

High-performance railway hose meets R22/R23 test requirements for hazard levels 3 and 3



EATON

Powering Business Worldwide


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The challenge facing the rail industry is to make rail travel as reliable, efficient, safe and comfortable as possible. Power is fundamental to keeping rail networks moving--whether managing power in a centralized depot, in the rolling stock or in helping ensure sufficient power reaches remote stations.

Driven by regulations and increased globalization, train builders and railway operators must find ways to reduce downtime, increase productivity and enhance safety and security to drive profitability and make the industry more sustainable.

Eaton understands the need for power solutions that work. Powering the rail industry means helping our customers build better and safer trains, while enabling railway operators to operate competitively with products designed for maximum reliability. Our focus on energy efficiency and safety means our customers can rest assured that they'll be able to meet stringent regulations and drive the industry towards a sustainable future. With technical expertise and project management capabilities, plus a broad portfolio of electrical and hydraulic solutions, Eaton can help you minimize risk and secure your rail projects.

Upgrade to a railway hose that meets inside and outside requirements

EN 45545-2 is the single standard for hose assembly fire behavior (toxicity, smoke density and oxygen-depletion), now adopted by all EU nations. Over the next few years EN45545-2 will replace the country-by-country standards formerly in place.

The Eaton Railway Hose series of hoses conforms to the EN45545-2 standard and is now available for use on a variety of railway uses. In fact, the Railway series of hoses also

meet up to R22/HL3 and R23/HL3 requirements for our 1SN, 2SN. The Railway series of hoses are available with R22/HL2 and R23/HL3 in 1SC, 2SC and 2TE models.

Further hose types are tested to cover additional applications with R22/HL1 and R23/HL2.

Eaton is offering leading products that guarantee the highest levels of safety and performance for all areas within the conveyance systems used.

Tested conformance to EN45545-2

The advent of a single standard for hose assembly fire behavior (EN 45545-2) has been adopted by and is replacing country by country standards. Eaton supplies hoses that conform to every part of the standard. But Eaton hoses actually elevate the product offering to HL3 compatible parts

Table 1
EN45545-2 conformance tests by country

Country	Standard	Test Item
France	French standard NF F 16-101 Tests fire behavior, fire effluents and toxicity of the hose	Smallest, medium and largest width of a specific hose type: <ul style="list-style-type: none"> • Flame resistance class I3 • Smoke generation and toxicity class F3
Germany	German standard DIN 5510 part 2 (05/2009) Tests fire behavior, fire effluents and toxicity of the hose	Smallest and largest nominal width of a specific hose type: <ul style="list-style-type: none"> • Flammability class S3 • Droplet class ST2 • Smoke generation class SR2 • Toxicity FED (t zul.) < 1
Great Britain	British standard BS 6853 Tests fire behavior and fire effluents of the hose cover material	Rubber hose cover material Smoke behavior Release of toxins meets the limit value: category Ib, II
Italy	Italian standard UNI CEI 11170-3 Tests fire behavior and fire effluents of hose material	The smallest and largest nominal width of a specific hose type: <ul style="list-style-type: none"> • Smoke generation • Fire resistance • Toxicity • Overall class: LR4

Meets and exceeds hazard requirements

Most manufacturers have yet to meet the stringent requirement sets for R22 and R23. Eaton Railway hoses are certified to conform to the EN45545-2 standards.

Requirement set used for	Test Method & Reference	Testing for (unit)	Minimum / Maximum	Thresholds HL1	HL2	HL3	Eaton Railway Hoses
Inside uses R22 (IN16; EL2; EL6A; EL7A; M2)	T01 EN ISO 4589-2: 01	Oxygen Content (%)	Minimum	28	28	32	Meets and/or exceeds HL3 minimum threshold
	T10.03 EN ISO 5659-3 25kWm ⁻²	Smoke Density (D _s max. dimensionless)	Maximum	600	300	150	Meets and/or exceeds HL3 maximum threshold
	T12 NF X70-100-1 and -2, 600° C	Smoke Toxicity (CIT _{NLP} dimensionless)	Maximum	1.2	0.9	0.75	Meets and/or exceeds HL3 maximum threshold
Outside uses R23 (EX12; EL2; EL5 EL6B; EL7B; M3)	T01 EN ISO 4589-2: 01	Oxygen Content (%)	Minimum	28	28	32	Meets and/or exceeds HL3 minimum threshold
	T10.03 EN ISO 5659-3 25kWm ⁻²	Smoke Density (D _s max. dimensionless)	Maximum	-	600	300	Meets and/or exceeds HL3 maximum threshold
	T12 NF X70-100-1 and -2, 600° C	Smoke Toxicity (CIT _{NLP} dimensionless)	Maximum	-	1.8	1.5	Meets and/or exceeds HL3 maximum threshold

Hose type	Hose spec	R22 (internal)	R23 (external)	Size	Comment
EC112 (1SC)	EN857	HL2	HL3	-4 up to -16	ISO 15540
EC212 (2SC)	EN857	HL3	HL3	-4 up to -32	ISO 15540
EC109 (1SN)	EN853	HL3	HL3	-4 up to -16	ISO 15540
EC209 (2SN)	EN853	HL3	HL3	-4 up to -16	ISO 15540
EC045 (2TE)	EN854	HL2	HL3	-3 up to -16	
EC045 (2TE)	EN854	HL3	HL3	-5 and -10	
GH506	4SH	HL1	HL2	-12 up to -32	
GH466	6SP/SAE100R15	HL1	HL2	-20 up to -32	
EC850	500BAR	HL1	HL2	-10 up to -20	
EC525 AQP	4SP AQP	HL1	HL2	-12 up to -32	
FC800+624	Air conditioning	HL2	HL3	-12 up to -24	Fire sleeve 624 required to achieve HL
FC350-624	AQP - Fuel	HL2	HL3	-4 up to -24	Fire sleeve 624 required to achieve HL
FC510	SAE100R2 AQP	HL1	HL2	-4 up to -20	
EC190	SAE 100R4	HL1	HL2	-12 up to -48	

EN45545-2 conforming railway hose

1 wire braid, synthetic rubber cover (EN853 type 1SN / EN45545-2)

# Part Number	DN	Hose I.D.		W.B.O.D. max.		O.D. max.		Max. OP	Proof	Burst	Bend Radius	Weight
		mm	in	mm	in	mm	in	bar	bar	bar	mm	kg/m
EC109-04	6	6,4	0.25	11,6	0.46	14,1	0.55	225	450	900	100	0,22
EC109-05	8	7,9	0.31	13,1	0.52	15,7	0.62	215	430	860	115	0,26
EC109-06	10	9,5	0.38	15,5	0.61	18,1	0.71	180	360	720	130	0,33
EC109-08	12	12,7	0.50	18,6	0.73	21,4	0.84	160	320	640	180	0,41
EC109-10	16	15,9	0.63	21,7	0.85	24,5	0.96	130	260	520	200	0,47
EC109-12	19	19,0	0.75	25,7	1.00	28,5	1.12	105	210	420	240	0,59
EC109-16	25	25,4	1.00	33,6	1.32	36,6	1.44	88	176	352	300	0,87

