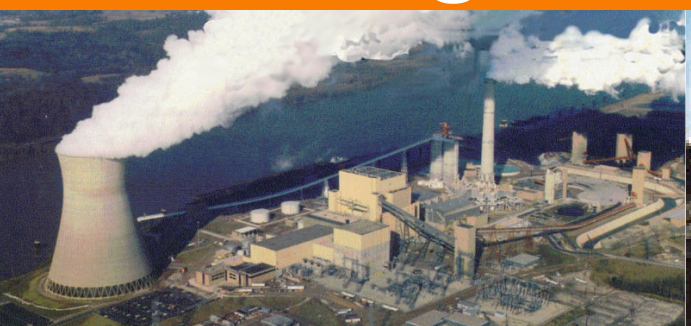
FENNER DUNLOP

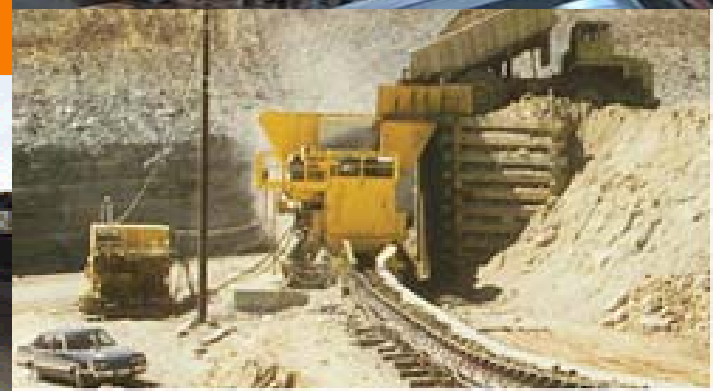
CONVEYOR BELTING AMERICAS

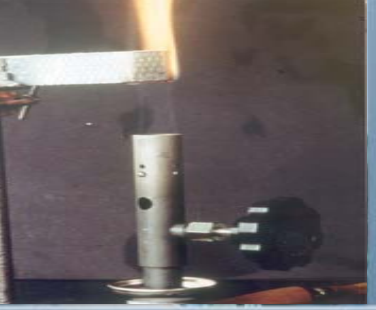
Technical Study Panel

Utilization of Belt Air

Pittsburgh March 2007







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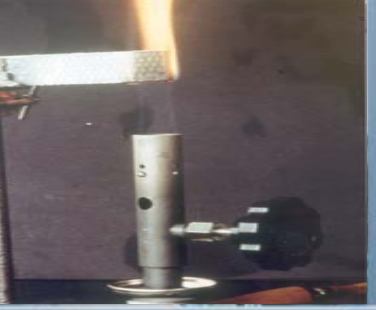
CONVEYOR BELTING AMERICAS

Fenner Team

- David Hurd : President Fenner Dunlop Americas (FDA)
- Geoff Normanton: Vice President Technology FDA
- Brian Rothery: Head of Development Fenner Dunlop Europe & Chairman CEN WG3
- Chuck Felix: Vice President Mining Sales FDA



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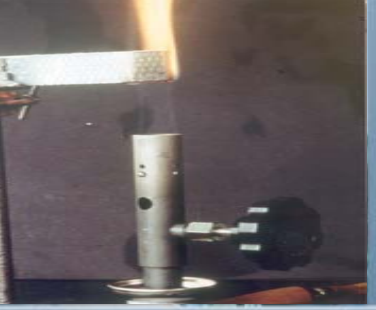
AGENDA

- INTRODUCTION TO FENNER DUNLOP
- WORLD TESTING OVERVIEW
- CURRENT WORLD STANDARDS
- FENNER DUNLOP PRODUCTS IN MINING
- SMOKE HAZARDS
- EUROPEAN APPROACH TO SAFETY

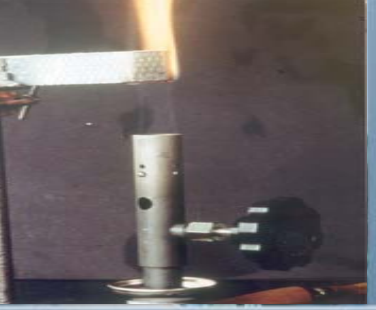


FENNER DUNLOP
CONVEYOR BELTING AMERICAS

WHO IS FENNER?

We are a Conveyor Belting company founded in Hull in 1861.

- Headquarters in Hessle, England
- 21 manufacturing plants
- Operations on all 5 Continents
- Quoted on the London Stock Exchange (FENR)



