ICANZ

THE RIGHT INSULATION MATTERS

Guide to assessing ceiling insulation R-values in existing homes

Foreword

The Insulation Council of Australia and New Zealand (ICANZ) has developed this informative guide for assessing ceiling insulation R-values in the home, with assistance from Tony Isaacs Consulting Pty Ltd.

"The Affiliated Insulation Industry Coalition is pleased to endorse the ICANZ ceiling insulation evaluation guide. We acknowledge that it will simplify the process of assessing insulation, making it accessible to individuals without extensive training. This guide supports our commitment to ensuring Australian homes are properly insulated, enhancing energy efficiency, comfort and health outcomes for all." Affiliated Insulation Industry Coalition

The guide refers to a range of commonly found insulation materials that may exist in older homes and how the R-value of the material and coverage can be assessed.

May 2024

Before reading this guide please note

The contents of this document is intended to provide professional installers with practical guidance in the installation of insulation. It should be read in conjunction with technical or safety instructions, product information and guidance material provided by the product manufacturer and any applicable laws and standards. The information provided is general in nature and the user should establish its applicability to any specific circumstances.

Images are provided by way of illustration only.

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Assessing ceiling insulation

These guidelines aim to help householders, landlords, and energy efficiency professionals assess the performance level of insulation in the ceilings of existing homes (Class 1 dwellings as defined by the NCC[1]) .

These guidelines do not quantify the benefits of improving ceiling insulation as these benefits will vary depending on the local climate and the home's design. Assessors using NatHERS Existing Home software can help householders estimate the benefits of installing or upgrading insulation in existing houses.

Installing ceiling insulation in homes without (or with very little) insulation and topping-up existing levels of low insulation will always provide substantial benefits to the home's occupants.

The following sections help to assess ceiling insulation levels in an existing home with three basic steps:

1. Establish what type of insulation is installed, and what is its thickness. (pages 2 to 4)

   Different types of insulation provide a different R-value for a given thickness, so it is essential to identify the type of insulation installed to determine the performance of the current insulation.

2. Determine if the existing level of insulation would benefit from being improved. (page 5)

   The decision to upgrade or remove existing insulation can be made relatively quickly if the thickness is below the ceiling joists over the whole ceiling or in parts, and/or if there are lots of gaps or problems due to pests.

3. Establish the estimated R-value of the existing insulation installation. (pages 6 to 7)

   This section helps you determine the existing insulation's R-value given the type, thickness and compensation for gaps in the insulation.

The assumptions behind these calculations are shown on pages 8. From page 9 onwards, examples of gaps in insulation and how to classify them are provided.

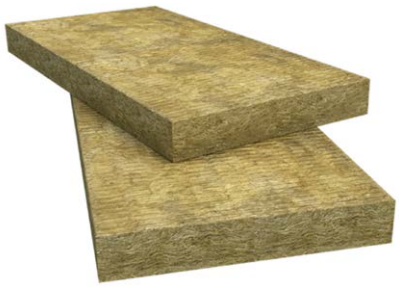
What sort of insulation is installed in the ceiling?

The following provides descriptions to assist with the identification of the most common insulation materials in older houses.

Rockwool insulation

ROCKWOOL INSULATION	
Appearance	Fibrous appearance and typically a mottled dark grey-green colour, although colour may vary by manufacturer.
Composition	Typically derived from melting volcanic rock and spinning into fibres using a binding agent.
Format	Available as a batt, board, blanket and loose-fill blow-in.
Safe Handling	If in doubt about the identification of the material, seek expert advice. Old Rockwool insulation is safe to handle with appropriate respiratory dust protection.

Example of blown in Rockwool



Example of Rockwool batts

1 NCC: The National Construction Code of Australia sets minimum standards for all types of new buildings. Detached houses and row houses are referred to as Class 1 in this document. Class 2 includes apartments, which are built on top of or below another dwelling.

Glasswool insulation

GLASSWOOL INSULATION	
Appearance	Fibrous appearance and typically a consistent colour (such as white, yellow, pink or brown) although colour may vary by manufacturer.
Composition	Typically derived from melting sand and recycled glass and spinning into fibres using a binding agent.
Format	Available as a batt, board, blanket and loose-fill blow-in.
Safe Handling	If in doubt about the identification of the material, seek expert advice. Old Glasswool insulation is safe to handle with appropriate respiratory dust protection.