For use with EATON Global Braided TTC Fittings

2 wire braid, synthetic rubber cover (EN853 type 2SN / EN45545-2)

# Part Number	DN	Hose I.D.		W.B.O.D. max.		O.D. max.		Max. OP	Proof	Burst	Bend Radius	Weight
		mm	in	mm	in	mm	in	bar	bar	bar	mm	kg/m
EC209-04	6	6,4	0.25	13,3	0.52	15,7	0.62	400	800	1600	100	0,38
EC209-05	8	7,9	0.31	14,8	0.58	17,3	0.68	350	700	1400	115	0,43
EC209-06	10	9,5	0.38	17,2	0.68	19,7	0.78	330	660	1320	130	0,54
EC209-08	12	12,7	0.50	20,3	0.80	23,0	0.91	275	550	1100	180	0,64
EC209-10	16	15,9	0.63	23,4	0.92	26,2	1.03	250	500	1000	200	0,75
EC209-12	19	19,0	0.75	27,4	1.08	30,1	1.19	215	430	860	240	0,93
EC209-16	25	25,4	1.00	35,2	1.39	38,9	1.53	165	330	660	300	1,29

For use with EATON Global Braided TTC Fittings

High-performance railway hose meets R22/R23 test requirements for hazard levels 2 and 3

Requirement set used for	Test Method & Reference	Testing for (unit)	Minimum / Maximum	Thresholds			Eaton Railway Hoses
				HL1	HL2	HL3	
Inside uses R22 (IN16; EL2; EL6A; EL7A; M2)	T01 EN ISO 4589-2: OI	Oxygen Content (%)	Minimum	28	28	32	Meets and/or exceeds HL2 minimum threshold
	T10.03 EN ISO 5659-3 25kWm ⁻²	Smoke Density (D _s max. dimensionless)	Maximum	600	300	150	Meets and/or exceeds HL2 maximum threshold
	T12 NF X70-100-1 and -2, 600° C	Smoke Toxicity (CIT _{NLP} dimensionless)	Maximum	1.2	0.9	0.75	Meets and/or exceeds HL2 maximum threshold
Outside uses R23 (EX12; EL2; EL5 EL6B; EL7B; M3)	T01 EN ISO 4589-2: OI	Oxygen Content (%)	Minimum	28	28	32	Meets and/or exceeds HL3 minimum threshold
	T10.03 EN ISO 5659-3 25kWm ⁻²	Smoke Density (D _s max. dimensionless)	Maximum	-	600	300	Meets and/or exceeds HL3 maximum threshold
	T12 NF X70-100-1 and -2, 600° C	Smoke Toxicity (CIT _{NLP} dimensionless)	Maximum	-	1.8	1.5	Meets and/or exceeds HL3 maximum threshold

EN45545-2 conforming railway hose

1 wire braid, synthetic rubber cover (EN857 type 1SC / EN45545-2)

# Part Number	DN	Hose I.D.		W.B.O.D. max.		O.D. max.		Max. OP		Burst	Bend Radius	Weight
		mm	in	mm	in	mm	in	bar	bar			
EC112-4	6	6,4	0.25	10,8	0.43	13,5	0.53	225	450	900	50	0,18
EC112-5	8	7,9	0.31	12,1	0.48	14,5	0.57	215	430	860	55	0,21
EC112-6	10	9,5	0.38	14,5	0.57	16,9	0.67	180	360	720	65	0,26
EC112-8	12	12,7	0.50	18,1	0.71	20,4	0.80	160	320	640	90	0,35
EC112-10	16	15,9	0.63	21,0	0.83	23,0	0.91	130	260	520	100	0,43
EC112-12	19	19,0	0.75	24,4	0.96	26,7	1.05	105	210	420	120	0,50
EC112-16	25	25,4	1.00	31,9	1.26	34,9	1.37	88	176	352	150	0,74

* Exceeds EN857 bend radius requirement, allowing increased flexibility with smaller bends and easier installation.
For use with EATON Global Braided TTC Fittings

2 wire braid, synthetic rubber cover (EN857 type 2SC / EN45545-2)

# Part Number	DN	Hose I.D.		W.B.O.D. max.		O.D. max.		Max. OP		Burst	Bend Radius	Weight
		mm	in	mm	in	mm	in	bar	bar			
EC212-4	6	6,4	0.25	11,7	0.46	14,2	0.56	400	800	1600	50	0,29
EC212-5	8	7,9	0.31	13,3	0.52	16,0	0.63	350	700	1400	55	0,33
EC212-6	10	9,5	0.38	15,6	0.61	18,3	0.72	330	660	1320	65	0,41
EC212-8	12	12,7	0.50	19,1	0.75	21,5	0.85	275	550	1100	90	0,58
EC212-10	16	15,9	0.63	22,3	0.88	24,7	0.97	250	500	1000	100	0,69
EC212-12	19	19,0	0.75	26,4	1.04	28,6	1.13	215	430	860	120	0,81
EC212-16	25	25,4	1.00	34,3	1.35	36,6	1.44	165	330	660	150	1,17
EC212-20	31	31,8	1.25	41,6	1.64	44,4	1.75	125	250	500	210	1,53
EC212-24	38	38,1	1.50	48,5	1.90	51,5	2.03	100	200	400	250	1,89
EC212-32	51	50,8	2.00	61,2	2.41	64,2	2.53	90	180	360	315	2,42

* Exceeds EN857 bend radius requirement, allowing increased flexibility with smaller bends and easier installation.
For use with EATON Global Braided TTC Fittings

1 textile braid, synthetic rubber cover (EN854 type 2TE / EN45545-2)

# Part Number	DN	Hose I.D.		O.D. max.		Max. OP		Burst	Bend radius	Weight
		mm	in	mm	in	bar	bar			
EC045-3	5	4,8	0.19	12,6	0.50	80	160	320	35	0,12
EC045-4	6	6,4	0.25	14,2	0.56	75	150	300	40	0,15
EC045-5	8	7,9	0.31	15,7	0.62	68	136	270	50	0,17
EC045-6	10	9,5	0.38	17,3	0.68	63	126	250	60	0,20
EC045-8	12	12,7	0.50	20,7	0.81	58	116	230	70	0,24
EC045-10	16	15,9	0.63	24,9	0.98	50	100	200	90	0,33
EC045-12	19	19,0	0.75	28,0	1.10	45	90	180	110	0,38
EC045-16	25	25,4	1.00	35,9	1.41	40	80	160	150	0,55

For use with EATON Global Braided OTC Fittings (1G...)

