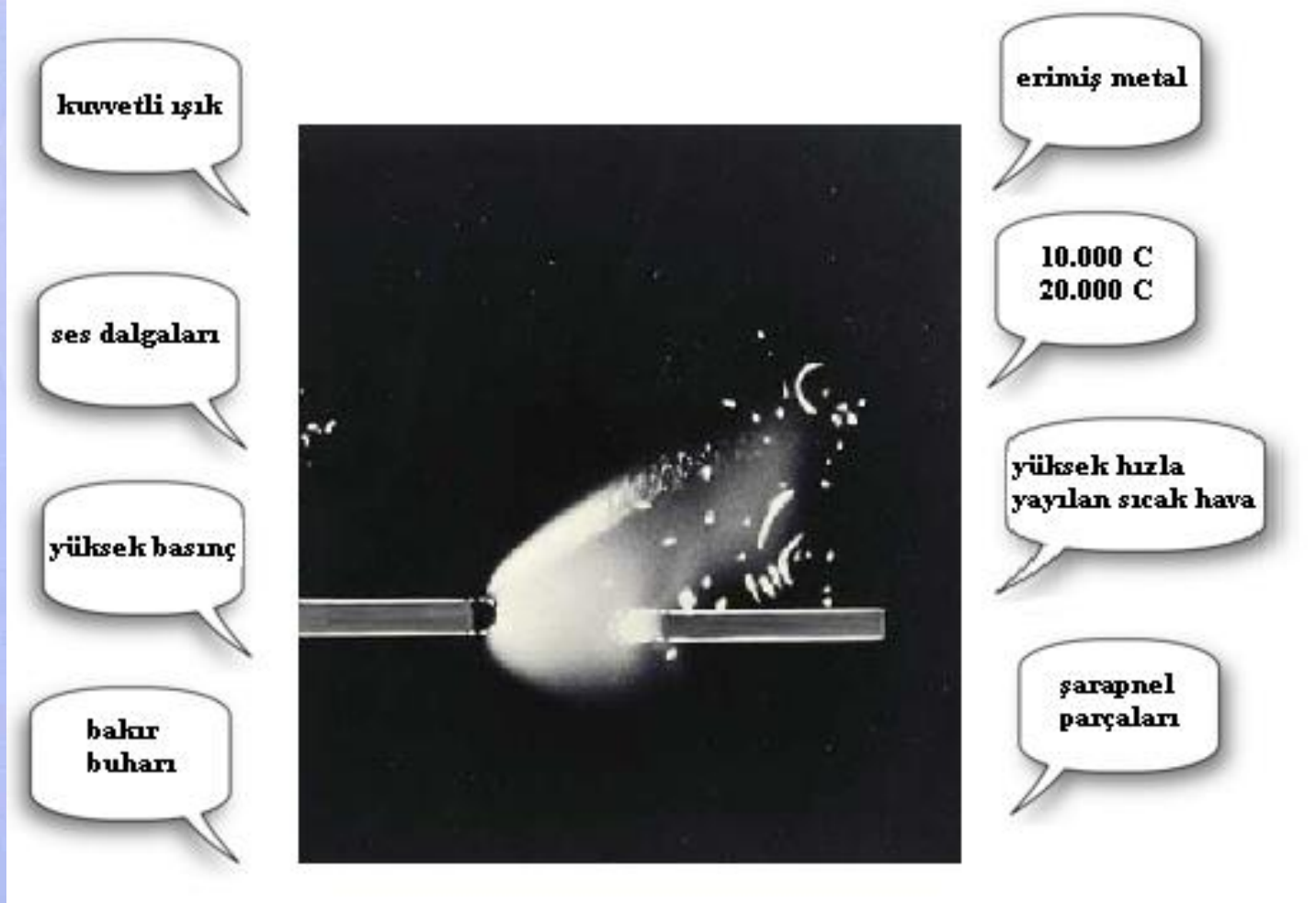


ELEKTRİK ARKLARININ TERMAL ETKİLERİNE KARŞI KORUYUCU GİYSİLER



ELEKTRİK ARKININ OLUŞTURDUĞU TEHLİKELER



KİMLER RİSK ALTINDA ?

- ARABA TAMİR BAKIM SERVİSLERİ
- KİMYA TESİSLERİ
- GIDA İŞLEME FABRİKALARI
- HASTANELER
- OTELLER
- METAL İŞLERİ
- KAĞIT VE KAĞIT HAMURU FABRİKALARI
- PETROL RAFİNERİLERİ
- MATBAALAR
- MAĞAZALAR – ALIŞVERİŞ MERKEZLERİ
- ULAŞIM- TAŞIMACILIK





KAZADAN HEMEN SONRA OLAY YERİ







Sonu olarak;

bir elektrik arkı tehlikeli derecede enerji üretir. Ölüme sebebiyet verecek derecede yanıklara sebep olur.

Elektrik kazaları sebebiyle hastanelere başvuranların büyük çoğunluğunun maruz kaldığı kaza sebepleri elektrik çarpması veya elektrik şoku değil elektrik ark kazalarıdır.

Bu kazalar sonucu oluşan yüksek dereceli yanıkların ve ölümlerin çoğu alev geciktiricili olmayan giysinin alev alması ve yanmaya devam etmesi sonucu meydana gelir.



İŞ YERİNDEKİ RİSK KATEGORİSİ NASIL BELİRLENİR VE UYGUN EKİPMAN SEÇİMİ NASIL YAPILIR?

