Aluminium foil insulations serve many useful functions and are commonly used in roll form under roofs and in framed walls for thermal insulation, waterproofing and condensation control. Roll foil insulations can be double or single-sided and with airspaces are powerful radiant heat barriers, reflecting 97% or emitting 3% of all radiant heat and one foil surface operating is able to reduce the majority of radiation flow – two surfaces are not essential. When roll foil is used under roofs and as wall wraps, the dominant thermal surface is always the inward-facing foil surface because the outer surface is coloured for sunglare safety.

"R-value" means "resistance to the flow of heat" and foil insulations are always expressed as **Total R-value** for the entire roof/ceiling, wall or floor, determined by a *calculation* process of airspace values – refer www.afia.com.au. Foil insulations produce **optimum R-value** with adjoining airspaces of minumum 50mm facing downwards and 20mm in walls. Inward foil surfaces will constantly emit or re-radiate 3% of all the radiant heat energy they are subjected to. A good analogy is a cooked chicken wrapped in foil or an aluminum coffee pot sitting on a bench where the coffee stays hot, not because of reflection as conduction/contact has occurred on the inner metal surface, rather the outward low emitting surface. Most heat is lost by conduction where the pot or chicken sits on the bench.

Another simple test to prove this is to heat your oven at home to say 200 degC, pull down the door and you will feel a blast of radiant heat. Now stand a fibrous batt, say an R1.5 (75 mm thick) on the door and rest against the oven. After a few minutes you will find the heat radiating at you from the batt which is now quite warm to touch. Then place a sheet of foil, eg cooking foil or a **Concertina *FOIL BATT*** against the batt. You will immediately find there is little or no radiation and even though the foil is warm to touch, there is only this low 3% emission or radiation from the foil surface. And it will stay that way. **It is the foil that does the summer insulating, not the fibrous batt.**

In hot climates across Australia, the underside of roofs can radiate at 80-100degC. With foil/fibreglass building blanket compressed under metal roofs, downward radiation is stopped by the foil with a downward airspace, not the fibreglass. In summer, foil on framed walls can transfer heat into any fibre batts by conduction. A severe wall example is with upper storey clad wall extensions that are commonly impossible to shade from solar radiation where fibre batts push the foil hard up against the cladding, accelerating the summer heat progression through the wall to the plasterboard. **Concertina *FOIL BATTS*** are the answer, stapled between the timbers, completely replace the fibrous batt, split the stud cavity into two airspaces, combined with the foil wrap forming multiple aluminium airspaces - similar to the thermos flask principle. Also, the ***FOIL BATTS*** provide air pockets for "breather" foil on clad walls to allow free escape of moisture vapour.

Bulk fibrous insulations are claimed to have the same R-value in winter and summer, and have a **Material R-value** measured in a Heat Flow Meter between hot and cold contact plates set at 33 and 13 degC, where the mean (average) temperature is 23 deg. A doubling in thickness equals a doubling in Rvalue but that does not mean doubling the insulating benefit, particularly when roof space temperatures are typically 50-70deg across Australia, combined with the fact that there has never been any insulation testing in Australia for high temperature radiant heat effects on bulk insulations. All insulation materials must conform to AS/NZS 4859.1(2002) "Materials for the thermal insulation of buildings" which requires the assessment of all of the factors which may affect thermal performance, including radiant heat energy. **It is an established scientific fact that when mean temperature increases for <u>any</u> insulation, R-value falls.** In reality all insulations have variable R-values – claimed "guaranteed R-values" for bulk insulations are valid only for the standardised test conditions.

Concertina *FOIL BATTS* laid on top of ceilings or any fibrous insulation will significantly reduce downward radiation penetration and likely lead to reductions in ceiling temperatures. The unique triangular foil airspaces operate efficiently because low emitting downward airspaces exist compared to foil laid flat which immediately loses its most valuable lower surface by conduction.

In warm to hot climates where winter heating is very low or non-existent, – quoting Prof. Richard Aynsley, formerly Head of the Australian Institute of Tropical Architecture, James Cook University, Townsville:

"Horizontal reflective foil airspaces in roofs have the unique characteristic of having a greater resistance to heat flow down than up. They act as one-way valves for summer heat flow, restricting daytime heat gain while facilitating night time heat loss. This is important because indoor discomfort in the evening which inhibits sleep can be very debilitating". Houses using foil insulations combined with natural ventilation can avoid airconditioning.

FOIL BATTS

Basic properties of double-sided aluminium foil against radiant heat