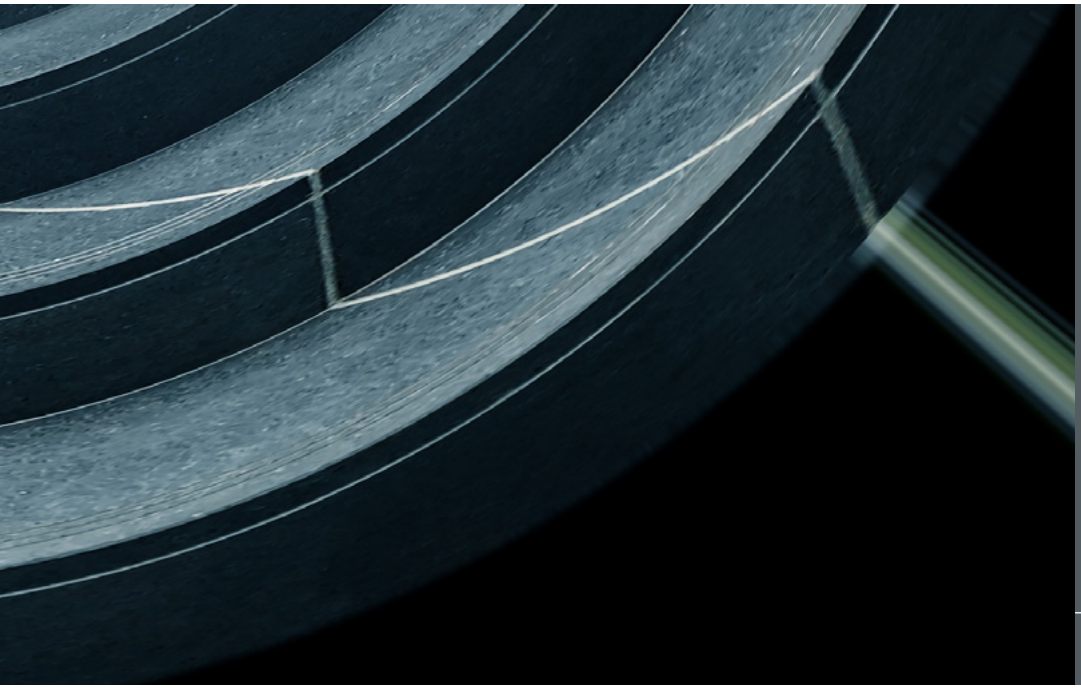

Section A

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GENERAL INFORMATION

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A 6 Materials

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PRELIMINARIES

Introduction

This manual is intended for use by building designers, builders, certifiers and plastering contractors dealing with fire rated and acoustic construction. It provides fire rating, acoustic and structural performance data for a wide range of Knauf building systems including lightweight wall and ceiling systems, masonry upgrades and beam/column fire protection systems.

In addition to the systems listed in this publication, Knauf offers many other system configurations to suit specific project requirements. Performance data on the full range of Knauf systems can be found at **knauf.com/en-AU/knauf-gypsum/services/tools/eselector**

Scope

This manual lists Knauf fire rated wall systems up to FRL -/180/180 and FRL 120/120/120.

Fire rated ceiling systems are available up to FRL 120/20/120 (from below) and beam/column fire protection systems up to FRL 120/-/-.

A wide range of acoustic systems are available to meet National Construction Code (NCC) and other performance requirements. These include plasterboard wall and ceiling systems with $R_w + C_{tr}$ 50 or higher, a range of Knauf acoustic ceiling tiles up to NRC 0.75, and Knauf Stratopanel with an NRC of up to 0.90.

Certification

Knauf systems have been assessed to meet the relevant requirements of Australian Standards and the NCC:

Fire Resistance

Fire testing and assessment has been done to AS 1530.4 *Methods for fire tests on building materials, components and structures — Fire resistance test of elements of construction* and carried out by:

- CSIRO, Manufacturing and Infrastructure Technology, North Ryde, NSW
- Warrington Fire, Dandenong, Victoria
- BRANZ, Judgeford, New Zealand.

Acoustic Ratings

All acoustic ratings provided in this publication are either laboratory tested results or opinions provided by Renzo Tonin & Associates (RT&A), SLR Consulting Australia (SLR) or PKA Acoustic Consulting (PKA) and are covered by the stated Opinion Reference in each table. These opinions are based on acoustic tests of similar systems (laboratory and/or site tests) as well as theoretical models, and are produced by experienced acousticians who are members of the Australian Acoustical Society. RT&A, SLR and PKA are member firms of the Association of Australian Acoustical Consultants (AAAC).

Structural

Structural testing of wall systems has been carried out at the NATA registered laboratories of Knauf at Pinkenba. Structural appraisal of the systems was carried out by Wynton Stone Australia Pty Ltd and Taylor Thomson Whitting of Melbourne.

Fire, acoustic and structural test reports and opinions can be made available on request from Knauf.

NOTES:

- Various system certifications are valid only when the relevant systems are constructed in accordance with Knauf specifications and using the stated materials and components. Fastening should be of the same type and at centres no greater than detailed for particular systems.
- While Knauf systems are certified to achieve the stated fire resistance and acoustic ratings, it is the responsibility of the relevant project consultant to ensure that the selected systems satisfy project requirements.
- Acoustic ratings provided in this publication are the expected laboratory test results based on the opinion of acoustical experts. Laboratory measurements are conducted under strict and near ideal conditions. On-site performance is generally lower due to flanking effects.

PRELIMINARIES

Standards

The following Australian and other Standards are referenced in this publication:

- AS 1530.4 *Methods for fire tests on building materials, components and structures — Fire resistance test of elements of Construction*
- AS ISO 717.1 A*coustics — Rating of sound insulation in buildings and of building elements — Airborne sound insulation*
- AS ISO 717.2 A*coustics — Rating of sound insulation in buildings and of building elements — Impact sound insulation*
- AS 1191 *Acoustics — Method for laboratory measurement of airborne sound transmission insulation of building elements*
- AS/NZS 2499 *Acoustics — Measurements of sound insulation in buildings and of building elements — Laboratory measurement of room-to-room airborne sound insulation of a suspended ceiling with a plenum above it*
- AS ISO 11654 *Acoustics — Rating of sound absorption — Materials and systems*
- AS/NZS 1170.2 *Structural Design Actions — Wind actions*
- AS 1170.4 *Structural Design Actions — Earthquake actions*
- AS 1397 *Steel Sheet and Strip — hot dipped, zinc coated or aluminium/zinc coated*
- AS 1684 *Residential timber framed construction*
- AS/NZS 1716 *Respiratory protective devices*
- AS/NZS 2588 *Gypsum Plasterboard*
- AS/NZS 2589 *Gypsum Linings — Application and finishing*
- AS 3566.1 *Self-drilling screws for the building and construction industries*
- AS 3600 *Concrete Structures*
- AS 3700 *Masonry Structures*
- AS 3740 *Waterproofing of domestic wet areas*
- AS 4055 *Wind loads for housing*
- AS/NZS 4600 *Cold-formed steel structures*
- AS/NZS 4858 *Wet Area Membranes*
- AS/NZS 5601.1 *Gas installations – General installations*
- AS/NZS ISO 9001 *Quality management systems — Requirements*
- ISO 9002 *Quality systems – Model for quality assurance in production, installation and servicing*
- ASTM G21 *Determining Resistance of Synthetic Polymeric Materials to Fungi*
- ASTM D3273 *Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.*

Abbreviations

The following abbreviations are used throughout this manual:

TABLE A1: **ABBREVIATIONS**

ABBREVIATION	DESCRIPTION
AAAC	The Association of Australasian Acoustical Consultants
BCA	Building Code of Australia
NCC	National Construction Code
BMT	Base Metal Thickness
ctrs	Centres
Max	Maximum
LB	Load Bearing
Min	Minimum
NLB	Non-Load Bearing
Nom	Nominal
NA	Not Applicable
p	Page
pbd	Plasterboard
RT&A	Renzo Tonin & Associates
SLR	SLR Consulting Australia
PKA	PKA Acoustic Consulting
UNO	Unless Noted Otherwise

Performance Indicators

The following performance indicators are mentioned in various parts of this manual:

TABLE A2: **PERFORMANCE INDICATORS**

INDICATOR	DESCRIPTION
Fire Resistance Properties	
FRL	Fire Resistance Level
RISF	Resistance to Incipient Spread of Fire
Acoustic Properties	
α_w	Weighted Sound Absorption Coefficient
CAC	Ceiling Attenuation Class
$D_{nc,w}$	Weighted Suspended Ceiling Normalised Level Difference (laboratory performance)
$D_{nT,w}$	Weighted Standardised Sound Level Difference (field performance)
$D_{nT,w} + C_{tr}$	Weighted Standardised Sound Level Difference with Spectrum Adaptation Term (field performance)
$L_{n,w}$	Weighted Normalised Impact Sound Pressure Level (laboratory performance)
$L'_{nT,w}$	Weighted Standardised Impact Sound Pressure Level (field performance)
NRC	Noise Reduction Coefficient
R_w	Weighted Sound Reduction Index (laboratory performance)
$R_w + C_{tr}$	Weighted Sound Reduction Index with Spectrum Adaptation Term (laboratory performance)
T_{60}	Reverberation Time
Other	
LR	Light Reflectance

For the full description of various performance indicators refer to the relevant parts of the General Information section.

PRELIMINARIES

Quality Assurance

Knauf is a Quality Endorsed Company (Lic No 0400) conforming to AS/NZS ISO 9001 *Quality management systems – Requirements*.

All Australian Knauf plasterboard production facilities are certified under ISO 9002 *Quality systems – Model for quality assurance in production, installation and servicing.*

Knauf plasterboard is machine made under a continuous process to the requirements of AS/NZS 2588 *Gypsum plasterboard.*

Sustainability

Raw Materials

Gypsum used in locally manufactured Knauf plasterboard products is mined from abundant resources at Kevin in South Australia.

The mine has in place a rehabilitation and revegetation strategy aimed at creating a landscape with natural appearance and native local vegetation.

Plasterboard paper liner is manufactured from 100% recycled waste paper fibre and contains no virgin paper fibre.

FIBEROCK Aqua-Tough gypsum board contains 95% recycled content.

Plasterboard Manufacture

Apart from natural gypsum and recycled paper, the key inputs in the plasterboard manufacturing process are natural gas and potable water.

Knauf aims at exceeding the local Environment Protection requirements and at maximising the use of recycled water at its manufacturing facilities.

Recycling

Plasterboard waste can be recycled into new plasterboard or as soil conditioner.

For further information contact your local Knauf office.

