ADVANCED FIRE PROTECTION FOR RAILWAY VEHICLES

ArmaFlex® Rail

The first flexible closed-cell insulation to meet hazard levels 2 and 3 of Requirement Set R1 for railway vehicles according to EN45545

// Built-in water vapour barrier reduces risk of corrosion under insulation (CUI)
// Low smoke density
// Does not generate flaming droplets
// Reduce risk of mould and mildew, contributing to improved indoor air quality

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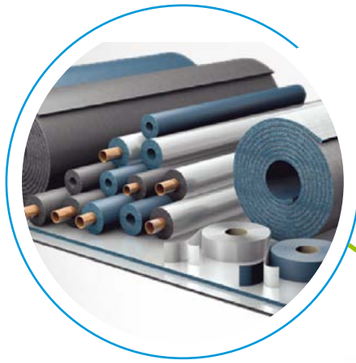
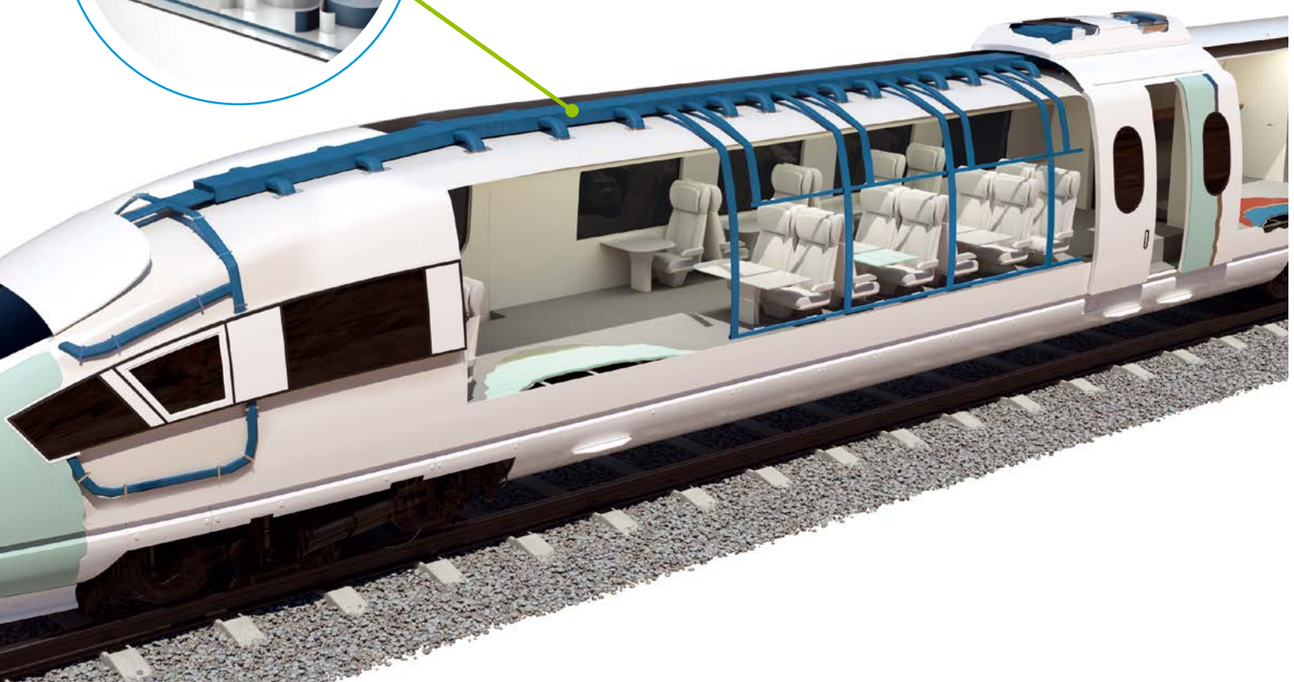
armacell®
ArmaFlex®

ArmaFlex Rail

With more than 50 years of experience in the railway industry, Armacell knows the requirements and standards and offers global support and technology you can rely on.



ArmaFlex Rail is the first flexible closed-cell insulation to achieve the hazard levels HL2 and 3, R1.