Example of blown in Glasswool

Example of Glasswool batts

Cellulose Fibre insulation

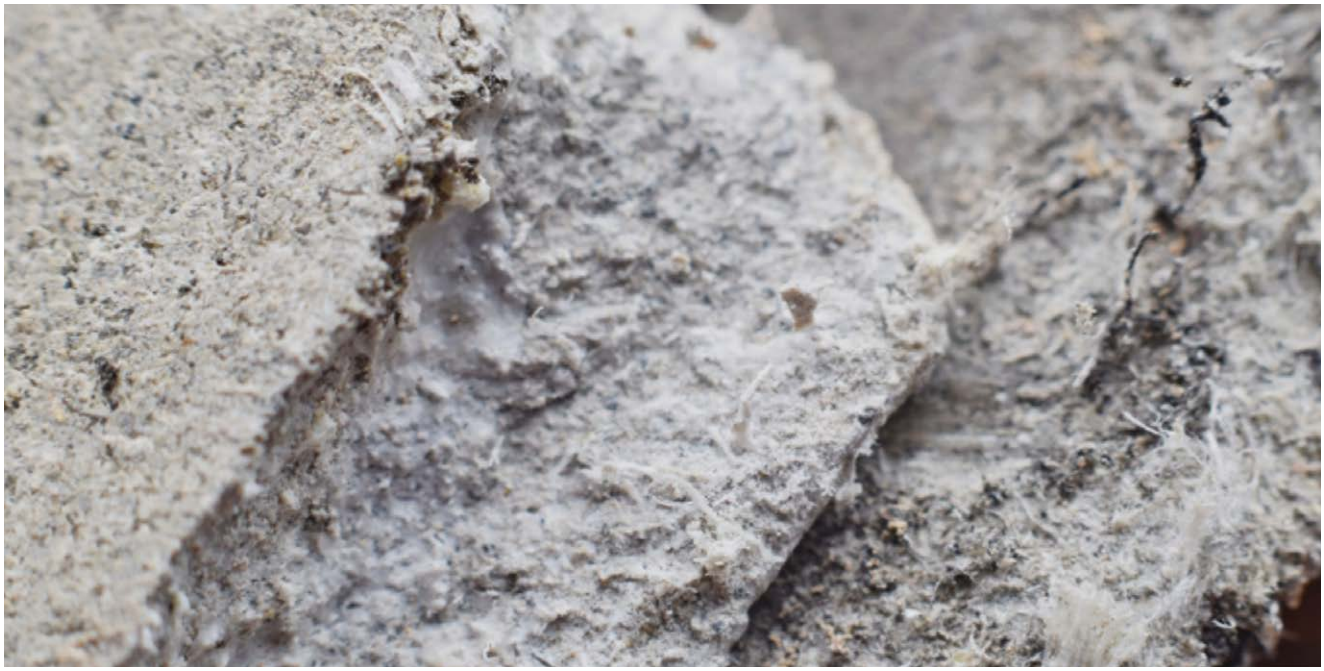
CELLULOSE INSULATION	
Appearance	Mottled in appearance and may vary in colour (and contain multi-colours) depending upon the original mix of materials used to create the product.
Composition	Typically derived from wood, and more specifically from paper: recycled newspapers, cardboard, office paper, and other common waste paper products.
Format	Only available as loose-fill blow-in.
Safe Handling	If in doubt about the identification of the material, seek expert advice. Old Cellulose insulation is safe to handle with appropriate respiratory dust protection.

Examples of blown in Cellulose fibre

Asbestos insulation

CAUTION: High-risk insulation. Do not enter the ceiling where asbestos is suspected

ASBESTOS INSULATION	
Appearance	Difficult to distinguish from other types of loose-fill insulation, such as cellulose. Fibrous in appearance and may appear as a greyish, white or brown material, although may vary by manufacturer.
Composition	Typically derived from a fibrous silicate mineral combined with other minerals and bonding agents.
Format	Loose-fill blow-in, spray on or board
Safe Handling	Warning – **DO NOT DISTURB OR HANDLE** - Immediately seek expert advice.



Source: Junee Shire Council

Examples of Asbestos insulation

When should ceiling insulation be upgraded?

Some older homes may have some insulation, whilst others won't have any at all. If the ceiling has no insulation or the level of insulation is below an acceptable level, the energy efficiency of the home may not be sufficient to meet the needs of its occupants, able to provide occupant comfort, minimise heating & cooling costs, and be more resilient to climate change.

Where bulk insulation exists in the ceiling or is being installed/topped-up then this guidance should be read in conjunction with Australian Standard 3999:2015 – Bulk thermal insulation – Installation, in particular Appendix 4 (a), (b), (c) and (d) and the relevant State electrical safety guidance.

Depending upon the energy efficiency targets or guidelines established for the property, the insulation may need a **top-up** if:

- the insulation is below the level of the ceiling joist (assuming a typical 90mm ceiling joist). Insulation of this thickness will generally have an insulation level of < R2.0, no matter what type of insulation is installed: or
- if there is substantial variation in the installed thickness ranging from above to below the ceiling joist; or
- if there are multiple layers of insulation from different installs, as shown in Figure 1, then only the top layer thickness should be used to estimate the R-value based upon 90mm thickness, as the lower layer may have deteriorated / compacted with time.

The insulation may need to be **removed** if:

- there is evidence of vermin; or
- signs of degradation of the insulation, e.g. some older blown-in insulation may have compacted, and the effectiveness of fire retardant may have diminished; or
- blown-in insulation is unevenly distributed across the area; or
- if a product cannot meet or be rectified to meet AS3999:2015.

The insulation may need **remedial work** if:

- There are gaps between insulation batts or between the insulation and framing, significant sections (area) that have no insulation or too much clearance around exhaust fans or light fittings.

The tables in the next section explain how to estimate the effects of gaps on insulation performance.

