Metodi di prova per la determinazione della reazione al fuoco: evoluzione del quadro europeo

Silvio Messa

21 Marzo 2013

1ª Conferenza Nazionale
POLIURETANO ESPANSO RIGIDO
Isolamento Termico e Risparmio Energetico

Parc Hotel - Castelnuovo del Garda (VR)

L.S.FIRE TESTING INSTITUTE srl

Our laboratories

L.S.Fire Testing Institute Srl

Via Olgiate, 15
22070 Oltrona di S.M. (CO)

Via Bonifica, 4
64010 Controguerra (TE)

Tel. +39-031-890588
e-mail: labo@lsfire.it

L.S.FIRE TESTING INSTITUTE srl

THE TEST METHODS USED IN THE STANDARD **EN 13501-1** edition 2009

Fire classification of construction products and building elements

Part 1: Classification using data from reaction to fire tests

Classificazione al fuoco dei prodotti e degli elementi da costruzione

Parte 1: Classificazione in base ai risultati delle prove di reazione al fuoco

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Normative references EN 13501-1

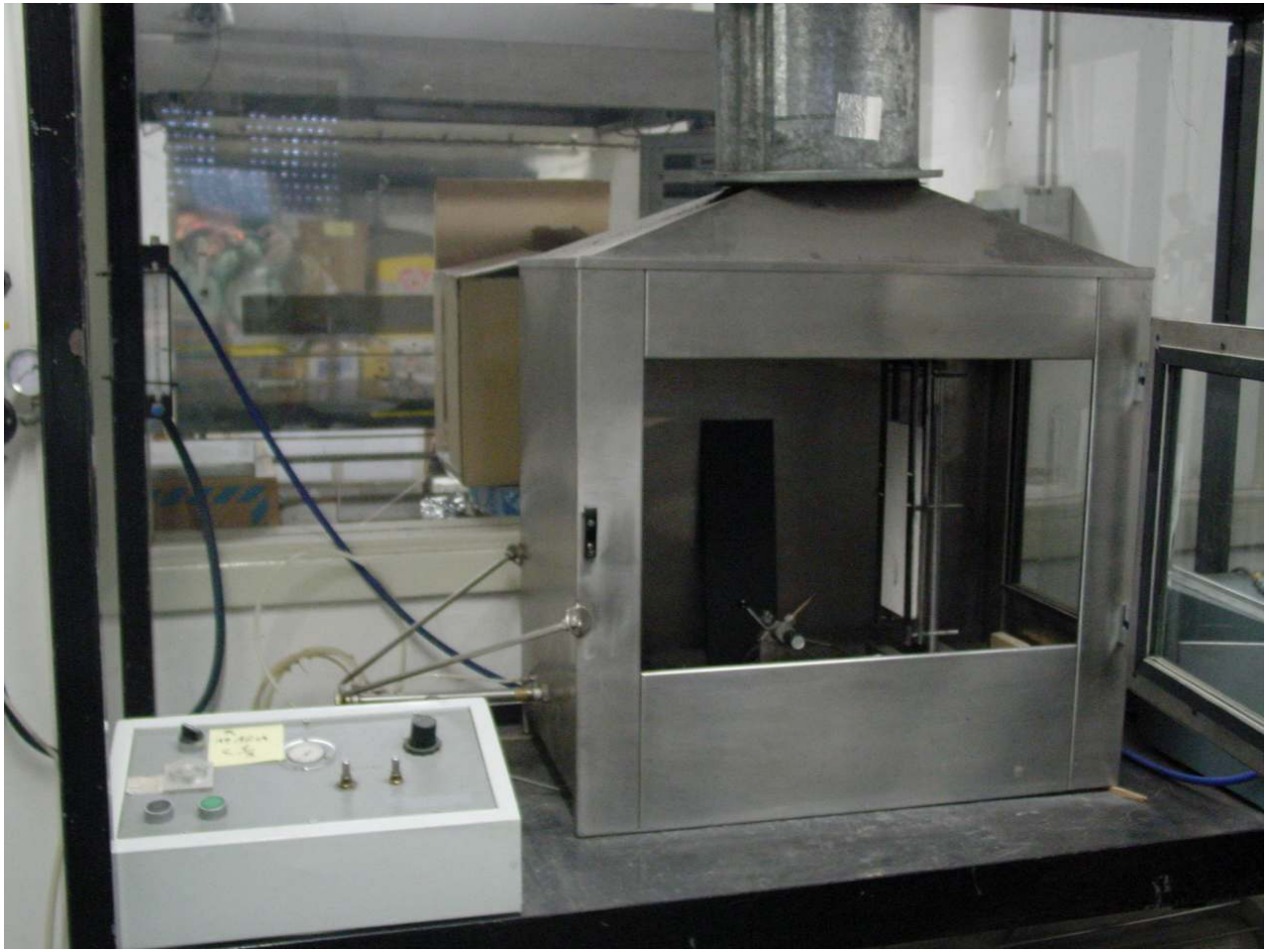
EN ISO 11925-2	Reaction to fire tests Ignitability of building products subjected to direct impingement of flame Part 2: Single-flame source test
EN 13823	Reaction to fire tests for building products Building products excluding floorings exposed to the thermal attack by a single burning item
ISO 9705 EN 14390	Fire tests Full-scale room test for surface products

