

The background of the advertisement features a blue gradient with a city skyline at the bottom. On the left, several cylindrical samples of Aeroflex insulation are shown in various sizes and colors (black, silver, copper). The main title 'AEROFLEX' is in large, bold, yellow letters with a registered trademark symbol. Below it, the text 'CLOSED CELL ELASTOMERIC THERMAL INSULATION FOR HVAC & R SYSTEM' is written in white. To the right, the year '2001' is displayed in large, white, outlined digits. A curved banner at the bottom right contains the text 'SAVE ENERGY SAVE EARTH' in white, set against a backdrop of a globe showing Asia and Australia.

# AEROFLEX®

CLOSED CELL ELASTOMERIC THERMAL INSULATION FOR HVAC & R SYSTEM

2001

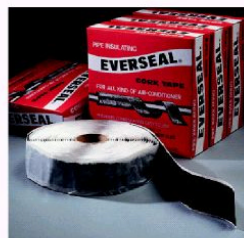
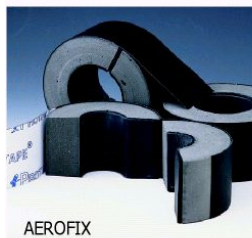
## THE ADVANCED ENERGY CALCULATION PROGRAM FOR HVAC & R SYSTEM

AVAILABLE IN:  
ENGLISH, GERMAN, CHINESE, JAPANESE and THAI

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PROGRAM HANDBOOK

## AEROFLEX Family Products



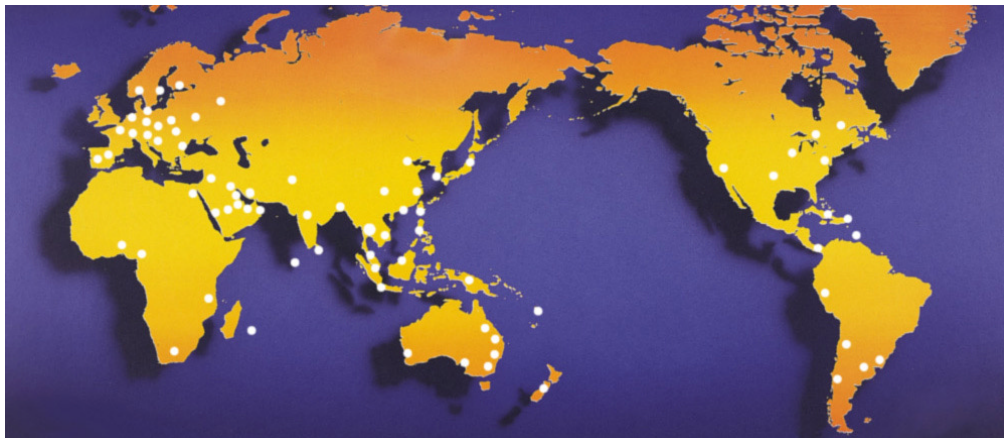
## **AEROFLEX in service worldwide**



*...and many other of high standard buildings worldwide*



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*For more information, please contact your local distributor*



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## **Introduction to AEROFLEX 2001**

This program is designed to help calculate and determine the appropriate thickness of AEROFLEX Closed Cell Thermal Insulation for use in HVAC & R applications (heating, ventilation, air condition & refrigeration) and other general information for your convenience. The technical information and recommendations are average values obtained under typical conditions. The results described herein are based on theoretical guidelines and its accuracy is not guaranteed, particularly when application is used in different environments.

### **Important**

This calculation program has been made to the best of our knowledge, as an analysis aid. Neither the manufacturer of AEROFLEX insulation materials, nor, Engineering Applications Specialists Inc assumes any responsibility or liability on the use of this software.

Physical properties or chemical properties of AEROFLEX Closed Cell Elastomeric Thermal Insulation represents typical average values obtained in accordance with accepted test methods. However, the manufacturer has no control over the end applications of these materials, particularly when used with or attached to other products.

Therefore, the same results as described herein may not be obtained, or the recommendation made by this program may vary due to possible differences in the actual environments. It is recommended that end user should consult the manufacturer or authorized distributors for more information, otherwise, make their own tests to determine adaptability of material for their particular application.

Due to continuous development of the products, some properties are subject to change without notice.

## Features of AEROFLEX 2001

- Can display in 5 languages, i.e. English , German , Chinese , Japanese and Thai.
- This computer program can recommend insulation thickness under following conditions:
  1. k Value fixed (Thermal conductivity fixed) and varying %RH (relative humidity).
  2. %RH fixed (relative humidity) and varying k Value (thermal conductivity).
  3. Check outer surface temperature of insulation with fixed k Value.
  4. Check the thickness of insulation material when fixing the outer surface temperature and varying the k Value.
  5. Under varying insulation thickness, the computer program can show the difference of surface temperature.
  6. Temperature rise, temperature drop in pipelines.
  7. Temperature change in pipelines without flow.
  8. Heat gain or heat loss from the metal pipes when being insulated with insulation materials of varying thickness.
  9. Energy loss from the heating and cooling system.
  10. Graph recommend how to select the economic thickness of insulation.
- Calculate the thickness of AEROFLEX when being used for air-duct to prevent condensation. Enter ambient and operating temperature.
- Calculate AEROFLEX insulation thickness when being used for storage tanks :
  - (1) Rectangular tank
  - (2) Cylinder tank
  - (3) Sphere tanksimply enter the dimensions, initial temperature, final temperature, time for storage, the program will recommend the insulation thickness.



- Calculate the insulation thickness when used with operating tank to determine the thickness of insulation to prevent condensation and heat gain to the operating tank.
- Calculate R Value of various thickness of insulation sheet and tube to required R Value or country regulation.
- Convertible between SI Unit, Imperial Unit (English unit) and kCal Unit.
- Display results in table and graph.
- Convection coefficient ( $h_a$ ) can be entered manually.
- Check dew point temperature, relative humidity (%RH) of the atmosphere.
- Pipe sizes, k Value (Thermal Conductivity), % relative humidity (%RH), cost of insulation and energy can be changed or adjusted by user.
- Work fast and easy with mouse.
- To show full specifications, physical properties & technical information of AEROFLEX Closed Cell Elastomeric Thermal Insulation as per general catalogue.