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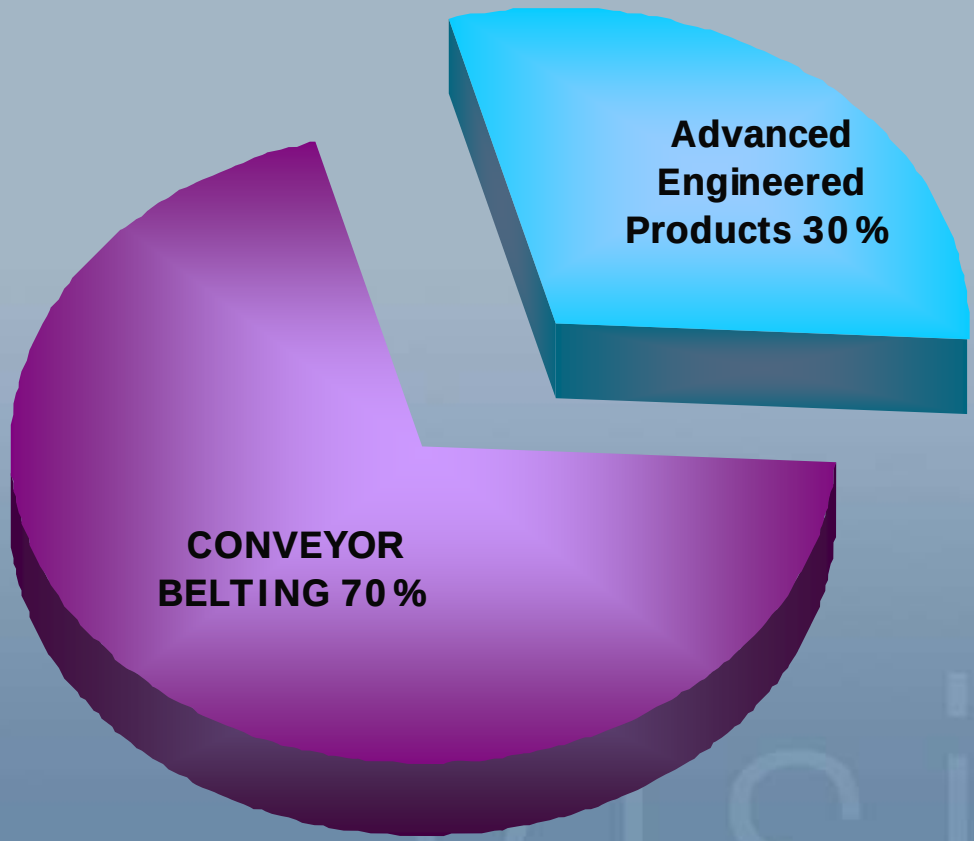
WHO IS FENNER?



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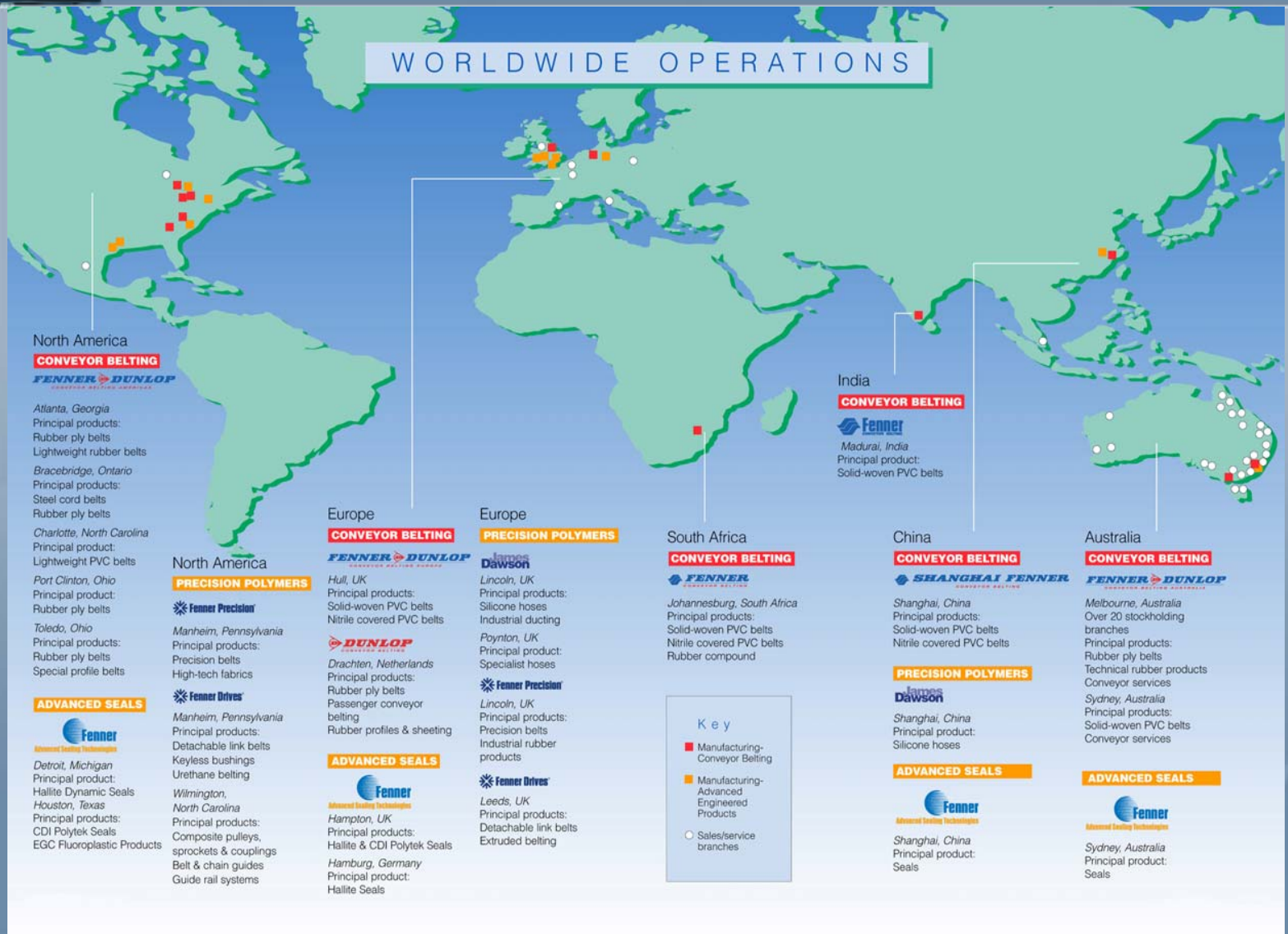
FENNER WORLDWIDE



