

BETAflam[®] Solar 电缆
BETAflam[®] Solar Cables

质量连接
The Quality Connection

LEONI
 **STUDER CABLES**

目录

Table of contents

	页码		Page
LEONI – 质量连接	4	LEONI – The Quality Connection.	4
光伏电力电缆 BETAflam® Solar		Photovoltaic Power Cables BETAflam® Solar	
BETAflam® Solar 125-flex FRNC	8	BETAflam® Solar 125-flex FRNC	8
BETAflam® Solar 125-flex UL 4703	10	BETAflam® Solar 125-flex UL 4703	10
BETAflam® Solar 125 UL 4703	12	BETAflam® Solar 125 UL 4703	12
技术信息		Technical information	
额定电流 120 °C / 248 °F	15	Current rating 120 °C / 248 °F	15
电子束交联	16	Electron-beam cross-linking	16
无卤素和防火性能	18	Halogen free and Fire performance	18
其它产品	23	Further products	23

LEONI – 质量连接 是什么把我们联系在一起

LEONI – The Quality Connection.

What connects us.

LEONI – 通信和基础设施的专家

LEONI 是一家拥有超过47,000名员工的强大公司，公司遍布36个不同国家的95个地点。我们兼备企业家的远见卓识，一流的质量以及高层次的创新，这使得我们成为面向汽车行业和其他行业供应电缆系统的领先供应商。LEONI 开发和生产先进的技术产品，从单一的核心汽车配线到复杂的船上供电系统，并提供相关服务。此外，业务范围还包括向各种工业市场提供电线和编缆，标准电缆和特种电缆以及完全组装系统。

您的市场 – 我们的实力

由于产品和服务范围不同，因此，LEONI 提供产品的市场和行业也不同。我们的活动集中在以下市场中的客户：

汽车，通讯和基础设施，工业和医疗保健，电器和导线与铜缆解决方案。

电缆，组件及完整系统：在世界各地，我们的通讯和基础设施的客户不仅受益于创新，还获得了质量可靠，耐用的产品。他们还能从中享受到我们齐全的服务，包括项目工程，实施和维护。而达到欧洲领先的电缆制造商在生产安全通信方面的及基础设施产品等的高超技术应该不会让人感到惊讶。LEONI-连接未来。

在通信和基础设施行业，LEONI 将其产品和服务进行捆绑，一方面，用于办公室和工业建筑中的数据和电信。另一方面，对基础设施项目的投资集中在交通运输路线，建筑，机场，铁路，海洋技术和大型工业厂房，如石油和天然气精炼厂。LEONI 为太阳能发电场造电缆，其全系列产品的满足两大国际标准TüV（欧洲）和UL（美国）。

LEONI – Expertise in Communication & Infrastructure

LEONI is a strong company group with over 47,000 employees scattered across 95 locations in 36 different countries. Entrepreneurial far-sightedness, top quality and a high level of innovation have made us a leading cable system provider for the automobile and other industries. LEONI develops and produces sophisticated technical products from single core vehicle wiring up to complex on board power supply systems and provides the associated services. Moreover, the range of services includes wires and braid, standardised and special cables plus fully assembled systems for applications in various industrial markets.

Your markets – our strengths

As diverse as the range of products and services is, so varied are the markets and sectors that LEONI supplies. Our activities are concentrated on customers in the markets

Automotive, Communication & Infrastructure, Industry & Healthcare, Electrical Appliances and Conductors & Copper Solutions.

Cables, components and complete systems: Around the globe, our Communication & Infrastructure customers benefit not only from innovations but quality products that are reliable and durable. They also reap the benefits from our complete range of services involving project engineering, implementation and maintenance. That this applies equally to the skills of Europe's leading cable manufacturer for secure communication and infrastructure products should come as no surprise. LEONI – Connecting the future.

In the Communication & Infrastructure sector LEONI bundles its products and services for data and telecommunications in offices and industrial building on the one hand. On the other, the portfolio for infrastructure projects concentrates on transportation routes, buildings, airports, rail and marine technology and major industrial plants such as oil and gas refineries. LEONI manufactures special cables for solar parks that fulfil the two relevant international standards TÜV (Europe) and UL (America) for the entire range of products.



BETAflam® Solar – 应用于清洁能源的清洁电缆

无论这是一个离网光伏应用系统或在网光伏系统 - 我们的电缆均符合太阳能组件所需要的同样高的期望 - 即长寿命和高耐候性。

我们的双绝缘，电子束交联电缆符合欧洲和美国重要的光伏太阳能市场对太阳能电缆的最高要求，并可不受限制地用作模块或连接电缆。

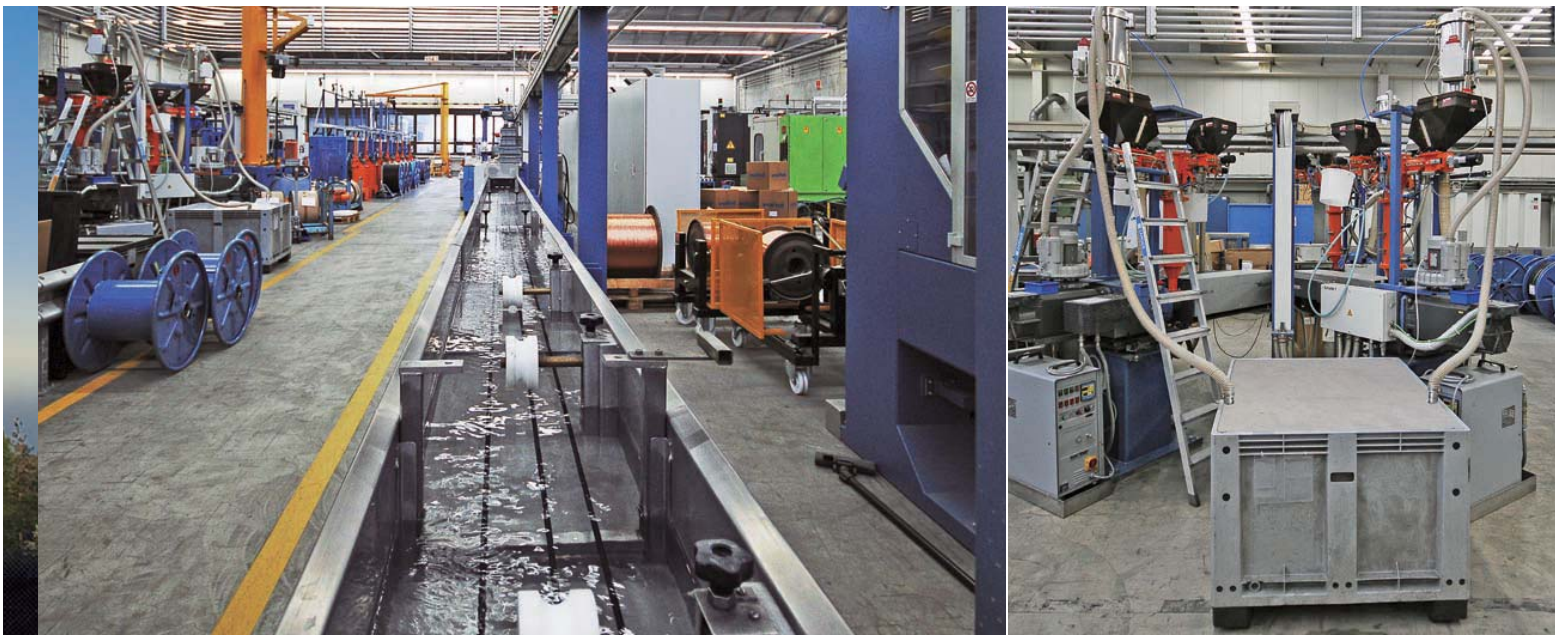
我们的产品在欧洲市场具有TUV认证；而UL认证是根据美国的最新NEC规范（国家电气标准2008 / UL认证大纲4703）。

BETAflam® Solar – Clean cables for clean energy

Whether it is an off-grid application or a grid connected PV-System – our cables meet the same high expectations that are demanded from the solar modules – which are longevity and high weather resistance.