## **SYSTEM REQUIREMENT**

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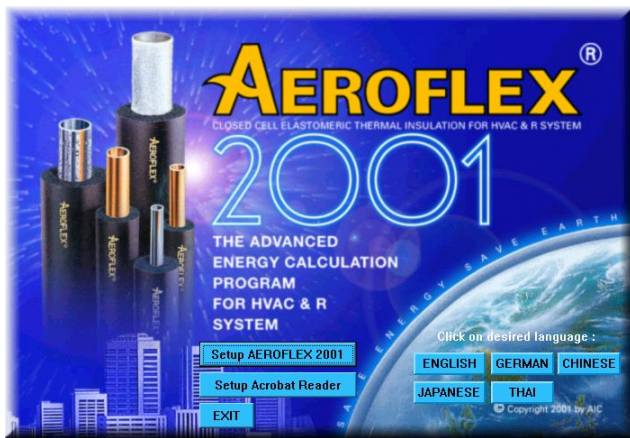
### **System Requirement**

1. IBM or IBM compatible Computer
2. Operating System : Windows 95, 98, ME, NT
3. CPU Pentium 133 or higher
4. RAM 32 MB or higher
5. VGA Resolution 800x600-256 Color or higher
6. Minimum Hard Disk Space 20 MB

## Program Installation

Insert CDROM to CD drive and wait for AEROFLEX 2001 program to appear on screen as in picture No.1. To execute calculation program, just simply click on desired language button. The program is now ready to use in that language.

If you want to install in hard disk, just click on **Setup AEROFLEX 2001** then follow the program instructions displayed on the screen until finish. After installation the monitor will display the logo of AEROFLEX 2001 at the sub menu of program menu (see picture No.5).



Picture No.1 Displays AEROFLEX 2001 calculation program after inserting CDROM.

## CDROM Layout

AEROFLEX 2001 Program contents are shown in picture No.2 , Details as follows :

- Folder “English” : contents English language program.
- Folder “German” : contents German language program.
- Folder “Chinese” : contents Chinese language program.
- Folder “Japanese” : contents Japanese language program.
- Folder “Thai” : contents Thai language program.
- Folder “Install” : contents setup program for installing in hard disk
- Folder “Acrobat Reader 4” : contents setup program for installing acrobat reader version 4.0 to windows system
- Folder “Handbook” : contents AEROFLEX 2001 program handbook file (acrobat format file)
- AEROcd.exe : contents starting program for this CDROM



Picture No.2 Shows AEROFLEX 2001 CDROM Layout.

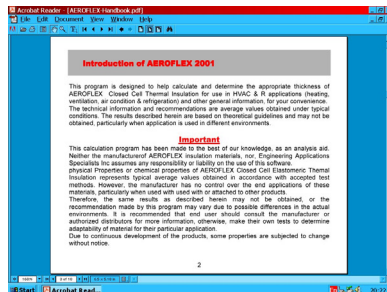


## Program Handbook

AEROFLEX 2001 Handbook is created in “ACROBAT ” program. So “ACROBAT” program is needed in your WINDOWS. “Acrobat Reader 4” program is provided in this CDROM. For those who requires “ACROBAT”, just simply click at **Setup Acrobat Reader** . “ACROBAT” program will be set up automatically in your WINDOWS. After installation, the monitor will display the logo of AEROFLEX 2001 Handbook at the sub menu of program menu (see picture No.5). Start to read the handbook just click on “AEROFLEX 2001 Handbook” then the monitor will display the front page of the handbook (picture No.3). Use “ACROBAT” program toolbars to read or print out to make a hard copy of handbook. Picture No.4 displays page 2 of AEROFLEX 2001 Handbook. AEROFLEX 2001 Handbook is also provided in the Menu file. Choose “AEROFLEX 2001 Handbook” to read.



Picture No.3 Shows the front page of AEROFLEX Handbook.



Picture No.4 Shows page 2 of AEROFLEX Handbook.

## Language Switch & Start AEROFLEX 2001 Program

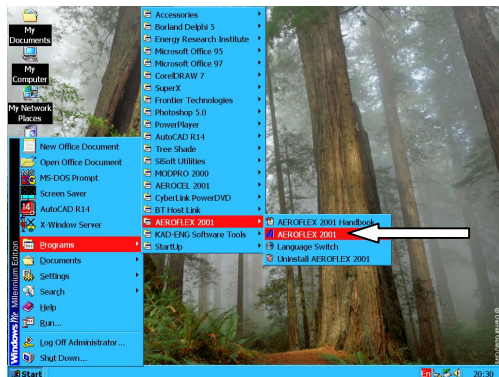
After installation “AEROFLEX 2001”, the monitor will display “AEROFLEX 2001” at the menu of file program on “the main menu” (see picture No.5).

Language Switch is for language selection (see picture No.6) which is available in 5 languages, i.e. English, German, Chinese, Japanese and Thai . Simply click the mouse on desired language, then click **OK** button, “AEROFLEX 2001” will display information, data & reports in the language that you have selected.

After language selection, start the calculation program by clicking on “AEROFLEX 2001” from the main menu (see picture No.5), or double click icon “AEROFLEX 2001”, then the monitor will display front page of the program (picture No.7). Click “the green button”



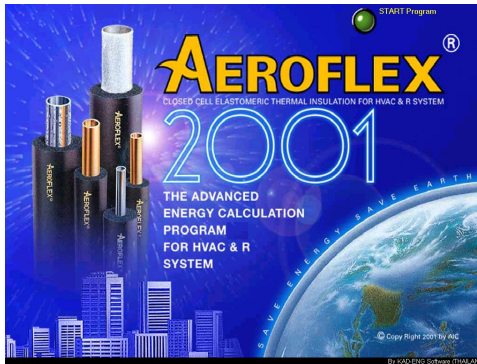
at top right corner of the screen in order to begin AEROFLEX 2001.



Picture No.5 Displaying menu of AEROFLEX 2001.




Picture No.6 Displays language switch.



Picture No.7 Screen displaying the front page of AEROFLEX 2001.

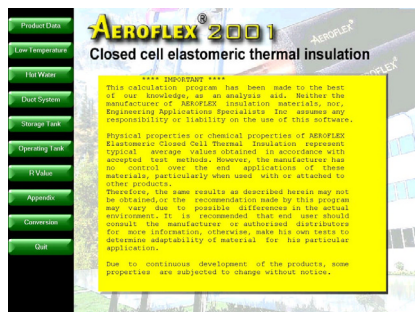


## Main Menu

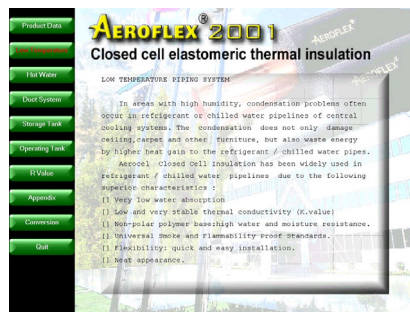
Start the program, by clicking "the green button"  at top right corner of the front page of " AEROFLEX 2001" (picture No.7), the monitor will display main menu as shown in picture No.8. Please read **\*\*\* IMPORTANT \*\*\*** message carefully to assure that it is clearly understood before using this calculation program.

