# Characteristics* of insulating and sheath materials

| Designation | | | | Electrical | | | | | Thermic | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | VDE Initial-code | Abbreviations | Materials | Density g/m³ | Breakdown-voltage- KV/mm (20°C) | Spezific volume resistivty Ohm · cm 20°C | Dielectric constant 50 Hz/20°C | Dielectric loss-factor tan δ | Working temperature permanent °C | Working temperature short time °C | Melt-temperrature +°C | Flame-resistance | Oxygen index LOI (% $O_2$) | Heating value $H_0$ MJ · $kg^{-1}$ | |
| Thermoplastic | Y | PVC | Polyvinylchloride compounds | 1,35–1,5 | 25 | $10^{13}$–$10^{15}$ | 3,6–6 | $4 \times 10^{-2}$ to $1 \times 10^{-1}$ | – 30 + 70 | +100 | >140 | self-extinguishing | 23–42 | 17–25 | |
| | Yw | PVC | Heat-resistant 90°C | 1,3–1,5 | 25 | $10^{12}$–$10^{15}$ | 4–6,5 | | – 20 + 90 | +120 | >140 | | | 16–22 | |
| | Yw | PVC | Heat-resistant 105°C | 1,3–1,5 | 25 | $10^{12}$–$10^{15}$ | 4,5–6,5 | | – 20 +105 | +120 | >140 | | 24–42 | 16–20 | |
| | Yk | PVC | Cold resistant | 1,2–1,4 | 25 | $10^{12}$–$10^{15}$ | 4,5 –6,5 | | – 40 + 70 | +100 | >140 | | | 17–24 | |
| | 2Y | LDPE | Low density Polyethylene | 0,92–0,94 | 70 | $10^{17}$ | 2,3 | $2 \times 10^{-4}$ | – 50 + 70 | +100 | 105–110 | flammable | ≦22 | 42-44 | |
| | 2Y | HDPE | High density Polyethylene | 0,94–0,98 | 85 | $10^{17}$ | 2,3 | $3 \times 10^{-4}$ | – 50 +100 | +120 | 130 | | | | |
| | 2X | VPE | Cross-linked Polyethylene | 0,92 | 50 | $10^{12}$–$10^{16}$ | 4–6 | $2 \times 10^{-3}$ | – 35 + 90 | +100 | – | | | | |
| | O2Y | | Foamed Polyethylene | ~0,65 | 30 | $10^{17}$ | ~1,55 | $5 \times 10^{-4}$ | – 40 + 70 | +100 | 105 | | 18–30 | | |
| | 3Y | PS | Polystrole | 1,05 | 30 | $10^{16}$ | 2,5 | $1 \times 10^{-4}$ | – 50 + 80 | +100 | >120 | | ≦22 | 40–43 | |
| | 4Y | PA | Polyamide | 1,02 –1,1 | 30 | $10^{15}$ | 4 | $2 \times 10^{-2}$ bis $1 \times 10^{-3}$ | – 60 +105 | +125 | 210 | | ≦22 | 27–31 | |
| | 9Y | PP | Polypropylene | 0,91 | 75 | $10^{16}$ | 2,3 –2,4 | $4 \times 10^{-4}$ | – 10 + 90 | +140 | 160 | | | 42–44 | |
| | 11Y | PUR | Polyurethane | 1,15 –1,2 | 20 | $10^{10}$ –$10^{12}$ | 4–7 | $2,3 \times 10^{-2}$ | – 55 + 80 | +100 | 150 | | 20–26 | 20–26 | |
| | TPE-E (12Y) | | Polyester Elastomer | 1,2 –1,4 | 40 | >$10^{10}$ | 3,7 –5,1 | $1,8 \times 10^{-2}$ | – 50 +100 | +140 | 190 | | ≦29 | 20–25 | |