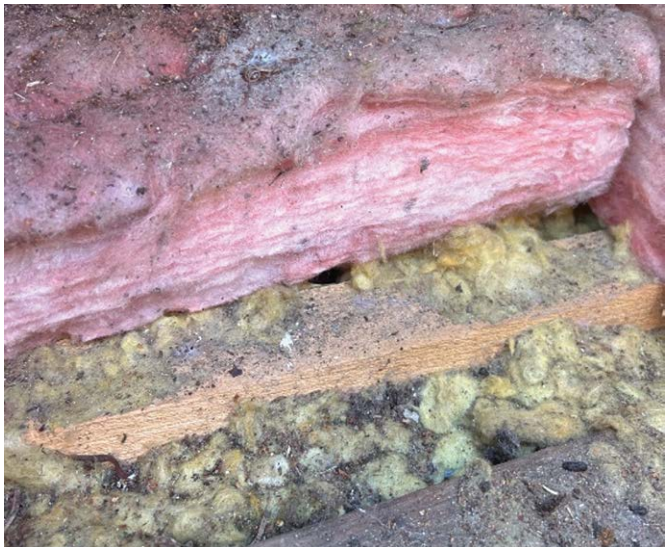


Figure 1. Multiple layers of insulation materials

If the insulation is clearly above the level of the ceiling joists, there are no gaps across the ceiling, and there is no evidence of vermin infestation, it can be assumed that the insulation value is greater than R2.0.

Where there are gaps in insulation, it will be beneficial to fill these gaps with insulation, even if the R-Value of the insulation is acceptable. Uninsulated gaps in the ceiling may result in condensation forming on the ceiling surface. This condensation can cause mould growth, which can cause health related issues and can damage the paint or ceiling lining. Gaps in insulation over rooms that are heated and/or cooled will also have the biggest impact on energy bills.

What is my ceiling insulation R-value?

Some gaps in insulation are required for electrical and fire safety. For example, some types of downlights, exhaust fans, heater flues and chimneys, and heating lights in bathrooms must all have a minimum clearance to insulation to operate safely. Old wiring may not be sufficiently well insulated and appropriately rated to allow it to be covered with insulation. ***Before filling gaps in insulation, always check that it is safe to reduce the current clearance around fittings and the electrical wiring is safe to cover.***

The tables below show how to estimate the R-value of your ceiling insulation given:

- The type of insulation,
- The thickness of the insulation, and
- The extent of gaps in the insulation.

The R-value referred to in these tables demonstrates the reduction in R-value as a result of gaps, which create areas of uninsulated ceiling. This results in the insulation material is not providing the thermal performance that is intended.

NB The reduction in R-value due to gaps increases as the insulation thickness increases, demonstrating that adherence to correct installation practices are required to achieve the intended product R-value.

Effective R-value table Batts: Glasswool

Thickness	Gap size with Batt Glasswool (% of ceiling area shown below)			
	No Gap/ no missing insulation across entire ceiling	Slight Gap/Poor Fit	Obvious Gaps/ Loose fit	Large Gaps / Missing Insulation
	0%	3%	6%	12%
50mm	R0.87	R0.77	R0.70	R0.57
100 mm	R1.79	R1.47	R1.24	R0.92
150 mm	R2.84	R2.14	R1.70	R1.17
200 mm	R3.85	R2.70	R2.05	R1.34
250 mm	R5.21	R3.33	R2.40	R1.49
300 mm	R7.50	R4.16	R2.83	R1.65

Effective R-value table Batts: Rockwool

Thickness	Gap size with Batt Rockwool (% of ceiling area shown below)			
	No Gap/ no missing insulation across entire ceiling	Slight Gap/Poor Fit	Obvious Gaps/ Loose fit	Large Gaps / Missing Insulation
	0%	3%	6%	12%
50mm	R1.25	R1.08	R0.94	R0.74
100 mm	R2.50	R1.94	R1.57	R1.10
150 mm	R3.95	R2.75	R2.08	R1.35
200 mm	R5.56	R3.47	R2.48	R1.52
250 mm	R6.95	R3.98	R2.74	R1.62
300 mm	R8.34	R4.41	R2.94	R1.70

Effective R-value table Batts: Polyester/Wool

Thickness	Gap size with Batt Polyester/Wool (% of ceiling area shown below)			
	No Gap/ no missing insulation across entire ceiling	Slight Gap/Poor Fit	Obvious Gaps/ Loose fit	Large Gaps / Missing Insulation
	0%	3%	6%	12%
50mm	R0.84	R0.75	R0.68	R0.56
100 mm	R1.73	R1.43	R1.21	R0.90
150 mm	R2.68	R2.05	R1.64	R1.14
200 mm	R3.93	R2.74	R2.07	R1.35
250 mm	R4.91	R3.20	R2.33	R1.46
300 mm	R5.89	R3.60	R2.55	R1.55

Effective R-value table blown-in: Glasswool

Thickness	Gap size with Blown-in Glasswool (% of ceiling area shown below)			
	No Gap/ no missing insulation across entire ceiling	Slight Gap/Poor Fit	Obvious Gaps/ Loose fit	Large Gaps / Missing Insulation
	0%	3%	6%	12%
50 mm	R1.20	R1.04	R0.91	R0.71
100 mm	R2.39	R1.87	R1.52	R1.08
150 mm	R3.58	R2.56	R1.96	R1.30
200 mm	R4.77	R3.13	R2.30	R1.45
250 mm	R5.96	R3.62	R2.56	R1.55
300 mm	R7.15	R4.05	R2.77	R1.63