"Main Menu" will be displayed in 2 portions. The "Topic Menu" which has 10 topic buttons as shown in picture No.8 and the explanation of each topic will be displayed on the right hand side if the cursor is placed on the topic title.


For e.g. the explanation on Low Temperature can be displayed by placing the cursor on the "Low Temperature" topic button (picture No.9).



Picture No.8 Shows "main menu" of AEROFLEX 2001.



Picture No.9 Provides explanation of Low Temperature.

Click  for general information on AEROFLEX Closed Cell Elastomeric Thermal Insulation. Product data topic consists of :

1. Introduction
2. Production and Application
3. Characteristics and Main Advantages
4. Specifications
5. Hot Water Piping
6. Chilled Water Piping
7. In Service Worldwide
8. Standard Packing (IMPERIAL SYSTEM)
9. Standard Packing (METRIC SYSTEM)
10. International Distribution

Click the desired tabbars on top part of the display as shown in picture No.10. The information and technical data can be printed by clicking on the printer icon at the top left hand corner of display.

Toolbars at the bottom (picture No.10) performs the following functions:



Click to return to main menu.



Click this icon to change the parameters for further calculations i.e. pipe size, thermal conductivity value (k Value), %RH, surface temperature and other factors (see more details on page 31).



Click this icon to check thermal conductivity value (AEROFLEX k Value) at various temperatures (see more details on page 36).



Click this icon to enter or change size of insulation material. This data is necessary for calculating the R Value (see more details on page 37).



Click this icon to enter cost of insulation material plus installation cost. This data is necessary for calculating the economic thickness recommendation (see more details on page 39).

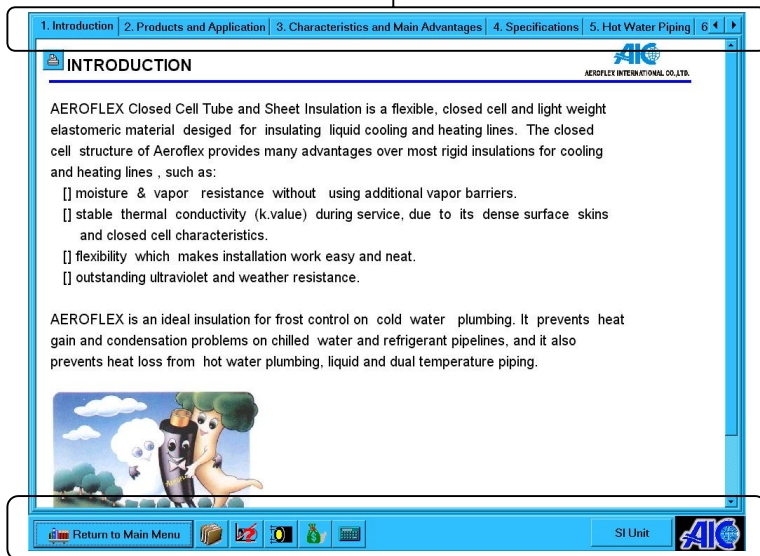


Click this icon to use the calculator which is provided by MS WINDOWS system.

SI Unit

Three unit systems are available that can be selected by clicking this icon i.e Imperial Unit (English Unit) , SI UNIT and kCal Unit.

## Tabbars



## Toolbars

Picture No.10 Shows the product data of AEROFLEX, tabbars and toolbars.

Low Temperature

**Low Temperature**

Click **Low Temperature** button to calculate the recommended thickness of the insulation. The menu of Low Temperature system calculation consists of 3 classified groups with 8 calculation methods as shown in pictures No.11 and 12.

**Low Temperature Calculation**

Minimum Insulation Thickness Recommendations to Prevent Condensation  
 Inside Temperature 33°C  
 Operating Temperature 5°C  
 k, Thermal Conductivity 0.0354 W/m.K

ha, Convection Coefficient of air 8.0 W/m².K

Low Temperature Calculation

Condensation Minimum Thickness Recommendation	Temperature Control	Economic Thickness Recommendation
k Constant	Surface Temperature	Energy Gain
%RH Constant	Line Temp. by Length	Energy Gain Cost
	Line Temp. by Time	Overall Cost

Table Room Temperature 30 °C  
 Top Operating Temperature 5 °C  
 ha, Convection Coefficient of air 8.0 W/m².K

Low air movement 6.0-8.0  
 Moderate air movement 8.0-9.0  
 Forced air 12.0-96.0

Close

**Low Temperature Calculation**

Condensation Minimum Thickness Recommendation	Temperature Control	Economic Thickness Recommendation
k Constant	Surface Temperature	Energy Gain
%RH Constant	Line Temp. by Length	Energy Gain Cost
	Line Temp. by Time	Overall Cost

Tdb, Room Temperature 30 °C  
 Top, Operating Temperature 5 °C  
 ha, Convection Coefficient of air 8.0 W/m².K

ha, Convection Coefficient of air (W/m².K)  
 Low air movement 6.0-8.0  
 Moderate air movement 8.0-9.0  
 Forced air 12.0-96.0

Close

Picture No.11 Shows the calculation form of the Low Temperature system and windows for entering the data for further calculation.

Picture No.12 Shows the menu of Low Temperature system calculation which consists of 3 classified group with 8 calculation methods.

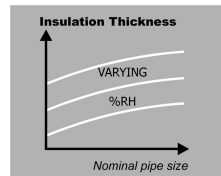
## Program calculation usage :

### 1. Condensation : Minimum Thickness Recommendation

1.1

k Constant

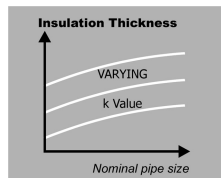
This button is for calculating minimum thickness of insulation tube/sheet required to prevent condensation with fixed k Value (Thermal Conductivity) and varying %RH (Relative Humidity) values.



1.2

%RH Constant

This button is for calculating minimum thickness of insulation tube/sheet required to prevent condensation with fixed %RH value and varying k Values (Thermal Conductivity).

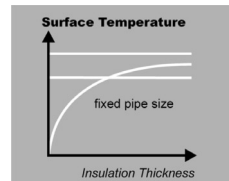


## 2. Temperature Control

2.1

Surface Temperature

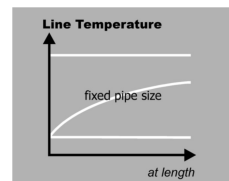
This button is for checking surface temperature of the insulation at selected pipe sizes.



