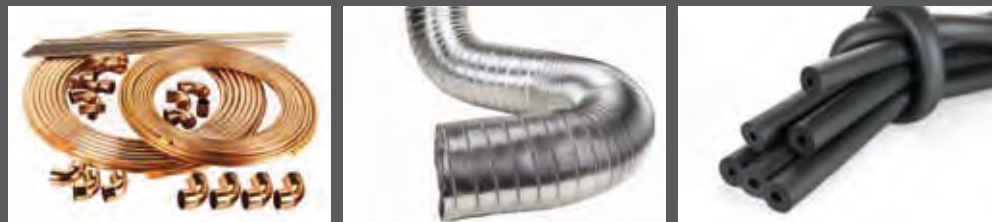




GULF·O·FLEX

PRODUCT OF RUBBERWORLD

P R E - Q U A L I F I C A T I O N M A N U A L



COMPLETE RANGE OF QUALITY HVAC PRODUCTS



GULF-O-FLEX
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Introduction

C1



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Introduction

Rubber World Industry LLC is an ISO 9001:2008 certified that was established in 1993 to manufacture a versatile range of HVAC&R Rubber Insulation products. Our Products are sold under our flag ship brand “**Gulf"O"Flex**”.

It's a part of the Shaikhani Group of Companies; RWI is a pioneer UAE national enterprise that is an industry leader in the entire Middle East. Our Manufacturing plant is located in Ajman, United Arab Emirates.

We cater to over 56% of the region's requirements for rubber insulation products, we also trade in complete range of HVAC products.

Apart from Middle East our products are exported to USA, Canada, Africa, Asia and other countries.

Company Quality Policy

The major factor for our success is due to of all as aspects of quality, management and supply chain by providing cost effective solution in HVAC & R industries.

All our Insulation products are manufactured as per ASTM & BS Standards using World Class production Line. The high reliability of all Gulf.O.Flex products is due to the careful selection of raw materials and constant quality control. Our continuous efforts in the most appropriate system with perfect balance result of cost-ratio and customer satisfaction has been the formula for our success.

SHAIKHANI GROUP – REDEFINING; GROWTH

Since 1978, Shaikhani Group has distinguished itself as a value- based organization focused on the customer needs. Be it real estate development, technology, manufacturing, or international trade, Shaikhani Group has been a torch bearer showing the path; leading the way.

In a world that gets complicated with every passing day, the group owes its success to its unflinching focus on the basics: Offering feature-rich projects; long term value-based relationships with customers and following this with dedicated service. The legacy of Shaikhani Group is built around the customer and their needs. We are opening our arms to invite you to our world. A world where you can chart your own bright future!



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SHAIKHANI
FOUNDATION



MEMON
INVESTMENTS



SHAIKHANI
CONTRACTING



SHAIKHANI
DEVELOPMENTS



TAKMEEL
PROJECT MANAGEMENT



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CHAIRMAN'S MESSAGE



I am proud to welcome you to Rubber World Industry LLC, the region's leading rubber insulation manufacturers. From our humble beginnings we have reached to the top rung only because of our hard work. With the customer in mind we create solutions that meet their needs. Our relentless pursuit of excellence, our stringent quality standards and customer focused solutions have earned us a reputation which is second to none. With a world class brand like Gulf-O-Flex, the ISO 9001:2008 certification was well earned by Rubber World. But still we know we have miles to go and day by day we are improving ourselves to be at par with the global players and compete with the best of the brands in our industry. Without the support of our esteemed customers and associates, it would not be possible. We look forward to build a brighter future with you.

Warm Regards,

Late Abu Baker Shaikhani



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Clients and Project references

C2



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CLIENTS & PROJECT REFERENCES

RWI is leveraging on the strengths and abilities of the local partners and is now looking towards tapping into several emerging and advanced markets. The move to consolidate and maintain our presence in the Middle East region will be a long and interesting journey, but truly a rewarding one in the end. RWI clients are from diversified industries ranging from oil & gas to infrastructure from construction to sports.

RWI is continually expanding its vision of engineered foams to achieve faster, affective and value-driven solutions, continue supply chain over 90 countries is adding fuel to our prospective & confidence.

Burj Khalifa and Dubai Downtown

RWI supplied Burj Khalifa and Dubai Downtown Development project for Emaar Properties with high quality rubber products for tallest tower and largest single-phased development in the world.



Green Community

RWI has been awarded the contract to supply AED 875,000 worth of top quality rubber insulation products for the 'Green Community West Villas and Apartments' project – a high profile development of Union Properties (UP).



Al Raha Beach Development

RWI is working on an AED1 million contract to supply 'Gulf-o-Flex' rubber insulation products to 'Al Bandar' the prestigious project in Al Raha Beach Development project, Abu Dhabi by Aldar Properties PJSC.



Sadiyat Island

RWI has bagged an insulation contract for the 'Saadiyat Island' project in Abu Dhabi. The agreement involves the delivery of AED 600,000 worth of top quality rubber insulation products for the 'Manarat Al Saadiyat' component of the project.



Yas Island

RWI supplied Yas Island' Development project in Abu Dhabi under Aldar Properties with high quality rubber products, in line with the eco-friendly construction processes.



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CASE STUDIES - SRI LANKA PROJECTS

Custom Headquarters, Colombo, Sri Lanka

RWI supplied top quality "Gulf.O.Flex" rubber insulation products for the construction of custom headquarters in Colombo Sri Lanka.

Bandaranaike International Airport, Colombo, Sri Lanka

RWI has been awarded a contract to supply "Gulf.O.Flex" rubber insulation products for the development of Bandaranaike International Airport.

Taj Samudra Hotel, Colombo, Sri Lanka

RWI supplied the majestic Taj Samudra Hotel with top quality "Gulf.O.Flex" rubber insulation products.

Cinammon Bay, Colombo, Sri Lanka

RWI has been granted a contract to supply the renowned Cinnamon Bay with top quality "Gulf.O.Flex" insulation products.

University Complex, Colombo, Sri Lanka

RWI took part in the development of University complex in Colombo Sri Lanka by supplying top quality "Gulf.O.Flex" insulation products.



APPROVED PROJECTS

GULF.O.FLEX RUBBER INSULATION

• Project	Dubai Sustainable City Project	• Project	Arabian Ranches Development Dist. 2 Alma 2
• Contractor	Jeet Contracting Company LLC	• Contractor	EFFECO
• Consultant	Al Ajmi Engineering Consultant	• Consultant	Al Hashemi Planners, Architect, Engrs
• Client	Diamond Developers	• Client	Arabtec
• Project	Jumeirah Park Villas, Package 7B&C	• Project	Darwasl Development
• Contractor	Works ACTCO Gen. Cont. Co LLC	• Contractor	Saifco Engineering
• Client	Dar Al Handasah Jumeirah Park LLC	• Consultant	Tech and Mech
		• Client	Al Oroba Contracting
• Project	G+R (11 Commercial Villas) Jumeirah	• Project	Mizin – Arjan West Side & Sheffield
• Contractor	Dubai Al Ghurair Contracting Company	• Contractor	Menasco Mech. Contracting LLC
• Client	X-Architects & Group Consultants	• Consultant	Torontec
		• Client	DAMAC
• Project	New Dubai Gate 2 Tower (E0103)	• Project	G+M 42 Bldg in Ajman
• Contractor	Bin Belaila Contracting Company	• Contractor	Karam Contracting Company
• Consultant	Engr. Adrian Saffarini	• Consultant	Canadian Consultant
• Client	Bonyan International Investment Group	• Client	His Highness Sheikh Amaar Al Noaimi
• Project	Emirates Hills Springs – 1370 Villas	• Project	G+16 9 Bldg in Ajman
• Contractor	Al Hamed Contracting Company	• Contractor	Solanki Contracting Company
• Consultant	Ian Banham	• Client	Canadian Consultant
• Client	Mizin		His Highness Sheikh Homaid Al Noaimi
• Project	Dubai Island Resort Palm Jumeirah	• Project	B+1P+15 Bldg in Ajman
• Contractor	Laing Roirke	• Contractor	Al Deewan Development
• Client	Cundal Consultant	• Client	Canadian Consultant Mr. Raseea Sait Al Homrai
• Project	The Onyx Complex – Dubai	• Project	G+4P+20+Gym in Sharjah
• Contractor	SAIFCO	• Contractor	Fyax Contracting Company
• Consultant	Eng. Adnan Safrini	• Client	Canadian Consultant
• Client	The Onyx		His Highness Sheikh Homaid Al Noaimi
• Project	Carrefour Hypermarket – Burjuman	• Project	International City Package – 10
• Contractor	Center	• Contractor	Al Sahil Contracting Company
• Consultant	United Masters Electromechanical LLC	• Client	ACE International
• Client	Hyder Consulting Ltd. Majid Al Futtaim		Nakeel
• Project	Lakeside Towers	• Project	Discovery Gardens
• Contractor	Eagle Electromechanical	• Contractor	Pauling Middle East
• Consultant	ZAS/PSE Architecture Engr. Interior	• Client	ACE International
• Client	Planning The Waves – DAMAC		Nakeel
• Project	409 Villas in Sharjah	• Project	485 Villas M.R
• Contractor	Ali Moosa & Sons Contracting	• Contractor	Ayubco Contracting
• Consultant	International Engineering	• Client	Horizon Consulting
• Client	Sheikh Zayed Housing Programme		
• Project	Reem Raam Projects	• Project	Global Golf 2 Best Homes Dubai Sports
• Contractor	Al Hamed Contracting Company	• Contractor	Dubco Construction LLC
• Consultant	Ian Banham	• Client	Dimension Engineering
• Client	Mizin		Bay View Investment Limited
• Project	Baniyas Residential Development (411	• Project	G+3M+28 Al Sarah Tower at Sharjah
• Contractor	Villas)	• Contractor	Al Sabah Central LLC
• Client	EFFECO	• Client	Gulf Intl Eng Consultant
	Arabtec		



<ul style="list-style-type: none"> • Project B+G+22 Stories Burj 2000 at Sharjah • Contractor Gulf Delta AC Installation • Consultant Gulf Intl. Eng Consultant • Client 	<ul style="list-style-type: none"> • Project RAK Medical & Health Science University • Contractor Al Nuaumi Group LLC • Consultant Albonian Consultant Engineers RAK Human Development Board
<ul style="list-style-type: none"> • Project China Town Phase IV • Contractor Al Sahil Contracting Company • Consultant ACE International • Client Nakeel 	<ul style="list-style-type: none"> • Project 2B+G+9TYP+HC Offices Bldg • Contractor Cairo Contracting Company • Consultant ADNAN Safrini Memon Development FZC
<ul style="list-style-type: none"> • Project Palm Island 131 Villa • Contractor Pauling Middle East • Consultant KEO International Nakeel 	<ul style="list-style-type: none"> • Project B+G+13+H.C.+S.P Typical Floors • Contractor Al Sarh Contracting Dubai • Consultant ADNAN Safrini • Client Mr. Ahmed Shaikhani
<ul style="list-style-type: none"> • Project Marine Crown • Contractor Trans Emirates Contracting • Consultant Artec International • Client Al Zarroni Real Estate 	<ul style="list-style-type: none"> • Project Sparkle Tower • Contractor MENASCO Mechanical Contracting LLC • Consultant ADC Architect Design Consultants • Client TEBYAN
<ul style="list-style-type: none"> • Project G+12 7G+13-4 Bldg. • Contractor Horizon Contracting Company • Consultant • Client 	<ul style="list-style-type: none"> • Project NOVO Cinemas LLC • Contractor Divion 9 Interior Design LLC • Consultant DAR Al Hansadah • Client NOVO Cinemas LLC
<ul style="list-style-type: none"> • Project DMCC • Contractor REMCO • Consultant Engineering Consulting Group • Client 	<ul style="list-style-type: none"> • Project Al Zohrah Golf Community 700 • Contractor EM Tech Electromechanical • Consultant NAGA Architect • Client Al Zohrah Golf Community
<ul style="list-style-type: none"> • Project Sport Hall at Dibba • Contractor Karam Construction • Consultant CAB Consultant • Client 	<ul style="list-style-type: none"> • Project G+4 Bldg. • Contractor Al Nakheel Gen. Cont. • Consultant Ali Humaid Ali Kumaithy (Al Zora Clinic) • Client
<ul style="list-style-type: none"> • Project Jebel Ali Power & Desalination Station "L" Phase • Contractor Shin Nippon Airtech (Middle East) LLC • Consultant Lahmeyer International • Client 	<ul style="list-style-type: none"> • Project G+1 Hatta Heritage Souk & Motel Dubai • Contractor Jzahurt Al Safa Contracting • Consultant Al Fahidi Consultant • Client Dubai Municipality
<ul style="list-style-type: none"> • Project Abu Dhabi University New Campus • Contractor Al Muraiki Contracting Company • Consultant Arkon Consultant Mace 	<ul style="list-style-type: none"> • Project Big 5 + Design Area Al Dana 5 • Contractor Al Dar Laing Rourke • Consultant KEO Consultant • Client
<ul style="list-style-type: none"> • Project Trader Hotels, Abu Dhabi • Contractor Al Jaber LEGT Engineering & Contracting Co • Consultant KEO Consultant 	<ul style="list-style-type: none"> • Project Personal Status Court • Contractor Construction & Bldg Engineering • Consultant Ariciteknik International • Client Dubai Municipality
<ul style="list-style-type: none"> • Project Jumeirah Village, Triangle Zone 2 • Contractor Samco International • Consultant Dar Al Handasah • Client Nakeel 	<ul style="list-style-type: none"> • Project 2B+G+M+3 Commercial & Offices Bldg Cargo Village Aroma Intl Bldg Contracting • Contractor Al Fahidi Engineering Consultant • Consultant DNATA • Client
<ul style="list-style-type: none"> • Project International City Package 3 • Contractor Trinity Eng. Services • Consultant Art Consultants • Client 	<ul style="list-style-type: none"> • Project Jumeirah Park Villas, Package 7A • Contractor ACTCO General Cont. Co LLC • Consultant Dar Al Handasah • Client Jumeirah Park LLC
<ul style="list-style-type: none"> • Project 11 No Villas of commercial & Service Block • Contractor Cool Valley LLC • Consultant Al Ghurair CEW • Client The Kanoo Group 	<ul style="list-style-type: none"> • Project Fujeirah Hotel Resort (S+G+6F+R) • Contractor Ghantoot Group Building Division • Consultant National Engineering Bureau • Client Alain Properties

<ul style="list-style-type: none"> • Project 500 Villas in Living Legends at Dubailand • Contractor Delta Al Emarate • Consultant Al Burj Engineering Consultants • Client 	<ul style="list-style-type: none"> • Project 3 Star Hotels @ Plot No. Cd.002D Impz 1 & 2 • Contractor Al Bonian
<ul style="list-style-type: none"> • Project Al Khayrien Tower Doha Qatar • Contractor PAT Engineering Enterprises Co. WLL • Consultant Dimension Engineering Consultant • Client Mr. Muhammad Saeed Al Khayrien 	<ul style="list-style-type: none"> • Project Proposed G+1 Luxury Villas At Jumeirah • Contractor Al Tariq Contracting LLC • Consultant X-Architects • Client Al Wasl
<ul style="list-style-type: none"> • Project Park Lane Tower Business Bay • Contractor Bin Laden Contracting Group LLC • Consultant Arki Plan Consulting Architect & Eng. • Client The Developers/IAH Project 	<ul style="list-style-type: none"> • Project International School Of Choueifat, Ajman • Contractor Darwish Engineering Emirates • Consultant Arab & Turk International
<ul style="list-style-type: none"> • Project ASW/112 Villas/MT/A/C/3 Khorfakan Sharjah • Contractor Aswar Engineering & Gen Con. Co. WLL • Consultant Ministry of Public Works • Client Ministry of Public Works 	<ul style="list-style-type: none"> • Project Construction Of Ajman Housing Complex • Contractor Ali Moosa & Sons Contracting • Consultant Altorath International Engineering Consultants • Client Shaikh Zayed Housing Programme
<ul style="list-style-type: none"> • Project B+G+11 & B+G+9F Bldg, Sports City • Contractor AB Building Contracting Co. LLC • Consultant National Engineering Bureau • Client M/S GGICO 	<ul style="list-style-type: none"> • Project Proposed Residential Building (G+P+7) • Contractor Al Rais Electromechanical • Consultant Emsquare Engineering
<ul style="list-style-type: none"> • Project Construction of Officer Accommodation • Contractor Fujairah • Consultant DAMAS maintenance and general contracting • Client UAE Armed Forces Command Military Works 	<ul style="list-style-type: none"> • Project Commercial / Residential Building (2B+G+9+R) • Contractor ARJ Engineering LLC • Consultant Art Consultants
<ul style="list-style-type: none"> • Project KM Trading Dubai Industrial City • Contractor RHLLC • Consultant Free Line Engineering Consultant • Client 	<ul style="list-style-type: none"> • Project G+8Typ Floor+Roof On Plt 23-020 @Dsoa • Contractor Becon Electromechanical Co. LLC • Consultant
<ul style="list-style-type: none"> • Project Construction of Commercial Building • Contractor Frayland Design & Interior • Consultant Al Turath Consultant • Client Eiffel Boulevard 	<ul style="list-style-type: none"> • Project Residential & Commercial Building (B+G+6Flrs) • Contractor Modern Building Contracting Company • Consultant Al Khawajah Engineering Consultancy • Client Ismail Issa Ismail Dkeidek
<ul style="list-style-type: none"> • Project Wyndham Garden Hotel • Contractor Al Hamad Building Cont. LLC • Consultant Bu Humaid Engineering Consultant • Client R Holding 	<ul style="list-style-type: none"> • Project 2B+G+6+Gym Floor Residential & Commercial • Contractor Union Contractor • Consultant
<ul style="list-style-type: none"> • Project Amna Hotel Building (B+G+5+Hc) • Contractor Aevitas Air Conditioning System 	<ul style="list-style-type: none"> • Project 23 Villas On Plot 2517064 Mirdif, Dxb • Contractor • Consultant • Client
<ul style="list-style-type: none"> • Project City Apartments (B+G+4+R) • Contractor Aevitas Air Conditioning System 	<ul style="list-style-type: none"> • Project 23 Villas On Plot 2517064 Mirdif, Dxb • Contractor Atheer Al Jazira Electromechanical Works LLC • Consultant VICC Contracting Co.
<ul style="list-style-type: none"> • Project A/C Works Of G+6 Residential Bldg. • Contractor Al Arabia Electromechanical LLC 	<ul style="list-style-type: none"> • Project Proposed G+5P+15Typ On Plot No. (901 Mulk) • Contractor Alsareh Alkabeer Contracting • Consultant Pioneer Eng. Engineering Consultants • Client Mr. Hassan Alalkeem Alzaabi





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APPROVAL LIST

Building Projects Directorate

Emaar

Dubai Properties

Burj Dubai Development

Parsons

Emirates of Abu Dhabi Department of Municipalities & Agriculture



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APPROVAL LIST

Telal Hotel & Apartment

SUBMITTAL TRANSMITTAL SHEET # TEL-MECH-02

Project Name: TELAL HOTEL & APARTMENT
Project No.: 12
Contract No.: 1000
Date: 2016/16

Submittal No.: TELAL-MECH-02
Submittal Title: MATERIAL SUBMITTAL

ITEM NO.	DESCRIPTION	TYPE	QTY	REMARKS
1	MATERIAL SUBMITTAL FOR RUBBER INSULATION - GULFO FLEX - ARCON	RF	3	FOR APPROVAL

Subcontractor: STRAAM ELECTRO MECHANICAL CO. LTD.
Signature: Eng. Yany Yan
Date: 2016/16

Main Contractor: ASAR
Signature: Eng. Yousef
Date: 2016/16

Remarks: 1) Self-submitted rubber insulation accepted for submission to the consultant for approval. 2) Consultant to follow standard installation method. 3) Submit for the project specification compliance and marking approval.

ENBD New Deira Branch

DESIGN DESIGN Emirates NBD

Project: ENBD NEW DEIRA BRANCH

Material Submittal

Submittal No.: ENBD-DEIRA-001
Submittal Title: RUBBER INSULATION - GULFO FLEX - ARCON

Manufacturer / Supplier: Rubber world industrial/Contractor: Rubber System Factory

Material Description: Rubber Insulation (Gulfo Flex - Arcon)

Remarks: 1) Self-submitted rubber insulation accepted for submission to the consultant for approval. 2) Consultant to follow standard installation method. 3) Submit for the project specification compliance and marking approval.

Al Majaz 2

ASAR Al Sorb Al Kaberi

Project: AL MAJAZ 2

Material Submittal

Submittal No.: ALMAJAZ-001
Submittal Title: RUBBER INSULATION - GULFO FLEX - ARCON

Manufacturer / Supplier: Rubber World Industries

Remarks: 1) Self-submitted rubber insulation accepted for submission to the consultant for approval. 2) Consultant to follow standard installation method. 3) Submit for the project specification compliance and marking approval.

Handwritten note: Submit to the consultant for approval. 17/11/2016

Sharjah Project-Bldg Apt.

FASCO

Project: SHARJAH PROJECT - BLDG APT.
Reference No.: PS-ACMS-0012

Material Submittal

Submittal No.: SHARJAH-001
Submittal Title: RUBBER INSULATION - GULFO FLEX - ARCON

Manufacturer / Supplier: Rubber World Industries

Remarks: 1) Self-submitted rubber insulation accepted for submission to the consultant for approval. 2) Consultant to follow standard installation method. 3) Submit for the project specification compliance and marking approval.

Ajman Housing Complex

ASAR

Project: AJMAN HOUSING COMPLEX

Material Submittal

Submittal No.: AJMAN-001
Submittal Title: RUBBER INSULATION - GULFO FLEX - ARCON

Manufacturer / Supplier: Rubber World Industries

Remarks: 1) Self-submitted rubber insulation accepted for submission to the consultant for approval. 2) Consultant to follow standard installation method. 3) Submit for the project specification compliance and marking approval.

Dubai School Building

WILSHAW AL SAQR

Project: DUBAI SCHOOL BUILDING

Material Submittal

Submittal No.: DUBAI-SCHOOL-001
Submittal Title: RUBBER INSULATION - GULFO FLEX - ARCON

Manufacturer / Supplier: Rubber World Industries

Remarks: 1) Self-submitted rubber insulation accepted for submission to the consultant for approval. 2) Consultant to follow standard installation method. 3) Submit for the project specification compliance and marking approval.





