EUROPEAN STANDARDS

FOR FLAME RESISTANT

PERSONAL PROTECTIVE CLOTHING

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THE HEAT PROTECTION FIBER

Alexander Gstettner, Lenzing AG Austria

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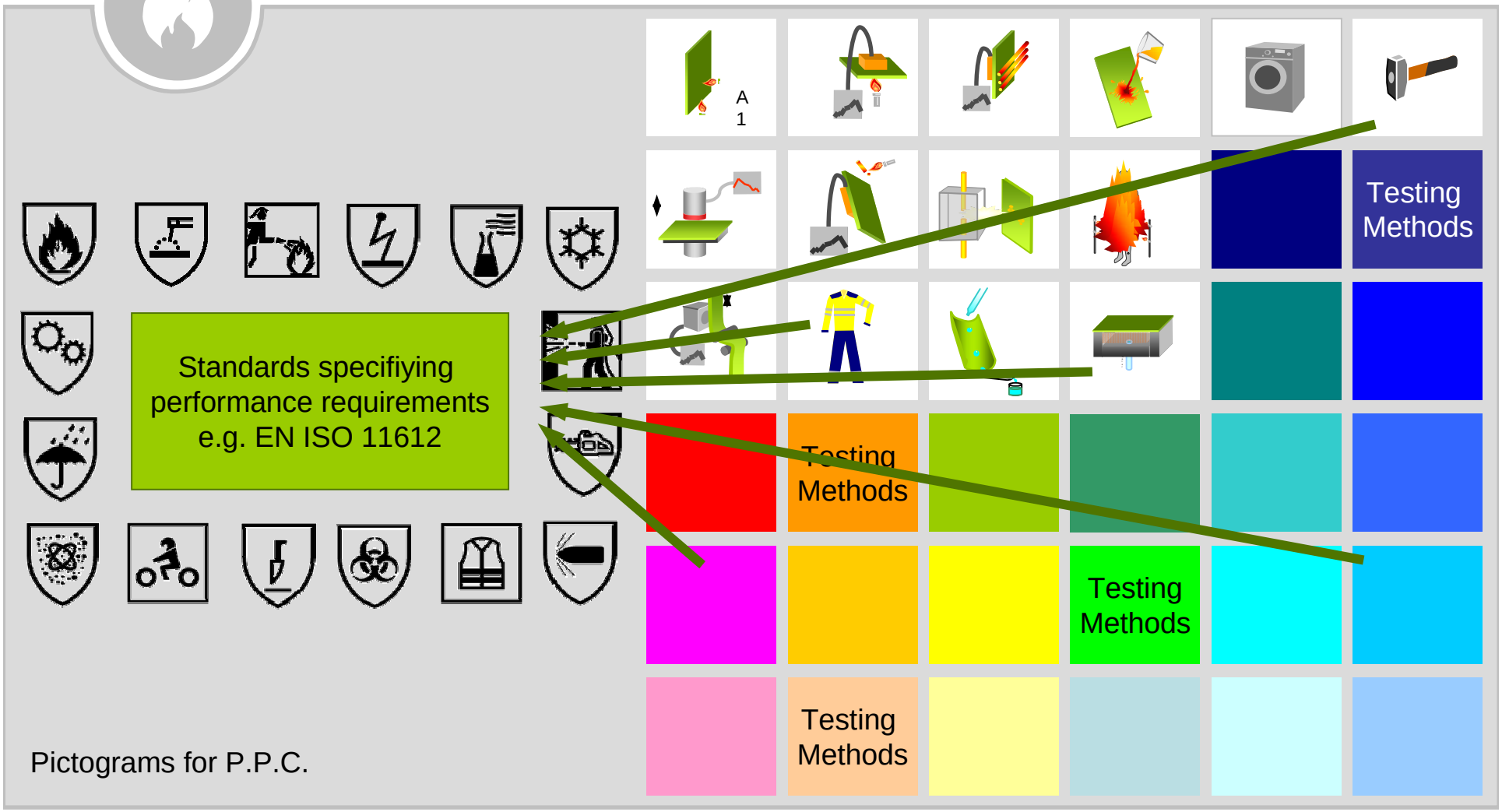
How are the standards organized?