# Part Number	DN	Hose I.D.		Hose O.D. max.		Max operating pressure		Burst pressure		Minimum bend radius		Vacuum	Weight	
		mm	in	mm	in	bar	psi	bar	psi	mm	in		bar	kg/m
EC190-12	19	19.0	0.75	32.6	1.28	21	305	84	1220	40	1.57	-0.80	0.83	0.56
EC190-16	25	25.4	1.00	38.2	1.50	17	245	68	980	45	1.77	-0.80	0.97	0.65
EC190-20	31	32.0	1.26	46.0	1.81	14	205	56	820	60	2.36	-0.80	1.29	0.87
EC190-24	38	38.0	1.50	52.4	2.06	10	145	40	580	65	2.56	-0.80	1.66	1.12
EC190-32	51	50.8	2.00	66.0	2.60	7	100	28	400	100	3.94	-0.80	2.37	1.59
EC190-40*	63	63.5	2.50	79.1	3.11	4	60	16	240	140	5.51	-0.80	2.92	1.96
EC190-48*	80	76.2	3.00	95.0	3.74	4	60	16	240	180	7.09	-0.80	4.18	2.81

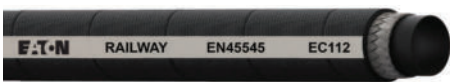



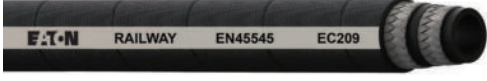
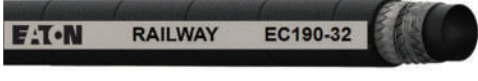
* Available as bulk hose only

For use with EATON Global Braided OTC Fittings (1G...)

EN45545-2 conforming railway hose

Railway hose technical data

EN45545- Conforming Hose

Image	Construction	Operating Temperatures	Application
EC112 (1SC) 	<ul style="list-style-type: none"> Synthetic rubber tube Single wire braid reinforcement Black fire retardant synthetic rubber cover 	-40°C to +125°C (-40°F to +250°F) Air max. +75°C max.: +165°F Water max.: +85°C max.: +185°F	Hydraulic Railway Systems with Petroleum and Water-Glycol Base Fluids, for Lubricating oils and water
EC212 (2SC) 	<ul style="list-style-type: none"> Synthetic rubber tube Two wire braid reinforcement Black fire retardant synthetic rubber cover 		
EC045-2TE 	<ul style="list-style-type: none"> Synthetic rubber tube Single textile braid Reinforcement Black fire retardant synthetic rubber cover 		
EC109-1SN 	<ul style="list-style-type: none"> Synthetic rubber tube Single wire braid reinforcement Black fire retardant synthetic rubber cover 		
EC209-2SN 	<ul style="list-style-type: none"> Synthetic rubber tube Two wire braid reinforcement Black fire retardant synthetic rubber cover 		
EC190 	<ul style="list-style-type: none"> Synthetic rubber inner tube High tensile synthetic textile, steel helix wire and antistatic copper strand Black fire retardant synthetic rubber cover 	-40°C to +125°C* (-40°F to +275°F) Air max +75°C(+165°F) Water max +85°C(+185°F) Water Glycol emulsion max +95°C (+203°F) Short term up to +130°C (+266°F)	For use in Railway in suction applications for petroleum, lubricating oils, fuel, gasoline, air, water and water glycol.

Further certificate

EN ISO-15540 (EN45545-4)

The EC112 and EC212 have passed the 15 min. fire flame test (800°C) and follow 2 min. proof pressure without any additional fire sleeve.





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RAPPORTO DI PROVA / TEST REPORT
NO. 2548-2549.1S0040/17

METODO DI PROVA: UNI EN 45545-2: 2015
Test method

DENOMINAZIONE DELLA PROVA: Requisiti di comportamento al fuoco di materiali e componenti
Description of the standard

RICHIEDENTE: EATON Germany GmbH
Sponsor
Dr. Reckeweg Straße 1
D-76532 Baden-Baden (Germany)

DENOMINAZIONE DEL MATERIALE: EC112
Denomination of the material

GAMMA DIAMETRI NOM. DEI CAMPIONI: Diameter from 6.4 mm to 25.4 mm
Nominal diameters range of the samples
6÷25 (Size from -04 to -16)

DESCRIZIONE DEL MATERIALE: Tubo con rivestimento di colore nero con rinforzo metallico.
Description of the material
Hose with black cover with a metal reinforcement.

Questo documento fa riferimento ai Rapporti di Prova no. 2548-2549.050030/17, no. 2548-2549.1S0030/17 e no. 2548-2549.1S0050/17 emessi da questo Laboratorio.
This certificate refers to the Test Reports no. 2548-2549.050030/17, no. 2548-2549.1S0030/17 and no. 2548-2549.1S0050/17 issued by this Laboratory.

Prodotto / Product	M2 (Tubazioni flessibili per interno / Hoses - Interior) M3 (Tubazioni flessibili per esterno / Hoses - Exterior)					
Requisiti / Requirements	R22 - R23					
Prove richieste / Tests required	EN ISO 4589-2	EN ISO 5659-2		NF X 70-100-1/-2		
Parametro / Parameter	LOI (%)	(25 kW/m ² - Flaming) Ds max		CIT _{max}		
Valori trovati / Values found (Size -4 - DN 6 - Rif. Lab. 2548/17)	41.3	69		0.17		
Valori trovati / Values found (Size -16 - DN 25 - Rif. Lab. 2549/17)	39.5	61		0.12		
	Per / For	R22	R23	R22	R23	
Limiti di accettazione Acceptance limits	H1: ≥ 28% H2: ≥ 28% H3: ≥ 32%	H1: ≤ 600 H2: ≤ 300 H3: ≤ 150	H1: --- H2: ≤ 600 H3: ≤ 300	H1: ≤ 1.2 H2: ≤ 0.9 H3: ≤ 0.75	H1: --- H2: ≤ 1.8 H3: ≤ 1.5	

Legenda --- Nessun requisito / No requirement

VALUTAZIONE / JUDGEMENT


Sulla base dei risultati di prova sopra riportati il materiale in oggetto **È CONFORME** alle richieste di UNI EN 45545-2:2015 per livelli di rischio H1 - H2 - H3 set di requisiti R22 e R23 per la gamma di diametri sopra riportati.
On the basis of the above results the sample in object COMPLIES with the requirements of UNI EN 45545-2: 2015 for Hazard Levels H1 - H2 - H3 requirements set R22 and R23 for the diameters range reported above.