2.2

Line Temp. by Length

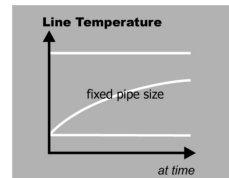
This button is for checking refrigerant or chilled water temperature at varying lengths of selected pipe sizes.



2.3

Line Temp. by Time

This button is for checking the rise in temperature of refrigerant or chilled water by time.



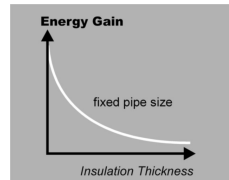


### 3. Economic Thickness Recommendation

3.1

Energy Gain

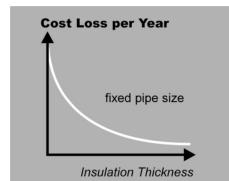
This button is for calculating heat gain per meter or feet for various insulation thickness.



3.2

Energy Gain Cost

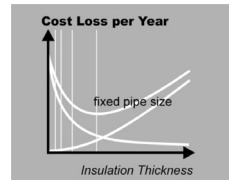
This button is for calculating energy loss cost per length per year at various insulation thickness.




3.3



Overall Cost

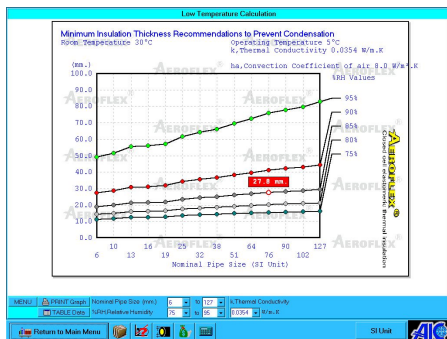
This button is for checking the economic thickness of insulation to determine the minimum total cost of insulation, installation and energy loss. The graph also provides the minimum insulation thickness to prevent condensation at various %RH.



Select the method of calculation from the menu (picture No.12), enter all data required for calculation as shown in picture No.11. If the graph does not appear in the background, data entered is incomplete or inappropriate.

Click  to close the Low Temperature calculation windows for displaying the graph in full screen (picture No.13). The graph can also be displayed by dragging the Low Temperature calculation window -- to drag the Low Temperature calculation window click, hold and drag the title bar.

Click  to view the results in table form (picture No.14). To start a new calculation click  again (picture No.11).



Picture No.13 Shows calculation result in graph.

## Low Temperature Calculation

Minimum  
Insulation  
Thickness

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AEROFLEX<sup>®</sup>

AEROFLEX<sup>®</sup>  
Minimum Insulation Thickness Recommendations

Minimum Insulation Thickness Recommendations to Prevent Condensation

Room Temperature 30°C

Operating Temperature 5°C

$\lambda$  Thermal Conductivity 0.0254 W/m.K

Insulation Thickness (mm)

$h_a$  Convection Coefficient of air 8.0 W/m<sup>2</sup>.K

SI Unit

Minimum Insulation Thickness (mm)

600  
500  
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## Hot Water

## Hot Water

Click at **Hot Water** button to calculate the recommended thickness of the insulation. The menu of hot water system calculation consists of 3 classified groups with 8 calculation methods as shows in picture No.15 and 16.

**Hot Water Calculation**

Line Temperature by Time  
 Nominal Pipe Size 64(mm.)  
 Room Temperature 25°C  
 Insulation Thickness 25mm.

Operating Temperature 65°C  
 k, Thermal Conductivity 0.0407 W/m.K  
 ha, Convection Coefficient of Air 9.25 W/m²K

Minimum Thickness Recommendation	Temperature Control	Economic Thickness Recommendation
k Constant	Surface Temperature	Energy Loss
Temperature Constant	Line Temp. by Length	Energy Loss Cost
	Line Temp. by Time	Overall Cost

Tdb, Room Temperature: 25 °C  
 Top, Operating Temperature: 65 °C  
 ha, Convection Coefficient of air: 9.25 W/m²K  
 ha, Convection Coefficient of Air (W/m²K)  
 Low air movement: 6.0-8.0  
 Moderate air movement: 8.0-9.0  
 Forced air: 12.0-96.0

Close

**Hot Water Calculation**

Minimum Thickness Recommendation	Temperature Control	Economic Thickness Recommendation
k Constant	Surface Temperature	Energy Loss
Temperature Constant	Line Temp. by Length	Energy Loss Cost
	Line Temp. by Time	Overall Cost

Tdb, Room Temperature: 25 °C  
 Top, Operating Temperature: 65 °C  
 ha, Convection Coefficient of air: 9.25 W/m²K

ha, Convection Coefficient of Air (W/m²K)  
 Low air movement: 6.0-8.0  
 Moderate air movement: 8.0-9.0  
 Forced air: 12.0-96.0

Close

Picture No.15 Shows the calculation form of hot water system and windows for entering the data for further calculation.

Picture No.16 Shows the menu of hot water system calculation which consists of 3 classified groups with 8 calculation methods.

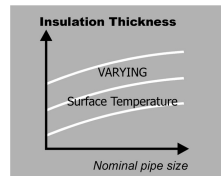
## Program calculation usage :

### 1. Minimum Insulation Thickness Recommendation

1.1

k Constant

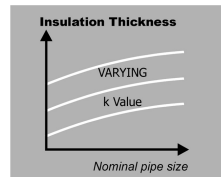
This button is for calculating minimum thickness of insulation to obtain the desired surface temperature of insulation with fixed k Value (Thermal Conductivity) and varying surface temperatures of insulation.



1.2

Temperature Constant

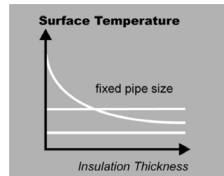
This button is for calculating the minimum thickness of insulation with fixed surface temperature of insulation and varying k Value (Thermal Conductivity).



## 2. Temperature Control

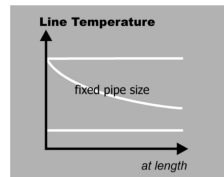
### 2.1 Surface Temperature

This button is for calculating the surface temperatures of varying insulation thickness.



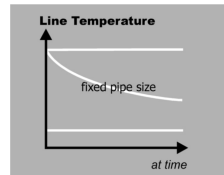
### 2.2 Line Temp. by Length

This button is for calculating the temperature drop on the hot water at selected pipe size by length.



### 2.3 Line Temp. by Time

This button is for calculating the temperature drop of hot water at selected pipe size by time.