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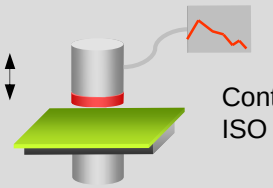
Testing Methods for Flame resistant P.P.C.

Vertical Flame Test
EN ISO 15025

Convective Heat Test
EN ISO 9151

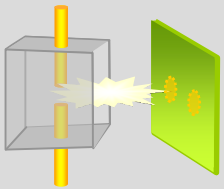
Radiant Heat Test
EN ISO 6942

Metal Splash Test
EN 373
ISO 9185

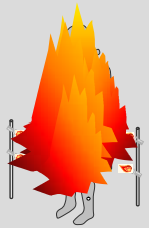


Contact Heat Test
ISO 12127

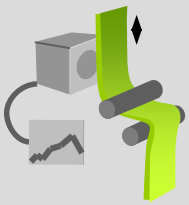
Welding Test
EN ISO 9150



Electric Arc Test
EN ISO 61482-1-2
EN ISO 61482-1-1

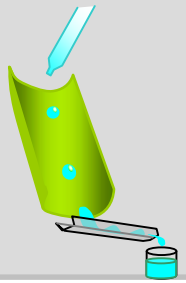


Full Manikin Testing
ISO 13506

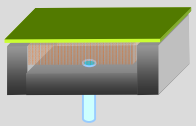


Anti Static Test
EN 1149

High Visibility Test
EN 471



Chemical Rep. Test
EN 368
EN 14325



Physiological Test
EN ISO 31092
ISO 11029

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Vertical flame test EN ISO 15025

Protective Clothing – Protection against heat and flame – Method of test for limited flame spread

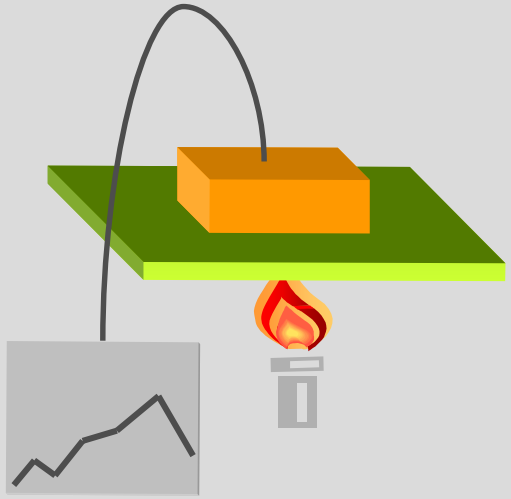
- EN ISO 15025 (ex EN 532)
- 6 specimen (3 warp 3 weft direction)
- 200 x 160 mm
- Vertical orientation
- Flame exposure = 10 sec.
- 2 Procedures: A Surface, B Edge

Observations shall be recorded:

- Flaming to the top or side edge of the specimen
- Time of afterburn
- Afterglow outside of the charred area
- Time of afterglow
- Molten or flaming debris
- Ignition of filterpaper (if used) by flaming or molten debris
- Hole formation and in which layer in case of multilayers

Convective heat test EN ISO 9151

Protective Clothing against heat and flame – Determination of heat transmission on exposure to flame



- EN ISO 9151 (ex EN 367)
- 3 specimen
- 140 x 140 mm
- Horizontal orientation
- Heatflux = 80kW/m²
- Time until second degree burn
- Classification according to the relevant standard e.g. EN ISO 11612

Radiant heat test EN ISO 6942

Protective Clothing – Protection against heat and fire – Method of test: Evaluation of materials and material assemblies when exposed to a source of radiant heat

- EN ISO 6942 (ex EN 366)
- 3 specimen
- 230 x 70 mm
- Vertical orientation
- Heatflux = 20kW/m²
- Time until second degree burn
- Classification according to the relevant standard e.g. EN ISO 11612

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Liquid metal splash test ISO 9185

Protective Clothing – Assessment of resistance of materials to molten metal splash

- ISO 9185 (EN 373 harmonisation pending)
- 4 specimen
- 260 x 100 mm
- Pouring height 225 mm
- Aluminium 60° Iron 75° angel
- Damage of skin simulant
- Hole formation in the fabric
- Classification according to the relevant standard e.g. EN ISO 11612