Our double insulated, electron-beam cross-linked cables meets the highest requirements for solar cables in the most important photovoltaic markets of Europe and the USA and can be used unrestrictedly as a module or connecting cable.

Our products have both TÜV approval for the European market and UL approval according to the latest NEC specifications (National Electric Code 2008 / UL Outline 4703).





概括光伏电力电缆 BETAflam® Solar 无卤素及阻燃

Summary Photovoltaic Power Cables BETAflam® Solar *Halogen free and flame retardant*

根据 TÜV 认证
Approval according
to TÜV



BETAflam® Solar 125-flex FRNC
■ 第8页

BETAflam® Solar 125-flex FRNC
■ page 8



根据 TÜV 和
UL 认证
Approval according
to TÜV and UL



BETAflam® Solar 125-flex UL 4703
■ 第10页

BETAflam® Solar 125-flex UL 4703
■ page 10



根据UL认证
Approval according
to UL



BETAflam® Solar 125 UL 4703
■ 第12页

BETAflam® Solar 125 UL 4703
■ page 12



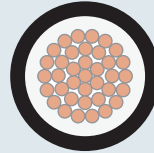
光伏太阳能电缆

BETAflam® Solar 125-flex FRNC 无卤素，阻燃



Photovoltaic Power Cables

BETAflam® Solar 125-flex FRNC halogen free, flame retardant



应用

双绝缘，电子束交联电力电缆，用于光伏发电。

结构

- **导体**：镀锡细铜链，根据 VDE 0295 / IEC 60228，5级
- **绝缘**：聚烯烃共聚物电子束交联
- **外护套**：聚烯烃共聚物电子束交联
- **外皮颜色**：黑色

技术指标

- **额定电压**： $U_0/U=600/1000$ 伏交流，1000/1800伏直流
- **测试电压**：4000 V，50 Hz，5分钟。
- **温度等级**：
 - 40 °C 至 +125 °C
 - 40 °F 至 +257 °F
- **环境温度**：>25年 (TÜV)
 - 40 °C 至 +90 °C
 - 40 °F 至 +194 °F
- **最大短路温度**：280°C，+536°F
- **弯曲半径**： $\geq 4 \times$ 外径 \varnothing

标准/材料特性

- **防火性能类型**：IEC 60332-1
- **烟尘排放**：IEC 61034；EN 50268-2
- **低火灾荷载**：DIN 51900
- **认证**：TÜV PFG 1169/08.2007 PV1-F
- **应用标准**：UNE 21123；UNE 20.460-5-52，UTE C 32-502

Application

Double insulated, electron-beam cross-linked cables for Photovoltaic power applications.

Construction

- **Conductor**: Tinned fine copper strands, according to VDE 0295 / IEC 60228, class 5
- **Insulation**: Polyolefin Copolymer electron-beam cross-linked
- **Outer sheath**: Polyolefin Copolymer electron-beam cross-linked
- **Sheath colour**: Black

Technical specification

- **Nominal voltage**: $U_0/U = 600 / 1000$ V AC, 1000 / 1800 V DC
- **Test voltage**: 4000 V, 50 Hz, 5 min.
- **Temperature rating**:
 - 40 °C up to +125 °C
 - 40 °F up to +257 °F
- **Ambient temperature**: > 25 years (TÜV)
 - 40 °C up to +90 °C
 - 40 °F up to +194 °F
- **Max. short circuit temperature**: 280 °C, +536 °F
- **Bending radius**: $\geq 4 \times$ outer \varnothing

Standards / Material properties

- **Fire performance**: IEC 60332-1
- **Smoke emission**: IEC 61034; EN 50268-2
- **Low fire load**: DIN 51900
- **Approvals**: TÜV PFG 1169/08.2007 PV1-F
- **Application standards**: UNE 21123; UNE 20.460-5-52, UTE C 32-502

优点

- 电子束交联化合物
- 抗紫外线和臭氧
- 耐水解
- 耐高温，材料不会熔化或流动
- 良好冷柔韧性
- 很长的生命周期
- 兼容所有常用连接器

Advantages

- Electron-beam cross-linked compounds
- UV and ozon resistant
- Hydrolysis resistant
- High temperature resistant, the materials do not melt or flow
- Good cold flexibility
- Very long life cycle
- Compatible to all popular connectors

尺寸, 重量

Dimensions, Weight

结构 Construction	零件号 Part no.	导体 \varnothing Conductor \varnothing	外径 \varnothing Outer \varnothing	重量 Weight	Cu-基数 Cu factor	火灾荷载 Fire load
n × mm ²		mm	mm	kg / km	kg / km	kWh / m
1 × 1,5	302840	1,55	4,85	38	14,4	0,103
1 × 2,5	226111	2,05	5,50	52	24,0	0,128
1 × 4	224803	2,55	6,05	69	38,4	0,150
1 × 6	225577	3,10	6,95	96	57,6	0,189
1 × 10	302191	4,10	8,30	147	96,0	0,250

黑体印刷零件号 = 库存项目
按要求可进一步设计。

*Bold printed part no. = stock item
Further designs upon request.*

订购单位

Order Units

结构 Construction	零件号 Part no.	零件号 Part no.	零件号 Part no.	零件号 Part no.	零件号 Part no.	零件号 Part no.
n × mm ²	18 × 500 m	8 × 1000 m	1 × 4000 m	1 × 5000 m	1 × 6000 m	1 × 8000 m
1 × 1,5	\varnothing	\varnothing	\varnothing	\varnothing	\varnothing	\varnothing
1 × 2,5	226111V2	226111V3	\varnothing	\varnothing	\varnothing	\varnothing
1 × 4	224803V2	224803V3	\varnothing	\varnothing	224803V4	\varnothing
1 × 6	225577V2	225577V3	\varnothing	225577V4	\varnothing	\varnothing
1 × 10	\varnothing	\varnothing	\varnothing	\varnothing	\varnothing	\varnothing

零件号 货盘尺寸
xxxxxxV2 80 × 120 × ~100 cm (欧洲货盘)
xxxxxxV3 100 × 100 × ~90 cm
xxxxxxV4 100 × 100 × ~60 cm

Part no. Pallet size
xxxxxxV2 80 × 120 × ~100 cm (Europallet)
xxxxxxV3 100 × 100 × ~90 cm
xxxxxxV4 100 × 100 × ~60 cm