GECA Certification

The following Knauf plasterboards have been certified by Good Environmental Choice Australia (GECA):

- 10 mm / 13 mm SHEETROCK ONE
- 10 mm SHEETROCK PLUS
- 13 mm WetStop
- 13 mm / 16 mm FireStop
- 13 mm ImpactStop
- 13 mm / 16mm MultiStop ONE
- 13 mm MultiStop ONE HI
- 13 mm / 16 mm FIBEROCK Aqua-Tough
- 25 mm Shaftliner MouldStop

Embodied Energy

As shown in the following table, embodied energy per kg of plasterboard compares favourably with other common lining materials:

TABLE A3: **EMBODIED ENERGY OF LINING MATERIALS**

MATERIAL	PER* EMBODIED ENERGY (MJ/ kg)
Plasterboard	4.4
Fibre cement	4.8
Particleboard	8.0
Plywood	10.4
MDF	11.3
Hardboard	24.2

* PER - Process Energy Requirements.
Source: Building Materials Energy and the Environment, Bill Lawson, The Royal Australian Institute of Architects, 1996.

Safety

The following precautions are recommended when installing and finishing plasterboard:

- Avoid creating dust when handling plasterboard or mixing plaster compounds.
- When sanding, minimise the effects of dust by:
  - providing adequate ventilation
  - wearing eye protection
  - wearing a respiratory mask conforming to AS/NZS 1716 *Respiratory protective devices*
  - using mechanical sanding tools fitted with dust extractor and storage bag.
- Keep tools and materials out of reach of children. In addition, the users should observe Occupational Health and Safety tips contained on the packaging labels for Knauf products as well as safe manual handling practices.

First Aid

- If plaster compound or dust comes into contact with the eyes, wash eyes thoroughly with clean potable water.
- If plaster compound or dust comes into contact with skin, wash skin thoroughly with soap and water.
- If dust is inhaled, move to a fresh air environment.
- If plastering compound or dust is ingested, drink plenty of water.

Material Safety Data Sheets for Knauf products can be downloaded from **knauf.com**

In emergencies call **1800 033 111**

For poison assistance call **13 11 26**

PRELIMINARIES

Plasterboard Properties

Thermal Resistance

The thermal resistance ratings (R-values) of some plasterboard produced by Knauf, are provided in the following table:

TABLE A4: **THERMAL RESISTANCE**

PLASTERBOARD PRODUCT	R-VALUE
13 mm FireStop	0.061 $m^2K/W \pm 10\%$
13 mm FIBEROCK Aqua-Tough	0.049 $m^2K/W \pm 10\%$
16 mm FireStop	0.074 $m^2K/W \pm 10\%$
25 mm Shaftliner MouldStop	0.112 $m^2K/W \pm 10\%$

Calculation of the above R-values is based on test data of thermal conductivity as reported in BRANZ Report No EC0713, 22/10/2003. FIBEROCK Aqua-Tough R-values are based on tests carried out by USG.

When plasterboard is fixed to framework, creating a cavity construction, R-values of plasterboard systems can be easily upgraded through addition of bulk or reflective insulation.

Total thermal resistance ratings of various external wall systems are shown in the relevant system tables.

Specific Heat Capacity

The Specific Heat Capacity is a measure of a material's capacity to store heat, the higher the Specific Heat Capacity the greater the capacity to store heat.

TABLE A5: **SPECIFIC HEAT**

PRODUCT	SPECIFIC HEAT CAPACITY	BASIS
13 mm FireStop	960 J/kgK ±10%	BRANZ Report No EC0713/2, 22/10/03
25 mm Shaftliner MouldStop	979 J/kgK ±10%	BRANZ Report No EC0713/2, 22/10/03

Temperature Effects

Thermal co-efficient of linear expansion of plasterboard is 16.2×10^{-6} mm/(mm°C) over the range 4°C to 38°C.

Knauf does not recommend the use of radiant heating systems continuously subjecting plasterboard ceilings to temperatures in excess of 52°C.

Moisture Effects

The hygrometric co-efficient of linear expansion of plasterboard is 7.2×10^{-6} mm/(mm% RH) over the range 5% to 90% relative humidity.

As exposure to moisture may affect performance of plasterboard linings, it is recommended that plasterboard is installed in well ventilated areas protected from moisture penetration.

Building designers should be aware that some types of bulk insulation tend to absorb and retain the moisture against the face of plasterboard.

Impact Resistant Linings

Knauf offers a number of lining products specifically developed for applications requiring enhanced impact resistance:

TABLE A6: **IMPACT RESISTANCE LININGS**

PRODUCT	IMPACT RESISTANCE LEVEL
SHEETROCK PLUS	Impact
ImpactStop, MultiStop ONE	High Impact
MultiStop ONE HI	Very High Impact
FIBEROCK Aqua-Tough	Ultimate Impact

Water and Mould Resistance

Although plasterboard is not a waterproof material, Knauf offers a number of lining products classified as water resistant under the NCC requirements for domestic wet areas. These products include:

- SHEETROCK PLUS
- WetStop
- MultiStop ONE and ONE HI
- FIBEROCK Aqua-Tough
- Shaftliner MouldStop

The following Knauf products are classified as mould resistant:

- MultiStop ONE and ONE HI (achieved no mould growth with a rating of 0 when tested in accordance with ASTM G21, and the highest score of 10 when tested in accordance with ASTM D3273)
- FIBEROCK Aqua-Tough (achieved the highest score of 10 when tested in accordance with ASTM D3273)
- Shaftliner MouldStop (achieved no mould growth with a rating of 0 when tested in accordance with ASTM G21, and the highest score of 10 when tested in accordance with ASTM D3273).

MATERIALS

Plasterboard

Knauf offers a wide range of plasterboard products to suit various applications:

TABLE A7: **KNAUF PLASTERBOARD**

PRODUCT NAME	NOMINAL THICKNESS mm	NOMINAL MASS kg/m²	APPLICATIONS
SHEETROCK ONE	10 13	5.9 8.5	Residential wall and ceiling linings Residential/ Commercial wall and ceiling linings
SHEETROCK PLUS	10	8.5	Residential wet area, external & garage ceiling, acoustic wall and ceiling and impact resistant linings
WetStop	13	9.2	Wet area, external and garage ceiling linings
FireStop	13 16	10.9 13.4	Fire resistant wall and ceiling linings
ImpactStop	13	12.0	High impact, sound and fire resistant linings
MultiStop ONE	13 16	12.0 14.6	High impact, fire, sound, water and mould resistant linings
MultiStop ONE HI	13	12.0	Very high impact with mesh reinforcement, sound, fire, water and mould resistant linings
ShaftlinerMouldStop	25	20.5	Shaft enclosures & seperating wallls
Flexiboard	6.5	4.1	Curved wall and ceiling linings
FIBEROCK Aqua-Tough	13 16	11.7 15.1	Ultimate impact, water, sound, fire and mould resistant linings
EchoStop	12.5	10.0	Sound absorption within a room
Stratopanel	12.5	7.4 - 8.6	Sound absorption within a room
GIB X-Block	13	17.2	X-ray radiation protection

Note:
Product availability should be checked with Knauf as some products may only be available on order and/or in minimum order quantities.

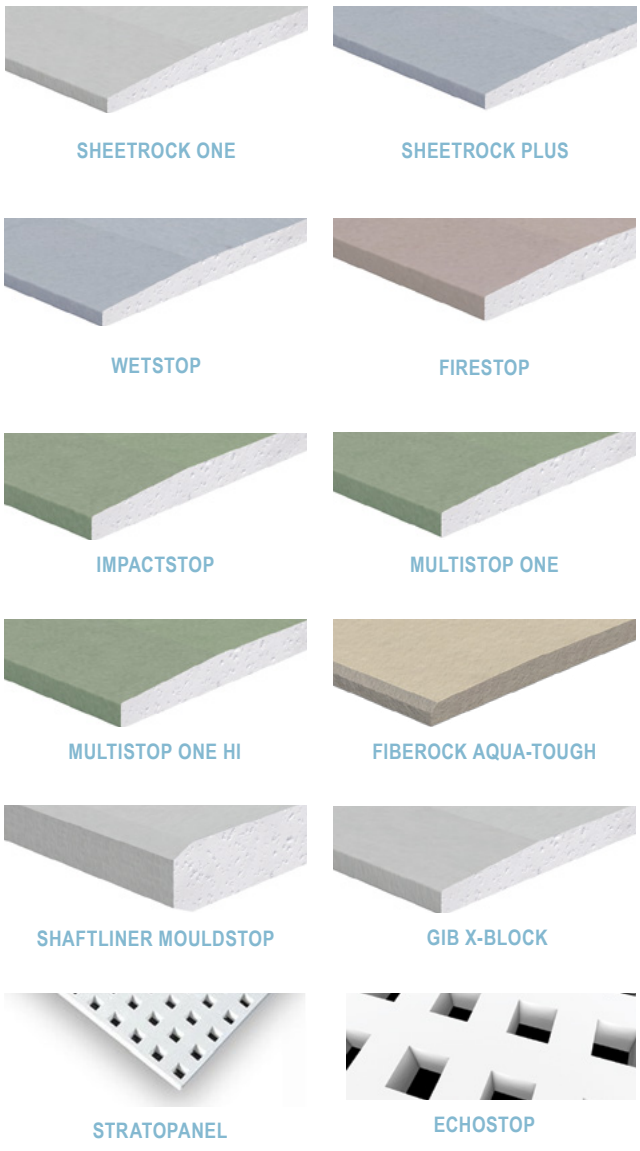


Figure A1: **Knauf Plasterboards**

MATERIALS

Metal Components

Steel Stud Walls

Knauf steel stud wall systems utilise Rondo lipped C-studs, wall tracks and deflection head tracks as listed in the Steel Stud Walls section.

ShaftWall

Knauf Shaftwall system utilises Rondo CH-Studs and other components as listed in Specialty Systems – Service Shafts.

Furred Systems

Knauf furred wall and ceiling systems utilise Rondo furring channels and fixing clips as outlined in the relevant sections of this manual.

Suspended Ceilings

Knauf suspended ceilings utilise the following suspension systems:

- Rondo DONN® Brand Exposed Grid
- Rondo Xpress Drywall Grid
- Rondo KEY-LOCK® Suspended Ceiling System
- Rondo DUO® Exposed Grid Ceiling System.

Timber Sections

Knauf timber stud wall systems utilise standard stud and plate sizes as listed in the Timber Stud Walls section.

Acoustic ratings of timber framed floor/ceiling systems are based on 240 mm deep joists.

Insulation

Glasswool Insulation

Knauf glasswool insulation offers a unique combination of performance characteristics – delivers high levels of thermal performance, high levels of sound absorption, is naturally non-combustible and is inherently low in embodied carbon. Knauf glasswool insulation contains up to 80% recycled content and is manufactured using a unique bio-based binder – ECOSE Technology, which is made from natural raw materials that are rapidly renewable, and is 70% less carbon intensive to manufacture than traditional binders. Unlike binders used to manufacture traditional and alternative glasswool products, ECOSE Technology binder contains no added formaldehyde or phenol resulting in Knauf Insulation glasswool products subsequently being awarded the Declare Red List Free label by the International Living Future Institute.