Prato, 26/09/2017
Valid until: 25/09/2022

Il Responsabile Certificazione
The Certification Manager
Dr. Massimo Borsini
Il Direttore del Laboratorio
The Director of the Laboratory
Dr. Luca Ermilini

Questo documento deve essere letto congiuntamente ai Rapporti di Prova sopra riportati, per la descrizione del prodotto e per ogni altra notizia di dettaglio. Questo documento non costituisce approvazione di tipo né certificazione di prodotto né tantomeno dichiarazione di conformità, che spetta esclusivamente al Produttore / Sponsor. Il riconoscimento Certifier si riferisce alle prove di EN 45545-2 riportate nella lista pubblicata.
This document has to be read in conjunction with the Test Reports listed above, for the description of the product and for every other detail. This document does not represent type approval or certification of the product neither declaration of compliance, that is exclusively under the responsibility of the Manufacturer or Sponsor. The Certifier approval refers to the tests according to EN 45545-2 reported in the published list.

Il presente Rapporto di Prova non può essere riprodotto in forma parziale senza l'autorizzazione scritta di questo Laboratorio





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RAPPORTO DI PROVA / TEST REPORT
NO. 2550-2551.1S0040/17

METODO DI PROVA: UNI EN 45545-2: 2015
Test method

DENOMINAZIONE DELLA PROVA: Requisiti di comportamento al fuoco di materiali e componenti
Description of the standard

RICHIEDENTE: EATON Germany GmbH
Sponsor
Dr. Reckeweg Straße 1
D-76532 Baden-Baden (Germany)

DENOMINAZIONE DEL MATERIALE: EC212
Denomination of the material

GAMMA DIAMETRI NOM. DEI CAMPIONI: Diameter from 6.4 mm to 50.8 mm
Nominal diameters range of the samples
6÷51 (Size from -04 to -32)

DESCRIZIONE DEL MATERIALE: Tubo con rivestimento di colore nero con rinforzo metallico.
Description of the material
Hose with black cover with a metal reinforcement.

Questo documento fa riferimento ai Rapporti di Prova no. 2550-2551.050030/17, no. 2550-2551.1S0030/17 e no. 2550-2551.1S0050/17 emessi da questo Laboratorio.
This certificate refers to the Test Reports no. 2550-2551.050030/17, no. 2550-2551.1S0030/17 and no. 2550-2551.1S0050/17 issued by this Laboratory.

Prodotto / Product	M2 (Tubazioni flessibili per interno / Hoses - Interior) M3 (Tubazioni flessibili per esterno / Hoses - Exterior)					
Requisiti / Requirements	R22 - R23					
Prove richieste / Tests required	EN ISO 4589-2	EN ISO 5659-2		NF X 70-100-1/-2		
Parametro / Parameter	LOI (%)	(25 kW/m ² - Flaming) Ds max		CIT _{max}		
Valori trovati / Values found (Size -4 - DN 6 - Rif. Lab. 2550/17)	40.7	70		0.17		
Valori trovati / Values found (Size -32 - DN 51 - Rif. Lab. 2551/17)	40.8	147		0.17		
	Per / For	R22	R23	R22	R23	
Limiti di accettazione Acceptance limits	H1: ≥ 28% H2: ≥ 28% H3: ≥ 32%	H1: ≤ 600 H2: ≤ 300 H3: ≤ 150	H1: --- H2: ≤ 600 H3: ≤ 300	H1: ≤ 1.2 H2: ≤ 0.9 H3: ≤ 0.75	H1: --- H2: ≤ 1.8 H3: ≤ 1.5	

Legenda --- Nessun requisito / No requirement

VALUTAZIONE / JUDGEMENT

Sulla base dei risultati di prova sopra riportati il materiale in oggetto **È CONFORME** alle richieste di UNI EN 45545-2:2015 per livelli di rischio H1 - H2 - H3 set di requisiti R22 e R23 per la gamma di diametri sopra riportati.
On the basis of the above results the sample in object COMPLIES with the requirements of UNI EN 45545-2: 2015 for Hazard Levels H1 - H2 - H3 requirements set R22 and R23 for the diameters range reported above.

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Questo documento deve essere letto congiuntamente ai Rapporti di Prova sopra riportati, per la descrizione del prodotto e per ogni altra notizia di dettaglio. Questo documento non costituisce approvazione di tipo né certificazione di prodotto né tantomeno dichiarazione di conformità, che spetta esclusivamente al Produttore / Sponsor. Il riconoscimento Certifier si riferisce alle prove di EN 45545-2 riportate nella lista pubblicata.
This document has to be read in conjunction with the Test Reports listed above, for the description of the product and for every other detail. This document does not represent type approval or certification of the product neither declaration of compliance, that is exclusively under the responsibility of the Manufacturer or Sponsor. The Certifier approval refers to the tests according to EN 45545-2 reported in the published list.

Il presente Rapporto di Prova non può essere riprodotto in forma parziale senza l'autorizzazione scritta di questo Laboratorio

Eaton: your single-source supplier

Not only is Eaton the first manufacturer to carry an EN45545-2-conforming railway hose, but this hose also meets HL3 requirements for outside use. And beyond that, Eaton also carries a full range of hoses, couplings and PMC.







The high performance high pressure hose GH466 combines the 2 Mil flex impulse cycle capabilities with R22/HL1 and R23/HL2 performance. In combination with the Eaton Internal Skive fittings 1W, leakage class 0 can be guaranteed up to 2 Mil impulse cycles.

Spiral hose specifications r22/r23 test requirements for hazard levels 1 and 2

Requirement set used for	Test Method & Reference	Testing for (unit)	Minimum / Maximum	Thresholds			Eaton Railway Hoses
				HL1	HL2	HL3	
Inside uses R22 (IN16; EL2; EL6A; EL7A; M2)	T01 EN ISO 4589-2: 01	Oxygen Content (%)	Minimum	28	28	32	Meets and/or exceeds HL1 minimum threshold
	T10.03 EN ISO 5659-3 25kWm ⁻²	Smoke Density (D _s max. dimensionless)	Maximum	600	300	150	Meets and/or exceeds HL1 maximum threshold
	T12 NF X70-100-1 and -2, 600° C	Smoke Toxicity (CIT _{NLP} dimensionless)	Maximum	1.2	0.9	0.75	Meets and/or exceeds HL1 maximum threshold
Outside uses R23 (EX12; EL2; EL5 EL6B; EL7B; M3)	T01 EN ISO 4589-2: 01	Oxygen Content (%)	Minimum	28	28	32	Meets and/or exceeds HL2 minimum threshold
	T10.03 EN ISO 5659-3 25kWm ⁻²	Smoke Density (D _s max. dimensionless)	Maximum	-	600	300	Meets and/or exceeds HL2 maximum threshold
	T12 NF X70-100-1 and -2, 600° C	Smoke Toxicity (CIT _{NLP} dimensionless)	Maximum	-	1.8	1.5	Meets and/or exceeds HL2 maximum threshold