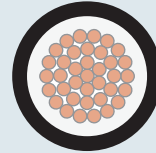


光伏电力电缆

BETAflam® Solar 125-flex UL 4703 无卤素，阻燃

Photovoltaic Power Cables

BETAflam® Solar 125-flex UL 4703 halogen free, flame retardant



应用

双绝缘，电子束交联电力电缆，用于光伏发电。

结构

- 导体：镀锡细铜链，根据 VDE 0295 / IEC 60228，5 级
- 绝缘：聚烯烃共聚物电子束交联
- 外护套：聚烯烃共聚物电子束交联
- 外皮颜色：黑色

技术指标

- 额定电压： $U_0/U = 600 / 1000$ 伏电流，1000 / 1800 伏电流
- 测试电压：4000 V, 50 Hz, 5 分钟。
- 温度等级：
 - 40 °C 至 +125 °C
 - 40 °F 至 +257 °F
- 环境温度：> 25 年 (TÜV)
 - 40 °C 至 +90 °C
 - 40 °F 至 +194 °F
- 最大短路温度：280 °C, +536 °F
- 弯曲半径： $\geq 4 \times$ 外径- \varnothing

标准/材料特性

- 防火性能类型：IEC 60332-1; UL 1581 1061 / VW1
- 烟尘排放：IEC 61034; EN 50268-2
- 低火灾荷载：DIN 51900
- 认证：TÜV PFG 1169/08.2007 PV1-F; UL 4703 PV wire; UL 854 USE-2
- 应用标准：NEC 2008 / UL PV wire, USE-2; UNE 21123; UNE 20.460-5-52, UTE C 32-502

Application

Double insulated, electron-beam cross-linked cables for Photovoltaic power applications.

Construction

- Conductor: Tinned fine copper strands, according to VDE 0295 / IEC 60228, class 5
- Insulation: Polyolefin Copolymer electron-beam cross-linked
- Outer sheath: Polyolefin Copolymer electron-beam cross-linked
- Sheath colour: Black

Technical specification

- Nominal voltage: $U_0/U = 600 / 1000$ V AC, 1000 / 1800 V DC
- Test voltage: 4000 V, 50 Hz, 5 min.
- Temperature rating:
 - 40 °C up to +125 °C
 - 40 °F up to +257 °F
- Ambient temperature: > 25 years (TÜV)
 - 40 °C up to +90 °C
 - 40 °F up to +194 °F
- Max. short circuit temperature: 280 °C, +536 °F
- Bending radius: $\geq 4 \times$ outer \varnothing

Standards / Material properties

- Fire performance: IEC 60332-1; UL 1581 1061 / VW1
- Smoke emission: IEC 61034; EN 50268-2
- Low fire load: DIN 51900
- Approvals: TÜV PFG 1169/08.2007 PV1-F; UL 4703 PV wire; UL 854 USE-2
- Application standards: NEC 2008 / UL PV wire, USE-2; UNE 21123; UNE 20.460-5-52, UTE C 32-502

优点

- 电子束交联化合物
- 抗紫外线和臭氧
- 耐水解
- 耐高温，材料不会熔化或流动
- 良好冷柔韧性
- 很长的生命周期
- 兼容所有常用连接器

Advantages

- Electron-beam cross-linked compounds
- UV and ozone resistant
- Hydrolysis resistant
- High temperature resistant, the materials do not melt or flow
- Good cold flexibility
- Very long life cycle
- Compatible to all popular connectors

尺寸, 重量

Dimensions, Weight

结构 Construction	零件号 Part no.	导体 Conductor	外径 Outer	重量 Weight	基数 Cu factor	火灾荷载 Fire load
n × mm ²		mm	mm	kg / km	kg / km	kWh / m
1 × 1,5 16 AWG	300690	1,55	5,50	45	14,4	0,136
1 × 2,5 14 AWG	226243	2,05	6,50	66	24,0	0,187
1 × 4 12 AWG	224780	2,55	7,05	84	38,4	0,213
1 × 6 10 AWG	226135	3,10	7,60	107	57,6	0,238
1 × 10 8 AWG	302192	4,10	9,30	166	96,0	0,340

黑体印刷零件号=库存项目
按要求可进一步设计。

*Bold printed part no. = stock item
Further designs upon request.*

订购单位

Order Units

结构 Construction	零件号 Part no.	零件号 Part no.	零件号 Part no.	零件号 Part no.	零件号 Part no.	零件号 Part no.
n × mm ²	18 × 500 m	8 × 1000 m	1 × 4000 m	1 × 5000 m	1 × 6000 m	1 × 8000 m
1 × 1,5 16 AWG	300690V2	∅	∅	∅	∅	300690V4
1 × 2,5 14 AWG	226243V2	∅	∅	226243V4	∅	∅
1 × 4 12 AWG	∅	224780V3	∅	224780V4	∅	∅
1 × 6 10 AWG	∅	226135V3	226135V4	∅	∅	∅
1 × 10 8 AWG	∅	∅	∅	∅	∅	∅

零件号 货盘尺寸
xxxxxxV2 80 × 120 × ~100 cm (欧洲货盘)
xxxxxxV3 100 × 100 × ~90 cm
xxxxxxV4 100 × 100 × ~60 cm

Part no. Pallet size
xxxxxxV2 80 × 120 × ~100 cm (Europallet)
xxxxxxV3 100 × 100 × ~90 cm
xxxxxxV4 100 × 100 × ~60 cm



光伏太阳能电缆

BETAflam® Solar 125 UL 4703 无卤素，阻燃

Photovoltaic Power Cables

BETAflam® Solar 125 UL 4703 halogen free, flame retardant



应用

双绝缘，电子束交联电力电缆，用于光伏发电。

建筑施工

- 导体：镀锡细铜链，根据 VDE 0295 / IEC 60228，5级
- 绝缘：聚烯烃共聚物电子束交联
- 外护套：聚烯烃共聚物电子束交联
- 外皮颜色：黑色

技术指标

- 额定电压： $U_0/U=600/1000$ 伏交流，1000/1800 伏直流
- 测试电压：4000 V，50 Hz，5分钟。
- 温度等级：
 - 40 °C 至 +125 °C
 - 40 °F 至 +257 °F
- 环境温度：>25年 (TÜV)
 - 40 °C 至 +90 °C
 - 40 °F 至 +194 °F
- 最大短路温度：280 °C，+536 °F
- 弯曲半径： $\geq 4 \times$ 外径 \varnothing

标准/材料特性

- 防火性能类型：IEC 60332-1
- 烟尘排放：IEC 61034；EN 50268-2
- 低火灾荷载：DIN 51900
- 认证：TÜV PFG 1169/08.2007 PV1-F
- 应用标准：UNE 21123；UNE 20.460-5-52，UTE C 32-502

Application

Double insulated, electron-beam cross-linked cables for Photovoltaic power applications.