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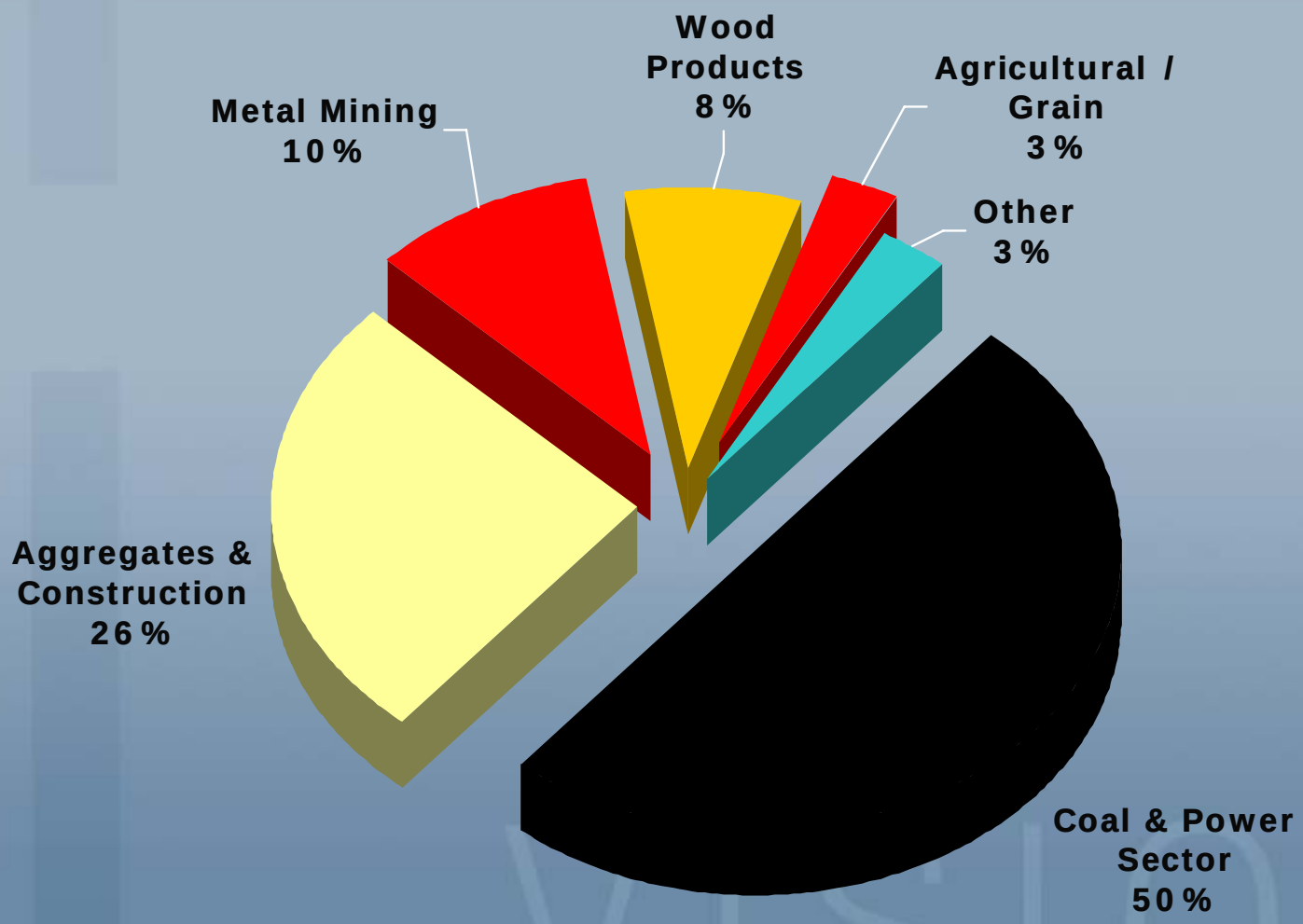
Conveyor Belting End User Segments



FENNER DUNLOP
CONVEYOR BELTING AMERICAS

Who is Fenner Dunlop Americas?

- Fenner introduction into North America
  - Acquired Nationwide Belting in 1996
  - Acquired Scandura Inc in 1997
  - Acquired Unipoly conveyor belting business in 2001, including Georgia Duck & Cordage Mill