High performance spiral hydraulic hose

Dynamax EC850

# Part Number	DN	 Hose I.D.		 Hose O.D.		 Max. Operating Pressure		 Burst Pressure		 Min. Bend Radius		 Weight	
		mm	in	mm	in	bar	psi	bar	psi	mm	in	kg/m	lbs/ft
EC850-10	16	15,9	0.63	29,0	1.14	500	7250	2000	29000	200,0	7.87	1,23	0.82
EC850-12	19	19,1	0.75	33,3	1.31	500	7250	2000	29000	215,0	8.46	1,52	1.01
EC850-16	25	25,4	1.00	40,4	1.59	500	7250	2000	29000	270,0	10.63	2,31	1.54
EC850-20	31	31,8	1.25	50,9	2.00	500	7250	2000	29000	380,0	14.96	4,01	2.69







GH466 6SP

(Type SAE100R15/EN 45545-2 super high pressure hydraulic hose)







# Part Number	DN	Hose Size 1/16"	 Hose I.D.		 Hose O.D.		 Max. Operating Pressure		 Burst Pressure		 Min. Bend Radius		 Weight	
			mm	in	mm	in	bar	psi	bar	psi	mm	in	kg/m	lbs/ft
GH466-20	-	-20	31,8	1.25	49,4	1.94	420	6100	1680	24,400	420	16.54	3,5	2.35
GH466-24	38	-24	38,1	1.50	57,3	2.26	420	6100	1680	24,400	500	19.69	4,6	3.09
GH466-32	51	-32	51,4	2.02	71,7	2.82	420	6100	1680	24,400	630	24.80	6,7	4.50

GH506 high pressure hydraulic hose

(EN856 4SH/EN 45545-2 super high pressure hydraulic hose)

# Part Number	DN	Hose Size 1/16"	 Hose I.D.		 Hose O.D.		 Max. Operating Pressure		 Burst Pressure		 Min. Bend Radius		 Weight	
			mm	in	mm	in	bar	psi	bar	psi	mm	in	kg/m	lbs/ft
GH506-12	19	-12	19,0	0.75	32,2	1.27	420	6100	1680	24,400	280	11.02	1,62	1.09
GH506-16	25	-16	25,4	1.00	38,3	1.51	420	6100	1680	24,400	340	13.39	2,00	1.34
GH506-20	31	-20	31,8	1.25	45,5	1.79	350	5075	1400	20,300	460	18.11	2,50	1.68
GH506-24	38	-24	38,1	1.50	53,5	2.11	300	4350	1200	17,400	560	22.05	3,30	2.22
GH506-32	51	-32	50,8	2.00	68,1	2.68	250	3625	1000	14,500	700	27.56	4,70	3.16

EC 525 AQP™ PLUS hi-temp 4-spiral hose

# Part Number	DN	 Hose I.D.		 Hose O.D.		 Max. Operating Pressure		 Burst Pressure		 Min. Bend Radius		 Weight	
		mm	in	mm	in	bar	psi	bar	psi	mm	in	kg/m	lbs/ft
EC525-12	19	19,1	0.75	31,5	1.24	345	5000	1380	20000	241,3	9.50	1,28	0.86
EC525-16	25	25,4	1.00	38,5	1.52	345	5000	1380	20000	304,8	12.00	1,73	1.16
EC525-20	31	31,8	1.25	47,5	1.87	240	3500	960	14000	419,1	16.50	2,30	1.55
EC525-24	38	38,1	1.50	54,9	2.16	240	3500	960	14000	508,0	20.00	2,95	1.98
EC525-32	51	50,8	2.00	68,5	2.70	225	3250	900	13000	635,0	25.00	4,40	2.96

High performance spiral hydraulic hose

Spiral hose technical data

EN45545- Conforming Hose

	Image	Construction	Operating Temperatures	Application
EC850		<ul style="list-style-type: none"> Synthetic rubber tube, multiple heavy spiral wire (4-spiral wire in -10, -12, -16), (6-spiral wire in -20), Highly abrasion resistant DURA-TUFF rubber cover 	-40°C to + 100°C (-40°F to + 212°F)	<ul style="list-style-type: none"> High pressure hydraulic systems with petroleum based fluids Highly demanding applications: hydrostatic drive systems, high pressure direct steering and extremely high pressure hydraulic applications Critical applications in forestry, construction, agriculture, snow removal and other off-highway equipment
GH466		<ul style="list-style-type: none"> Synthetic NBR rubber tube, 6 high tensile spiral wire reinforcement Synthetic CR rubber cover 	-40°C to + 120°C (-40°F to + 250°F)	<ul style="list-style-type: none"> High pressure hydraulic systems with constant high working pressure for use with petroleum based fluids. Applications like construction equipment, earth-moving machines, agriculture machines, presses, injection molding machines, mining Super high performance product Qualified with 2 million flex impulse cycles with leakage class 0 according to SAE J1176 Extremely long life Qualified with the high performance designed ISC fittings
GH506		<ul style="list-style-type: none"> Synthetic NBR rubber tube, 4 high tensile spiral wire reinforcement Synthetic CR rubber cover 	-40°C to + 100°C (-40°F to + 212°F) Short term -40°C to + 120°C (-40°F to + 250°F)	<ul style="list-style-type: none"> High pressure hydraulic systems with petroleum based fluid. Challenging applications like construction equipment, agriculture machines, stationary applications Qualified with 2 million flex impulse cycles with leakage class 0 according to SAE J1176 Extremely long life Qualified with the high performance designed ISC fittings
EC525-AQP Plus		<ul style="list-style-type: none"> AQP elastomer tube and cover 4-spiral wire hose construction 	-40°C to + 150°C (-40°F to + 302°F)	<ul style="list-style-type: none"> Hydraulic system service with petroleum fire-resistant and water-based fluids Fuel and lubricating systems For additional approved hydraulics fluids reference the fluid compatibility charts shown in Eaton catalogs