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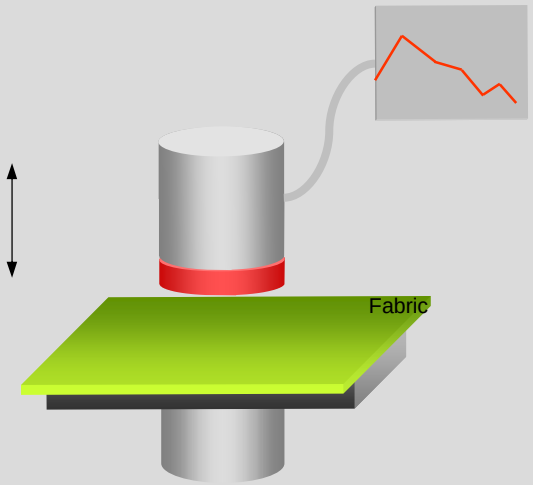
Contact heat test ISO 12127

Clothing for protection against heat and flame – Determination of contact heat transmission through protective clothing or constituent materials



- ISO 12127:1996
- Horizontal orientation
- 3 specimen
- 80 mm diameter
- Hot cylinder 250°C
- Time until second degree burn
- Classification according to the relevant standard e.g. EN ISO 11612

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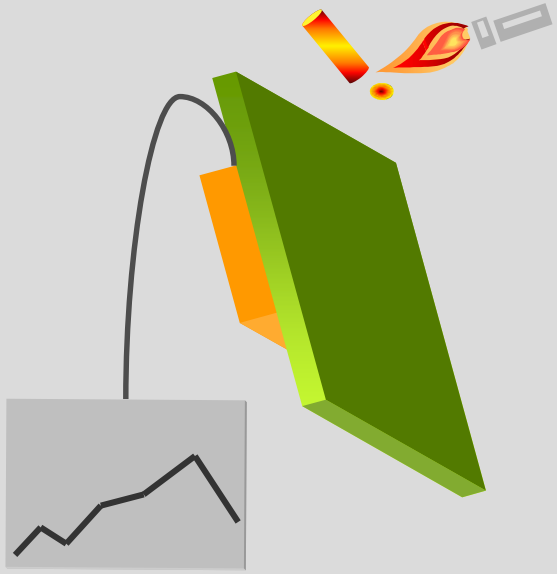
Welding Test ISO 9150:1988

Protective Clothing – Determination of behaviour of materials on impact of small splashes of molten metal



- ISO 9150:1988
- Min 10 specimens
- Size of specimen 120 x 20 mm
- Metal rod, specified frequency of droplets
- Measurement of temperature increase by calorimeter
- Classification according to the relevant standard e.g. EN ISO 11611

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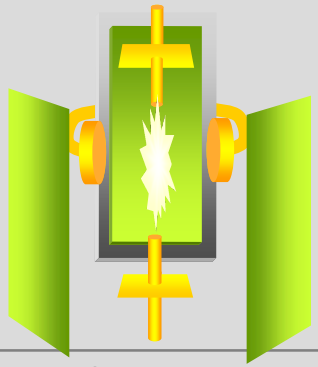
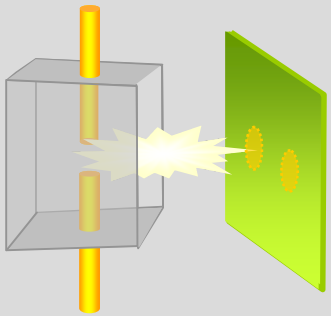
Electric Arc Test EN ISO 61482

Live working – Flame resistant materials for clothing for thermal protection of workers – Thermal hazards of an electric arc





	EN ISO 61482-1 panel test	EN ISO 61482-1-2 box test
Number of specimen	min. 20 values each shot 3 specimen	min. 4
Specimen size	610 x 305 mm	500 x 500 mm
Arc current	8 ± 1kA	4 kA, 7kA
Electrode gap	300 mm	30 mm
Arc distance to specimen	300 mm	300 mm
Duration time	0,05 s up to 1,5 s	0,5 s
Results	Incident energy 2nd° burn injury (using Stoll curve) Arc thermal performance value ATPV Heat attenuation factor HAF Breakopen threshold energy EBT Other parameter to fulfill e.g. ignition…	All eight value pairs are below corresponding Stoll values Burning time ≤ 5 s No melting through to the innser side No hole bigger than max. 5 mm in every direction (in the innermost layer)

