

Hydraulic Hoses for Rail application meet new EN 45545 standard

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The rail rolling stock industry is one of the most demanding markets when it comes to harsh environments for mechanical and electrical components, especially with the operating extremes for vibration and temperature. This has been compounded by competitive pressures and the demand for increased safety requirements base on higher train driving speeds, the usage of longer tunnels and increased survivability in case of fire.

Until the formation of the EU though, railway regulation was carried out at a country level, leading to a concern over the potential of trade barriers. Manufacturers and operators were forced to meet diverse local standards and perform additional testing resulting in additional costs. With trains now operating across European borders and through the Channel tunnel, the EU realised that new standards had to be put in place to ensure a safe and interoperable rail system across Europe.

One standard that had to be introduced was the harmonisation requirement for safety criteria to assess materials for fire protection on rolling stock across the European Union. Germany used DIN5510 Part 2, France had the NF F 16-101 standard, Italy UNI CEI 11170-3, and the UK had British Standard BS6853. A 20-year project was started to develop the EN 45545 fire safety standard, with participation by industry experts from testing laboratories, train designers, component manufacturers, regulators and the certification bodies. The standard was published in September 2013.

Now that the new EN 45545 standard is published, there are some seismic changes happening in the rolling stock sector. To fully comprehend the enormity of the project, almost everything on a train weighing in excess of 100 grams is subject to testing for the new stringent fire safety standard. EN 45545 is mandatory for all new railway projects, with a transition period for aftermarket and existing systems. The existing national standards will be withdrawn by March 2016.

When compared to other transport modes, the ERA's data shows that the number of rail accidents is quite low. The majority occur in marshalling yards and/or involve human error, with the minority being collisions, derailments and accidents at level crossings. It is interesting

that very few rail incidents involve fire. The human psychological impact though dominates the need for regulation, with the general public not accepting nor tolerating the thought of a fire aboard a train. Revisions were made to the standard following accidents where enclosed spaces made train evacuation difficult, and where smoke caused the air to quickly become unbreathable. These changes included clarification of what types of new trains would be allowed to access tunnels, especially those tunnels with considerable length.

EN44545 is broken down in to several subsections; most important are -1 for categories and -2 for test methods, -4 for operability in case of fire. The operation categories are broken down into four numeric types:

- The regular use of tunnels (including Euro-Tunnel, the Metro and other underground networks), where an evacuation would be impossible
- The regular use of tunnels, where a slow evacuation would be possible
- T regular use of tunnels, where a fast evacuation is possible
- No underground lines, only for above-surface use

The design categories are broken down into four types:

1. Vehicles forming part of an automatic train with no staff on board to deal with emergencies
2. Double decker vehicles
3. Sleeping and couchette vehicles
4. All other (standard) vehicles



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This led to the definition of a Hazard Level (HL) matrix where HL3 is the most stringent

