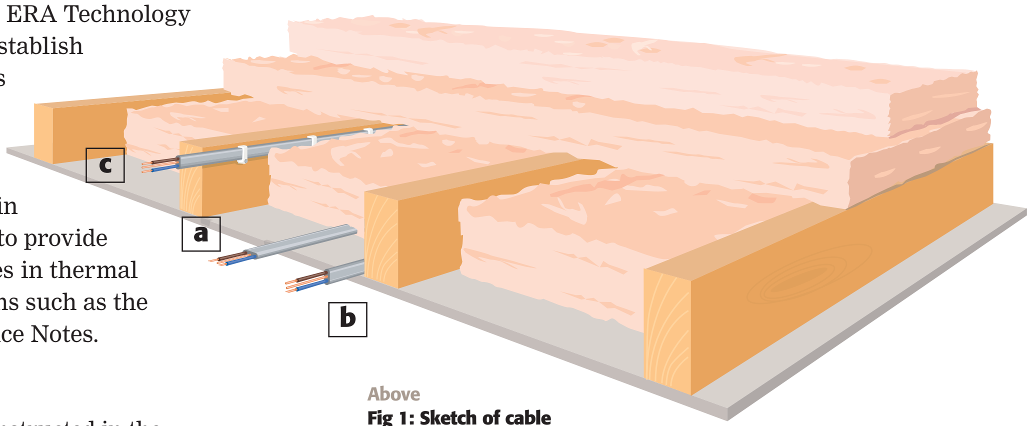
ESTABLISHING CURRENT RATINGS FOR CABLES IN THERMAL INSULATION

by John Ware

THE IEE recently commissioned ERA Technology Ltd to perform a series of tests to establish the accuracy of the derating factors given in BS 7671 for flat twin-and-earth cables installed in the increased thicknesses of loft insulation now being installed in dwellings. The results will be used to provide tables of standard circuits for cables in thermal insulation in future IEE publications such as the Electrician's Guide and the Guidance Notes.



Above
Fig 1: Sketch of cable and insulation arrangements

Test setup

A thermally insulated ceiling was constructed in the laboratory and flat twin-and-earth cable run in three positions, as shown in fig 1. The three positions are:
(a) laid flat along the ceiling
(b) clipped to the side of a joist at the bottom (in contact with the ceiling), and
(c) clipped to the side of a joist at the top.

The ceiling was then covered with a 100mm layer of mineral wool insulation. The cables were energised and the test results recorded.

Results

Table 1 illustrates the results for three sizes of cable and three thicknesses of insulation. The series of tests also produced information concerning time constants and results for cables run at 90°C .

Time constants

The time constant of a cable is defined as the time taken for the cable to reach 63.2% of its final temperature after a change in the load. The time constant for each cable, installed at the top of the joist with 270mm of insulation, was derived from the chart recorder plots. Examples of the temperature plots for these time constants are reproduced in fig 2.

Cables operating at 90ºC

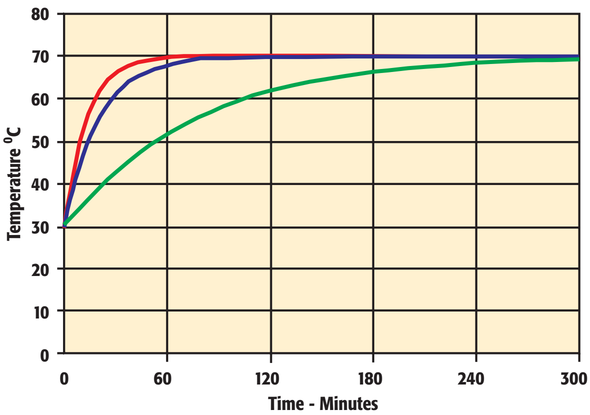
Certain cables are permitted to run at 90°C. However, a problem arises as most accessories are rated to 70°C. The installation may be configured such that there is a length of cable beyond the thermal insulation, prior to connection to an accessory. Such an exposed length of cable would allow cooling so that the 70°C accessory was not subject to excessive temperatures. The graph (fig 3) indicates that approximately 0.5m of cable should be allowed beyond the thermal insulation if an accessory rated at 70 °C is fitted to a cable operating at 90°C within thermal insulation.