GULF-O-FLEX
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APPROVAL VENDOR LIST

M. SALIM ENGINEERING CONSULTANT OFFICE
ARCHITECTURAL & ENGINEERING CONSULTANT

مكتب م. سليم للإستشارات الهندسية
مهندسون - معماريون واستشاريون

General Requirements

Flexible Ducts	ThermoFlex ATCO Duct mate: Sattflex
Rubber Insulation	Gulf O Flex Armaflex - AF Aeroflex Apcoflex
Fibreglass Insulation	Kimmco Arabian Fibreglass Pfleiderer
Sound Liner	Manville Manson Knauf
Copper Pipe & Fittings	Wadnesbury Yorkshire Nibco
Adhesive & Coating	Foster Kingsco Childer
Vibration Isolators/Acoustic	Mason Unison Kinetics
Expansion Joints/ Flex connections	Mason Fix Well (UK)

REG. No. 28034, Tel.: 96-9658998, Fax: 96-9681115, Sharjah - U.A.E.
Email: msalimengineering@gmail.com

Concept **كو نسبست**
مهندسون استشاريون
Consulting Engineers

Sound Attenuators	Advance air Sound Attenuators Ltd. Titus Trox Euro Register Senior Colman Ltd GMAMCO
Grooved Fittings (UL Listed / FM)	Victaulic - USA Grinnell - Japan Shield - UK Central NAFFCO Faking
Duct Liner	Johns-Manville Knauf Manson Kimmco Afcoc
Vibration Isolation	Kinetics Mason WESCO Mupro Unison Satta flex
Rapier Insulation (CHW pipe insulation, Duct insulation)	APCOFLEX ARMACELL GULF-O-FLEX
Expansion joints/ flex connections	Durodyne Weloco Mason Crane Co. Kinetics Bookington & Scott Ltd Procco Metaflex (UK) Fix Well (UK)
Flex air duct	Duct mate Scapa Interlock (UK) Satta flex

General Requirements **Section 2** **20**

22. Vibration isolators/Acoustic	Mason Boating floors Kinetics Unison Christie and Grey
23. Fibreglass insulation	Kimmco Pfleiderer Arabian Fibreglass
24. Rubber insulation	Gulf O Flex Armaflex-AF K-Flex -ST Aeroflex
25. Sound Liner	Manville Manson Knauf
26. Flexible Ducts	Safid ThermoFlex ATCO Supaflex Sattflex
27. Flexible Duct Connector	Durodyne Climmtech Cain
28. Access Doors	FROST U.K KHS Austria Flotek Safid Ruskin
29. Adhesive and Coating	Foster Kingsco Childer
30. Copper pipe and fittings	Crane Enfield Wadnesbury Yorkshire Nibco MM Kembla Outokumpu
31. uPVC/ABS/HDPE pipe & fittings	Hepworth Terrain Durapipe

GAB CONSULTANTS

AL-HANDASIAH
الهندسية

المكتب الهندسي

Sound Attenuators	Advance air Sound Attenuators Ltd. Titus Trox Euro Register Senior Colman Ltd. GMAMCO
Groove Fittings (UL Listed / FM)	Victaulic - USA Grinnell - Japan Shield - UK Central NAFFCO Faking
Duct Liner	Johns-Manville Knauf Manson Kimmco Afcoc
Vibration Isolation	Kinetics Mason WESCO Mupro Unison Satta flex
Rapier Insulation (CHW pipe insulation, Duct insulation)	APCOFLEX ARMACELL GULF-O-FLEX
Expansion joints/flex connections	Durodyne Weloco Mason Crane Co. Kinetics Bookington & Scott Ltd. Procco Metaflex (UK) Fix Well (UK)
Flex air duct	Duct mate Scapa Interlock (UK) Satta flex

CONSULT. ARCH. CIVIL

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Products

C3



**RUBBER
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INSULATION PRODUCTS & ACCESSORIES



Gulf-O-Flex Tube & Coil

- Slit tubes without adhesive
- Slit Tubes with adhesives
- Continuous coil tubes
- Colored tubes
- White tubes with adhesive
- White tube without adhesive
- Slit tubes in colors
- Class O class 1 insulation tubes

Gulf-O-Flex Sheet & Roll

- Insulation sheet roll
- Insulation sheet box
- Insulation sheet rolls with adhesives
- Insulation sheet boxes with adhesives
- Insulation sheet for sound resistant's and sound proofing
- Insulation sheet for duct liner
- Insulation sheet for base control and vibration
- Insulation sheet for duct outer purpose
- Insulation sheet for flooring (3mm)
- Insulation sheet for sports track

Gulf-O-Flex Glue & Tape

- Pvc tapes
- Black and white pvc tapes
- Insulation tapes
- Insulation tapes with re inforced
- Duct tapes
- Bopp tapes
- Aluminum foil tapes
- Aluminum tapes with reinforced

Trading Products

- Flexible insulated dust
- Flexible un insulated duct
- Aluminium rigid duct
- Jublie brand strap
- Strap lock
- Duct sealant
- Suniso oil
- Canva cloth
- Anti vibrant pad
- Anti vibrant pad with cork
- Duct mount
- Refrigerants
- Thermostate
- Capacitor
- Contractor
- Compressor
- Duct accessories
- Pipe clamp and support
- Motors
- Air condition fans
- Transformer
- XLPE Tubes & Sheets



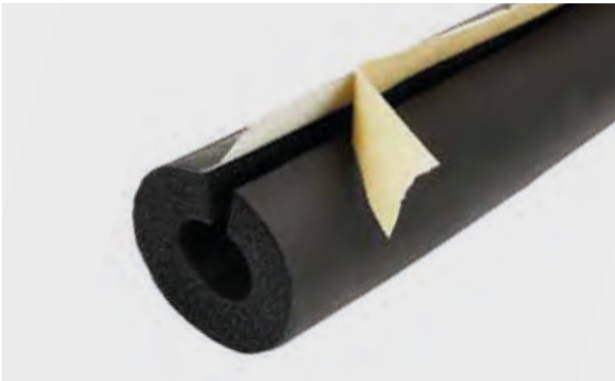
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WORLD**



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GULF-O-FLEX INSULATION TUBES & COILS



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GULF-O-FLEX
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GULF-O-FLEX INSULATION TUBES

Flexible Closed Cell Elastomeric Pipe Insulation .The Product you can rely on.

DESCRIPTION

Gulf-O-Flex pipe insulation is an environmentally friendly CFC free, flexible elastomeric thermal insulation. It is available in a wide range of colors. With smooth shark skin and is available in unslit form in wall thickness of 1/4", 3/8", 1/2", 3/4", 1", 1-1/4" in sizes ranging from 1/4" ID to 4-3/8" Iron Pipe size. Gulf-O-Flex pipe is non porous and resists mildew growth.

APPLICATION

Gulf-O-Flex is used to retard heat gain and prevent Condensation or frost formation on refrigerant lines, cold water plumbing and chilled water systems. It also retard heat loss for hot water plumbing, liquid heating, dual temperature piping and many solar systems.

Gulf-O-Flex is recommended for application ranging from -40°C to +120°C. The expanded closed cell structure makes an efficient insulator and an effective moisture vapour retarder.

Gulf-O-Flex has a very tough Shark Skin which withstands tearing rough handling and severe environmental conditions. And yet is quite flexible for easy installation. Gulf-O-Flex has superior cold weather flexibility. Gulf-O-Flex can be used with heat tracing/heat tapes.

Cut tubular sections, cover, flanges, etc. from our Gulf-O-Flex Sheets.

INSTALLATION

With a factory applied coating of talc on the smooth inner surface, Gulf-O-Flex slides easily over pipes or tubing for quick installation. When applied to existing lines, tubing is slit lengthwise and snapped into place. (Slitting can be done on the job with a sharp knife. All seams and butt joints should be sealed with an approved contact adhesive (Gulf-O-Glue is available on request) making sure both surfaces to be joined are coated with adhesive. Fittings are fabricated from Miter.

FLAME AND SMOKE RATING

Gulf-O-Flex pipe insulation has a flame spread rating of 25 or less and a smoke development rating of 50 or less as tested by a third party testing lab. (ASTME 84 Method of testing surface burning characteristics of building materials complied.)

Gulf-O-Flex is acceptable for use in duct/planning application.

OUTDOOR APPLICATIONS

Gulf-O-Flex pipe insulation is made from a UV resistant elastomeric blend, for moderate UV exposure applications, no additional protection is needed. However, for severe UV exposure applications (rooftop application) or where optimum performance is required, an approved UV protected coating or appropriate jacketing or cladding should be used. For best appearance two coats are recommended.

UNDERGROUND.

For buried line above the water table use a clean fill such as sand (3ft-5ft layer) to protect Gulf-O-Flex before back filling. It is recommended that materials to be buried are properly sealed at all seams and butt joints with an approved contact adhesive. For optimum performance, the lines should be encased in a conduit to protect them from problems associated with ground water.

RESISTANCE TO MOISTURE VAPOUR FLOW

The closed-cell structure and unique formulation of Gulf-O-Flex effectively retard the flow of moisture vapour and is considered a low transmittance vapour retarded. For most applications, Gulf-O-Flex needs no additional protection.

Additional vapour barrier protection may be necessary for Gulf-O-Flex when installed on low temperature surfaces that are exposed to continuous high humidity.

SPECIFICATION COMPLIANCE

- ASTM C 518
- ASTM D 1056-00-2C1
- CLASS 0
(Fire propagation test according to BS 476 part 6 & 7 complies with the requirements of UK.)
- CLASS 1
(Fire propagation test according to BS 476 part 6 & 7 complies with the requirements of UK.)
- ASTM E-84 (25 / 50)



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Product Data

Physical Properties				
1	Cell Structure	Closed		
2	Density Gms / Cm ³	0.050 - 0.070 Gms / cm ³	BS 476 Part 6 & 7 ASTM D 3575-91	Factory Test
3	Thermal ConductivityK Valueat 40CmeanTemperature	0.0338 w/m - K	ASTM C518	BS 8741986
4	Temperature limit °C	-40 °C to +120 °C		
5	Thermal Stability %Shrinkage	2.54 (7 days at 95 °C)	ASTM D3575-91	
6	Water Absorption	2.98	ASTM D3575-91	
7	Water vapor Permeability perm/Max	0.00 Perm - in	ASTM E 96-95	ASTM E 96-95
8	Resistance toOzone	Excellent	ASTM D1149	
9	Flammability	Self Extinguishing	ASTM D635-91	
10	Fire Rating	Class 0, Class1 25 / 50	BS 476 Part 6 & 7 ASTM E-84	
11	Average time of Burning	Less then 4Sec	ASTM D1149	
12	Average extend of Burning	15min		
13	Flexibility	Excellent	ASTM D 1056-85	
14	Resistance to Weather & Ultra Violet Rays	Very Good	ASTM G 53-96	
15	Resistance toChemicals	Very Good		
16	Odour	Negligible	SAEJ 1351	
17	Mildew resistance	No Fungal Growth	ASTM G 21-80	
18	Copper Corrosion	Negligible	ASTM C 665-94	

Thickness Recommendations to control Condensation

THICKNESS RECOMMENDATIONS								
PIPE SIZE USED	LINE TEMP		LINE TEMP		LINE TEMP		LINE TEMP	
	50°F	10°C	35°F	2°C	0°F	-18°C	-20°F	-29°C
NORMAL CONDITIONS (Max 85 Deg.F, 29Deg.C -70% RH)								
3/8" I.D.thru 1-3/8"IPS	3/8"		1/2"		3/4"		1"	
Over 1-3/8"thru 3"IPS	3/8"		1/2"		1"		1"	
Over 3"IPS thru 4"IPS	1/2"		1/2"		1"		1-1/4"	
Over 4" IPS	1/2"		3/4"		1"		1-1/4"	
MILD CONDITIONS (Max 80 Deg.F, 26Deg.C -50%RH)								
3/8" I.D. thru 2-1/8" IPS	3/8"		3/8"		1/2"		1/2"	
Over 2-1/8"thru 3"IPS	3/8"		3/8"		1/2"		3/4"	
Over 3"IPS thru 4"IPS	1/2"		1/2"		3/4"		3/4"	
Over 4" IPS	1/2"		1/2"		3/4"		3/4"	
SEVERE CONDITIOINS (Max.90 Deg.F, 32 Deg.C.-80%RH)								
3/8" I.D. thru 1-1/4" IPS	3/4"		3/4"		1-1/4"		1-1/4"	
Over 1-1/4" ID thru 4" IPS	3/4"		1"		1-1/2"		1-1/2"	
Over 4" IPS	3/4"		1-1/4"		1-3/4"		2"	



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Pipe "R" Values per Square Foot

Pipe O.D or Normal Insulation I.D.		R Value 3/8"(10mm) Wall	R Value 1/2 "(13mm) Wall	R Value 3/4"(19mm) Wall	R Value 1"(25mm) Wall
3/8"	9mm	2.5	3.0	5.1	-
1/2"	13mm	2.4	3.1	5.1	-
5/8"	16mm	2.4	3.1	5.2	6.7
3/4"	19mm	2.3	3.1	5.1	6.5
7/8"	22mm	2.2	3.1	5.1	6.5
1-1/8"	29mm	2.1	3.1	5.3	6.8
1-3/8"	35mm	1.6	3.1	5.1	6.7
1-5/8"	41mm	2.2	3.1	4.9	6.4
1-1/2" IPS	48mm	2.3	2.9	4.7	6.9
2-1/8"	54mm	2.2	3.0	4.7	6.3
2" IPS	60mm	2.2	3.0	4.6	6.2
2-1/2" IPS 64mm	64mm	2.2	3.0	4.5	6.0
2-5/8"	67mm	2.2	3.0	4.5	6.0
3-1/8"	79mm	2.2	2.9	4.4	5.9
3" IPS	89mm	2.2	2.9	4.4	5.8
3-5/8"	92mm	2.1	2.9	4.4	5.8
3-1/2" IPS 102mm	102mm	2.1	2.9	4.3	5.7
4-1/8"	105mm	2.1	2.9	4.3	5.7

Gulf-O-Flex		Copper Pipe		Iron Pipe		Tubing Unit Length 1.8 Meters (Standard)															
Nominal Insulation Size ID		Nominal Size OD		Nominal Size IPS		Nominal 6 mm wall		Nominal 9 mm wall		Nominal 13 mm wall		Nominal 19 mm wall		Nominal 25 mm wall		Nominal 32 mm wall					
mm	inch	mm	inch	mm	inch	No. of Per Carton	Total Meters Per Carton	No. of Pcs per Carton	Total Meters Per Carton	No. of Pcs per Carton	Total Meters Per Carton	No. of Pcs per Carton	Total Meters Per Carton	No. of Pcs per Carton	Total Meters Per Carton	No. of Pcs per Carton	Total Meters Per Carton				
6	1/4	6	1/4	-	-	180	324	168	302.4	90	162	50	90	35	63	30	54				
9	3/8	9	3/8	-	-	170	306	130	234	80	144	40	72	25	45	25	45				
13	1/2	13	1/2	6	1/4	150	270	115	207	65	117	40	72	25	45	20	36				
16	5/8	16	5/8	10	3/8	120	216	90	162	60	108	35	63	25	45	20	36				
19	3/4	19	3/4	-	-	100	180	76	136.8	45	81	30	54	20	36	15	27				
22	7/8	22	7/8	13	1/2	90	162	70	126	40	72	30	54	20	36	15	27				
25	1	25	1	-	-	80	144	55	99	40	72	25	45	20	36	15	27				
28	1-1/8	-	1-1/8	19	3/4	70	126	55	99	36	64.8	25	45	18	32.4	15	27				
32	1-1/4	32	1-1/4	-	-	-	-	40	72	30	54	20	36	15	27	15	27				
35	1-3/8	35	1-3/8	25	1	60	108	36	64.8	30	54	20	36	15	27	12	21.6				
38	1-1/2	38	1-1/2	-	-	-	-	-	-	24	43.2	17	30.60	12	21.6	12	21.6				
42	1-5/8	42	1-5/8	32	1-1/4	-	-	30	54	25	45	17	30.60	12	21.6	10	18				
48	1-7/8	48	1-7/8	38	1-1/2	-	-	25	45	20	36	15	27	10	18	10	18				
51	2	51	2	-	-	-	-	-	-	20	36	15	27	9	16.2	9	16.2				
54	2-1/8	54	2-1/8	-	-	-	-	25	45	20	36	15	27	9	16.2	9	16.2				
60	2-3/8	60	2-3/8	51	2	-	-	20	36	18	32.4	12	21.6	9	16.2	6	10.8				
67	2-5/8	67	2-5/8	-	-	-	-	-	-	15	27	10	18	8	14.4	6	10.8				
73	2-2/8	73	2-7/8	-	-	-	-	-	-	15	27	10	18	6	10.8	4	7.2				
76	3	76	3	-	-	-	-	-	-	12	21.6	10	18	6	10.8	4	7.2				
79	3-1/8	79	3-1/8	-	-	-	-	-	-	12	21.6	10	18	6	10.8	4	7.2				
89	3-1/2	89	3-1/2	75	3	-	-	-	-	10	18	8	14.4	6	10.8	4	7.2				



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GULF-O-FLEX CONTINUOUS COIL

(COIL LONGER, MORE EFFICIENT LESS WASTE)

DESCRIPTION

Gulf-O-Flex Continuous Coil is a system designed for convenience and labor savings with superior toughness. It is provided in continuous-length coils, designed to minimize waste, reduce butt joints, and is packaged in easy-handle, easy-store cartons. The pipe insulation is tough but flexible elastomeric thermal insulation, supplied as continuous length unslit tubing in nominal wall thicknesses of 3/8"(9 mm) and 1/2"(13mm) in popular sizes up to 1-1/8"ID. Its closed cell structure makes it an efficient insulation with the proven performance of Gulf-O-Flex ECR. It is manufactured without the use of CFC's, HCFC's or HFC's. It is also formaldehyde free, dust free, fiber free and resists mold and mildew.



USES

Gulf-O-Flex Continuous Coil is engineered for air conditioning applications in which speed, ease of installation; convenient handling and on-site durability are of primary importance. It slides on the pipe easier, making the installation job faster and more profitable for contractors.

INSTALLATION

Gulf-O-Flex Continuous Coils uncoils easily from its convenient carton, so it can be cut to desired lengths for longer runs with fewer seams. It also slides on the pipe easier, making the installation job faster and more profitable for contractors. The specially formulated lubricating powder effectively reduces friction, and relaxed I.D. tolerances accommodate elbows and fittings. Its thermal conductivity (0.27), WVT (0.80), flame spread and smoke developed index (25/50) and temperature use ranges(-70° F to +220°F) are the best. Installs with simple hand tools and Gulf-O-Glue (which is a low V.O.C. adhesive). Gulf-O-Glue is a contact adhesive, therefore, in all cases both surfaces to be joined are coated with Gulf-O-Glue.

TUBE COIL BOX

DIMENSIONS OF BOX: 50X50X20 CMS

Tube		Thickness 6 mm	
Inches	mm	m/Box	
1/4"	6	50	
5/16"	8	48	
3/8"	9	46	
1/2"	12	40	
5/8"	15	38	
3/4"	18	30	
7/8"	22	23	
1 1/8"	28	20	

Tube		Thickness 9 mm	
Inches	mm	m/Box	
1/4"	6	45	
5/16"	8	40	
3/8"	9	40	
1/2"	12	35	
5/8"	15	30	
3/4"	18	25	
7/8"	22	20	
1 1/8"	28	15	

Tube		Thickness 13mm	
Inches	mm	m/Box	
1/4"	6	23	
5/16"	8	20	
3/8"	9	20	
1/2"	12	15	
5/8"	15	12	
3/4"	18	10	
7/8"	22	10	
1 1/8"	28	6	



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Product Data

Physical Properties				
1	Cell Structure	Closed		
2	Density Gms / Cm ³	0.050 - 0.070 Gms / cm ³	BS 476 Part 6 & 7 ASTM D 3575- 91	
3	Thermal Conductivity K Value at 40C mean Temperature	0.0338 w/m - K	ASTM C518	BS 874 1986
4	Temperature limit °C	-40 °C to +120 °C		
5	Thermal Stability % Shrinkage	2.54 (7 days at 95°C)	ASTMD 3575-91	
6	Water Absorption	2.98	ASTMD 3575-91	
7	Water vapor Permeability perm/Max	0.00 Perm - in	ASTM E 96-95	ASTM E 96-95
8	Resistance to Ozone	Excellent	ASTMD 1149	
9	Flammability	Self Extinguishing	ASTMD 635-91	
10	Fire Rating	Class 0, Class 1 25 / 50	BS 476 Part 6 & 7 ASTM E-84	
11	Average time of Burning	Less then 4 Sec	ASTMD 1149	
12	Average extend of Burning	15min		
13	Flexibility	Excellent	ASTMD 1056-85	
14	Resistance to Weather & Ultra Violet Rays	Very Good	ASTM G 53-96	
15	Resistance to Chemicals	Very Good		
16	Odour	Negligible	SAEJ 1351	
17	Mildew resistance	No Fungal Growth	ASTM G 21-80	
18	Copper Corrosion	Negligible	ASTM C 665-94	

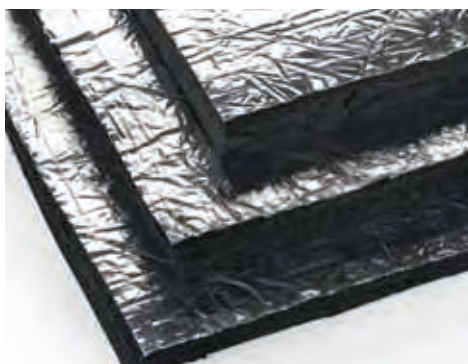




GULF-O-FLEX
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GULF-O-FLEX INSULATION SHEETS & ROLLS



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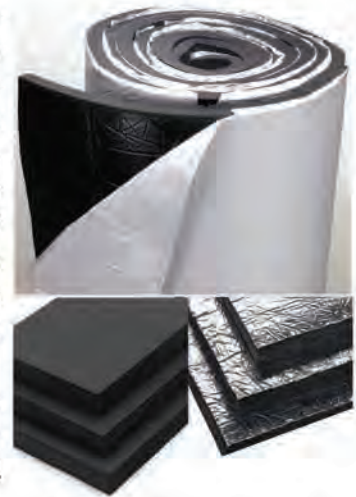
GULF-O-FLEX SHEETS

(PLAIN, SELF-ADHESIVE, ALUMINIUM FOIL
& SELF-ADHESIVE PLUS ALUMINIUM)

DESCRIPTION

Gulf-O-Flex Sheet and Roll Insulation are flexible, elastomeric thermal insulations. Both are supplied in flat sheets 36"x 48" (0.92m X 1.22m), in popular thicknesses. Gulf-O-Flex sheet is also available in 48" (1.22m) x 360" (9.20m) continuous rolls in 1/8", 1/4", 3/8", 1/2", 3/4", 1", 1-1/4", 1-1/2" and 2". The insulations are furnished with a smooth skin one side or both sides on request, which forms the outer exposed insulation surface. The expanded closed-cell structure of Gulf-O-Flex makes it an efficient insulation. It is manufactured without the use of CFC's, HCFC's or HFC's. It is also formaldehyde free, dust free, fiber free and resists mold and mildew. "Method of Test for Surface Burning Characteristics of Building Materials" Gulf-O-Flex Sheet Insulations have a flame-spread index of less than 25 and a smoke-developed index of less than 50 as tested by the third party testing lab. (ASTM E 84 Method of testing surface burning characteristics of building materials complied.)

