Plastic energy chains

ekd plastic energy chains are manufactured from high quality polyamide. In addition the series PLE with stays of seawater resistant aluminum and chains made of the plastic Kolibri and PKK are in the product range.

The standard material is polyamide 6 reinforced with 35% glass fibres (PA 6 GF 35). The continuous service temperature range for energy chains made of this material is -20 ° C to 100 ° C. Outside these limits a significant decrease in the mechanical strength characteristics must be expected. A detailed design is then essential.

The resistance to environmental influences is generally very good except for concentrated acids and bases, see chapter chemical resistance.
Depending on the order, polyolefins can be used that provide chemical resistance in a wide range of applications.

RoHS

For special applications, the material in modified:

High impact (HI), food applications (FDO), flame retardant (V-0), for explosion-endangered areas (EX) or against electrostatic discharges (ESD).

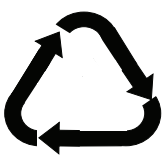
CE 0102 Ex II 2 GD

To optimize the flexibility energy chains they are manufactured from non-reinforced polyamide 6 and polyamide 66, and thermoplastic elastomers (SYSTEM ALLROUND).

With a combination of special construction and material properties in particular for clean room applications excellent technical results are achieved (SYSTEM REINTEC).

IPA Fraunhofer TESTED DEVICE
Energieführungsketten
EKD Gelenkrohr
Report No. EK 0604-345

All components of the plastic energy chains are made of thermoplastic materials that are recyclable.



Plastic energy chains are suitable for operating temperatures from -20 ° C to 100 ° C.

MATERIAL DATA SHEET
PA 6 GF35 (standard)

Listed properties are guide values and may be used as knowledge base. The ekd material specifications may differ from this values and are under reservation of necessary technical changes.

Property	(standard)	Test condition	Value d.a.m.	Value conditioned	Unit
Mechanical properties					
Yield stress	(ISO 527)	5 mm/min	170	120	MPa
Yield strain	(ISO 527)	5 mm/min	3,0	7,0	%
Tensile modulus	(ISO 527)	1 mm/min	10000	7000	MPa
Charpy impact strength	(ISO 179u)	23 °C	100	110	kJ/mm^2
Charpy impact strength	(ISO 179u)	-30 °C	85	85	kJ/mm^2
Flexural modulus	(ISO178)	2 mm/min	9000	5500	MPa
Flexural strain at flexural strength	(ISO 178)	2 mm/min	4,0	6,0	%
Thermal properties					
Melting temperature	(ISO 11357-1, -3)	10 °C/min	213		°C
Temperature of deflection	(ISO 75-1, -2)	1,8 MPa	ca. 200		°C
Coeff. of linear therm. exp., paralle	(ISO 11359)	23 to 55°C	0,2		10^{-4}/K
Coeff. of linear therm. exp., transv.	(ISO 11359)	23 to 55°C	0,9		10^{-4}/K
Thermal conductivity	(ISO 8302)	23°C	0,3		W/(mK)
Burning behavior	(UL 94)	1,6 mm	HB		-
Electrical properties					
Relative permitivity	(IEC 60250)	100 Hz	4,0	10	-
Relative permitivity	(IEC 60250)	1 Hz	4,0	5,0	-
Volume resistivity	(IEC 60093)		1E13	1E10	Ohm m
Surface resistivity	(IEC 60093)		1E14	1E12	Ohm
Other properties (23°C)					
Water absorption (saturation value)		water at 23°C	ca. 6,5		%
Water absorption (equilibrium value)		23°C, 50% r.h.	ca. 1,8		%
Density	(ISO1183)		1400		kg/m^3
Glass fibre content	(ISO 3451)		35		%

MATERIAL DATA SHEET
PA 66 (HIGH IMPACT)

ekd gelenkrohr energy drag chains

Listed properties are guide values and may be used as knowledge base. The ekd material specifications may differ from this values and are under reservation of necessary technical changes.