Conclusions

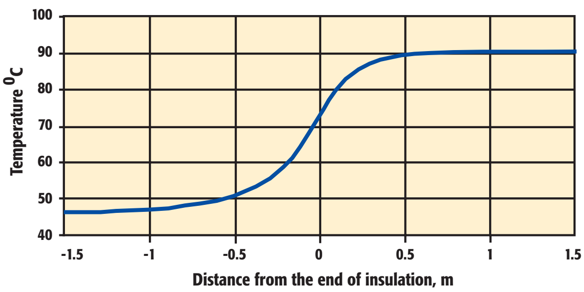
The current rating of any selected cable was highest when it was installed along the bottom of the joist.

Current rating (A)			
Cable size (mm²)	**Top of joist**		
	100	**270**	**440**
2.5	21	17.5	16.7
6	34	28	27
16	57	45	46
	Bottom of joist		
2.5	22	22	21
6	36	35	34
16	62	60	58
	Laid on the ceiling		
2.5	19.7	18.7	18.6
6	36	35	34
16	59	57	55

Above **Table 1: Corrected current ratings for insulation thicknesses 100, 270 and 440 mm for cables of 2.5, 6 and 16 mm^2**



Above **Fig 2: Temperature rise curves.**
The red curve represents the temperature rise curve for 2.5 mm^2 twin-and-earth flat cable.
The blue curve represents the temperature rise curve for 6 mm^2 twin-and-earth flat cable.
The green curve represents the temperature rise curve for 16 mm^2 twin-and-earth flat cable.



Above **Fig 3 Temperature profile along a cable**

This cable is in contact with both the joist and the ceiling. The current ratings derived from the tests have, within the limits of experimental accuracy, confirmed a number of points.

1) The ratings given in BS 7671 for cables installed in an insulated wall may be used for cables installed in a ceiling constructed of wooden joists and plasterboard and insulated with 100mm of mineral wool insulation.

2) The ratings given in BS 7671 for cables installed in an insulated wall should not be used for cables installed in a ceiling where the insulation thickness is increased to that now recommended, 270mm unless the cable is in contact with the ceiling.

3) Increasing the insulation thickness to greater than 270mm has small effect on the current rating.

4) Instead of increasing the conductor size where a cable runs in thermal insulation a different cable type having a higher operating temperature could be selected. The effect of the higher temperature on the accessories would have to be considered. If the cable was run outside of the thermal insulation for a distance of approximately 0.5m before entering the accessory then its temperature at the accessory would be considerably lower than that in the insulation as indicated in fig 3.

5) Where a lighting circuit, protected by a 6A or 10A overcurrent protective device, is fixed to a joist under thermal insulation, a 1mm^2 or 1.5mm^2 flat twin-and-earth cable can be used providing it is not subject to other derating factors.

6) Where the cable of a ring final circuit protected by a 32A fuse or circuit-breaker is installed fixed to a joist and with more than 100mm of thermal insulation the installation designer may have to consider using a cable larger than 2.5mm^2.

7) For cables carrying higher loads such as cookers or electric showers the cable sizes that are commonly used may need to be increased where they are installed under thermal insulation in lofts.

The results of this research will be incorporated in IEE publications, such as future editions of the *On Site Guide, IEE Guidance Notes*, and the *Electrician's Guide to the Building Regulations*.

Please note that the series of British Standard BS 5803: *Thermal insulation for use in pitched roof spaces in dwellings* gives further information on the specifications for thermal insulation. ■

The IEE wishes to express its thanks to ERA Technology Limited, in particular Mark Coates, for the report upon which this article is based.