FIRE STANDARD
EN 45545-2
TAKES THE **FIRST**
PRINCIPLES INTO
CONSIDERATION

Flame spread
Ignitability
Rate of heat release
Smoke emissions
Toxic gas emissions

EN 45545-2 "Railway applications. Fire protection on railaway vehicles." is a seven-part European standard for fire protection on railway vehicles. The objectives of this standard are to minimise both the risk of a fire starting and spreading within railway vehicles and its effects on passengers and employees. As a consequence, this provides **the best level of protection against the occurrence of a fire on board**.

To achieve the highest possible level of safety in trains, both materials and components must meet strict fire, smoke and toxicity requirements. Depending on where they are used, materials are assigned to the categories R1 to R26 (R = Requirement Set). The various operating and design classes provide the basis for hazard levels (HLs) which in turn define the requirements of the classification system. There are a total of three hazard levels (HL1 to HL3). HL3 is the highest level and thus makes the highest demands of the materials used.

85 - 90% are covered by **HL2**

TYPE OF VEHICLE AND OPERATION DETERMINE THE REQUIRED HAZARD LEVEL

Operation category (OC)	N: Standard vehicles	A: Vehicles of automatic train, no emergency trained staff on board	D: Double decked vehicles	S: Sleeping / couchette vehicles
OC1: Railway vehicles may be stopped with minimum delay, and where a safe area can always be reached immediately.	HL1	HL1	HL1	HL2
OC2: Vehicles for operation on underground sections, tunnels and/ or elevated structures, **with side evacuation available** and where there are stations or rescue stations that offer a place of safety to passengers, **reachable within a short running time.**	HL2	HL2	HL2	HL2
OC3: Vehicles for operation on underground sections, tunnels and/ or elevated structures, **with side evacuation available** and where there are stations or rescue stations that offer a place of safety to passengers, **reachable within a long running time.**	HL2	HL2	HL2	HL3
OC4: Vehicles for operation on underground sections, tunnels and/ or elevated structures, **without side evacuation available** and where there are stations or rescue stations that offer a place of safety to passengers, **reachable within a short running time.**	HL3	HL3	HL3	HL3

EN 45545-2 specifies the test methods, test conditions and reaction to fire performance requirements for all onboard materials and components used on railway vehicles as defined by the HL. Key fire tests defined in this standard are flame propagation, cone calorimeter and the smoke and toxicity tests. For requirement set R1, they are all based on radiant panels with 50 kW/m² heat fluxes.

REQUIREMENT SET FOR R1 (INSULATION MATERIAL)

European standard	Test standard	Parameter unit	Requirement definition	HL1	HL2	HL3
EN 45545-2	Spread of flame ISO 5658-2	CFE kWm^{-2}	Minimum	20	20	20
Railway application. Fire protection on railway vehicles - Requirements for fire behaviour of materials and components.	Heat release, smoke production and mass loss rate ISO 5660-1	MARHE kWm^{-2}	Maximum		90	60
	Smoke optical density and toxicity EN ISO 5659-2	$D_s(4)$ dimensionless	Maximum	600	300	150
		VOF_4	Maximum	1200	600	300
		CIT_G dimensionless	Maximum	1.2	0.9	0.75

TECHNICAL DATA - ARMAFLEX RAIL SD

Brief description	A highly flexible, closed cell insulation foam with improved fire retardant properties, low smoke generation and built in Microban® antimicrobial protection for railway vechicles.
Material type	Elastomeric foam based rubber manufactured with ArmaPrene® patented technology; US patent no. 8 163 811, EU patent no. 2 261 305.
Colour	Blue.
Material special features	The pressure-sensitive adhesive coating is based on modified acrylate basis with mesh structure and covered with polyethylene foil. Traces of silicone can be found on the protection paper / foil used to protect self-adhesive closures.
Applications	Insulation / protection for air ducts and pipes (incl. elbows, fittings, flanges etc.) of air-conditioning / refrigeration systems to prevent condensation. Not designed for insulations exposed to sunlight / not UV stable.
Installation	The ArmaFlex manual should be consulted before assembly.

