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# Insulation Buried Attic Ducts— Analysis, Laboratory and Field Evaluation Findings

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## ABSTRACT

*The Building America program, funded by the Department of Energy, applies a systems engineering approach to residential construction. The ultimate goal is to improve energy and resource efficiency without increasing the builder's cost. A key element of the systems engineering approach for most Building America projects has been to improve space conditioning system efficiency by reducing or eliminating duct losses or gains. The Consortium for Advanced Residential Buildings (CARB), one of five Building America industry teams, has been researching the benefits of burying attic ducts under loose-fill attic insulation. Research has included analysis using finite element modeling, laboratory testing using Oak Ridge National Laboratory's climate simulator test facility, and field testing in California homes.*

*Initially, a finite element analysis was used to determine the effective R-value that conventional hung ducts must be wrapped with to achieve the same thermal performance as buried ducts. This effective R-value could then be applied in energy simulation tools to assess the peak energy demand and annual energy use benefits of the buried duct concept. The analysis results were simplified, as presented in Table 1, and became the basis for Table R4-12 of the Residential ACM Manual proposed for California's 2005 Building Energy Efficiency Standards. Simulation results from small ducts and large ducts were combined, making these guidelines applicable to ducts of all size commonly encountered in residential applications. This simplification is valid since for a particular buried duct classification, the impact of duct size on effective R-value was found to be small.*

*For the simplified results, the buried ducts are classified as either "deeply," "fully," or "partially" buried. Deeply buried indicates that the depth of the loose-fill insulation is at least 3.5 in. higher than the top of the insulating duct wrap. Fully buried indicates that the depth of the loose-fill insulation is even with the top of the insulating duct wrap. Partially buried indicates that the depth of the loose-fill insulation is 3.5 in. lower than the top of the insulating duct wrap. The duct wrap is 1.25 in. thick with*

**Table 1. Guidelines for Effective Buried Duct System R-Values (ft<sup>2</sup>·h·°F/Btu)**

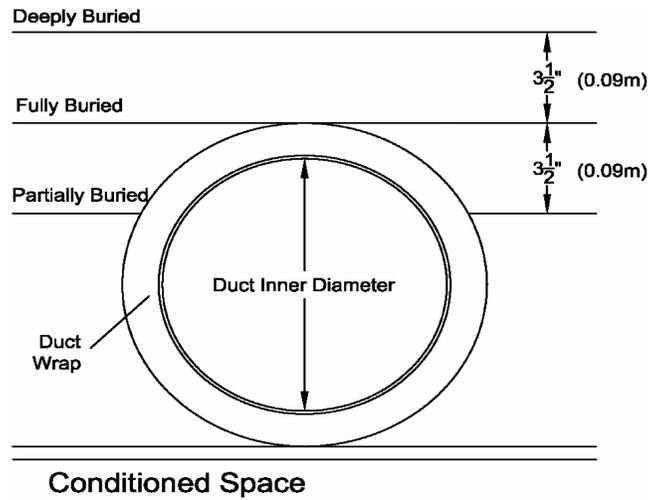
Loose-Fill Insulation Type	Buried Duct Classification		
	Deeply	Fully	Partially
Fiberglass	25	13	9
Cellulose	31	15	9

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an  $R$ -value of  $4.2 \text{ ft}^2 \cdot \text{h} \cdot ^\circ\text{F}/\text{Btu}$ , representing standard construction practice at the time of this study. A schematic illustrating these classifications is presented in Figure 1.

Laboratory and field test results suggest that the analytical results provide a reasonably accurate estimate of duct performance.



**Figure 1** Buried duct classifications.