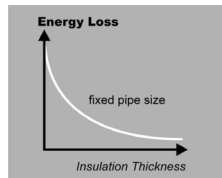


### 3. Economic Thickness Recommendation

3.1

Energy Loss

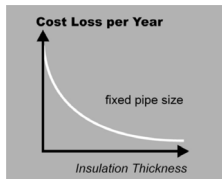
This button is for calculating the energy loss when using various thicknesses of insulation.



3.2

Energy Loss Cost

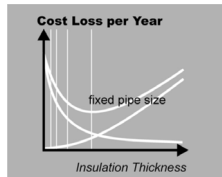
This button is for calculating energy loss cost per length per year with various insulation thicknesses.




3.3



Overall Cost

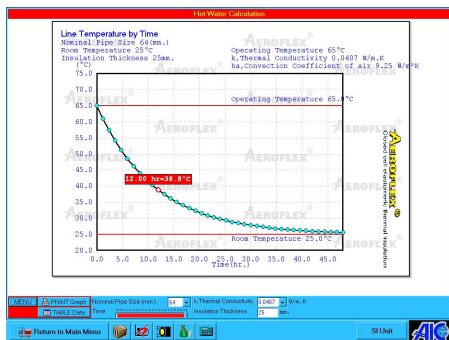
This button is for calculating the economic thickness of insulation to determine the minimum total cost of insulation, installation and energy loss. The graph also provides surface temperature of insulation at various thicknesses.



Select the method of calculation from the menu (picture No.16), enter all data required for calculation as shown in picture No.15 . If the graph does not appear in the background, data entered is incomplete or inappropriate.

Click  to close the hot water calculation window for displaying the graph in full screen (picture No.17). The graph can also be displayed by dragging the hot water calculation window -- to drag the hot water calculation window click, hold and drag the title bar.

Click  to view the results in table form (picture No.18). To start a new calculation click  again (picture No.15).



Picture No.17 Displays calculation result in graph form.

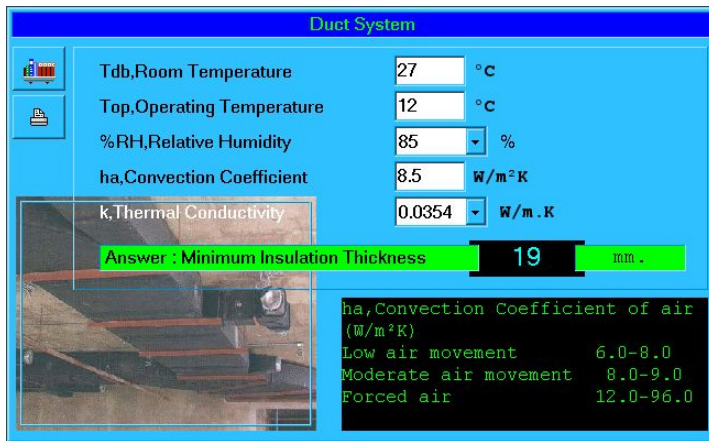
t (h)	T (°C)	Q (W/m²)	t (h)	T (°C)	Q (W/m²)	t (h)	T (°C)	Q (W/m²)
1.00	61.0	13.20	37.0	25.0	20.7	37.00	25.0	20.7
2.40	57.5	14.40	38.0	25.40	20.9	38.40	25.9	21.0
3.60	54.1	15.60	39.0	25.80	21.0	39.60	26.3	21.3
4.80	51.1	16.80	40.0	26.1	21.1	40.80	26.1	21.1
6.00	48.5	18.00	41.0	27.0	21.2	42.00	26.0	21.0
7.20	46.1	19.20	42.0	27.4	21.3	43.20	25.8	20.8
8.40	44.0	20.40	43.0	27.3	21.3	44.40	25.6	20.6
9.60	42.1	21.60	44.0	27.1	21.4	45.60	25.7	21.0
10.80	40.4	22.80	45.0	26.6	21.4	46.80	25.6	20.8
12.00	38.9	24.00	46.0	26.1	21.4	48.00	25.6	20.8

Picture No.18 Displays calculation result in table form.



To calculate insulation thickness for use on air-ducts to prevent condensation. Click **Duct System** and input all necessary information. The recommended thickness of AEROFLEX insulation will immediately appear in the "Answer: minimum insulation thicknees" as shown in picture No.19.

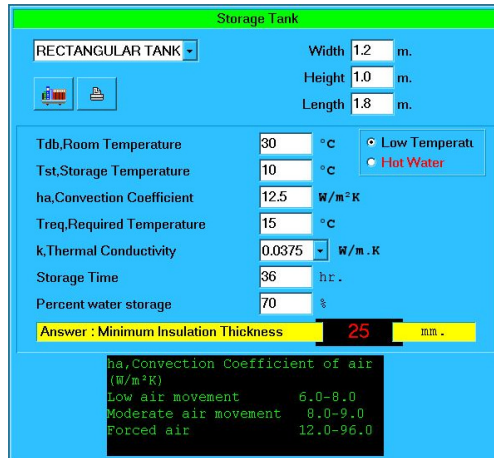
N/A will be displayed in the answer column if the data is incomplete or inappropriate.



Duct System	
Tdb, Room Temperature	27 °C
Top, Operating Temperature	12 °C
%RH, Relative Humidity	85 %
ha, Convection Coefficient	8.5 W/m <sup>2</sup> K
k, Thermal Conductivity	0.0354 W/m.K
<b>Answer : Minimum Insulation Thickness</b> <b>19</b> mm.	
<b>ha, Convection Coefficient of air (W/m<sup>2</sup>K)</b>	
Low air movement	6.0-8.0
Moderate air movement	8.0-9.0
Forced air	12.0-96.0

Picture No.19 Displays the program for minimum insulation thickness on air-ducts.

Storage tank has 3 types : Rectangular, Cylindrical, and Spherical. To calculate the thickness for each type, select the appropriate type in the menu and input the necessary data as shown in Picture No.20. The recommend thickness of AEROFLEX insulation will appear immediately in the answer column. N/A will be displayed in the answer column if the data is incomplete or inappropriate.



Storage Tank

RECTANGULAR TANK

Width 1.2 m.

Height 1.0 m.

Length 1.8 m.

Tdb,Room Temperature 30 °C

Tst,Storage Temperature 10 °C

ha,Convection Coefficient 12.5 W/m<sup>2</sup>K

Treq,Required Temperature 15 °C

k,Thermal Conductivity 0.0375 W/m.K

Storage Time 36 hr.