The following Knauf Insulation glasswool products have been tested and or assessed to be used in Knauf systems to achieve designated fire, acoustics and thermal performance:

- KI 25G24 - 25 mm glasswool insulation 24 kg/m^3 density
- KI 50G11 - 50 mm glasswool insulation 11 kg/m^3 density
- KI 50G14 - 50 mm glasswool insulation 14 kg/m^3 density
- KI 75G11 - 75 mm glasswool insulation 11 kg/m^3 density
- KI 90G11 - 90 mm glasswool insulation 11 kg/m^3 density
- KI 90G14 - 90 mm glasswool insulation 14 kg/m^3 density
- KI 90G24 - 90 mm glasswool insulation 24 kg/m^3 density
- KI 90G32 - 90 mm glasswool insulation 32 kg/m^3 density
- KI 90G R1.5 - R1.5 Wall Batts glasswool insulation
- KI 90G R2.0 - R2.0 Wall Batts glasswool insulation
- KI 90G R2.5 - R2.5 Ceiling Batts glasswool insulation
- KI 145G R3.0 - R3.0 Ceiling Batts glasswool insulation
- Foil-faced 60 mm (R1.4) nom roof insulation blanket.

MATERIALS

Fasteners

The following fasteners are suitable for fixing of plasterboard linings:

TABLE A8: **PLASTERBOARD SCREWS**[1]

SCREW TYPE		APPLICATION
S		Steel BMT* up to 0.75 mm
W		Timber only
D		Steel BMT* 0.80 - 2.00 mm
L		Gypsum board laminating

* BMT – Base Metal Thickness.

TABLE A9: **PLASTERBOARD TO PLASTERBOARD FASTENERS**

NUMBER OF LAYERS OF PLASTERBOARD x THICKNESS		TYPE L[10] SCREWS FOR FIXING PLASTERBOARD A TO B
PLASTERBOARD A	PLASTERBOARD B	
1x13 mm	1x13 mm	10-8x32 mm
1x16 mm	1x16 mm	10-8x38 mm
1x16 mm	2x16 mm	6-8x50 mm

TABLE A10: **PLASTERBOARD TO FRAME FASTENERS**

PLASTERBOARD THICKNESS mm	TIMBER FRAME				STEEL FRAME
	KNAUF SMOOTH SHANK GOLD PASSIVATED NAILS[9]	KNAUF ANNULAR RING SHANK NAILS[9] AND UNI-NAILS[9]	GALVANISED NAILS[9] (2.8 mm DIA UNO)	TYPE W SCREWS[2]	TYPE S[3] AND TYPE D[4] SCREWS
1x10	40 softwood 30 hardwood	30	40 softwood 30 hardwood	6-9x25W wall 6-9x32W ceiling	6-18x25[7] D, S
1x13	40 softwood 30 hardwood	30	40 softwood 30 hardwood	6-9x32W	6-18x25[7] D, S
1x16	50	-	50 softwood 40 hardwood	6-9x40W	6-18x30 D, S
1x25	-	-	-	-	6-18x40D, S
2x10	50	-	50	6-9x40W	6-18x30D, S
2x13	65	-	50	6-9x50W	6-18x40D, S
13+16	65	-	50	6-9x50W	6-18x40D, S
2x16	65	-	65	6-9x60W	6-18x45D, S
3x13	-	-	75x3.75	8-8x60W	7-16x50S
3x16	-	-	75x3.75	8-8x75W	8-15x60S

NOTES:

1. Screws to be Class 3 or Class 4 as appropriate for the corrosion conditions for wet areas and protected external applications.
2. "W" is a needle point, bugle head type W gypsum screw for fixing to hardwood and softwood framing. In some instances double start thread screws are permissible (refer Knauf).
3. "S" is a needle point, bugle head type S gypsum screw for fixing to steel gauges of up to 0.75 mm BMT.
4. "D" is a drill point, bugle head type D gypsum screw for fixing to steel gauges 0.80 to 2.00 mm BMT.
5. "L" is a needle point, bugle head type L gypsum screw for fixing plasterboard to plasterboard.
6. Screw designation given as (minimum screw gauge) — (threads per inch +1) x (minimum screw length).
7. For ease of construction with framing steel gauges of less than 0.8 mm BMT use 30 mm minimum screw length.
8. Correct screw length is critical when fastening to resilient furring channel to avoid acoustic bridging.
9. Nail lengths are minimums, however care is needed when selecting longer nails to avoid nail bending in hardwoods or popping of plasterboard with unseasoned timber.
10. For wall systems only. Tables to be read in conjunction with plasterboard installation details.

MATERIALS

PERMAROCK® Cement Board

Knauf Permarock Cement Boards are manufactured with aggregated Portland cement and coated glass fibre mesh embedded in the back and front surfaces.

PERMAROCK Cement Board is non combustible and water-resistant. Under water impact, PERMAROCK Cement Board displays extremely slight and system-safe changes in form.

The cement board changes neither its structural cohesion nor its static characteristics. PERMAROCK Cement Board is resistant to mould growth and is therefore also suitable for use in areas where there is a high level of damp.

Altogether, this robustness, resistance and reliability in performance makes PERMAROCK Cement Board ideal for both walls and ceilings systems in wet environments. Knauf utilises the following products in our wall and ceiling systems.

- 12.5 mm PERMAROCK Cement Board Indoor (approx.11.0 kg/m^2)
- 12.5 mm PERMAROCK Cement Board Outdoor (approx.16.0 kg/m^2)

Figure A2: **PERMAROCK Board**

Jointing Tapes

Jointing tapes are used to provide reinforcement to plasterboard joints and angles.

Paper tape is recommended by Knauf for jointing of gypsum wall and ceiling linings due to its high strength and suitability for all jointing compounds and applications.

Paper jointing tape must be used in wet area and fire rated applications and with air-drying type jointing compounds.

Figure A3: **Paper Jointing Tape**

Sealants

H.B. Fuller Firesound™ sealant is recommended for sealing of perimeter gaps and penetrations in Knauf fire rated and acoustic systems.

A suitable flexible waterproof sealant must be used to seal the sheet ends of water resistant plasterboard to other surfaces, such as preformed shower bases, baths and plumbing fixtures (see Wet Areas).

MATERIALS

Jointing Compounds Range

This technical information is intended to provide general information on plasterboard products and should not be used as a substitute for professional building advice.
We recommend you use a qualified person to install Knauf plasterboard. To ensure the information you are using is current, Knauf recommends you review the latest building information available on the Knauf website knauf.com

		Bedding & Base			All Purpose	
		 BaseCote™ 45 BaseCote™ 60 BaseCote™ 90	 Uniflott™ [5]	 RediBase™	 All Purpose Premix	 Total Joint Finish
Jointing	1st Coat	✓[3]	✓[5]	✓[3]	✓[3]	✓[3]
	2nd coat	✓	–	✓	✓	✓
	Finishing Coat	–	–	-	✓	✓
	External Angles	✓	–	✓	✓[4]	✓[4]
	Mechanical Tools	✓	–	✓	✓	✓
Systems	Fire Rated [1]	✓	–	✓	✓	✓
	Wet Area	✓[2]	–	–	✓[7]	✓[7]
	Curing Type	Setting	Setting	Air-Drying	Air-Drying	Air-Drying
	Working Times	45, 60 or 90 mins	45 mins	–	–	–
	Product Size	20 kg bag 10 kg available for BC45	5 kg bag	18 kg pail	18 kg pail	12 kg pail, 4.8 kg pail, 2 kg pail
	Packs /Pallet Quantity	56 (20 kg) 91 (10 kg)	200	48	48	64 (12 kg), 144 (4.8 kg), 245 (2 kg)
	Scrape Back	Easy to scrape	–	Very easy to scrape	Very easy to scrape	Very easy to scrape
	Sanding	–	–	–	Moderate 150 - 180 grit	Moderate 150 - 180 grit
	Compound Type	Powder	Powder	Ready Mix	Ready Mix	Ready Mix
	Colour	Off-White	White	Off-White	White	White

Note 1 – Fire Rated
Paper tape must be used in fire-rated applications.

Note 2 – Wet Area
Knauf base compounds can be used if a waterproofing membrane installed by a specialist contractor and complying with the requirements of AS/NZS 4858 Wet Area Membranes is applied over the whole face of Wet Area walls. Paper tape must be used in wet area applications.

Note 3
Paper tape must be used with first coat compounds when jointing.

Note 4 – Air Drying/ Ready Mix Compounds
Mix Compounds are not recommended for embedding External Angles due to the extended drying time.

MATERIALS

Finishing Compounds			Patching	X-ray
				
SHEETROCK® Total LITE™	**LiteFinish™**	**FinalCote™**	**Patching Plaster**	**GIB X Block® Jointing Compound[6]**
–	–	–	–	✓[6]
✓	✓	–	–	✓
✓	✓	✓	–	-
–	–	–	–	✓
✓	✓	✓	–	✓
✓	✓	✓	–	✓
✓[7]	✓[7]	✓	–	–
Air-Drying	Air-Drying	Air-Drying	Setting	Air-Drying
–	–	–	50 mins	–
17.5 kg pail	18 kg pail	20 kg pail	1.5 kg pail	25 kg bag
48	48	48	245	25
-	-	-	Scrape while green	Easy to scrape
Very easy sanding	Very easy sanding	Easy sanding	Moderate	-
180 - 220 grit	180 - 220 grit	180 grit	150 - 180 grit	
Ready Mix	Ready Mix	Ready Mix	Powder	Powder
Yellow	Yellow	Off-White	Off-White	Brown

Note 5 – Stratopanel
Uniflott is only for use in Stratopanel ceiling systems.

Note 6 – X Ray GIB X-Block
Jointing Compound is specifically designed to give lead equivalent joints on walls and ceilings when using GIB X-Block Plasterboard. GIB X-Block Jointing Compound must be applied to all joints including inner layer joints of 2 or more layer systems. Paper tape must be used for jointing and at least 2 coats of GIB X-Block Jointing Compound should be applied to prevent penetration of X-Rays at joints. Joints can be finished with any of the Knauf premium finishing compounds. GIB X-Block Jointing Compound is an air-drying type compound so ensure each coat has thoroughly dried before applying the next coat.

Note 7 – Only when used as a finishing coat.

DESIGN

Structural

As required by the NCC and relevant Australian Standards, in addition to any acoustic or fire design, building elements must be checked for structural adequacy under dead, live, wind and other applicable loads.

Wall design must allow for:

- Expected vertical deflection due to building movement
- Thermal expansion during fire service
- The support, including lateral support of any door or access panel frames, supported external cladding, internal lining, dampers, shelves, cupboards, attachments or other loadings required to be supported by the wall or wall embedded frame
- Any loadings due to internal or external pressure differentials
- Vertical loads.

Head Clearance

Almost all structures will deflect during service. Designers should be aware of the expected deflections of the building structure as they affect partitions. These deflections may be due to both dead and live loadings. Non-load bearing partitions are not designed to take any axial loading due to building deflection.