Property	(standard)	Test condition	Value d.a.m.	Value conditioned	Unit
Mechanical properties					
Yield stress	(ISO 527)	5 mm/min	60	40	MPa
Yield strain	(ISO 527)	5 mm/min	8,0	12,0	%
Tensile modulus	(ISO 527)	1 mm/min	2100	1100	MPa
Charpy imp. strength (notched)	(ISO 179/1eA)	23 °C	18	100	kJ/mm^2
Charpy impact strength	(ISO 179/1eU)	23 °C	n.b.	n.b.	kJ/mm^2
Flexural modulus	(ISO178)	2 mm/min	2000	1000	MPa
Flexural strain at flexural strength	(ISO 178)	2 mm/min	80	40	%
Thermal properties					
Melting temperature	(ISO 11357-1, -3)	10 °C/min	258		°C
Temperature of deflection	(ISO 75-1, -2)	1.8 MPa	ca. 80		°C
Coeff. of linear therm. exp., transv.	(ISO 11359)	23° bis 85°C	0,7		$10^{-4}/K$
Thermal conductivity	(ISO 8302)	23 °C	k.A.		W/(mK)
Burning behavior	(UL 94)	1,6mm	HB		-
Electrical properties					
Volume resistivity	(IEC 60093)		1E17	1E14	Ohm m
Surface resistivity	(IEC 60093)		2E13	2E12	Ohm
Other properties (23°C)					
Water absorption		24h,23°C	ca. 0,75		%
Density	(ISO1183)		1080		kg/m^3
Glass fibre content	(ISO 3451)		0		%

CHEMICAL RESISTANCE PA

The following list of substances and compounds are reference values for the resistance of polyamides. Polyamides are generally resistant to aliphatic and aromatic hydrocarbons (eg, fuel), fats and oils and to many organic solvents. Polyamides are not resistant to organic and inorganic acids, some even in low concentrations, as well as to strong oxidizing agents. Fittings made of polyamide are generally regarded as stress crack resistance.

resistant

acetone	acetylene	allyl alcohol	ammonia	ammonium nitrate
ammonium sulfate	benzene	beer	bio gasoil	bitumen
brake fluids	bromo	butane	butanol	camphor oil
chloramines	chlorobenzene	citric	citrus	cyclohexanol
dibuthylphtalat	gasoil	dibutyl ether	dimethylamine	dioxane
ferricIII chloride (neut.)	petroleum	ether gas	ethane	ether
ethyl acetate	ethylene	ethylene oxide	CFC	fatty alcohols
fats, waxes	fish oils	fixing baths	photo developer	fruit juices
furfural	gelatin	gear oil	glycerol	urea (20%)
heating oil	heptane	hexan	hexachlorobenzene	isocyanate
potassium carbonate	potassium chloride (10%)	isopropanol	isooctane	ketones
co2	carbon fuels (gasoline)	copper sulfate	linseed oil	
seawater	methane	lactic	mineral oils	
sodium carbonate	sodium chloride	sodium sulfide		
sodium hydroxide (10%)	paraffin oil	petroleum ether	lamp oil	phosphates
phosphoric acid (30%)	rapeseed oil	propane	carbon disulphide	
hydrogen sulphide	welding solution (pH 9.5)	silver nitrate(10%)	silicone	soda solution
nitrogen	styrene	tallow (beef fat)	turpentine	
carbon tetrachloride	tetrafluoromethane	ink	toluene	urine
tartaric acid	xylene	benzene hydrogen	sugar solution	

conditionally stable

acetaldehyde	aniline	benzyl alcohol	chloroform	vapor
diethylene glycol	dimethyl formamide	dimethylsuloxid	ferric III chloride, acidic,watery	
acetic acid (5%)	ethanol, conc.	ethylene glycol	formaldehyde (10%)	formamide
glycol	hydraulic fluids	potassium dichromate	potassium hydroxide, conc.	
methyl alcohol	oxalic acid (10%)	phosphoric acid (10%)	sulfur dioxide dry	propanol
sulfuric acid	vinyl chloride	triethanolamine	trichlorethylene vapor	
tin chloride (aqueous)				