Percent water storage 70 %

Answer : Minimum Insulation Thickness 25 mm.

ha,Convection Coefficient of air (W/m<sup>2</sup>K)

Low air movement 6.0-8.0

Moderate air movement 8.0-9.0

Forced air 12.0-96.0

Picture No.20 Displays the calculation program for storage tank.

Operating Tank

## Operating Tank

Click **Operating Tank** to calculate the minimum insulation thickness recommended to prevent condensation. Key in all necessary data, the program will calculate the minimum thickness of AEROFLEX closed cell insulation to prevent condensation and will also calculate the heat gain on the operating tank, as shown in Picture No.21. N/A will be displayed in the answer column if the data is incomplete or inappropriate.

**Operating Tank (low Temperature)**

Tdb,Room Temperature	25	°C
Top,Operating Temperature	10	°C
%RH,Relative Humidity	85	%
ha,Convection Coefficient	9.0	W/m².K
k,Thermal Conductivity	0.0375	W/m.K

**Minimum Insulation Thickness Recommendations to Prevent Condensation**

19 mm.

**Heat Gain**

24.3 W/m²

ha,Convection Coefficient of air (W/m².K)

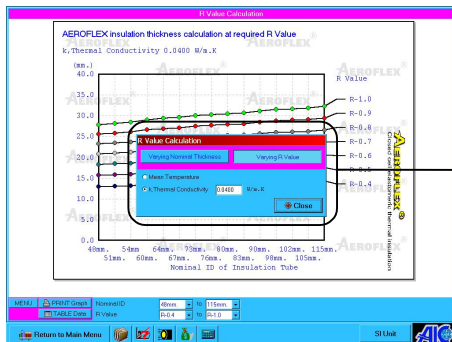
Low air movement	6.0-8.0
Moderate air movement	8.0-9.0
Forced air	12.0-96.0

Picture No.21 Displays the calculation program for operating tank.

R Value

**R Value**

Click at **R Value** to calculate thickness by varying R Values or vice versa. There are 2 calculation methods as shows in Pictures No.22 and 23. Above values can be obtained by entering either k Value or mean temperature. After entering mean temperature , the AEROFLEX k Value will appear and ready for calculation.



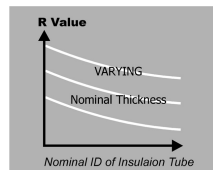
Picture No.22 Shows the calculation form of R Value and windows for entering the data for further calculation.

Picture No.23 Shows the menu of R Value calculation which consists of 2 calculation methods.

## Program calculation usage :

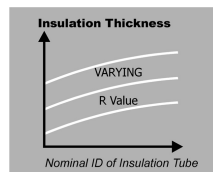
1. Varying Nominal Thickness

This button is for calculating R Value of each nominal thickness of AEROFLEX insulation.



2. Varying R Value

This button is for calculating the thickness of insulation required to have the desired R Value.



## Appendix

## Appendix

After clicking **Appendix**, Picture No.24 will appear on the screen. The top part as shown in Picture No.25 is for calculating %RH and dew point temperature. Input the room temperature and %RH to calculate the dew point temperature. Input room temperature and dew point temperature to calculate %RH.

Other information in the appendix consists of :

1. Abbreviations and Symbols
2. Heat Transfer
3. Conduction Heat Transfer
4. Thermal Conductivity
5. Convection Heat Transfer
6. Convection Coefficient of Air
7. Psychrometrics
8. Thermodynamic Fundamentals
9. Physical Constants
10. Formula (for calculation in AEROFLEX 2001 program)

The screenshot shows the 'Appendix' window with a yellow header. Below the header, there are input fields for 'Tdb, Room Temperature' (25 °C), 'Tdp, Dew Point Temperature' (22 °C), 'RH, Relative Humidity' (75 %), and 'Tdp, Dew Point Temperature' (20.5 °C). The 'RH, Relative Humidity' field is highlighted in black. Below the input fields, there is a tabbed interface with tabs for '6. Convection Coefficient of Air', '7. Psychrometrics', '8. Thermodynamic Fundamentals', '9. Physical Constants', and '10. Formula'. The '6. Convection Coefficient of Air' tab is selected. The formula for the convection coefficient of air is displayed as follows:

$$Ra_{crit} = \frac{k (T_s - T_{\infty})}{h_a (T_{\infty} - T_s)}$$

Below the formula, the variables are defined:

- $k$  = Thermal Conductivity of Insulation
- $h_a$  = Convection Coefficient of air

Picture No.24 Shows the list in appendix.

The screenshot shows the 'Appendix' window with a yellow header. Below the header, there are input fields for 'Tdb, Room Temperature' (25 °C), 'Tdp, Dew Point Temperature' (22 °C), 'RH, Relative Humidity' (75 %), and 'Tdp, Dew Point Temperature' (20.5 °C). The 'RH, Relative Humidity' field is highlighted in black. Below the input fields, there is a tabbed interface with tabs for '6. Convection Coefficient of Air', '7. Psychrometrics', '8. Thermodynamic Fundamentals', '9. Physical Constants', and '10. Formula'. The '10. Formula' tab is selected. The formula for the convection coefficient of air is displayed as follows:

$$Ra_{crit} = \frac{k (T_s - T_{\infty})}{h_a (T_{\infty} - T_s)}$$


Below the formula, the variables are defined:

- $k$  = Thermal Conductivity of Insulation
- $h_a$  = Convection Coefficient of air

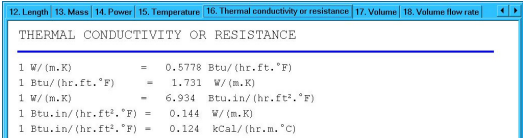
Picture No.25 Shows calculation program for checking %RH and also dew point temperature.

Conversion

## Conversion

After clicking , Picture No.26 will be shown on the screen. This menu consists of 18 categories and can be selected by clicking tabbars :

1. Acceleration
2. Area
3. Density
4. Energy or work
5. Flow rate (mass)
6. Flow rate (volume)
7. Flow rate (volume/area)
8. Force
9. Heat flux
10. Heat loss coefficient of building
11. Heat transfer coefficient
12. Length
13. Mass
14. Power
15. Temperature
16. Thermal conductivity or resistance
17. Volume
18. Volume flow rate



1 W/(m.K)	=	0.5778 Btu/(hr.ft. <sup>2</sup> .°F)
1 Btu/(hr.ft. <sup>2</sup> .°F)	=	1.731 W/(m.K)
1 W/(m.K)	=	6.934 Btu.in/(hr.ft <sup>2</sup> .°F)
1 Btu.in/(hr.ft <sup>2</sup> .°F)	=	0.144 W/(m.K)
1 Btu.in/(hr.ft <sup>2</sup> .°F)	=	0.124 kCal/(hr.m. <sup>2</sup> .°C)

Picture No.26 Shows units conversion.