Construction

- Conductor: Tinned copper strands, according to VDE 0295 / IEC 60228, class 2
- Insulation: Polyolefin Copolymer electron-beam cross-linked
- Outer sheath: Polyolefin Copolymer electron-beam cross-linked
- Sheath colour: Black

Technical specification

- Nominal voltage: $U_0/U = 600 / 1000$ V AC, 1000 / 1800 V DC
- Test voltage: 4000 V, 50 Hz, 5 min.
- Temperature rating:
 - 40 °C up to +125 °C
 - 40 °F up to +257 °F
- Ambient temperature: > 25 years (TÜV)
 - 40 °C up to +90 °C
 - 40 °F up to +194 °F
- Max. short circuit temperature: 280 °C, +536 °F
- Bending radius: $\geq 4 \times$ outer \varnothing

Standards / Material properties

- Fire performance: IEC 60332-1; UL 1581 1061 / VW1
- Smoke emission: IEC 61034; EN 50268-2
- Low fire load: DIN 51900
- Approvals: UL 4703 PV wire; UL 854 USE-2
- Application standards: NEC 2008 / UL PV wire, USE-2



优点

- 电子束交联化合物
- 抗紫外线和臭氧
- 耐水解耐高温，材料不会熔化或流动
- 良好冷柔韧性
- 很长的生命周期
- 兼容所有常用连接器

Advantages

- Electron-beam cross-linked compounds
- UV and ozon resistant
- Hydrolysis resistant
- High temperature resistant, the materials do not melt or flow
- Very long life cycle
- Compatible to all popular connectors

尺寸, 重量

Dimensions, Weight

结构 Construction	零件号 Part no.	导体 Conductor	外径 Outer	重量 Weight	Cu 基数 Cu factor	火灾荷载 Fire load
n × mm ²		mm	mm	kg / km	kg / km	kWh / m
1 × 10 AWG	303326	3,00	7,55	106	51,1	0,259

黑体印刷零件号=库存项目
按要求可进一步设计。

*Bold printed part no. = stock item
Further designs upon request.*

订购单位

Order Units

结构 Construction	零件号 Part no.	零件号 Part no.	零件号 Part no.	零件号 Part no.	零件号 Part no.	零件号 Part no.
n × mm ²	18 × 500 m	8 × 1000 m	1 × 4000 m	1 × 5000 m	1 × 6000 m	1 × 8000 m
1 × 10 AWG	Ø	Ø	Ø	Ø	Ø	Ø

零件号 货盘尺寸
 xxxxxxV2 80 × 120 × ~100 cm (欧洲货盘)
 xxxxxxV3 100 × 100 × ~90 cm
 xxxxxxV4 100 × 100 × ~60 cm





Part no. Pallet size
 xxxxxxV2 80 × 120 × ~100 cm (Europallet)
 xxxxxxV3 100 × 100 × ~90 cm
 xxxxxxV4 100 × 100 × ~60 cm





电流等级 120 °C / 248 °F Current rating 120 °C / 248 °F

环境温度 30 °C / 86 °F Ambient temperature 30 °C / 86 °F

结构 Construction	在空气中没包围 Free in air	无相反接触的表面 On surfaces without opposite contact	有相反接触的表面 On surfaces with opposite contact	在管道, 套管, 导管中 In conduit, casing, duct
				
mm ²	A	A	A	A
1,5	39	37	26	21
2,5	51	48	34	27
4	68	65	45	36
6	88	84	59	47
10	121	115	80	64





如上表所示的连续电流荷载。
对其施加120 °C的导体温度。
(根据IEC 60287进行计算)

Continuous duty with current loads as per above table.
This gives a conductor temperature of 120 °C.
(Calculation according IEC 60287)

环境温度偏差转换基数 (基础 30 °C) Conversion factors for deviating ambient temperatures (basis 30 °C)

温度 Temperature	120 °C 电流等级 Current rating at 120 °C
°C	基数 / Factor
20	× 1,05
30	× 1,00
40	× 0,94
50	× 0,88
60	× 0,82
70	× 0,75
80	× 0,67
90	× 0,58

环境温度 90 °C / 194 °F Ambient temperature 90 °C / 194 °F

结构 Construction	在空气中没包围 Free in air	无相反接触的表面 On surfaces without opposite contact	有相反接触的表面 On surfaces with opposite contact	在管道, 套管, 导管中 In conduit, casing, duct
				
mm ²	A	A	A	A
1,5	22	21	15	12
2,5	29	27	19	15
4	39	37	26	20
6	51	48	34	27
10	70	66	46	37

如上表所示的连续电流荷载。
对其施加120 °C的导体温度。
(根据IEC 60287进行计算)

Continuous duty with current loads as per above table.
This gives a conductor temperature of 120 °C.
(Calculation according IEC 60287)

电子束交联 Electron-beam cross-linking

物理交联

我们在最先进的现代化辐射中心将电缆绝缘材料与高能电子（beta射线）进行交叉连接。当这些电子在聚合物中减速时，其动能消失。通过对电子的影响建立自由基，其伴有化学反应与分子交联。

交联绝缘材料

交联使聚合物链通过一种化学方法进行交叉连接（在非晶相中）。这导致形成了三维网络。该聚合物链不再进行自由移动（不论温度如何）。高于融化温度时，材料将不再流动，但它会处于橡胶弹性状态。

交联绝缘材料优势：

- 增加剪切和抗压强度
- 电气故障时（过载，短路）改进完整性
- 改进的耐化学性能
- 不溶性，耐熔性
- 改进抗冲击强度和抗裂性
- 更好的耐候性和耐磨性

Physical cross-linking

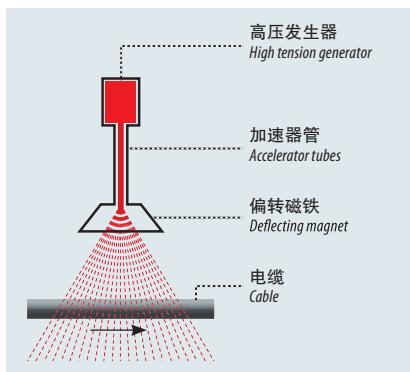
We cross-link our cable insulations with highenergy electrons (betarays) in our own state-of-the-art irradiation centre. These electrons cede their kinetic energy when slowed down in the polymer. Through the impact of the electrons radicals are built, which with chemical reaction interlink the molecules.

Cross-linked insulating materials

Cross-linking binds together the polymer chains by means of a chemical linking (in the amorphous phase). This leads to a three-dimensional network. The polymer chain can no longer move freely (irrespective of temperature). Above the melting temperature the material can no longer flow but it goes into a rubber-like elastic state.

