

Best Practice – Knob and Tube Wiring

Date: Revised January 3, 2017

Subject: Knob and Tube (K&T) Wiring & Priority List

Problem or Question: Should we weatherize homes that have knob and tube wiring (K&T) or should we decline to weatherize on the grounds that there may be a future hazard if attics and walls with K&T are insulated?

Discussion: K&T wiring, usually in older homes, does present a challenge to the weatherization worker, and if insulation is installed without regard to K&T wiring, a hazard can potentially develop. However, if a few cautionary steps are taken during insulation installation, the overall thermal boundary of the house shell can be significantly improved while safeguarding the home from possible hazards. Care should be taken during insulation installation to keep it (3 inches minimum distance) from the K&T wiring. This can be accomplished with moderate effort, as in the case of the attached photos. An insulation baffle or “insulation dam” can be constructed to avoid covering the K&T with insulation (regardless if fiber or cellulose is used).

Make sure to use an electrical load indicator (“non-contact AC voltage tester”) while working with K&T. This helps you determine if or what K&T lines are carrying an electrical load, and therefore must be safeguarded. Additionally, the initial determination of whether K&T wiring is live or dead should be documented in the whole house assessment.

If live K&T is in the walls, the Department recommends not insulating the walls. The insulating of stud bays and not insulating stud bays containing K&T tends to cause moisture issues in the wall structure. In addition, the reduction in total R-value may not be cost effective.

During the client education portion of the weatherization program, it should be stressed to the client that during future activity in the attic (repairs, storage, etc.) that care should be taken to keep insulation and foreign objects away from the wiring.

The practices associated with weatherizing a K&T home can be found in the Single Family Standard Work Specifications Field Guide and the Material Installation Standards Manual posted on-line under “Weatherization Tools and Guides” on the Department Website.

<http://www.tdhca.state.tx.us/community-affairs/wap/guidance.htm>

Some regions may have rehabilitative programs that may allow K&T wiring replacement, so it is recommended to check into your communities programs to see if assistance is available in your region. The Texas Weatherization Field guide suggests K&T replacement where possible, “However if the cost of re-wiring a home is excessive WAP Subrecipients may cost effectively insulate the attic as follows:

- Determine if insulating the attic is cost effective by using the calculations in the next section.
- Install the batts to leave 3” of clearance around the knob & tube components.
- Blow insulation in remaining areas, using the fiberglass batts to act as a dam for the blown insulation, keeping it away from the wiring.
- Do not insulate wall cavities containing live knob & tube wiring systems.”



How to determine if insulating an attic with knob and tube wiring is cost effective.

IMPORTANT: The following formulas will tell you if it is cost effective to dam around K&T wiring and insulate. It is important to note that **you cannot guess** whether a house should be insulated when it has K&T wiring. You must run these formulas to determine if the net R-value is at or above R-11. These calculations and your resulting decision (see flowchart) must be included in the house file.

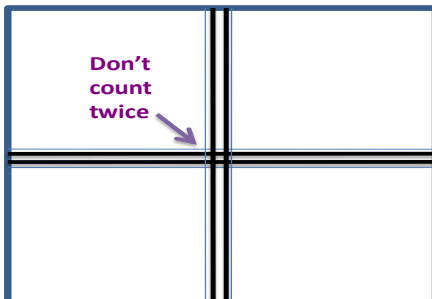
FORMULAS and EXAMPLES:

1. Compute the total R-value using the following formula

$$U = 1/R = [(A1 \times U1) + (A2 \times U2)] / \text{total sq footage}$$

Example "A"

- 30 x 30 attic floor
- 2 strips of K&T down the middle
- R-value of insulated(covered) area = R30
- Total Area = 900 sq.ft.
- Area of uninsulated(30+30-1.5=58.5) = 58.5'X1.5(18" wide batt)= 87.75 A1
- Area of insulation = (900-87.75)= 812.25sqft=A2
- U1 = the r-value of the ceiling(attic floor)= reciprocal of R2 = .5 = U1
- U2 = the r-value of insulated area = 1/R30 = .033 = U2



$$U\text{value} = 1/R\text{value} = [(A1 \times U1) + (A2 \times U2)] / \text{total sqft}$$

$$U\text{value} = (87.75\text{sqft} \times .5) + (812.25\text{sqft} \times .033) / 900\text{sqft}$$

$$U\text{value} = 43.875 + 26.804 / 900\text{sqft} = .0785 = U\text{value}$$

$$1/.0785 = \text{an R-Value of } 12.7$$

This means there is a drop from R30 to R12.7 because of the 87.75 sqft left uncovered.

