Code of Australia, Sound Insulation Guideline.