CEVAP : NFPA 70 E

Table 130.7(C)(11) Protective Clothing Characteristics

Hazard/Risk Category	Typical Protective Clothing Systems Clothing Description	Required Minimum Arc Rating of PPE [J/ cm ² (cal/cm ²)]
0	Non-melting, flammable materials (i.e., untreated cotton, wool, rayon, or silk, or blends of these materials) with a fabric weight at least 4.5 oz/yd ²	N/A
1	Arc-rated FR shirt and FR pants or FR coverall	16.74 (4)
2	Cotton or FR underwear — conventional short or long sleeve and brief/shorts or long johns, plus FR shirt and FR pants	33.47 (8)
3	Arc-rated FR shirt and pants or FR coverall, and arc flash suit selected so that the system arc rating meets the required minimum	104.6 (25)
4	Arc-rated FR shirt and pants or FR coverall, and arc flash suit selected so that the system arc rating meets the required minimum [ROP-419], [ROP-421]	167.36 (40)

Note: Arc rating is defined in Article 100 and can be either ATPV or E_{BT}. ATPV is defined in ASTM F 1959-05a as the incident energy on a material or a multilayer system of materials that results in a 50 % probability that sufficient heat transfer through the tested specimen is predicted to cause the onset of a second-degree skin burn injury based on the Stoll curve, cal/cm². E_{BT} is defined in ASTM F 1959-05a as the incident energy on a material or material system that results in a 50 % probability of breakopen. Arc rating is reported as either ATPV or E_{BT} whichever is the lower value.

NEREDE NE RİSK VAR?

Table 130.7(C)(9) [ROP 321] Hazard/Risk Category Classifications and Use of Rubber Insulating Gloves and Insulated and Insulating Hand Tools [ROP 328]

Tasks Performed on Energized Equipment [ROP 338]	Hazard/ Risk Category	Rubber Insulating Gloves [ROP 331, 342]	Insulated and Insulating Hand Tools [ROP 331]
Panelboards or Other Equipment Rated 240 V and Below — Note 1 [ROP 341]			
Perform infrared thermography and other non-contact inspections outside the restricted approach boundary [ROP 329]	0	N	N
Circuit breaker (CB) or fused switch operation with covers on	[ROP 329]	[ROP 329]	[ROP 329]
CB or fused switch operation with covers off	0	N	N
Work on exposed live parts, including voltage testing [ROP 332]	1	Y	Y
Remove/install CBs or fused switches	1	Y	Y
Removal of bolted covers (to expose live parts) [ROP 332]	1	N	N
Opening hinged covers (to expose live parts) [ROP 332]	0	N	N
Work on exposed live parts of utilization equipment fed directly by a branch circuit of the panelboard [ROP 307]	1 [ROP 307]	Y [ROP 307]	Y [ROP 307]
Panelboards or Switchboards Rated >240 V and up to 600 V (with molded case or insulated case circuit breakers) — Note 1 [ROP-333]			
Perform infrared thermography and other non-contact inspections outside the restricted approach boundary [ROP 329]	1 [ROP 329]	N [ROP 329]	N [ROP 329]
CB or fused switch operation with covers on	0	N	N
CB or fused switch operation with covers off	1	Y	N
Work on exposed live parts, including voltage testing [ROP 332]	2*	[ROP 330]	Y
Work on exposed live parts of utilization equipment fed directly by a branch circuit of the panelboard or switchboard [ROP 307]	2* [ROP 307]	Y [ROP 307]	Y [ROP 307]
600 V Class Motor Control Centers (MCCs) — Note 2 (except as indicated) [ROP 333]			
Perform infrared thermography and other non-contact inspections outside the restricted approach boundary [ROP 329]	1 [ROP 329]	N [ROP 329]	N [ROP 329]
CB or fused switch or starter operation with enclosure doors closed	0	N	N
Reading a panel meter while operating a meter switch	0	N	N

HANGİ GİYSİ ÇEŞİDİ VE HANGİ TİP KKD GEREKİR?

Table 130.7(C)(10) Protective Clothing and Personal Protective Equipment (PPE) Matrix

Protective Clothing and Equipment Hazard/Risk Category Number	Protective Systems for Hazard/Risk Category					
	0	1	2	2* [ROP-406]	3	4
Non-melting (according to ASTM F 1506-00) or Untreated Natural Fiber						
a. T-shirt (short-sleeve)			AN	AN	AN	AN
b. Shirt (long-sleeve)	X					
c. Pants (long)	X	AN	AN	AN	AN	AN
FR Clothing (Note 1)						
a. Arc Rated Long-sleeve shirt		X	X (Note 6)	X (Note 6)	AR (Note 9)	AR (Note 10)
b. Arc Rated Pants		X [ROP-382]	X (Note 6)	X (Note 6)	AR (Note 9)	AR (Note 10)
c. Arc Rated Coverall		(Note 5)	(Note 7)	(Note 7)	AR (Note 9)	AR (Note 10)
d. Arc-Rated Jacket, parka, or rainwear		AN	AN	AN	AN	AN
FR Protective Equipment						
a. Arc Rated Flash suit jacket					AR (Note 9)	AR (Note 10)
b. Arc Rated Flash suit pants					AR (Note 9)	AR (Note 10)
c. Head protection						
1. Hard hat		AR [ROP-375]	X	X	X	X
2. FR hard hat liner					AR	AR
d. Eye protection						
1. Safety glasses	SR	SR	SR	SR	SR	SR
2. Safety goggles	SR	SR	SR	SR	SR	SR
e. Face and head area protection						
1. Arc-rated face shield, or flash suit hood		X (Note 8)	X (Note 8)			[ROP-379]
2. Arc Rated Flash suit hood				X (Note 11) [ROP-406]	X	X
3. Hearing protection (ear canal inserts)					X	X
f. Hand protection						
Leather gloves (Note 2)	AN	X	X	X	X	X
g. Foot protection						
Leather work shoes		AN	X	X	X	X

KORUYUCU GİYİSİ VE İLAVE OLARAK KULLANILACAK KİŞİSEL KORUYUCULAR

250.1 Maintenance Requirements for Personal Safety and Protective Equipment.

Personal safety and protective equipment such as the following shall be maintained in a safe working condition:

- (1) Grounding equipment
- (2) Hot sticks
- (3) Rubber gloves, sleeves, and leather protectors
- (4) Voltage test indicators
- (5) Blanket and similar insulating equipment
- (6) Insulating mats and similar insulating equipment
- (7) Protective barriers
- (8) External circuit breaker rack-out devices
- (9) Portable lighting units
- (10) Safety grounding equipment
- (11) Dielectric footwear
- (12) Protective clothing
- (13) Bypass jumpers [ROP-460]
- (14) Insulated and insulating hand tools [ROP-460]



ELEKTRİK DONANIMLARINDAN GÜVENLİ ÇALIŞMA İÇİN MİNİMUM UZAKLIK

Table 400.21 Minimum Depth of Clear Working Space at Electric Equipment

Nominal Voltage to Ground	Minimum Clear Distance					
	Condition 1		Condition 2		Condition 3	
	m	ft	m	ft	m	ft
601-2500 V	0.9	3	1.2	4	1.5	5
2501-9000 V	1.2	4	1.5	5	1.8	6
9001-25,000 V	1.5	5	1.8	6	2.8	9
25,001-75 kV	1.8	6	2.5	8	3.0	10
Above 75 kV	2.5	8	3.0	10	3.7	12

Note: Where the conditions are as follows:

Condition 1 — Exposed live parts on one side of the work space and no live or grounded parts on the other side of the working space, or exposed live parts on both sides of the working space that are effectively guarded by insulating materials.

Condition 2 — Exposed live parts on one side of the work space and grounded parts on the other side of the work space. Concrete, brick, or tile walls shall be considered as grounded.

Condition 3 — Exposed live parts on both sides of the work.

DÜZENLEYİCİ KURALLAR VE STANDARTLAR

NFPA 70 E Çalışma ortamındaki elektriksel güvenlik için standart

ASTM F 1959 Standard Test Method for Determining Arc Thermal Performance Value of Textile Materials for Clothing by Electric Arc and Related Thermal Hazards

ASTM F 1506

Standard Performance Specification for Flame Resistant Textile Materials for Wearing Apparel for Use by Electrical Workers Exposed to Momentary Electric Arc and Related Thermal Hazards

EN 61482-1-1

Gerilim altında çalışma-Elektrik arkı termal etkilerine karşı koruyucu giysiler-Bölüm 1-1:Deney metotları-Metod 1:Giysiler için malzemelerin aleve dayanıklılığının ark beyan değerlerinin belirlenmesi (ATPV veya $E < (\text{İndeks}) \text{BT}50 >$)

EN 61482-1-2

Gerilim altında çalışma-Elektrik arkı termal etkilerine karşı koruyucu giysiler-Bölüm 1-2:Deney metotları-Metod 2:Malzemenin ve giysinin ark koruma sınıfının, yönlendirilmiş ark (kutu testi)kullanarak tayini



ELEKTRİK ARKLARINA KARŞI KORUYUCU GİYSİLER NASIL TEST EDİLİR?

NFPA 70 E /ASTM F1959 : ELEKTRİK ARK TESTİ

Açık alan KUMAŞ TEST EDİLİR GEÇTİ/KALDI YOK APTV ÖLÇÜLÜR

Bu değerlerde test edildiğinde stoll eğrisinin altında kalmalı.

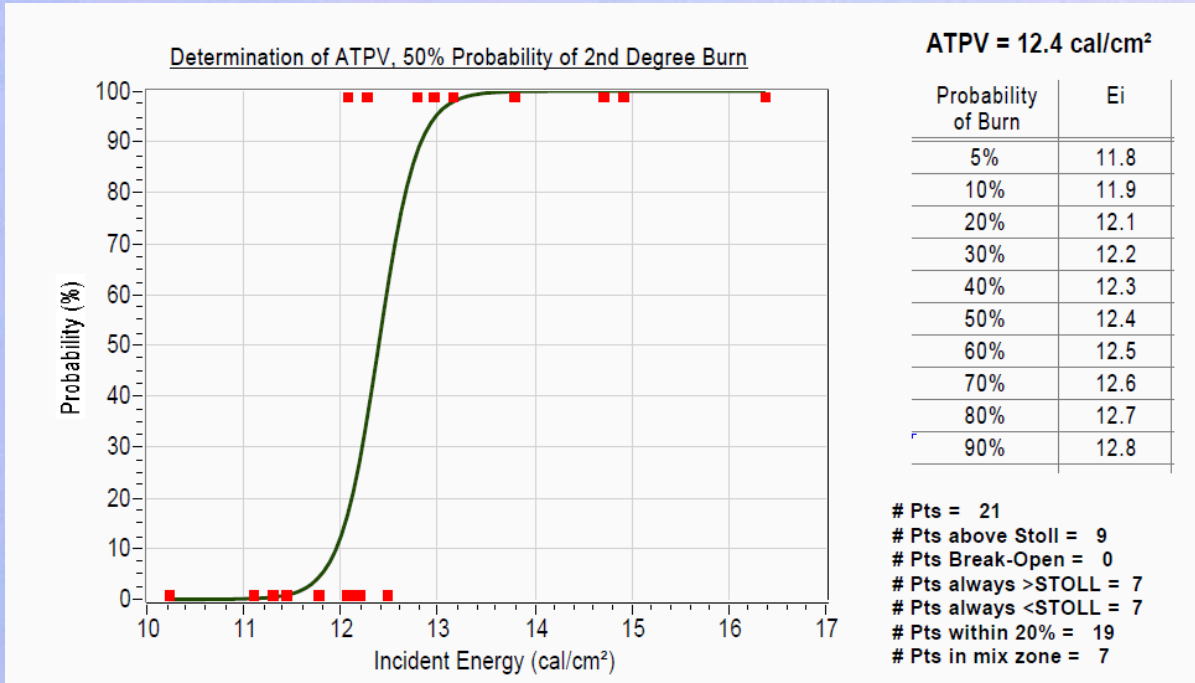
(% 50 İHTİMALLE 2. DERECE YANIK OLUŞTURMA OLASILIĞI)