In fire rated steel stud walls, thermal expansion of studs of up to 5 mm/m should be expected during fire service. Stud shortening due to thermal bowing may reduce the expansion, especially in thinner walls.

Designers should make due allowance for expected vertical deflections and stud thermal expansion in considering deflection head requirements and, where necessary, refer to Knauf for further information. Standard partition head details should accommodate normal service deflections.

Plasterboard as Structural Bracing

Knauf does not recommend the use of plasterboard ceiling linings to brace the roof structure or individual roof truss chords.

Knauf does not recommend the use of plasterboard for dedicated bracing of walls.

Maximum Wall Heights

Wall heights for non-load bearing steel stud walls must not exceed the maximum heights specified in Steel Stud Walls section.

Maximum heights for non-load bearing steel stud walls have been provided for 0.25kPa lateral serviceability pressure and are based on L/240 deflection criteria set out in the NCC. For maximum heights at 0.35kPa serviceability pressure refer **knauf.com/en-AU/knauf-gypsum/services/tools/eselector**

For other design pressures contact TecASSIST **1800 811 222**

Load Bearing Walls

A load bearing wall is a wall that is intended to resist vertical forces in addition to its own weight.

Refer to Steel Stud Walls section for notes on load bearing steel stud frames.

Refer to Timber Stud Walls section for maximum loads on fire rated timber framed walls.

Wall Loading

Walls, including fire rated walls, that carry shelf loadings must be designed accordingly. Refer to Rondo for permissible shelf loadings on steel stud walls.

Timber noggings and plywood bracing may be incorporated within steel framed fire rated walls to allow for attachments such TVs, hand rails or picture frames etc. The attachment loads must be included in the structural design of steel framing and in accordance with fire assessment reports. Refer Rondo for structural design requirements and contact TecASSIST 1800 811 222 for nogging and plywood backing details.

The following shear loads can be supported directly by FIBEROCK Aqua-Tough linings under non-fire rated conditions:

TABLE A11: **MAXIMUM LOADS ON FIBEROCK AQUA-TOUGH GYPSUM BOARD**

FIBEROCK AQUA-TOUGH THICKNESS	MAXIMUM POINT LOAD PARALLEL TO THE BOARD*
10 mm	10 kg
13 mm	13 kg
16 mm	16 kg

* Loads should be attached with minimum 8 gauge high thread screws installed with the thread for the full thickness of the board.

Allowable Ceiling Loads

Plasterboard spans and loads directly supported on ceiling linings must not exceed the maximum values indicated in Table G1 in the Ceilings section.

DESIGN

Seismic

Seismic compliance refers to the use of approved systems and designs that meet the seismic design requirements of a building project to provide life safety to occupants and maintain building function during and after an earthquake. Non-structural components often represent a high percentage of a project's capital investment. Failure of these components in an earthquake has the potential to cause harm, block egress and impede rescue efforts, and can disrupt the building's function. The basic objectives of seismic design for non-structural components are to provide life safety, minimise property loss and prevent functional loss.

All framing components and connections for walls and ceilings must be suitably designed by Rondo or project engineer in accordance with AS/NZS 1170.4 earthquake actions and other relevant standards for use in seismic applications.

Knauf recommends that all Suspended Grid Ceiling Systems be designed and installed in accordance with AS/NZS 2785 'Suspended ceilings - Design and Installation'.

Every project must be specifically designed to meet AS 1170.4 and/or AS/NZS 2785 requirements based on the project location, importance level, and application type, and must be certified and approved based on local State building regulations and requirements.

Fire Resistance

Fire Resistance Level (FRL)

Fire rating requirements of the Building Code of Australia are specified in terms of Fire Resistance Level (FRL). The FRL specifies the performance, in minutes, for each of the following three design criteria when specimens are fire tested to the requirements of the Australian Standard AS 1530 *Methods for Fire Tests on Building materials, Components and Structures — Part 4: Fire-Resistance Tests of Elements of Building Construction*:

Structural Adequacy

The specimen can no longer carry its load (self weight and superimposed loads).

Integrity

Cracks or openings develop that allow the passage of flames or hot gases.

Insulation

The unexposed face temperature rises by more than 140°C on average or 180°C for a single point.

For example, a wall system under fire test that carries its load for 120 minutes and maintains its integrity and insulation for 120 minutes is given a FRL of 120/120/120, ie 120 minutes structural adequacy, 120 minutes integrity and 120 minutes insulation.

Systems that achieve a particular FRL can be used to satisfy the requirements for a lesser FRL.

Support

Any structure required to support a fire rated system must have a fire resistance structural adequacy level of at least that of the system. This includes vertical support to ceilings and walls and lateral support to the top of walls which may be provided from both sides. Refer NCC for specific requirements.

DESIGN

Adjacent Structure

The NCC requires that building elements, other than roof sarking or certain roof battens, must not pass through or cross a fire rated wall unless the Fire Resistance Level of that wall is maintained. Where trusses and beams pass over or through a fire rated partition, the following measures can be taken to ensure that the Fire Resistance Level of the partition is not degraded due to a failure of these members in the case of fire:

- Construct a fire rated ceiling that protects the structural members
- Fire protect the structural member or
- Ensure the partition can carry loading from the fire affected structural member and that the member can still carry its loading when it is supported on a partition (for trusses this may mean the inclusion of additional webbing above the partition). Ensuring the partition can carry these new loadings may require:
  - Making it into a load bearing partition
  - Constructing the partition with a protected column within it or
  - Constructing unprotected columns on both sides of the partition.

Portal Frame Behaviour

In portal frames affected by the fire the rafters often push outwards on the column members until the ridge sinks and then pulls the columns inwards. Should drywall be used to provide a fire separation within portal framed building, the above mode of failure needs to be recognised by the designer.

As mentioned above, load bearing elements may need to be incorporated within, or adjacent to, the partition to maintain support to the roof structure during a fire event.

Direction of Attack by Fire

In most cases the direction of attack by fire is assumed to be from both sides of the partition. In some cases, such as exterior walls of a Class 10 building or exterior walls of a Class 2-9 building of Type C Construction adjacent to a fire source feature (as defined in the NCC), the rating may be required from one side only. For conventional fire rated plasterboard ceiling systems direction of attack by fire is always from below, while for spanning ceilings it can also be from both sides or from above. Applicable fire attack direction is indicated for each fire rated system listed in this manual.

Maximum Heights

Maximum heights listed for fire rated steel stud partitions are the lesser of maximum fire heights and structural heights for a given wall configuration and stated lateral pressure. Maximum fire heights were derived from full scale tests carried out by CSIRO, BHP, BRANZ and from fire engineering principles.

Maximum structural heights have been obtained by computation and from extensive mechanical testing. Refer to maximum wall height tables for steel stud systems, and Rondo for varying stud configurations to achieve alternative heights.

Resistance to Incipient Spread of Fire (RISF)

The NCC stipulates instances when a ceiling system must be resistant to the incipient spread of fire. This requirement determines the ability of the ceiling to provide adequate thermal insulation to combustible materials within the ceiling plenum thus avoiding the danger of the materials there igniting.

Many of the ceiling systems in this manual carry an RISF rating which is noted as such. RISF is a more onerous requirement than FRL.

Systems that achieve a particular RISF may be used to satisfy the requirements for a lesser RISF.

Insulation Materials

Insulation for thermal or acoustic reasons may be placed within partition cavities. The following is a list of insulation materials, that will not adversely affect the FRL:

TABLE A12: **INSULATION MATERIALS**

MATERIAL	RESTRICTION
Foil-backed sarking, batt, blanket or loose rockwool or ceramic fibre	No restriction
Batt, blanket, loose wool or glasswool	Any thickness but density not less than a tested system

Fire Hazard Properties

Wall and ceiling lining materials in certain types of buildings must comply with the Fire Hazard Properties requirements of the NCC.

All Knauf gypsum board lining products are classified as Group 1 (least hazardous) materials and have a smoke growth rate index less than 100 and/or an average specific extinction area less than 250 m^2/ kg when tested in accordance with the NCC.

DESIGN

Combustibility

In accordance with Deemed-to-Satisfy Provision C2D10 of the NCC Volume One, and H3D2 of the NCC Volume Two, gypsum boards can be used wherever a non-combustible material is required.

NOTE:
FIBEROCK Aqua-Tough and PERMAROCK cement board are deemed non-combustible when tested in accordance with AS 1530.1-1994.

Gas Reticulation in Fire Rated Walls

Oxygen or combustible fluid reticulation systems should not be located within fire rated walls unless designed, fire tested and constructed to suit this application.

Penetrations

Penetrations in a fire rated system must be treated strictly in accordance with relevant test reports and approved installation details in order to maintain the system's Fire Resistance Level.

Where components by others are specified in Knauf fire rated penetration details (ie dampers GPOs, fire collars, etc), such components must be installed in accordance with the manufacturer's specifications. It is the responsibility of the component manufacturer to ensure that the fire rating performance of the system is not affected.

Smoke Walls

Where smoke walls are required in accordance with the NCC, such walls can be lined with minimum 13 mm SHEETROCK ONE plasterboard.

Jointing

Compounds used for finishing plasterboard joints in fire rated systems may be any plaster or vinyl based compounds supplied by Knauf that are normally used for this purpose.

Knauf vinyl jointing compounds have been shown by test not to self ignite at temperatures below 200°C and thus are suitable for use in fire rated systems.

Acoustics

Weighted Sound Reduction Index (R_w)

The NCC has adopted the Weighted Sound Reduction Index (R_w) as a measure of sound insulation of building elements. A partition with a high R_w isolates sound better than a partition with a low R_w (an increase of 10 points in R_w indicates doubling in perceived performance).

R_w ratings are obtained from tests carried out in certified laboratories, under controlled conditions. Determination of R_w is defined in AS ISO 717.1 *Acoustics — Rating of sound insulation in buildings and of building elements Part 1: Airborne sound insulation.*

In practice the sound insulation is used to measure the speech privacy between spaces, but the level of privacy depends on both the background noise as well as the sound insulation between spaces. Indicative examples of the speech privacy using Knauf wall systems, based on a background noise level of 30 dB(A), is shown below.

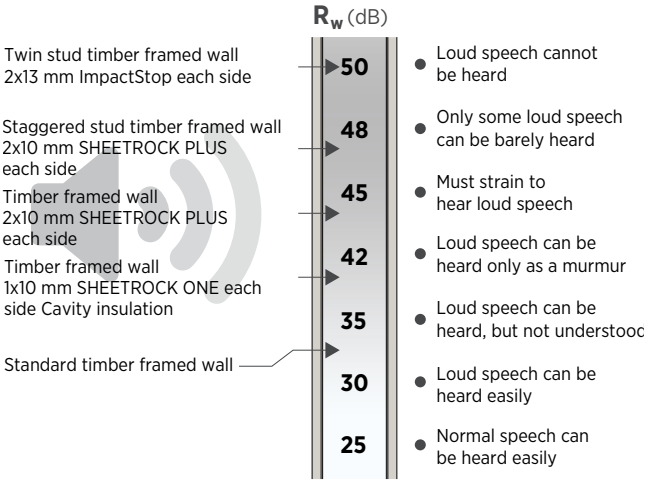


Figure A4: **Noise Levels**

DESIGN

Spectrum Adaptation Term (C_{tr})

The R_w alone is not a good indicator of how well the partition isolates low frequency (bass) sounds. To better measure the low frequency performance of wall & floor/ceiling partitions, the NCC requires specific walls to meet an $R_w + C_{tr}$ criterion.