| | TPE-O | | Polyolefine Elastomer | 0,89–1,0 | 30 | >$10^{14}$ | 2,7–3,6 | | | +130 | 150 | | ≦25 | 23–28 | |
| Elastomere | G | NR SBR | Natural rubber Styrol-butadiene-rubber-compounds | 1,5–1,7 | 20 | $10^{12}$–$10^{15}$ | 3–5 | $1,9 \times 10^{-2}$ | – 65 + 60 | +120 | – | flammable | ≦22 | 21–25 | |
| | 2G | SiR | Silicone rubber | 1,2 –1,3 | 20 | $10^{15}$ | 3–4 | $6 \times 10^{-3}$ | – 60 +180 | +260 | – | high flash point | 25–35 | 17–19 | |
| | 3G | EPR | Ethylen-propylene rubber-compounds | 1,3–1,55 | 20 | $10^{14}$ | 3–3,8 | $3,4 \times 10^{-3}$ | – 30 + 90 | +160 | – | flammable | ≦22 | 21–25 | |
| | 4G | EVA | Ethylen-vinylacetat copolymer-compunds | 1,3–1,5 | 30 | $10^{12}$ | 5–6,5 | $2 \times 10^{-2}$ | – 30 +125 | +200 | – | | | 19–23 | |
| | 5G | CR | Polychloroprene compounds | 1,4–1,65 | 20 | $10^{10}$ | 6–8,5 | $5 \times 10^{-2}$ | – 40 +100 | +140 | – | self-extinguishing | 30–35 | 14–19 | |
| | 6G | CSM | Chlorsulfonated Polyethylene compunds | 1,3–1,6 | 25 | $10^{12}$ | 6–9 | $2,8 \times 10^{-2}$ | – 30 + 80 | +140 | +160 | | | 19–23 | |
| High temp. materials | 10Y | PVDF | Polyvinylidene fluoride Kynar/Dyflor | 1,7–1,9 | 25 | $10^{14}$ | 9–7 | $1,4 \times 10^{-2}$ | – 40 +135 | +160 | >170 | self-extinguishing | 40–45 | 15 | |
| | 7Y | ETFE | Ethylene-Tetrafluor ethylene | 1,6–1,8 | 36 | $10^{16}$ | 2,6 | $8 \times 10^{-4}$ | –100 +150 | +180 | >265 | self-extinguishing | 30–35 | 14 | |
| | 6Y | FEP | Fluorine ethylene propylene | 2,0–2,3 | 25 | $10^{18}$ | 2,1 | $3 \times 10^{-4}$ | –100 +205 | +230 | >225 | self-extinguishing | >95 | 5 | |
| | 5YX | PFA | Perfluoralkoxypolimeric | 2,0–2,3 | 25 | $10^{18}$ | 2,1 | $3 \times 10^{-4}$ | –190 +260 | +280 | >290 | self-extinguishing | >95 | 5 | |
| | 5Y | PTFE | Polytetrafluorethylene | 2,0–2,3 | 20 | $10^{18}$ | 2,1 | $3 \times 10^{-4}$ | –190 +260 | +300 | >325 | self-extinguishing | >95 | 5 | |
| halogen-free compouns | H | not cross-linked | halogen-free polymer-compounds | 1,4–1,6 | 25 | $10^{12}$–$10^{14}$ | 3,4–5 | ~$10^{-3}$ | – 30 + 70 | +100 | >130 | self-extinguishing | ≦40 | 17-22 | |
| | HX | cross-linked | halogen-free polymer-compounds | 1,4–1,6 | 25 | $10^{13}$–$10^{14}$ | 3,4–5 | $10^{-2}$–$10^{-3}$ | – 30 + 90 | +150 | – | self-extinguishing | ≦40 | 16–25 | |