Under the supervision of our R&D dept. based in Germany consistently provide actual values on these key performance criteria for mechanical system insulation. Thermal Conductivity: 0.0391 w/m-K in 40°C. Fire Rating: Class 0 and Class 1 under the specification of BS 476 Parts 6 & 7.



USES

Gulf-O-Flex is used to retard heat gain and control condensation drip from chilled water and refrigeration systems. It also efficiently reduces heat flow on hot systems. Gulf-O-Flex Sheet/Roll Insulations are particularly adaptable for insulating ductwork, large piping and fittings, tanks, and vessels. Their flexibility allows application to curved and irregular surfaces. They are very adaptable to making all types of fitting cover insulations. The recommended temperature usage range for Gulf-O-Flex Sheet Insulation is -40°C to +120°C according to method of application. When used for pipe insulation with adhesive adhering seams and joints only, Gulf-O-Flex Sheet can be applied to lines that will operate to a limit of 120°C. For use on cold surfaces, Gulf-O-Flex thickness has been calculated to control condensation on the insulation outer surface, as shown in the table of thickness recommendations.

RESISTANCE TO MOISTURE VAPOUR FLOW

The closed-cell structure of Gulf-O-Flex insulations effectively retards the flow of moisture vapour, and Gulf-O-Flex is considered a low-transmittance vapour retarder. For many applications, Gulf-O-Flex needs no supplementary protection. Additional vapour-retarder protection may be necessary for Gulf-O-Flex when installed on very low temperature surfaces or piping or where exposed to continually high humidity conditions.

APPLICATION

Gulf-O-Flex Sheet is installed using Gulf-O-Glue Adhesive for application to large flat or curved metal surfaces such as ducts, very large pipes, tanks, and vessels, where full adhesive coverage is used. For applications as pipe insulation and fitting covers, only the seams and joints are adhered with adhesive. Gulf-O-Glue Adhesives are contact adhesives; therefore, in all cases, both surfaces to be joined are coated with adhesive. Sheet insulations are designed for installation above ground. Indoors, no protective finish is required. Outdoor, a weather-resistant protective finish is to be applied.

SPECIFICATION COMPLIANCE.

ASTM C 518

ASTM D 1056-00-2C1

CLASS 0

(Fire propagation test according to BS 476 part 6 & 7 complies with the requirements of UK.)

CLASS 1

(Fire propagation test according to BS 476 part 6 & 7 complies with the requirements of UK.)

ASTM E-84 (25/50)



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Physical Properties				
1	Cell Structure	Closed		
2	Density Gms / Cm ³	0.050 - 0.070 Gms / cm ³	BS 476 Part 6 & 7 ASTM D 3575- 91	
3	Thermal Conductivity K Value at 40C mean Temperature	0.0338 w/m-k	ASTM C518	BS 874 1986
4	Temperature limit °C	-40 °C to +120 °C		
5	Thermal Stability % Shrinkage	2.54 (7 days at 95 °C)	ASTM D 3575-91	
6	Water Absorption	2.98	ASTM D 3575-91	
7	Water vapor Permeability perm/Max	0.00 Perm-In	ASTM E 96-95	ASTM E 96-95
8	Resistance to Ozone	Excellent	ASTM D 1149	
9	Flammability	Self Extinguishing	ASTM D 635-91	
10	Fire Rating	Class 0, Class 1 25 / 50	BS 476 Part 6 & 7 ASTM E-84	
11	Average time of Burning	Less then 4 Sec	ASTM D 1149	
12	Average extend of Burning	15min		
13	Flexibility	Excellent	ASTM D 1056-85	
14	Resistance to Weather & Ultra Violet Rays	Very Good	ASTM G 53-96	
15	Resistance to Chemicals	Very Good		
16	Odour	Negligible	SAEJ 1351	
17	Mildew resistance	No Fungal Growth	ASTM G 21-80	
18	Copper Corrosion	Negligible	ASTM C 665-94	

INSULATION THICKNESS RECOMMENDATIONS THICKNESS RECOMMENDATIONS FOR CONTROLLING OUTER INSULATION SURFACE SWEATING

	50°F (10°C)	35°F (2°C)	0°F (-18°C)
<p>BASED ON NORMAL DESIGN CONDITIONS Gulf-O-Flex in the thicknesses noted and within the specified temperature ranges will control outer insulation surface condensation indoors under normal design conditions, a maximum severity of 85°F (29°C) and 70% RH. Gulf-O-Flex research and field experience indicate that indoor conditions anywhere in the US States seldom exceed this degree of severity.</p>	Nom 3/8"(9mm)	Nom 3/4"(19mm)	Nom 1-1/2"(38mm)
<p>BASED ON MILD DESIGN CONDITIONS Gulf-O-Flex in the thicknesses noted and within the specified temperature ranges will control outer insulation surface condensation indoors under mild design conditions, a maximum severity of 80°F (27°C) and 50% RH. Typical of these conditions are most air conditioned spaces and arid climates.</p>	Nom 1/8"(3mm)	Nom 1/4"(6mm)	Nom 1/2"(13mm)
<p>BASED ON SEVERE DESIGN CONDITIONS Gulf-O-Flex in the thicknesses noted and within the specified temperature ranges will control outer insulation surface condensation indoors under severe design conditions, a maximum severity of 90°F (32°C) and 80% RH. Typical of these conditions are indoor areas in which excessive moisture is introduced or in poorly ventilated confined areas where the temperature may be depressed below ambient.</p>	Nom 1"(25mm)	Nom 1-1/2"(38mm)	Nom 2"(50mm)



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Packing List

Standard Continuous Roll Sizes		
Nominal Thickness		Size per Roll
mm	inch	Meter
06	1/4	10 x 1
09	3/8	10 x 1
13	1/2	10 x 1
16	5/8	10 x 1
19	3/4	10 x 1
25	1	10 x 1
32	1-1/4	8 x 1
38	1-1/2	6 x 1
50	2	4 x 1

Standard Flat Sheet Sizes			
Nominal Thickness		Size per Sheet	No of Sheets Per Carton
mm	inch	Feet	
06	1/4	4x3	40
09	3/8	4x3	26
13	1/2	4x3	20
16	5/8	4x3	16
19	3/4	4x3	14
25	1	4x3	10
32	1-1/4	4x3	8
38	1-1/2	4x3	6
50	2	4x3	4



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Technical data sheet

C4



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GULF-O-FLEX INSULATION THICKNESS RECOMMENDATION (FOR STANDARD & SPECIFIED PARAMETERS BY CONSULTANT)

INDOOR CONDITIONS

Ambient Temperature	=	24 °C
Relative Humidity	=	50%
Service Or Line Temperature	=	2- 15 (°C)
Thermal Conductivity	=	0.035-0.040 W/m-K
Density	=	50-80 Kg/m ³
Surface Coefficient of Heat Transfer	=	9 W/m ² -K
Dew Point Temperature	=	12.9 °C

OUTDOOR CONDITIONS

Ambient Temperature	=	46 °C
Relative Humidity	=	80%
Service Or Line Temperature	=	2- 15 (°C)
Thermal Conductivity	=	0.035-0.040 W/m-K
Density	=	50-80 Kg/m ³
Surface Coefficient of Heat Transfer	=	12 W/m ² -K
Dew Point Temperature	=	41.7 °C

S. No.	Pipe Diameter (mm)	GOF Recommended Insulation Thickness (mm)
1	300	25
2	250	25
3	200	19
4	150	19
5	125	13
6	100	13
7	80	13
8	65	13
9	50	9
10	40	9
11	32	9
12	25	9
13	20	9

S. No.	Pipe Diameter (mm)	GOF Recommended Insulation Thickness (mm)
1	300	50
2	250	50
3	200	38
4	150	38
5	125	32
6	100	32
7	80	32
8	65	32
9	50	32
10	40	25
11	32	25
12	25	25
13	20	25





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GULF.O.FLEX

Thermal Conductivity of Gulf.O.Flex at different temperature

°C	-40	-30	-20	-10	0	10	20	30	40
W/m-k	0.0260	0.0270	0.0280	0.0290	0.0300	0.0310	0.0320	0.0338	0.0340

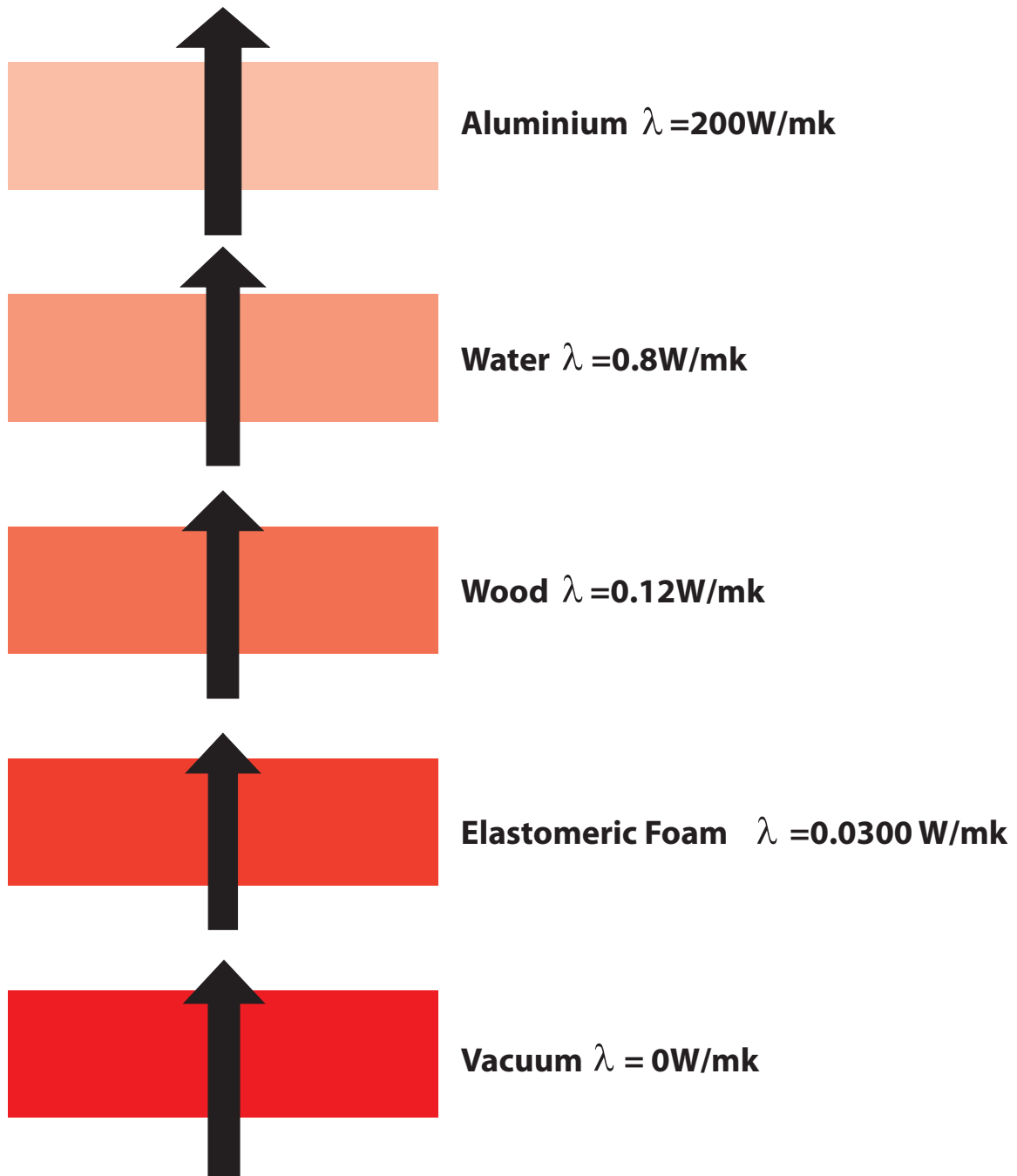


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COMPARISON OF THERMAL CONDUCTIVITIES

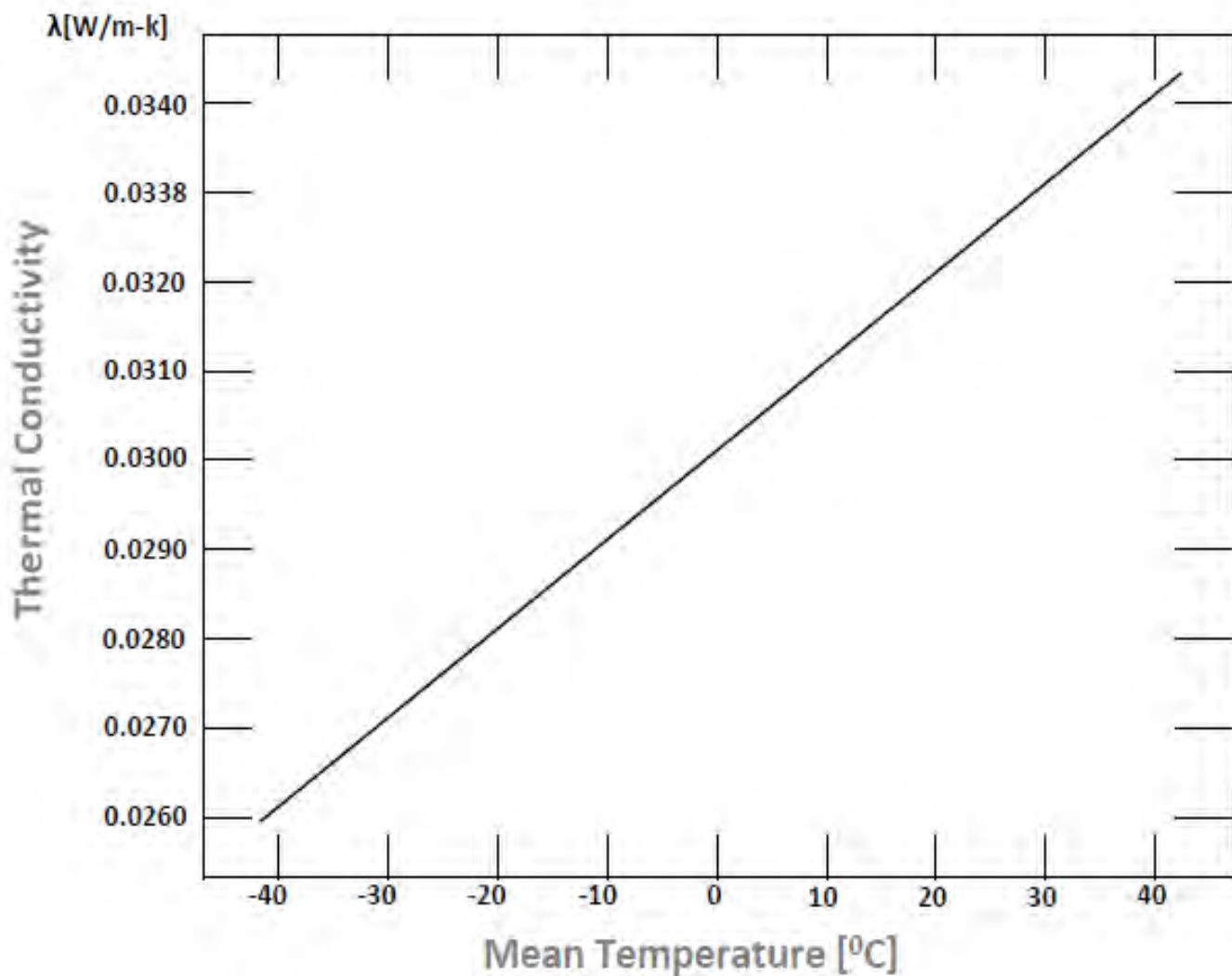


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GULF-O-FLEX
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TEMPERATURE DEPENDENCE OF THERMAL CONDUCTIVITY



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CALCULATION OF INSULATION THICKNESS

Sheet S_F

$$S_F = \frac{\lambda}{\alpha_a} \left(\frac{v_a - v_i}{v_a - v_K} - 1 \right)$$

Pipe S_R

$$\frac{d_a}{2} \ln \frac{d_a}{d_i} = \frac{\lambda}{\alpha_a} \left(\frac{v_a - v_j}{v_a - v_K} - 1 \right) \quad S_R = (d_a - d_i)/2$$

λ = Thermal Conductivity [W/mK]

α_a = Thermal Transition Coefficient (outside) [W/m²K]

d_a = Outside Diameter of the insulated Pipe [m]

d_i = Outside Diameter of the non-insulated Pipe [m]

v_a = Outside Temperature (Surrounding) [°C]

v_i = Inner Temperature (Medium) [°C]

v_K = Dew Point Temperature [°C]

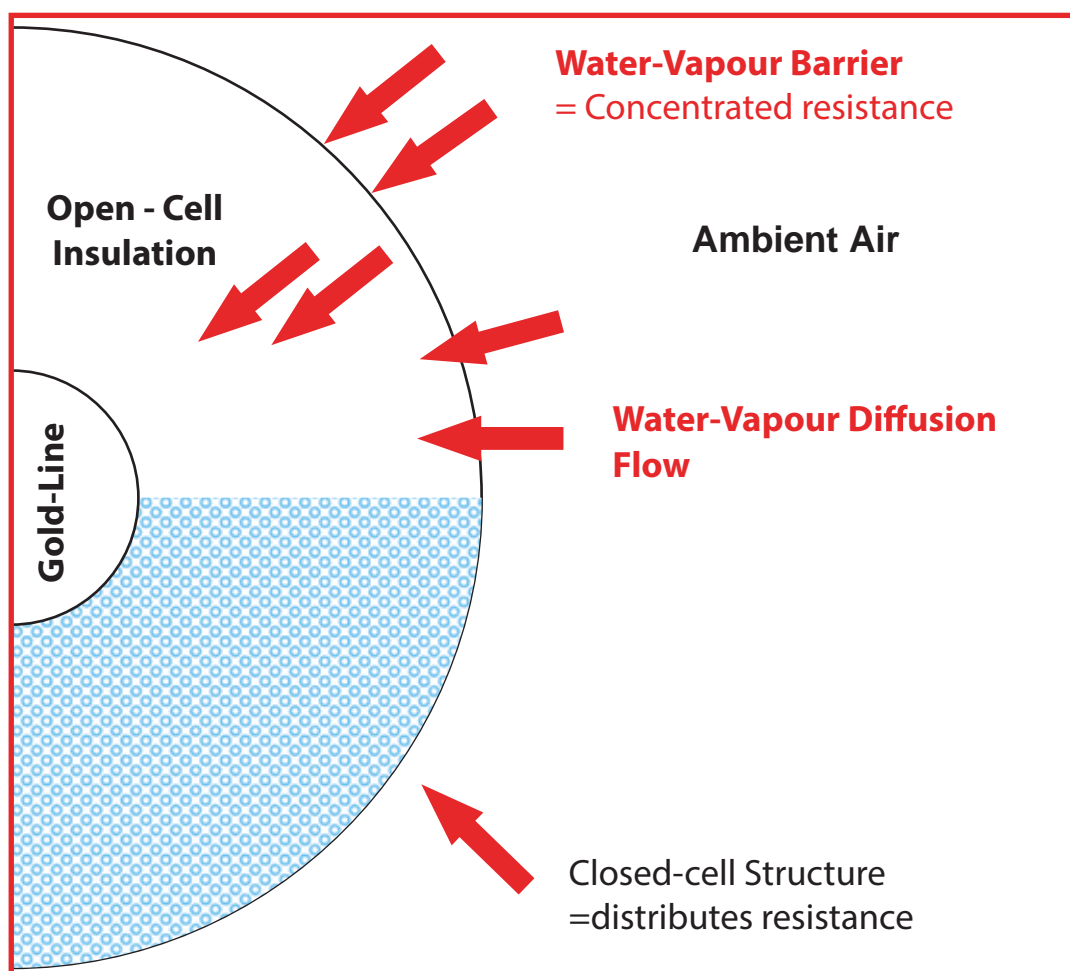




GULF-O-FLEX
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WATER-VAPOUR DIFFUSION RESISTANCE

Open-cell/closed-cell Insulation Material

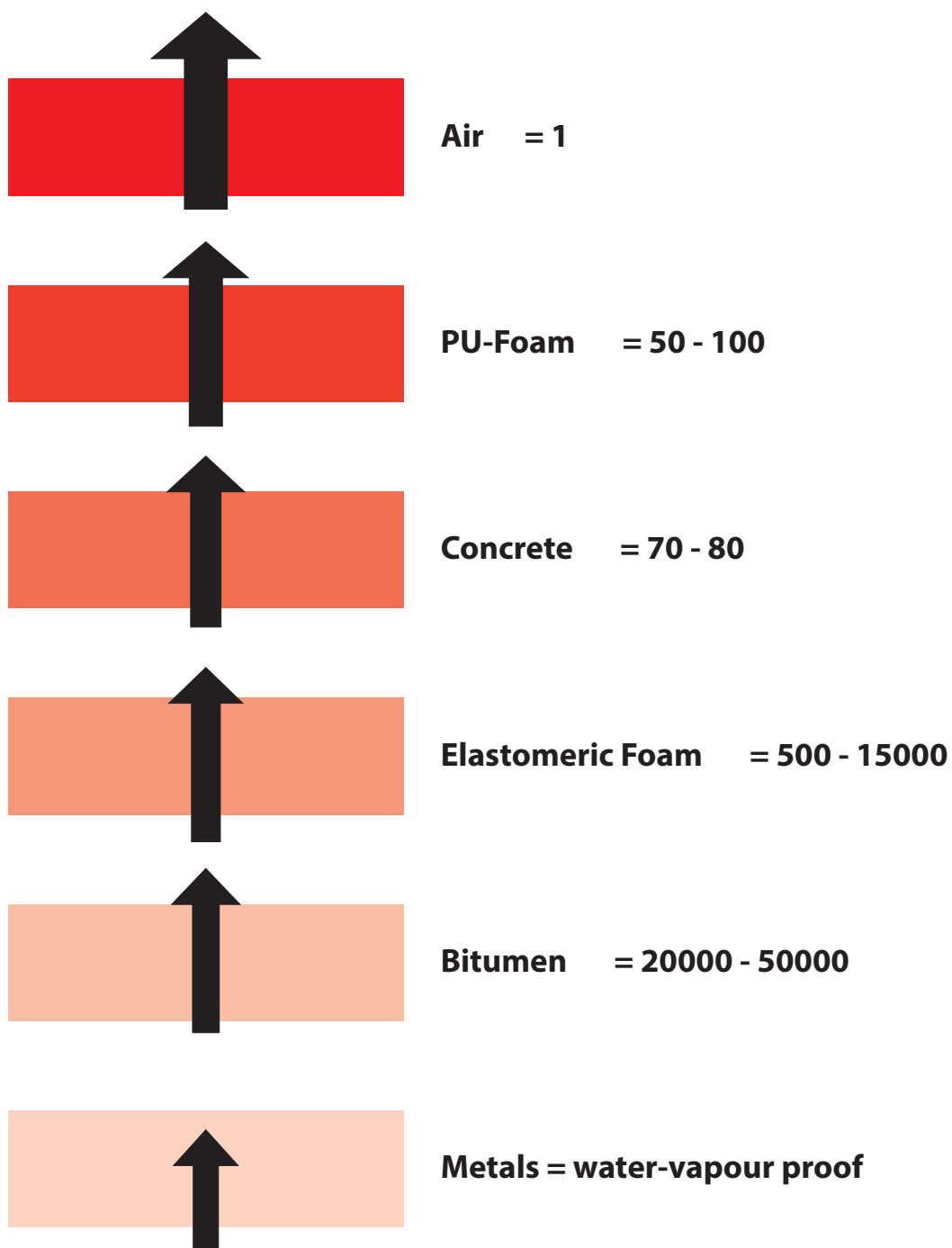


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GULF-O-FLEX
PRODUCT OF RUBBERWORLD