When the C_{tr} is combined with the R_w the result is a single number index which provides a more reliable indicator of the ability of the partition to isolate noise containing low frequency components.

Two partitions with the same $R_w + C_{tr}$ value will typically have similar low frequency isolation properties even if their respective C_{tr} terms are very different. The higher the $R_w + C_{tr}$ value for a wall or ceiling partition the better the sound insulation performance, particularly in the low frequencies.

The C_{tr} typically ranges between -1 dB to -15 dB and is calculated from the airborne performance of a partition in the range of frequency bands measured. Determination of C_{tr} is defined in AS ISO 717.1 *Acoustics — Rating of sound insulation in buildings and of building elements Part 1: Airborne sound insulation.*

Impact Sound Insulation

Walls

NCC requires that certain walls between sole occupancy units in multi-residential buildings Class 1, 2, 3 and 9c must provide impact sound insulation.

Under the deemed-to-comply provisions of the NCC walls requiring impact sound insulation in Class 2 and 3 buildings must be of 'discontinuous construction'. The NCC defines discontinuous construction as a wall having *a minimum 20 mm cavity between two separate leaves*, and:

- For masonry, where wall ties are required to connect leaves, the ties are of the resilient type
- For other than masonry, there is no mechanical linkage between leaves except at the periphery.

Knauf wall systems qualifying as 'discontinuous construction' include:

- Twin stud wall systems, both in timber and steel
- IntRwall systems (which include a separate steel stud at least to one side)
- PartiWall systems (with aligned floors on each side of separate dwellings)
- Masonry acoustic upgrade systems with a free-standing wall at least on one side.

NOTE:
The NCC states that a staggered stud wall is not deemed to be discontinuous construction.

Floors

In addition to a minimum sound isolation performance ($R_w + C_{tr}$), the NCC contains a requirement for an impact sound rating of floors between sole occupancy units in multi-residential buildings Class 2 and 3, expressed as $L_{n,w}$.

The Weighted Normalised Impact Sound Pressure Level ($L_{n,w}$) is measured in a laboratory and indicates how much sound reaches the receiving room from a standard tapping machine. The lower the number the better the performance of the floor at isolating impact sounds.

$L_{n,w}$ is defined in AS ISO 717.2 *Acoustics — Rating of sound insulation in buildings and of building elements — Impact sound insulation.*

Difference Between Laboratory and Field Acoustic Performance

On-site field testing is allowed as a verification method to comply with the provisions of the NCC. The on-site rating measurement under the NCC is the $D_{nT,w}$ (Weighted Standardised Level Difference) and is, technically, slightly different to the laboratory R_w assessment.

When identical partitions are tested on site it is often found that the site rating, $D_{nT,w}$, is lower than the R_w (laboratory performance). This reduction in performance can be due to:

- Incorrect installation procedures
- Flanking paths (ie. noise passing through adjacent parts of the building)
- Non-ideal measurement conditions. For instance, small room sizes may affect accurate measurements in particular frequencies.

The NCC allows a 5 dB concession between the laboratory performance and the field performance to allow for flanking and the technical difference in units. Therefore, the $D_{nT,w} + C_{tr}$ may be up to 5 dB less than the $R_w + C_{tr}$.

For the transmission of impact generated sound through floors, the NCC does not allow any concession from the laboratory performance to the field performance. Therefore, the on-site performance requirement, $L'_{nT,w}$ (Weighted Standardised Impact Sound Pressure Level), cannot exceed the maximum $L_{n,w}$ required by the NCC.

DESIGN

Sound Insulation Rating of Services

The NCC requires ducts, soil and waste pipes and water supply pipes that serve or pass through more than one SOU, including those located in a party wall or floor cavity to be acoustically separated from Habitable and non-Habitable rooms by a construction with a minimum $R_w + C_{tr}$ rating.

In addition to the airborne rating, the NCC requires that water supply pipes must only be installed in the cavity of discontinuous construction.

To achieve the sound insulation requirements of the NCC, one of the options for soil and waste pipe treatment includes acoustic lagging of the pipes which typically comprises a loaded vinyl isolated from the pipe with foam or fibreglass. It is important that the lagging and pipe are not in contact with ceilings, walls or supports and the pipe mounts and supports are not in contact the surrounding bulkheads or risers.

Over-partition Noise Rating

Sound can easily travel through an exposed grid or flush suspended ceiling and over the top of a partition where it abuts the underside of a suspended ceiling. This is a common source of sound transmission particularly where the ceiling is porous to sound.

In this case the sound rating of the ceiling element is stated as the $D_{n,c,w}$ — Weighted Suspended-Ceiling Normalised Level Difference.

The $D_{n,c,w}$ is defined in AS ISO 717.1 *Acoustics - Rating of sound insulation in buildings and of building elements Part 1: Airborne Sound Insulation*, where the individual $D_{n,c}$ values (Suspended Ceiling Normalised Level Differences) are determined by laboratory measurements as defined in AS/NZS 2499 *Acoustics — Measurements of sound insulation in buildings and of building elements — Laboratory measurement of room-to-room airborne sound insulation of a suspended ceiling with a plenum above it.*

Where sound insulation is important, partitions should, wherever possible, continue through the ceiling to the structural soffit and be sealed at their perimeter.

Figure A5: **Sound Transfer Over Partition**

Sound Absorption Rating

The reverberation time is a critical element in determining the acoustic quality of a space. The reverberation time is determined by a number of factors, but the most important is the amount of acoustic absorption in the space. The overall acoustic absorption is determined by the area of absorptive material and the absorption coefficient of the material.

The sound absorption coefficient, α, is a measure of how well a material stops sound being reflected as is measured in accordance with AS ISO 354 *Acoustics - Measurement of Sound Absorption in a Reverberation Room*. The absorption coefficient varies as a function of frequency, and the sound absoprtion of a material is usually expressed as a single number rating, the Weighted Sound Absorption Coefficient, α_w, which is calculated in accordance with AS ISO 11654 *Acoustics - Rating of Sound Absorption - Materials and Systems*.

Construction Changes and Substitutions

Changes in construction and substitution of different materials can increase or decrease the acoustical isolation of wall and floor/ceiling systems and may result in the acoustical isolation falling below the specification or NCC requirements. The following comments apply to wall systems unless otherwise noted:

Studs

- Except for staggered stud and twin stud wall systems, substituting timber studs in place of steel studs generally results in a significant decrease in sound insulation.
- In single stud walls lined both sides increasing the thickness of steel studs from 0.50 BMT or 0.55 BMT to 0.75 BMT or 1.15 BMT will generally decrease sound insulation.
- Decreasing the stud spacing will decrease the sound insulation.

Plasterboard

Substituting with lighter plasterboard will usually result in a change in R_w of around 1-2 dB for most systems, although a greater reduction may occur with separating wall systems such as PartiWall.

Insulation

- Thinner insulation may decrease the sound insulation.
- Thicker insulation may increase the sound insulation.
- Higher density insulation will generally increase the acoustic performance of a system.

DESIGN

Fixings

- Using more screws or nails than specified may reduce the sound insulation.
- Using cornice adhesive or other methods of laminating plasterboard, other than nailing or screw fixing, will reduce the sound insulation.

Perimeter Acoustical Sealing

It should be noted that as the sound insulation requirement of a partition increases, the control of flanking paths becomes more critical. Consequently, the perimeter sealing requirements for a low sound rating wall, such as R_w 30 dB, are lower than for a high sound rating wall, such as R_w 60 dB. It cannot be over-emphasised that for high performance walls, the sealing of each face must be virtually airtight.

For a sealant to be effective at controlling noise passing through gaps, it must have the following properties:

- Good flexibility, elastic set
- Low hardness
- Excellent adhesion, usually to concrete, timber, plaster and galvanised steel
- Minimal shrinkage (less than 5%)
- Density greater than 800 kg/m^3
- Fire rated (where required).

All of the above properties must be maintained over the useful life of the building.

Some silicone sealants and some acrylic latex sealants are examples of suitable sealants. Reference should be made to the manufacturer to ensure the particular type or grade of sealant is suitable for the purpose.

Knauf recommends H.B. Fuller Firesound sealant for caulking of acoustic systems.

NOTE:
The use of expanding foam sealants is not acceptable.

Noise Flanking

Noise flanking can significantly reduce the perceived isolation of a wall or floor/ceiling system and should therefore be given careful consideration.

Typical flanking paths for a wall include:

- Through ceilings and via the ceiling cavity above
- Through floors and via the floor crawl space below
- Through glazing and windows
- Through light switches, or GPOs, located in the wall
- Through gaps, cracks, holes or other penetrations or services (continuous pipes, ducts, etc.)
- Through shared building elements such as floor boards, floor joists, continuous plasterboard walls, continuous plasterboard ceilings and even continuous concrete walls and floors
- Through the perimeter joints between the wall and the floor, or the wall and the ceiling (or underside of the floor slab) or wall junctions
- Via adjacent walls or facade walls.

Typical flanking paths for a floor/ceiling system include:

- Through windows
- Through light fittings or air conditioning fixtures in the ceiling
- Through shared building elements, such as external walls
- Through any sound leaks
- Through the perimeter joints between the floor and walls, or between the ceiling and wall.

DESIGN

Acoustic Performance On Site

Acoustic performance ratings stated in this manual are based on tested laboratory results or the expected laboratory results based on the opinions of independent acoustical consultants.

To reproduce the stated performance in the field, attention to detail in the design and construction of the partition/ceiling and its associated structure is of prime importance. Even the most basic principles, if ignored, can significantly downgrade the sound insulation performance.

Knauf cannot guarantee that the site tested acoustic performance of the systems will achieve the laboratory test results or the expected laboratory performance (opinion). The NCC provides a margin of 5 dB between the laboratory tested values and the equivalent site tested values for airborne sound transmission loss, and different types of systems are likely to have different variances between laboratory and site tested values. However, with careful attention during erection of the wall or ceiling, correct installation to specification and proper caulking/sealing, the difference between the laboratory or estimated laboratory value and the site measured value should be minimised.

Apart from installation procedures, workmanship and caulking the following factors can also affect the acoustic performance on site:

Doors

Hollow core and even solid doors generally provide unsatisfactory sound insulation between rooms. Doors can also provide direct air leaks between rooms thus having a detrimental effect on the overall sound insulation of the partition in which they are located. The higher the insulation of the partition, the worse is the effect of doors.