Effective R-value table blown-in: Rockwool

Thickness	Gap size with Blown-in Rockwool (% of ceiling area shown below)			
	No Gap/ no missing insulation across entire ceiling	Slight Gap/Poor Fit	Obvious Gaps/ Loose fit	Large Gaps / Missing Insulation
	0%	3%	6%	12%
50 mm	R1.32	R1.13	R0.98	R0.76
100 mm	R2.64	R2.03	R1.63	R1.13
150 mm	R3.95	R2.75	R2.08	R1.35
200 mm	R5.27	R3.35	R2.42	R1.50
250 mm	R6.58	R3.85	R2.68	R1.60
300 mm	R7.90	R4.28	R2.88	R1.68

Effective R-value table blown-in: Cellulose

Thickness	Gap size with Blown-in Cellulose (% of ceiling area shown below)			
	No Gap/ no missing insulation across entire ceiling	Slight Gap/Poor Fit	Obvious Gaps/ Loose fit	Large Gaps / Missing Insulation
	0%	3%	6%	12%
50 mm	R1.25	R1.08	R0.94	R0.74
100 mm	R2.50	R1.94	R1.57	R1.10
150 mm	R3.75	R2.65	R2.02	R1.32
200 mm	R5.00	R3.24	R2.36	R1.47
250 mm	R6.25	R3.74	R2.62	R1.58
300 mm	R7.50	R4.16	R2.83	R1.65

Assumptions

The thermal conductivity values shown below have been used to calculate the R-value impact of gaps in insulation installation. They have been developed to work with NatHERS existing home tool assessments.

The R-values do not allow for the thermal bridging of framing members. The NatHERS existing homes tool models the impact of different frame R-values for timber and steel. It also allows for additional insulation over steel frames to reduce the heat lost. Consequently, Energy Assessors only need to know how the insulation material, thickness, and size of gaps affect the effective R-value of the insulation.

Insulation products may not have the same thermal conductivity for all material thicknesses. The table below shows the thermal conductivity which has been assumed for the various insulation materials based upon the expected age and thicknesses of the material.

Thickness up to	Assumed Conductivity (W/(mK))						
	Blown-in			Batt			Board
	Cellulose	Glasswool	Rockwool	Glasswool	Rockwool	Polyester/Wool	PIR / Phenolic
50mm	0.040	0.042	0.038	0.058	0.040	0.060	0.022
100 mm	0.040	0.042	0.038	0.056	0.040	0.058	0.021
150 mm	0.040	0.042	0.038	0.053	0.038	0.056	0.021
200 mm	0.040	0.042	0.038	0.052	0.036	0.051	0.021
250 mm	0.040	0.042	0.038	0.048	0.036	0.051	-
300 mm	0.040	0.042	0.038	0.040	0.036	0.051	-

These conductivities are a representative set of data taken from Trade Literature, The ICANZ Insulation Handbook, the AccuRate NatHERS tool help file developed by CSIRO, and AS/NZS 4859.2:2018 – actual product performance may vary.

Glasswool and Rockwool products may be available in low or high-density variants. Since it is unlikely that householders or energy assessors will be able to differentiate product density when the product is installed, the density with the lowest R-value has been assumed.

Classifying gaps in insulation

The table below provides various classifications of gaps in insulation across the ceiling. This data has been used to produce the Effective R-value tables by product listed earlier.

Extent of Gaps	Assumed value (average)	Range	
		Low	High
No Gap	0%	0%	0%
Slight Gap/Poor Fit	3%	2%	4%
Obvious Gaps/Loose fit	6%	4%	8%
Large Gaps/Missing Insulation	12%	8%	14%

The figures displayed in the following section that serve to calculate and classify the gaps are based on a sample ceiling area of 150m2.