COMPARISON OF WATER-VAPOUR Diffusion Factors



**RUBBER
WORLD**

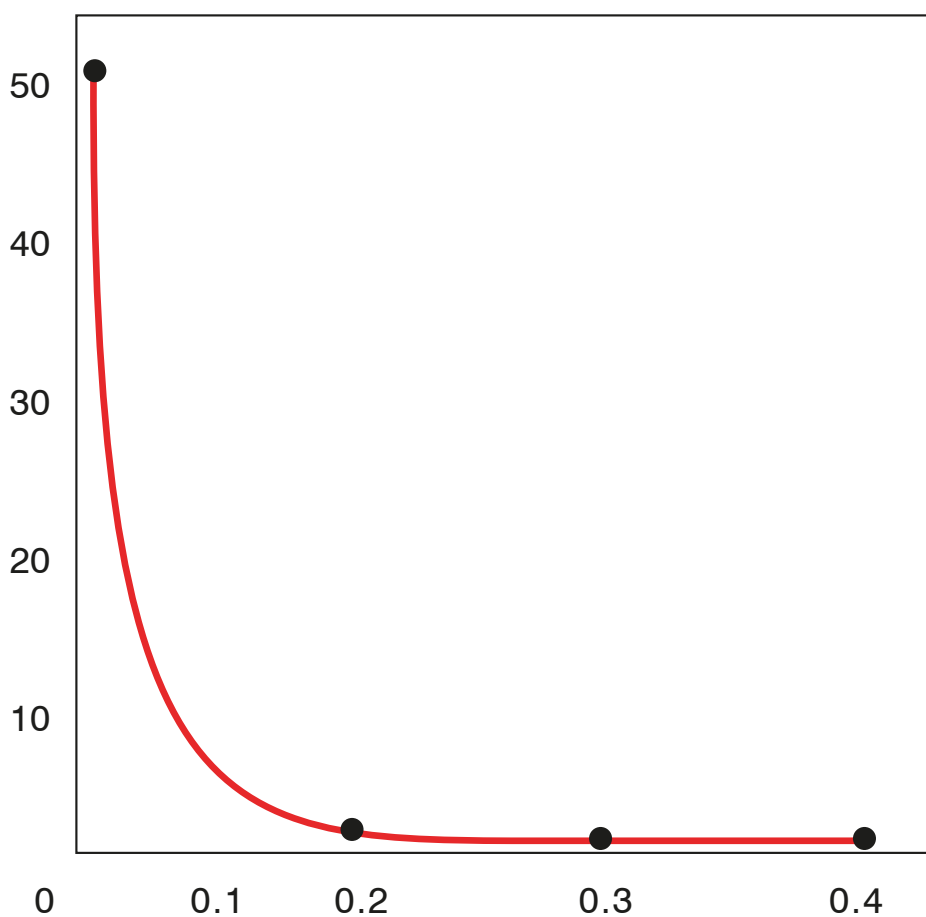


GULF-O-FLEX
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FUNCTION OF WATER-VAPOUR DIFFUSION

Resistance of Alu-cladded Glassfibre and Pin Hole Area

$$\mu = [1000]$$



Hole-area [mm² / m²]



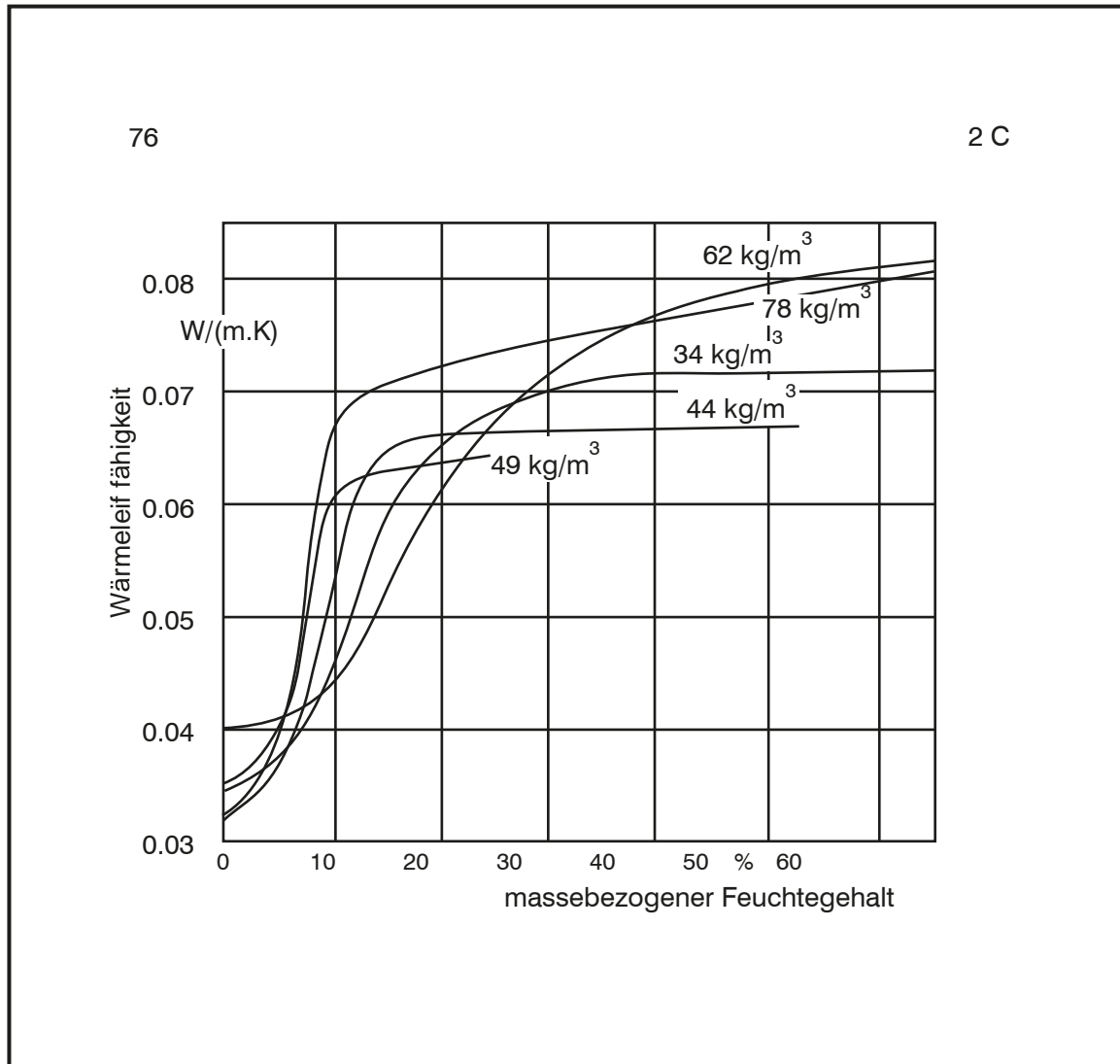
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GULF-O-FLEX
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THERMAL CONDUCTIVITY OF MINERAL-FIRE

Insulation of different density in dependence of absorbed humidity by weight % at 10°C mean temperature



Source- W. F. Cammerer,
Insulation Cold-Warm,
Spring 1995

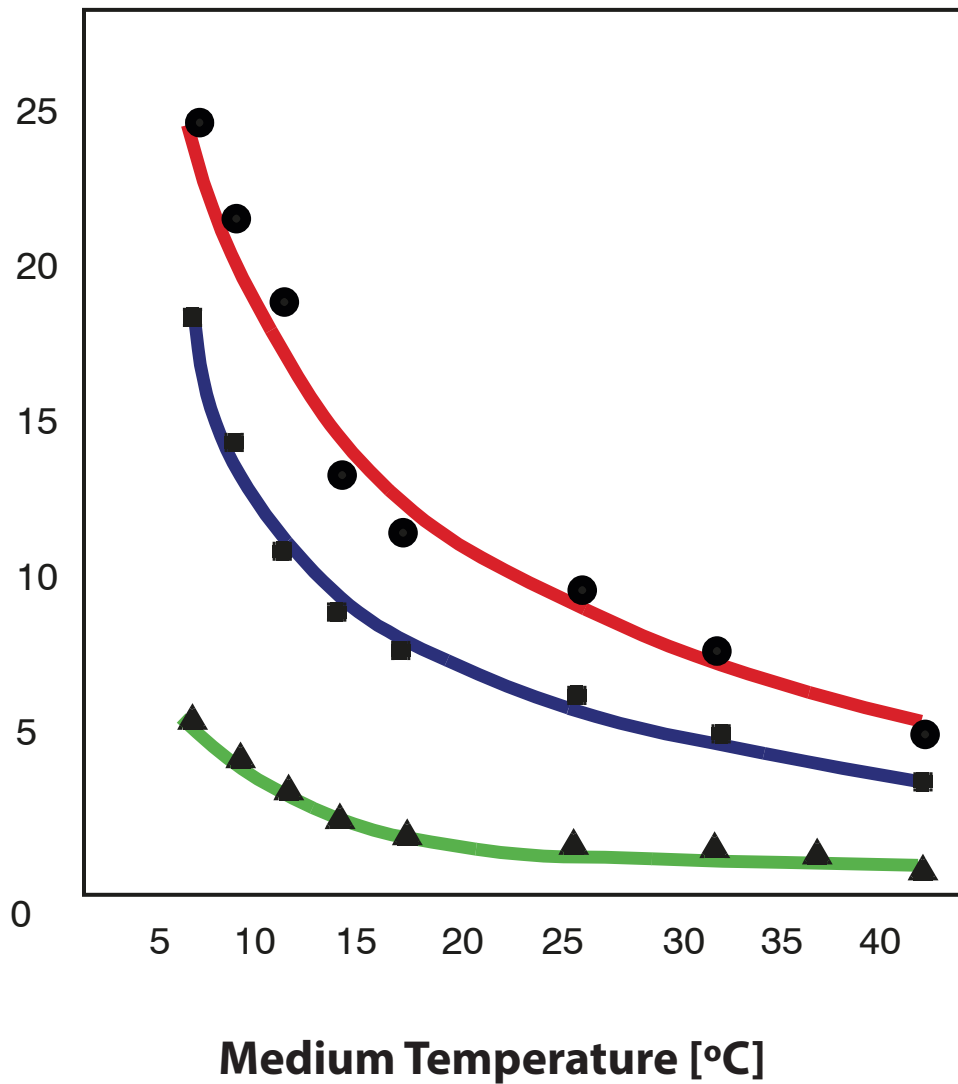


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GULF-O-FLEX
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WATER-VAPOUR DIFFUSION RESISTANCE AND TEMPERATURE FUNCTION



**RUBBER
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Material safety data sheet

C5



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Material Safety Data Sheet

Manufacturer Information

Manufacturer Name & Address	MSDS Information	: +971-6-7434176
<u>Rubber World industries L.L.C.</u>	Date Issued	: October 2005
New Industrial Area - Ajman, UAE		

1.0 Identification

Chemical Name : NBR / PVC Elastomeric Foam CAS No.: N/A
 Trade Name : Gulf-O-Flex Rubber Insulation Pipes, Sheets on Cut Pieces & Continuous Rolls
 Gulf-O-Flex Self Adhesive Reinforcement Insulation Tape

2.0 Special Regulatory Hazards

<u>Hazardous Ingredient</u>	<u>CAS No.</u>	<u>Exposure Limit</u>
None	N/A	N/A

This material is classified as an article under CFR 1910.1200 C

3.0 Physical Data

Appearance and Odor: Black / Color Tubes & Sheet Material.

Solubility	: Insoluble		
Melting Point (°C)	: N/A	Vapor Pressure @ 20°C	: 0.1
Boiling Point (°C)	: N/A	Vapor Density (Air = 1)	: N/A
Specific Gravity (H ₂ O=1)	: N/A	Other	: N/A

4.0 Fire and Explosion Hazard Data

Flash Point	: N/A	Auto ignition Temp	: N/A
Extinguishing Media	: Water, CO2 dry Chemical	Flammable Limits	: N/A
Unusual Hazards	: N/A		

Special Fire Fighting Procedures : Recommend NIOSH/MSHA approved self-contained breathing apparatus and full protective clothing be worn

5.0 Reactivity Data

Stability	: (X) Stable	() Unstable
Incompatibility	: N/A	
Decomposition Products	: Upon combustion, HCl, HCN and other hazardous gases may be evolved	

MSDS-GOF-1003

Rubber World Industries L.L.C.

New Industrial Area, P. O. Box - 2435

Ajman - United Arab Emirates

Pge 1 of 2

Tel:- +971 - 6 - 7434176 Fax:- +971-6-7434197





6.0 Special Protection Information

Engineering Controls : Local exhaust ventilation is recommended for control of airborne dust, fumes and vapors in confined areas.

Personal Protection Equipment : Recommend light to medium duty cloth or leather gloves and approved safety glasses.

7.0 Storage Spills and Disposal Information

Storage : Avoid storage in confined areas where temperatures may exceed 51 degree C (125 degree F)

Spills : N/A

Disposal : Not a RCRA hazardous waste. Dispose of in accordance with local/state and federal regulations.

8.0 Health Related Data

Ingestion	Acute Health Hazard : Unlikely route of exposure Chronic Health Hazard : N/E Emergency & First Aid Procedures : No adverse effects anticipated by this route of exposure
Skin	Acute Health Hazard : N/E Chronic Health Hazard : N/E Emergency & First Aid Procedures : If rash or irritation develops, wash with soap & water. If rash or irritation persists, consult a physician.
Eye	Acute Health Hazard : N/E Chronic Health Hazard : N/E Emergency & First Aid Procedures : Flush with water. If irritation persists, consult a physician
Inhalation	Acute Health Hazard : Unlikely route of exposure Chronic Health Hazard : N/E Emergency & First Aid Procedures : N/E

Medical Conditions Aggravated by Exposure : N/E

CODE USED : N/A = NOT APPLICABLE N/E = NOT ESTABLISHED

The information & recommendations contained herein are based upon data that is accurate & reliable to the best of Rubber World Industries knowledge and belief. With respect to information and recommendations, RWI makes representation and warranties of any kind of nature, express or implied.





GULF·O·FLEX
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Certificates

C6



**RUBBER
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GULF-O-FLEX
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حكومة عجمان
Government of Ajman

دائرة التنمية الاقتصادية
Department of Economic Development

السجل التجاري

تاريخ تجديد القيد
11/28/2016

شهادة تجديد

قيد شركة في سجل التجاري

Registry Number	10547	10547	رقم القيد
Date of Registration	30/08/1995	30/08/1995	تاريخ القيد
Date of Expiry	28/10/2017	28/10/2017	تاريخ انتهاء القيد
Legal Classification	LIMITED LIABILITY COMPANY	شركة ذات مسؤولية محدودة	الشكل القانوني للمؤسسة
Trade Name	RUBBER WORLD INDUSTRY / L.L.C	(مصنع مطاط العالم) ذ.م.م. صناعة المنتجات المطاطية	الاسم التجاري النشاط التجاري
Business Activities	Rubber Products Manufacturing		
Capital (AED)	300,000.00	300,000.00	رأس المال
Receipt Number	قيمة الرسم ورقم إيصال التحصيل رقم الإيصال / 637894 / 100		
Issued On	28/11/2016	28/11/2016	تحريراً في

مدير دائرة التنمية الاقتصادية في عجمان

80095 / +971 6 7033888 +971 6 7033998 870, Ajman, U.A.E. www.ajmanded.ae ajmanded ajmanded 1791282

الرؤية: اقتصاد ناشئ ملتزم لاستدامة التنمية في إمارة عجمان



**RUBBER
WORLD**
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GULF-O-FLEX
PRODUCT OF RUBBERWORLD



Certificate of Registration

The organization located at address shown below

Rubber World Industry L.L.C

P.O. Box # 2435, Shaikhani Group Building New Industrial Area 1, Ajman,
United Arab Emirates

has been assessed and registered by Systems Certification International
and found compliant in accordance with the requirements of the
standard detailed below:

ISO 9001:2015

Quality Management System

Scope of certification covers:

**Manufacturer And Supplier Of Rubber Closed Cell
Elastomeric Foam Insulation And Hvac & R Accessories
Products**

Certificate No: AE-368 QC
Original Certification: 08-Nov-2016
Issue Date: 08-Nov-2016
Expiry Date: 08-Oct-2019


Nicole Ashley
on behalf of
Certification Approval Panel
Systems Certification International

This certificate verifies the original certificate issued and is valid as long as it is displayed as an electronic copy at www.systemscertification.com and surveillance audits are satisfactorily completed. This certificate is authorized for issue by Accreditation Service for Certifying Bodies (Europe) Limited who have assessed Systems Certification International as a System Assessment Body for compliance with ISO 17021:2011. Certificate holders are listed in the International Register of Quality Assessed Organizations: www.irqao.com



Systems Certification International
17-15 Station Street, Queens Garden, London, EC2A 4EJ,
United Kingdom
CONTACT US
info@systemscertification.com www.systemscertification.com

International Register of Quality Assessed Organizations (IRQAO)
6, Tollymore Park, Bournemouth, Dorset, BH3 3AL,
United Kingdom
www.irqao.com



**RUBBER
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GULF-O-FLEX
PRODUCT OF RUBBERWORLD



UNITED ARAB EMIRATES
MINISTRY OF INFRASTRUCTURE
DEVELOPMENT



الإمارات العربية المتحدة
وزارة تطوير البنية
البنائية

شهادة تسجيل مورد

146244_2 : Registration No / رقم التسجيل
Rubber World Industry LLC : Commercial Name / الاسم التجاري
عجمان : Address / الإمارة
(06) 743-4176 : Phone / الهاتف
2435 : PO.Box / ص. ب.
(06) 743-4197 : Fax / الفاكس
: Registration Fields / مجال التسجيل

Name of product: Rubber Closed Cell Elastomeric Foam Insulation , Scope of Accreditation: الميكانيكية, Brand: Gulf-O-Flex, Country of Origin: UAE

15/08/2016 : Issue Date / تاريخ الإصدار
14/08/2017 : Expiry Date / تاريخ الانتهاء
160050804182 09/08/2016 : Receipt No. & Date / رقم الإيصال و تاريخه

ملاحظة: - هذه الشهادة صادرة من وزارة تطوير البنية ولا تحتاج إلى توقيع أو ختم رسمي.
- تعتبر هذه الشهادة ملغية في حال إنتهت صلاحية الرخصة التجارية.



**RUBBER
WORLD**
INDUSTRIES


**DUBAI CENTRAL LABORATORY DEPARTMENT
 TYPE 1 CERTIFICATION - EVALUATION REPORT**

EVALUATION REPORT NO.	RA15051262
DATE:	21 December 2015
COMPANY NAME	RUBBER WORLD INDUSTRIES (CS - 23)
PRODUCT DESCRIPTION	RUBBER CLOSED CELL ELASTOMERIC INSULATION - GULF - O - FLEX INSULATION TUBE & SHEET
REFERENCE STANDARD	Green Building Regulations and Specification (GBRS), Clause 502.11 Pipe and Duct Insulation
SAMPLE ID NO.	JS 1044
APPLICATION NO.	AP15050416

DETAILS OF EVALUATION:

REQUIREMENTS	STANDARD CRITERIA	RESULT	TESTING LABORATORY	TEST REPORT NO.	REMARKS
Thermal Conductivity	As per BS 5422: 2009	0.0338 W/(m·K)	DUBAI CENTRAL LABORATORY	2015123167	PASSED for some specific application (See Note 1)
Thickness	As per BS 5422: 2009	25.1 mm	DUBAI CENTRAL LABORATORY	2015123167	PASSED for some specific application (See Note 2)
Water Vapor Permeance	Shall not be more than the maximum permitted water vapor permeance specified in Table 1 of BS 5422:2009	0.00 perms	DUBAI CENTRAL LABORATORY	2015131232	PASSED
Fire Performance	Shall comply with Class O Material as follows	Class 1 Surface Flame Spread Fire Propagation Index = 10.8 Sub-index = 5.2 max.	TUV SUD PSB Singapore	7191125328-MEC15/1-YWA	PASSED
	a) Has a Class 1 surface spread of flame rating;		TUV SUD PSB Singapore	7191125328-MEC15/2-YWA	PASSED
	b) Has a Fire Propagation Index (I) of not more than 12.0;		TUV SUD PSB Singapore	7191125328-MEC15/2-YWA	PASSED
	c) Has a sub index (i2) of not more than 6		TUV SUD PSB Singapore	7191125328-MEC15/2-YWA	PASSED

NOTE 1: Since no specific application is specified by the client, the minimum thickness of insulation to be used shall be determined from the appropriate tables in BS 5422 taking into consideration:

- The thermal conductivity (0.0338 W/m-k)
- Emissivity (high)
- Diameter of the pipe (from Table)
- Temperature inside the pipe (from Table)
- Ambient temperature (from Table)
- Relative humidity (from Table)

NOTE 2: The minimum thickness required as determined (as per NOTE 1) shall not be less than the actual thickness of 25 mm.

NOTE 3: To achieve the required results, the user of the insulation shall ensure that the conditions specified in NOTE 1 and NOTE 2 are satisfied.