High performance braided hydraulic hose

FC510 (AQP hose, hi-pac)
Exceeds SAE 100R2

# Part Number	DN	Hose Size 1/16"	Hose I.D.		Hose O.D.		Max. Operating Pressure		Burst Pressure		Min. Bend Radius		Weight	
			mm	in	mm	in	bar	psi	bar	psi	mm	in	kg/m	lbs/ft
FC510-4	6	-4	6,4	0.25	14,5			345		1380		75		0,34
FC510-6	10	-6	9,5	0.38	17,2			275		1100		90		0,43
FC510-8	12	-8	12,7	0.50	20,1			240		960		130		0,50
FC510-10	16	-10	15,9	0.62	23,6			190		760		150		0,66
FC510-12	19	-12	19,0	0.75	27,4			155		620		180		0,77
FC510-16	25	-16	25,4	1.00	34,4			138		560		230		1,05
FC510-20	31	-20	31,8	1.25	43,0			112		450		280		1,61

High performance special hose with fire sleeve

FC350 (AQP engine & airbrake)
FMVSS106

# Part Number	Hose Size 1/16"	Hose I.D.		Hose O.D.		Max. Operating Pressure		Burst Pressure		Min. Bend Radius		Weight	
		mm	in	mm	in	bar	psi	bar	psi	mm	in	kg/m	lbs/ft
FC350-04	-4	4,8	0.19	13,2	0.52	140,0	2000	560,0	8000	19,1	0.75	0,22	0.13
FC350-05	-5	6,4	0.25	14,7	0.58	105,0	1500	420,0	6000	25,4	1.00	0,34	0.16
FC350-06	-6	7,9	0.31	17,3	0.68	105,0	1500	420,0	6000	31,8	1.25	0,35	0.20
FC350-08	-8	10,4	0.41	19,6	0.77	87,0	1250	350,0	5000	44,5	1.75	0,43	0.23
FC350-10	-10	12,7	0.50	23,9	0.94	87,0	1250	350,0	5000	57,2	2.25	0,59	0.33
FC350-12	-12	16,0	0.63	27,4	1.08	52,0	750	210,0	3000	69,9	2.75	0,68	0.39
FC350-16	-16	22,4	0.88	31,2	1.23	28,0	400	112,0	1600	88,9	3.50	0,74	0.50
FC350-20	-20	28,4	1.12	38,1	1.50	21,0	300	84,0	1200	114,3	4.50	0,87	0.56
FC350-24	-24	35,1	1.38	44,5	1.75	17,0	250	70,0	1000	139,7	5.50	1,02	0.63

FC800

# Part Number	DN	Hose Size 1/16"	Hose I.D.		Hose O.D.		Max. Operating Pressure		Burst Pressure		Min. Bend Radius		Weight	
			mm	in	mm	in	bar	psi	bar	psi	mm	in	kg/m	lbs/ft
FC800-12	19	-12	16,4	0.65	27,2	1.071	35	500	140	2000	70	3.0	0.67	0.45
FC800-16	25	-16	22,8	0.90	31,5	1.24	35	500	140	2000	80	3.5	0.71	0.48
FC800-20	31	-20	29,3	1.15	38,6	1.52	35	500	140	2000	100	4.0	0.92	0.62
FC800-24	38	-24	35,5	1.40	45,6	1.80	35	500	140	2000	160	6.5	1.16	0.78

Quick disconnect couplings

Eaton operates efficiently and meets requirements in a wide variety of markets at the forefront of technology, including aerospace, chemical, automotive, military, and the gas industries. Eaton's proven know-how in the railway industry enables a large range of couplings which are used in a variety of primary applications (Table 2). Table 3 shows commonly used quick-disconnect couplings. Figure 1 shows the three types of Walterscheid tube connectors.

Table 2
Eaton leadership across sectors and industries












Sector	Industry	Applications
Rolling Stock 	Train - Locomotive 	<ul style="list-style-type: none"> Compressed air circuit Air conditioning Braking system Hydraulic On-board electronic cooling Fill & drain reservoirs
	Tram - Underground 	
Infrastructure 	Hydraulic Tools 	

Table 3
Commonly used quick-disconnect couplings

Series	Type/ Application	Image	Materials	 Sizes (in)	 Work Pressure (bar)
R-4000	Pneumatic arc blowing system		Brass, NBR	1/8	20
5400	Air conditioning		Steel Guardian Seal™ plating for excellent corrosion resistance, Chloropren	-4 -8 -12 -16	48 to 207
FF	Hydraulic circuit		Steel, NBR, FKM, EPDM	1/4 to 2	300 to 350
HW-15000	Fill and drain reservoirs for engine cooling (diesel loco)		Stainless steel, HNBR	1	5

Aluminum railway cooling coupling

Developed for cooling systems in electric applications with circulating water and antifreeze fluids. This coupling is providing an enhanced solution for preventing spillage of cooling agent which can cause technical failures, system shutdowns, and difficult clean-ups.

Eaton® Aluminium Flat Face ADB coupling for Railway water glycol cooling applications

- Eaton Flat face Aluminum (ADB) coupling is light weight and strong, providing resistance to environmental exposure, pressure and mechanical stress.
- It is designed to extend the life of the coupling, minimizing spill risk in critical electric cooling applications, offering end users reduced maintenance and safer operations.
- Optimal to be used in environments with vibration and heat exposure. It connects with 4-times safety factor at maximum operating pressure of 25 bar.
- Options are available for railway applications with an enhanced version for vibration resistance tested according to EN 61373. Higher pressure rate from 29% to 62% compared to ISO 16028 requirements, reducing pressure drops and increasing cooling system efficiency.
- Pre-guided system that helps users pre-position the coupling in difficult environments, making connection easy and reducing maintenance time.
- Full range of optional seals, end connections and sizes, helping manufacturers benefit from the design in any type of application.
- Eaton Flat face ADB couplings, due to the aluminum material, are available in a variety of color coding options, and can be anodized in colors such as red, blue and even in Gold, aiding assembly and field maintenance processes.