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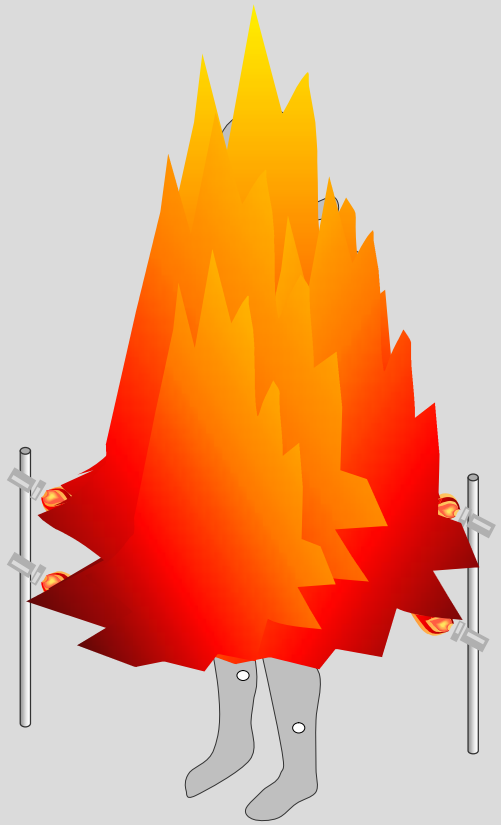
Full manikin testing ISO 13506

Protective Clothing against heat and flame - Test method for complete garments – Prediction of burn injury using an instrumented manikin



- ISO 13506
- min. 100 heat flux sensors
- 8-12 burners, heatflux 80kW/m²
- Flame exposure min. 4 sec. – 8 sec.
- 60-120 seconds calculation time
- Pedicted burn injury calculation
- Other observations shall be recorded e.g. afterflame, shrinkage,..

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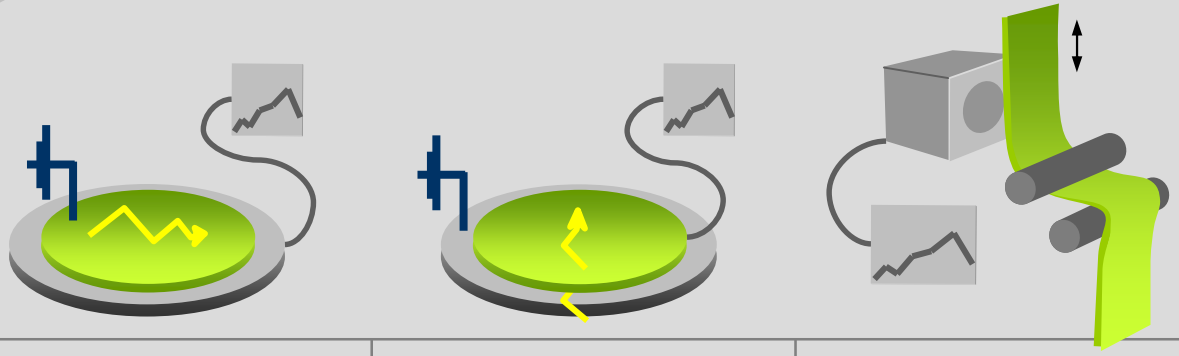
Protection agaist static electricity EN 1149

Protective Clothing – Electrostatic properties – Part 1-5



	EN 1149-1 Test method for measurement of surface resistivity	EN 1149-2 Test method for measurement of the electrical resistance through a material	EN 1149-3 Test methods for measurement of charge decay	EN 1149-5 Material performance and design requirements
Number of specimen	5	5	12	Material has to fulfill one of the following requirements
Specimen size	100 mm diameter	100 mm diameter	50 x 300 mm	T50 < 4 s or S > 0,2 tested according EN 1149-3 procedure 2
Voltage	100 $\pm$ 5V	100 $\pm$ 5V		Surface resistivity of $\leq$ 2,5 x 10^9 Ω tested according EN 1149-1
Duration time	15 $\pm$ 1 s	15 $\pm$ 1 s	60 s	Distance of anti static grid has to $\leq$ 10 mm in all directions
	Measurement of surface resistivity	Mmt. of electrical resistance through a material	Measurement of charge decay	