unstable

acrylic acid	formic acid (10%)	benzaldehyde	bromide	butyric acid (conc.)
calcium hypochlorite	chloramines	chlorine	hydrochloric	acetic acid (30%)
hydrofluoric	hydrofluoric acid (40%)	iodine	iodide	perchlorate (2%)
potassium	permanganate (10%)	solder liquid	sodium hypochlorite	20 ppm of ozone
nitric acid	perchloric acid (1%)	hydrochloric acid (1%)	oxygen	sulfuric acid(10%)
thionyl chloride	trichloroacetic	trichloroethyl hydrogen peroxide (10%)		cinnamaldehyde
Zinc halides (aqueous)				

soluble

formic acid (85%)	calcium chloride	aniline	alcohol. Chloral hydrate	
dimethylformamide	ethylene glycol	dimethyl	phenol	cresols
hydrochloric acid conc.	sulfuric acid (96%)			

About this catalogue

Descriptions and technical informations which are shown in this catalog are purely informative and provide only the general Information. An assurance of properties for certain applications is denied. The catalog reflects the technical state of the art at the time of the edition. Changes to the products remain at any time. The in the order and contract agreed properties of the product is binding.

General operating and safety instructions

Energy chains are technical products, which are constructed as part of an engineering-design for concrete applications according to the state of the art. In dealing with these products the compliance to the operating and safety instructions and general rules of technology is assumed.

Thus, for example, the stay in the work area of an energy chain is only allowed if adequate safeguards are in place to prevent accidental moving of the chain. The accident prevention regulations are strictly to be observed. Further requirements, such as when operating in explosive hazardous areas are - if applicable - to take into account as well.

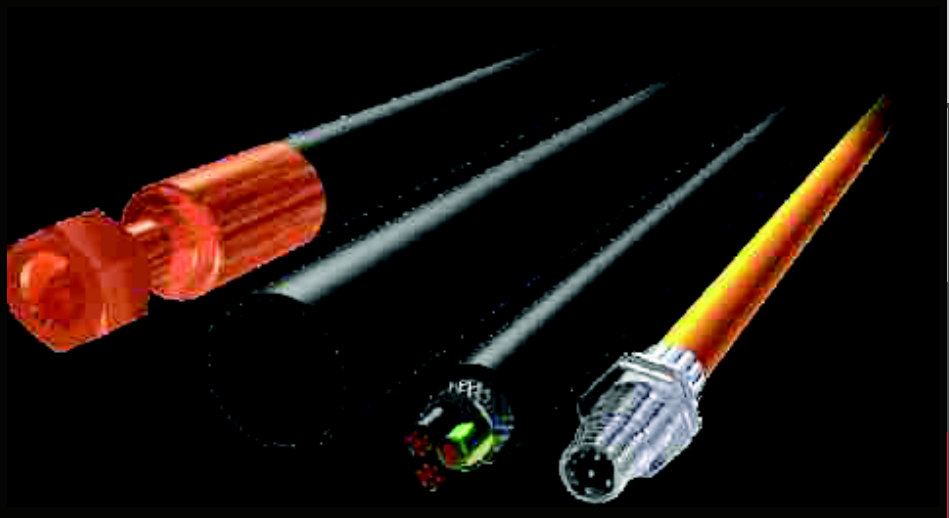
The intended use has to be in compliance with the design limits of energy chains. The below known from practical experience can lead to considerable functional errors or demage of the energy chain :