EN ISO 11925-2

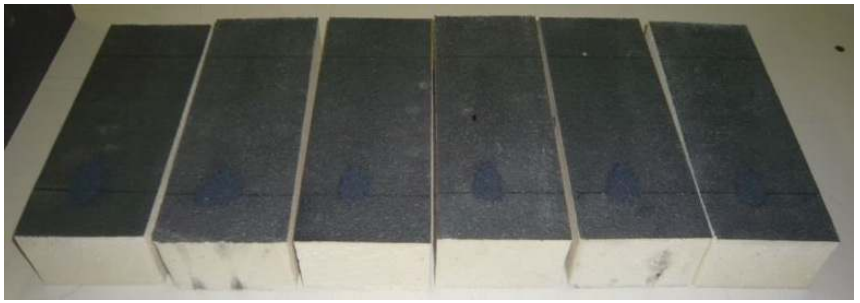
Prove di reazione al fuoco - accendibilità dei prodotti da costruzione sottoposti all'attacco diretto della fiamma
Parte 2: prova con l'impiego di una singola fiamma

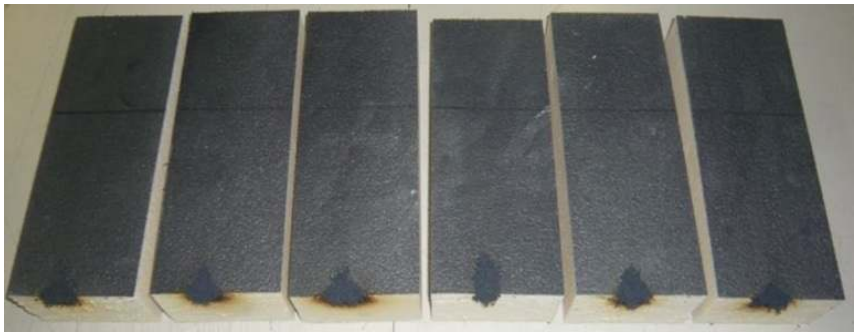
Reaction to fire tests - Ignitability of building products subjected to direct impingement of flame
Part 2: Single-flame source test Ignition (with a small flame)

EN ISO 11925-2



EN ISO 11925-2



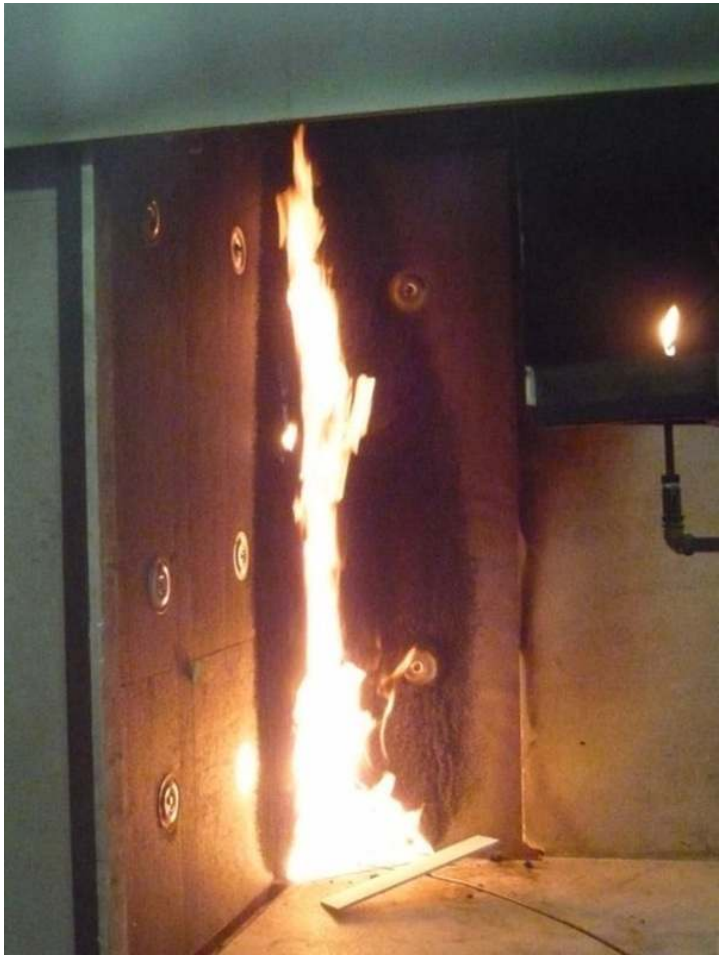


EN 13823

Prove di reazione al fuoco dei prodotti da costruzione – Prodotti da costruzione esclusi i pavimenti esposti ad un attacco termico prodotto da un singolo oggetto in combustione

Reaction to fire tests for building products - Building products excluding floorings exposed to the thermal attack by a single burning item