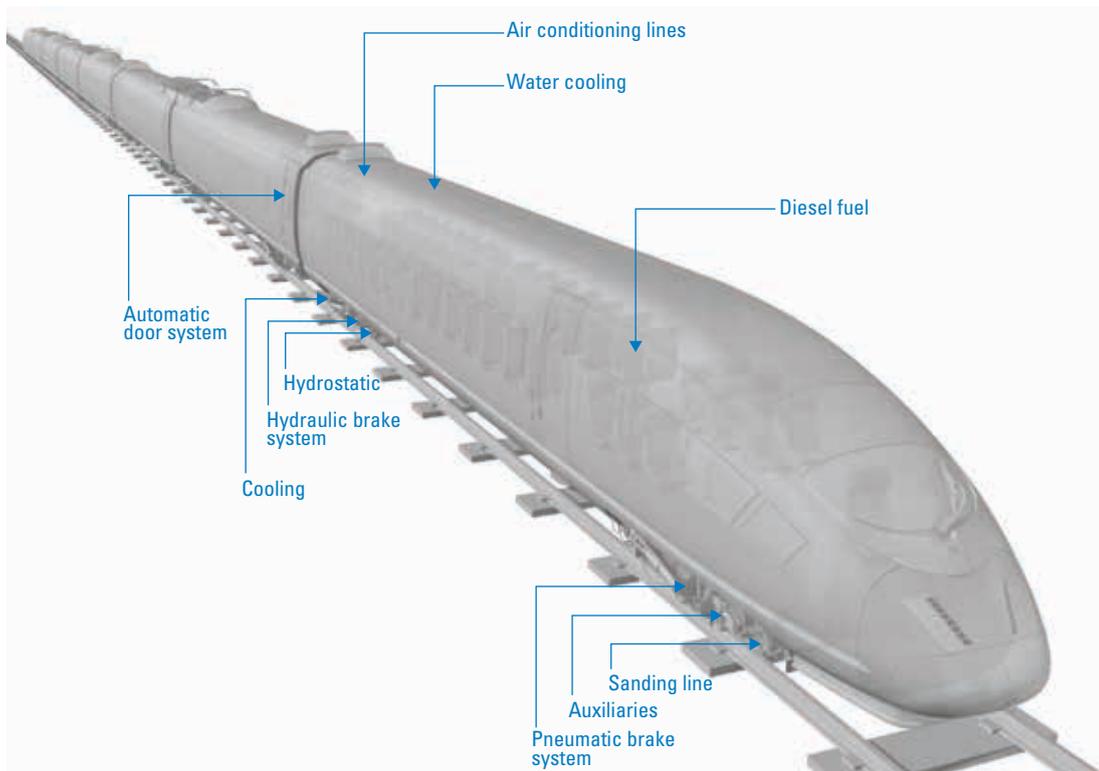
Table 1. Design category

Operation category	N (Standard)	A (Automated)	D (DoubleDeck)	S (Sleeping)
1 No tunnels	HL1	HL1	HL1	HL2
2 Fast evac tunnels	HL2	HL2	HL2	HL2
3 Slow evac tunnels	HL2	HL2	HL2	HL3
4 No evac tunnels	HL3	HL3	HL3	HL3

Eaton provides hoses for many rolling stock applications. This includes on-board hydraulic lines, diesel fuel lines, air / hydraulic braking, sanding lines, sanitary facilities, air conditioning, water cooling and automatic door systems.

For Eaton’s hoses used in the rail industry, the main testing for compliance is EN 45545-2 and is based on three tests:

1. The oxygen content percentage uses a technique to measure the minimum percentage of oxygen in the test atmosphere that is required to marginally support combustion. The standard used is EN ISO 4589-2.
2. Smoke density is measured to EN ISO 5659-2 using optical methods to determine the amount of smoke produced.
3. Smoke toxicity determines the toxicity of materials during a fire. The limits (minimum or maximum) are stated below, with different Hazard Levels set for inside or outside use. Naturally the most severe limits are for inside hoses.



Requirement set used for	Test method & reference	Testing for (unit)	Minimum / Maximum	Thresholds		
				HL1	HL2	HL3
Inside Use R22 (IN16; EL2; EL6A; EL7A; M2)	T01 EN ISO 4589-2: OI	Oxygen Content (%)	Minimum	28	28	32
	T10.03 EN ISO 5659-3 25kWm-2	Smoke Density (DS max. dimensionless)	Maximum	600	300	150
	T12 NF X70-100-1 and -2, 600° C	Smoke Toxicity (CITNLP dimensionless)	Maximum	1.2	0.9	0.75
Outside Use R23 (EX12; EL2; EL5 EL6B; EL7B; M3)	T01 EN ISO 4589-2: OI	Oxygen Content (%)	Minimum	28	28	32
	T10.03 EN ISO 5659-3 25kWm-2	Smoke Density (DS max. dimensionless)	Maximum	---	600	300
	T12 NF X70-100-1and -2, 600° C	Smoke Toxicity (CITNLP dimensionless)	Maximum	---	1.8	1.5

Following the testing, a certificate is issued showing the results for the three tests and the actual measurements. The testing is usually conducted across the hose range on the smallest and largest diameter hoses and one mid-range hose. The certificate will also list the highest HL number for both inside and outside use but the lowest achieved HL is driving the overall rating for the hose .



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RAPPORTO DI PROVA NO. 841.11S0040/15
Test Report no.

METODO DI PROVA: UNI CEI EN 45545-2: 2013
Test method

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

RICHEDENTE: Eaton Corporation Polymer Kauçuk San.Paz.A.Ş
Sponsor
Çekirgeci Organize Sanayi Bögesi, Karaağaç Mah. 6 sok No.3
Kuşadası / TEKİRDAĞ, TÜRKİYE

DENOMINAZIONE DEL MATERIALE: RAILWAY EN857-29C / EN45545 Diameter 50.8mm
Denomination of the material

DIAMETRO NOM. DEI CAMPIONI: 51 (42x-33)
Nominal diameter of the samples

DESCRIZIONE DEL MATERIALE: Tubo in gomma di colore nero con rinforzo metallico.
Description of the material
Black rubber hose with a metallic reinforcement.

Questo documento fa riferimento ai Rapporti di Prova no. 841.010000/15, no. 841.11S003/15, e no. 841.11S005/15 emessi da questo Laboratorio.
This certificate refers to the Test Reports no. 841.010000/15, no. 841.11S003/15 and no. 841.11S005/15 issued by this Laboratory.