Quit

**QUIT**

Click  to exit AEROFLEX 2001 program to window program.




## Toolbars



### PARAMETER SETUP

1.

#### Pipe Sizes

Click  , Picture No.27 will be shown on the screen. Key in desired preset data or make the necessary change of data and information for use in calculation program. There are 6 groups of parameter:

Input the data of nominal pipe size, O.D.(outer diameter) and I.D. (inner diameter) for copper pipe and iron pipe, see Picture No.27.

2.

#### k Values

There are 2 vertical sections to enter k Values, one side for low temperature and other for hot water calculation program, see Picture No.28.

3.

#### % RH

Input desired %RH values for use in the calculation program, see Picture No.29.

4.

#### R Values

Input desired R Values of the insulation, see Picture No.30.

5.

#### Surface Temperatures

Input desired outer surface temperatures of the insulation, see Picture No.31.

6.

### Misc. Factors

Entering the factors used in the overall cost calculation program such as currency, working days per year, work hours per day, energy source and energy cost as shown in Picture No. 32.

Parameters Setup

Surface Temperatures      Misc. Factors

Pipe Sizes      k Values      %RH Values      R Values

Select Pipe Type IPS

Item	Nominal Size	OD.(mm.)	ID. (mm.)
1	6	13	13
2	10	16	16
3	13	22	22
4	16	23	23
5	19	25	25
6	25	35	35
7	32	42	42
8	38	48	48
9	51	60	60
10	64	73	73
11	76	90	90
12	90	102	102
13	102	115	115

OK Cancel

Picture No.27 Shows standard copper and iron pipe sizes.

**Parameters Setup**

Surface Temperatures		Misc. Factors	
Pipe Sizes	k Values	%RH Values	R Values
<b>k Thermal Conductivity (W/m.k)</b>			
Item	Low Temperature	Hot Water	
1	0.0292	0.0362	
2	0.0302	0.0368	
3	0.0313	0.0375	
4	0.0323	0.0381	
5	0.0333	0.0388	
6	0.0344	0.0394	
7	0.0354	0.0400	
8	0.0364	0.0407	
9	0.0375	0.0414	
10	0.0385	0.0420	

OK Cancel

Picture No.28 Shows k Values for both low temperatures & hot water calculation program.

**Parameters Setup**

Surface Temperatures		Misc. Factors	
Pipe Sizes	k Values	%RH Values	R Values
<b>Relative Humidity (%)</b>			
Item	RH Relative Humidity		
1	50		
2	55		
3	60		
4	65		
5	70		
6	75		
7	80		
8	85		
9	90		
10	95		

OK Cancel

Picture No.29 Shows desired %RH data.

**Parameters Setup**

Surface Temperatures		Misc. Factors																																		
Pipe Sizes	k Values	%RH Values	R Values																																	
<p><b>R Thermal Resistance</b> (m<sup>2</sup> °C/W)</p> <table border="1"> <thead> <tr> <th>Item</th> <th>R Value Name</th> <th>R Value</th> </tr> </thead> <tbody> <tr><td>1</td><td>R-0.1</td><td>0.100</td></tr> <tr><td>2</td><td>R-0.2</td><td>0.200</td></tr> <tr><td>3</td><td>R-0.3</td><td>0.300</td></tr> <tr><td>4</td><td>R-0.4</td><td>0.400</td></tr> <tr><td>5</td><td>R-0.5</td><td>0.500</td></tr> <tr><td>6</td><td>R-0.6</td><td>0.600</td></tr> <tr><td>7</td><td>R-0.7</td><td>0.700</td></tr> <tr><td>8</td><td>R-0.8</td><td>0.800</td></tr> <tr><td>9</td><td>R-0.9</td><td>0.900</td></tr> <tr><td>10</td><td>R-1.0</td><td>1.000</td></tr> </tbody> </table>				Item	R Value Name	R Value	1	R-0.1	0.100	2	R-0.2	0.200	3	R-0.3	0.300	4	R-0.4	0.400	5	R-0.5	0.500	6	R-0.6	0.600	7	R-0.7	0.700	8	R-0.8	0.800	9	R-0.9	0.900	10	R-1.0	1.000
Item	R Value Name	R Value																																		
1	R-0.1	0.100																																		
2	R-0.2	0.200																																		
3	R-0.3	0.300																																		
4	R-0.4	0.400																																		
5	R-0.5	0.500																																		
6	R-0.6	0.600																																		
7	R-0.7	0.700																																		
8	R-0.8	0.800																																		
9	R-0.9	0.900																																		
10	R-1.0	1.000																																		

OK Cancel

Picture No.30 Shows desired R Values.

**Parameters Setup**

Surface Temperatures		Misc. Factors																							
Pipe Sizes	k Values	%RH Values	R Values																						
<p><b>Surface Temperatures</b> (°C)</p> <table border="1"> <thead> <tr> <th>Item</th> <th>T Temperature</th> </tr> </thead> <tbody> <tr><td>1</td><td>25.5</td></tr> <tr><td>2</td><td>26.0</td></tr> <tr><td>3</td><td>27.0</td></tr> <tr><td>4</td><td>29.0</td></tr> <tr><td>5</td><td>32.0</td></tr> <tr><td>6</td><td>35.0</td></tr> <tr><td>7</td><td>40.0</td></tr> <tr><td>8</td><td>44.0</td></tr> <tr><td>9</td><td>46.0</td></tr> <tr><td>10</td><td>48.0</td></tr> </tbody> </table>				Item	T Temperature	1	25.5	2	26.0	3	27.0	4	29.0	5	32.0	6	35.0	7	40.0	8	44.0	9	46.0	10	48.0
Item	T Temperature																								
1	25.5																								
2	26.0																								
3	27.0																								
4	29.0																								
5	32.0																								
6	35.0																								
7	40.0																								
8	44.0																								
9	46.0																								
10	48.0																								

OK Cancel

Picture No.31 Shows desired surface temperatures.