Good installation practices – no gaps

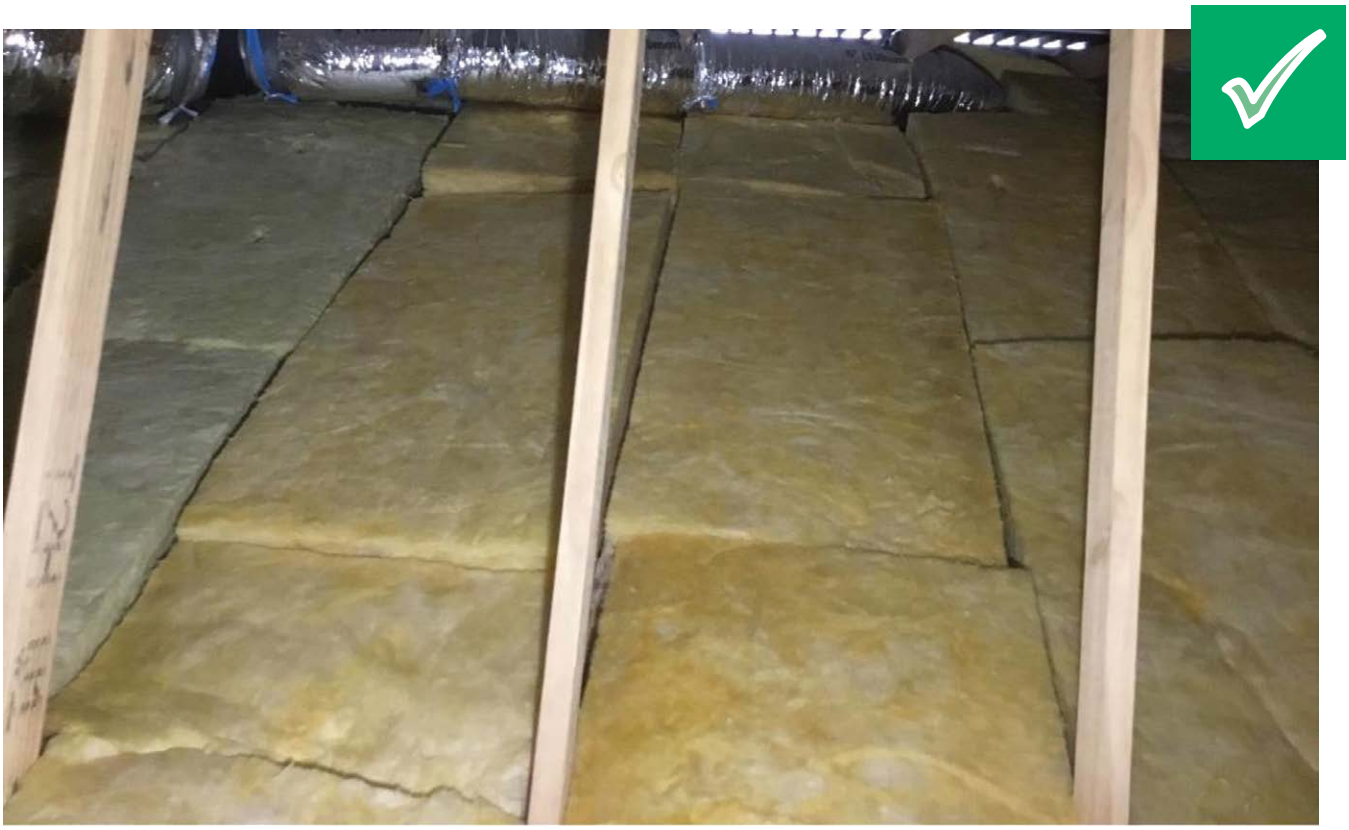


Figure 2. well-installed ceiling insulation

1. This photo shows an example of insulation installation that would be classified as having no gaps.
2. The insulation is higher than the level of the ceiling joists, so its R-Value can be assumed to be a minimum of R2.0.

This level of coverage is what you need to achieve to gain the maximum benefit of correctly installed insulation.

The following section shows you images of poor installation practices that will reduce the benefit of the installed insulation. Therefore, it will be important to fill in the gaps with insulation.

Poor installation practices – gaps

Good insulation coverage across the entire ceiling is critical to ensure the intended R-value is achieved. Even small gaps can affect the performance of the room below, which may result in condensation forming on the uninsulated ceiling.

Where gaps occur in the insulation these need to be rectified.