* The characteristics valid for unprocessed material

# Characteristics* of insulating and sheath materials

| Thermic | | | Mechanical | | | | | Halogen | Weather | | Designation | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Thermal-conduct-ivity<br>W·K$^{-1}$·m$^{-1}$ | Corrosive gases in case of fire | Radiation-resistance-max<br>Mrad | tensile strength<br>N/mm$^2$ | Elongation at break<br>% | Shore-hardness | Corrosion behaviour | Abrasion resistance | halogen-free | Weather resistance | Cold resistance | VDE-Ini-tial-code | Ab-bre-viat ions | Material | |
| 0,17 | Hydrogen chloride | 80 | 10–25 | 130–350 | 70–95 (A) | medium | 0,4 | no | medium in black | moderate-good | Y | PVC | Polyvinylchloride-compounds | Thermoplastic |
| | | | | | | | | | | | Yw | PVC 90°C | Heat-resistant | |
| | | | | | | | | | | | Yw | PVC 105°C | Heat-resistant | |
| | | | | | | | | | | very good | YK | PVC | Cold resistant | |
| 0,3 | no | 100 | 10–20 | 400–600 | 43–50 (D) | medium | 0,1 | yes | good | good | 2Y | LDPE | Low density Polyethylene | |
| 0,4 | | | 20–30 | 500–1000 | 60–63 (D) | good | | | | | 2Y | HDPE | High density Polyethylene | |
| 0,3 | | | 12,5–20 | 300–400 | 40–45 (D) | medium | | | good | | 2X | VPE | Cross-linked Polyethylene | |
| 0,25 | | | 8–12 | 350–450 | – | – | – | conditional[1] | – | | O2Y | | Foamed Polyethylene | |
| 0,25 | no | 80 | 55–65 | 300–400 | 35–50 (D) | good | 0,4 | yes | medium - good | moderate - good | 3Y | PS | Polystrole | |
| 0,23 | no | 10 | 50–60 | 50–170 | – | very good | 1,0–1,5 | | good | good | 4Y | PA | Polyamide | |
| 0,19 | | | 20–35 | 300 | 55–60 (D) | medium | 0,1 | | moderate | | 9Y | PP | Polypropylene | |
| 0,25 | | 100 (500) | 30–45 | 500–700 | 70–100 (A) | very good | 1,5 | yes[2] | very good | very good | 11Y | PUR | Polyurethane | |
| 0,5 | | 10 | 30 | >300 | 85 (A)<br>70 (D) | good | 1,5 | yes | | | TPE-E (12Y) | | Polyester Elastomer | |
| 1,5 | | 10 | 20 | | 55 (A)<br>70 (D) | | | | | | TPE-O | | Polyolefine Elastomer | |
| – | no | 100 | 5–10 | 300–600 | 60–70 (A) | moderate | 1,0 | no | moderate | very good | G | NR SBR | Natural rubber Styrol-butadiene-rubber-compounds | Elastomere |
| 0,22 | | 50 | | | 40–80 (A) | | | yes | good | | 2G | SiR | Silicone rubber | |
| – | | 200 | | 200–400 | 65–85 (A) | | | | very good | good | 3G | EPR | Ethylen-Propylene rubber-compounds | |
| – | | 100 | 8–12 | 250–350 | 70–80 (A) | | | | good | | 4G | EVA | Ethylen-vinylacetat copolymer-compunds | |
| – | Hydrogen chloride | 50 | 10–20 | 400–700 | 55–70 (A | medium | | no | very good | moderate - good | 5G | CR | Polychloroprene compounds | |
| – | | | | 350–600 | 60–70 (A) | | 1,5 | | | moderate | 6G | CSM | Chlorsulfonated Polyethylene compunds | |
| 0,17 | Hydro-fluoric | 10 | 50–80 | 150 | 75–80 (D) | very good | 0,01 | no | very good | very good | 10Y | PVDF | Polyvinylidene fluoride Kynar/Dyflor | High temp. materials |
| 0,24 | yes | 10 | 40–50 | 150 | 70–75 (D) | very good | 0,02 | | very good | very good | 7Y | ETFE | Ethylene-Tetrafluor ethylene | |
| 0,26 | yes | 1 | 15–25 | 250 | 55–60 (D) | very good | 0,01 | | very good | very good | 6Y | FEP | Fluorine ethylene propylene | |
| 0,21 | yes | 0,1 | 25–30 | 250 | 55–60 (D) | very good | 0,01 | | very good | very good | 5YX | PFA | Perfluoralkoxypolimeric | |
| 0,26 | yes | 0,1 | 80 | 50 | 55–60 (D) | very good | 0,01 | | very good | very good | 5Y | PTFE | Polytetrafluorethylene | |
| 0,17 | no | 100 | 8–13 | 150–250 | 65–95 (A) | medium | 0,2–1,5 | yes | medium in black: good | average | H | not cross-linked | halogen-free polymer-compounds | halogen-free compouns |
| 0,20 | no | 200 | 8–13 | 150–250 | | medium | | | | | HX | cross-linked | halogen-free polymer-compounds | |

[1] The propellent may be e.g. Fluor-Chlor-Hydrcarbon

[2] depend on the type compound