EN 13823



EN 13823

ISO 9705
EN 14390

Fire tests
Full-scale room test for surface products

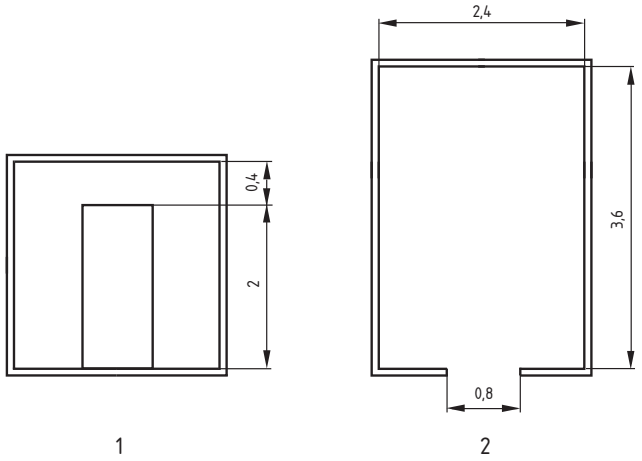
Room Corner Test - RCT

- Room:
  - length: 3,6 m
  - width: 2,4 m
  - height: 2,4 m

- Burner
  - 10 minutes at 100 kW

then

  - 10 minutes at 300 kW



ISO 9705
EN 14390

ISO 9705
EN 14390

NORMA EUROPEA

Isolanti termici per edilizia

Prodotti di poliuretano espanso rigido (PUR) e di poliisocianurato espanso rigido (PIR) spruzzati e formati in sito

Parte 1: Specifiche per il sistema espanso rigido a spruzzo prima dell'installazione

UNI EN 14315-1

MARZO 2013

Thermal insulating products for buildings

In-situ formed sprayed rigid polyurethane (PUR) and polyisocyanurate (PIR) foam products

Part 1: Specification for the rigid foam spray system before installation

La norma specifica i requisiti per i prodotti di poliuretano espanso rigido (PUR) e di poliisocianurato espanso rigido (PIR) quando applicati a pareti, soffitti, tetti, controsoffitti e pavimenti. La norma si applica ai sistemi di poliuretano rigido o poliisocianurato espanso rigido a spruzzo prima dell'installazione. La norma descrive le caratteristiche del prodotto e include procedimenti di prova, marcatura, etichettatura e regole per la valutazione di conformità.

NORMA EUROPEA

Isolanti termici per edilizia

Prodotti di poliuretano espanso rigido (PUR) e di poliisocianurato espanso rigido (PIR) formati in sito per iniezione

Parte 1: Specifiche per il sistema espanso rigido per iniezione prima dell'installazione

UNI EN 14318-1

FEBBRAIO 2013

Thermal insulating products for buildings

In-situ formed dispensed rigid polyurethane (PUR) and polyisocyanurate (PIR) foam products

Part 1: Specification for the rigid foam dispensed system before installation

La norma specifica i requisiti per i prodotti di poliuretano espanso rigido (PUR) e di poliisocianurato espanso rigido (PIR) formati in sito per iniezione quando installati nelle intercapedini dei muri.
La norma si applica ai sistemi di poliuretano espanso rigido (PUR) applicabili per iniezione prima dell'installazione.
La norma descrive le caratteristiche del prodotto e include procedimenti di prova, marcatura, etichettatura e regole per la valutazione di conformità.

THE TEST METHODS USED IN THE STANDARD **EN 45545-2** new edition 2013

Railway application – Fire protection on railway vehicles – Part 2

Requirements for fire behaviour of materials and components

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 45545-2

March 2013

ICS 45.060.01; 13.220.20

Supersedes CEN/TS 45545-2:2009

English Version

Railway applications - Fire protection on railway vehicles - Part 2: Requirements for fire behavior of materials and components

Applications ferroviaires - Protection contre les incendies dans les véhicules ferroviaires - Partie 2: Exigences du comportement au feu des matériaux et des composants

Bahnanwendungen - Brandschutz in Schienenfahrzeugen - Teil 2: Anforderungen an das Brandverhalten von Materialien und Komponenten

This European Standard was approved by CEN on 7 December 2012.

Normative references EN 45545-2

ISO 5658-2	Reaction to fire tests - Spread of flame Part 2: Lateral spread on building products in vertical configuration
ISO 5660-1	Reaction-to-fire tests Heat release, smoke production and mass loss rate Part 1:Heat release (cone calorimeter method)
ISO 5659-2	Plastics — Smoke generation Part 2: Determination of optical density by a single-chamber test
EN ISO 9239-1	Reaction to fire tests for floorings Part 1 : Determination of the burning behaviour using a radiant heat source

EN 45545-2 – table 2 pag.13 requirement of listed products

IN1A	Interior vertical surfaces	Interior components (structure and covering) such as side walls, front walls / end-walls, partitions, room dividers, flaps, boxes, hoods, louvres. Interior doors, interior lining of the front-/end-wall doors and external doors. Windows (including plastics and glazing) Insulation material and interior surface of body shell. Kitchen interior surfaces (except those of kitchen equipment).	R1
IN1B	Interior horizontal downward-facing surfaces	Interior components (structure and coverings) such as ceiling panelling, flaps, boxes, hoods, louvres. Insulation material and interior surface of body shell.	R1
IN1C	Interior horizontal upwards-facing surfaces	Interior components (structure and coverings) such as flaps, boxes, hoods, louvres. Insulation material and interior surface of body shell. Compliance with the requirements of R1 is also considered to be compliant for this requirement.	R10