Property	Value/Assessment			Standard/Test method
Temperature range				
Service temperature	Max. service temperature	+110 °C	+85 °C if glued to the object with its whole surface	EN 14706, EN14707, EN14304
	Min. service temperature	-50 °C		
Thermal conductivity				
	$\lambda_{0°C} \leq 0.040$ W/(m·K)	$[40+0.1 \cdot \vartheta_m + 0.0009 \cdot \vartheta_m^2]/1000$		EN ISO 13787, EN 12667, EN ISO 8497
Water vapour diffusion resistance				
Water vapour diffusion resistance factor	μ ≥ 5,000			EN ISO 12086, EN 13469
Fire performance and approvals				
Reaction to fire	Hazard level	HL2, R1 (3mm sheets & tape: HL3, R1)		EN 45545-2
	Fire behaviour and fire side effects	S4, ST2, SR2, FED < 1		DIN 5510-2, DIN 54837
	Russian Federation certificate of conformity	G1, B2, D2, T2		GOST 12.1.044-89
	Burning behaviour for use in motor vehicles (ECE Regulations)	Passed Annex 6,7,8,9		ECE R-118
	NFPA 130 American fire test to railway components	$I_s \leq 25$ $D_s(4.0) \leq 100$		NFPA 130:2014, ASTM E 162:20, ASTM E 662:2012
Practical fire behaviour	Self-extinguishing, does not drip, does not spread flames			
Other technical features				
Dimension and tolerances	In accordance with EN 14304, table 1			EN 822, EN 823, EN 13467
UV resistance	Protection against UV radiation is necessary. See Technical Bulletin 142.			
Fungal growth	No fungal growth is observed			ASTM G21
Health aspects	Fulfills hygiene requirements of Russian rail industry			
Storage and shelf life	Material should be stored in dry, clean rooms at normal relative humidity (50% - 70%) and ambient temperature (0°C - 35°C). Self adhesive sheets, tapes: 1 year			

TECHNICAL DATA - ARMAFLEX RAIL SD-C

Brief description	A highly flexible, closed cell, pre-covered insulation foam with improved retardant properties, low smoke generation and built in Microban antimicrobial protection for railway vechicles.
Material type	Elastomeric foam based rubber with high-tech coating and manufactured with ArmaPrene patented technology; US patent no. 8 163 811; EU patent no 2 261 305; patent for multi-layer coating technology EU patent no. 2 522 502.
Colour	Blue with silver metallic look coating.
Material special features	The pressure-sensitive adhesive coating is based on modified acrylate basis with mesh structure and covered with polyethylene foil. Traces of silicone can be found on the protection paper / foil used to protect self-adhesive closures.
Special features	The covering offers excellent durability, even under UV exposure when used for outdoor applications. It is also easy to clean.
Applications	Insulation / protection for air ducts and pipes (incl. elbows, fittings, flanges etc.) of air-conditioning / refrigeration systems to prevent condensation.
Installation	When dimensioning the insulation thickness, please calculate with an external suface coefficient of 8 W/(m²K). The ArmaFlex manual should be consulted before assembly.

Property	Value/Assessment			Standard/Test method
Temperature range				
Service temperature	Max. service temperature	+110 °C	+85 °C if glued to the object with its whole surface	EN 14706, EN 14707 & EN 14304
	Min. service temperature	-50 °C		
Thermal conductivity				
	$\lambda_{0°C} \leq 0.040$ W/(m·K)	$[40+0.1 \cdot \vartheta_m + 0.0009 \cdot \vartheta_m^2]/1000$		EN ISO 13787, EN 12667 & EN ISO 8497
Water vapour diffusion resistance				
Water vapour diffusion resistance factor	μ ≥ 10,000			EN ISO 12086 & EN 13469
Fire performance and approvals				
Reaction to fire	Hazard level	HL3, R1		EN 45545-2
	Russian Federation certificate of conformity	G1, B2, D2, T2		GOST 12.1.044-89
	NFPA 130 American fire test to railway components	$I_s \leq 25$ $D_s(4.0) \leq 100$		NFPA 130:2014, ASTM E 162:20 & ASTM E 662:2012
Practical fire behaviour	Self-extinguishing, does not drip, does not spread flames			
Other technical features				
Dimension and tolerances	In accordance with EN 14304, table 1			
Storage and shelf life	Material should be stored in dry, clean rooms at normal relative humidity (50% - 70%) and ambient temperature (0°C - 35°C). Self adhesive sheets, tapes: 1 year			