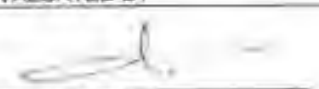

FINAL RECOMMENDATION

Three pcs of 1.0 m x 0.5 meter with nominal declared thickness of 25 mm and 9 pcs of 225 mm x 25 mm of the same thickness were prepared from randomly selected elastomeric rubber insulation sheet by DCL Representative from a batch of 50 sheets measuring 10 meters x 1.0 meter with batch number 421-1-160214. The three pieces were submitted to DCL for thermal conductivity, thickness and water vapor permeance test in accordance with test method, ASTM C 518 and ASTM E96 respectively. On the other hand, the 9 pieces samples were submitted to TUV SUD PSB Singapore for fire performance test as per BS 476 Part 6 & Part 7.

For the test results issued by DCL, since there is no specific application specified by Rubber World Insulation, the thermal conductivity and thickness evaluation shall be referred to the application table of the BS 5422 standard depending on its application. For water vapor permeance, the test report issued by DCL disclosed zero result which satisfy the requirements of the standard.

However for the fire performance tests, minimum requirements of Class O has been complied with the DCLD requirements. In view of the said satisfactory of test results, issuance of Certificate of Product Conformity on the above mentioned product can be generated.

"This recommendation is based on the full compliance with the requirements in the Type 1 General Rules and the relevant specific rules for the product being certified."

EVALUATED BY	NOTED & APPROVED BY
 JASSIM ALKHAJA Senior Products Quality Engineer Date 21/12/2015.	 ABDULLA MOHAMMED AL MARZOUQI Head, Certification Unit Date 21/12/2015

Dubai Central Laboratory
 Engineering Materials Laboratory Section – Structural Unit
TEST REPORT
 THERMAL TRANSMISSION PROPERTIES BY HEAT FLOW METER

REPORT NO. : 2015123167 DATE: 30/11/2015

WEB REQUEST NO. : DCL-16112015-0095

REQUEST NO. : 2015086952 SAMPLE NO. : 2015116282

PROJECT NO. : CS-23

PROJECT NAME : RUBBER WORLD INDUSTRIES

CONSULTANT : NO SPECIFIC CONSULTANT

CONTRACTOR : NO SPECIFIC CONTRACTOR

LOCATION : New Industrial Area, Ajman UAE

SOURCE : RUBBER WORLD INDUSTRIES LLC - AJMAN

SAMPLE DESCRIPTION : ELASTOMERIC INSULATION

SAMPLE TYPE : NG

SUPPORT / FACING : NIL

NOM. THICKNESS (mm) : 25 NOM. DENSITY (kg/m³) : NG

Date of Sampling	: 22/10/2015	Time	: 11:00	Lot No.	: 421-1-160214
Date of Receiving Sample	: 16/11/2015	Time	: 09:00	Lot Size	: 50 sheets
Size of Sample	: 6 pcs	Area No.	: -	Sender No.	: JS1044

CALIBRATION DETAILS

TYPE OF MATERIAL USED FOR CALIBRATION	STANDARD REFERENCE MATERIAL 1450C687
R VALUE @ 35°C [(m ² K) / W]	0.7169
DATE OF CERTIFICATION	10/12/2010
SOURCE OF CERTIFICATION	National Institute of Standards & Technology [NIST] - U.S.A.
EXPIRY & CERTIFICATION TEST NUMBER	Refer NIST special publication 260-130

TEST PARAMETERS

DATE SPECIMEN RECEIVED	16/11/2015
TEST START DATE	17/11/2015
NOM. THICKNESS OF SPECIMEN (mm)	25
TEMPERATURE, RH & TIME AT WHICH SPECIMEN CONDITIONED	35±2°C, 60±5% RH, 120 h
DATE OF CALIBRATION	25/11/2015
MEAN TEMP.(SET) °C	35
TEMPERATURE DIFFERENCE (ΔT) °C	20
NO. OF HEAT FLUX TRANSDUCER USED	2
TEST ARRANGEMENT	HORIZONTAL
METERING (TEST) AREA	100mm X 100mm

AUTHORIZED BY
 HEAD OF UNIT

This report is computer approved, it does not require any signature



Doc Ref.: F-EM-2011-3
 Issue Date: 31/07/2012

Rev. No.: 7
 Page: 1 of 2

P.O. BOX 67 DUBAI TEL : 00971-4-3369000, FAX : 00971-4-3366390
 E-Mail : info@dcl.gov.ae - Website : http://www.dcl.gov.ae/



GULF O-FLEX
PRODUCT OF RUBBERWORLD



GOVERNMENT OF DUBAI



DUBAI MUNICIPALITY

Dubai Central Laboratory

Engineering Materials Laboratory Section – Structural Unit

TEST REPORT

THERMAL TRANSMISSION PROPERTIES BY HEAT FLOW METER

REPORT NO. : 2015123167 DATE : 30/11/2015
 WEB REQUEST NO. : DCL-16112015-0095
 REQUEST NO. : 2015086952 SAMPLE NO. : 2015116282
 PROJECT NO. : CS-23
 PROJECT NAME : RUBBER WORLD INDUSTRIES
 CONSULTANT : NO SPECIFIC CONSULTANT
 CONTRACTOR : NO SPECIFIC CONTRACTOR
 LOCATION : New Industrial Area, Ajman UAE
 SOURCE : RUBBER WORLD INDUSTRIES LLC - AJMAN
 SAMPLE DESCRIPTION : ELASTOMERIC INSULATION
 SAMPLE TYPE : NG
 SUPPORT / FACING : NIL
 NOM. THICKNESS (mm) : 25 NOM. DENSITY (kg/m³) : NG

Date of Sampling	: 22/10/2015	Time	: 11:00	Lot No.	: 421-1-160214
Date of Receiving Sample	: 18/11/2015	Time	: 09:30	Lot Size	: 50 sheets
Size of Sample	: 6 pcs	Area No.	: -	Sender No.	: JS1044

MEASURED VALUES

TEST / SPECIMEN NO.	THICKNESS (MEASURED) mm	DENSITY (MEASURED) kg/m ³	MEAN TEMP. °C	THERMAL CONDUCTIVITY		THERMAL RESISTANCE		AVG. TEMP. GRADIENT K/m	HEAT FLUX W/m ² .K	CHANGE IN MASS (%)	DURATION OF TEST h:mm:ss
				W / (m . K)	Btu-in/ft ² °F	(m ² .K) / W	°F.in/ft ² / Btu				
1/1	25.1	83.0	35.25	0.0338	0.2340	0.7444	4.2276	792.30	2100	-0.037	01:00:36

Uncertainty of measurement for thermal conductivity 0.0010 W/m.K @ 95% confidence level, k factor 2.
Abridged ASTM C 518 Test Report.

SAMPLED BY : Jassim AL Khaja TESTED BY : YOUSUF ALMAGHRIBI
 SAMPLES BROUGHT IN BY : Jassim AL Khaja
 SAMPLING METHOD : - DCL - IC - 99
 SAMPLING REPORT NO. : -
 TEST METHOD : ASTM C518 : 2010
 TEST METHOD VARIATION : NIL
 REMARKS : THIS REPORT REPRESENTS THE SUBMITTED SAMPLE ONLY.

**AUTHORIZED BY
HEAD OF UNIT**

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Doc Ref.: F-EM-2044-3
Issue Date : 31/07/2013

Rev. No. : 7
Page : 2 of 2

P.O.BOX 67 DUBAI, TEL : 00971-4-3369900, FAX : 00971-4-3366399
E-Mail : labs@dm.gov.ae - Website : http://www.dm.gov.ae/



GULF-O-FLEX
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حكومة دبي
GOVERNMENT OF DUBAI



Dubai Central Laboratory

Engineering Materials Laboratory Section – Structural Unit
TEST REPORT

WATER VAPOR TRANSMISSION OF INSULATION MATERIALS

REPORT NO.	: 2015131232	DATE	: 21/12/2015
WEB REQUEST NO.	: DCL-16112015-0095	SAMPLE NO.	: 2015116282
REQUEST NO.	: 2015086952		
PROJECT NO.	: CS-23		
PROJECT NAME	: RUBBER WORLD INDUSTRIES		
CONSULTANT	: NO SPECIFIC CONSULTANT		
CONTRACTOR	: NO SPECIFIC CONTRACTOR		
LOCATION	: New Industrial Area, Ajman UAE		
SOURCE	: RUBBER WORLD INDUSTRIES LLC - AJMAN		
SAMPLE DESCRIPTION	: ELASTOMERIC INSULATION		
SAMPLE TYPE	: NG		
SUPPORT / FACING	: NIL		
NOM. THICKNESS (mm)	: 25		
NOM. DENSITY (kg/m ³)	: NG		
Date of Sampling	: 22/10/2015	Time	: 11:00
Date of Receiving Sample	: 16/11/2015	Time	: 09:30
Size of Sample	: 6 pcs	Area No.	: -
		Lot No.	: 421-1-160214
		Lot Size	: 50 sheets
		Sender No.	: JS1044

DATE OF SPECIMEN RECEIVED	16/11/2015
SPECIMEN NOM. THICKNESS (mm)	25
TEST METHOD USED	DESICCANT METHOD
TEST ROOM TEMPERATURE & RH	23±1°C, 50±2% RH
COMPOSITION OF SEALANT USED	PURIFIED PARAFFIN WAX
TEST START DATE & TIME	17/11/2015 @ 10:00 AM
TEST DURATION (h)	240

SPECIMEN NO.	1	2	3
SPECIMEN MEASURED THICKNESS (mm)	25.3	25.9	26.4
SPECIMEN MEASURED DENSITY (kg/m ³)	83.3	80.2	80.7
WATER VAPOR TRANSMISSION (g/h· m ²) - *METRIC UNIT	0.559	0.537	0.523
PERMEANCE (g/Pa· s· m ²) - *METRIC UNIT	1.11E-07	1.06E-07	1.04E-07
WATER VAPOR TRANSMISSION (grains/h· ft ²) - *INCH-POUND UNIT	0.80	0.77	0.75
PERMEANCE (perms) - *INCH-POUND UNIT	1.93	1.86	1.81
AVG. WATER VAPOR TRANSMISSION (grains/h· ft ²) - *INCH-POUND UNIT	0.77		
AVG. PERMEANCE (perms) - *INCH-POUND UNIT	1.87		

SAMPLED BY	: Jassim AL Khaja	TESTED BY	: NAZRUL ISLAM
SAMPLES BROUGHT IN BY	: Jassim AL Khaja		
SAMPLING METHOD	: - DCL - IC - 99		
SAMPLING REPORT NO.	: -		
TEST METHOD	: ASTM E96-00		
TEST METHOD VARIATION	: NIL		
REMARKS	: THIS REPORT REPRESENTS THE SUBMITTED SAMPLE ONLY.		

AUTHORIZED BY
HEAD OF UNIT

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Doc Ref.: F-EM-2053-3
Issue Date: 31/07/2013

Rev. No.: 4
Page: 1 of 1

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E-Mail: labs@dm.gov.ae - Website: http://www.dm.gov.ae/



**RUBBER
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INDUSTRIES**



GULF-O-FLEX
PRODUCT OF RUBBERWORLD

ACKNOWLEDGEMENT

We, Rubber World Industry LLC, are the manufacturer & supplier of Rubber Closed Cell Elastomeric Foam Insulation in Tube and Sheet Forms.

Following is the difference between Fire Resistant & Fire Retardant.

FIRE RESISTANT

It is defined as *"how long the specimen will take to catch the fire"* is referred to as Fire Resistant.

FIRE RETARDANT

It is defined as *"the self-extinguishing of specimen after catching fire"* is known as Fire Retardant.

In the light of above mentioned, we hereby endorse that GOF Insulation pertains both of the above characteristics.



(Technical Department)



**RUBBER
WORLD**



GULF-O-FLEX
PRODUCT OF RUBBERWORLD

CERTIFICATE OF ORIGIN

This is to certify that RUBBER WORLD INDUSTRY LLC is the sole manufacturer of Rubber Insulation Tubes and Sheets in United Arab Emirates under the registered brand name of GULF-O-FLEX.



Mohsin Moin

Mohsin Moin
(Production Manager)



**RUBBER
WORLD**



Test Report No. 7191125328-MEC15/2-YWA
dated 24 Nov 2015

Note: This report is issued subject to the Testing and Certification Regulations of the TÜV SÜD Group and the General Terms and Conditions of Business of TÜV SÜD PSB Pte Ltd. In addition, this report is governed by the terms set out within this report.



SUBJECT:

Fire propagation test on "Gulf-O-Flex" HVAC & R material submitted by Rubber World Industry LLC c/o Dubai Municipality on 28 Oct 2015.

TESTED FOR:

Rubber World Industry LLC
New Industrial Area
PO Box 2435
Ajman
UAE

DATE OF TEST:

18 Nov 2015

PURPOSE OF TEST:

To determine the Index of Performance of the material when it is exposed to the conditions of the test specified in British Standard 476 : Part 6 : 1989 + A1 : 2009 "Method of test for fire propagation for products".

The test was conducted at TÜV SÜD PSB's fire test laboratory located at No. 10 Tuas Avenue 10, Singapore 639134.



LA-2007-0380-A LA-2007-0384-G
LA-2007-0381-F LA-2007-0385-E
LA-2007-0382-B LA-2007-0386-C
LA-2007-0383-G LA-2010-0464-D

The results reported here in have been performed in accordance with the laboratory's terms of accreditation under the Singapore Accreditation Council - Singapore Laboratory Accreditation Scheme. Tests/Calibrations marked "Not SAC-SINGLAS Accredited" in this Report are not included in the SAC-SINGLAS Accreditation Schedule for our laboratory.

Laboratory:
TÜV SÜD PSB Pte. Ltd.
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Singapore 118221

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TÜV SÜD Asia Pacific Pte. Ltd.
1 Science Park Drive, #02-01
Singapore 118221
TUV®



**GULF-O-FLEX**
PRODUCT OF RUBBERWORLD**Test Report No. 7191125328-MEC15/2-YWA**
dated 24 Nov 2015

PSB Singapore

DESCRIPTION OF SPECIMENS:

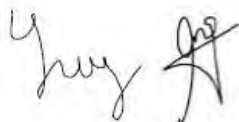
Six pieces of specimen, said to be "Gulf-O-Flex" (25mm thick x 55-70kg/m³) HVAC & R material comprising of Rubber Closed Cell Elastomeric Foam Insulation, each of nominal test size of 225mm x 225mm were submitted. The Fire Retardant used was said to be Aluminium Tri Hydride {ATH} Antimony Trioxide (Sb₂O₃) Deca Bromo (C₁₄H₄Br₁₀). The bulk density of the specimen was found to be approximately 78kg/m³.

TEST PROCEDURE:

Three specimens, backed with calcium silicate board, were tested with the smooth face exposed to the specified heating conditions, in an apparatus conforming to paragraph 5 and illustrated in Figures 1 to 3 of the Standard.

The calibration and test procedures were as defined in paragraphs 8 and 9, respectively, of the specification. The apparatus was calibrated prior to test and the actual calibration curve obtained is shown in Figure 1 of this report.

The mean temperature rise above ambient obtained from three specimens is also shown in Figure 1 (i.e. with the actual calibration curve). The mean temperature readings for the material and the calibration curve were obtained at the following intervals from the start of the test: at 1/2 minute intervals up to 3 minutes, at 1 minute intervals from 4 to 10 minutes, and at 2 minutes intervals from 12 to 20 minutes.





GULF-O-FLEX
PRODUCT OF RUBBERWORLD

Test Report No. 7191125328-MEC15/2-YWA
dated 24 Nov 2015



PSB Singapore

From these readings, the index of performance for the material was determined as follows:

$$s_1 = \frac{\sum_{t=0.5}^{t=3} \frac{\Theta_s - \Theta_c}{10t}}{\quad}; \quad s_2 = \frac{\sum_{t=4}^{t=10} \frac{\Theta_s - \Theta_c}{10t}}{\quad}$$

and $s_3 = \frac{\sum_{t=12}^{t=20} \frac{\Theta_s - \Theta_c}{10t}}{\quad};$

$$S = s_1 + s_2 + s_3$$

where S = Index of performance for each of the specimens tested and s_1 , s_2 and s_3 are sub-indices

t = Time in minutes from the origin at which readings are taken.

Θ_s = Temperature rise in deg. C for the specimen at time, t

Θ_c = Temperature rise in deg. C for the calibration sheet at time, t

In computations only the positive value of $\frac{\Theta_s - \Theta_c}{10t}$ was used.

Yuy Ho



**RUBBER
WORLD**



GULF-O-FLEX
PRODUCT OF RUBBERWORLD

Test Report No. 7191125328-MEC15/2-YWA
dated 24 Nov 2015



PSB Singapore

RESULTS OF TEST:

The following test results were obtained for each specimen tested:

Specimen	Sub-Indices			Index of Performance
	S ₁	S ₂	S ₃	S
A	4.3	6.4	0.4	11.1
B	5.4	5.4	0.6	11.4
C	5.7	3.7	0.4	9.8

CONCLUSION:

The test results obtained, as an average of the 3 samples tested are as follows:

Index of overall performance, I = 10.8

(Fire propagation index)


Sub-index, i₁ = 5.1

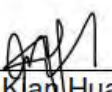
Sub-index, i₂ = 5.2

Sub-index, i₃ = 0.5

REMARKS:

The test results relate only to the behaviour of the test specimens of the product under the particular conditions of test; they are not intended to be the sole criterion for assessing the potential fire hazard of the product in use.


Ye Wint Aung
Associate Engineer


Ong Kian Huat
Senior Associate Engineer
(Fire Property)
Mechanical



Test Report No. 7191125328-MEC15/2-YWA
dated 24 Nov 2015

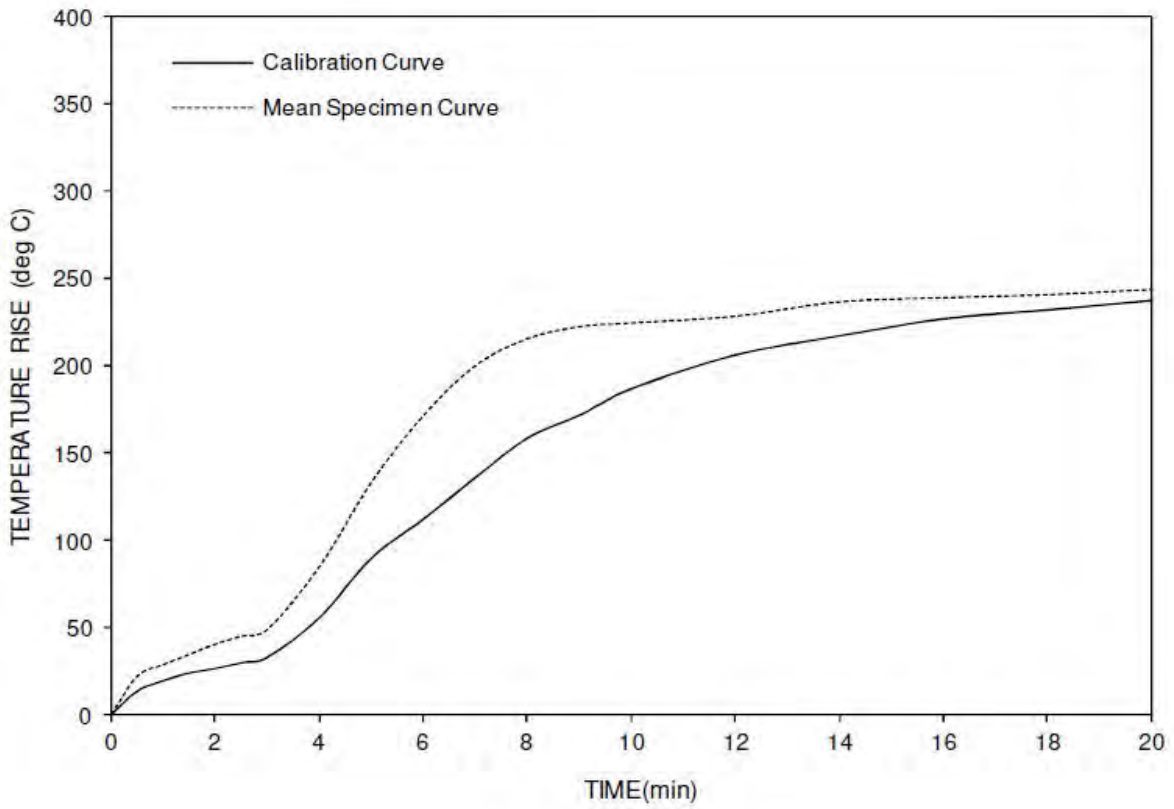


FIGURE 1 : COMPARISON OF MEAN SPECIMEN AND CALIBRATION CURVES

Ying Ho



**GULF-O-FLEX**
PRODUCT OF RUBBERWORLD**Test Report No. 7191125328-MEC15/2-YWA**
dated 24 Nov 2015

PSB Singapore

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July 2011





Test Report No. 7191125328-MEC15/1-YWA
dated 23 Nov 2015

Note: This report is issued subject to the Testing and Certification Regulations of the TÜV SÜD Group and the General Terms and Conditions of Business of TÜV SÜD PSB Pte Ltd. In addition, this report is governed by the terms set out within this report.



SUBJECT:

Large scale surface spread of flame test on "Gulf-O-Flex" HVAC & R material submitted by Rubber World Industry LLC c/o Dubai Municipality on 28 Oct 2015.

TESTED FOR:

Rubber World Industry LLC
New Industrial Area
PO Box 2435
Ajman
UAE

DATE OF TEST:

11 Nov 2015

PURPOSE OF TEST:

To determine the tendency of the surface of a material or a combination of materials to support the spread of flame across its surface and to classify the surface according to the test given in British Standard 476 : Part 7 : 1997.

The test was conducted at TÜV SÜD PSB's fire test laboratory located at No. 10 Tuas Avenue 10, Singapore 639134.



		LA-2007-0390-A	LA-2007-0384-G	The results reported herein have been performed in accordance with the laboratory's terms of accreditation under the Singapore Accreditation Council - Singapore Laboratory Accreditation Scheme. Tests/Calibrations marked "Not SAC-SINGLAS Accredited" in this Report are not included in the SAC-SINGLAS Accreditation Schedule for our laboratory.
		LA-2007-0391-F	LA-2007-0385-E	
LA-2007-0392-B	LA-2007-0386-C			
LA-2007-0393-G	LA-2010-0454-D			

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Singapore 118221
TÜV®





Test Report No. 7191125328-MEC15/1-YWA
dated 23 Nov 2015



DESCRIPTION OF SPECIMENS:

Nine pieces of specimen, said to be "Gulf-O-Flex" (25mm thick x 55-70kg/m³) HVAC & R material comprising of Rubber Closed Cell Elastomeric Foam Insulation, each of nominal test size of 885mm x 270mm were submitted. The Fire Retardant used was said to be Aluminium Tri Hydride {ATH} Antimony Trioxide (Sb₂O₃) Deca Bromo (C₁₄H₄Br₁₀). The bulk density of the specimen was found to be approximately 78kg/m³.