Where sound insulation is important, specialised heavyweight doors or, preferably, two doors separated by an absorbent lined airspace or lobby should be used.

Because air leakage largely determines the sound insulation of a single door, consideration must be given to providing airtight seals between the door and the frame and at the threshold. The joints between the door frame and partition structure should also be sealed. The door seal must be compatible with the fire resistance of a door if required.

Lightweight Panels Above Doors

These are often incorporated for aesthetic reasons, however, the performance of a partition with high sound insulation can be considerably downgraded by lightweight panels.

Air Paths through Gaps, Cracks or Holes

Gaps, cracks or openings, however small, readily conduct airborne sounds and can considerably reduce the sound insulation of a construction.

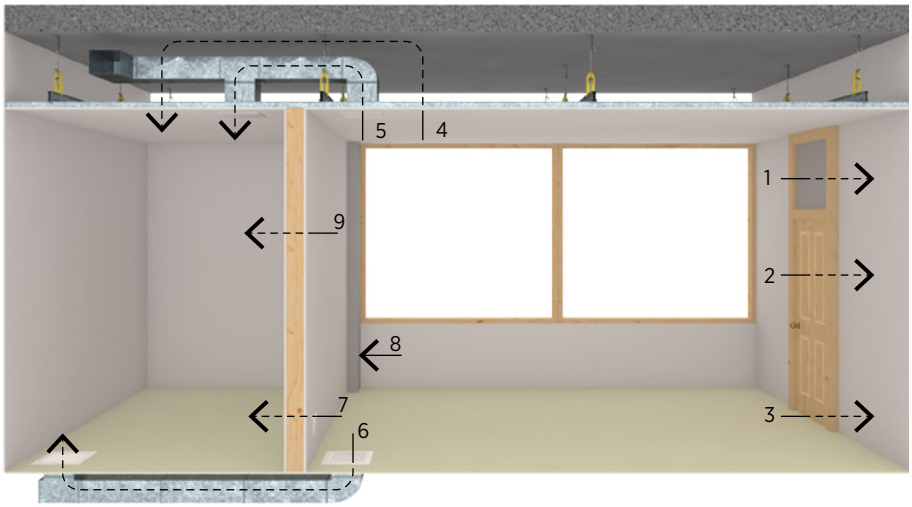


Figure A6: **Sound Flanking Paths**

Diagram Key

1. Lightweight panels above doors
2. Doors
3. Air leaks through gaps, cracks or holes
4. Sound transmission via suspended ceilings/partitions
5. Common ventilation system without sound absorbent treatment
6. Common floor duct
7. Electrical outlets and service pipes
8. Lightweight mullions or mullion/ partition closers
9. Partition performance.

DESIGN

Appliances

In cases where sound insulation is important, noise producing fixtures or appliances such as water closets, cisterns, water storage tanks, dishwashers, washing machines and pumps should be repositioned or isolated from the structure with resilient mountings and flexible service leads and connections.

Where fittings are duplicated on opposite sides of partitions, such as back to back baths or unit shower cubicles, the partition wall should be continuous between the fittings, otherwise a path for direct sound transmission will exist.

Electrical Outlets and Service Pipe Penetrations

Penetrations in separating walls should be avoided. This includes recessed fittings or ducts such as skirting heating, electrical or other wiring, light fittings, intercommunication systems and alarms, medical and laboratory gas outlets.

Plumbing connections between fittings or appliances on opposite sides of a partition offer a path for transmission of sound and should be sealed. If possible introduce discontinuity in the pipe work between fittings, such as a flexible connection within or on the face of a partition.

The acoustic performance may be downgraded where penetrations or services exist within the wall unless extreme care is taken at the detailing and construction stages. This is especially likely with acoustical bridging caused by plumbing or electrical services or by structural members including flooring.

Where penetrations are not avoidable in separating walls, electrical outlets, switch boxes and similar penetrations should not be placed back-to-back. Seal backs and sides of boxes and the perimeter of all penetrations with acoustic sealant. Preferably, sound-rated electrical outlets and switches should be used, or outlets and switches should be surface mounted on sound rated walls.

The NCC states that electrical outlets must be offset from each other in timber or steel framed walls by not less than 300 mm.

Penetrations in Linings Separating Soil and Waste Pipes

The acoustic ratings for unlagged soil and waste pipes are provided in Section I of Systems+.

The effect of penetrations differs between the unlagged and lagged and clad pipes. Lagging and cladding has the benefit of reducing the noise emitted from the pipe itself.

Refer to lagging manufacturer's data for acoustic ratings of lagged soil and waste pipes.

Wet Areas

Regulatory Requirements

Wet area as defined in the National Construction Code (NCC) is an area within a building supplied with water from a water supply system and includes bathrooms, showers, laundries and sanitary compartments.

According to NCC, building elements in wet areas must be waterproof or water resistant depending on the location within a wet area and must comply with AS 3740 *Waterproofing of domestic wet areas*.

AS 3740 sets out minimum material, design and installation requirements for waterproofing of wet areas within residential buildings and other buildings with a similar usage intensity. It also outlines typical wet area construction materials and methods.

Water-resistant plasterboard manufactured to AS/NZS 2588 *Gypsum Plasterboard* constitutes a water resistant substrate for the purposes of AS 3740.

Waterproofing membranes used in wet areas must comply with AS/NZS 4858 *Wet Area Membranes*.

Refer to AS 3740 and the NCC for minimum extent of waterproofing in wet areas.

Ceilings over Wet Areas

As the NCC does not require the use of water resistant ceiling linings over wet areas, Knauf non-water resistant gypsum boards provide an adequate solution for this application. Knauf water resistant gypsum boards can be used in wet area ceilings if desirable.

Knauf recommends that ceiling paint in wet areas should be impervious to moisture.

Knauf Wet Area System

Knauf Wet Area System comprises materials and installation details outlined in Knauf Installation Manual and must be installed in accordance with Knauf specification to achieve the required performance.

Knauf Wet Area System complies with the requirements of AS 3740 and is therefore suitable for use in residential buildings and other buildings with a similar usage of wet areas.

Knauf Wet Area System is not suitable for use in high exposure applications such as group shower rooms, steam rooms, etc. or in areas of high humidity (above 90% RH). For such applications refer to Knauf Permarock Cement Board Indoor systems in this manual.

DESIGN

Radiation Protection

Medical X-ray diagnostic rooms require protective barriers to shield operators and occupants of adjacent areas against excessive levels of radiation.

Radiation intensity depends on the application and the minimum shielding requirements are set out by the relevant Government Authorities. Advice on X-ray protection for a particular installation must be sought from a qualified Health Physicist to ensure the requirements for occupational and public protection are met.

Shielding for diagnostic X-ray rooms tends to be specified in terms of the thickness of lead required to achieve the appropriate level of protection.

GIB X-Block is a lead-free plasterboard that provides X-ray and Gamma ray protection. X-block avoids the health and waste disposal issues associated with using lead and is lighter and easier to install than lead based solutions.

Refer to the GIB X-Bock Radiation Shielding Systems manual for product performance data and installation specifications.

Thermal Insulation

Under the Deemed-to-Satisfy provisions of the NCC, the elements of building envelope must achieve minimum thermal resistance (R) values stipulated for various Classes of buildings and Climate Zones (thermal resistance requirements for Class 2 buildings are summarised in Multi-Residential section).

The total R-value of a building system is a sum of R-values of the system components, enclosed air gaps and internal and external air layers. R-values of various Knauf lining products are shown in Table A4.

Although plasterboard itself does not provide high thermal resistance, R-values of framed plasterboard systems can be significantly increased by incorporating bulk or reflective cavity insulation.

Refer to the External Walls section for thermal resistance ratings of Knauf external wall systems.

Design Considerations

Condensation

Condensation occurs when warm and humid air comes into contact with cold surfaces.

Condensation on internal building surfaces is more likely to occur where there are large temperature fluctuations and the moisture content inside a house (often generated in a bathroom, laundry or kitchen) is high.

Repeat or prolonged condensation may lead to; nail-popping, sagging ceiling linings, rotting, mould growth, joint and corner cracking and deterioration of internal air quality. If left untreated, condensation may result in structural damage to the building and health concerns for the building occupants.

The following precautions can help minimise internal condensation:

- Keep air spaces well ventilated to promote moisture dissipation, especially in the roof and sub-floor spaces.
- In rooms such as bathrooms, kitchens and laundries exhaust moisture-laden air to the outside of the building and not into the roof or ceiling space.
- Use vapour barriers in conjunction with insulation around the building envelope. Place vapour barrier on the warm side of insulation.
- Use thermal breaks on steel framing members (refer NCC).

Devices Generating Heat

Knauf Plasterboard does not recommend the use of radiant heating systems continuously subjecting plasterboard ceilings to temperatures in excess of 52°C.

Prolonged exposure to temperatures higher than 52°C may cause changes in the chemical composition of the gypsum core and loss of plasterboard integrity over time.

The following regulatory and normative requirements must be followed in order to prevent plasterboard deterioration due to excessive temperatures from heat generating devices:

- NCC provisions for installation of heating appliances, fireplaces, chimneys and flues
- AS 2918 *Domestic solid-fuel burning appliances — Installation*
- AS/NZS 5601.1 *Gas installations.*

In accordance with AS/NZS 5601.1, combustible surfaces within 200 mm of the edge of the nearest burner must be protected to a height of not less than 150 mm above the periphery of that burner and for the full length of the cooking surface area.

10 mm plasterboard covered with 5 mm ceramic tiles or toughened safety glass is an acceptable method of protection for combustible surfaces in domestic applications. An additional layer of 6 mm fibre cement fixed over the plasterboard is required for a sheet metal facing.

13 mm and 16 mm FIBEROCK Aqua-Tough is classified as a fire resistant material in accordance with AS/NZS 5601.1 Appendix C and is suitable for use in non-loadbearing applications to protect combustible surface materials adjacent to appliances other than commercial catering appliances.

Refer to AS/NZS 5601.1 for clearance zones around domestic and commercial gas installations, and splashback fire protection requirements by relevant State and Territory authorities.

NOTE:
Knauf does not advise the use of plasterboard as a wall lining behind and around fireplaces unless protected in accordance with the NCC.

DESIGN

Control and Movement Joints

The purpose of control joints is to accommodate hygrometric (moisture caused) and/or thermally caused changes in plasterboard dimensions. Control joints are required in unbroken plasterboard walls and ceilings at no greater than 12 metre centres in both directions (6 metre maximum spacing for external ceilings).

Movement joints are required in walls and/or ceilings in order to accommodate movements in the building structure (ie. due to shrinkage, settlement, wind or seismic forces) and include construction and expansion joints and joints at changes in substrate materials.

Control joints in non-fire rated systems can be formed by fitting Rondo P35 control joint or plastic expansion beads that leave a neat and flexible joint.

Control joints in plasterboard walls and ceilings must coincide with control/movement joints in superstructure.