EN 45545-2 – table 5 material requirement sets

Requirement set (relevant product no.)	Test method reference	Parameter and unit	Maximum or Minimum	HL1	HL2	HL3
R1 (IN1A; IN1B; IN1D; IN1E; IN4; IN5; IN6A; IN7; IN8; IN9B; IN11; IN12A; IN12B; IN14; F5)	T02 ISO 5658-2	*CFE* kWm^{-2}	Minimum	20 [a]	20 [a]	20 [a]
	T03.01 ISO 5660-1: 50 kWm^{-2}	*MARHE* kWm^{-2}	Maximum	[a] -	90	60
	T10.01 EN ISO 5659-2: 50 kWm^{-2}	$D_s(4)$ dimensionless	Maximum	600	300	150
	T10.02 EN ISO 5659-2: 50 kWm^{-2}	VOF_4 min	Maximum	1 200	600	300
	T11.01 EN ISO 5659-2: 50 kWm^{-2}	CIT_G dimensionless	Maximum	1,2	0,9	0,75

EN 45545-2 – table 5 material requirement sets

Requirement set (relevant product no.)	Test method reference	Parameter and unit	Maximum or Minimum	HL1	HL2	HL3
R10 (IN1C; IN15)	T04 EN ISO 9239-1	*CHF* kWm^{-2}	Minimum	4,5	6	8
	T03.02 ISO 5660-1: 25 kWm^{-2}	*MARHE* kWm^{-2}	Maximum	–	–	–
	T10.03 EN ISO 5659-2: 25 kWm^{-2}	D_s max. dimensionless	Maximum	600	300	150
	T11.02 EN ISO 5659-2: 25 kWm^{-2}	CIT_G dimensionless	Maximum	1,2	0,9	0,75