TEST PROCEDURE:

Prior to test, the specimens were prepared and conditioned in accordance with paragraphs 5.3 to 5.6 of the standard and secured to a specimen holder as described in paragraph 6.3.

Six specimens, backed with calcium silicate board, were tested with the smooth face exposed to the specified thermal radiation from the apparatus described in paragraph 6.1 of the standard. The intensity of the radiated heat incident on the specimen varies with distance from the hotter end, so that when the specified calibration panel is mounted in the place to be occupied by the specimen, the irradiance of the radiometer is as given in Table 1. The test was terminated when the flame front reached the 825mm reference line, or after 10 minutes has elapsed, whichever is the shorter.

Table 1 : Irradiance Along Horizontal Reference Line on the Calibration Board

Distance along reference line from inside edge of specimen holder mm	Irradiance kW/m ²		
	specified	min.	max.
75	32.5	32.0	33.0
225	21.0	20.5	21.5
375	14.5	14.0	15.0
525	10.0	9.5	10.5
675	7.0	6.5	7.5
825	5.0	4.5	5.5

Ying Ho





Test Report No. 7191125328-MEC15/1-YWA
dated 23 Nov 2015



PSB Singapore

RESULTS OF TEST:

Specimen No.	1	2	3	4	5	6
Spread of flame at first 1½ minutes (mm)	0	0	0	0	0	0
Distance (mm)	Time of spread of flame to indicated distance (minutes • seconds)					
Start of flaming	nil	nil	nil	nil	nil	nil
75	-	-	-	-	-	-
165	-	-	-	-	-	-
190	-	-	-	-	-	-
215	-	-	-	-	-	-
240	-	-	-	-	-	-
265	-	-	-	-	-	-
290	-	-	-	-	-	-
375	-	-	-	-	-	-
455	-	-	-	-	-	-
500	-	-	-	-	-	-
525	-	-	-	-	-	-
600	-	-	-	-	-	-
675	-	-	-	-	-	-
710	-	-	-	-	-	-
750	-	-	-	-	-	-
785	-	-	-	-	-	-
825	-	-	-	-	-	-
865	-	-	-	-	-	-
Time of maximum spread of flame (minutes • seconds)	-	-	-	-	-	-
Distance of maximum spread of flame (mm)	0	0	0	0	0	0
Comments	None					

Yuy J





GULF-O-FLEX
PRODUCT OF RUBBERWORLD

Test Report No. 7191125328-MEC15/1-YWA
dated 23 Nov 2015



PSB Singapore

Classification of Surface Spread of Flame

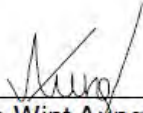
Classification	Spread of flame at 1.5 min.		Final spread of flame	
	Limit (mm)	Limit for one specimen in sample (mm)	Limit (mm)	Limit for one specimen in sample (mm)
Class 1	165	165 + 25	165	165 + 25
Class 2	215	215 + 25	455	455 + 45
Class 3	265	265 + 25	710	710 + 75
Class 4	Exceeding the limits for class 3			

CONCLUSION:

In accordance with the class definitions specified in the Standard, the test results show that the sample tested has a Class One Surface Spread of Flame.

REMARKS:

The test results relate only to the behaviour of the test specimens of the product under the particular conditions of test; they are not intended to be the sole criterion for assessing the potential fire hazard of the product in use.


Ye Wint Aung
Associate Engineer


Ong Kian Huat
Senior Associate Engineer
(Fire Property)
Mechanical

**GULF-O-FLEX**
PRODUCT OF RUBBERWORLD**Test Report No. 7191125328-MEC15/1-YWA**
dated 23 Nov 2015

PSB Singapore

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July 2011





GULF-O-FLEX
PRODUCT OF RUBBERWORLD

FINAL REPORT

REACTION TO FIRE TEST

TEST SPONSOR:

Rubber World Industries LLC
P.O. Box: 2435
Ajman, UAE
T: +971 6 743 4176, F: +971 6 743 4197
Website: www.gulfoflex.com

TESTED MATERIAL/ASSEMBLY:

Gulf-O-Flex Rubber Insulation Foam

TEST STANDARD:

ASTM E84-15a: Standard Test Method for Surface Burning Characteristics of Building Materials



THOMAS BELL-WRIGHT
INTERNATIONAL CONSULTANTS

Issue Date: 12-Jan-16

File: PH026

File Name: PH026 test report

PO BOX 26385, DUBAI UAE T +971 (0)4 333 2692 admin@bell-wright.com www.bell-wright.com

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GULF-O-FLEX
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**THOMAS BELL-WRIGHT
INTERNATIONAL CONSULTANTS**

Test Report Ref. No. PH026

Accreditation

Testing

ISO/IEC 17025: General requirements for the competence of testing and calibration laboratories *with*

1. United Kingdom Accreditation Service (UKAS) - Testing Laboratory : **4439**
2. International Accreditation Service (IAS) - Testing Laboratory : **TL-626**
3. GCC Accreditation Center (GAC) -Testing Laboratory : **ATL-0017**
www.ukas.com www.iasonline.org www.gcc-accreditation.org



Inspection

ISO/IEC 17020: Conformity Assessment - Requirements for the operation of various types of bodies performing inspection *with*

International Accreditation Service (IAS) as a Type A (Third Party) Inspections Body (AC98 & ISO 17020:2012): **AA-748**

Accredited to conduct Inspections as per International Building Code (IBC) Chapter 17, Section 1704 and Section 1705 *with*

International Accreditation Service (IAS) as a Special Inspection Agency (AC291): **SIA-211**



Certification

ISO/IEC 17065: 2012: Conformity Assessment - Requirements for bodies certifying products, processes and services *with*

United Kingdom Accreditation Service (UKAS) - Certification Body: **6762**



Memberships

Members of European Group of Organization for Fire Testing, Inspection and Certification

www.egolf.org.uk

Member of International Trade Council

www.thetradecouncil.com

Member of Association for Specialist Fire Protection

www.asfp.org.uk

Member of Centre for Window and Cladding Technology

www.cwct.co.uk



The work which is a subject of this document falls wholly or partly under the accreditation marked below:

ISO 17025 UKAS	<input checked="" type="checkbox"/>	ISO 17020 IAS	<input type="checkbox"/>
ISO 17025 IAS	<input type="checkbox"/>	ISO 17065 UKAS	<input type="checkbox"/>
ISO 17025 GAC	<input checked="" type="checkbox"/>	AC 291 IAS	<input type="checkbox"/>



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WORLD**



**THOMAS BELL-WRIGHT
INTERNATIONAL CONSULTANTS**

Test Report Ref. No. PH026

Non-accredited test

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**THOMAS BELL-WRIGHT
INTERNATIONAL CONSULTANTS**

Test Report Ref. No. PH026

1. INTRODUCTION

Determination of the flame spread index and the smoke developed index of Gulf-O-Flex Rubber Insulation Foam as per ASTM E84; Standard Test Method for Surface Burning Characteristics of Building Materials.

This test method is also published under the following designations:

- a. NFPA 255
- b. UL 723

2. SPONSOR

Rubber World Industries LLC

P.O. Box: 2435

Ajman, UAE

T: +971 6 743 4176

F: +971 6 743 4197

Website: www.gulfoflex.com

3. TESTING LABORATORY

Thomas Bell-Wright International Consultants

25b Street Ras Al Khor Industrial Area

P.O. Box 26385

Dubai, U.A.E.

4. DATE OF TEST

Sample received: 27-Dec-15

Test date: 30-Dec-15

The test has been witnessed by:

Name	Company	Contact Number
Mirza Shahzad	Rubber World Industries LLC	+971 50 545 3371
Naveel Honey		+971 55 596 5883
Mohsin Moin		+971 55 370 1425



5. SPECIMEN DESCRIPTION

Product Tested	Gulf-O-Flex Rubber Insulation Foam
Fire side	Foam smooth surface
Product Description	Closed Cell Elastomeric Rubber Insulation Foam in Sheet form, black in color
Dimensions per panel	2440 x 600 x 25mm (l x w x thk) (measured)
No. of panel	3
Total dimension	7320 x 600 x 25mm (l x w x thk) (measured)
Specimen preparation	The test specimen was prepared in accordance with ASTM E 2231 Section 6.4 and is summarized below: The insulation foam was mounted on a 6.3mm thick Fiber-cement board substrate using stick pins placed in two longitudinal rows at 0.6m intervals.
Specimen placement	3 sections of Gulf-O-Flex Rubber Insulation Foam mounted on a fiber cement board substrate were butt jointed end-to-end. The test specimen was placed directly to the tunnel ledges with the foam smooth surface towards the flame source.
Density	45 kg/m ³ (as measured)

The test specimen was submitted by the client and TBWIC has not been involved in the selection and configuration of the specimen.

6. METHOD OF TEST

6.1. Placing of test specimen

The test specimen consisted of 3 sections of Gulf-O-Flex Rubber Insulation Foam. The total dimensions of the specimen were 7320 x 600 x 25mm (l x w x thk).

Several sections of cement board butt jointed end-to-end with overall dimensions of 7350 x 600 mm (l x w), were placed at the back of the sample to protect the furnace lid assembly.

6.2. Test Method

The specimen was installed horizontally in the Steiner Tunnel and supported by the ledges. The foam smooth surface of Gulf-O-Flex Rubber Insulation Foam (fire side) was exposed to a flaming exposure during the 10 minute test duration.

Flame spread and density of the smoke are measured and recorded while the results are computed against the standard calibration materials (cement board and red oak flooring).

6.3. Conditioning

After delivery on 27-Dec-15, the specimen was stored in room temperature for 3 days prior to the test at 20.2 to 25.8°C and 45 to 55% relative humidity.



**THOMAS BELL-WRIGHT
INTERNATIONAL CONSULTANTS**

Test Report Ref. No. PH026

7. OBSERVATION

Test Data and Observation

Observations	
Ignition Time (min:sec)	0:02
Time to maximum flame front advance (min:sec)	0:45
Maximum flame spread (ft)	3.6
Time to end of tunnel reached (min:sec)	Not Reached
Maximum temp recorded at the exposed thermocouple located near the end of the tunnel (°F / °C)	389/198
Dripping (min:sec)	None
Flaming on the floor (min:sec)	0:46
After flame on the top (min:sec)	None
After flame on the floor (min:sec)	None
Delamination (min:sec)	None
Sagging (min:sec)	None
Shrinkage (min:sec)	None
Fallout (min:sec)	None
FS*Time Area (ft*min)	35.04
Smoke Area (%A*min)	388.50
Red Oak Smoke Area (%A*min)	85.8

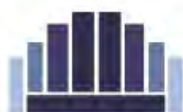
8. SUMMARY OF RESULTS

The test specimen has been evaluated in accordance with ASTM E84; Standard Test Method for Surface Burning Characteristics of Building Materials.

The test results are:

FLAME SPREAD INDEX (FSI)	20
SMOKE DEVELOPED INDEX (SDI)	450

Results are valid for the tested configuration only.



**THOMAS BELL-WRIGHT
INTERNATIONAL CONSULTANTS**

Test Report Ref. No. PH026

9. CLASSIFICATIONS

The following information is designed to help put these test results into context. Flame Spread Index and Smoke Developed Index results from an ASTM E84 test are often used by regulatory agencies to approve materials for various applications. For example, the International Building Code 2012, Section 803.1.1 requires that:

Interior wall and ceiling finish materials shall be classified in accordance with ASTM E84 or UL 723-10th Ed. 2008. Such interior finish materials shall be grouped in the following classes in accordance with their flame spread and smoke-developed indexes.

Class A: Flame spread index 0 - 25; smoke-developed index 0 - 450.

Class B: Flame spread index 26 - 75; smoke-developed index 0 - 450.

Class C: Flame spread index 76 - 200; smoke-developed index 0 - 450.

Note that the above example is the IBC requirement for interior wall and ceiling finishes only; your application may be different.



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Test Report Ref. No. PH026

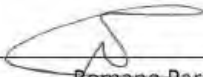
10. LIMITATIONS

Testing of materials that melt, drip, or delaminate to such a degree that the continuity of the flame front is destroyed, results in low flame spread indices that do not relate directly to indices obtained by the testing materials that remain in place

Thomas Bell-Wright International Consultants recommend that the relevance of test reports should be considered after a period of five years.

This test report is respectfully submitted by: Thomas Bell-Wright International Consultants

Prepared By:


Romano Parungao
Fire Testing Engineer

Reviewed By:


Fredilyn Paragoso
Fire Testing Engineer

Approved By:


David Campbell, GIFireE
Regional Director of Fire Compliance

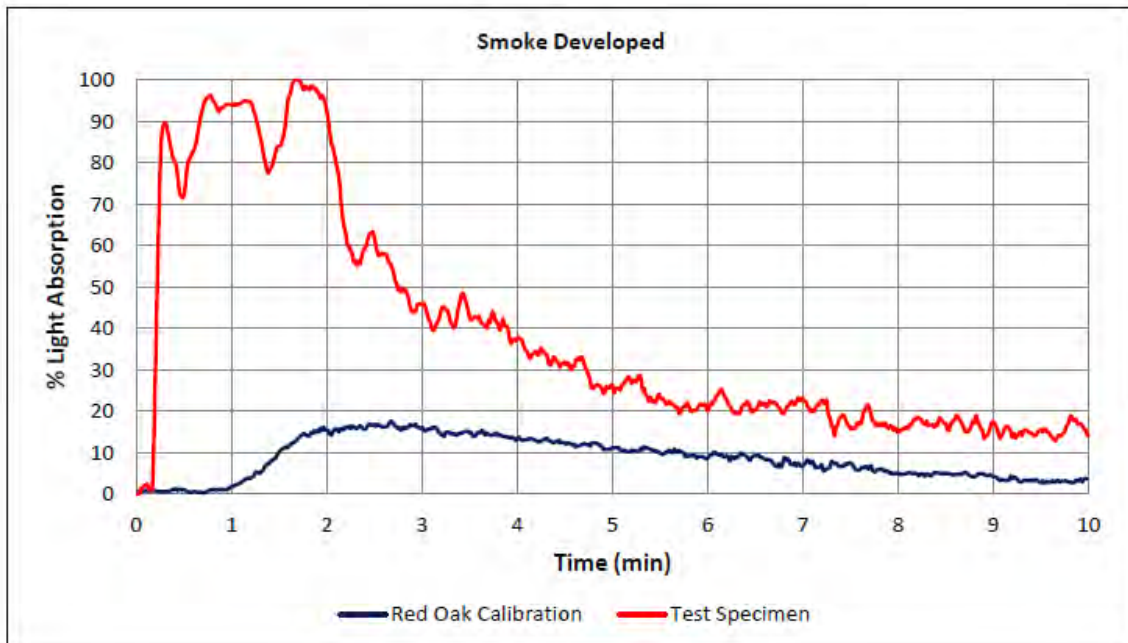
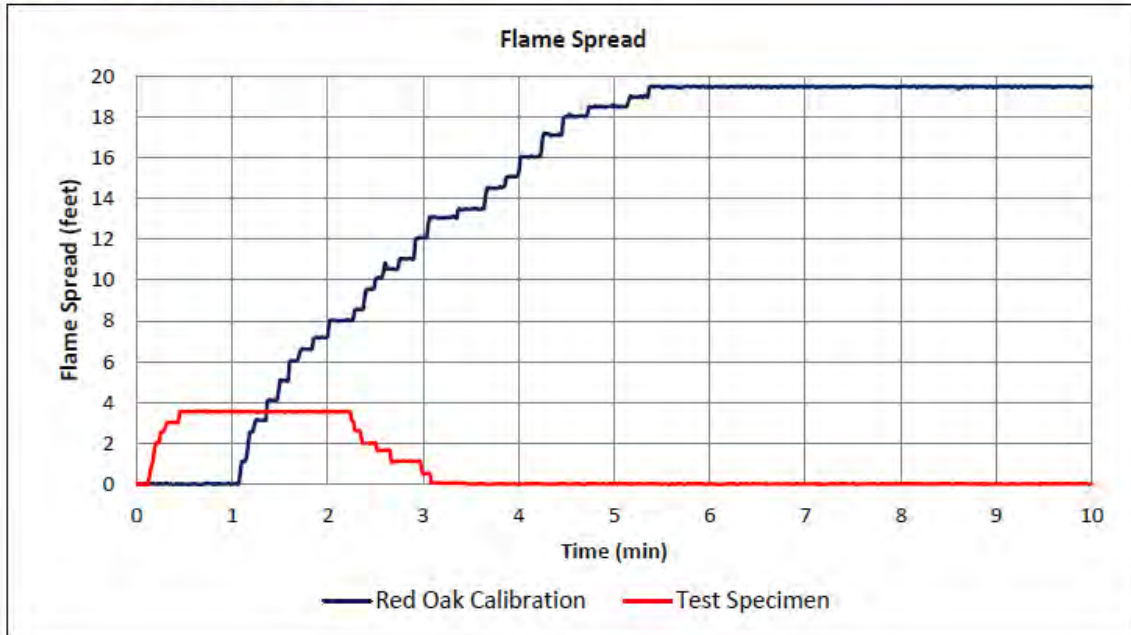


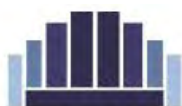


THOMAS BELL-WRIGHT
INTERNATIONAL CONSULTANTS

Test Report Ref. No. PH026

11. APPENDIX 1- GRAPHS





12. APPENDIX 1- PICTURES



Photo 1: Specimen before the test
(Non-fire side)



Photo 2: Specimen before the test
(Fire side)



Photo 3: Specimen after the test
(located near the fire end)



Photo 4: Specimen after the test
(located near the exhaust end)



GULF FLEX
PRODUCT OF RUBBERWORLD

A comparison with fiber glass

C7



RUBBER
WORLD

INSULATION MATERIALS

- MMF
- Foam Glass
- Calcium Silicate
- Rigid Foams
- (Pu, Pf, Ps)
- Flexible Foams
- (PE, FEF, PU)

REQUIREMENTS

- Thermal Conductivity
- Reaction to Fire
- Temperature Limit
- Water Vapour
- Transmission
- Installation



GULF-O-FLEX
PRODUCT OF RUBBERWORLD

TYPES OF PRODUCTS

Fibrous, Thermoplastic, Rigid, Elastomeric

Material	Open /Closed (O/C)	Diffusion Resistancy	Thermal efficiency 10°C [W/mk]
MMF/ Glassfibre	O	N/L	0,035 - 0,040 Relation to density important,
PE/ Polyethylene	C	not applicable	0,040 - 0,038
PU (PIR)/ Polyurethane	C(O)	low	0,035 - 0,038 Ageing to be considered
PF/ Phenolic Foam	C	low	0,035 - 0,038 Take ageing and acidity into account
FEF/ Elastomeric Foam	C	high	0,035 - 0,040 It is essential to take quality
Foam Glass	C	high	level into account 0,040 - 0,045

DIFFERENTIATION POTENTIAL

Reaction to Fire

- **Smoke composition**
- **Toxicity rating**
- **Full scale testing**

CORROSION ASPECTS INSTALLATION



**RUBBER
WORLD**



COMPARISON TABLE OF PRODUCTS USED FOR COLD LINE AND AIR DUCT INSULATION

Used for Cold Line and Air Duct Insulation				
		Elastomeric I (Gulf-O-Flex)	Phenolic Foam	Glass Fibre
1	Cellular Structure Closed: Open:	+(90%) (-)	+(90%) (-)	(-) Fibrous
2	Diffusion Coefficient ($\mu\text{gm/N.h.}$)	0.09 Max	(10) (!)	(-)
3	Diffusion Resistance factor μ	> 7000	(700 (!)	1
4	Water absorption Vol % 28 days % 7 days	1.1 Max 0.5 Max	Considerable 5	Considerable Considerable
5	Thermal Conductivity (W/mK) 40 ^o C 20 ^o C 0 ^o C	0.039 0.037 0.035	!Without ageng! Factor for Gas diffusion 0.020 (10 ^o C)	0.035 (20 ^o C)
6	Fire Classification BS 476/7 BS 476/6	Class 1 Class 0	Class 1 Class 0	Class 1 Class 0
7	Suitable Temperature range for application	-40 ^o C +120 ^o C	+12 ^o +120 ^o C	+12 ^o C +300 ^o C
8	Flexibility (Of total system for installation / Easy to install	Very Good	Rigid	Rigid
9	Corrosion risk Steel Tubes Copper Stainless Steel	Low Low Low	2 High (P ₁₁ =205) Medium Medium	Low Low Low
10	Health Aspects Fibres (Yes/No) Combustion Carbonmonoxyde Generation	No Low	No Low	Yes Low
11	Cell Gas Content (Blowing Agent)	CO ₂ N ₂ (Air)	HCFC	No CELLS
12	Durability on cold lines	Excellent	Poor	Poor
13	Chemical/ Environmental Resistance	Good	Medium	Good





Insulation Comparison

Rubber Closed Cell Elastomeric Insulation (Pipe/Sheet)	Fibreglass Insulation	Rockwool/Wool/Mineral Wool Insulation
<ul style="list-style-type: none"> ✓ Elastomeric Insulation is NBR-PVC based. 	Fibreglass Insulation is based on glasswool.	Rockwool Insulation is based on actual rocks and minerals.
It is oil and UV resistant and can be used for Oil Pipelines Insulation.	It is Oil and UV resistant and can be used for Oil Pipelines Insulation.	It is Oil and UV resistant and can be used for Oil Pipelines Insulation.
Temperature Range -40°C to +120°C.	Temperature Range -183°C to +538°C.	✓ Temperature Range -200°C to +1649°C.
CFC Free Flexible Thermal Insulation.	CFC Free Rigid Thermal Insulation.	CFC Free Rigid Thermal Insulation.
ODP (Ozone Depletion Potential) is negligible.	ODP (Ozone Depletion Potential) is negligible.	ODP (Ozone Depletion Potential) is negligible.
Elastomeric Insulation can be used for Acoustic proofing.	Fibreglass Insulation can be used for Acoustic proofing.	Rockwool Insulation can be used for Acoustic proofing.
It doesn't emit disastrous gases.	It doesn't emit disastrous gases.	It doesn't emit disastrous gases.
✓ No health and safety issues.	Potential health risks such as lung damage.	Potential health risks including respiratory and other cancers.
✓ Use in residential, schools, hospitals thus, provide proper hygiene.	Mostly used for commercial or industrial purpose thus, do not provide proper hygiene.	Mostly used for commercial or industrial purpose thus, do not provide proper hygiene.
✓ No additional vapor barrier layer is required as it has a smooth shark skin to retard moisture.	Needs an additional vapor barrier layer to protect it from moisture.	Needs an additional vapor barrier layer to protect it from moisture.
✓ R value is maintained due to closed cell structure.	R value is reduced due to woodframing.	R value is maintained in Rockwool and used for higher thermal conditions.
✓ Easy installation due to its flexibility.	It is rigid and it can't bear vibration. Easily become damage when pressure is applied.	It is rigid and it can't bear vibration. Easily become damage when pressure is applied.
Fire Rated, BS 476 Part 6 & 7 (ClassO/Class1).	Fire Rated, BS 476 Part 6 & 7 (ClassO/Class1).	Fire Rated, BS 476 Part 6 & 7 (ClassO/Class1).