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*EN 1149-4 Testing of clothing (under preparation)

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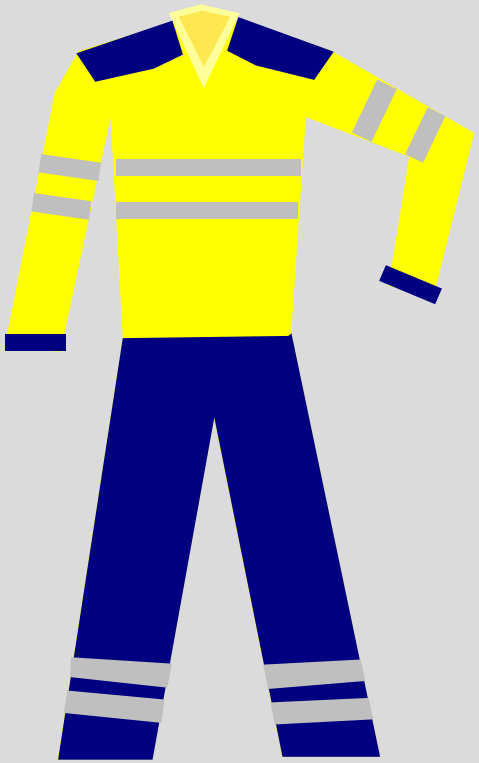
High Visibility test EN 471

High – visibility warning clothing for professional use – Test methods and requirements



- EN 471
- min. amount of contrast and retro-refective material
- 3 Classes
- Color and luminance factor requirement has to be matched
- Different fastness requirements e.g. sweat, washing…
- Washing stability
- Textile durability requirements
- Watervapour resistance RET

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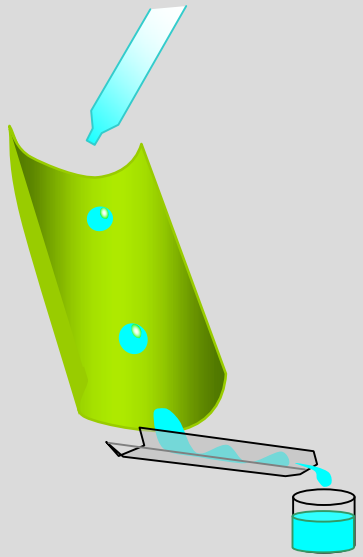
Chemical repellency test EN ISO 6530

Protective clothing – Protection against liquid chemicals. Test method: resistance of materials to penetration by liquids



- EN ISO 6530
- Specimen size 360 x 235 mm
- 6 specimen each liquid (3 warp, 3 weft)
- 10 cm^3 liquid
- Pouring time 10 s
- Classification according to the relevant standard e.g. EN ISO 13034, EN 14325

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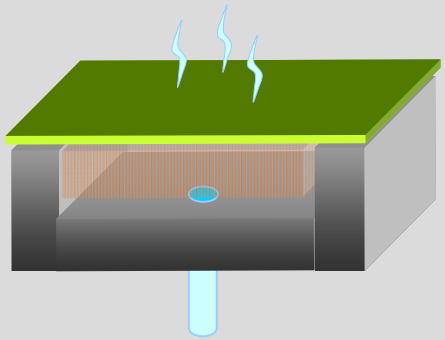
Physiological properties RET - EN 31092

Textiles - Determination of physiological properties - Measurement of thermal and water-vapour resistance under steady-state conditions (sweating guarded - hotplate test) (ISO 11092)



- Hotplate test
- Specimen size 270 x 270 mm
- 2 specimen
- Resistance of watervapour through the textile material
- Classification according to the relevant standard e.g. EN 469, EN 471

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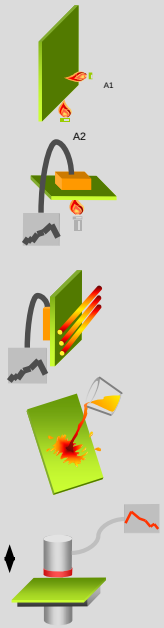
EN ISO 11612:2010 – ex EN 531:1995

Protective Clothing – Protection against heat and flame

CODE LETTERS

A	Limited Flame Spread
B	Convective Heat
C	Radiant Heat
D	Molten Aluminium Splash
E	Molten Iron Splash
F	Contact Heat
W	Optional – Resistance to water penetration



OTHER REQUIREMENTS

- Design requirements
- Washing stability
- Textile durability requirements
- Heat resistance 180°C, 260°C

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What makes the difference?

