REPORT ON THERMAL PERFORMANCE OF INSULATED CEILINGS WITH / WITHOUT USING ISOLITE™ OR FLEXI™ DOWNLIGHT ENCLOSURES FOR ARROWFORM PTY LTD

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1. AIM

To determine the AS/NZS 4859.1:2002/Amdt 1 2006 Total R-Values of insulated ceiling systems incorporating an ISOLITE™ or FLEXI™ DOWNLIGHT ENCLOSURE around each recessed downlight and hence determine its thermal insulation benefit as compared to downlights not enclosed by Isolite™ or Flexi™ Downlight Enclosure.

These installations are assessed as subject to the installation requirements of AS/NZS 3000:2007 Clause 4.5.2.3 options b, or d (based on halogen table).

Note that this insulation study report excludes analysis of additional benefits of the unventilated Isolite™ or Flexi™ Downlight Enclosure in eliminating air leakage when installed over ventilated downlights.

The client for this calculation set is ArrowForm Pty Ltd, PO Box 949, Swan Hill VIC 3585, Phone: 1800 852 741, Fax: 1300 722 165, and Email: sales@arrowform.com.au.

2. CALCULATIONS

The following calculations are based upon AS/NZS 4859.1:2002 /Amdt 1 2006 Materials for the thermal insulation of buildings, the Australian Institute of Refrigeration Air-conditioning & Heating (AIRAH) Handbook Millennium Edition 2000, Section 6.

The results reported are per AS/NZS 4859.1:2002 Clause 1.5.3.3 – *"Total thermal resistance - A total resistance associated with a material or a system or construction of materials, specified as a Total R, including surface film resistances."*

Air space calculations are iterative and only the converged results are shown.

In accordance with AS/NZS 4859.1:2002 /Amdt 1 2006 Clause K3.1, results are presented for indoor air temperatures of 24°C (summer), and 18°C (winter).

3. CONCLUSION

The ISOLITE™ / FLEXI™ DOWNLIGHT ENCLOSURE was estimated to have negligible thermal resistance (R0.1m²·K/W), however it allows insulation to almost abut the downlight, significantly reducing the thermal bridging through the normal significant area cleared, uninsulated, around a downlight.

In fact, if the ISOLITE™ / FLEXI™ DOWNLIGHT ENCLOSURE had significant thermal resistance, it would overheat the downlight it enclosed. Its effectiveness relies on enhancing the surface area through which a downlight releases lamp heat into the attic whilst having minimal interruption to ceiling insulation.

If a downlight is ventilated (gimballed), the fitting of an ISOLITE™ / FLEXI™ DOWNLIGHT ENCLOSURE eliminates that ventilation. This reduces the convective heat transfer through the ceiling. The ISOLITE™ / FLEXI™ DOWNLIGHT ENCLOSURE thus improves the efficacy of the heating and cooling systems of the conditioned room. The benefit cannot be calculated as it depends on too many variable factors (wind, ambient temperature, attic construction, etc.).

This report and all calculations were done by:

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This report is a revised version of the report of October 2007

SUMMARY

	Ceiling Total R	
Comparison reference - Insulated ceiling with no downlight:	**Summer**	**Winter**
CONTINUOUS R3.5 INSULATION ON 10MM PLASTERBOARD CEILING:	**R3.88**	**R3.78**

Ceiling with downlight - AVERAGE SURFACE RESULTS -	Ceiling Total R after thermal bridging Summer	Winter
1) THERMAL PERFORMANCE *WITHOUT* ISOLITE™ DOWNLIGHT ENCLOSURE. DOWNLIGHT WITHIN 0.49M X 0.49M INSULATION CUT-OUT AS REQUIRED.		
A) ONE DOWNLIGHT PER 2M X 2M CEILING	R2.50	R2.16[2]
Large reduction of:	R1.38	R1.62
[2] Even with R13.0 bulk insulation, the winter Surface Average Total R would be only R3.5		
B) ONE DOWNLIGHT PER 1.2M X 1.2M CEILING	R1.53	R1.22[3]
Large reduction of:	R2.35	R2.56
[3] Even with R100.0 bulk insulation, the winter Surface Average Total R would be only R1.6		
2) THERMAL PERFORMANCE *WITH* ISOLITE™ DOWNLIGHT ENCLOSURE, ABUTTING INSULATION.		
A) ONE DOWNLIGHT PER 2M X 2M CEILING	R3.76	R3.64
Reduction of only:	R0.12	R0.14
B) ONE DOWNLIGHT PER 1.2M X 1.2M CEILING	R3.57	R3.42
Reduction of only:	R0.31	R0.36
3) THERMAL PERFORMANCE *WITH* ISOLITE™ DOWNLIGHT ENCLOSURE *AND* TRANSFORMER ISOLATOR ACCESSORY, ABUTTING INSULATION.		
A) ONE DOWNLIGHT PER 2M X 2M CEILING	R3.72	R3.59
Reduction of only:	R0.16	R0.19
B) ONE DOWNLIGHT PER 1.2M X 1.2M CEILING	R3.47	R3.30
Reduction of only:	R0.41	R0.48
4) THERMAL PERFORMANCE *WITH* ISOLITE™ DOWNLIGHT ENCLOSURE *AND* TRANSFORMER ISOLATOR ACCESSORY, WITHIN 220MM DIA. INSULATION CUTOUT.		
A) ONE DOWNLIGHT PER 2M X 2M CEILING	R3.66	R3.51
Reduction of only:	R0.22	R0.27
B) ONE DOWNLIGHT PER 1.2M X 1.2M CEILING	R3.32	R3.12
Reduction of only:	R0.56	R0.66
5) THERMAL PERFORMANCE *WITH* FLEXI™ DOWNLIGHT ENCLOSURE, ABUTTING INSULATION.		
A) ONE DOWNLIGHT PER 2M X 2M CEILING	R3.78	R3.66
Reduction of only:	R0.10	R0.12
B) ONE DOWNLIGHT PER 1.2M X 1.2M CEILING	R3.61	R3.47
Reduction of only:	R0.26	R0.30

NOTE:
The above results were calculated for still air films and the downlight turned off.
The thermal resistance of the ISOLITE™ DOWNLIGHT ENCLOSURE was estimated to be R0.1 m²·K/W
The thermal resistance of the FLEXI™ DOWNLIGHT ENCLOSURE was estimated to be R0.2 m²·K/W
With the downlight on, the results would be almost identical as the dominant influence is the thermal bridging through bare ceilings.
This insulation study report excludes analysis of the benefits from elimination of ventilation when the downlight enclosure is installed over ventilated downlights as many variables affect this.

CONCLUSION

The use of an ISOLITE™ or FLEXI™ DOWNLIGHT ENCLOSURE significantly reduces thermal bridging, and restores ceiling insulation effectiveness.

(report of detailed calculations available upon request)