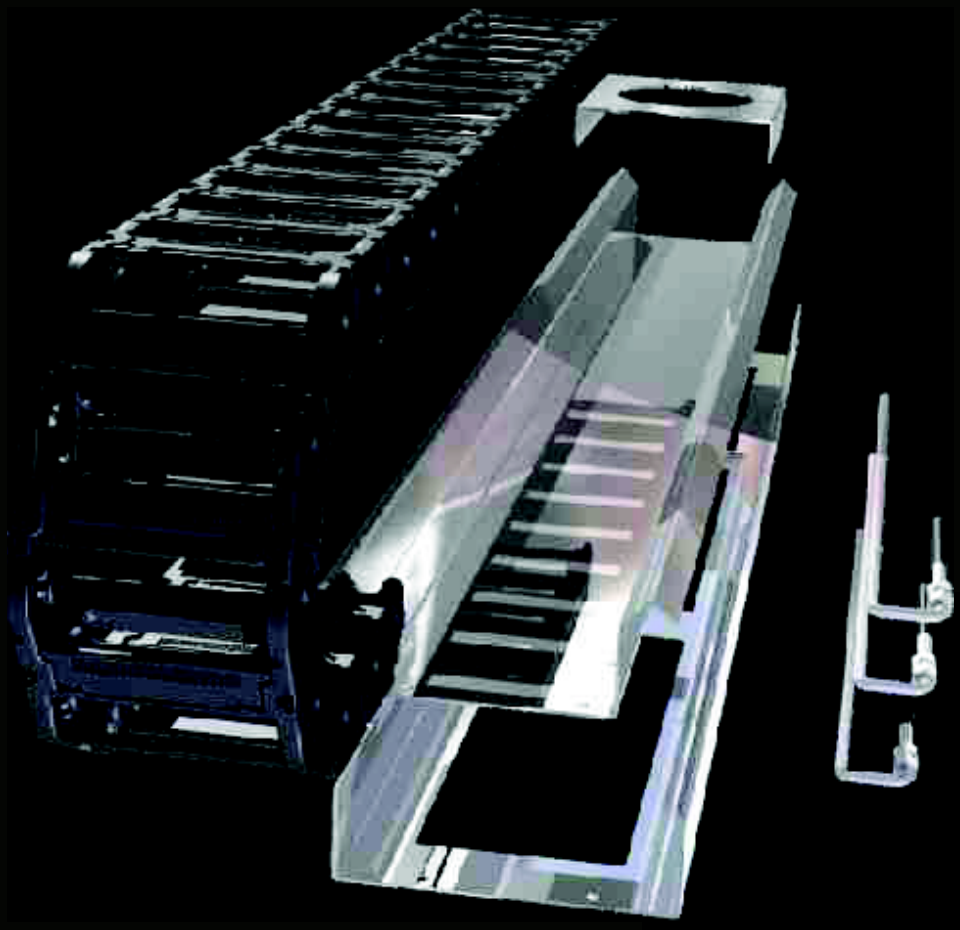
- improper handling of the energy chain during transport and assembly
- undue weight load of the energy chain, especially of a free carrying upper strand of the chain
- operating the energy chain out of the limits of the designed travel distance
- introduction of interference contours, components or parts thereof into the operating area
- improper line load

Are the operating conditions such as wear-boundary conditions of abrasive dust entry or plant-vibration and oscillations can not be avoided, so by appropriate constructive steps and inspection intervals, particularly in unsupervised, automated operating systems, unforeseen equipment failures have to be avoid.

ekd gelenkrohr

energy chains
lines
accessories





energy guiding systems

complete systems

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Plastic energy chains

ekd plastic energy chains are manufactured from high quality polyamide. In addition the series PLE with stays of seawater resistant aluminum and chains made of the plastic Kolibri and PKK are in the product range.

The standard material is polyamide 6 reinforced with 35% glass fibres (PA 6 GF 35). The continuous service temperature range for energy chains made of this material is -20 ° C to 100 ° C. Outside these limits a significant decrease in the mechanical strength characteristics must be expected. A detailed design is then essential.

The resistance to environmental influences is generally very good except for concentrated acids and bases, see chapter chemical resistance.
Depending on the order, polyolefins can be used that provide chemical resistance in a wide range of applications.

RoHS

For special applications, the material in modified:

High impact (HI), food applications (FDO), flame retardant (V-0), for explosion-endangered areas (EX) or against electrostatic discharges (ESD).

CE 0102 Ex II 2 GD

To optimize the flexibility energy chains they are manufactured from non-reinforced polyamide 6 and polyamide 66, and thermoplastic elastomers (SYSTEM ALLROUND).

With a combination of special construction and material properties in particular for clean room applications excellent technical results are achieved (SYSTEM REINTEC).