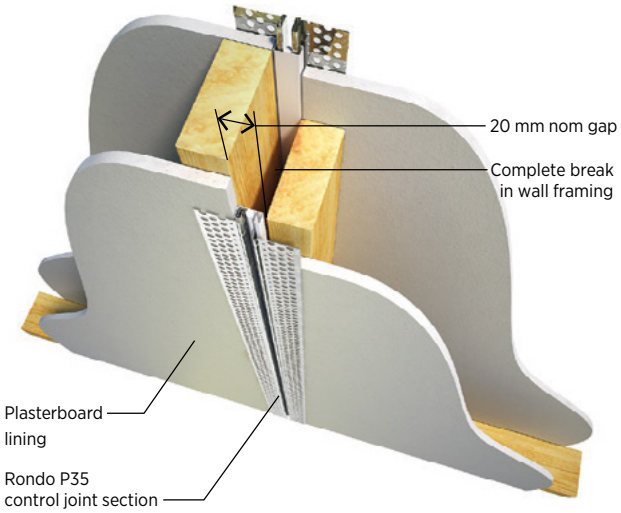


Figure A7: **Control Joint in Non-Fire Rated System**

Refer to Junctions and Penetrations section for details of Knauf online CAD Finder for control and movement joints in fire rated systems.

Jointing

Compounds used for finishing plasterboard joints in fire rated systems may be any plaster or vinyl based compounds supplied by Knauf that are normally used for this purpose.

Knauf vinyl jointing compounds have been shown by test not to self ignite at temperatures below 200°C and thus are suitable for use in fire rated systems.

Impact Resistance

Impacts on walls come in three basic forms: soft body, abrasive and hard body. Each of these can affect the wall lining in different ways and consequently affect the choice of the lining system.

Soft Body Impact

Soft body impact is the type of impact one would associate with people hitting walls with their shoulder or hip. Soft body impact testing is a requirement under the NCC (Specification 6) for certain types of wall systems.

Up to the point of breaking the lining, soft body impacts rarely leave any visible marks on the face of the wall, unlike hard body and abrasive impacts.

Where required, Knauf systems comply with the soft body impact resistance provisions of the NCC.

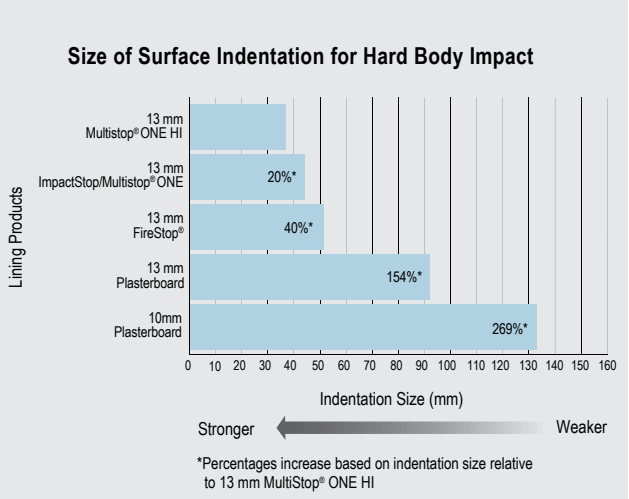
Figure A8: **Impact Test In Progress**

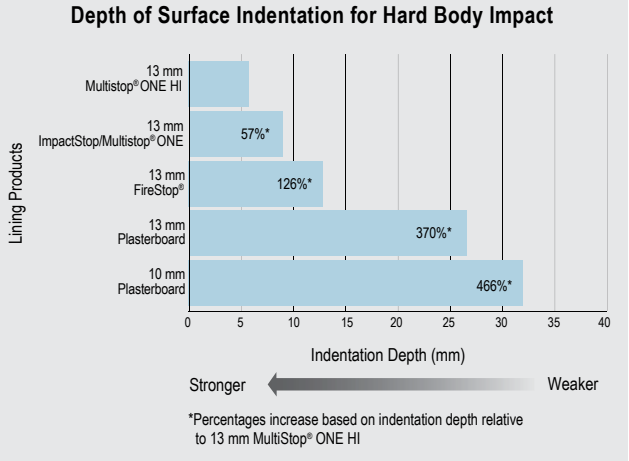
DESIGN

Hard Body Impact

The NCC specifies a static test measuring resistance to indentation of wall linings (Specification 6), but no hard body impact requirements. All plasterboard products produced by Knauf meet this surface indentation criteria.

These hard body impacts result in dents or gouges and sometimes penetration of the wall lining. Examples of hard body impacts would include kicks and hits with trolleys or hockey sticks. Knauf has developed hard body impact test simulations with a 4.0 kg steel ball on various plasterboard products. Refer below for relative hard body impact performance.





Abrasive Impact

This impact occurs when an object is scraped along the face of the wall and usually is seen by marks in the paint covering the wall lining.

Resistance against abrasion is more a function of the surface coating over the face of the wall lining, than the lining itself.

With a glancing impact, where a hard body object strikes the wall at an angle of less than 90 degrees, the damage will often be a combination of abrasion and denting.

Design Options

The following design options can be incorporated in Knauf wall systems if required:

Insulation

Various forms of insulation can be placed within wall cavities and over ceilings to achieve acoustic or thermal requirements. However, designers should be aware of the following:

- The mass of insulation acting directly on ceilings must not exceed maximum loads indicated in Table G1 in the Ceilings section.
- Insulation that attracts and holds moisture for prolonged periods is not recommended for use in Knauf ceiling systems.

Overall Width of Partition

Twin and staggered stud walls, often used to form a services duct, can be varied in width to suit the building design. Note that reducing the width may adversely affect the acoustic properties of the partitions.

Where discontinuous construction is required by the NCC, the gap between the two leaves of the partition should not be less than 20 mm.

Frame

Other factors remaining the same, steel stud depth and gauge greater than that specified may be used without adversely affecting the fire resistance of the wall system (note that changes in stud size or gauge may affect the system acoustic rating).

Permissible variations for fire rated timber framed systems include the following:

- Timber sections other than specified can be used provided that they are of the same:
  - stress grade or higher
  - section or deeper, and/or wider
  - or higher average density.
- Treated timber can be used in place of untreated timber provided that its charring rate is proven by fire testing to be no greater
- Studs or noggings may be paired, or installed at closer centres than shown (acoustic considerations may limit the minimum stud centres).
- Flat strap, sheet or angle bracing flattened over studs before lining is applied may be used in timber framed walls without affecting the FRL or design capacity of the system provided the studs remain unnotched. These types of bracing can also be used in staggered stud walls.
- Top plates in timber framed walls should be designed by a suitably qualified Structural Engineer where dead and/or live loads are applied at more than 1.5x plate depth from the stud.

DESIGN

Frame Spacing

Unless noted otherwise, all plasterboard supporting framework must be spaced at no greater than 600 mm centres.

Stud Substitution

Rondo steel studs have been used in the development of Knauf acoustic and fire rated systems.

Limiting heights and spans listed are for Rondo studs only. Other stud sections should not be used unless it can be shown that they are at least equal to Rondo studs in all of the relevant performance characteristics.

Structural and fire properties of unlipped C-studs can vary significantly from those of lipped studs, therefore unlipped C-studs must not be used without their independent assessment by a qualified Engineer.

Cavity Structures

Ballistic or forcible entry protective items may be included within walls. In the case of fire rated walls, adequate allowance must be made for expansion relief at the perimeter of ballistic/protective steel sheets. Security mesh may be incorporated within steel framed fire rated walls to Knauf details. Structural steel or timber sections may be incorporated within fire rated walls, refer to Column and Beam protection systems for details.

Noggings and plywood bracing may be incorporated within steel framed fire rated walls. Contact TecASSIST **1800 811 222** for nogging and plywood backing details.

Board Orientation

In wall systems the sheets of plasterboard may be oriented with the bound edges horizontal, vertical or, in the case of multilayer systems, both horizontally and vertically oriented layers. This option may be useful in achieving the best outcome in the prevailing lighting conditions.

Beams and Columns

Wall support beams, walls under beams, structural frames and columns within walls may be incorporated as per standard Knauf details.

Fastener Size and Spacing

Screws and nails of greater gauge and at lesser centres than specified may be used without adversely affecting the fire resistance level of a partition or ceiling (note that acoustic performance of the system may be affected).

Curved Walls and Ceilings

Refer to Knauf for construction details for curved fire rated and non-fire rated walls and ceilings.

Curved fire rated ceilings to have a radius of no less than 6000 mm.

Attachments, Shelf Loading Capacity

In general, items may be attached through a fire rated lining to the wall frame providing that:

- The frame is designed and constructed to take the loading from the attachments and
- The attachments have a self ignition temperature of not greater than 200°C.

Electrical conduits may be attached to steel stud partitions by means of clipping to screw fixed pressed metal sections without detrimentally affecting the FRL of the partition provided that:

- The conduits are self supporting and do not impose any axial load on the partition and
- The clips used to restrain the conduits are manufactured from a material having a melting point not exceeding 250°C.

Refer to Knauf for attachment options for non-load bearing walls. For load bearing steel stud walls, framing and fastenings are to be designed by an appropriately qualified Structural Engineer and shall comply with AS 4600 *Cold-formed steel structures*.

Exterior Cladding, Lining

Exterior cladding or interior lining may be added to walls providing the frame is designed and constructed to accommodate the extra loading and, in the case of fire rated walls, the self ignition temperature of the cladding components exceeds 200°C.

As with other materials, plasterboard lined exterior walls will require careful detailing to avoid possible problems associated with effects of moisture.

Penetrations

Access hatch, duct, GPO, lighting recesses, tapsets, pipe and cable penetrations in fire rated walls and ceilings are to be constructed to fire tested or assessed details.

The incorporation of services and penetrations must not adversely affect the structural capacity of the framing members or the acoustic properties of the wall system.

DESIGN

Lighting Recesses and Service Chases

Where items such as lights, plumbing, heating or electrical services are fitted within or pass up through a fire rated wall, the recess/chase must first be framed out then the top, bottom, sides and back are to be lined using the same thickness and number of linings as on the penetrated face of the wall.

All corners between plasterboard linings are to be formed herringbone style, backed by a stud, metal stud track or angle of greater than 0.7 mm BMT and any cable penetrations are to be sealed with an approved fire grade sealant. Refer to the relevant details in the Junctions and Penetrations section.

NOTES:

- The acoustic insulation capacity of walls is likely to suffer where chases and/or lighting recesses are provided within the wall or ceiling.
- Lighting or other heat producing items should not be included within walls where there is any likelihood that, through continuous, extensive use, temperatures in the plasterboard surrounding the fitting remain above 52°C for a prolonged period of time.

Access Panels

Access panels up to 600 mm square may be constructed within non-load bearing fire rated walls with a FRL of up to –/120/120. Prefabricated non-fire rated and fire rated access panels are also available (refer to panel manufacturers for installation details and fire test reports/certificates).