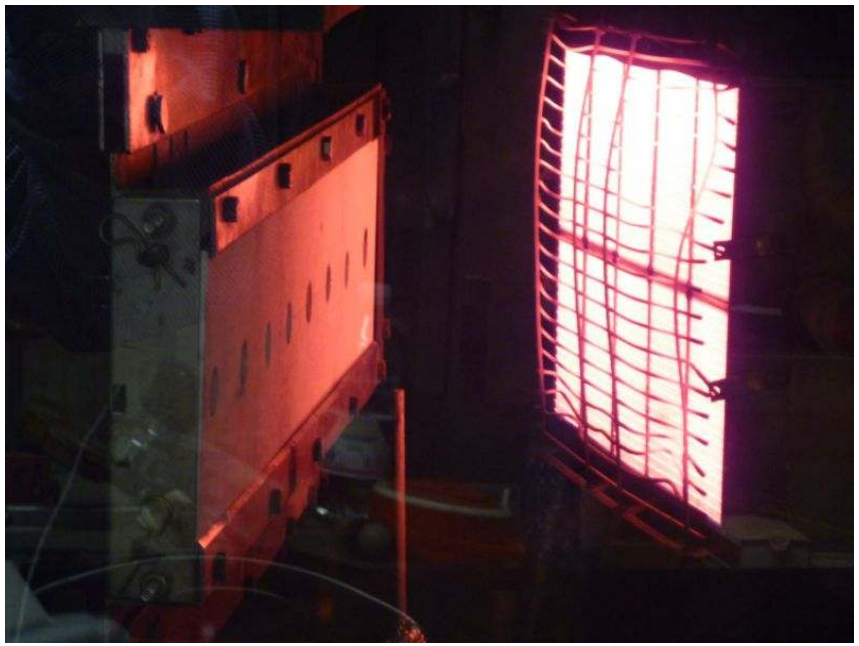
ISO 5658-2

Reaction to fire tests- Spread of flame

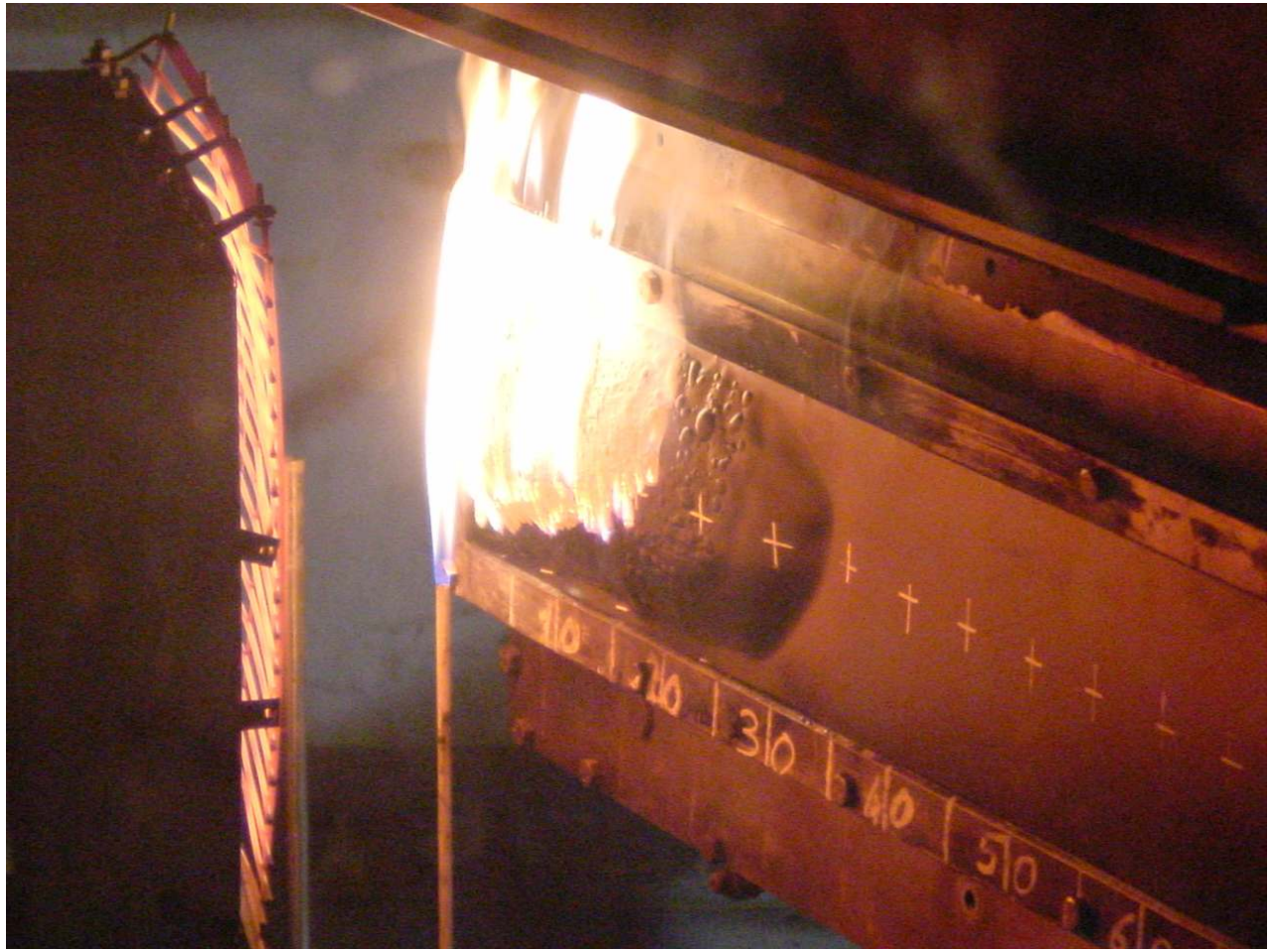
Part 2:

Lateral spread on building products in vertical configuration

ISO 5658-2



ISO 5658-2



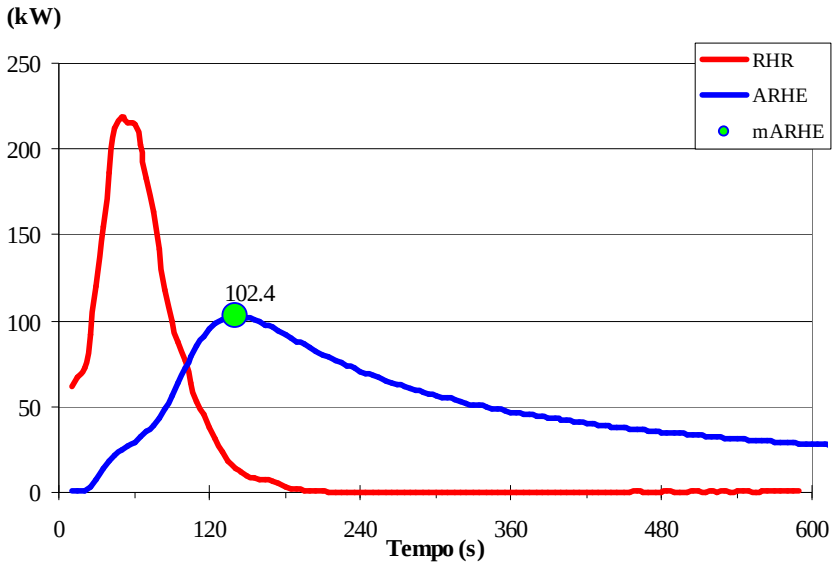
ISO 5660-1

Reaction-to-fire tests
Heat release, smoke production
and mass loss rate

Part 1:
Heat release (cone calorimeter method)

ISO 5660-1

ISO 5660-1


(kW)
250
200
150
100
50
0
RHR
ARHE
mARHE
102.4
0
120
240
360
480
600
Tempo (s)