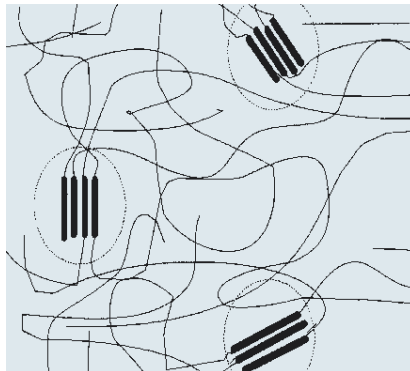
Advantages of cross-linked insulation materials:

- Increased shear and compressive strength
- Improved integrity in case of electrical failures (overload, short circuit)
- Improved resistance to chemicals
- Infusible, soldering iron resistance
- Improved impact strength and crack resistance
- Better weather and abrasionresistance



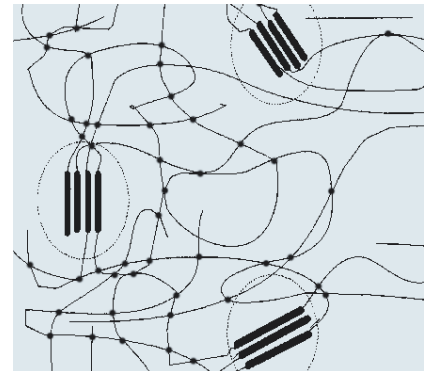
电子束加速器可使绝缘材料在几秒钟内进行交叉连接。均匀辐照暗示同质交联，因此确保特别适合于处理系统。除了在辐照交联中的化学交叉连接，在合成混合物中没有加入过氧化物或硅氢化合物。

With the electron-beam accelerators the insulation materials can be cross-linked within a few seconds. The homogenous irradiation and implicit the homogenous cross-linking are ensured by therefore especially adapted handling systems. Other than in the chemical cross-linking in the irradiation cross-linking no peroxides or hydro-silicones are incorporated into the synthetic mixtures.



交联之前
交联前的脂肪质大分子图。聚合物链的自由流动（无融化和稀释）。

Before cross-linking
Chart of the aliphatic macromolecules before cross-linking. Free movement of the polymer chain (within the melt and the dilution).



交联后
交联后的脂肪质大分子图。聚合物链三维交联（活动自由度受到严重限制）。

After cross-linking
Chart of the aliphatic macromolecules after cross-linking. 3-D cross-linking of the polymer chain (strongly limited freedom of movement).

温度指数

根据 IEC 60216 / VDE 0304第21部分

温度指数描述了塑料的长期性能。温度指数定义了老化温度(°C)，即在 20 000 小时以后，该材料仍然具有50%的绝对断裂伸长率。当温度指数高出10°C时，可使得塑料的预期寿命大约增加一倍。

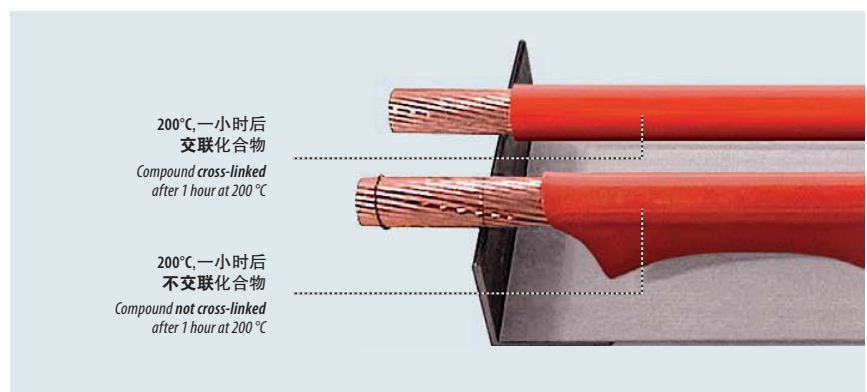
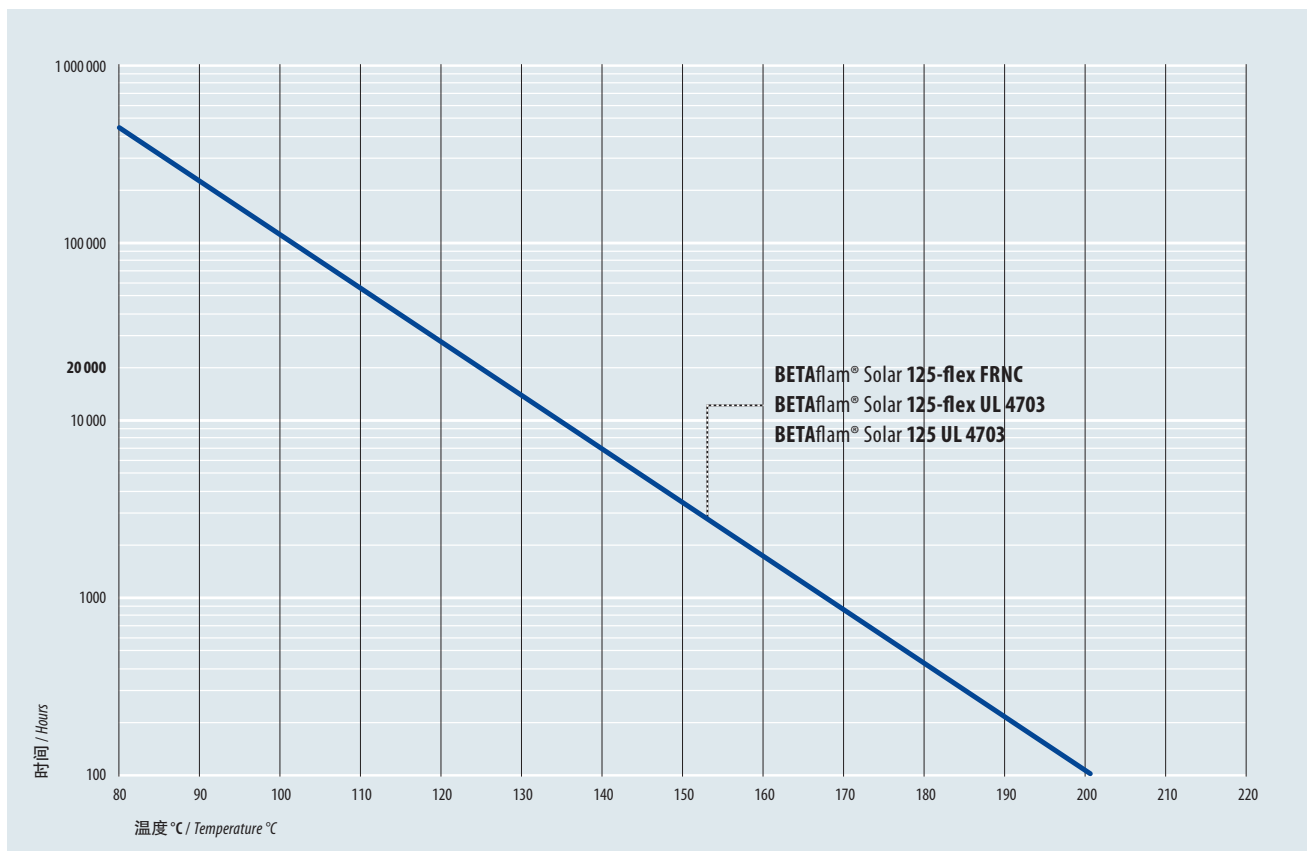
为了确定绝缘材料的长期温度稳定性，对其对应于不同温度的不同老化时间在所谓的阿列纽斯图表中(纵坐标轴:对数时间,横坐标轴:绝对温度的倒数)进行了测量和记录。绘制一直线连接各记录点。将直线延长,直到其与 20 000 小时轴相交,则可确定其寿命或温度指数。

Temperature index

as per IEC 60216 / VDE 0304 part 21

The temperature index describes the long-term performance of plastics. The temperature index defines the ageing temperature (in °C), at which the material still has an absolute elongation at break of 50 % after 20 000 hours. A 10 °C higher temperature index results in approximately doubling the life expectation of the plastic.