Ducts, Dampers and Grilles

Where items such as ducts, dampers and grilles pass through a fire rated wall, the penetration systems must be fire tested or assessed for compliance by Fire Testing Authority. The aperture must first be framed out allowing for lining and sealing of the aperture and expansion of the penetrating item during fire service where required. A useful rule of thumb for the amount of expansion to be allowed for is 10 mm + 1% of the side under consideration. Some dampers are built to absorb their thermal expansion within their outside dimensions (refer to damper manufacturer's specifications).

The wall frame may need to be strengthened locally to account for any crippling of studs causing redistribution of loadings into the adjacent full height studs (ie. these studs may be required to be boxed or require additional structural steel).

The aperture should be lined using the same thickness and number of linings as on the face of the wall. The sealing/mounting system around the penetrating item is to be as tested or assessed for that particular item.

Appearance

Levels of Finish

The term 'Level of Finish' applies to plasterboard linings prior to decoration.

AS/NZS 2589 *Gypsum linings — Application and finishing* defines three levels of finish: 3, 4 and 5. Level 4 is the default level of finish for plasterboard linings, unless specified otherwise.

It is essential that the level of finish is determined at the design stage since each level has specific requirements for substrate tolerances and plasterboard installation, jointing and finishing. The desired level of finish may not be achieved unless all of these requirements are met through various stages of construction.

Levels of finish recommended for various lighting conditions and surface decorations are shown in Figure A9.

For the full description of levels of finish and guidelines on assessment of finished surfaces refer AS/NZS 2589.
A summary of various levels of finish is provided below:

Level 3

This level of finish is used in areas that do not require decoration or where finish is not important (for example, above ceiling level or inside service shafts and the like).

All joints and interior angles must have tape embedded in the joint compound and one separate coat of joint compound applied over all joints and fastener heads.

Butt joints and recessed joints in walls and ceilings can be on framing members.

Level 4

This is the default and generally accepted level of plasterboard finish. All joints and interior angles must have tape embedded in the jointing compound and a minimum of two separate coats of joint compound applied over all joints, angles, fastener heads and accessories.

Wall butt joints can be on framing members. If wall butt joints are between framing menbers, any butt joints longer than 400 mm and less than 2 m above the floor must be back-blocked.

Ceiling butt joints must be between framing members. All ceiling butt joints must be back-blocked. Ceiling recessed joints must be back-blocked in any area containing three or more recessed joints.

If Level 4 surface is to be exposed to critical light (see Glancing Light on page A26), it should be covered with textured finishes or wall coverings. Smooth textured finishes and flat/matt or low sheen paints can be used when Level 4 finish is illuminated by non-critical lighting. Flat paints in this situation tend to conceal joints better.

DESIGN

Weight, texture and sheen level of wall coverings and finishes should be carefully evaluated and joints should be adequately concealed if wall-covering material is lightweight, glossy or lightly patterned.

NOTES:

- In critical lighting conditions, surface variations may still be apparent in a Level 4 surface finish.
- Gloss, semi-gloss or deep tone paints are not recommended for Level 4 finish, as they accentuate surface variations.

Level 5

Level 5 finish should be used where gloss or semi-gloss paints are specified or where lining surfaces will be exposed to critical lighting conditions.

Level 5 finish is characterised by a parity of surface texture and porosity. All joints and interior angles must have tape embedded in the jointing compound and a minimum of two separate coats of jointing compound applied over all joints, angles, fastener heads and accessories.

Butt joints in walls and ceilings must be between framing members and back-blocked. Recessed joints in the ceilings must be back-blocked.

The work is finished with proprietary surface preparations or skim coating to remove differential surface textures and porosity. A suitable paint or plaster material (eg SHEETROCK Tuff-Hide primer surfacer) is sprayed, rolled or trowelled over the defined area. The surface texture must be random and monolithic, concealing joints and fixing points.

NOTES:

- If Level 5 finish is desired for a decorated plasterboard surface, this must be specified at the design stage.
- Level 5 finish is difficult to achieve and always requires the cooperation of the framer, plasterer and painter in establishing suitable work practices that deliver the agreed painted finish for the given project.
- Some minor surface variations may still be visible in Level 5 finish, however, these will be minimised.
- The surface of the defined area may require sanding to be suitable for decoration.

Framing Tolerances

Refer to Table A8 for maximum allowable framing tolerances for various levels of finish.

Influences

There are many factors in modern building design that influence the overall appearance of a wall or ceiling.

Modern features such as lower unbroken ceiling areas across adjoining rooms, large open living areas, and importantly, larger windows with greater use of natural light from skylights and mirrored walls etc often create conditions in which it is difficult to achieve the desired level of finish.

Consumers are often not aware of the difficulties involved in achieving their expectations, particularly when some design conditions highlight rather than camouflage surface conditions. It is therefore very important that the consumer's expected standard of finish matches the level of finish the tradesperson is capable of achieving given the particular design features of the project.

Glancing Light

Glancing light is the light that shines across the surface of a wall or ceiling rather than directly on it. When considering the type of finish required it is important to understand how the overall appearance is likely to be affected by glancing light in a particular situation.

Refer Knauf publication *Guide to Lighting and Decoration of Plasterboard* for guidance on good lighting and decoration practices.

Gloss/Sheen Paints

Full gloss paint finish is not recommended on plasterboard walls or ceilings. When semi-gloss paint is to be used in large open rooms or vast areas with uncurtained windows, the highest level of finish (Level 5) is essential.

Where gloss or impervious sheen paint finishes are desired for purely functional reasons eg, kitchens, bathrooms etc, some loss of appearance should be accepted.

Paint Discolouration

Whilst a plasterboard installation may conform to the relevant Australian Standards, discolouration of the joints may occur due to effects of condensation, mould growth, contaminated paint or other factors.

The risk of paint discolouration can be reduced through good design practices and the use of quality products and workmanship.

TABLE A8: **LEVELS OF FINISH REQUIREMENTS SUMMARY**

LEVEL OF FINISH	ALLOWABLE BUTT JOINTS LOCATION		CEILING BUTT JOINTS BACK-BLOCKING	CEILING RECESSED JOINTS BACK-BLOCKING		FRAMING TOLERANCES* (mm)		JOINTING SYSTEM
	WALLS	CEILINGS		LESS THAN 3 RECESSED JOINTS IN A ROOM	3 OR MORE RECESSED JOINTS IN A ROOM	90% OF AREA	REMAINING AREA	
3	On or between framing members	On or between framing members	Optional	Optional	Optional	4	5	Tape Coat + 2nd Coat
4	On or between framing members	Between framing members only	Must	Optional	Must**	4	5	Tape Coat + 2nd Coat + Finishing Coat
5	Between framing members only	Between framing members only	Must	Must	Must	3	4	Tape Coat + 2nd Coat + Finishing Coat + Skim Coat over whole face

* Maximum deviation at any point of the bearing surface of the finished framing prior to installation of plasterboard linings, when measured with 1.8 m straight edge (refer AS/NZS 2589).

** Level 4 ceilings supported by a ceiling suspension system in accordance with AS/NZS 2785 do not require back-blocking of recessed joints provided there is not rigid connection between ceiling and wall.

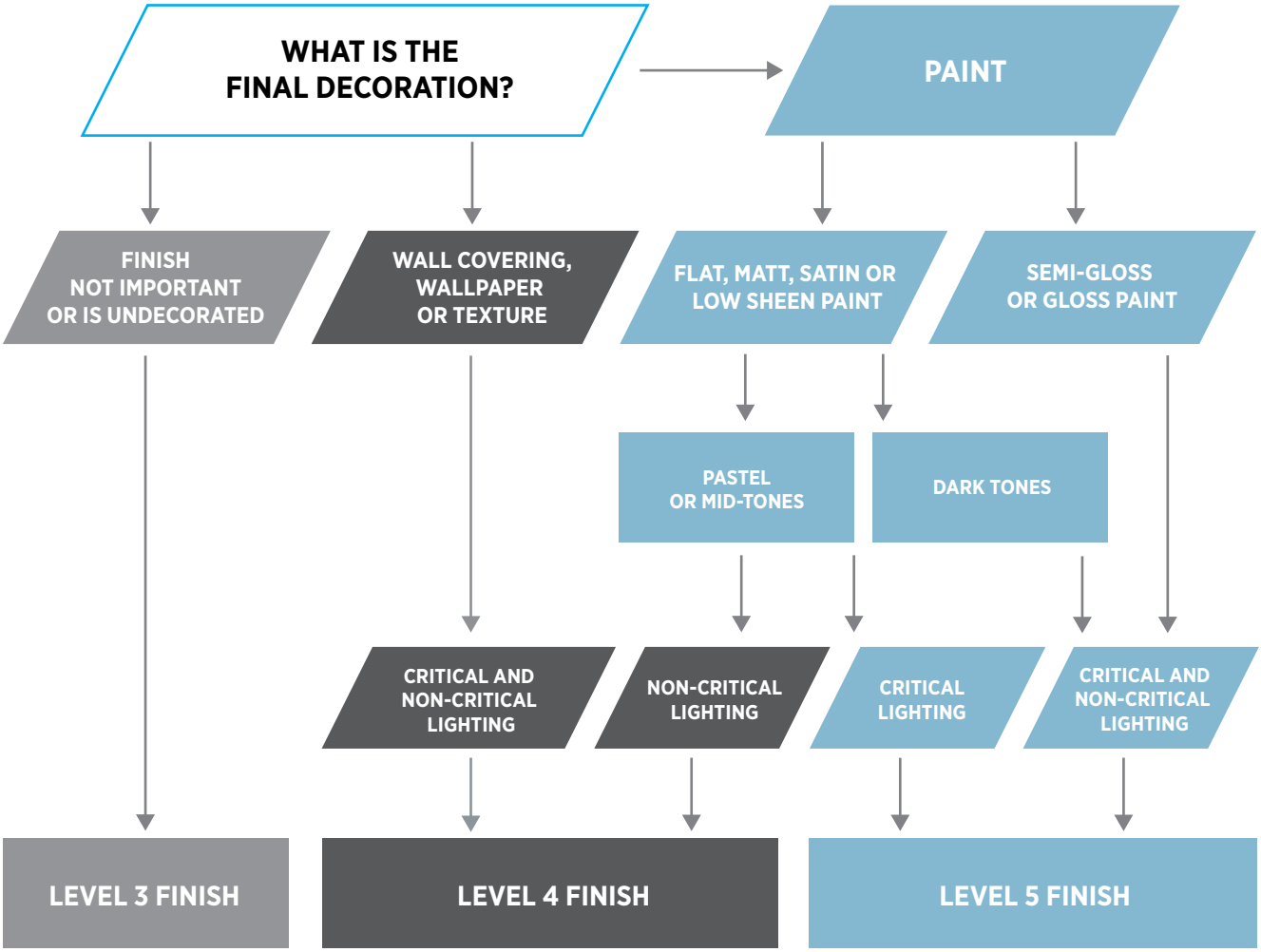


Figure A9: **Levels of Finish**