Prodotto / Product	NLP (Non Listed Products)		
	R22 - R23		
Requisiti / Requirements	R22 - R23		
Prove richieste / Tests required	EN ISO 4589-2	EN ISO 5609-2	NF X.T0-100-1A-2
Parametro / Parameter	LOI (%)	(20 kW/m ² - Flaming) De max	CFR ₁₀
Valori trovati / Values found	34.8	48	0.14
	Per / For	Per / For	Per / For
Limiti di accettazione Acceptance limits	R22 - R23	R22	R23
	HL1 ≥ 28%	HL1 ≥ 600	HL1 —
	HL2 ≥ 28%	HL2 ≥ 300	HL2 ≥ 600
	HL3 ≥ 52%	HL3 ≥ 150	HL3 ≥ 300
			HL2 ≥ 0.9
			HL3 ≥ 0.75
			HL3 ≥ 1.5

Legende
--- Nonconformità / No requirements

VALUTAZIONE / JUDGEMENT
Sulla base dei risultati di prova sopra riportati il materiale in oggetto **E' CONFORME** alle richieste di UNI CEI EN 45545-2: 2013 per livelli di rischio HL1 - HL2 - HL3 set di requisiti R22 e R23.
On the basis of the above results the sample in object **COMPLIES** with the requirements of UNI CEI EN 45545-2: 2013 for Hazard Levels HL1 - HL2 - HL3 requirements set R22 and R23.

Prato, 04/06/2015. **Il Responsabile Certificazione** **Il Direttore del Laboratorio**
The Certification Manager **Dr. Massimo Basso** The Director of the Laboratory **Dr. Luca Emili**

Valid until: 03/09/2018

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In addition to complying with the EN 44545 standard, Eaton's railway hoses meet further hydraulic hose based EN standards. The EC045 series meets the EN 854 standard for rubber hoses and hose assemblies of the textile reinforced hydraulic type.

The EC112 & EN212 meet the EN 857 and EC109 & EC209 the EN853 for rubber hoses and hose assemblies with wire braid reinforced for hydraulic applications. The EC112 & EN212 hoses are also qualified in according to the ISO 15545 requirements (EN45545-4). The Eaton hose offering currently meets the following Hazard Levels:



Hose PN	Product name	Construction	Specification	Size	Working temp	EN45545 hazard lvl R22	EN45545 hazard lvl R23
EC045	Railway hose	2TE	EN854	- 3 up to size - 16	[-40°C + 125°C]	HL2	HL3
EC112	Railway hose	1SC	EN857	- 4 up to size - 16	[-40°C + 100°C]	HL2	HL3
EC212	Railway hose	2SC	EN857	- 4 up to size - 16	[-40°C + 125°C]	HL2	HL3
EC109	Railway hose	1SN	EN853	- 4 up to size - 16	[-40°C + 125°C]	HL3	HL3
EC209	Railway hose	2SN	EN853	- 4 up to size - 16	[-40°C + 125°C]	HL3	HL3
EC060	-	3TE	EN854	- 4 up to size - 16	[-40°C + 125°C]	HL2	HL3
2755	-	4SP	EN856	- 6 up to size - 16	[-40°C + 100°C]	HL1	HL2
GH506	-	4SH	EN856	- 12 up to size - 32	[-40°C + 100°C]	HL1	HL2
GH466	-	6SP	100R15	- 20 up to size - 32	[-40°C + 120°C]	HL1	HL2
EC525	AQP	4SP	-	- 12 up to size - 32	[-40°C + 150°C]	HL1	HL2

Hose Type	Hose spec	R22 (internal)	R23(external)	Size	Comment
EC112 (1SC)	EN857	HL2	HL3	- 4 bis - 16	ISO 15540
EC212 (2SC)	EN857	HL2	HL3	- 4 bis - 32	ISO 15540
EC109 (1SN)	EN853	HL3	HL3	- 4 bis - 16	-
EC209 (2SN)	EN854	HL3	HL3	- 4 bis - 16	-
EC045 (2TE)	EN854	HL2	HL3	- 3 bis - 16	-
EC045 (2TE)	EN854	HL3	HL3	- 5 and - 10	-
2755	4SP	HL1	HL1	- 6 bis - 16	-
GH506	4SH	HL1	HL1	- 12 bis - 32	-
GH466	6SP/SAE 100R15	HL1	HL1	- 20 bis - 32	-
EC850	500BAR	HL1	HL1	- 10 bis - 20	-
EC525 AQP	4SP AQP	HL1	HL1	- 12 bis - 32	-
FC800 + 624	Air conditioning	HL2	HL3	- 12 bis - 24	Fire sleeve 624 required to achieve HL
2781 (2ST)	EN853	HL1	HL2	- 4 bis - 32	-
FC350-624	AQP - Fuel	HL2	HL3	- 4 bis - 24	Fire sleeve 624 required to achieve HL
FC510	SAE100R2 AQP	HL1	HL2	- 10 bis - 20	No HL for smaller sizes

Note: All wire braided hoses are qualified with Eaton's Global **TTC** fittings and textile reinforced with Eaton's **OTC** fittings (reduced pressure) and **2V sockets & global fittings** according to EN 854 working pressure.

Conclusions

The challenges facing the rail industry are 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 like EN 45545 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 minimize risk and ensure secure rail projects."

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Printed in USA
August 2017

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