



## Israel Gas Transmission Project

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  <p style="text-align: center; color: blue;">ISRAEL NATURAL GAS LINES LTD (INGL)</p> <p>Contractor <span style="float: right;">Company</span></p>			<p>Document Title</p> <p><b>Specification for Thermal and Acoustic Insulation of Pipework and Vessels</b></p>						
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## 1 General

### 1.1 Scope

This specification covers the general requirements for the supply and installation of acoustic and thermal insulation materials on pipework, ductwork, vessels and auxiliary equipment.

#### 1.1.1 Definitions

Company	: Israel Natural Gas Lines Ltd. (INGL)
EEN	: E-ON Engineering [Design Engineer]
Contractor	: The company employed by the Company carrying out the insulation activities.
Third Party	: Authority employed by the Company / INGL to inspect insulation work.

Specific requirements are included in following Chapters:

- Hot Service Thermal Insulation
- Acoustic Insulation

#### 1.1.2 Environmental Data

The following environmental conditions shall be quoted as guaranteed:

Min. ambient temperature:	+5°C
Max. ambient temperature:	+65 °C
Maximum relative humidity:	95 %
Atmosphere:	humid, salty (See water atmosphere)
Area classification	none



### 1.1.3 Insulation Classes

The various insulation classes are shown in table G1,

## 1.2 **Regulations, Codes and Standards**

All insulation components, systems and design shall, as a minimum meet the requirements of the latest edition, of the following codes and standards.

DIN 4140 / T1 Thermal Insulation

DIN 18421 Thermal Insulation on plants





### 3 Design

#### 3.1 **General**

Equipment, vessels, piping and ductwork shall be insulated according to the insulation class, operating temperature and insulation thickness stated in table G1 in the data sheets, line lists and piping isometrics or general arrangement drawings.

Insulation and jacketing which can be removed without being damaged (removable), shall be provided on vessels, pipelines and machinery when specified in the data sheets and/or drawings.

Detailed drawings and description of design and application of all types of offered insulation, jacketing and sealing shall be available for Company to review.

Nameplates, coding tags and directional arrows shall be insulated. A duplicate nameplate shall be installed by insulation Contractor on the outside surface of the insulation installation. Valve actuators shall not be insulated.

If especially noted: Flanges and valve bodies (control valves i.e.) shall be insulated and protected with removable sheet metal weather shields, (boxed in ) i.e. supplied with snap locks,.

Pipe insulation shall be furnished to the manufacturer's dimensional standards which permit nesting-and-sleeve-type construction of contraction joints, covering for flanges, and the like.

If Al-alloy is used as jacketing, steel wires, cables, stainless, steel nameplates, 'S' clips or bands should be insulated from the Al-alloy with plastic tape to avoid galvanic corrosion.



Machinery shall be insulated in accordance with data sheets and this specification and subject to Company and the machinery suppliers written approval.

### 3.2 Vessel Insulation

The use of welded steel studs to support blanket insulation on spherical vessels or on irregular compound curved surfaces must be approved in writing by the Company. In such applications there shall be minimum 4 studs per square metre of insulation.

Speed clips shall be used to hold insulation on studs that are cut flush above the clip. Slip pins shall be spared, bent over and imbedded 12 mm into the insulation.

Vessels of diameter 600 mm and smaller, to be insulated as piping.

### 3.3 Pipe and Fitting Insulation

Insulation on long vertical pipe runs shall be supported on rings spaced on 6400 mm maximum centres. Width of rings shall be minimum 1/3 of and maximum 12 mm less, than the insulation thickness. Support rings may be bolted in position depending on materials, economics and agreement between the installation Contractor and the Company. The material of support rings shall be compatible with the material of attached vessel / pipe such as to avoid galvanic corrosion.

***For acoustical insulation supporting shall not be used.***

Valves and fittings shall be insulated with preformed jacketing pipe insulation, lags cut from standard blocks or blankets, fitted and wired in place.





### 3.4 Machinery Insulation

Large machinery surfaces shall be insulated with blocks, sectional insulation or blankets and in accordance to the machinery suppliers standard.

### 3.5 Insulation Jacketing

Insulation shall be protected from weather, oil spillage, mechanical wear or other damage by sheet jacketing where required by choice of insulation material.

Plastic weatherproofing may be used for small pipe dimensions and irregular surfaces on vessels, machinery and pipe fittings, subject to Company's approval.