NOTE: IF this R-value is R-11 or above then continue; as in Example A. This same 900sqft house, that netted an R-value of R-12.7, changes if it has a third uninsulated line(Example B). Notice that the total R-value now drops **below R-11**. The overall R-Value is 7.5. You would **NOT insulate** this attic.

Example “B”

- 30 x 30 attic floor
- 3 cross strips of K&T
- R-value of insulated(covered) area = R30
- Total Area = 900 sq.ft.
- Area uninsulated = $30+30+42.43-3.0$ (2x18” overlap) = $129.43 \times 1.5 =$
194.145sqft = A1
- Area insulated (900-194.145) = 705.855= **A2**
- U1 = the r-value of the ceiling(attic floor)= reciprocal of R2 = .5 = U1
- U2 = the r-value of insulated area = $1/R30 = .033 = U2$

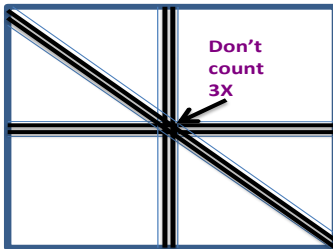
$$Uvalue = 1/Rvalue = [(A1 \times U1) + (A2 \times U2)] / \text{total sqft}$$

$$Uvalue = (194.145\text{sqft} \times .5) + (705.855\text{sqft} \times .033) / 1600\text{sqft}$$

$$Uvalue = 97.07 + 23.29 / 900\text{sqft} = .134 = Uvalue$$

$$1/.134 = \text{an R-Value of } 7.46$$

This means there is a drop from R30 to R7.46 because of the 194 sqft left uncovered.



However, notice that if we increase the size of the attic floor area, the R-value increases to the cut-off point, with an overall R-value of R-11.

Example “C”

- 40 x 40 attic floor
- 3 cross strips of K&T
- R-value of insulated(covered) area = R30
- Total Area = 1600 sq.ft.
- Area uninsulated = $40+40+56.57-3.0$ (2x18” overlap) = $133.57 \times 1.5 =$
200.36sqft = A1
- Area insulated (1600-200.36) = 1399.64= **A2**
- U1 = the r-value of the ceiling(attic floor)= reciprocal of R2 = .5 = U1
- U2 = the r-value of insulated area = $1/R30 = .033 = U2$

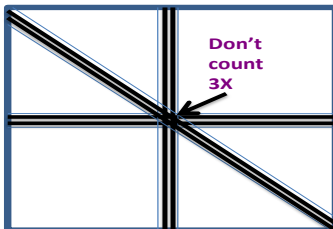
$$Uvalue = 1/Rvalue = [(A1 \times U1) + (A2 \times U2)] / \text{total sqft}$$

$$Uvalue = (200.36\text{sqft} \times .5) + (1399.64\text{sqft} \times .033) / 1600\text{sqft}$$

$$Uvalue = 100.18 + 46.18 / 1600\text{sqft} = .09 = Uvalue$$

$$1/.09 = \text{an R-Value of } 11.11$$

This means there is a drop from R30 to R11.11 because of the 200.36sqft left uncovered.



Recommendation Summary: The decision whether to insulate a K&T attic is based upon the heat transmission formula and the net R-factor determination, as described above. Applying these formulas will determine the net R-value of the attic floor insulation.

Knob and tube wiring is not a reason to disqualify a homeowner from the weatherization program. However, weatherization of K&T homes is a specific task requiring an understanding of how to keep insulation away from the K&T wiring while continuing to weatherize all other aspects of the home.