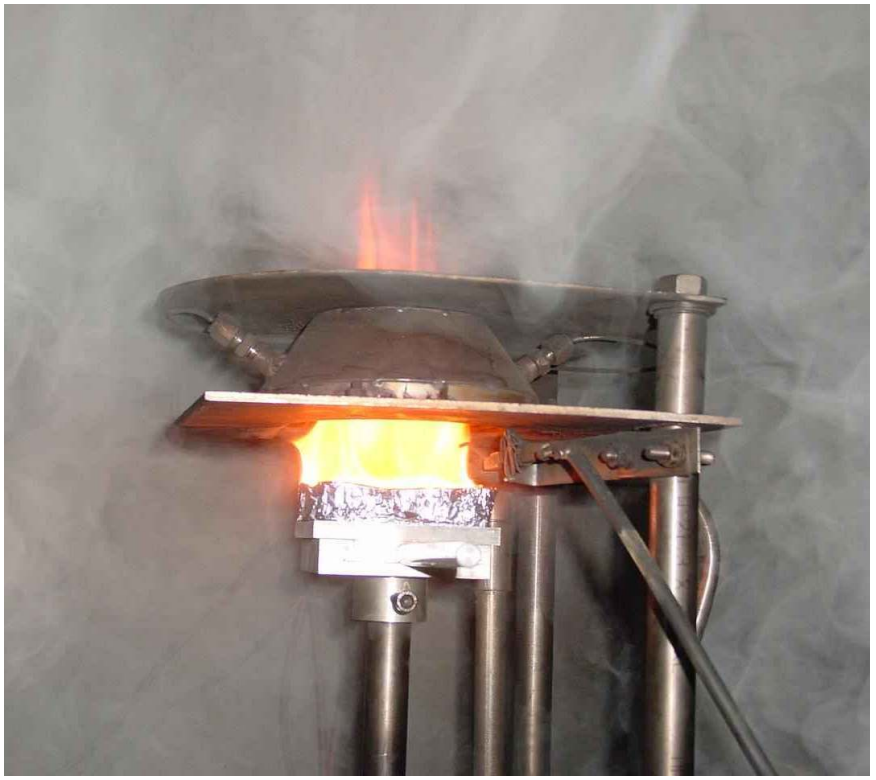
ISO 5659-2

Plastics — Smoke generation —

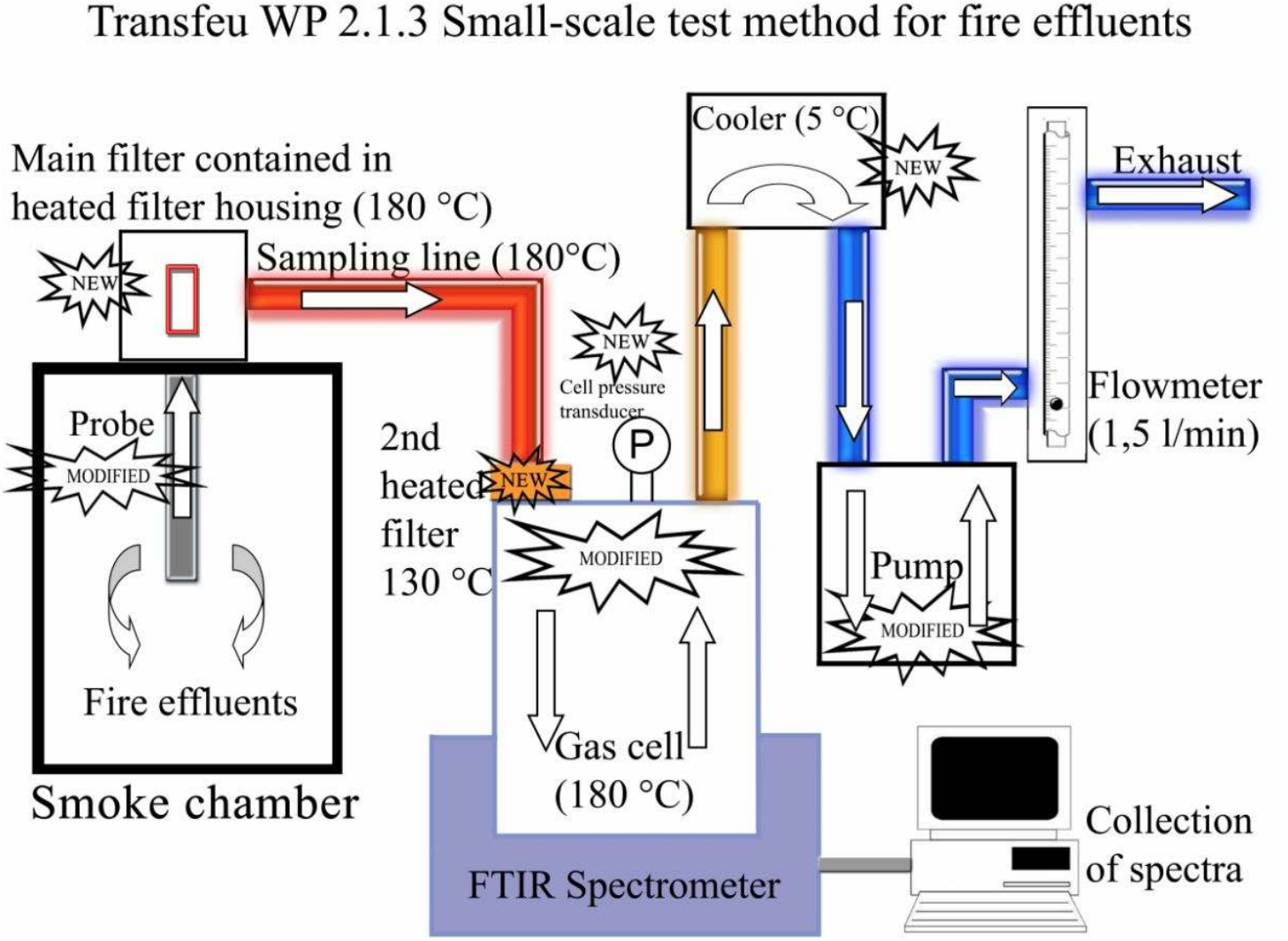
Part 2:

Determination of optical density by a single-chamber test

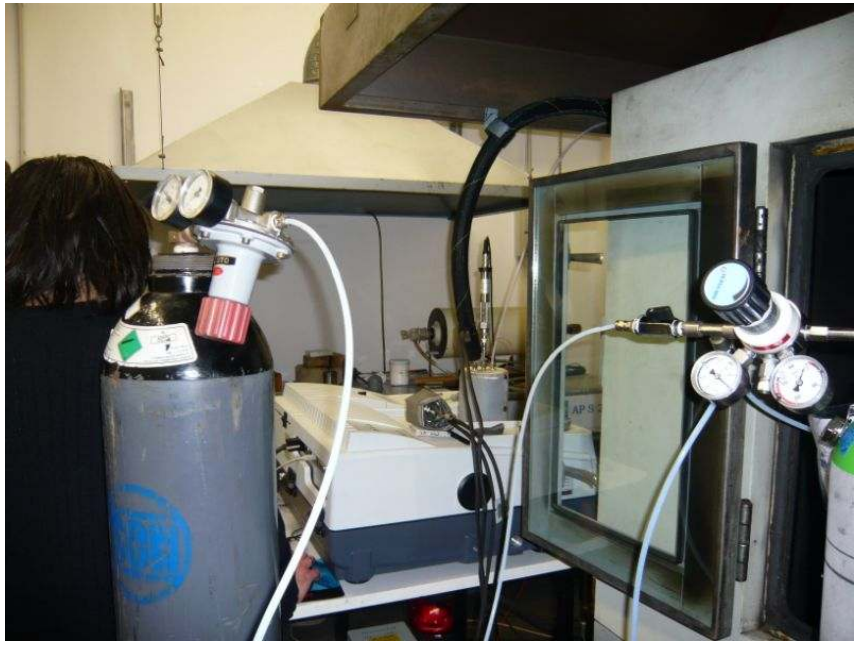
ISO 5659-2



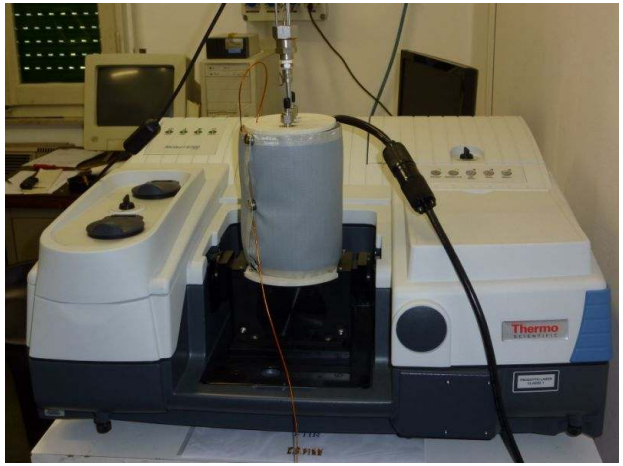
ISO 5659-2 for TRANSFEU

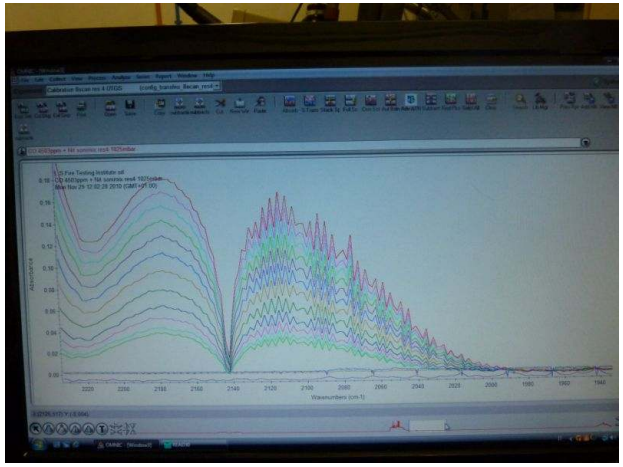


ISO 5659-2 + new FTIR



calibration





ISO 5659-2 + EN 45545-2 Ann.C

CIT - Conventional Index of Toxicity

$$CIT = [\text{Precursor Term}] \times [\text{Summation Term}]$$

$$CIT_G = \frac{0.51m^3 \times 0.1m^2}{150m^3 \times 0.004225m^2} \times \sum_{i=1}^{i=8} \frac{c_i}{C_i}$$

EN ISO 9239-1

Reaction to fire tests for floorings - Part 1 : Determination of the burning behaviour using a radiant heat source