Plastic weatherproofing shall not be used on vessels, piping, pipe fittings and valves subject to fire hazard.

Both top and bottom heads of leg supported vessels shall be covered. Removable covers shall be provided for vessel heads that are removable.

The bottom heads of skirt supported vessels may be covered with reinforced plastic weatherproofing rather than a metallic jacket.

Insulation jacketing on machinery shall be the same as for vessels.

### 3.6 Personnel Protection, Insulation Class 3

Personnel protection shall be specified for not insulated piping having a surface temperature above **65 °C**. The protection shall be confined to a distance of not more than 2,1 m vertically and 0,8 m horizontally of access walkway's, and normal working areas. The pipes shall be guarded by a perforated sheet metal jacketing.



## 4 Materials

### 4.1 General

Insulation material shall be water-repellent and shall not release aggressive gases when exposed to fire.

Insulation material shall be non-combustible, non-toxic and shall not deteriorate or support corrosion of the insulated surface.

### 4.2 Insulation Materials

Mineral wool as specified below shall be used for hot service and for acoustic insulation. For cold service insulation the materials are specified in the appendixes.

Mineral wool, blankets, blocks or loose fill, shall have a neutral pH and contain little excess shot.

The density of mineral wool shall be 120 kg/m<sup>3</sup>.

The wire net to be stainless steel when insulation S.S. vessels and pipework. Galvanised steel may be used for carbon steel vessels and pipework.

### 4.3 Sheet Metal Jacketing

Stainless jacketing to ASTM A 167 GR 316 or 316 L or equivalent shall be used for all classes in fire hazardous areas for class 5 - Fireproofing.

Aluminium alloy may be used for all classes except for class 5 - Fireproofing and except if aluminised steel is specified for noise reduction.

Aluminized steel will have no additional PVC-colour coat on the exterior side.

The sheets shall have no coating.



The jacketing to be used for noise insulation system shall have a thickness of 1,0 mm for pipes and vessels.

Thickness of jacketing shall be enlarged if specified on P&ID and/or Iso's.

#### 4.4 Accessories (Additional Materials)

Wire to secure insulation shall be 1.0 mm stainless steel or adequate dimensioned stainless steel clamps. Heavier steel wire cable or clamps shall be used for floating rings insulation on vessel heads if necessary.

Bands and seals for securing insulation and jacketing shall be stainless steel.

The sizes shall be as follows:

- a) Piping and machinery            12 mm by 0.4 mm
- b) Vessels                                19 mm by 0.4 mm
- c) Expander-type bands breather springs for bonds shall be subject to Company approval.

Stainless steel "S" clips shall have a minimum thickness of 0.4 mm. Al-alloy "S" clips shall have a minimum thickness of 0.8 mm.

18 Cr-8Ni stainless steel screws shall be used for fastening Al-alloy sheets. Screw fasteners shall be stainless steel self tapping type with pan head.

Rivets for Al-alloy sheets shall be Al-alloy expanding "pop" type with stainless steel centre core.

Edge protection to be applied on metal jacketing where heat cables penetrate the jacketing shall be of type: Flexiform G5T/AA or similar.



## 5 Application

### 5.1 **General**

Surfaces to be insulated shall be clean and dry, and have to be coated according to Specification for Surface Preparation and Protective Coating. The Insulation Contractor shall take precautions to ensure that surface treatment of items to be insulated and heat tracing cables (if required) are checked and approved by Company before application of insulation.

Single-layer insulation shall be applied with longitudinal joints staggered. In double-layer applications, joints of the outer layer shall be staggered with respect to inner layer joints. All insulation shall be installed with the joints tight.

Voids within the insulation, is not acceptable.

All insulation joints shall be carefully fitted so that the insulation in any layer fits snugly over the surface beneath and outer layer has a smooth contour.

If insulation work precedes leak testing of pipework then welds and joints should be left uninsulated to allow inspection during testing procedure.

Each day's application is to be protected overnight, or for the time of any interruption in the programme if this should arise.

The Installation Contractor shall take steps, such as sheeting or other precautions, to close openings or protect adjacent surfaces so that insulation work does not damage or affect areas near this job. This particularly applies to valve stems, handles, gauges glasses, etc.



Insulation materials shall be stored in such a way that they are protected from deteriorious effects of weather, dampness, etc. The insulation Contractor shall replace any material which becomes ineffectively. This applies during the course of the work.