			EN 531:1995	EN ISO 11612:2010
6.2	Heat Resistance at a temperature of 180 ± 5°C	ISO 17493	-	≤ 5% no ignition or melt
6.2.1	Optional requirement – heat resistance at a temperature of 260 ± 5°C	ISO 17493	-	≤ 10% no ignition or melt
6.3 **6.3.2.1**	Limited Flame spread Code A1 Surface ignition Test carried out before and after pre-treatment. Specimen including seams	EN ISO 15025 Procedure A	-no specimen shall suffer flaming to the top or side edge -no specimen shall suffer hole formation -no specimen shall melt or suffer flaming or molten debris -the mean value of afterflame time shall be ≤ 2s -the mean value of afterglow time shall be ≤ 2s	-no specimen shall suffer flaming to the top or side edge -no specimen shall suffer hole formation -no specimen shall melt or suffer flaming or molten debris -the mean value of afterflame time shall be ≤ 2s -the mean value of afterglow time shall be ≤ 2s -seams shall remain intact
6.3.2.2	Multilayer garments: flame shall be applied on outer material and innermost lining of the garment	EN ISO 15025 Procedure A	-	Shall meet the requirements of 6.3.2.1 No specimen shall suffer hole formation except for an interlining that is used for specific protection other than heat protection
6.3 **6.3.3.1**	Limited Flame spread Code A2 Edge ignition Test carried out before and after pre-treatment	EN ISO 15025 Procedure B	-	-no specimen shall suffer flaming to the top or side edge -no specimen shall melt or suffer flaming or molten debris -the mean value of afterflame time shall be ≤ 2s -the mean value of afterglow time shall be ≤ 2s

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What makes the difference?

			EN 531:1995	EN ISO 11612:2010
6.4	Dimensional change due to cleaning	ISO 5077	Wovens: ≤ 3% Knits: -	Wovens: ≤ 3% Knits: ≤ 5%
6.5.1	Tensile Strength	EN ISO 13934-1 EN ISO 3376	-	Fabrics: ≥ 300N Leather: ≥ 60N
6.5.2	Tear Strength	EN ISO 13937-2 EN ISO 3377-1	-	Fabrics: ≥ 15N Leather: ≥ 20N
6.5.3	Burst strength for knitted materials	EN ISO 13938-1	-	≥ 200kPa
6.5.4	Seam strength	EN ISO 13935-2	-	Fabrics: ≥ 225N Leather: ≥ 110N
6.6	Resistance to water penetration	EN 343	-	Resistance to water penetration Water vapor resistance Classification according to EN 343
6.7	Ergonomic requirements	Annex D	-	Practical performance testing
6.9.2	pH value	ISO 3071 ISO 4045	-	pH-value shall be > 3,5 and < 9,5

What makes the difference?

			EN 531:1995	EN ISO 11612:2010
6.9.3	Chromium content for leather	ISO 17075	-	Less than the detection limit
7.1	General		Code A plus one additional code letter	Code A1 and/or A2 plus 1 additional code letter
7.2	Convective heat code letter B	EN 367 ISO 9151	B1 3 until 6s B2 7 until 12s B3 13 until 20s B4 21 until 30s B5 ≥ 31s	B1 ≥ 4 < 10s B2 ≥ 10 < 20s B3 ≥ 20
7.3	Radiant heat code letter C	EN 366 EN ISO 6942, 20kW/m²	tested according to EN 366 C1 8 until 30s C2 31 until 90s C3 91 until 150s C4 ≥ 151s	tested according to EN ISO 6942 C1 ≥ 7 < 20s C2 ≥ 20 < 50s C3 ≥ 50 < 95s C4 ≥ 95s
7.4	Molten aluminium splash code letter D	EN 373 ISO 9185	D1 ≥ 100 < 200g D2 ≥ 200 < 350g D3 ≥ 350g	D1 ≥ 100 < 200g D2 ≥ 200 < 350g D3 ≥ 350g
7.5	Molten iron splash code letter E	EN 373 ISO 9185	E1 ≥ 60 < 120g E2 ≥ 121 < 200g E3 ≥ 201g	E1 ≥ 60 < 120g E2 ≥ 120 < 200g E3 ≥ 200g

What makes the difference?