FENNER DUNLOP
CONVEYOR BELTING AMERICAS

Geoff Normanton, VP Technology Fenner Dunlop Americas

Global Products, Specifications and Testing Review

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HISTORICAL PERSPECTIVE

UK MINE FIRES PROMPTED DEVELOPMENT OF CONVEYOR BELT TESTING AND SPECIFICATIONS

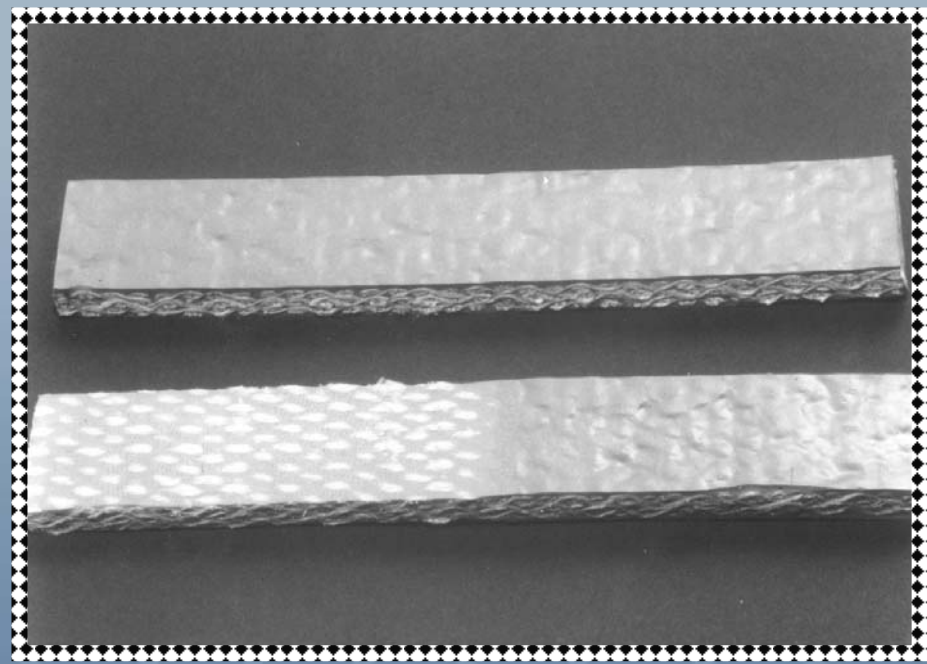
FRICTIONAL HEATING PRIME CAUSE OF FIRE 1950 AND STILL IS TODAY

PVC BELTING DEVELOPED 1948

4 KEY PARAMETERS SPECIFIED IN SAFETY TESTS

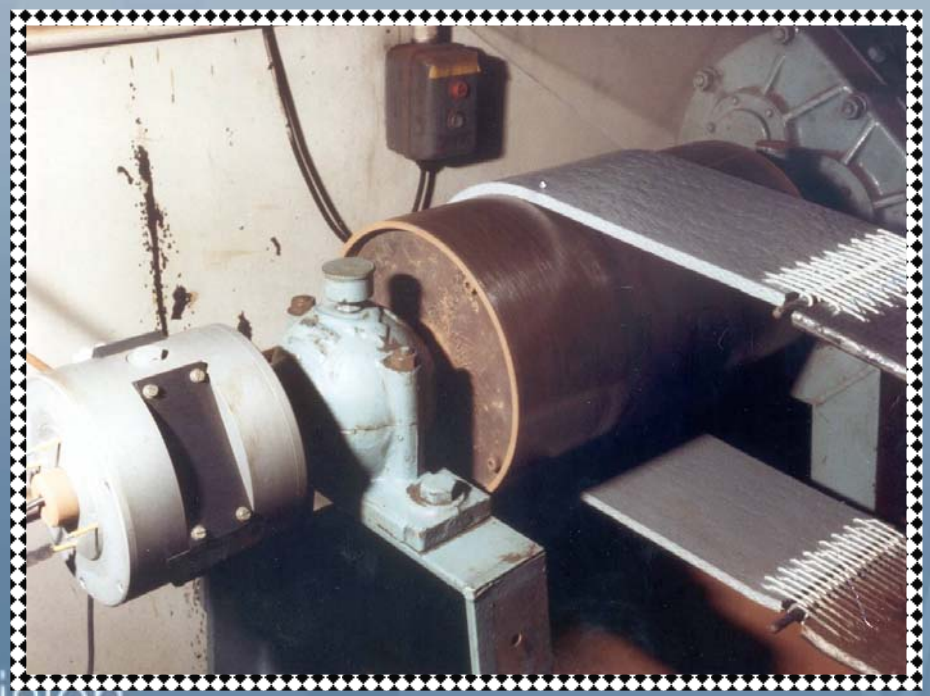
MINE SAFETY TEST 1

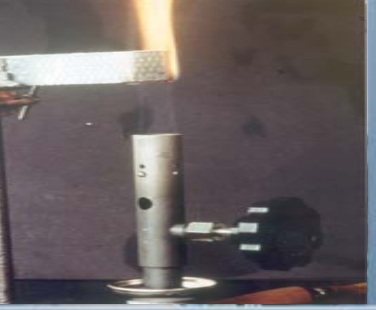
- **RESISTANCE TO IGNITION**
- LABORATORY ‘FINGER BURN’ TEST



MINE SAFETY TEST- 2

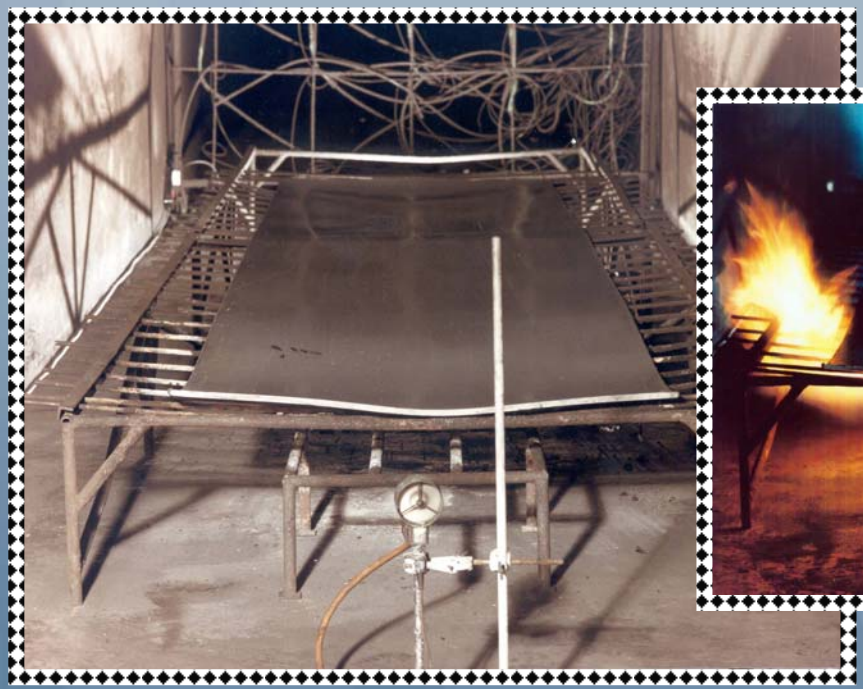
- **FRICTION TEST**
- ASSESS FOR FIRE / GLOW & TEMPERATURE RISE

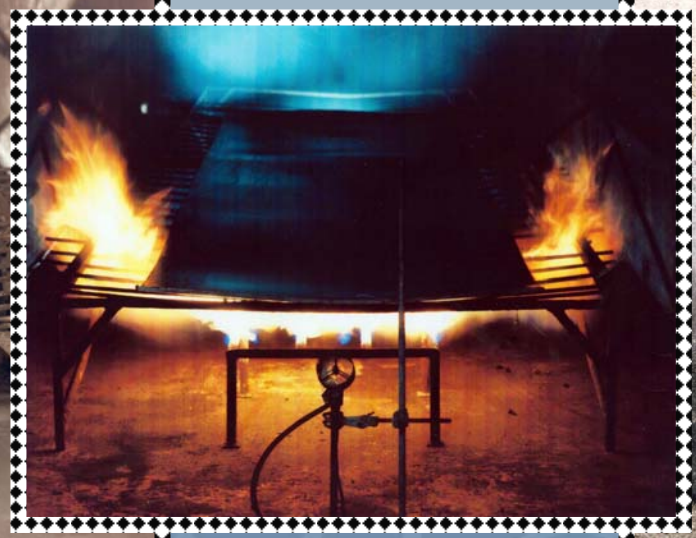




MINE SAFETY TEST - 3

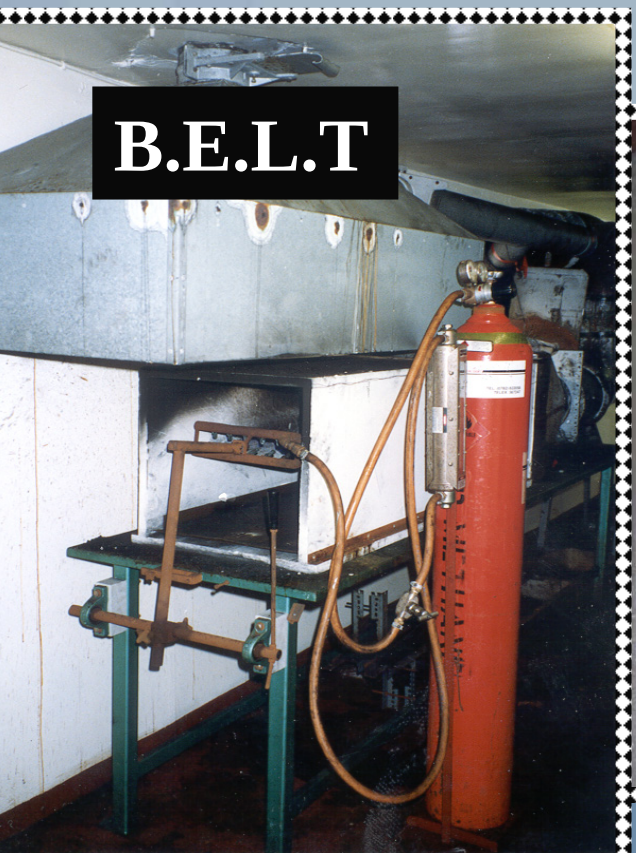
- **RESISTANCE TO FIRE PROPAGATION FULL-SCALE**





MINE SAFETY TEST - 3

- **RESISTANCE TO FIRE PROPAGATION MID-SCALE**



MINE SAFETY TEST - 4

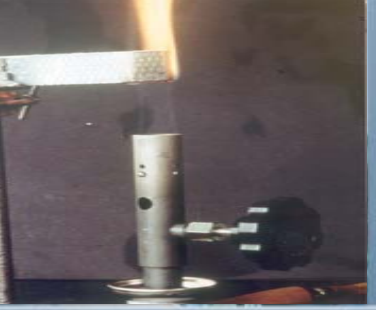
- **SURFACE RESISTANCE**
- **INTERNATIONAL LIMIT 300 MEGOHMS**