## **5.2 Vessel and Machinery Insulation**

### **5.2.1 Block Insulation**

- a) Insulation for vessel heads shall be curved blocks or standard flat block trimmed to fit.
- b) For single layer and the outer layer of double layer insulation, banding shall be placed on each side of all butt joints. The inside lay of double layer installation shall be banded on maximum 450 mm centres. Expander bands or breather springs shall be used as required for expansion.
- c) When banding is not practical on irregular surfaces, insulation shall be secured with stainless steel wire.

### **5.2.2 Blanket Insulation**

The last piece of insulation in each layer shall have a snug fit to make all joints tight. Contractions joints are not required for resilient insulation.

## **5.3 Piping Insulation**

### **5.3.1 Blanket Insulation**

- a) Insulation joints shall be buttered together firmly
- b) Insulation shall be secured with bands over the outer layer at each side of radial joints and the centre of each section.



c) Fittings and flange shall be covered with cut block insulation or blanket. Insulation shall be secured by wiring or banding.

#### 5.4 Plastic Weatherproofing

Plastic weatherproofing e.g. Armatech or similar shall not be use in class 5, Fire proofing.

#### 5.5 Sheet Metal Jacketing

Flat or embossed metal jacketing for vessel insulation shall be edge crimped and lapped 75 mm on the longitudinal seams and 100 mm on the circumference seams.

Corrugated metal jacketing for vessel (and tank) insulation shall be lapped two corrugations at longitudinal seams and 100 mm on the circumference seams.

Head covers shall overlap sheet covers by 100 mm.

Flat metal pipe jacketing shall be edge crimped and roller to provide a tight and fit and tight seam. Circumference seams shall be lapped at least 50 mm.

All jacketing shall be banded at overlapping joints, and at 200 mm to 300 mm intermediate spacing on pipe, and at 900 mm intermediate spacing on vessels.

On vessel jackets, breather springs shall be used on bands if required or expansion.

On vertical vessel, "S" clips a similar equipment shall be used to keep the jacket sheet from sliding. On vertical piping. "S" clips, screws, blind rivets or similar equipment may be used to fasten sections to prevent sliding; for pipe temperatures over 260 °C only "S" clips shall be used, minimum 4 clips shall be used per circumference seam.



All longitudinal overlaps on horizontal pipes shall be arranged weather side down longitudinal overlaps on vertical pipes shall be arranged away from the prevailing site wind direction.

Flange and valve covers shall be fitted with a drip hole 10 mm diameter at the lowest point for the purpose of leak detection, and shall be secured with stainless steel toggle fasteners of quick release type.

For acoustic insulation the jacket material shall be of the sandwich design.

1 mm outer sheet,

2,4 mm damping compound on the inside,

1 mm inner sheet.



## 6 **Combination of Insulation Classes**

In some cases it is necessary to combine acoustic insulation and thermal insulation. Below is given guidelines for such cases.

**Insulation contractor shall establish procedures for combination of insulation classes when occurring.**

### 6.1 **Fire Proofing and Acoustic Insulation**

Use class 5 fire proofing, but increase the thickness if this is necessary, to maintain requirements for the acoustic insulation. If lead sheets are required these shall be included. The jacketing shall be stainless steel in accordance with class 5. Table G2 has to be followed.

### 6.2 **Acoustic Insulation and Hot Service Insulation**

has to be done in accordance with acoustic insulation class, but increase the thickness of insulation if the hot service insulation requires this.

### 6.3 **Acoustic Insulation and Cold Service Insulation**

The insulation shall consist of a layer acoustic insulation (thickness in acc. with acoustic class), lead sheets if required, a layer of cold service insulation, vapour barrier if necessary and jacketing.

The thermal insulation provided by the acoustic lagging, will allow a reduction in the thickness of the cold service insulation. Minimum thickness of the cold service insulation shall be 20 mm if vapour barrier is required. This is to provide a rigid base for the vapour barrier.





## 7 **Inspection and Testing**

### 7.1 **General**

The Installation Contractor shall permit and support the inspection of the work during production, at delivery and all other pertinent phases.

Inspection shall be carried out before commencement of

following stages:

- a) Application of vapour barrier (cold service)
- b) Application of cold service insulation on mineral wool
- c) Application of mineral wool on cold service insulation and vapour barrier
- d) Application of metal jacketing

### 7.2 **Acceptance Criteria**

No holes or gaps can be accepted in vapour barriers or metal jacketing. Metal jacketing shall also be free from buckles in order to avoid water seeping in through the joints.