TECHNICAL DATA - ARMAFLEX RAIL ZH

Brief description	Halogen free, flexible closed-cell insulation foam with improved fire retardant properties and low smoke generation for railway vehicles.
Material type	Elastomeric foam based on synthetic rubber.
Colour	Dark grey.
Material special features	The pressure-sensitive adhesive coating is based on modified acrylate basis with mesh structure and covered with polyethylene foil. Traces of silicone can be found on the protection paper / foil used to protect self-adhesive closures.
Special features	Without halogens (chloride, bromide) acc. to DIN / VDE 0472, part 815. Fulfils DIN 1988 part 200.
Applications	Insulation / protection for air ducts and pipes (incl. elbows, fittings, flanges etc.) of air-conditioning / refrigeration systems to prevent condensation. Not designed for insulations exposed to sunlight and is not UV stable.
Installation	The ArmaFlex manual should be consulted before assembly.

Property	Value/Assessment			Standard/Test method
Temperature range				
Service temperature	Max. service temperature	+110 °C	+85 °C if glued to the object with its whole surface	EN 14706, EN14707 & EN14304
	Min. service temperature	-50 °C		
Thermal conductivity				
	$\lambda_{0°C} \leq 0.040$ W/(m·K)	[40+0.1 · ϑ_m + 0.0009 · ϑ_m^2]/1000		EN ISO 13787, EN 12667 & EN ISO 8497
Water vapour diffusion resistance				
Water vapour diffusion resistance factor	μ ≥ 1,000			EN ISO 12086 & EN 13469
Fire performance and approvals				
Reaction to fire	Hazard level	HL2, R1 (3mm sheets & tape: HL3, R1)		EN 45545-2
Practical fire behaviour	Self-extinguishing, does not drip, does not spread flames			
Other technical features				
UV resistance	Protection against UV radiation is necessary. See Technical Bulletin 142.			
Storage and shelf life	Material should be stored in dry, clean rooms at normal relative humidity (50% - 70%) and ambient temperature (0°C - 35°C). Self adhesive sheets, tapes: 1 year			

All data and technical information are based on results achieved under typical application conditions. Recipients of this information should, in their own interest and responsibility, clarify with our Technical department in due time whether or not the data and information apply to the intended application area.

TECHNICAL DATA - ARMAFLEX RAIL ZH-C

Brief description	Halogen free, flexible closed-cell insulation foam with improved fire retardant properties and low smoke generation for railway vehicles.
Material type	Elastomeric foam based on synthetic rubber with patented high-tech multi-layer coating EU patent no. 2 522 502.
Colour	Dark grey with silver metallic look coating.
Material special features	The pressure-sensitive adhesive coating is based on modified acrylate basis with mesh structure and covered with polyethylene foil. Traces of silicone can be found on the protection paper / foil used to protect self-adhesive closures.
Special features	Without halogens (chloride, bromide) acc. to DIN / VDE 0472, part 815. Fulfils DIN 1988 part 200. The covering offers excellent durability even under UV exposure when used for outdoor applications. The insulation system is designed for easy cleaning.
Applications	Insulation / protection for air ducts and pipes (incl. elbows, fittings, flanges etc.) of air-conditioning / refrigeration systems to prevent condensation. Not designed for insulations exposed to sunlight and is not UV stable.
Installation	When dimensioning the insulation thickness, please calculate with an external suface coefficient of 8 W/(m².K). The ArmaFlex manual should be consulted before assembly.