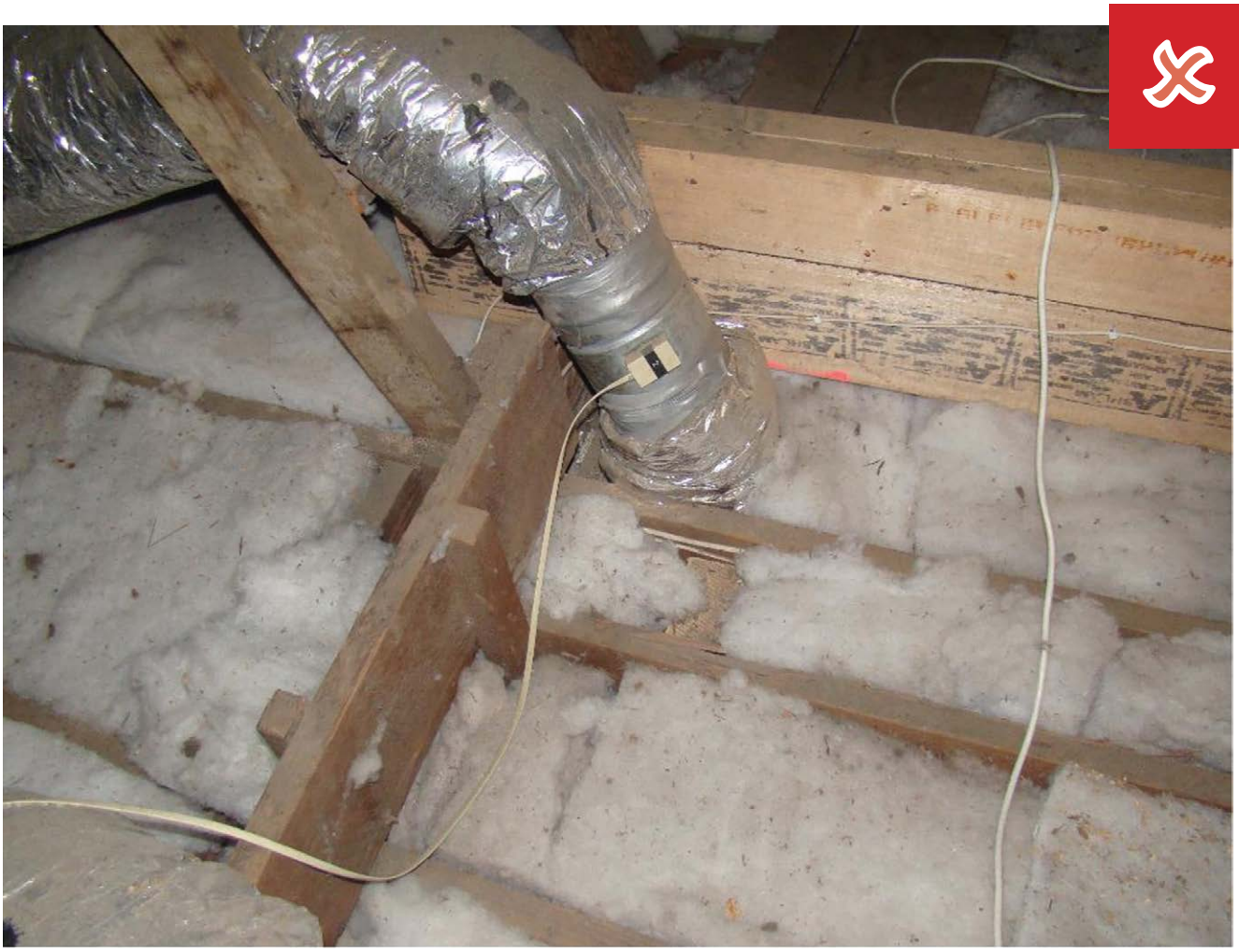


Figure 3. Poor installation practice

1. There are gaps between batts and some uninsulated areas.
2. The batts which were cut to fit the narrow gap between ceiling joists barely reach the level of the ceiling joists and do not fit well between the joists.

CLASSIFICATION OF GAPS:

The area shown uninsulated is small.

If this is the only gap in the insulation over the whole ceiling then, it may be considered a slight gap. Where other gaps exist, they should be added together to assess the total area loss. *All gaps should be rectified to ensure maximum thermal performance and condensation risk reduction.*

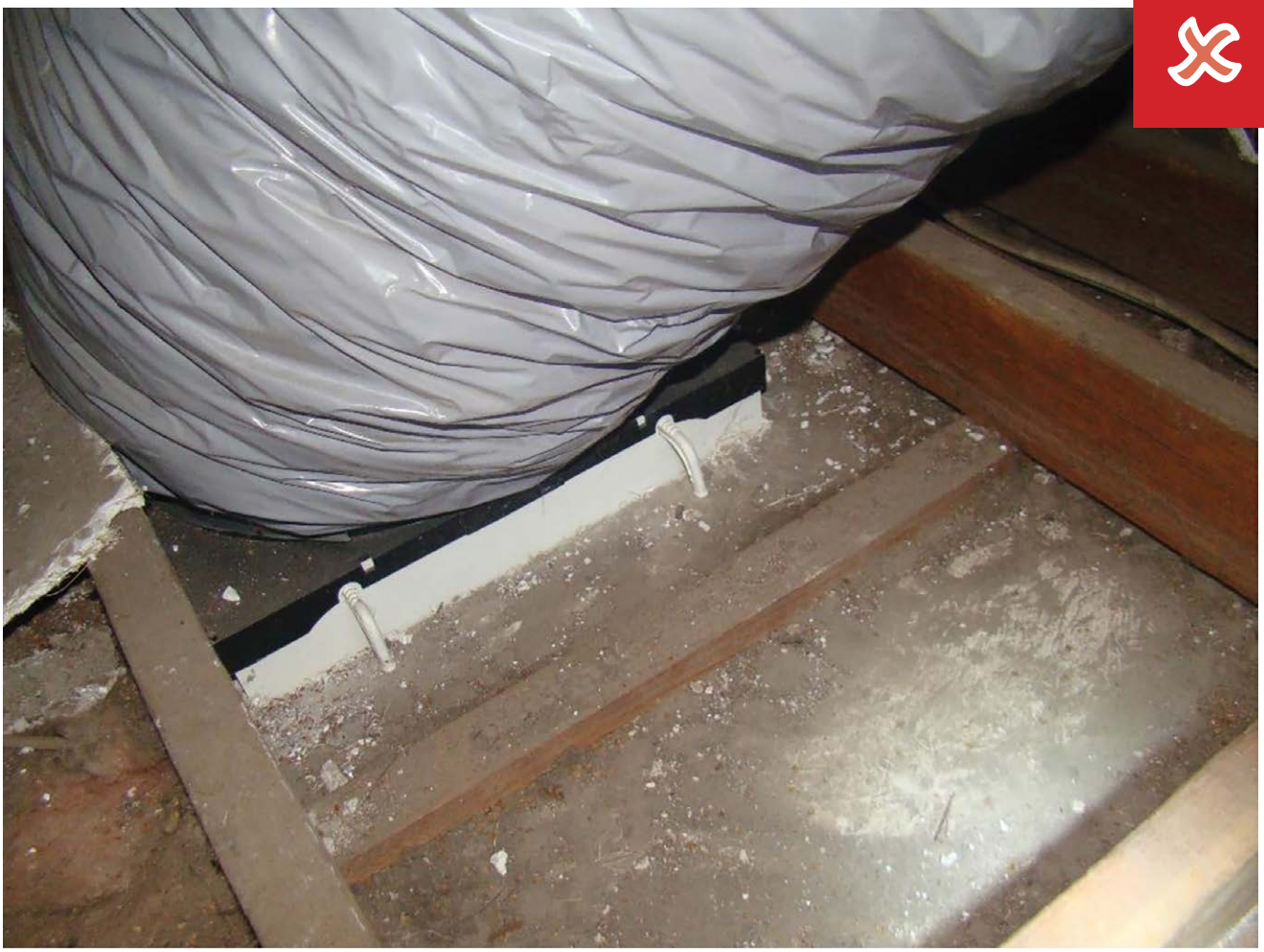


Figure 4. Poor installation practice

1. Insulation not replaced after installation of ductwork
2. Adjacent insulation doesn't reach the level of the ceiling joist, so an insulation top-up is needed. Further inspection may show that the insulation should be replaced.