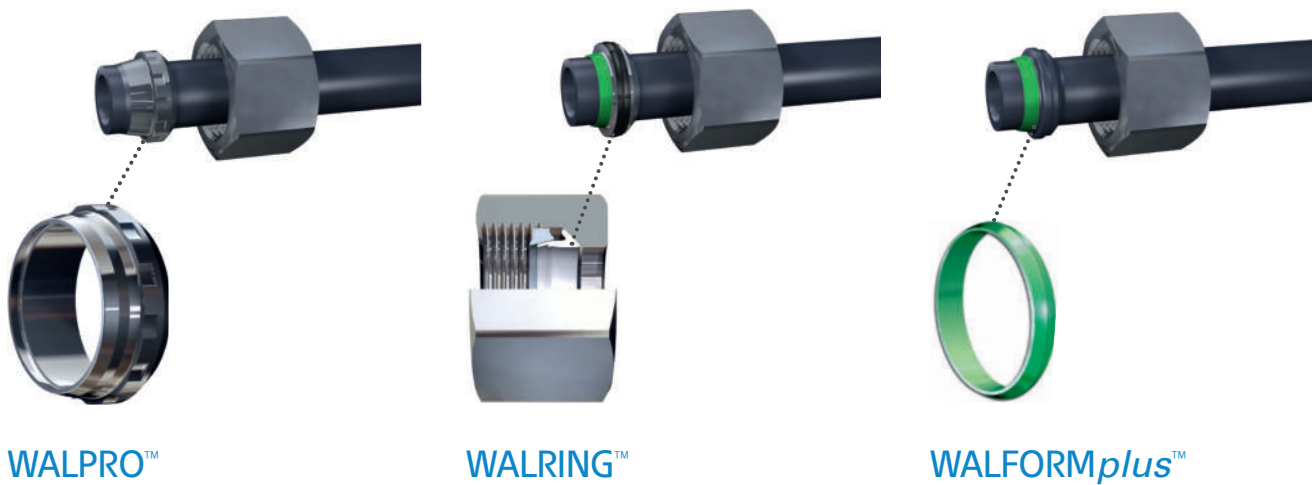
Walterscheid tube connectors and adapters

The Eaton Walterscheid Trilogy is engineered to deliver premium performance along with ease of installation. Walterscheid tube connectors (Figure 1) provide a number of benefits:

- Highest pressure performance
- Easy and safe assembling
- Highest assembly security
- Machine protect from failures
- Standard Viton soft seal – others materials available (NBR, EPDM)
- Most successful and first forming system with captive seal on the market
- Available in stainless steel for harsh environments

Furthermore, Eaton offers a wide range of adapters either in combination with the Walterscheid tube connectors or as individual components in tube and pipe works.

Figure 1
Three types of Walterscheid tube connectors



Technology		
Two-edge cutting ring (profile ring), controlled final assembly	Two-edge cutting ring with captive seal, machine assembly	Cold reshaping of the tube end with captive seal
System features		
Force closure, combined sealing and retaining functions	Force closure, separate sealing and retaining functions	Form closure, separate sealing and retaining functions
Sealing principle		
Metal-on-metal	Elastomeric + Metal-on-metal	Elastomeric + Metal-on-metal
Prefabrication		
Assembly machine	Assembly machine	Reshaping machine
Tightening travel for final in service assembly		
30°–60° after controlled final assembly	30°–60° after machine assembly	Up to the point of resistance
Torque reduction		
≈ 25% compared to manual assembly	≈ 25% compared to manual assembly of a cutting ring	> 25% compared to manual assembly of a cutting ring
Risk of assembly related failures		
Minimal with controlled final assembly machine	Minimal with machine pre-assembly	Minimal

Guardian Seal™ coating

Guardian Seal is a special, zinc-based surface treatment that is applied by electroplating. The zinc layer is passivated by a special process, resulting in an open-pored structure. Organic micro-particles are then impregnated into this structure in an optimized emersion process adapted to the chemical system. The cross-linked polymerization of the top layer is then completed via a unique curing process.

- Nickel-free corrosion protection – durable and health-friendly
- Corrosion protection up to 360 hrs. to white corrosion / 720 hrs. to red corrosion according to VDMA 24576, K5 (exceeding SAE J514 / 96 hrs. to red corrosion)
- Guardian Seal surface plating not only guarantees excellent, durable corrosion protection, but also provides a convincing answer from the point of view of health protection and environmental compatibility.

Eaton power units smooth the way for high speed trains in Switzerland

High speed trains at speeds can get passengers to their destinations in comfort and safety, but for train operators, the cost of installing dedicated high speed track, with gentle curves and gradients, is prohibitive for all but the most profitable routes.

Using hydraulics solutions from Eaton, Switzerland's national railway company, SBB CFF FFS, is now operating high speed trains on conventional track and delivering improved customer service and comfort.

In the case of Switzerland, with its numerous mountains and lakes that crisscross the major rail routes, building a dedicated high-speed rail infrastructure is impractical. The answer is the latest generation of tilting trains which can optimize their behavior around bends in the track and minimize wheel forces. The level of tilt is controlled by onboard computers that send messages to the bogie (wheel chassis) of each carriage.

SBB ordered 19 Pendolino trains, manufactured by Alstom. Each one comprises seven carriages that can accommodate up to 430 passengers and travel at speeds up to 250kph (155mph) on regular rail routes.

From its factory in Pessano, Italy, Eaton provided the powerful Hydraulic Power Units for each bogie. The power units contain PVM piston pumps, slip-in cartridge valves, servo valves and Eaton's filtration products.

"Our experience and high reputation on high speed trains, together with our competency to deliver a total hydraulic solution to meet stringent regulatory and performance parameters were instrumental in our selection as a partner for these trains," explained Mauro Mezzina, Eaton regional sales manager for Italy and the Middle East.

Following homologation runs in Germany, as well as acceptance runs in Switzerland and Italy, the first three trains were delivered in 2014 with the next delivery due to be handed over to SBB by the middle of 2015.

Certificates of conformance to EN4545-2

LAPI LAPI LABORATORIO PREVENZIONE INCENDI S.p.A.
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ACCREDITA LAPI 0108

RAPPORTO DI PROVA / TEST REPORT
 NO. 629-630/15
 EN 4545-2: 2013

METODO DI PROVA:
 Test method

DENOMINAZIONE DELLA PROVA:
 Description of the standard

RICHIEDENTE:
 Sponsor

DENOMINAZIONE DEI MATERIALI:
 Denomination of the materials

GAMMA DIAMETRI NOM. DEI CAMPIONI:
 Nom. diameter range of the samples

DESCRIZIONE DEL MATERIALE:
 Description of the material

Questo documento fa riferimento ai Rapporti di Prova no. 629-630/150500/15, no. 629-630/150500/15 e no. 629-630/150500/15 emessi da questo Laboratorio.
 This certificate refers to the Test Reports no. 629-630/150500/15, no. 629-630/150500/15 and no. 629-630/150500/15 issued by this Laboratory.

Prodotto / Product	NLP (Non Listed Products)		
Requisiti / Requirements	R22 - R23	R22 - R23	R22 - R23
Prove richieste / Tests required	EN ISO 4589-2	EN ISO 5659-2	NF X 70-100-1/2
Parametro / Parameter	LOI (%)	(25 W/m ² - Flaming) De max	CFI _{max}
Valori trovati / Values found	34,2	208	0,19
Valori trovati / Values found (11" - RE Lab. 629/15)	37,4	208	0,19
Valori trovati / Values found (11" - RE Lab. 629/15)	37,4	208	0,19
Limiti di accettazione	R22 - R23 HL1: ≥ 28% HL2: ≥ 20% HL3: ≥ 32%	R22 - R23 HL1: ≤ 600 HL2: ≤ 600 HL3: ≤ 300	R22 - R23 HL1: ≤ 1,2 HL2: ≤ 0,9 HL3: ≤ 0,75

Legenda
 --- Nonconformità / No requirement

VALUTAZIONE / JUDGEMENT
 Sulla base dei risultati di prova sopra riportati il materiale in oggetto è **CONFORME** alle richieste di EN 4545-2: 2013 per livelli di rischio HL1 - HL2 ed è di requisiti R22 e HL1 - HL2 ed è di requisiti R23 per la gamma di diametri sopra riportati (estremi inclusi).