NFPA 70 E : HRC (Tehlike Risk Sınıfı)

HRC 1: 4 cal/cm² HRC 2: 8 cal/cm² HRC 3: 25 cal/cm² HRC 4: 40 cal/cm²

TEST PARAMETRELERİ: 8 kA (vaka enerjisi 10 – 16 cal/cm²)

300 mm mesafe açık alan Ark açıklığı: 30 mm

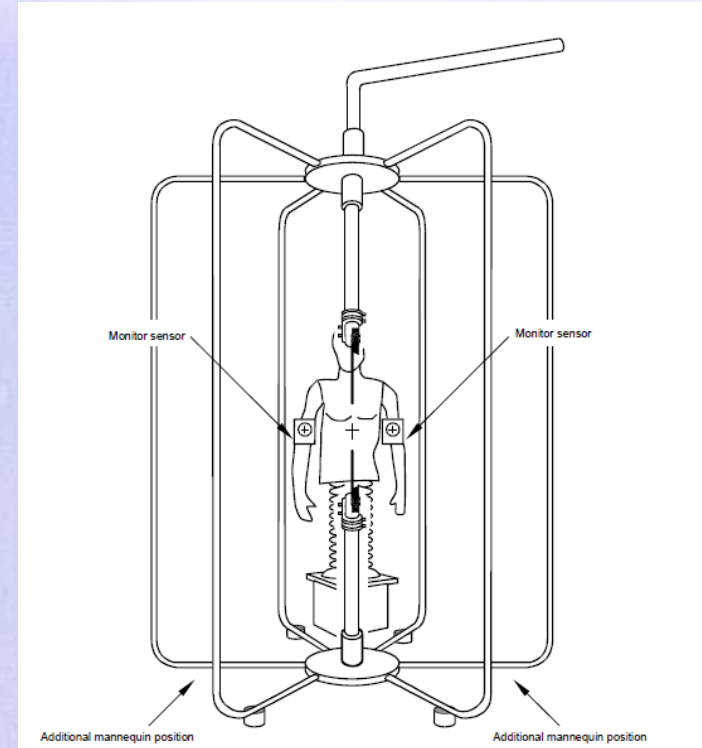
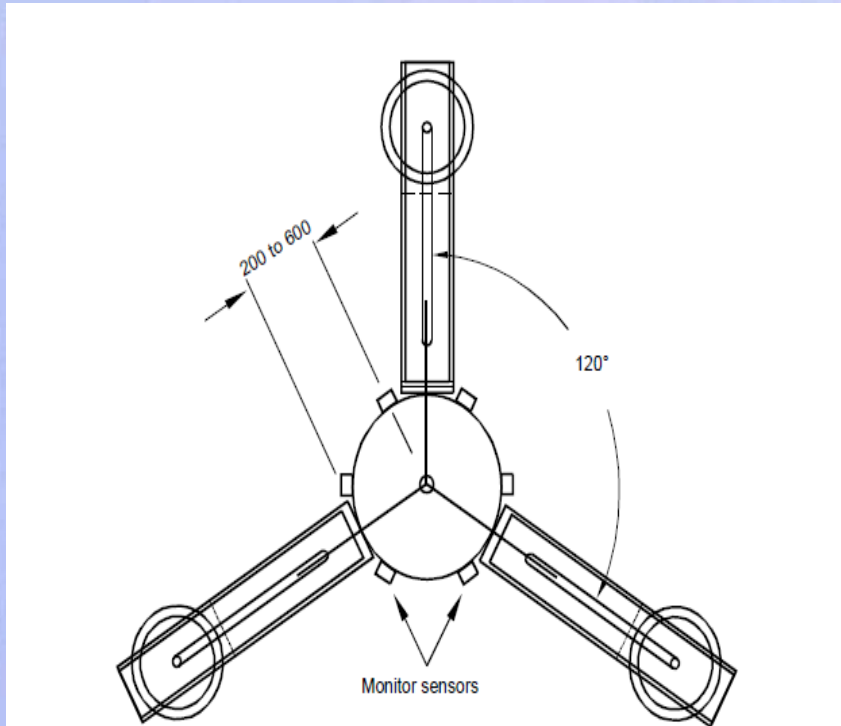


STOLL EĞRİSİ –2 DERECE YANIK YARALANMA VE AÇILMA OLASILIĞI İÇİN TİPİK VAKA ENERJİSİ SONUÇLARI

Table O.2.3 Typical Incident Energy Results for Probability for 2nd Degree Burn Injury or Breakopen

<u>Probability of 2nd Degree Burn Injury or Breakopen</u>	<u>Incident Energy J/cm²</u>	<u>Incident Energy cal/cm²</u>
1%	58.6	14.0
5%	64.8	15.5
10%	67.4	16.1
20%	70.7	16.9
30%	72.4	17.3
40%	74.1	17.7
50%	75.7	18.1
	<u>Arc Rating (ATPV or E_{BT})</u>	<u>Arc Rating (ATPV or E_{BT})</u>
60%	77.0	18.4
70%	78.7	18.8
80%	80.8	19.3
90%	83.7	20.0
95%	86.6	20.7
99%	92.5	22.1

EN 61482-1-1 TEST DÜZENEKLERİ



EN 61482-1-1



ARK ENERJİSİ : 8 kA

0.167 s

300 mm mesafe açık alan

Metod a kumaş

Metod b elbise **GEÇTİ/KALDI YOK**

APTV ÖLÇÜLÜR

20 değer ölçülür. Değerlerin %20'den fazlası **stoll** değerleri üstünde kalmamalı.