EN ISO 9239-1

EN ISO 9239-1

Il futuro

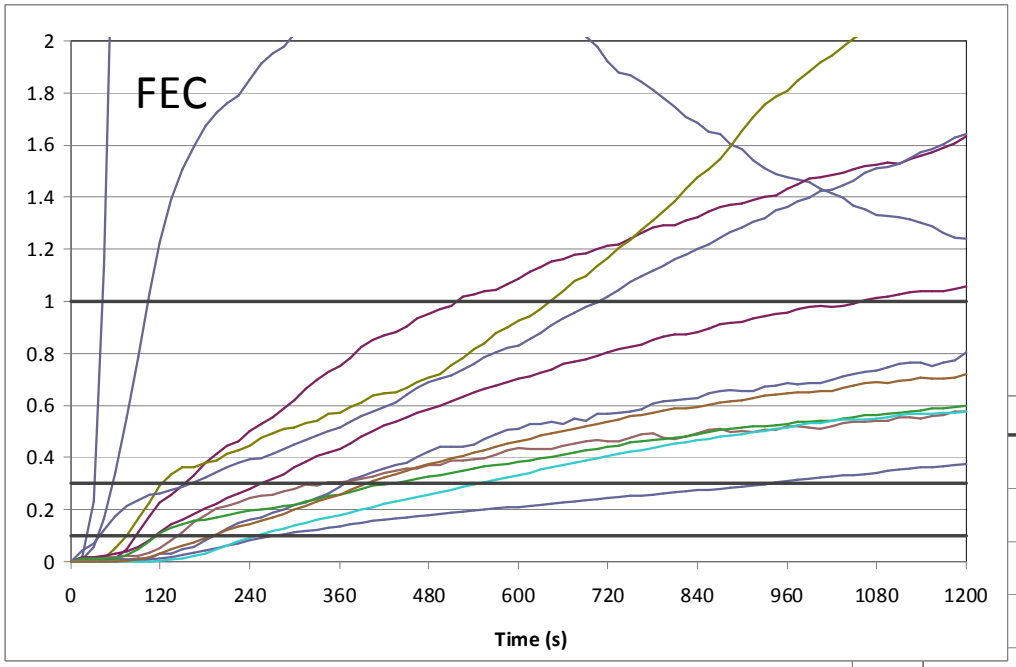
ORA

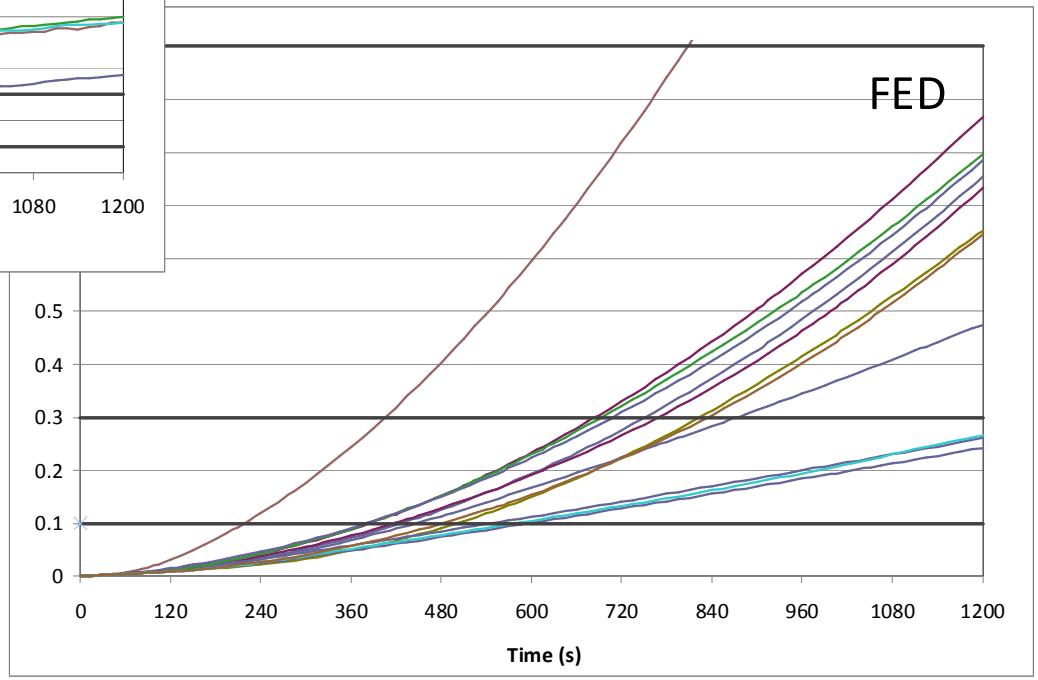
- Nella preparazione delle EN 45545 la valutazione della tossicità si fa con l'indice CIT
- **CIT - Conventional Index of Toxicity**
- **Il quale tiene conto delle concentrazioni di gas narcotizzanti ed irritanti a 4 minuti e 8 minuti**

In futuro

- **Nel prossimo futuro, il WG dovrebbe adottare la filosofia di Transfeu**
  - **Misura dei fumi e gas tossici in continuo per tutta la durata del test**
  - **Calcolo del FED e FEC e determinazione del tempo in cui si raggiunge la soglia di tenibilità**

FED/FEC index (according to ISO 13571)
bench scale (smoke box 50 kW/m² no pilot flame)





FEC e FED (ISO 13571)

- FED (Fractional Effective Dose)

$$FED = \sum_{t1}^{t2} \frac{\varphi_{CO}}{35000} \Delta t + \sum_{t1}^{t2} \frac{\exp(\varphi_{HCN} / 43)}{220} \Delta t$$

- FEC (Fractional Effective Concentration)

$$FEC = \frac{\varphi_{HCl}}{F_{HCl}} + \frac{\varphi_{HBr}}{F_{HBr}} + \frac{\varphi_{HF}}{F_{HF}} + \frac{\varphi_{SO_2}}{F_{SO_2}} + \frac{\varphi_{NO_2}}{F_{NO_2}} + \frac{\varphi_{acroleina}}{F_{acroleina}} + \frac{\varphi_{formaldeide}}{F_{formaldeide}} + \sum_i \frac{[\text{irritante}]_i}{Fc_i}$$