In order to determine the long term temperature stability of an insulation material the different ageing times corresponding to different temperatures are measured and recorded in a so called Arrhenius-Diagram (ordinate-axis: log time, abscissa axis: the reciprocal absolute temperature). A straight line is drawn to connect the various recorded points. By prolonging the straight line until it intersects the 20 000 h axis it is possible to determine the lifetime or the temperature index.



无卤素和防火性能

Halogen free and Fire performance

无卤素

卤素是排在元素周期表中第7族的元素：

氯 (Cl)，氟 (F)，溴 (Br)，碘 (I)。

无卤素电缆必须不含氯，氟和溴 (PVC 电缆含有卤素，PVC=聚氯乙烯)。

卤素是许多种酸的集成组件

- HCl = 盐酸
- HF = 氢氟酸
- HBr = 氢溴酸

含有卤素的最常见的塑料是PVC (聚氯乙烯)。在发生火灾时，或在高温下，聚氯乙烯性能会发生退化。会生成盐酸和其他裂变产品，并导致极其严重的腐蚀。因此，目前的趋势是将采用不含卤素的塑料替代含有卤素的塑料。例如，目前，聚氯乙烯已大规模地被聚烯烃取代，即聚乙烯。由于无卤素电缆的问世，可防止产生腐蚀性和有毒气体。

测试程序

必须将1000毫克的实验材料置于气体火焰中的预退火铜线末端。

要求

如果没有发现火焰颜色由绿转为蓝绿色，该材料将被认为不含卤素。氯和溴会导致产生上述变色，然而，按上述方法不能证明是否存在氟。

检测标准

IEC 60754-1, EN 50267-2-1

Halogen free

The halogens are the elements of the 7th group in the Periodic Table of Elements: chlorine (Cl), fluorine (F), bromine (Br), iodine (I).

Halogen free cables must be free of chlorine, fluorine and bromine (PVC cables contain halogen, PVC = Polyvinylchloride).

The halogens are an integrated component of many acids

- HCl = Salt acid (hydrochloric acid)
- HF = Hydrogenfluorid
- HBr = Hydrogenbromid

The most popular plastic containing halogens is PVC (polyvinylchloride). In case of fire or at high temperature PVC starts to degradate. Hydrochloric acid and other fission products are generated and leads to extremely aggressive corrosion. Therefore the current trend is to replace the halogen containing plastics with halogen free ones. For instance PVC is currently being replaced at a large scale with polyolefin i.e. polyethylene.

Thanks to halogen free cables the formation of corrosive and toxic gases can be prevented.

Test procedures

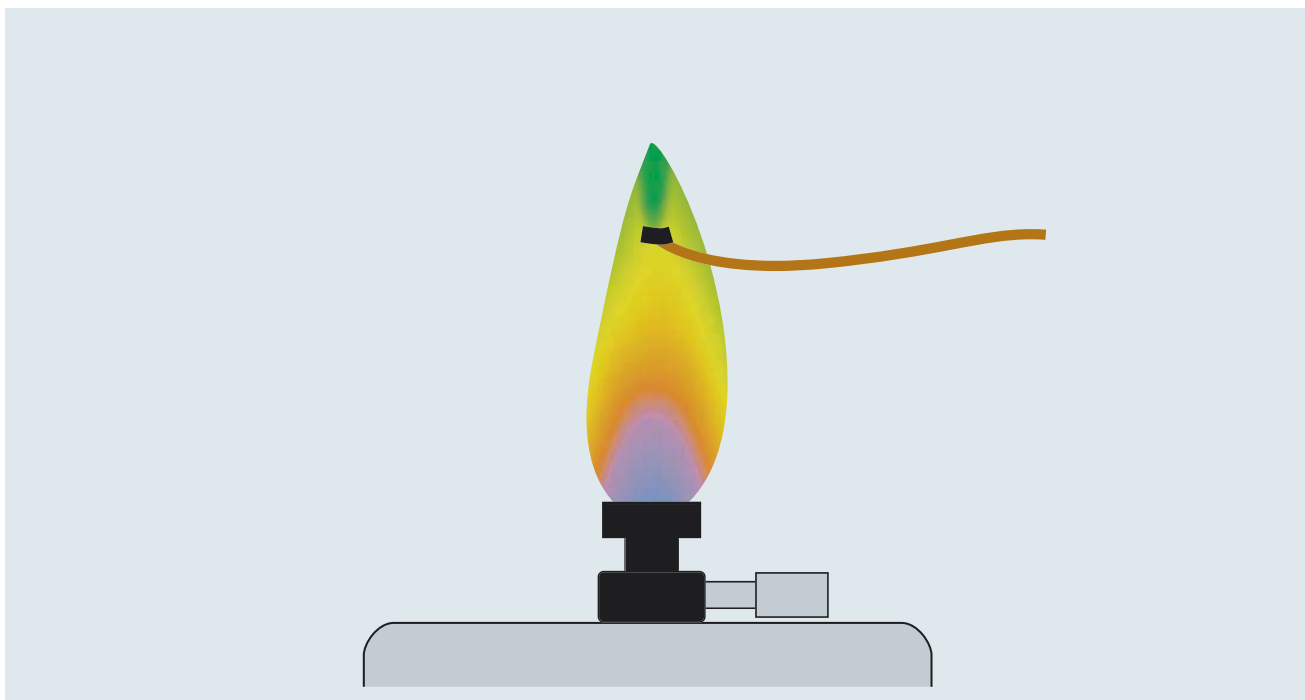
1000 mg of the testing material must be hold at one termination of an pre-annealed copper wire in a gas flame.

Requirement

The material is considered to be halogen free if no green to blue-green flame discoloration occurs. The chlorine and the bromine would cause such a discoloration, however the existence of fluorine cannot be proven like that.

Test standards

IEC 60754-1, EN 50267-2-1



燃烧气体的酸度

腐蚀性气体与湿气发生反应，会生成强酸，其将会腐蚀金属零件，并且导致产生大范围长期的损害，就算能限制火灾损失。这是因为腐蚀性气体往往在整个建筑中通过通风系统或在整个装置中进行蔓延。这些损害可能不限于直接受到火灾影响的部位。电子装置和电子接触特别容易受到伤害，因为其是独立的或采用混凝土封闭的钢结构。

测试程序

在焚烧炉中燃烧1000 mg绝缘材料，温度 $\geq 935^{\circ}\text{C}$ ，且送入预先确定的气体保持30分钟以上。通过两个气体洗涤容器，在气流中测定电导率和pH值。如此进行，即使是含有少量的卤素物质也可被发现并测出。

可认为通过测试

- 当pH值 $> 4,3$
- 电导率 $< 10 \mu\text{S}/\text{mm}$ 时，

检测标准

IEC 60754-2, EN 50267-2-2

Degree of acidity of combustion gases

Corrosive gases act with moisture to produce aggressive acids which corrode metal parts and cause extensive long-term damage, even though the fire damage may only be limited; this is because corrosive gases often spread throughout a building through the ventilation system or within whole installations. The damage may not be limited to the area immediately affected by the fire. Electronic units and electronic contacts are particularly vulnerable, as are free-standing or concrete enclosed steel constructions.