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Energieführungsketten
EKD Gelenkrohr
Report No. EK 0604-345

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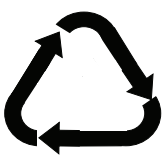

Plastic energy chains are suitable for operating temperatures from -20 ° C to 100 ° C.

MATERIAL DATA SHEET
PA 6 GF35 (standard)

Listed properties are guide values and may be used as knowledge base. The ekd material specifications may differ from this values and are under reservation of necessary technical changes.

Property	(standard)	Test condition	Value d.a.m.	Value conditioned	Unit
Mechanical properties					
Yield stress	(ISO 527)	5 mm/min	170	120	MPa
Yield strain	(ISO 527)	5 mm/min	3,0	7,0	%
Tensile modulus	(ISO 527)	1 mm/min	10000	7000	MPa
Charpy impact strength	(ISO 179u)	23 °C	100	110	kJ/mm^2
Charpy impact strength	(ISO 179u)	-30 °C	85	85	kJ/mm^2
Flexural modulus	(ISO178)	2 mm/min	9000	5500	MPa
Flexural strain at flexural strength	(ISO 178)	2 mm/min	4,0	6,0	%
Thermal properties					
Melting temperature	(ISO 11357-1, -3)	10 °C/min	213		°C
Temperature of deflection	(ISO 75-1, -2)	1,8 MPa	ca. 200		°C
Coeff. of linear therm. exp., paralle	(ISO 11359)	23 to 55°C	0,2		10^{-4}/K
Coeff. of linear therm. exp., transv.	(ISO 11359)	23 to 55°C	0,9		10^{-4}/K
Thermal conductivity	(ISO 8302)	23°C	0,3		W/(mK)
Burning behavior	(UL 94)	1,6 mm	HB		-
Electrical properties					
Relative permitivity	(IEC 60250)	100 Hz	4,0	10	-
Relative permitivity	(IEC 60250)	1 Hz	4,0	5,0	-
Volume resistivity	(IEC 60093)		1E13	1E10	Ohm m
Surface resistivity	(IEC 60093)		1E14	1E12	Ohm
Other properties (23°C)					
Water absorption (saturation value)		water at 23°C	ca. 6,5		%
Water absorption (equilibrium value)		23°C, 50% r.h.	ca. 1,8		%
Density	(ISO1183)		1400		kg/m^3
Glass fibre content	(ISO 3451)		35		%

MATERIAL DATA SHEET
PA 66 (HIGH IMPACT)

ekd gelenkrohr energy drag chains

Listed properties are guide values and may be used as knowledge base. The ekd material specifications may differ from this values and are under reservation of necessary technical changes.

Property	(standard)	Test condition	Value d.a.m.	Value conditioned	Unit
Mechanical properties					
Yield stress	(ISO 527)	5 mm/min	60	40	MPa
Yield strain	(ISO 527)	5 mm/min	8,0	12,0	%
Tensile modulus	(ISO 527)	1 mm/min	2100	1100	MPa
Charpy imp. strength (notched)	(ISO 179/1eA)	23 °C	18	100	kJ/mm^2
Charpy impact strength	(ISO 179/1eU)	23 °C	n.b.	n.b.	kJ/mm^2
Flexural modulus	(ISO178)	2 mm/min	2000	1000	MPa
Flexural strain at flexural strength	(ISO 178)	2 mm/min	80	40	%
Thermal properties					
Melting temperature	(ISO 11357-1, -3)	10 °C/min	258		°C
Temperature of deflection	(ISO 75-1, -2)	1.8 MPa	ca. 80		°C
Coeff. of linear therm. exp., transv.	(ISO 11359)	23° bis 85°C	0,7		$10^{-4}/K$
Thermal conductivity	(ISO 8302)	23 °C	k.A.		W/(mK)
Burning behavior	(UL 94)	1,6mm	HB		-
Electrical properties					
Volume resistivity	(IEC 60093)		1E17	1E14	Ohm m
Surface resistivity	(IEC 60093)		2E13	2E12	Ohm
Other properties (23°C)					
Water absorption		24h,23°C	ca. 0,75		%
Density	(ISO1183)		1080		kg/m^3
Glass fibre content	(ISO 3451)		0		%