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Fundamentals of Insulation

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FUNDAMENTALS OF INSULATION

What is heat? And, how does it flow from object to object? Heat is a form of energy. And heat ALWAYS moves from warm to cold. It does this until both objects reach the same temperature. Cold is merely the absence of heat... even ice cubes contain some heat; until you get to absolute zero.

There are 3 types of heat transfer: **Conduction**, **Convection** and **Radiation**. Poor conductors of heat are good insulation products. A good conductor of heat is water. Water and water vapour is the prime enemy of an insulation system.

When reviewing the manufacturers data sheets to calculate your insulation requirements you will need to be concerned with BTU's, K, R and C Factors.

BTU is a British Thermal Unit. (BTU/HR/SF/inch thickness) It measures the quantity of heat. It is the amount of heat needed to raise the temperature of one pound (lb) of water 1 degree F and enables us to measure a material's ability to resist heat flow (insulate).

K Value is the material property which measures conductivity. It is the same number regardless of the thickness of insulation. It is the quantity of BTU's/HR that pass through a 1" Thick X 12" Wide X 12" Long section of insulation lowering the temperature from the hot side to the cold side 1 degree F. Materials with lower K Factors are better insulators. Most manufacturers report their product's insulation value in K at 75 F degree mean temperature.

Mean Temperature is the inner surface temperature plus the outer surface temperature, divided by 2. As mean temperatures rise, so does the K Factor of a product. Be careful when examining the data sheets. Make sure you are comparing insulations at the same reporting temperatures. Also, it is important when comparing materials to obtain the insulation curve from the manufacturer at the lower pipe operating temperatures found in refrigeration systems as each materials ability to insulate is not linear.

C Factor measure thermal conduction. It is the rate of heat flow through an actual thickness of material.

R Factor: Thermal resistance is resistance to heat flow provided by a given thickness of material. It is obtained by dividing the thickness of material by the K Factor. R Values change as the thickness of the insulating material changes. Primarily building building insulation products and plans are measured and specified by the material's R Factor.

Heat Flow (Round VS Flat) -It is important to note that the heat flow is different from a flat surface as compared to round surfaces. Because of the orientation of the cellular structure (fibrous in above ambient) of the insulation being vertical versus horizontal (flat); and the addition of a horizontal joint in pipe covering, the apparent thermal conductivity could be 20% or higher than a flat piece of block (board). Make sure that appropriate safety factors from the manufacturer's data is properly representing the thermal values you need for design in your application.



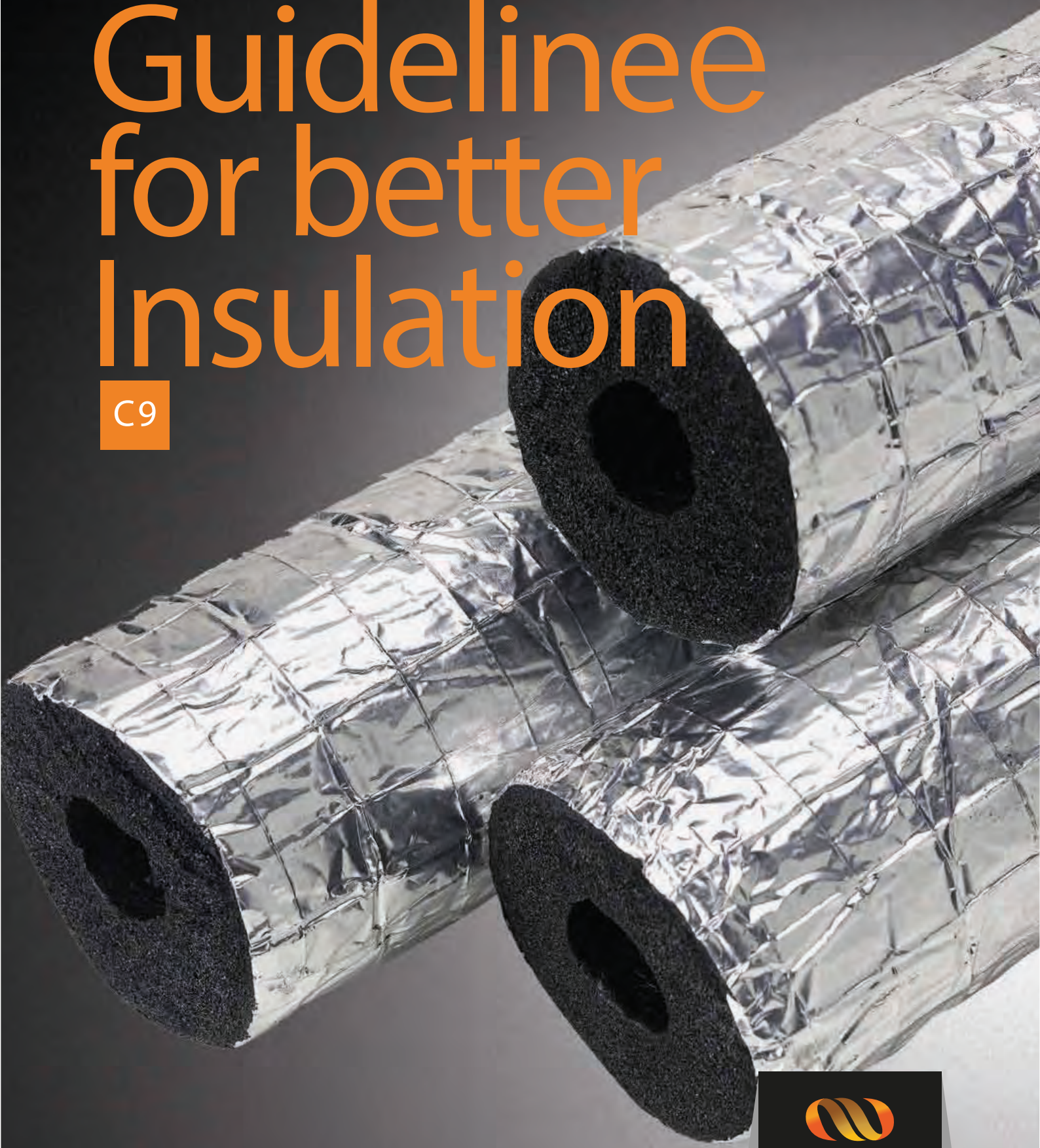
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Guidelinee for better Insulation

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GUIDELINE FOR BETTER INSULATION SYSTEM

This chapter will deal with insulation systems operating in below-ambient temperatures ranging from +50°F to -100°F. This is a guide to specifying insulation systems for piping, fittings, and vessels typically required in these systems.

The success of an insulation system for cold piping is contingent upon several factors, which include:

- Correct refrigeration system design
- Correct specification of insulating system;
- Correct specification of insulation thickness;
- Correct installation of the insulation and related materials such as vapour retarders; and
- Workmanship of the insulation installer.
- Adequate maintenance of the insulating system.



In steam and hot water lines it is common to use a variety of insulation materials. These systems are insulated for the following reasons:

- Heat conservation and/or freeze prevention;
- Process control;
- Personal protection;
- Fire protection.

These systems have different insulation requirements from systems operating at below ambient temperatures. Refrigeration systems are insulated for vastly different reasons. Some of these reasons are to:

- Minimize heat gain to the refrigerant suction gas and liquid line. This improves efficiency which in turn reduces energy consumption and operating costs;
- Control surface condensation
- Provide noise reduction
- Protect personnel and prevention of unsafe ice formations.

Below-ambient systems are affected by a number of properties that may affect insulation system performance. These properties include:

- Water absorption;
- Water vapour permeability;
- Thermal expansion/contraction; and
- Wicking of water.

Water absorption is the ability of material to absorb and hold liquid water. Water absorption is important on systems that may be exposed to water. This water may come from a number of external sources such as rain, surface condensation or wash down water. The property of water absorption is especially important on outdoor systems.



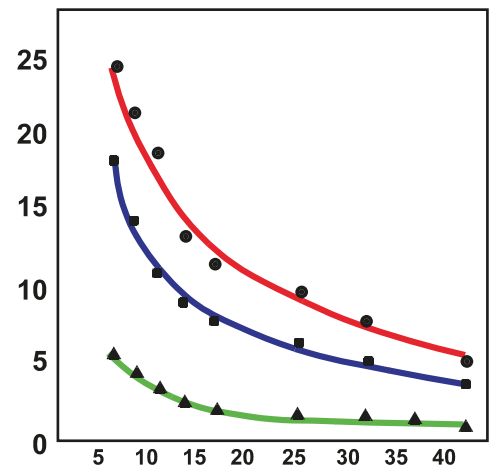
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Water vapour permeability measured in units of perm-inches is an indication of the ability of a material to allow the passage of water vapour through it. The lower the permeability, the higher is the resistance of the material to water vapour intrusion. Water vapour permeability can be a critical design consideration because water vapour has the ability to penetrate materials that are unaffected by water in the liquid form. Water vapour intrusion is a particular concern to insulation systems subjected to a thermal gradient. Driving forces are created due to pressure differences between ambient conditions and the colder operating conditions of the piping. These forces drive water vapour into the insulation system, where it may be retained as water vapour, condense to liquid water or condense and freeze to form ice. Thermal properties of insulation materials are negatively affected as the moisture or vapour content of the insulation material increases.

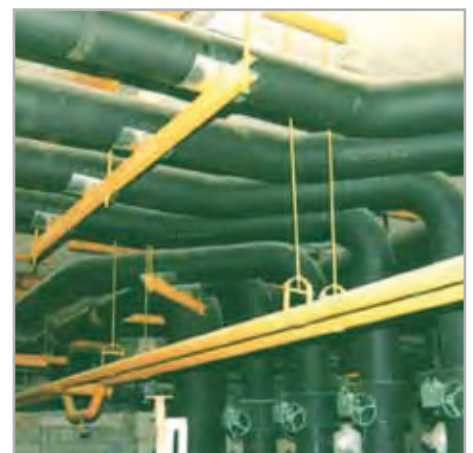
Thermal expansion/contraction is a concern both for insulation systems that operate continuously at below ambient conditions or systems that cycle between below-ambient conditions and elevated temperatures. Thermal contraction coefficients of insulation materials may be substantially different from those of the metal pipe. A large difference in the amount of contraction between the insulation and the piping may result in open joints of the insulation system. These open joints not only create a thermal short circuit at that point in the system, but may also affect the integrity of the entire system. Insulation materials that have large contraction coefficients, and do not have a high enough tensile strength or compressive strength to compensate, may experience shrinkage and subsequent cracking within the material. At the elevated temperature end of the cyclic process, the reverse is considered. High thermal expansion coefficients may result in warping or buckling of a material that for some insulation materials is permanent and irreversible. In this instance, the possibility of resulting stress on an external vapour retarder or weather barrier should be considered.



Wicking is the tendency of an insulation material to absorb liquid due to capillary action. Wicking is measured by partially submerging a material and measuring both the amount of liquid that is absorbed, and the amount of space by volume the liquid has consumed within the insulation material.

Open cell or fibrous materials tend to perform worse in water absorption, water vapour permeability and wicking than do closed-cell materials. The amount of closed cell structure compared to open cell structure may be to some degree an indicator of the performance of the material, however closed cell materials may still have high permeance so comparison of all specific physical properties is important.

HVAC systems and chilled water systems are often insulated to conserve energy and prevent surface condensation or "sweating". When an open-cell material is used on these systems and the vapour retarder system fails, water vapour may move into the insulation, condense and eventually saturate the insulation material. This may lead to partial or complete insulation system failure. The problem becomes more severe as the system temperatures move lower and when the system operates continuously in the cold mode. The driving forces are greater on these systems and water vapour will condense and freeze on or within the insulation. Again, as more water vapour is absorbed, the thermal conductivity of the insulation material moves higher which leads to lower surface temperatures. These lower surface temperatures lead to more condensation which may eventually lead to insulation system freeze-up, frost-ups and "popping off" of the insulation material due to ice formation. Considering that refrigeration systems may operate at temperatures of -70°F or colder, the problem may be severe. These problems may not only lead to insulation failures but may also lead to a complete failure of the entire insulation system.



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These are several components of insulation systems which include:

- Insulation material;
- Insulation joint sealant;
- Vapor retarders;
- Weather barriers;
- Weather barrier sealants;
- Jacketing;
- Pipe protection; and
- Adhesives, sealants or caulks.

The following is a brief summary of each component, but each individual component will be explored in more detail later in the chapter.

Pipe preparation

Before any type of insulation is applied, all equipment and pipe surfaces **MUST** be dry and clean from contaminants and rust. Corrosion of any metal under any thermal insulation can occur for a variety of reasons. The outer surface of the pipe should be properly prepared prior to the installation of the insulation. With any insulation, the pipe can be primed to minimize the potential for corrosion. Careful consideration at the time of the insulation system design stage is essential. Specific guidelines were detailed later in this chapter. Corrosion concerns

Insulated carbon steel surfaces that operate continuously below 25°F do not present major corrosion problems. However, equipment or piping operating either steadily or cyclically at or above these temperatures may present significant corrosion problems.



These problems are aggravated by inadequate insulation thickness, improper insulation material, improper insulation system design and improper installation of insulation.

Common flaws are:

1. Incorrect insulation materials used on below-ambient systems, such as open-cell, wicking and high permeance materials;
2. Improper specification of insulation materials by generic type rather than specifying specific material properties required for the intended service; and
3. Improper or unclear application methods.

Carbon steel

Carbon steel corrodes not because it is insulated, but because it is contacted by aerated water and/or a water-borne corrosive chemical. For corrosion to occur, water must be present. Under the right conditions, corrosion can occur under all types of insulation. Improperly insulated systems create conditions that may promote corrosion. Examples include:

Annular space or crevice for the retention of water; Insulation material that may wick or absorb water; and Insulation material that may contribute contaminants that may increase the corrosion rate.

The corrosion rate of carbon steel is dependent on the temperature of the steel surface and the contaminants in the water. The two primary sources of water are infiltration of liquid water from external surfaces and condensation of water vapor on cold surfaces.



Infiltration occurs when water from external sources enters an insulated system through breaks in the vapor retarder system or breaks in the insulation itself. The breaks may be the result of inadequate design, incorrect installation, abuse or poor maintenance practices. Infiltration of external water can be reduced or prevented.



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Condensation results when the metal temperature or the insulation surface temperature is lower than the dew point temperature. Insulation systems cannot always be made vapor tight, so condensation must be recognized in the system design.

The main contaminants found in insulation are chlorides and sulfates. These contaminants may have been introduced during the manufacture of the insulation or from external sources. These contaminants may hydrolyze in water to produce highly corrosive free acids.

Copper

External Stress Corrosion Cracking (ESCC) is a type of localized corrosion of various metals notably copper. For ESCC to occur in a refrigeration system, the copper must undergo the combined effects of a sustained stress and a specific corrodant species. During ESCC, copper degrades so that localized chemical reactions occur often at the grain boundaries in the copper. The localized corrosion attack creates a small crack which advances under the influence of the tensile stresses into the metal. The common form of ESCC in copper results from grain boundary attack (i.e. Intergranular ESCC). Once the advancing crack extends through the metal section, the pressurized refrigerant within the line will leak.



ESCC occurs in the presence of four conditions:

1. The presence of oxygen (air),
2. The presence of a tensile stress, either residual or applied. In copper, stress can be put into the metal at the time of manufacture (residual) or during installation (applied) of a refrigeration system.
3. The presence of a chemical corrodant.
4. The presence of water (or moisture) to allow the copper corrosion process to occur.

A number of precautions reduce the risk of ESCC in refrigeration systems:

- Properly seal all seams and joints of the insulation systems to prevent a path for condensation between the insulation and the copper tubing.
- Avoid introducing applied stress to copper during installation. Applied stress can be the result of any manipulation, direct or indirect, resulting in stresses in the copper tubing, for example, applying stress to a copper tube to align with a fitting or physical damage to the copper prior to installation.
- Under no circumstances use chlorinated solvents such as 1,1,1-trichloroethane to clean a refrigeration system. Such solvents have been linked to rapid corrosion.
- Use no acidic materials such as citric acid or acetic acid (vinegar) on copper systems. Such acids are found in many cleaners.
- Make all soldered connections gas-tight, as a leak could result in failure to the section of insulated copper tubing. This prevents self-evaporating lubricating oil, and even refrigerants themselves, from reacting with moisture to produce corrosive acidic materials such as acetic acid.
- Choose the appropriate thicknesses of insulation for the environment and the operating conditions must be used to avoid condensation of the copper tubing.
- Never mechanically constrict or adhere the insulation to the copper. An example of mechanical constriction is the use of wire ties to compress the insulation. This operation may result in the pooling of water between the insulation and the copper tubing.
- Prevent extraneous chemicals or chemical-bearing materials such, such as corrosive cleaners containing ammonia and/or amine salts, wood smoke, nitrites and ground or trench water, from coming in contact with the insulation or copper.
- Prevent the entrance of water between the insulation and the copper. Where the layout of the system is such that condensation may form and run along uninsulated copper by gravitational force, the beginning run of insulation must be adhered completely to the copper and sealed or vapor stops installed.



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- Use copper that complies with ASTM B 280. Buy copper from a reputable manufacture. When pressure testing copper tube systems, take care not to exceed the specific yield point of the copper.
- When testing copper for leaks, use only a commercial refrigerant leak detector solution specifically designed for that purpose. It must be assumed that all commercially available soap and detergent products contain ammoniacal or amine materials, all of which contribute to the formation of stress cracks.
- Replace any insulation that has become wetted or saturated with refrigerant lubricating oils. Such oils can react with moisture to form corrosive materials.



Stainless Steel

Certain grades of stainless steel piping are susceptible to ESCC. ESCC occurs in austenitic steel piping and equipment when chlorides in the environment or insulation material are transported in the presence of water to the hot surface of stainless steel and are then concentrated by evaporation of the water. This most commonly occurs beneath thermal insulation but the presence of insulation is not a requirement. Thermal insulation simply provides a medium to hold and transport the water with its chlorides to the metal surface.

Most ESCC failures occur when the metal temperature is in the hot water range of 120°F to 300°F. Failures are less frequent when the metal temperature are outside of this range. Below 120°F the reaction rate is slow and the evaporative concentration mechanism is not significant. Equipment that cycles through the water dew point temperature is particularly susceptible. Water that is present at the low temperature evaporates at the higher temperature. During the high temperature cycle the chloride salts dissolved in the water concentrate on the surface.

As with copper, in order for ESCC to develop, sufficient tensile stress must be present in the stainless steel. Most mill products, such as sheet, plate, pipe and tubing, contain enough residual processing tensile stresses to develop cracks without additional applied stress. When stainless steel is used coatings may be applied to prevent ESCC. A metallurgist should be consulted to avoid catastrophic piping system failures.

Insulation systems

Five distinct components characterize a quality insulation job. It is important to define and distinguish each one.

1) Insulation The insulation itself should be a low thermal conductivity material with low water vapor permeability and it should be nonwicking.

2) Insulation Joint Sealant All insulations operating at below ambient conditions should utilize a joint sealant. The joint sealant should be resistant to liquid water, water vapor, and be able to bond to the specific insulation surface. The joint sealant is applied as a full bedding coat to all sealant joints. A properly designed and constructed insulation/sealant/insulation joint will retard liquid water and water vapor migration through the insulation system.



3) Vapor retarders Some insulation materials are commonly considered closed-cell and that as such will not absorb water. This is not exactly the case as most insulations will absorb a certain amount of water. Care should be taken to either use low permeance (water vapor permeability less than 0.1 perm-inches) insulation materials or use a continuous and effective vapor retarder system. Vapor retarders function to keep out water, water vapor and prevent water vapor infiltration, thus keeping the insulation dry. This will prevent degradation of thermal properties due to the presence of water and will prevent any moisture from reaching the cold-side surface of the pipe or vessel.

The service life of the insulation and pipe depends primarily on the in-place water vapor permeance of the vapor retarder. Therefore, the vapor retarder must be free of discontinuities and penetrations. The insulation and the vapor retarder will expand



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and contract with ambient temperature cycling. The vapor retarder system must be installed with a mechanism to permit this expansion and contracting without compromising the integrity of the vapor retarder. See manufacturers for design and installation instructions specific to their products.

4) Jacketing The purpose of jacketing on insulated pipes and vessels is to protect the vapor retarder system and the insulation. Various plastic and metallic products are available for this purpose.

Some specifications suggest that the jacketing should function to preserve and protect the delicate "egg-shell like" vapor retarder over the insulation. This being the case, it should be obvious that any devices used to secure the jacketing must be of the band type which holds and clamps the jacketing in place circumferentially. Pop rivets, sheet metal screws, staples or any other item that punctures should not be used because they will compromise the vapor retarder. The use of such materials may be an indication that the insulation installer does not understand the vapor retarder concept and corrective education steps should be taken.



Protective jacketing is designed to be installed over the vapor retarder and insulation to prevent weather and abrasion damage. The protective jacketing must be installed independently and in addition to any factory or field applied vapor retarder. Ambient temperature cycling will cause the jacketing to expand and contract. The jacketing must be installed with a mechanism to permit this expansion and contraction to occur without compromising the vapor retarder. See manufactures for design and installation instructions specific to their products.

Metal jacketing may be smooth, stucco, embossed, or corrugated aluminum or stainless steel with a continuous moisture retarder. PVC jacketing or other finishes may also be appropriate, depending upon the environment or other factors. PVC should be smooth, UV inhibited, in precurled rolls. The minimum thickness of PVC should be 0.030". Other types of jacketing may be appropriate depending upon environmental or other factors. Metallic type jackets are recommended for exposed roof mounted piping systems. Protective jacketing is required whenever piping is exposed to wash downs, physical abuse or traffic. Inside of buildings where ultraviolet degradation from sunlight is not a

factor, the most popular type of jacketing is white PVC. Colors can be obtained at little, if any, additional cost if desired. All longitudinal and circumferential laps should be seal welded using a solvent welding adhesive. The laps should be located at 10:00 o'clock or 2:00 o'clock positions. A sliding lap (PVC) expansion/contraction joint should be located near each end point and at immediate joints no more than twenty feet apart. Where very heavy abuse and/or hot, scalding washdowns are encountered a special CPVC material is required. These materials can withstand temperatures as high as 225°F, where standard PVC will warp and disfigure at 140°F.