Test procedures

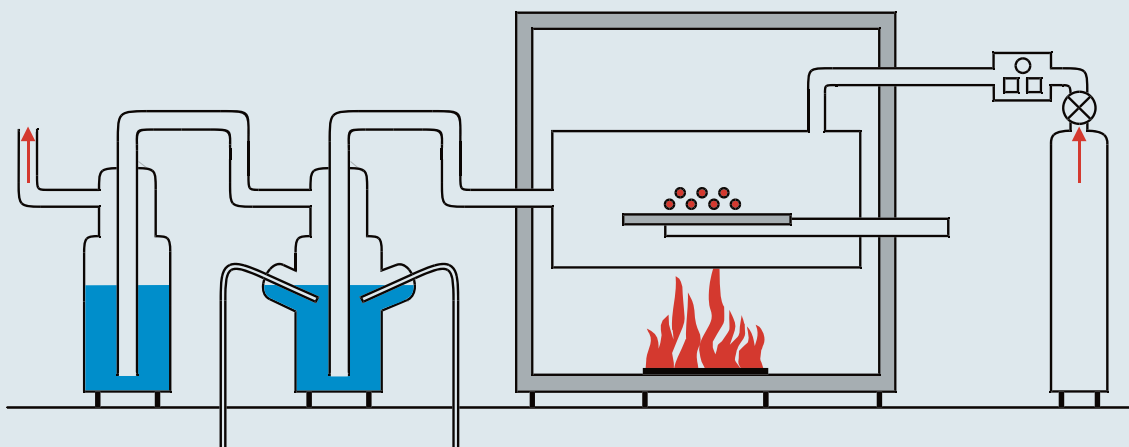
1000 mg insulation material is burned in a combustion furnace at $\geq 935^{\circ}\text{C}$ with pre-defined air supply for over 30 minutes. By means of two gas washing containers, held in the airflow the conductivity and the pH-value are measured. Like that even small quantities of halogen containing substances can be detected and proven.

The test is considered to be passed when

- the pH-value $> 4,3$
- the conductivity $< 10 \mu\text{S}/\text{mm}$

Test standards

IEC 60754-2, EN 50267-2-2



烟雾密度

烟雾的形成会导致产生几个使人厌恶的后果。一方面，它会显著降低火警发生时的能见度，而阻碍在封闭房间中的被困人员逃生以及消防员展开救援工作以及灭火工作。另一方面，由于可产生一氧化碳，会引发烟雾中毒。考虑到会产生燃烧气体，PVC会产生严重脱落。

测试程序

烟雾排放浓度可以采用光穿透率进行测量。在测试室中采用酒精点燃电缆样品（边长为3米的立方体）。所形成的烟雾通过通风设备进行均匀分布，并影响光测量机构。

光穿透率达到以下要求时，可认为通过测试：

危险等级	要求
HL 1	-
HL 2 和 HL 3	60 %
HL 4	70 %

检测标准

IEC 61034, EN 61034

Smoke density

The formation of smoke has several unpleasant consequences. On one hand it considerably lowers the visibility in a fire event, thus impeding the people trapped inside closed rooms escape of and the efforts of the firemen to carry on their rescue and fire fighting actions. On the other hand it produces smoke poisoning because of the carbon monoxide. Regarding the formation of the combustion gases the PVC comes off quite badly.

Test procedures

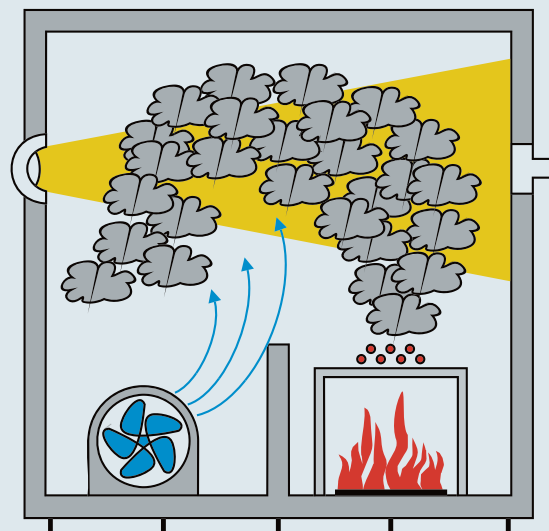
The density of smoke emission can be determined by measuring of the light penetrability. Cable samples are lit with alcohol in a test chamber (cubical with an edge length of 3 m). The so formed smoke is uniformly spread by a ventilator and influences the light measuring section.

The test is considered to be passed when the following light penetrability is reached:

Dangerous level	Requirements
HL 1	-
HL 2 and HL 3	60 %
HL 4	70 %

Test standards

IEC 61034, EN 61034



阻燃

阻燃电缆是在一种电缆，当进行单根安装时，虽然暴露于火源时会燃烧，但一旦火源被撤除之后，其将大大降低火焰蔓延和自熄灭性。

然而，在垂直电缆束中，例如垂直立管，火势可沿着电缆蔓延（烟囱效应）。为了避免产生此类危险，应使用所谓的“无火焰蔓延”电缆。

测试程序

此测试程序描述了阻燃电缆的最低要求，且其仅对导线或单根电缆有效。

一根导线或电缆即为丙烷气燃烧器（1 kW的火焰）。

测试持续时间

- $\varnothing \leq 25$ = 60 s
- $\varnothing 25 \dots 50$ = 120 s
- $\varnothing 50 \dots 75$ = 240 s
- $\varnothing > 75$ = 480 s

燃烧的电缆应具有自熄性，即当移除火源后，应自动熄灭。火灾损耗不得超过60cm。

如果达到以下要求，可认为通过测试：

该样品没有被烧毁，且其破坏（碳化）并未到达样品末端的任意部分（>50mm）。

检测标准

IEC 60332-1, EN 60332-1

Flame retardant

Flame retardant cables are cables which, when installed as a single cable, although ignitable on exposure to flame source, will greatly reduce flame spread and selfextinguish once the flame source is removed.

However in a vertical cable bundle, e.g. in vertical risers, fire can spread along the cables (chimney effect). In order to avoid this danger, the so called «no flame propagating» cables should be used.

Test procedures

This test procedure describes the minimum requirements for flame retardant cables and it is valid for lead wires or on single cables only.

A lead wire or a cable is being aflamed with a propane-air-burner (1 kW flame).