CHEMICAL RESISTANCE PA

The following list of substances and compounds are reference values for the resistance of polyamides. Polyamides are generally resistant to aliphatic and aromatic hydrocarbons (eg, fuel), fats and oils and to many organic solvents. Polyamides are not resistant to organic and inorganic acids, some even in low concentrations, as well as to strong oxidizing agents. Fittings made of polyamide are generally regarded as stress crack resistance.

resistant

acetone	acetylene	allyl alcohol	ammonia	ammonium nitrate
ammonium sulfate	benzene	beer	bio gasoil	bitumen
brake fluids	bromo	butane	butanol	camphor oil
chloramines	chlorobenzene	citric	citrus	cyclohexanol
dibuthylphtalat	gasoil	dibutyl ether	dimethylamine	dioxane
ferricIII chloride (neut.)	petroleum	ether gas	ethane	ether
ethyl acetate	ethylene	ethylene oxide	CFC	fatty alcohols
fats, waxes	fish oils	fixing baths	photo developer	fruit juices
furfural	gelatin	gear oil	glycerol	urea (20%)
heating oil	heptane	hexan	hexachlorobenzene	isocyanate
potassium carbonate	potassium chloride (10%)	isopropanol	isooctane	ketones
co2	carbon fuels (gasoline)	copper sulfate	linseed oil	
seawater	methane	lactic	mineral oils	
sodium carbonate	sodium chloride	sodium sulfide		
sodium hydroxide (10%)	paraffin oil	petroleum ether	lamp oil	phosphates
phosphoric acid (30%)	rapeseed oil	propane	carbon disulphide	
hydrogen sulphide	welding solution (pH 9.5)	silver nitrate(10%)	silicone	soda solution
nitrogen	styrene	tallow (beef fat)	turpentine	
carbon tetrachloride	tetrafluoromethane	ink	toluene	urine
tartaric acid	xylene	benzene hydrogen	sugar solution	

conditionally stable

acetaldehyde	aniline	benzyl alcohol	chloroform	vapor
diethylene glycol	dimethyl formamide	dimethylsuloxid	ferric III chloride, acidic,watery	
acetic acid (5%)	ethanol, conc.	ethylene glycol	formaldehyde (10%)	formamide
glycol	hydraulic fluids	potassium dichromate	potassium hydroxide, conc.	
methyl alcohol	oxalic acid (10%)	phosphoric acid (10%)	sulfur dioxide dry	propanol
sulfuric acid	vinyl chloride	triethanolamine	trichlorethylene vapor	
tin chloride (aqueous)				

unstable

acrylic acid	formic acid (10%)	benzaldehyde	bromide	butyric acid (conc.)
calcium hypochlorite	chloramines	chlorine	hydrochloric	acetic acid (30%)
hydrofluoric	hydrofluoric acid (40%)	iodine	iodide	perchlorate (2%)
potassium	permanganate (10%)	solder liquid	sodium hypochlorite	20 ppm of ozone
nitric acid	perchloric acid (1%)	hydrochloric acid (1%)	oxygen	sulfuric acid(10%)
thionyl chloride	trichloroacetic	trichloroethyl hydrogen peroxide (10%)		cinnamaldehyde
Zinc halides (aqueous)				

soluble

formic acid (85%)	calcium chloride	aniline	alcohol. Chloral hydrate	
dimethylformamide	ethylene glycol	dimethyl	phenol	cresols
hydrochloric acid conc.	sulfuric acid (96%)			

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The intended use has to be in compliance with the design limits of energy chains. The below known from practical experience can lead to considerable functional errors or demage of the energy chain :

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The resistance to environmental influences is generally very good except for concentrated acids and bases, see chapter chemical resistance.
Depending on the order, polyolefins can be used that provide chemical resistance in a wide range of applications.