GLOBAL MINING SAFETY STANDARDS

FENNER LOCATION	STANDARD
USA	30CFR18.65: 1978
EUROPE	EN 22721(2007?) / 14973: 2006 / 12881-1: 2005
AUSTRIALIA	AS4606 / AS1332:2000
SOUTH AFRICA	SABS971:2003
CHINA	MT914:2002
CANADA	CAN/CSA M422-M87: 1995
INDIA	IS3181:1992

GLOBAL MINING SAFETY STANDARDS

	IGNITION	FRICTION	PROPAGATION	ELECTRICAL
EUROPE				
AUSTRALIA				
CANADA				
CHINA				
INDIA				
SOUTH AFRICA				
USA				



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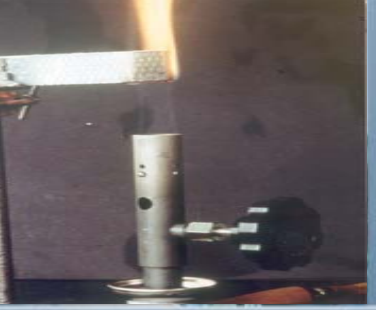
FDA PRODUCT CAPABILITY USA

	IGNITION	FRICTION	PROPAGATION	ELECTRICAL
MSHA-F	🔥			💡
Fire Boss®	🔥🔥			💡
Fire Boss Plus®	🔥🔥	🔥	🔥	💡



FENNER DUNLOP
CONVEYOR BELTING AMERICAS

MINING RUBBER COMPOUNDS USA

- **MSHA-F**
  · Fire Retardant abrasion resistant MSHA compound that meets U.S. Mine Safety and Health Administration requirements per MSHA Title 30, Section 18.65.
  · Excellent abrasion resistant cover compound for mining applications where MSHA specifications are required.
  · For underground applications

- **Fire Boss®**
  · Meets MSHA Title 30 and ISO 340 standards.
  · Ideal when an increased fire retardant level is desirable.

