FOIL BATT FACTS No. 1
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CONCERTINA FOIL BATTS™ THE RADIANT HEAT BARRIER

FAILURE OF AIR-CONDITIONING DUCTWORK INSULATION IN HOT ROOF SPACES

IT IS A KNOWN FACT that aluminium foil insulation with an adjoining airspace will stop approximately 97% of all radiant heat it is subjected to and only emit 3% on its other side (reference - 'Physics of Foil' at www.concertinafoilbatts.com).

Insulation in a roof space can take many forms and is dependant on climatic conditions. In general for a hot/cold dual climate Wren recommends R2.5 bulk insulation in ceilings to control winter heat loss and Concertina FOIL BATTS laid over the bulk insulation, with their cleverly designed triangular aluminium foil airspaces, to act as a summer radiant heat barrier.

However, whilst this combination will work well to keep a house cool in summer and warm in winter there still exists a problem for air-conditioning and in particular the ductwork that exists in the roof.

Air-conditioning ductwork needs to be insulated to protect cooled air from heating during transit to the vents in the house. Traditionally fibrous or bulk insulation (typically R1.5) is wrapped inside a layer of plastic around the duct as the only form of insulation. The problem is that the air temperature in the roof cavity on a 'hot day' can vary between 60 to 80 degrees Celsius while the air being generated from the air-conditioner starts at around 9 degrees C – a huge variation.

Bulk insulation works well in cold climates to trap warm air. It has millions of tiny air pockets that slow the rate of heat transfer down and act like a doona does on a bed in winter. The testing regime (referred to as Steady State) for bulk insulation was devised from northern hemisphere conditions. To determine its R-value the product is placed between two fixed temperature plates set at 33 and 13deg C over a 4 hours test period and a measurement is taken of the rate of heat transfer and presented as an R-value. The problem with this test is that in the ducting condition above, the temperature difference is from 9 degrees C to around 70 degrees C. In these situations bulk insulation will just not be good enough.

An example of the problems associated with fibrous insulated air-conditioning ductwork is contained in the letter to Wren Industries overleaf.

By TIM RENOUF
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On the other hand, aluminium foil insulation works on a completely different set of principles. As mentioned earlier, aluminium foil is a radiant heat barrier and provided there is an adjoining airspace will reflect 97% of the heat subjected to the surface.

Concertina FOIL BATTS stapled between rafters protects air-conditioning ductwork from intense heat radiating from the roof

In order to improve the performance of air-conditioning ductwork, the heat load from the roof must firstly be reduced. As most heat entering the roof space is radiant (ie the sun hits the roof and the heat radiates into the roof space), the best solution to reduce roof space heat is a layer of reflective foil laminate under the tiles (or roofing material) and maybe the installation of venting fans.

Another solution can be seen by the approach taken by Mr Belic (see over). What is more than apparent is the remarkable effect reflective foil, with airspaces, will have on the reduction of radiant heat flow and the overall improvement in the thermal performance of the duct and the subsequent lowering of air-conditioning running costs.

The insulation industry is in the midst of change and increasing regulation as a result of the Federal Government's commitment to lowering greenhouse emissions via the five star energy rating scheme for new dwellings.

A key component of these changes are contained in the insulation standard AS/NZS4859.1 (2002) which underpins the federal Building Code of Australia Building Energy Efficiency Provisions. A revision of 4859.1 has been underway for over 12 months and ductwork insulation is one item now being incorporated into the revision. Central to 4859.1 is that all insulation product R-values must account for all anticipated environmental effects and this includes **radiant energy effects.**

However AS/NZS4859.1 still permits R-value labelling for all bulk insulations to be assessed for **conducted heat** at Steady State (see above), which is not an appropriate test for real roof space high temperature radiation effects. Energy efficiency regulations are meant to assist in reducing peak load electricity demand in summer, demand which is caused to a very large degree by the proliferation of domestic air-conditioning which consumes the most energy of any cooling option. Air-conditioners in hot weather frequently run continuously and struggle to maintain desired indoor temperature settings because of the penetration of **radiant heat into the duct**.

It is in the public and national interest that "**radiation effects**" are accounted for in all insulation materials including ductwork, and that Steady State (conduction) measurement alone is deemed an inappropriate testing criteria when selecting thermal insulation resistances for use in buildings experiencing radiant heat and wide temperature differences between indoor and outdoor as is commonplace in roof spaces for hot climates across Australia.

Concertina FOIL BATTS reduce radiation and lower cooling costs.

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Concertina FOIL BATTS between roofing rafters

Dear Tim,

In 2003, I bought a house in a Mirvac estate "The Heath", Heatherton, in the south-west of Melbourne. The two level house itself is a very modern contemporary design. Mirvac installed some foil insulation under the black tiles but only in a couple first rows of tile work, which is not enough. They also installed fibreglass insulation on the ceiling.

We moved into the house in August 2003. As August is not a very hot month we did not know what would happen when hotter days arrived. In October we started to be aware of the large amount of heat upstairs and it was difficult to live or sleep at night. I knew that the builder has installed some insulation and I did not want to complain much about the heat problem.

In November 2003, I decided to install a central airconditioning system to be prepared for the increasing summer heat. After installation I did not get much improvement in the second level and I started to complain about the airconditioning. People from Dandy Air came and tested the unit and said everything was fine. As I was not satisfied with the testing I called Lennox, the manufacturer of the airconditioning system, to investigate my problem with the heat. I remember that one of the technicians measured a starting temperature of cooled air generated at 9 degC, and on one of the outlet points discharging cool air into an upstairs room, the temperature was 19 degC. From start to finish, that was a 10 degC increase in temperature of the cooled air passing through the airconditioning ductwork which is laid across the roof space.

I was complaining for two years and finally gave up in December 2005. Then I started to think about insulation and to take some action in that way. After I visited the Home Ideas Centre in Clayton, I contacted Tim Renouf at Wren Industries who explained to me that the reason for my problem with airconditioning not working properly is that the fibre insulation around the ductwork is not able to cope with the intense heat radiating down from the roof tiles. He said this heat can be around 70-80 degC which makes it extremely difficult for the airconditioning system to operate efficiently.

Firstly, I installed two roof fans and achieved a two degree C drop in temperature upstairs. Following this I have stapled Tim's product Concertina FOIL BATTS between all the roofing rafters as well as also wrapping FOIL BATTS around the ductwork. The room outlet temperature now recorded 12 degC – this is 7 degC lower compared to the original 19 degC. Now my airconditioner is starting to work properly and it can much more easily maintain thermostat temperature settings of 24-26 degC and will have much lower running costs.

Better advice is needed about how different insulation products work. It seems clear to me that fibre insulations do not work properly in stopping high temperature radiation. Thankyou to Wren for their advice and great product.

Regards,

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