İST

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EN 61482-1-1

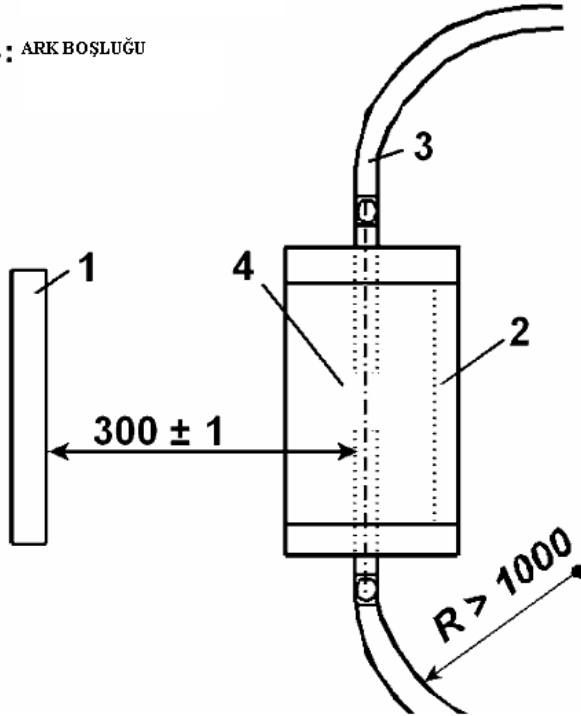
Stoll değerleri: İnsan derisinin ısıya karşı toleransı – ikinci derece yanık
Stoll eğrisi -İnsan dokusunun ısıya toleransı verisinden üretilen ve ikinci derece yanık yaralanmalarının başlangıcını tahmin etmekte kullanılan termik enerji ve zaman eğrisi

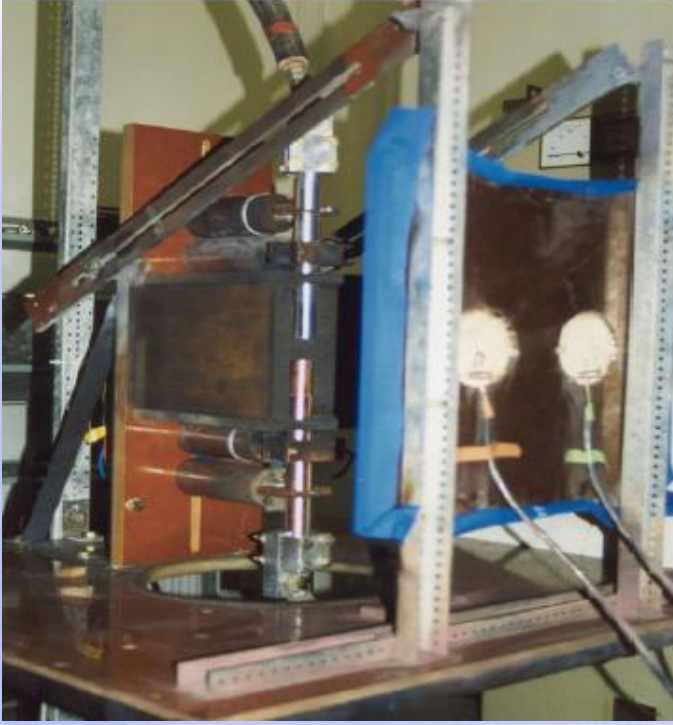
Table 1 – Human tissue tolerance to heat, second-degree burn [1]

Exposure time	Heat flux	Total heat	Calorimeter equivalent iron/constantan thermocouple	
			ΔT °C	ΔmV
s	kW/m ²	kW·s/m ²	ΔT °C	ΔmV
1	50	50	8,9	0,46
2	31	61	10,8	0,57
3	23	69	12,2	0,63
4	19	75	13,3	0,69
5	16	80	14,1	0,72
6	14	85	15,1	0,78
7	13	88	15,5	0,80
8	11,5	92	16,2	0,83
9	10,6	95	16,8	0,86
10	9,8	98	17,3	0,89
11	9,2	101	17,8	0,92
12	8,6	103	18,2	0,94
13	8,1	106	18,7	0,97
14	7,7	108	19,1	0,99
15	7,4	111	19,7	1,02
16	7,0	113	19,8	1,03
17	6,7	114	20,2	1,04
18	6,4	116	20,6	1,06
19	6,2	118	20,8	1,08
20	6,0	120	21,2	1,10
25	5,1	128	22,6	1,17
30	4,5	134	23,8	1,23

EN 61482-1-2 KAPALI KUTU

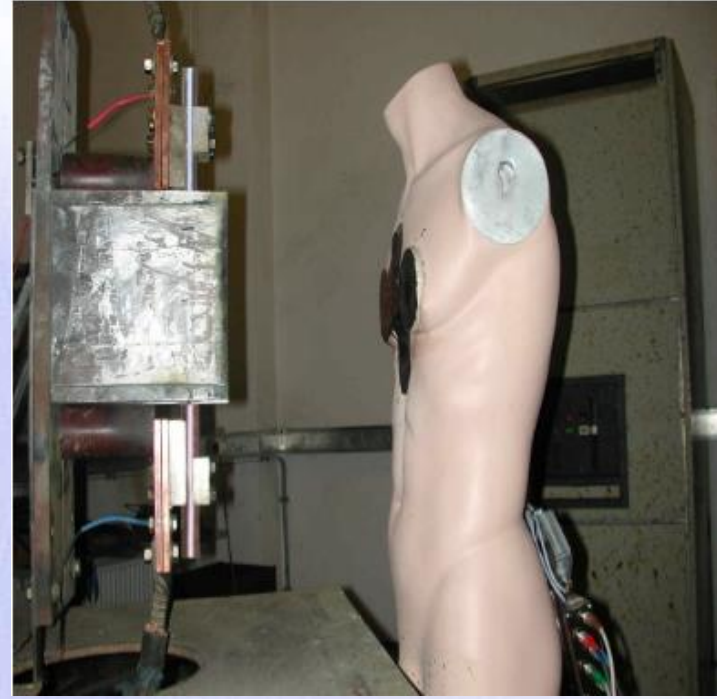
- 1: TEST PLAKASI VE NUMUNE KUMAŞ VEYA MANKENE GİYDİRİLMİŞ KOMPLE ELBİSE
- 2: TEST KUTUSU
- 3: BAĞLANTI KABLOLARI
- 4: ARK BOŞLUĞU