CLASSIFICATION OF GAPS:

The area of missing insulation is around 450mm x 450mm, i.e. around 0.2m^2.

If this is the only gap in the insulation over a 150m2 ceiling it would represent 0.18% of uninsulated ceiling area and therefore for the house as a whole would be considered a no gap. Where other gaps exist, they should be added together to assess the total area loss. *All gaps should be rectified to ensure maximum thermal performance and condensation risk reduction.*

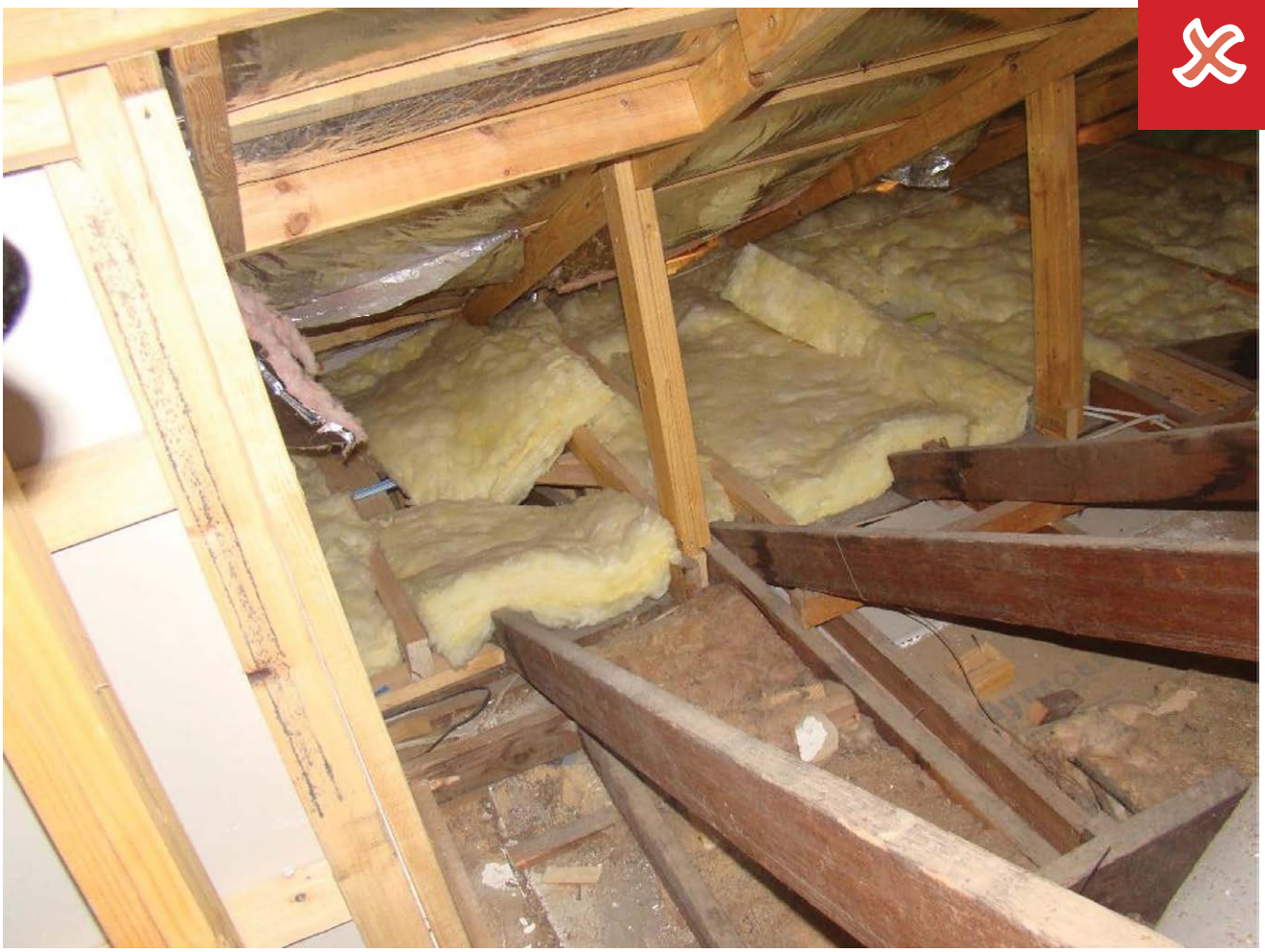


Figure 5. Poor installation practice

1. There is new insulation around the perimeter, but the batt is not placed hard against ceiling and will not work as intended.
2. Existing insulation is left in place and does not reach the level of the ceiling joist.
3. Significant areas without any insulation.