- **Fire Boss Plus®**
  · Grade I compound
  · Compliant with ASTM E162 and the Australian standards AS4606 / AS1332/B.E.L.T providing a high degree of resistance to fire propagation with Premium abrasion and moderate oil resistance.

GLOBAL MINING SAFETY STANDARDS: PRODUCTS

	SBR	CHLOROPRENE	PVC	PVG
EUROPE		+	+	+
AUSTRALIA		+	+	+
CANADA			+	+
CHINA			+	+
INDIA			+	+
SOUTH AFRICA			+	+
USA	+		+	

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MINE TEXTILE PLIED PRODUCT

MineFlex®

MineHaul®

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MINE STEEL CORD

Steel Cord
This type of belt is made using a series of parallel, pre-tensioned steel cords, encased in rubber, to which rubber covers are applied. This type of belt has very high tensile strength and low elongation

Dynaflight®

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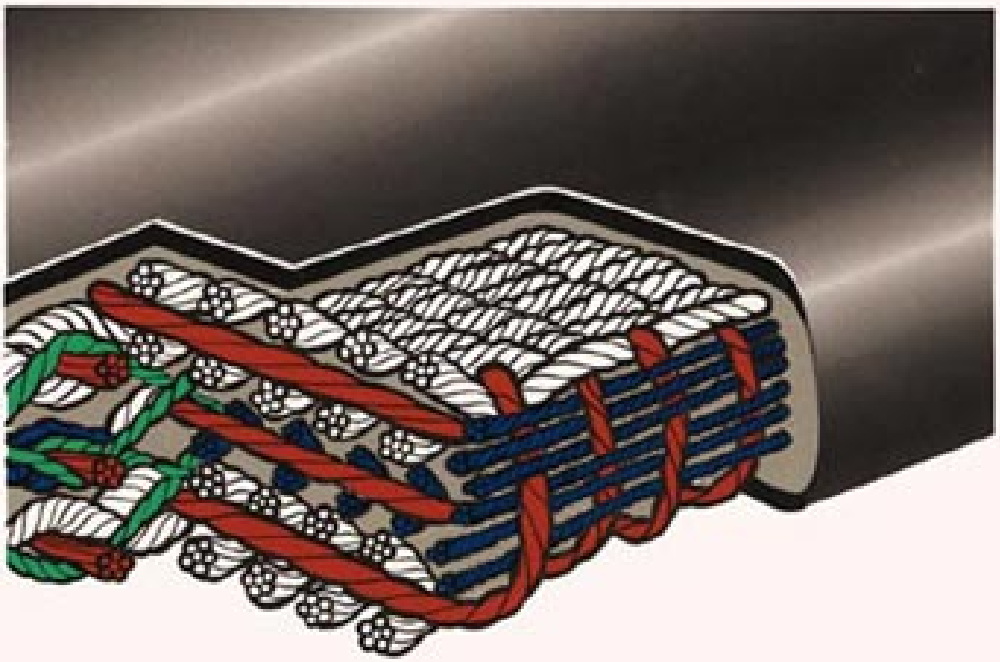
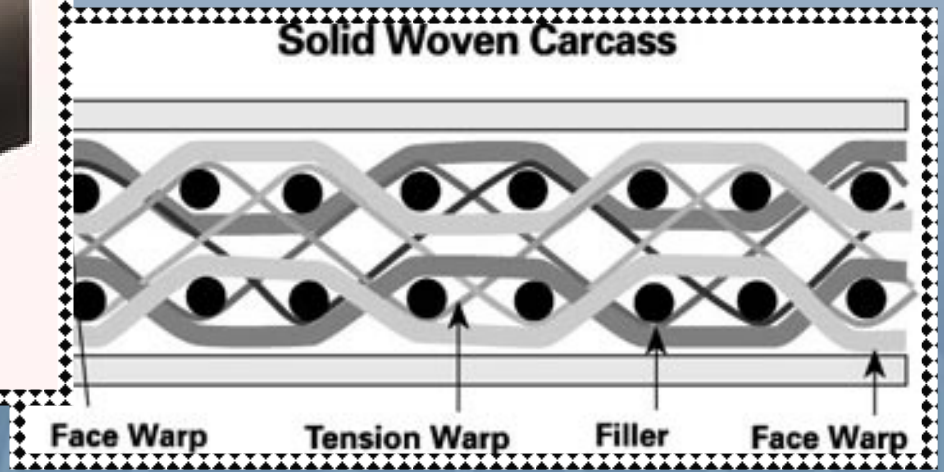
PVC SOLID WOVEN

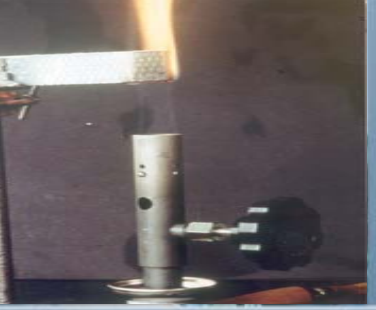
Goldline®





Smoke Toxicity (BPF 1996)

- The majority of people die in fires as they become unable to escape from the highly toxic fire environment. Major lethal component Carbon Monoxide (CO) Ref Creswell colliery Fire
- Apart from CO the other elements are:
- Toxic gases such as HCN, SO2 etc.
- Irritants such as smoke particulates
- Convective and radiant heat
- Oxygen depletion



Smoke Toxicity: Belts

- Germany, Poland, Czech Republic and others have had belt test standards related to smoke / composition
- For highly fire retardant belts, toxic fumes may build up much slower if involved in a fire
- Investigation of toxicity of fumes from a FRAS conveyor belt under friction tested in 2001 by TES Bretby
- Testing was due to the failure of detection devices under a frictional heating scenario at a UK Mine
- VOC < 70 microgram / liter and well below exposure limits
- Smoke and CO detectors were activated during the testing.