Test duration

- $\varnothing \leq 25$ = 60 s
- $\varnothing 25 \dots 50$ = 120 s
- $\varnothing 50 \dots 75$ = 240 s
- $\varnothing > 75$ = 480 s

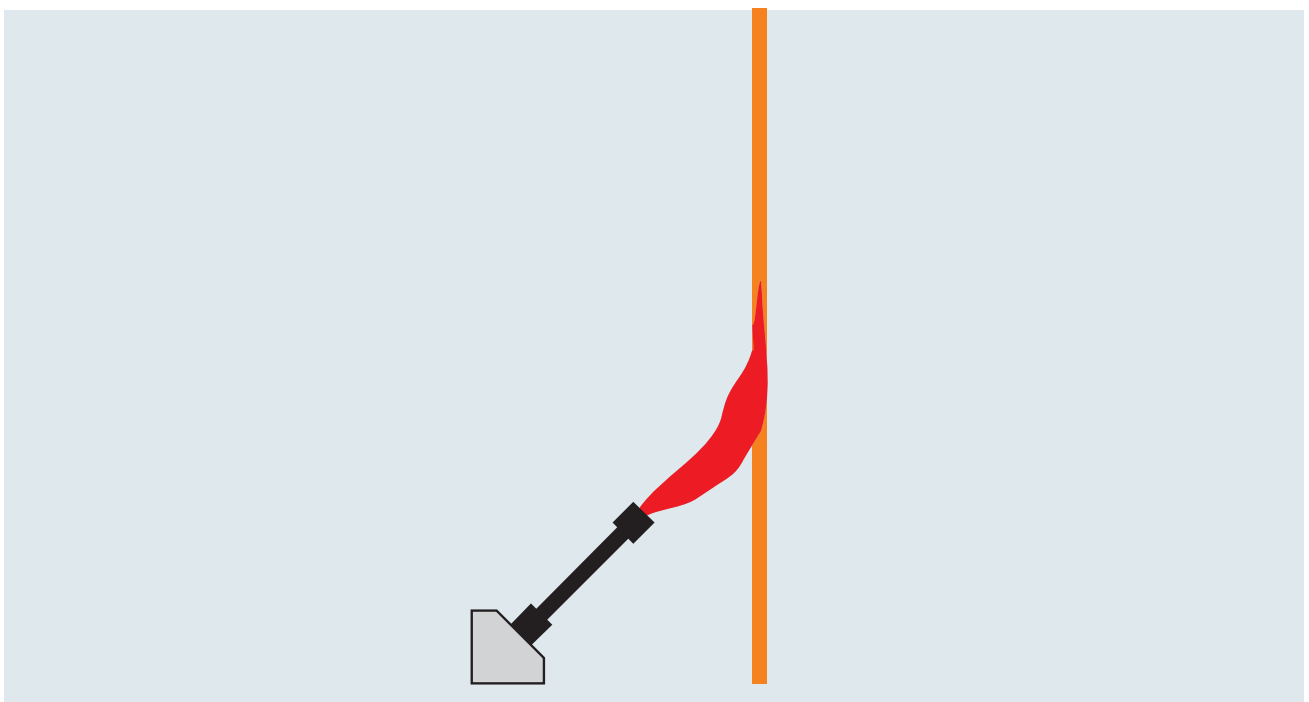
The burning cable should self-extinguish as soon as the fire source has been removed. The fire damage may not be higher than 60 cm.

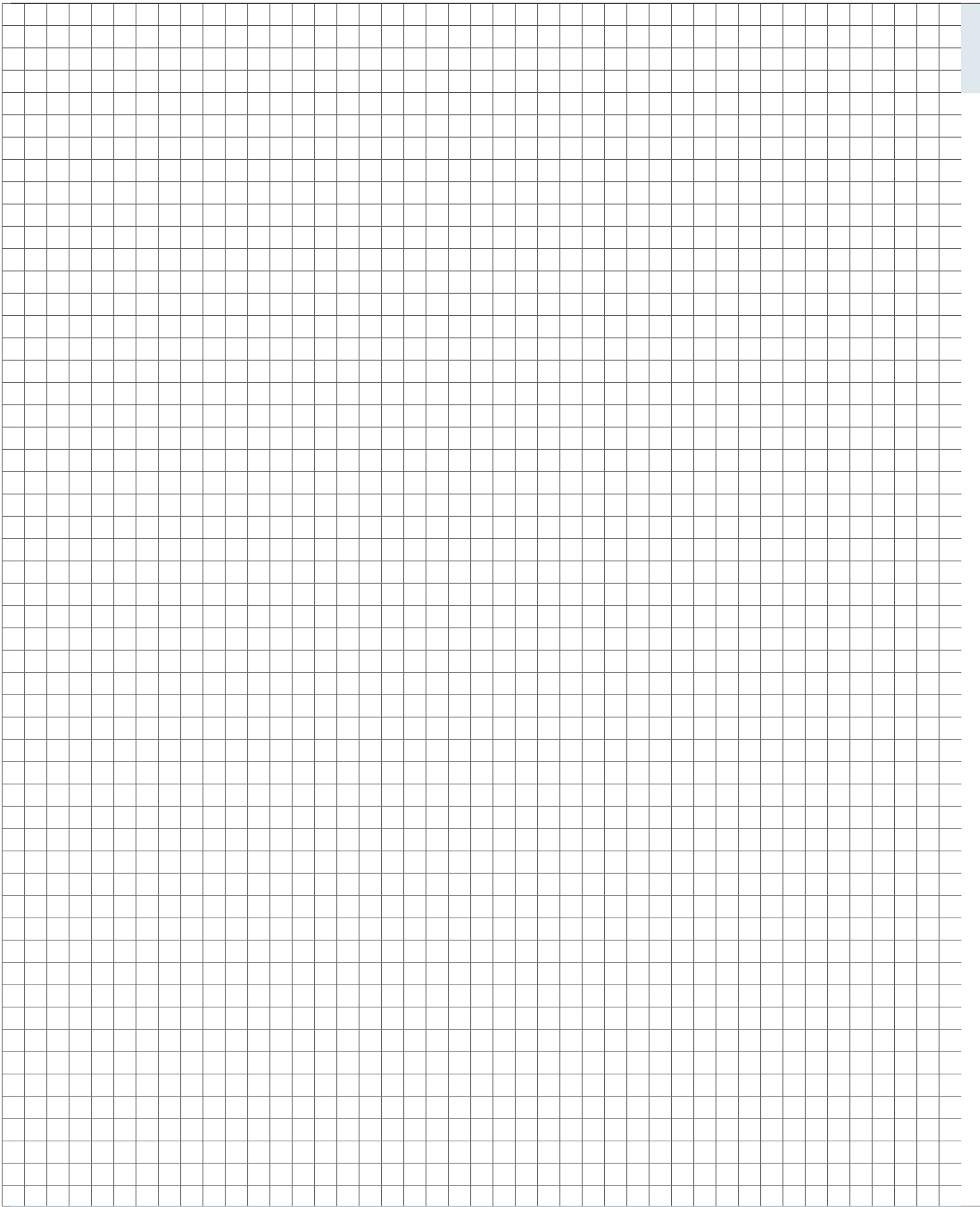
The test is considered to be passed if:

The sample has not burned and the damage (carbonisation) has not reached any of the terminations of the sample (> 50 mm).

Test standards

IEC 60332-1, EN 60332-1





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BETAtrans®

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- 可用于太阳能发电

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- Temperature resistant, increased dielectric strength, easy stripping

BETAflam® flex

- Premium flexible connection and power cables
- Good resistance to aggressive media, halogen free and flame retardant

BETAflam® CHEMAflex®

- Oil and chemical resistant connection and power cables
- Temperature resistant, halogen free, flame retardant, easy stripping

BETAtrans®

- Premium flexible halogen free connection and power cables
- Excellent mechanical and dielectric strength

BETAflam® Solar

- Double insulated lead wires
- Electron-beam cross-linked and halogen free
- For solar power applications

BETAjet®

- 400 Hz ground power cable systems
- For mobile and static applications

BETAlux®

- Media resistance 5 kV-primary cables
- Feeder cables for airfield lighting

BETAflam®

- Safety cables

BETAfixss®

- Laying systems

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