**Parameters Setup**

Pipe Sizes	k Values	%RH Values	R Values
Surface Temperatures		Misc. Factors	
Convection Coefficient <input type="text" value="By Manual Input"/>			
Unit of currency <input type="text" value="\$"/>			
Working day per year <input type="text" value="365"/>		days	
Working Hours per day <input type="text" value="24"/>		hr.	
<b>Source of Energy</b>			
Source of Energy <input type="text" value="Electricity"/>			
Electricity	<input type="text" value="0.095"/>	\$/kW.hr	
Gas	<input type="text" value="0.297"/>	<input type="text" value="6.0"/>	\$/kg kW.hr/kg
Oil Fuel	<input type="text" value="0.270"/>	<input type="text" value="7.0"/>	\$/Ltr kW.hr/Ltr
Other	<input type="text" value="0.080"/>	\$/kW.hr	
<b>Air Conditioning System Power Consumption</b>			
<input type="text" value="1.5"/>		kW/TR	

OK Cancel

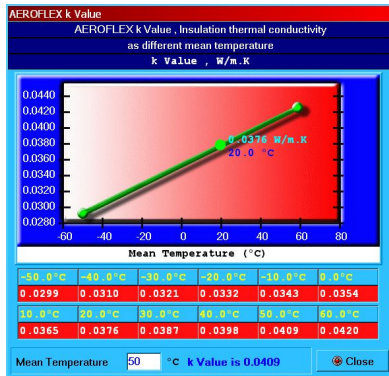
Picture No.32 Shows desired data in Misc. Factors for overall cost calculation.



## AEROFLEX k Value

Thermal conductivity value (k Value) of AEROFLEX varies directly with an average temperature of both surfaces. Therefore, k Value is very important for each calculation. The k Value of AEROFLEX can be checked from 3 methods (see Picture No.33).

1. Click on the green dot along the graph, the k Value will be displayed in various mean temperature.
2. Read the k Value from the table.
3. To check the accurate k Value, enter average temperature, the k Value will be displayed at the right hand side.




Picture No.33 Displays the program for calculation or checking the k Value of AEROFLEX closed cell elastomeric thermal insulation.



## Insulation Size



Click  , Picture No.34 will be shown on the screen. Input all desired preset data or make the necessary change of nominal thickness, actual thickness for both sheet and tube, and also ID (Inner Diameter) of insulation tube as shown in Pictures No.34, No.35 and No.36 for use in calculation program.

**Insulation Size**

Sheet | ID of Insulation Tube | Insulation Tube Actual Thickness

Item	Nominal	Actual (mm.)
1	3mm.	3.0
2	6mm.	6.0
3	10mm.	10.0
4	13mm.	13.0
5	20mm.	20.0
6	25mm.	25.0
7	32mm.	32.0
8	38mm.	38.0
9	44mm.	44.0
10	50mm.	50.0
11	56mm.	56.0
12	63mm.	63.0

Please refer to AEROFLEX Standard

✓ OK X Cancel

Picture No.34 Shows desired nominal & actual insulation thickness of sheet already filled in.

**Insulation Size**

Sheet | ID of Insulation Tube | Insulation Tube Actual Thickness

**ID of Insulation Tube**

Item	Nominal	Actual (mm.)
1	6mm.	6.0
2	10mm.	10.0
3	13mm.	13.0
4	16mm.	16.0
5	19mm.	19.0
6	22mm.	22.0
7	25mm.	25.0
8	28mm.	28.0
9	32mm.	32.0
10	35mm.	35.0

Please refer to AEROFLEX Standard

✓ OK X Cancel

Picture No.35 Shows desired nominal & actual ID of insulation tube already filled in.



Insulation Size						
Sheet	ID of Insulation Tube	Insulation Tube Actual Thickness				
Input Actual Thickness of Insulation Tube						
Thickness	ID of Insulation Tube					
Nominal	6mm.	10mm.	13mm.	16mm.	19mm.	22mm.
3mm.	3	3	3	3	3	3
6mm.	6	6	6	6	6	6
10mm.	10	10	10	10	10	10
13mm.	13	13	13	13	13	13
20mm.	20	20	20	20	20	20
25mm.	25	25	25	25	25	25
32mm.	32	32	32	32	32	32
38mm.	38	38	38	38	38	38
44mm.	44	44	44	44	44	44
50mm.	50	50	50	50	50	50
56mm.	56	56	56	56	56	56
63mm.	63	63	63	63	63	63


Please refer to AEROFLEX Standard

OK Cancel

Picture No.36 Shows actual insulation thickness of tube.



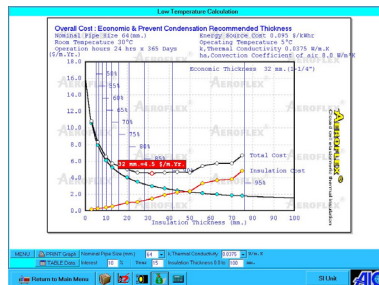
## INSULATION COST

The insulation cost for insulating hot & cold water pipes vary directly with size of the pipes and the thickness of insulation. When entering the insulation cost, do not forget to add in the cost for installation. After entering all necessary information, click  **OK** (see Picture No.37). AEROFLEX 2001 will save the costing data for calculation the overall cost, i.e. calculation of Economic & Prevent Condensation Thickness Recommendation (see Picture No.38).

Insulation Cost						
Insulation and Installation Cost Table (\$/m)						
#PS	Copper Pipe		Nominal Pipe Size			
Insulation Thickness	6	10	15	16	19	25
3 mm (.187")	0.35	0.42	0.49	0.51	0.53	0.70
6 mm (.315")	0.44	0.53	0.62	0.64	0.66	0.88
10 mm (.393")	0.66	0.80	0.93	0.97	1.00	1.33
13 mm (.507")	0.88	1.06	1.24	1.30	1.33	1.77
20 mm (.787")	1.50	1.83	2.14	2.21	2.29	3.05
25 mm (.984")	1.89	2.27	2.65	2.74	2.84	3.78
32 mm (1.26")	2.60	3.13	3.65	3.78	3.91	5.21
38 mm (1.52")	4.17	5.01	5.85	6.06	6.26	8.35
44 mm (1.73")	5.28	6.34	7.39	7.65	7.82	10.56
50 mm (2")	5.72	6.86	8.00	8.27	8.57	11.43
56 mm (2.18")	8.22	9.86	11.50	11.90	12.32	16.43
63 mm (2.48")	9.80	11.76	13.72	14.21	14.70	19.00
70 mm (2.75")	11.11	13.33	15.55	16.11	16.67	22.22
75 mm (2.95")	11.54	13.85	16.16	16.74	17.31	23.08
100 mm (4")	19.10	22.92	26.74	27.70	28.65	38.20

Remark: \$/m.  **OK**  **Cancel**

Picture No.37 Shows desired total insulation costs including installation cost already filled in.



Picture No.38 Shows calculation result of Economic & Prevent Condensation Thickness Recommendation of AEROFLEX closed cell elastomeric thermal insulation.



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