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Brian Rothery, Fenner Dunlop Europe
Chairman of BSI PRI/67 Committee and
Convener of CEN TC/188 WG3

The European Approach to Safety

UK APPROACH TO UNDERGROUND SAFETY SINCE THE CRESSWELL MINE DISASTER

1. The belt should not be the cause of a fire
    a. belt surface should be sufficiently conductive to prevent the build up of static electric charge
    b. belt should be ‘safe’ under stalled belt / rotating drum scenario i.e. drum friction test
2. The belt should be difficult to ignite (Bunsen burner type tests)
3. An ignited belt should not spread the fire i.e. be self-extinguishing (larger scale fire propagation tests)

SURFACE RESISTANCE

- One recognised standard for conveyor belting – a max value 3 x 10^8 ohms when tested by the method described in BS EN ISO 284:2003.

DRUM FRICTION

- Basic test methods are given in BS EN 1554 but requirements differ in European countries
- There are two main approaches:
  - use of the belt alone to provide safety (325°C max drum temp, no flame or glow)
  - use of other devices to provide additional safety, often referred to as secondary safety devices (higher drum temps, no flame, glow allowed)

DRUM FRICTION

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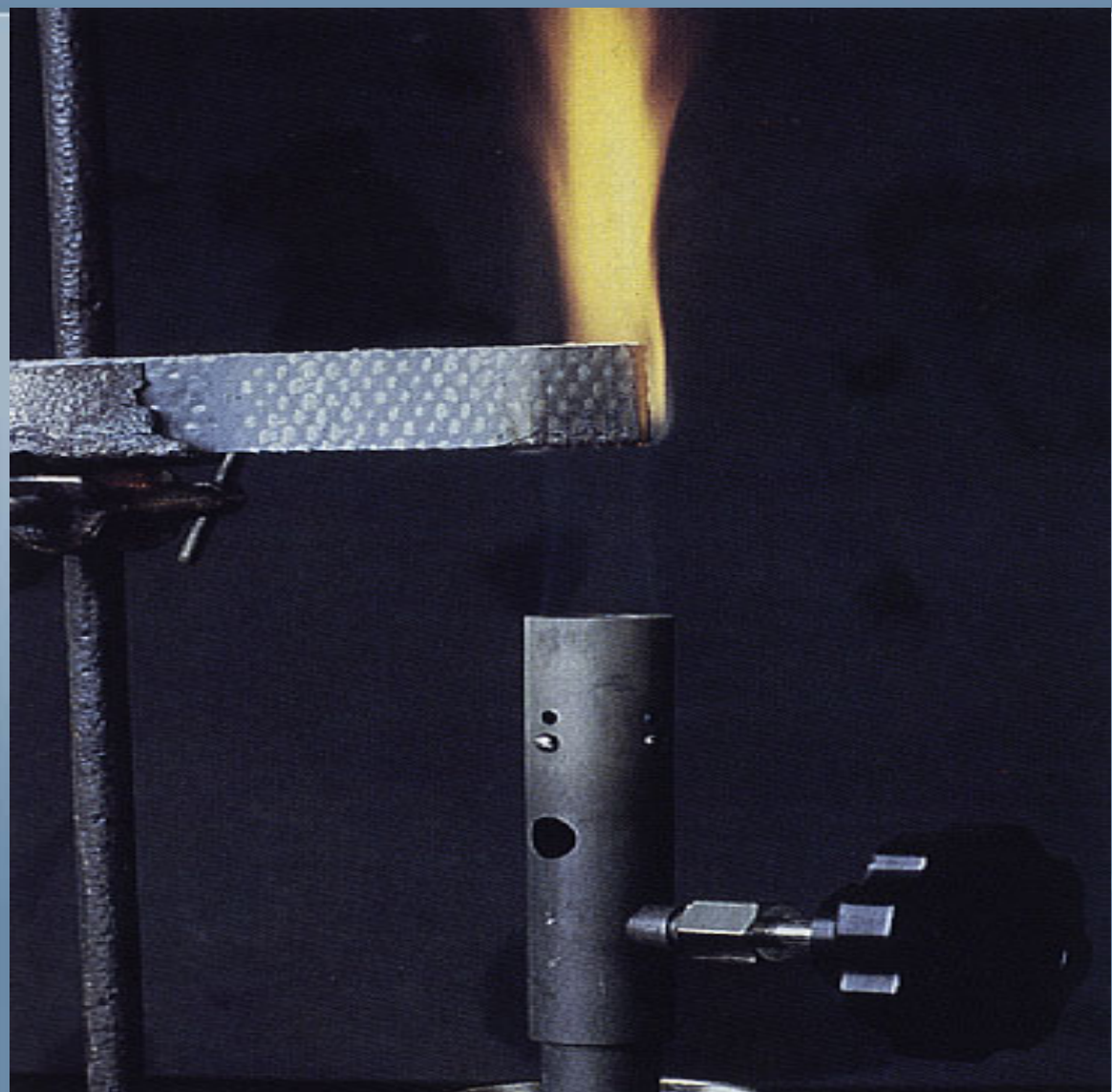
LABORATORY FLAME/IGNITION TEST

- EN ISO 340 is used in much of the world. This is slightly less severe than the Barthel burner test specified in BS 3289 due to longer flame/glow times being allowed.
- Some countries test with and without covers, others with covers on only

LABORATORY FLAME/IGNITION TEST (BARTHEL BURNER)



LABORATORY FLAME/IGNITION TEST (ISO 340)

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FIRE PROPAGATION TESTS

BACKGROUND

- 2 metre standard energy test used in Europe since early 70's (1.3 kgs propane/10 mins)
  - test OK for lighter textile belts
  - insufficient energy to ignite heavier textile & steel cord belts, hence test does not necessarily measure fire propagation
- Higher energy tests were needed to overcome this problem