CLASSIFICATION OF GAPS:

The area shown uninsulated is at least 1350mm x 1800mm. i.e. around 2.4m^2.

If this is the only gap in the insulation over a 150m2 ceiling it would represent 1.6% of uninsulated ceiling area and therefore for the house as a whole would be considered a slight gap. Where other gaps exist, they should be added together to assess the total area loss. *All gaps should be rectified to ensure maximum thermal performance and condensation risk reduction.*

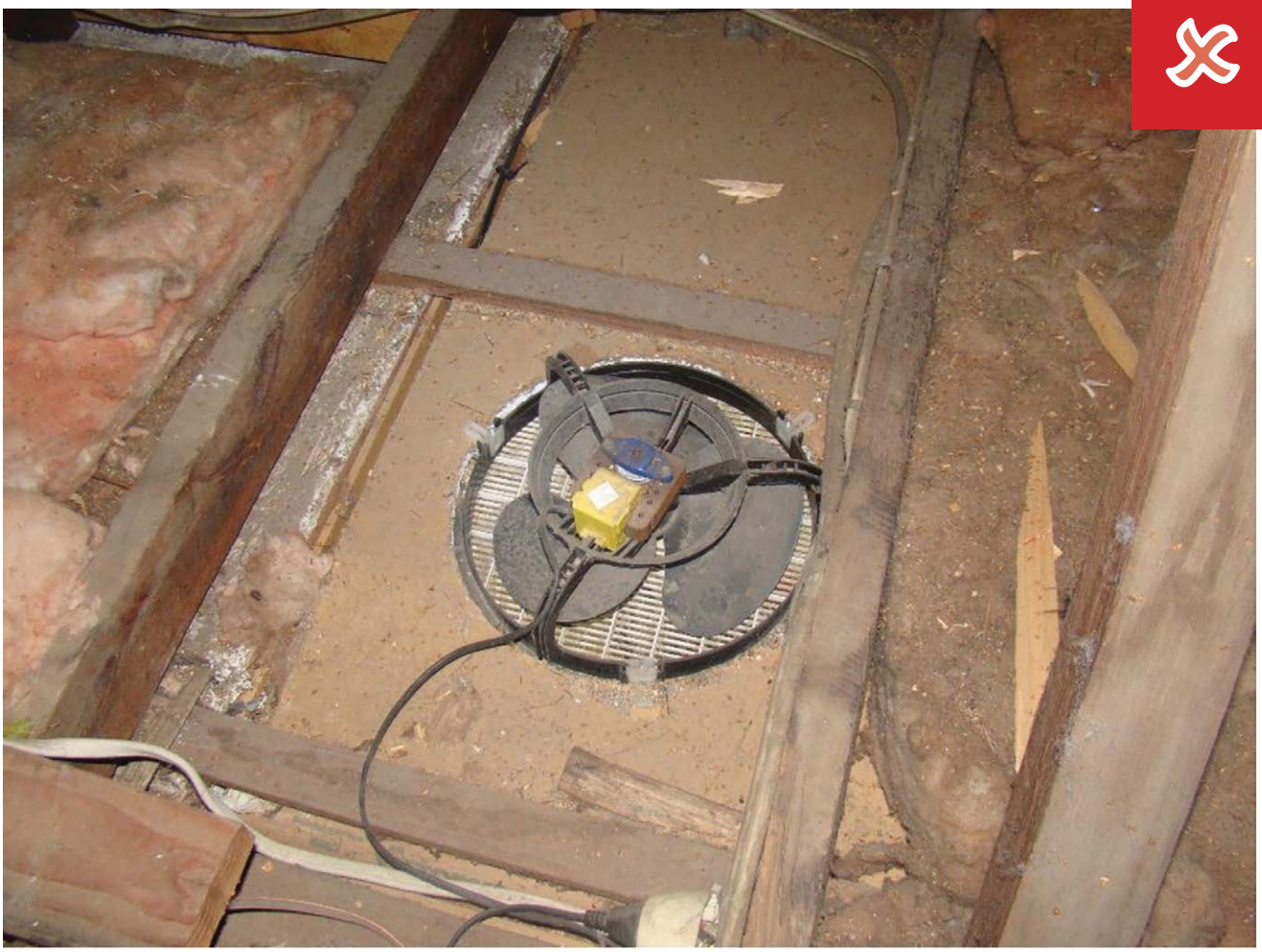


Figure 6. Poor installation practice

1. The insulation around the ceiling fan was removed entirely.
2. The ceiling fan should be covered with a Draft-Stoppa or equivalent to stop unnecessary air leakage. New insulation can be installed up to the edge of the Draft Stoppa, but electrical wiring may need clearance depending on its age and condition.
3. Insulation does not reach the top of the ceiling joist. Top-up insulation is needed.

CLASSIFICATION OF GAPS:

The area shown uninsulated is at least 450mm x 1800mm. i.e. around 0.8m^2.

If this is the only gap in the insulation over a 150m2 ceiling it would represent 0.53% of uninsulated ceiling area and therefore for the house as a whole would be considered a slight gap. Where other gaps exist, they should be added together to assess the total area loss. *All gaps should be rectified to ensure maximum thermal performance and condensation risk reduction.*

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