RESİM 1:

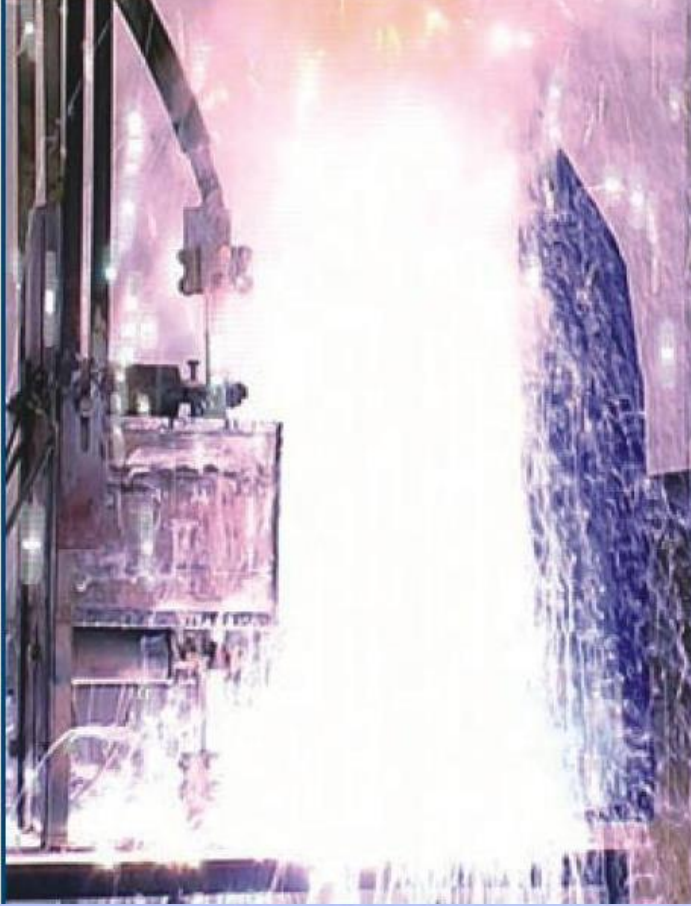
- ELEKTRİK ARK KUTUSU
- KALORİMETRELER
- KUMAŞ TEST NUMUNELERİ
- EN 61482-1-2 METOD1



RESİM 2:

- ELEKTRİK ARK KUTUSU
- KALORİMETRELER
- MANKEN (ÜZERİNE GİYSİ GİYDİRİLECEK)
- EN 61482-1-2 METOD2

EN 61482-1-2



ARK ENERJİSİ:

Sınıf 1 : 4 Ka

Sınıf 2 : 7 kA

Ark süresi: 500 ms

300 mm mesafe kapalı kutu

ELBİSE VE KUMAŞ TEST EDİLİR

GEÇTİ/ KALDI VAR

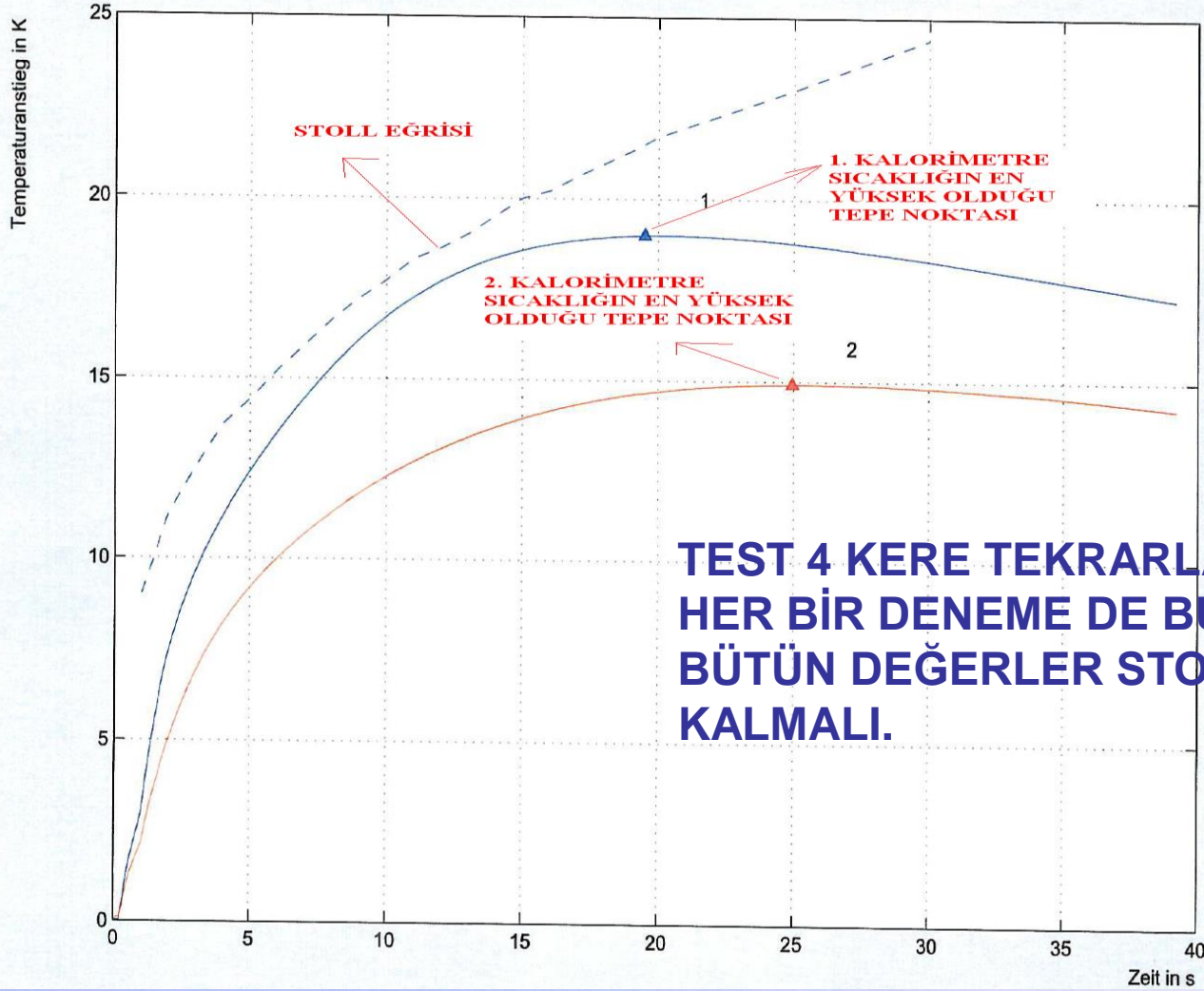
ELBİSE İÇİN KRİTERLER-METOD2

- Elbisenin yanma süresi, 5 sn'ye eşit veya daha az olacak,
- Elbisenin iç tarafına doğru erime görülmeyecek,
- Her yönde en fazla 5mm delik oluşacak (en iç tabakada),
- Bağlayıcılar(fermuarlar) işlevsel durumda olacak,
- Aksesuarların, yanma zamanı, erime ve delik formasyonu sonuçları üzerinde herhangi bir negatif etkisi olmayacaktır.

KUMAŞ KATMAN SİSTEMİ –METOD1

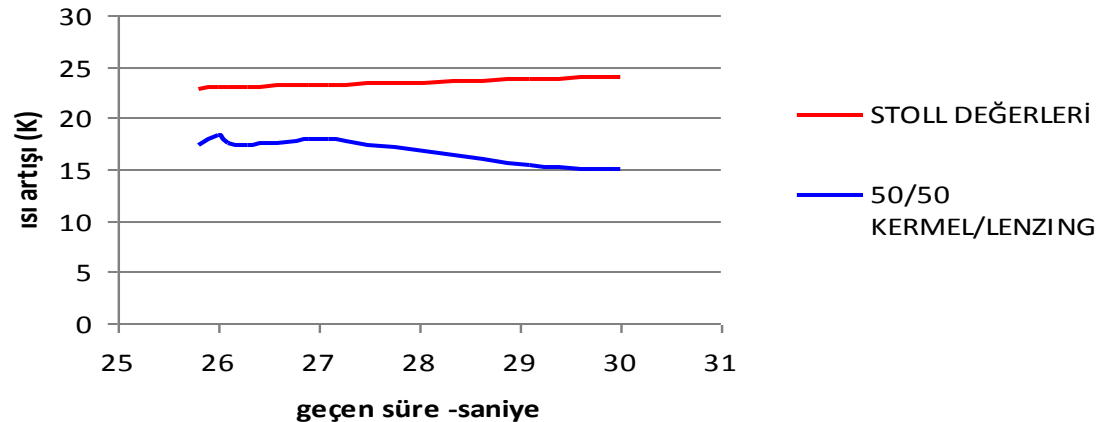
- Elbise kumaşının ark ışınması sonrasında yanma süresi 5 sn'ye eşit veya daha az olacak,
- Kumaş iç tarafına doğru erime görülmeyecek,
- Her yönde en fazla 5mm delik oluşmalı (en iç tabakada),
- **Isı yayılması E it- T max tekabül eden stoll değerlerinin altında kalacaktır.**





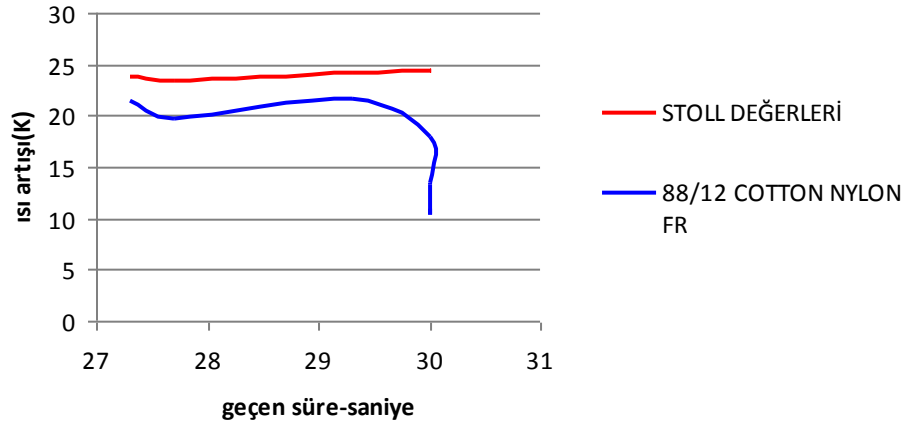
Property - fabric	Dimension	Test results – material combination 2ly outer material: aramid/viscose fr/ AS, 260g/m ² inner layer: aramid/viscose fr, 180g/m ²			
		08-A01	08-A02	08-A03	08-A04
<u>EN 61482-1-2 – arc resistance</u>		class 2 / 7 kA			
Afterflame time	s	0	0	0	0
Melting through to the inside		no	no	no	no
Hole formation		no*	no	no*	no
Maximum temperature rise T_{max} at the backside of the specimen (both calorimeters)	K	18,0 18,3	17,4 18,0	17,3 17,6	15,3 15,0
Time t to max. temperature rise T_{max}	s	26,9	26,3	25,8	29,1
	s	26,0	27,1	26,1	30,0
Comparison: allowed temperature rise to avoid 2 nd degree burning (<u>STOLL values at time t_{max}</u>)	K	23,1 22,9	23,0 23,2	22,8 22,9	23,7 23,9
Acceptance criteria		met	met	met	met