FIRE PROPAGATION TESTS CURRENT POSITION

- UK - 4 m high energy test (7.5 kgs propane/50 mins). This test now replaced by the equivalent mid-scale high energy test)
- Belgium & France - 2 m standard energy test still used for textile belts, double burner high energy test used for steel cord and aramid belts (5.2 kgs propane/20 mins).
- Germany - very high energy burning roadway test (Brandstrecke test)

FIRE PROPAGATION TESTS
2-M PROPANE TEST

FIRE PROPAGATION TESTS
MID-SCALE TEST

EUROPEAN STANDARDIZATION (CEN)

- CEN TC/188 committee formed in late 1989
- Aim was to prevent barriers to trade within Europe by the harmonization of conflicting national standards
- Five working groups were formed:
  - WG 1 Physical test methods
  - WG 2 Specifications for textile belts
  - **WG 3 Safety test methods & requirements**
  - WG 4 Specifications for steel cord belts
  - WG 5 Specifications & test methods for light belts

OTHER EUROPEAN APPROACHES TO UNDERGROUND SAFETY

- Surface resistance - same
- Drum friction - different
- Laboratory ignition - slightly different
- Fire propagation - **very different**

CEN CORRELATION PROJECT TO ASSESS FIRE PROPAGATION TEST METHODS

- Took place throughout 1994. Eight different belt types from four countries were tested.
- Each country performed the standard 2 m propane test on each sample. Good correlation was obtained.
- Each country performed it's own high energy test on each sample. Analysis of the results showed a complete lack of correlation

PROBLEMS WITH HARMONIZATION

- The conclusion from the high energy tests was that they were not measuring the same property.
- No country was willing to adopt an unfamiliar test that could possibly lead to a less safe situation underground.
- Result - STALEMATE!

GENERAL PURPOSE BELTING

- The European Machinery Directive requires risk assessments to be performed on all machines.
- Fire safety requirements for non-underground applications are not as demanding.
- A new standard was produced by WG 3 (BS EN 12882:2002) that introduced the concept of safety categories.
- This standard specifies a means of categorizing conveyor belts in terms of the level of safety required by the end-use application.

SUMMARY OF SAFETY CLASSES IN BS EN 12882:2002

Category	Elec. Resistance requirements	Ignition requirements	Drum friction requirements	Fire propagation requirements
1	**8**			
2	**8**	**8**		
3	**8**	**8**	**8**	
4	**8**			**8**
5	**8**	**8**	**8**	**8**

UNDERGROUND BELTING

- Any standard for underground belting in Europe has to satisfy and support the requirements of the ATEX Directive as well as the Machinery Directive.
- The risk assessment approach demanded by these Directives has provided a way out of the ‘stalemate’ situation for underground belting.
- EN 14973 contains five classes for belting, intended to provide safety in particular situations.

SUMMARY OF SAFETY CLASSES IN BS EN 14973:2006

- Class A, general use, the only hazard being limited access & means of escape
- Class B, as above plus a potentially explosive atmosphere
  - B1 - no secondary safety devices
  - B2 - with secondary safety devices
- Class C, as Class B plus flammable dust or material conveyed
  - C1 - no secondary safety devices
  - C2 - with secondary safety devices

SUMMARY OF SAFETY CLASSES IN BS EN 14973:2006

CLASS	APPLICATION	SURFACE RESISTANCE EN ISO 284	DRUM FRICTION EN 1554 Method B2[1]			IGNITION (EN ISO 340)		FIRE PROPAGATION
			Flame	Glow	Max temp	Aggregate of 6 test pieces	Max for any one test piece	
A	General use, hazard being limited access and means of escape	≤ 300 MΩ	No	Allowed	No limit	45 s	15 s	2 m propane test If incomplete ignition, use mid-scale or double burner test
B1	As **A**, plus potentially flammable atmospheres No secondary devices	≤ 300 MΩ	No	No	450°C	45 s	15 s	2 m propane test If incomplete ignition, use mid-scale or double burner test
B2	As **A**, plus potentially flammable atmospheres With secondary devices	≤ 300 MΩ	No	Allowed	No limit	45 s	15 s	2 m propane test If incomplete ignition, use mid-scale or double burner test
C1	As **B1**, plus flammable dust or material conveyed No secondary devices	≤ 300 MΩ	No	No	325°C	18 / 30 (cov on/off)	10 / 15 (cov on/off)	Mid scale or double burner test
C2	As **B2**, plus flammable dust or material conveyed, plus additional fuel sources. With secondary devices	≤ 300 MΩ	No	Allowed	No limit	45 s	15 s	Grosbrandstrecke test

SUMMARY OF EN/ISO STANDARDS

- SAFETY TESTS/REQUIREMENTS
  - EN 12882 – for general purpose belting
  - EN 14973 – for underground belting
- GENERAL PURPOSE BELTING STANDARDS
  - EN ISO 14890 – Textile belts
  - EN ISO 15236-1 – Steel cord belts
- UNDERGROUND BELTING STANDARDS
  - EN ISO 22721 – Textile belts (at ballot stage)
  - EN ISO 15236-3 – Steel cord belts (at ballot stage)

FURTHER READING !

- Comparisons of fire propagation tests on conveyor belts for use in underground coal mines (prepared by Cerberus (Mining Acceptance Services) Ltd
  - Reviewed the current situation and included a summary of the CEN correlation programme mentioned earlier
- Fire safety testing of conveyor belts (prepared by Cerberus (Mining Acceptance Services) Ltd for the HSE (HSE RSU Contract Ref: 4167/RO4.085)
  - Led to the development of the mid-scale high energy test based on the gallery used for the B.E.L.T. test.

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THANK YOU FOR YOUR ATTENTION!

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