			EN 531:1995	EN ISO 11612:2010
7.6	Contact heat code letter F	ISO 12127 Tc=250°C	-	F1 ≥ 5 < 10s F2 ≥ 10 < 15s F3 ≥ 15s
7.7	Optional Protection against the thermal effects of an electric arc event	Annex F	-	Optional according to risk assessment
7.8	Optional Whole garment testing	ISO 13506	-	Optional testreport and comment of testing institute shall be submitted

EN ISO 14116 – ex EN 533:1997

Protective Clothing – Protection against heat and flame – Limited flame spread materials, material assemblies and clothing

- Test method EN ISO 15025 procedure A (surface ignition)
- FR Classification 3 index,
- Information about FR performance, cleaning cycles and temperature
- General Clothing requirements
- Fabric durability requirements

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EN ISO 11611:2010 – ex EN 470-1

Protective Clothing for use in welding and allied processes

- General Clothing requirements
- Textile durability requirements
- Washing stability

- FR performance requirements tested acc. EN ISO 15025

- Welding performance tested acc. ISO 9150 (2 classes)

- Radiant heat protection tested acc. EN ISO 6942 (2 classes)

- Electrostatic properties tested acc. EN 1149-2

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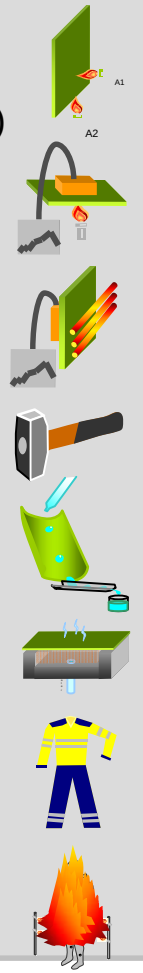
Fire Fighters Protective Clothing EN 469

Protective Clothing for firefighters - Performance requirements for protective clothing for firefighting

- Flame spread tested according to EN ISO 15025 procedure A (surface ignition)
- Heat transfer flame tested acc. EN ISO 9151 - 2 level
- Heat transfer radiation tested acc. EN ISO 6942 - 2 level
- Residual tensile strength of material when exposed to radiant heat
- Heat resistance 180°C, 5 min tested acc. ISO 17493
- Textile durability requirements
- Surface wetting
- Resistance to penetration by liquid chemicals tested acc. EN ISO 6530
- Resistance to water penetration tested acc. EN 20811 – 2 level
- Water vapour resistance tested acc. EN 31092 – 2 level
- Ergonomic performance acc. to annex D
- Visibility acc. to annex B and point 5.1 of EN 471:2003
- Optional whole garment testing acc. annex E



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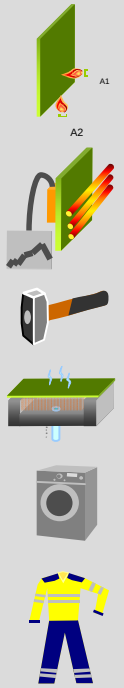
EN ISO Wildland

Protective Clothing – Protection against heat and flame – Method of test for limited flame spread

- Flame spread tested according to EN ISO 15025 procedure A and B
- Heat transfer radiation tested acc. EN ISO 6942 - 2 level
- Heat resistance 180°C or 260°C, depending on material tested acc. ISO 17493
- Textile durability requirements
- Thermal resistance (RCT) tested acc. ISO 11092
- Water vapour resistance (RET) tested acc. ISO 11092
- Dimensional change after washing
- Retroreflective or fluorescent performance tested acc. 7.3 and 6.3 of EN 471



Thank you for
your attention!

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