Property	Value/Assessment			Standard/Test method
Temperature range				
Service temperature	Max. service temperature	+110 °C	+85 °C if glued to the object with its whole surface	EN 14706, EN14707 & EN14304
	Min. service temperature	-50 °C		
Thermal conductivity				
	$\lambda_{0°C} \leq 0.040$ W/(m·K)	[40+0.1 · ϑ_m + 0.0009 · ϑ_m^2]/1000		EN ISO 13787, EN 12667 & EN ISO 8497
Water vapour diffusion resistance				
Water vapour diffusion resistance factor	μ ≥ 10,000			EN ISO 12086 & EN 13469
Fire performance and approvals				
Reaction to fire	Hazard level	HL3, R1		EN 45545-2
Practical fire behaviour	Self-extinguishing, does not drip, does not spread flames			
Other technical features				
Storage and shelf life	Material should be stored in dry, clean rooms at normal relative humidity (50% - 70%) and ambient temperature (0°C - 35°C). Self adhesive sheets, tapes: 1 year			

All data and technical information are based on results achieved under typical application conditions. Recipients of this information should, in their own interest and responsibility, clarify with our Technical department in due time whether or not the data and information apply to the intended application area.

ARMAFLEX RAIL SD

The first closed-cell insulation for increased safety in railway vehicles.

- Low smoke density and superior fire behaviour
- Built-in Microban protection reduces mould and bacteria growth
- Complies with most international railway standards for insulation materials
  - EN 45545 – HL2, R1
  - NFPA 130
  - DIN 5510-2
  - GOST 12.1.044-89
  - United Nations Regulation ECE R-118 Annex 6-9

Product range

2m length tubes, rolls, self-adhesive rolls and tape.

Tubes (Length: 2.0m, Colour: Blue)

9mm		13mm		Pipe maximum outside diameter
Item	Carton content	Item	Carton content	
	[m]		[m]	[mm]
RA-09X012	192	RA-13X012	130	12
RA-09X015	164	RA-13X015	112	15
RA-09X018	150	RA-13X018	98	18
RA-09X022	122	RA-13X022	88	22
RA-09X028	90	RA-13X028	64	28
RA-09X035	68	RA-13X035	56	35
RA-09X042	56	RA-13X042	48	42

Other information	
Length tolerance	± 1.5%
Thickness tolerance	± 1.5mm
Reaction to fire	Hazard level (HL) 2, R1 acc. to EN 45545-2

Rolls (Width: 1.0m, Colour: Blue)

Item	Insulation thickness	Length	Carton content
	[mm]	[m]	[sqm]
RA-03-99/E	3	30	30.0
RA-06-99/E	6	15	15.0
RA-09-99/E	9	10	10.0
RA-13-99/E	13	8	8.0
RA-19-99/E	19	5	5.0
RA-25-99/E	25	4	4.0

Other information	
Length tolerance	± 1.5%
Thickness tolerance	3 - 6mm: ± 1.0mm
	9 - 19mm: ± 1.5mm
Reaction to fire	HL2, R1 acc. to EN 45545-2 3mm sheets: HL3, R1

Self-adhesive rolls (Width: 1.0m, Colour: Blue)

Item	Insulation thickness	Length	Carton content
	[mm]	[m]	[sqm]
RA-03-99/EA	3	30	30.0
RA-06-99/EA	6	15	15.0
RA-09-99/EA	9	10	10.0
RA-13-99/EA	13	8	8.0
RA-19-99/EA	19	5	5.0
RA-25-99/EA	25	4	4.0

Other information	
Length tolerance	± 1.5%
Thickness tolerance	3 - 6mm: ± 1.0mm
	9 - 19mm: ± 1.5mm
Reaction to fire	HL2, R1 acc. to EN 45545-2 3mm sheets: HL3, R1

Accessories

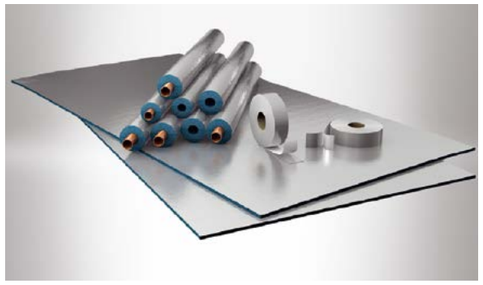
Item	Carton content	Article description
RA-TAPE	12 rolls	ArmaFlex Rail SD Tape (3mm thickness x 50mm width x 15m length)
AHU-700/1,0	12 x 1.0 litre cans	ArmaFlex Ultima® adhesive 700

Other information (ArmaFlex Rail SD Tape)	
Length tolerance	-1.5 / +5%
Thickness tolerance	-0.1 / +1.5mm
Reaction to fire	HL3, R1 acc. to EN 45545-2

ARMAFLEX RAIL SD-C

The first closed-cell insulation material for use in areas requiring the highest hazard level - HL3.