On the basis of the above results the sample in object **COMPLIES** with the requirements of EN 4545-2: 2013 for Hazard Levels HL1 - HL2 requirement set R22 and HL1 - HL2 requirement set R23 for the diameter range reported above (including extremities).

Prato, 06/05/2015
 Valid until: 04/05/2018

Il Responsabile Certificazione
 The Certification Manager
 Dr. Massimo Bazzani

Il Direttore del Laboratorio
 The Director of the Laboratory
 Dr. Luca Emme

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Laboratory approved by **CERTIFIER**

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ACCREDITA LAPI 0108

RAPPORTO DI PROVA / TEST REPORT
 NO. 669-670/15
 EN 4545-2: 2013

METODO DI PROVA:
 Test method

DENOMINAZIONE DELLA PROVA:
 Description of the standard

RICHIEDENTE:
 Sponsor

DENOMINAZIONE DEI MATERIALI:
 Denomination of the materials

GAMMA DIAMETRI NOM. DEI CAMPIONI:
 Nom. diameter range of the samples

DESCRIZIONE DEL MATERIALE:
 Description of the material

Questo documento fa riferimento ai Rapporti di Prova no. 669-670/150500/15, no. 669-670/150500/15 e no. 669-670/150500/15 emessi da questo Laboratorio.
 This certificate refers to the Test Reports no. 669-670/150500/15, no. 669-670/150500/15 and no. 669-670/150500/15 issued by this Laboratory.

Prodotto / Product	NLP (Non Listed Products)		
Requisiti / Requirements	R22 - R23	R22 - R23	R22 - R23
Prove richieste / Tests required	EN ISO 4589-2	EN ISO 5659-2	NF X 70-100-1/2
Parametro / Parameter	LOI (%)	(25 W/m ² - Flaming) De max	CFI _{max}
Valori trovati / Values found	34,2	216	0,19
Valori trovati / Values found (31" - RE Lab. 669/15)	35,4	216	0,19
Valori trovati / Values found (11" - RE Lab. 670/15)	34,2	216	0,19
Limiti di accettazione	R22 - R23 HL1: ≥ 28% HL2: ≥ 20% HL3: ≥ 32%	R22 - R23 HL1: ≤ 600 HL2: ≤ 600 HL3: ≤ 300	R22 - R23 HL1: ≤ 1,2 HL2: ≤ 0,9 HL3: ≤ 0,75

Legenda
 --- Nonconformità / No requirement

VALUTAZIONE / JUDGEMENT
 Sulla base dei risultati di prova sopra riportati il materiale in oggetto è **CONFORME** alle richieste di EN 4545-2: 2013 per livelli di rischio HL1 - HL2 ed è di requisiti R22 e HL1 - HL2 ed è di requisiti R23 per la gamma di diametri sopra riportati (estremi inclusi).

On the basis of the above results the sample in object **COMPLIES** with the requirements of EN 4545-2: 2013 for Hazard Levels HL1 - HL2 requirement set R22 and HL1 - HL2 requirement set R23 for the diameter range reported above (including extremities).

Prato, 13/05/2015
 Valid until: 12/05/2018

Il Responsabile Certificazione
 The Certification Manager
 Dr. Massimo Bazzani

Il Direttore del Laboratorio
 The Director of the Laboratory
 Dr. Luca Emme

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ACCREDITA LAPI 0108

RAPPORTO DI PROVA / TEST REPORT
 NO. 628-631/15
 EN 4545-2: 2013

METODO DI PROVA:
 Test method

DENOMINAZIONE DELLA PROVA:
 Description of the standard

RICHIEDENTE:
 Sponsor

DENOMINAZIONE DEI MATERIALI:
 Denomination of the materials

GAMMA DIAMETRI NOM. DEI CAMPIONI:
 Nom. diameter range of the samples

DESCRIZIONE DEL MATERIALE:
 Description of the material

Questo documento fa riferimento ai Rapporti di Prova no. 628-631/150500/15, no. 628-631/150500/15 e no. 628-631/150500/15 emessi da questo Laboratorio.
 This certificate refers to the Test Reports no. 628-631/150500/15, no. 628-631/150500/15 and no. 628-631/150500/15 issued by this Laboratory.

Prodotto / Product	NLP (Non Listed Products)		
Requisiti / Requirements	R22 - R23	R22 - R23	R22 - R23
Prove richieste / Tests required	EN ISO 4589-2	EN ISO 5659-2	NF X 70-100-1/2
Parametro / Parameter	LOI (%)	(25 W/m ² - Flaming) De max	CFI _{max}
Valori trovati / Values found	36,2	189	0,14
Valori trovati / Values found (11" - RE Lab. 628/15)	34,3	206	0,13
Valori trovati / Values found (11" - RE Lab. 628/15)	34,3	206	0,13
Limiti di accettazione	R22 - R23 HL1: ≥ 28% HL2: ≥ 20% HL3: ≥ 32%	R22 - R23 HL1: ≤ 600 HL2: ≤ 600 HL3: ≤ 300	R22 - R23 HL1: ≤ 1,2 HL2: ≤ 0,9 HL3: ≤ 0,75

Legenda
 --- Nonconformità / No requirement

VALUTAZIONE / JUDGEMENT
 Sulla base dei risultati di prova sopra riportati il materiale in oggetto è **CONFORME** alle richieste di EN 4545-2: 2013 per livelli di rischio HL1 - HL2 ed è di requisiti R22 e HL1 - HL2 ed è di requisiti R23 per la gamma di diametri sopra riportati (estremi inclusi).

On the basis of the above results the sample in object **COMPLIES** with the requirements of EN 4545-2: 2013 for Hazard Levels HL1 - HL2 requirement set R22 and HL1 - HL2 requirement set R23 for the diameter range reported above (including extremities).

Prato, 06/05/2015
 Valid until: 04/05/2018

Il Responsabile Certificazione
 The Certification Manager
 Dr. Massimo Bazzani

Il Direttore del Laboratorio
 The Director of the Laboratory
 Dr. Luca Emme

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