



# **THERMAL INSULATION HANDBOOK**

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**THE THERMAL INSULATION ASSOCIATION OF SOUTHERN AFRICA**  
Administered by  
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### INTRODUCTION

The Thermal Insulation Association of Southern Africa (TIASA), currently under the aegis of AAAMSA, promotes that part of the industry that specializes in the insulation of ceilings, walls, floors, piping and vessels with cold and hot insulation.

Membership constitutes manufacturers and suppliers of insulation materials, consultants for thermal insulation as well as contractors who sell and install insulation materials.

This specification refers to the measuring of completed insulation installations for industrial applications and will enable Architects, Engineers, Quantity Surveyors, Developers and other Specifiers to quantify their insulation requirements.

Having the installation done by contractors who are members of TIASA will ensure that the installation meets with the specified performance standards.

This handbook only addresses hot and cold insulation. TIASA is presently preparing information regarding ambient (building) insulation and the acoustical properties of insulation materials for inclusion in future editions of this handbook.

Readers are encouraged to submit their comments to the TIASA, which will be considered for inclusion in future editions.

We acknowledge the valuable input received from TIMSA (Thermal Insulation Manufacturers & Suppliers Association) whose information has been included in the Product Selection Guide – Hot Insulation Page 8-12 and Cold Insulation – Pages 19-27.

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## **INTRODUCING TIASA**

South Africa ratified the United Nation Framework Convention on Climate Change in August 1997 and is obliged to develop and submit a National Communication that contains an inventory of greenhouse gas emissions for a base year (1990) and a strategy to address climate change.

Globally at the centre of this activity are the window, glass and insulation industries and we take this opportunity to advise our readers that AAAMSA has been appointed to administer “TIASA – The Thermal Insulation Association of Southern Africa”.

Energy consumption in South Africa measured against output (GDP) is very high compared to its global competitors and conversely the use of insulation is very low. This is due to the misconception that insulation in the region is not essential and regarded as a luxury item and also because of the relatively inexpensive cost of electricity. Cheap fuel has not been used to Southern Africa’s advantage in the production of lower cost goods, to the contrary it has been abused and used excessively diminishing the long-term resources and contributing to environmental pollution. Apart from these issues, peak demand for electricity during the winter months far exceeds the capacity which Eskom can cost effectively supply and the vast majority of affordable homes currently being built are not energy efficient, further escalating the problem of energy abuse into the future.

### ***THESE ISSUES LED TO THE FORMATION OF TIASA***

The initiative of the Residential Demand Side Management (RDSM) Department of Eskom and a broad spectrum of concerned parties from government, NGOs and industry resulted in the establishment of TIASA.

TIASA embraces the entire thermal insulation marketplace, including manufacturers, distributors, contractors, specifiers, consultants, designers, architects, energy service companies, government, utilities and end users.

The mission of TIASA is to improve the environment, and the social and economic well-being of Southern Africans through the greater use, and better application of, thermal insulation.

Insulation has proved to be effective and beneficial in the following:

- Reducing energy costs
- Safety of personnel working in “hot” applications
- Home comfort control
- Temperature control in processing equipment
- Assisting in the reduction of environmental pollution
- Increasing the manufacturing competitiveness of companies
- Reducing the consumption of natural resources
- Reducing noise pollution
- Increasing the productivity of workers in factories, commercial buildings etc.

Southern Africa can no longer afford to disregard these benefits and ignore the advantages of a carefully and clearly defined policy on thermal insulation application.

### **TIASA PROMOTES THE BENEFITS OF INSULATION**

Although providing a service to all industries, TIASA will initially focus the development of its products and services for the building and construction industry with specific attention being paid to sustainable energy efficient affordable homes by:

- Promoting greater understanding and co-operation among all segments of the insulation industry.
- Capacity building through education and training on the correct selection and installation of energy-saving thermal insulation.
- Developing a database of all products, suppliers, contractors, and interested parties in thermal insulation and appropriate dissemination of information.
- Participating in technical, legislative and regulative committees on insulation.
- Developing international relationships.
- Enlisting the resources and support of government agencies, utilities, academic and professional societies.



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## 1. INTRODUCTION TO INSULATION

Energy Conservation is “buzz” words of our times. There are many forms of energy conservation and this handbook is only concerned with the methods of conserving energy by means of thermal insulation.

To change the temperature of an object, energy is required in the form of heat generation to increase temperature, or heat extraction to reduce temperature. Once the heat generation or heat extraction is terminated a reverse flow of heat occurs to revert the temperature back to ambient. To maintain a given temperature considerable continuous energy is required. Insulation will reduce this energy loss.

Heat may be transferred in three mechanisms: conduction, convection and radiation. Thermal conduction is the molecular transport of heat under the effect of a temperature gradient. Convection mechanism of heat occurs in liquids and gases, whereby flow processes transfer heat. Free convection is flow caused by differences in density as a result of temperature differences. Forced convection is flow caused by external influences (wind, ventilators, etc.). Thermal radiation mechanism occurs when thermal energy is emitted similar to light radiation.

Heat transfers through insulation material occur by means of conduction, while heat loss to or heat gain from atmosphere occurs by means of convection and radiation.

Heat passes through solid materials by means of conduction and the rate at which this occurs depends on the thermal conductivity (expressed in W/mK) of the material in question and the temperature drive. In general the greater the density of a material, the greater the thermal conductivity, for example, metals has a high density and a high thermal conductivity.

Materials, which have a low thermal conductivity, are those, which have a high proportion of small voids containing air or gas. These voids are not big enough to transmit heat by convection or radiation, and therefore reduce the flow of heat.

Thermal insulation materials fall into the latter category. Thermal insulation materials may be natural substances or man-made.

If the density of insulation is low, the air or gas voids are comparatively large and this makes for the best insulation for low to medium temperatures where compression and/or vibration is not a factor.

However, where higher temperatures are encountered, the air or gas voids need to be reduced in size to minimize the convection within the voids and this is achieved by increasing the density of the insulation. Density may be increased to a point where the solids content of the insulation is such that the heat bridge of the solids overcomes the insulating effect of the voids. It follows therefore, that by encasing a container of heat with thermal insulation material the reverse heat flow will be retarded with resultant reducing energy loss and cost.

The word “retarded” is important because no matter how much insulation is applied, the reverse flow of heat to ambient can never be stopped. The primary reasons for insulation are many and varied, the main ones being:

- To conserve energy
- To reduce heat loss or gain
- To maintain a temperature condition
- To maintain the effective operation of equipment or chemical reaction
- To assist in maintaining a product at a constant temperature
- To prevent condensation
- To create a comfortable environmental condition
- To protect personnel

The type and thickness of insulation depend on the foregoing primary reasons together with the parameters of the specific conditions.

Economic thickness is the thickness of insulation, which will result in minimum total cost of energy losses plus the cost of the erected insulation. The calculation of economic thickness is complex and in some cases is overruled by the other listed primary reasons, which can make the calculation unnecessary.

The exception is when retro fitting of insulation is envisaged. Retro fitting is the application of additional insulation to existing insulation to further reduce heat loss or gain in order to reduce the cost of energy losses.

The economic thickness calculation has to be prepared by the user and is not usually the function of the insulation contractor. It includes salient factors such as:

- Cost of the energy losses, which include capital cost of installed equipment to generate/extract heat
- Expected price movement in the cost of fuel
- Capital cost of installed insulation
- Payback period that the user requires for capital investments
- Various other accounting factors