- Built-in Microban protection reduces mould and bacteria growth
- Excellent mechanical protection and high degree of stability under exposure to UV
- Wash-down waterproof and easy to clean
- Meets the highest hazard level requirements
  - EN 45545 – HL3, R1



Product range

1m length pre-covered tubes, self-adhesive pre-covered sheets and tape.

Tubes (Length: 1.0m, Colour: Blue with silver covering)

9mm		Pipe maximum outside diameter
Item	Carton content	
	[m]	[mm]
SDC-09X012	96	12
SDC-09X015	82	15
SDC-09X018	75	18
SDC-09X022	61	22
SDC-09X028	45	28
SDC-09X035	34	35
SDC-09X042	28	42

Other information	
Length tolerance	± 1.5%
Thickness tolerance	9mm ± 1.5mm
Reaction to fire	HL3, R1 acc. to EN 45545-2

Self-adhesive sheets, precovered (Width: 1.0m, Colour: Blue)

Item	Insulation thickness	Length	Carton content
	[mm]	[m]	[sqm]
SDC-06MM/A	6	2	50.0
SDC-09MM/A	9	2	34.0
SDC-13MM/A	13	2	24.0
SDC-19MM/A	19	2	16.0
SDC-25MM/A	25	2	12.0

Other information	
Length tolerance	± 1.5%
Thickness tolerance	6mm: ± 1.0mm
	9 - 19mm: ± 1.5mm
	25mm: ± 2.0mm
Reaction to fire	HL3, R1 acc. to EN 45545-2

Accessories

Item	Carton content	Article description
ACH-PSATAPES-30	10 rolls	ArmaFlex Rail SD-C Tape (0.08mm thickness x 30mm width x 25m length)
ACH-PSATAPES-50	6 rolls	ArmaFlex Rail SD-C Tape (0.08mm thickness x 50mm width x 50m length)

ArmaFlex Rail insulation protects hot and cold water pipes against unacceptable temperature fluctuations which can lead to a contamination with legionella bacteria. The dust- and fibre-free material prevents condensation and thermal losses and the Microban technology offers protection against the development of bacteria and mould. Armacell also offers sandwich constructions based on ArmaForm® to offer low life-cycle costs and greater passenger comfort.

ARMAFLEX RAIL ZH

The first halogen-free, closed-cell insulation material to achieve HL2, R1 classification, under EN 45545.

- Halogen-free insulation minimises corrosive effects and smoke toxicity in the event of fire
- Low smoke density, superior fire behaviour
- Dust- and fibre-free material with low thermal conductivity
- High-tech insulation with built-in fire protection for railway vehicles
  - EN 45545 – HL2, R1

Product range

2m length tubes, rolls, self-adhesive rolls and tape.

Tubes (Length: 2.0m, Colour: Dark grey)

9 mm		
Item	**Carton conten**	**Pipe maximum outside diameter**
	[m]	**[mm]**
ZH-09X012	192	12
ZH-09X015	164	15
ZH-09X018#	150	18
ZH-09X022	122	22
ZH-09X028	90	28
ZH-09X035	68	35
ZH-09X042	56	42

#Made to order. Minimum order quantities and different lead times may apply.

Other information	
Length tolerance	± 1.5%
Thickness tolerance	9mm ± 1.5mm
Reaction to fire	HL2, R1 acc. to EN 45545-2

Rolls (Width: 1.0m, Colour: Dark grey)

Item	Insulation thickness	Length	Carton content
	[mm]	**[m]**	**[sqm]**
ZH-03-99/E	3	30	30.0
ZH-06-99/E#	6	15	15.0
ZH-10-99/E	10	10	10.0
ZH-13-99/E	13	8	8.0

#Made to order. Minimum order quantities and different lead times may apply.