ELECTPRO EN 61482-1-2 TEST SONUCU (7kA)



Property - fabric	Dimension	Test results - fabric double layer 88% Cotton / 12% PA flame retardant finished			
		10-EG1	10-EG2	10-EG3	10-EG4
<i>EN 61482-1-2 – arc resistance</i>		class 2 / 7 kA			
Afterflame time	s	0	0	0	0
Melting through to the inside		no	no	no	no
Hole formation		no	no	no	no
Maximum temperature rise T_{max} at the backside of the specimen (both calorimeter)	K	18,0	13,5	19,6	10,4
	K	21,5	13,3	21,6	10,9
Time t to max. temperature rise T_{max}	s	30,0	30,0	27,7	30,0
	s	27,3	30,0	29,3	30,0
Comparison: allowed temperature rise to avoid 2 nd degree burning (<u>STOLL values at time t_{max}</u>)	K	24,4	24,4	23,4	24,4
	K	23,7	24,4	24,2	24,4
Acceptance criteria		met	met	met	met

ELECTPRO COTTON EN 61482-1-2 TEST SONUCU (7kA)



ELEKTRİK ARKINA KARŞI KORUYUCU GİYSİLERİN SAHİP OLMASI GEREKEN ÖZELLİKLER

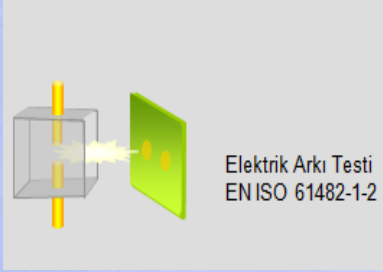
NORMAL KUMAŞLAR: Asetat, naylon, polyester, ipek veya bunların karışımından üretilmiş giysiler..... **GİYMİYİN!**

APRE GİBİ KİMYASAL İŞLEME TABİ TUTULMUŞ GÜÇ
TUTUŞUR KUMAŞLAR(Flame retardant FR).....**GİYİN!**

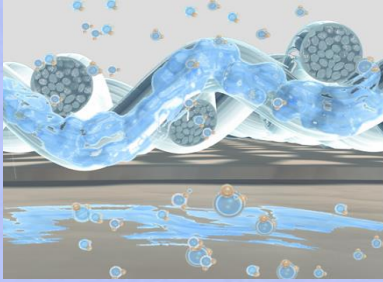
KENDİLİĞİNDEN ALEV ALMAZ (INHERENTLY FLAME
RETARDANT)...**GİYİN!**



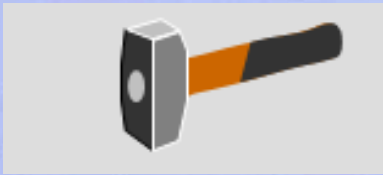
Çalışma ortamında hem korunmak hem de rahat ve konforunuzu sağlamak için mutlaka doğal içerikli kumaştan yapılmış elbiseleri tercih etmelisiniz.!



EN YÜKSEK KORUMA – STANDARTLARA UYGUNLUK
EN 61482-1-2 SINIF 2 7KA
EN ISO 11612 :2008
CE – 89/686/EEC DİREKTİFİ



DOĞAL VE SENTETİK İÇERİKLİ NEFES
ALABİLİR YAPI İLE MÜKEMMEL KONFOR



YÜKSEK DAYANIKLILIK

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ELECTPRO® COTTON ELEKTRİK ARKINA KARŞI KORUYUCU CEKET PANTOLON

89/686/EEC CE SERTİFİKALI

EN 61482-1-2 SINIF 2 7kA

IEC 61482-2

EN ISO 11612 A1 B2 C2

İPLİKLER: % 100 ARAMİD

KUMAŞ: 88/12 COTTON FR/ NYLON

330 GR/ M2 : 660 GR/M2 (ÇİFT KAT)

FERMUAR: ALEVE DAYANIKLI NYLON 66 (METAL PARÇA YOK)

**NOT: NFPA 70 E ...HRC 4...40 CAL/CM2... 2
layers - 13 oz./yd2 (441 g/m2) & 5.5 oz./yd2 (186
g/m2) TOPLAM: 627 GR/M2**

***ISI VE ALEVE KARŞI KORUYUCU
OLARAK DA KULLANILABİLİR.**





ELECTPRO® ELEKTRİK ARKINA KARŞI KORUYUCU CEKET PANTOLON

89/686/EEC CE SERTİFİKALI

EN 61482-1-2 SINIF 2 7kA

IEC 61482-2

EN ISO 11612 A1 B2 C2

İPLİKLER: % 100 ARAMİD

KUMAŞ:

ARAMİD / LENZING FR ®/ ANTİSTATİK

ELYAF – 260 GR /M2 –DIŞ KAT

ARAMİD / LENZING FR ®/ ANTİSTATİK

ELYAF – 260 GR /M2 –İÇ KAT

FERMUAR: ALEVE DAYANIKLI ARAMİD

NYLON 66 DİŞLİ (METAL PARÇA YOK)

ISI VE ALEVE KARŞI KORUYUCU

OLARAK DA KULLANILABİLİR.



ELEKTRİK ARKINA KARŞI KORUYUCU EKİPMANLAR



ELEKTRİKÇİ BARETİ
EN 397, EN 50365, ANSI Z89.1
ELEKTRİKÇİ VİZÖRÜ
EN 170, EN 166 “8” İŞARETLİ – 12
kA
ELEKTRİK ARK ELBİSESİ
EN 61482-1-2 SINIF 2 , EN ISO 11612
ÖRGÜ İÇ GİYİM
EN ISO 11612
İZOLE ELDİVEN
IEC 60903/ EN60903