Roof piping should be jacketed with a minimum 0.016 inch aluminum (embossed or smooth finish depending on aesthetic choice). On pitched lines, this jacketing should be installed with a minimum 2 inch overlap arranged to shed any water in the direction of the pitch. Only stainless steel bands should be used to install this jacketing (1/2" X 0.02" 304 stainless) and spaced every 12 inches. Jacketing on valves and fittings should match that of the adjacent piping.

Weather Barrier Joint Sealant

All metal jacketed insulation systems operating at below ambient conditions should utilize a weather barrier joint sealant. The joint sealant should be a liquid water resistant elastomeric material available to bond to the specified metal surface. The joint sealant is applied to all joints to prevent driven water from migrating through the joints, accumulating within the insulation system.



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Typee of Insulation

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TYPES OF INSULATION

THERMAL-INSULATION

Nowadays there is always an important & urgent emphasis on energy- conservation because of rising cost of fuel. The quantity of heat utilized is mainly determined by the following features of the insulating material:

- CHEMICAL – COMPOSITION
- DENSITY
- CELL - STRUCTURE
- THERMAL - CONDUCTIVITY
- VAPOUR –PERMEABILITY

Below are the various types of insulation materials based in terms of their MICRO-STRUCTURE . These have their own advantages & disadvantages.

- OPEN-CELL :- GLASSWOOL & ROCKWOOL
- INTERCONNECTED CELL :- P.S.FOAM
- SEMI-CLOSED CELL :- P.U.FOAM
- CLOSED-CELL :- FLEXIBLE RUBBER FOAM INSULATION

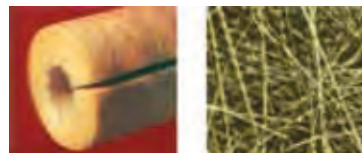
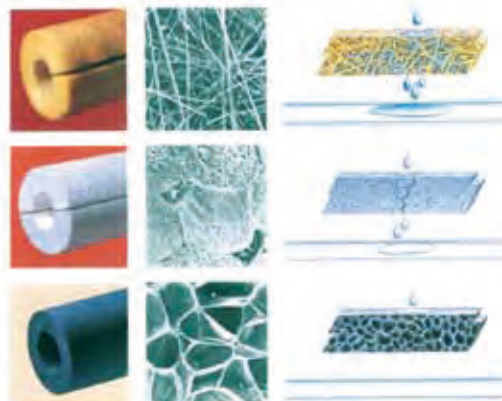
Thermal insulation materials serve as a filter, to restrain as much heat as possible from permeating through the other side. Most thermal insulations use the concept that air is a poor heat conductor. Therefore it explains why thermal insulation material contains porous air-spaces. The air-space which is referred as "cell" occur by compressing shreds of fiber or foam pellets together. The cell will have to be small enough to resist the internal air-current, resulting substantially to reduce convection to heat. When the insulating material itself high heat loss. So the insulating material itself should have low-conductivity and should be dark coloured or reflector in order to minimize heat-loss due to radiation.

OPEN CELL (CELLULAR GLASS)

This is air-permeable insulation type.

- This type insulation is made from compacted fibres. In which air occupies the space between the fibers.
- If applied to the cooling pipes it should be used in conjunction with corrosion-proofed, which should be fully painted (moisture proofing) on the pipes to protect them from corrosion.
- It is also very important that there is no torn vapour barrier during installation of the insulation.
- If there is any existence of torn-area condensation will occur and water-droplet will form on the surface of the pipe.
- The humid air will penetrate through the torn-area and condense the water in the insulation causing deterioration of insulation & pipe rapidly.
- Thermal-Conductivity (k-value) can not be stable when it absorbs water. As (k-value of water approximately 15 times higher than original insulation)
- Chemical resin will react with water and become alkaline thus causing corrosion to the pipes.
- This type of insulation performs worse in water absorption. Water vapour-permeability & wicking
- Installation in irregular pipes is difficult and time consuming.
- Higher in cost & lower in performance than other types of insulation.
- Hazardous to health (in lungs & skin)

Cellular Glass has excellent compressive strength but it is rigid. It is fabricated to be used on piping and vessels. When installed on applications that are subject to excessive vibration, the inner surface of the material may need to be coated. The coefficient of thermal expansion for this material is relatively close to that of carbon steel. When installed on refrigerant systems, provisions for expansion and contraction of the insulation are usually only recommended for application that cycle from below ambient to high temperatures. For outdoors or direct buried applications, a jacketing or mastic coating is recommended.





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Cellular glass is suitable for temperatures between -450°F and +800°F.

ASTM C552, Standard Specification for Cellular Glass Thermal Insulation, specifies cellular glass insulation requirements. Flame spread and smoke developed when tested according to ASTM E84 is flame spread index of 5 and a smoke developed index of 0.

The water vapour permeability as tested per ASTM E96, Procedure A is less than 0.005 perm-inches. Thermal Conductivity in Btu/H-ft²(°F/in) as tested by ASTM C177 or ASTM C518 are

at 0°F mean temperature 0.27

at +75°F mean temperature 0.31

at +120°F mean temperature 0.33

Density can vary between 6.3 and 8.6 lb/ft³. Density does not greatly affect the thermal performance of cellular glass.

INTER-CONNECTED CELL

This type of insulation is made by compressing foam or cork pallets to form tubes.

- The individual layers of this insulation are surrounded by empty – space
- Moisture has difficulty to penetrate through open-cells, but wet-ness can still make its way through the space between compressed pellets.
- Moisture-proofing by bitumen or any coating materials and wrapping with cotton or linen cloth is necessary .
- This type of insulation has a tendency to shrink, which can loosen or break the coated bitumen.
- Bitumen & coating materials has water – components that allow water to permit in the insulation and thus increasing thermal-conductivity.
- Installation must be done by expert, any mis-application will cause the insulation to fuse and reduce the thickness of insulation .



POLYSTYRENE INSULATION

Polystyrene insulation is light weight and has good compressive strength. This product does not meet the smoke developed index of 50 or less when tested according to ASTM E84. The test yields a flame spread index of 25 or less and a smoke developed index of 115.

ASTM C 578, Standard Specification for Rigid Cellular Polystyrene Thermal Insulation specifies material requirements. ASTM C 578 lists its temperature range from -65 to +165°F.

Thermal Conductivity in Btu/h-ft²(°F/in) as tested by ASTM C177 or ASTM C518 are at +75°F mean temperature 0.24
at +120°F mean temperature 0.26

The water vapour permeability of the unfaced material as tested per ASTM E96, Procedure A is 1.5 perm-inches or less.

SEMI-CLOSED CELL

This insulation is made from light-weight poly-ethylene (p.e.foam) and low-density poly-urethane (p.u.foam).

- It has many small independent-cells.
- The cell-wall is attached imperfectly with each-other.
- Imperfect attachment of the cell-walls increase the water-absorption over 10% by weight according to ASTM -D 1056 .
- Higher water-absorption value instantly effects to high thermal– conductivity.
- It has a very low – density of 1 to 3 lbs/ft³ because it is manufactured with only adequate quality to keep low price. Not considered the efficiency.
- The cells are thin resulting higher water permeability .
- The insulation material has low-elasticity, therefore it easily weakens & tears the cell-wall.
- The thermal-conductivity is higher than closed – cell.



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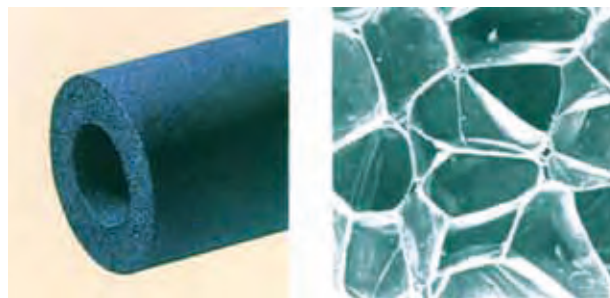


GULF-O-FLEX
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CLOSED – CELL (Flexible Elastomerics)

This type of insulating material is the most ideal. & economical insulation widely used in today's modern world.

- It is mostly produced from synthetic rubber elastomer materials having higher – resiliency and characteristically confirm to closed-cell.
- Insulation material is elastic enough to protect the cell-wall against rupturing or tearing .
- It contains a great number of tiny singular closed – cells.
- A single cell is enclosed by a strong wall.
- The surface of this type of insulation is thick, tough, water-proof on both inside & outside.
- The thickness of the cell wall is app 3- 7 micron. (A factor, which bears a direct relationship with density of the insulating material.)The proper density lies in the range of 3 to 7 lbs per cubic foot. (according to the Ashrae)
- Each cell contains a dry- gas (nitrogen + carbon –di-oxide). Which is emitted from a blowing agent.
- Gases filled in the cell has very low-boiling point \ high vapour – pressure. so in case of very low temperature it will remain in gas-form. And the gas – pressure with in the cell remains higher than the atmospheric - pressure resulting very-difficult for air & moisture to penetrate into the cell.
- The wall of the cell acts as an impenetrable against moisture.
- Perfect attachment of the cell- walls decreases the water-absorption value below 10% by weight according to ASTM – D 1056.
- Lowest water-permeability as compared with other types of insulation is a main factor which permits its thermal conductivity constant throughout its life.
- Longer durability than other types of insulations, are widely used in low temperature piping where relative – humidity is between 70% - 90% which exists throughout the year.



Flexible Elastomerics are soft and flexible. It is suitable for use on non-rigid tubing .It is light weight and has low vapour permeability.

Performed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form, specifies flexible elastomeric material requirements. These products can be manufactured to meet the flame spread index of 25 or less and the smoke developed index of 50 or less when tested according to ASTM E84.

Flexible elastomeric sheet is normally limited to service between -40°C up to 120°C. around -20°F flexible elastomeric insulation becomes stiff, but this does not affect its thermal performance or water vapour permeability.



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Insulation Installation

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RECOMMENDED PRACTICES FOR INSULATION APPLICATIONS

This guideline covers the recommended requirements and design features for typical refrigeration insulation applications. This guideline may be followed unless State or Local Building Codes dictate otherwise. For insulation and insulation accessories, specific manufacturer instructions will supersede the recommendations in this guideline. A qualified engineer may be consulted to specify both the insulation material and the insulation thickness based on specific design conditions. Please note that insulation thickness is chosen to either prevent or minimize condensation on the outside pipe surface or limit heat gain to 8 Btu/hr-ft² whichever thickness is greater.



All insulation must be stored in a cool, dry location and be protected from the weather before and during application.

Vapour retarders and weather barriers must be installed over dry insulation. Corrosion of any metal under any thermal insulation can occur for a variety of reasons. The outer surface of the pipe should be properly prepared prior to the installation of the insulation. With any insulation, the pipe can be primed to minimize the potential for corrosion. Careful consideration at the time of the insulation system design stage is essential. Specific guidelines were detailed earlier in this chapter.

INSULATION INSTALLATION GUIDELINES

All welding and other hot work should be completed prior to the installation of the pipe insulation. All hydrostatic and other performance testing should be completed prior to the installation of the insulation. Surfaces to be insulated should be free from all oil, grease, loose scale, rust and foreign matter and shall be dry and free from frost. Site touch-up of all shop coating including preparation and painting at field welds should be completed prior to the installation of the insulation.

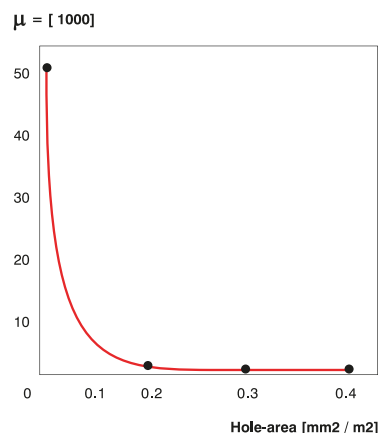
Insulation for fittings, flanges and valves should be the same thickness as the insulation of the pipe and shall be fully vapour sealed. If the valve design allows, insulate valves to the packing glands. Stiffener rings where provided on vacuum equipment and/or piping should be insulated with the same thickness and type of insulation as specified for the piece of equipment or line. The rings should be fully independently insulated. Where multiple layers of insulation are used, all joints should be staggered. Insulation should be applied with all joints fitted to eliminate voids. Large voids should not be filled with vapour sealant or fibrous insulation, but eliminated by refitting or replacing the insulation. All joints, with the exception of contraction joint locations and the inner layer of a double layer system, should be sealed with either the proper adhesive or a joint sealer during installation. Each line should be insulated as a single unit. Adjacent lines shall not be enclosed within a common insulation cover.

Open cell or high permeance insulations may require special protection during installation.

All insulation applied in one day should have at least one coat of the specified vapour retarder mastic applied the same day. If impractical to apply the first coat of vapour retarder mastic, the insulation must be temporarily protected with a moisture retarder, such as an appropriate polyethylene film, and sealed to the pipe or equipment surface. All exposed insulation terminations should be protected before work stoppages. Vapour stops should be installed using either sealant or the appropriate adhesive at all directly attached pipe support locations, guides, anchors and at all locations requiring potential maintenance, such as valves, flanges and instrumentation connections to piping or equipment. If for any reason valves or flanges are required to be left uninsulated until after plant start-up, temporary vapour stops should be installed using either sealant or the appropriate adhesive.

When applicable, the innermost layer of insulation should be applied in two half sections, secured with 3/4" wide pressure sensitive filament tape banding

Function of Water-Vapour Diffusion Resistance of alu-cladded glassfibre and pin hole area



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spaced at 9" maximum centers applied with a 50% overlap. Single and outer layers above 18" od, and where inner layers are applied in reduced and beveled segments, should be secured by 3/8" wide stainless steel bands at 9" maximum centers. The bands shall be firmly tensioned and sealed.

Irregular surfaces and fittings should be vapour sealed by applying a thin coat of vapour retarder mastic or finish with a minimum wet film thickness as recommended by the manufacturer. While the mastic or finish is still tacky, an open weave glass fiber reinforcing mesh should be laid smoothly into the mastic or finish and should be thoroughly embedded in the coating. Care should be taken not to rupture the weave. The fabric should be overlapped a minimum of 2" at joints to provide strength equal to that maintained elsewhere. Before the first coat is completely dry, a second coat should be applied over the glass fiber reinforcing mesh with a smooth unbroken surface. The total thickness of the mastic or finish should be in accordance with the coating manufacturer's recommendation.

When possible, the pipe support mechanism should be located outside of the insulation. Supporting the pipe outside of the protective jacketing eliminates the need to insulate over the pipe clamp, hanger rods, or other attached support components. This method minimizes the potential for vapour intrusion, and thermal bridges within the system as a continuous envelope surrounds the pipe.

Hangers need to be spaced to incorporate allowable loading on both the piping as well as the insulation material. ASME B31 standards establish basic stress allowances for the piping material. The loading on the insulation material is a function of its compressive strength. Related information in this table is also referenced in the 1996 ASHRAE Systems and Equipment Handbook.

Suggested Pipe Support Spacing for Straight Horizontal Runs			
Pipe O.D. (in)	Standard Steel Pipe /water	Standard Steel Pipe /steam	Copper Tube /water
1/2	7	8	
3/4	7	9	5
1	7	9	6
1-1/2	9	12	8
2	10	13	8
2-1/2	11	14	9
3	12	15	10
4	14	17	12
6	17	21	14
8	19	24	16
10	20	16	18
12	23	30	-
14	25	32	-
16	27	35	-
18	28	37	-
20	30	39	-
24	32	42	-

Source: Adapted from MSS Standard SP-69 an ASME B31.1

a) Spacing does not apply where span calculations are made or where concentrated loads are placed between supports such as flanges, valves, specialties, etc.

b) Suggested maximum spacing between pipe support for horizontal straight runs of standard and heavier pipe at maximum operating temperatures of 750°F (400C).

The compressive strength of the insulation material may or may not be comparable to support loading at these distances. The force (psi) on the bearing area of the insulation in the support configuration sustaining the load of the piping and contents should be calculated, and compared to the compressive strength of the insulation. In refrigerant piping, typically band style or clevis hangers are used in conjunction with rolled metal shields or cradles.



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Although the shields are typically rolled to wrap the outer diameter of the insulation in an arc of 180°, the bearing area is calculated over a 120° arc or the outer circumference of the insulation multiplied by the shield length. If the insulated pipe is subjected to point loading such as resting on a beam or a roller, the bearing area arc is reduced to 60° and multiplied by the shield length. In this case, rolled plate may be more suitable than sheet metal. Provisions should be made to secure the shield on both sides of the hanger (metal band), and the shield should be installed centered within the support.



Nominal Pipe Size (in)	Shield Length (in)	Shield Thickness (gage/in)
1/2 to 3-1/2	12	18/.048
4	12	16/.060
5-6	18	16/.060
8	24	14/.075

Source: Adapted from MSS Standard SP-69

Notes: Protection shield gages listed are for use with band type hangers only. For point loading, increase shield thickness and length.

Some installations may require the use of an expansion or contraction joint. These expansion/contraction joints are normally required in the innermost layer of insulation. Expansion/contraction joints may be constructed by using a 1" break in the insulation. All joints should then be tightly packed with fibrous insulation material. The insulation should be secured on either side of the expansion/contraction joint with stainless steel bands that have been hand tightened. Cover the expansion/contraction joint with the an appropriate vapour retarder and properly seal.

Maintenance of Insulation Systems

Insulation systems must be inspected and maintained to ensure that the system continues operation according to design. Periodic inspections are needed to determine the presence of moisture, which will lower the insulation thermal efficiency, often destroying the insulation system. Further, corrosion may develop on the exterior surface of the pipe if moisture is present and the temperature is above 25°F (-4°C).

The Frequency of inspection should be determined by the critical nature of the process, the external environment and the age of the insulation system. During a routine inspection of the insulation system:

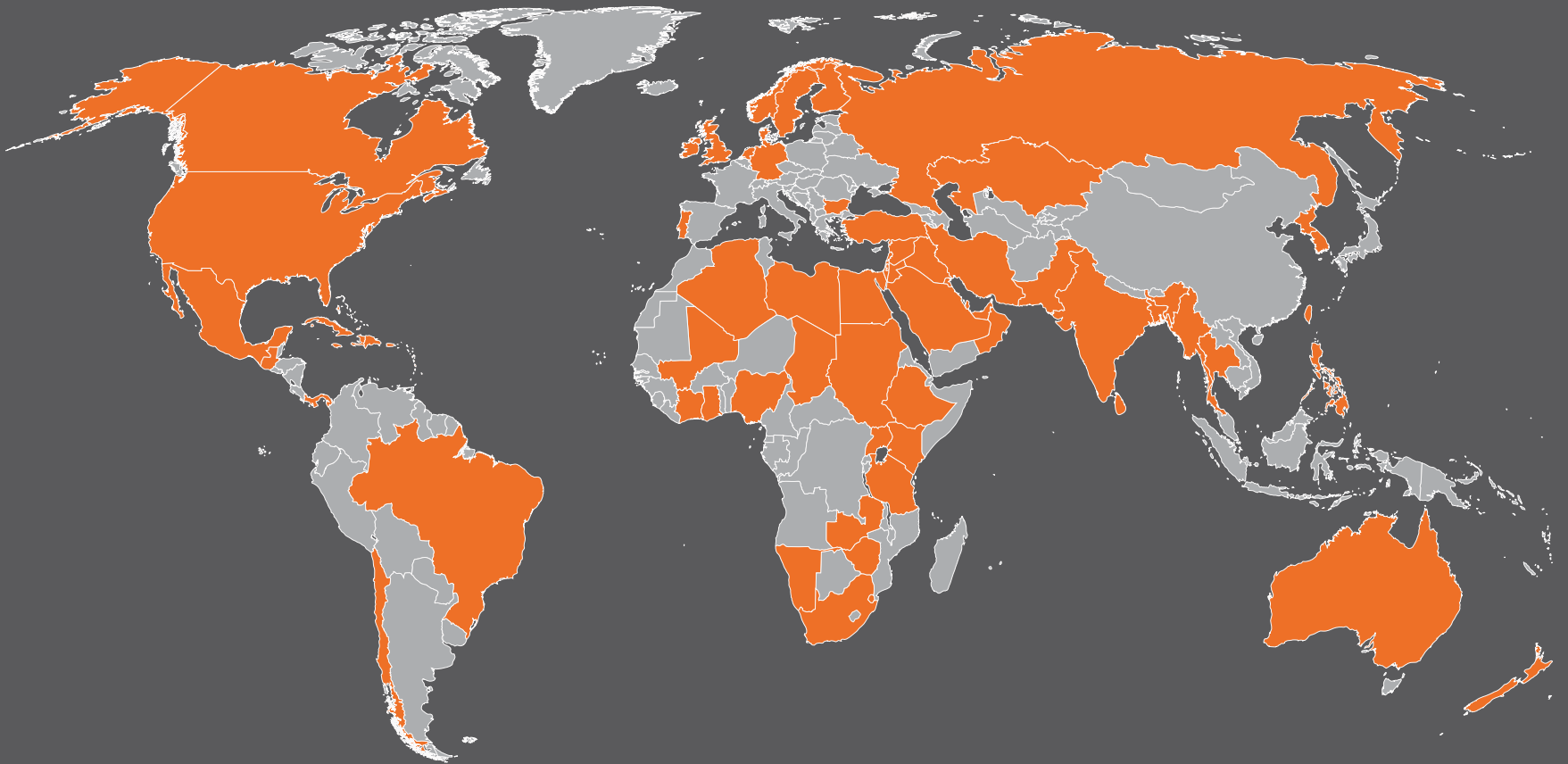
Look for signs of moisture or ice on the lower part of horizontal pipe, at the bottom elbow of a vertical pipe, and around pipe hangers/saddles as moisture may migrate to low areas.

- Look for jacketing penetrations, openings, or separations.
- Check the jacketing to determine if the banding is loose.
- Look for bead caulking failure especially around flange and valve covers.
- Look for jacketing integrity and open seams around all intersecting points such as pipe transitions, branches and tees.
- Look for cloth visible through the mastic or finish if the pipe is protected by a reinforced mastic weather barrier.

During an extensive inspection of an insulation system:

- Use thermographic equipment to isolate areas of concerns
- Design a method to repair, close and seal any cut into the insulation or vapour retarder so that a positive seal may be maintained throughout the entire system.
- Examine the pipe surface for corrosion if the insulation is physically wet.
- The extent of moisture present within the insulation system and (or) the corrosion of the pipe will determine the need to replace the insulation. All wet parts of the insulation must be replaced.

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