Other information	
Length tolerance	± 1.5%
Thickness tolerance	3 - 6mm: ± 1.0mm
	9 - 13mm: ± 1.5mm
Reaction to fire	HL2, R1 acc. to EN 45545-2 3mm sheets: HL3, R1

Self-adhesive rolls (Width: 1.0m, Colour: Dark grey)

Item	Insulation thickness	Length	Carton content
	[mm]	**[m]**	**[sqm]**
ZH-03-99/EA	3	30	30.0
ZH-06-99/EA	6	15	15.0
ZH-10-99/EA	10	10	10.0
ZH-13-99/EA	13	8	8.0

Other information	
Length tolerance	± 1.5%
Thickness tolerance	3 - 6mm: ± 1.0mm
	9 - 13mm: ± 1.5mm
Reaction to fire	HL2, R1 acc. to EN 45545-2 3mm sheets: HL3, R1

Accessories

Item	Carton content	Article description
ZH-TAPE	12 rolls	ArmaFlex Rail ZH Tape (3mm thickness x 50mm width x 15m length)

Other information	
Length tolerance	-1.5 / +5%
Thickness tolerance	-0.1 / +1.5mm
Reaction to fire	HL3, R1 acc. to EN 45545-2

ARMAFLEX RAIL ZH-C

The first halogen-free, closed-cell insulation material for rail applications with the highest hazard level requirements.

- Halogen-free insulation minimises corrosive effects and smoke toxicity in the event of fire
- Resistant to UV, salt water and chemicals
- Wash-down waterproof and easy to clean
- Factory-applied, silver metallic look with reinforced coating for increased hygienic requirements
- Achieves HL3, R1 classification under EN 45545

Product range

1m length pre-covered tubes, rolls, self-adhesive rolls and tape.

Tubes (Length: 1.0m, Colour: Dark grey with silver covering)

9mm		
Item	**Carton content**	**Pipe maximum outside diameter**
	[m]	**[mm]**
ZHC-09X012	96	12
ZHC-09X015	82	15
ZHC-09X018	75	18
ZHC-09X022	61	22
ZHC-09X028	45	28
ZHC-09X035	34	35
ZHC-09X042	28	42

Other information	
Length tolerance	± 1.5%
Thickness tolerance	9mm ± 1.5mm
Reaction to fire	HL3, R1 acc. to EN 45545-2

Self-adhesive sheets, precovered
(Width: 1.0m, Colour: Dark grey with silver covering)

Item	Insulation thickness	Length	Carton content
	[mm]	**[m]**	**[sqm]**
ZHC-06MM/A	6	2	50.0
ZHC-10MM/A	10	2	34.0
ZHC-13MM/A	13	2	24.0
ZHC-19MM/A	19	2	16.0
ZHC-25MM/A	25	2	12.0

Other information	
Length tolerance	± 1.5%
Thickness tolerance	6mm: ± 1.0mm
	9 - 19mm: ± 1.5mm
	25mm: ± 2.0mm
Reaction to fire	HL3, R1 acc. to EN 45545-2

Wherever energy is transported, part of the valuable resource is lost when the equipment is not, or poorly, insulated. With HVAC equipment being the second largest energy consumer, insulation with our dedicated ArmaFlex Rail products offers enormous energy-saving potential.

00216 | ArmaFlex Rail | ArmaFlex | TechSheet | 012020 | APAC | EN MASTER

ABOUT ARMACELL

As the inventors of flexible foam for equipment insulation and a leading provider of engineered foams, Armacell develops innovative and safe thermal, acoustic and mechanical solutions that create sustainable value for its customers. Armacell's products significantly contribute to global energy efficiency making a difference around the world every day. With 3,100 employees and 24 production plants in 16 countries, the company operates two main businesses, Advanced Insulation and Engineered Foams. Armacell focuses on insulation materials for technical equipment, high-performance foams for high-tech and lightweight applications and next generation aerogel blanket technology.

For more information, please visit:
www.armacell.com

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