**8 TABLE G1 - Key Data for Insulation Systems**

Insulation Class Service	Insulation		Jacketing Material	
	Material	Thickness		
Class 1 Heat Conservation Hot	Mineral wool or other suitable material *	N.A.	steel Al-alloy	To reduce heat losses to control temperatures for efficient operation of the process
Class 2 Cold Conservation Cold	Polyisocyanu- rate,***Cellular Glass or other suitable material *	N.A.	steel Al-alloy	To maintain low temperatures or control heat input to the process
Class 3 Personnel Protection Hot	None			Surfaces operating at tempera- tures of above <b>65 °C</b> accesible from access ways shall be guarded by perforated sheet metal jacketing to a height of 2100 mm and 800 mm horizon- tally of acces ways.
Class 4 Frost Proofing Cold	Polyisocyanu- rate Cellular Glass or other suitable material		steel Al-alloy See B2.6 Appendix B	To prevent freezing solidifica- tion or condensation in pipes / equipment (winterisation, trace heating add. required)
Class 6 Acoustic Insulation	See Table G2			
Class 7 Acoustic Insulation	See Table G2			
Class 8 Acoustic Insulation	See Table G2			
Class 11 Acoustic Insulation Sandwich Type	See Table G2			
Class 9 External Condesa- tion Cold	Polyiso- cyanurate Glass or other suitable mate- rials	N. A	steel Al-alloy	To prevent external conden- sation on pipes / equipment / ductwork
Class 10 Acoustic Ins. Ductwork Internal	Mineral wool	According to drawings	Galv. perfo- rated (30%) carbon steel sheet (in- side against airstream	To reduce noise generated by fans, dampers, etc.


**9 TABLE G2 - Key Data for Sound Insulation Systems**

Insulation Class	Insulation		Jacketing		Purpose / Location / Remarks
	Material	Thickness (mm)	Material	Thickness (mm)	
6	Ceramic wool / fibre	60	Stainless Steel	1,0 mm, with 2,4 mm thick damping material attached to the inner side	For fire hazardous areas, sound insulation impact sound proof supports for the sheet metal jacketing
	Mineral wool	60	aluminized steel / Al-alloy	1,0 mm, with 2,4 mm thick damping material attached to the inner side	Sound insulation impact sound proof supports for the sheet metal jacketing
7	Ceramic wool / fibre	100	Stainless Steel	1,0 mm, with 2,4 mm thick damping material attached to the inner side	For fire hazardous areas, sound insulation impact sound proof supports for the sheet metal jacketing
	Mineral wool	100	aluminized steel / Al-alloy	1,0 mm, with 2,4 mm thick damping material attached to the inner side	Sound insulation impact sound proof supports for the sheet metal jacketing
8	Ceramic wool / fibre	200	Stainless Steel	1,0 mm, with 2,4 mm thick damping material attached to the inner side	For fire hazardous areas, sound insulation impact sound proof supports for the sheet metal jacketing
	Mineral wool	200	aluminized steel / Al-alloy	1,0 mm, with 2,4 mm thick damping material attached to the inner side	Sound insulation impact sound proof supports for the sheet metal jacketing
11	Sandwich Type Ceramic wool / fibre	250	Stainless Steel	1,0 mm, with 2,4 mm thick damping material attached to the inner side 1mm inner sheet	For fire hazardous areas, sound insulation impact sound proof supports for the sheet metal jacketing
	Mineral wool	250	aluminized steel / Al-alloy	1,0 mm, with 2,4 mm thick damping material attached to the inner side	Sound insulation impact sound proof supports for the sheet metal jacketing


**10      Thickness of layers for Multi Layer Application**

Total Thickness mm	1st Layer	2nd Layer	3rd Layer
70	40	30	-
75	45	30	-
80	50	30	-
90	50	40	-
100	60	40	-
110	60	50	-
120	70	50	-
125	75	50	-
130	70	60	-
140	75	65	-
150	40	60	50
175	50	75	50
200	50	75	75
225	75	75	75


**11**      **Revision Record**

Rev. No.	Date	Description	Prepared	Checked	Approved	Date	Approved
			EEN			Company	
1	2004-07-12	Discipline Internal Check	ZAG	LAM	VDS		
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