RoHS

For special applications, the material in modified:

High impact (HI), food applications (FDO), flame retardant (V-0), for explosion-endangered areas (EX) or against electrostatic discharges (ESD).

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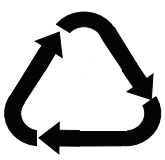

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MATERIAL DATA SHEET
PA 6 GF35 (standard)

Listed properties are guide values and may be used as knowledge base. The ekd material specifications may differ from this values and are under reservation of necessary technical changes.

Property	(standard)	Test condition	Value d.a.m.	Value conditioned	Unit
Mechanical properties					
Yield stress	(ISO 527)	5 mm/min	170	120	MPa
Yield strain	(ISO 527)	5 mm/min	3,0	7,0	%
Tensile modulus	(ISO 527)	1 mm/min	10000	7000	MPa
Charpy impact strength	(ISO 179u)	23 °C	100	110	kJ/mm^2
Charpy impact strength	(ISO 179u)	-30 °C	85	85	kJ/mm^2
Flexural modulus	(ISO178)	2 mm/min	9000	5500	MPa
Flexural strain at flexural strength	(ISO 178)	2 mm/min	4,0	6,0	%
Thermal properties					
Melting temperature	(ISO 11357-1, -3)	10 °C/min	213		°C
Temperature of deflection	(ISO 75-1, -2)	1,8 MPa	ca. 200		°C
Coeff. of linear therm. exp., paralle	(ISO 11359)	23 to 55°C	0,2		10^{-4}/K
Coeff. of linear therm. exp., transv.	(ISO 11359)	23 to 55°C	0,9		10^{-4}/K
Thermal conductivity	(ISO 8302)	23°C	0,3		W/(mK)
Burning behavior	(UL 94)	1,6 mm	HB		-
Electrical properties					
Relative permitivity	(IEC 60250)	100 Hz	4,0	10	-
Relative permitivity	(IEC 60250)	1 Hz	4,0	5,0	-
Volume resistivity	(IEC 60093)		1E13	1E10	Ohm m
Surface resistivity	(IEC 60093)		1E14	1E12	Ohm
Other properties (23°C)					
Water absorption (saturation value)		water at 23°C	ca. 6,5		%
Water absorption (equilibrium value)		23°C, 50% r.h.	ca. 1,8		%
Density	(ISO1183)		1400		kg/m^3
Glass fibre content	(ISO 3451)		35		%

MATERIAL DATA SHEET
PA 66 (HIGH IMPACT)

ekd gelenkrohr energy drag chains

Listed properties are guide values and may be used as knowledge base. The ekd material specifications may differ from this values and are under reservation of necessary technical changes.

Property	(standard)	Test condition	Value d.a.m.	Value conditioned	Unit
Mechanical properties					
Yield stress	(ISO 527)	5 mm/min	60	40	MPa
Yield strain	(ISO 527)	5 mm/min	8,0	12,0	%
Tensile modulus	(ISO 527)	1 mm/min	2100	1100	MPa
Charpy imp. strength (notched)	(ISO 179/1eA)	23 °C	18	100	kJ/mm^2
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Flexural modulus	(ISO178)	2 mm/min	2000	1000	MPa
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Thermal properties					
Melting temperature	(ISO 11357-1, -3)	10 °C/min	258		°C
Temperature of deflection	(ISO 75-1, -2)	1.8 MPa	ca. 80		°C
Coeff. of linear therm. exp., transv.	(ISO 11359)	23° bis 85°C	0,7		$10^{-4}/K$
Thermal conductivity	(ISO 8302)	23 °C	k.A.		W/(mK)
Burning behavior	(UL 94)	1,6mm	HB		-
Electrical properties					
Volume resistivity	(IEC 60093)		1E17	1E14	Ohm m
Surface resistivity	(IEC 60093)		2E13	2E12	Ohm
Other properties (23°C)					
Water absorption		24h,23°C	ca. 0,75		%
Density	(ISO1183)		1080		kg/m^3
Glass fibre content	(ISO 3451)		0		%

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The following list of substances and compounds are reference values for the resistance of polyamides. Polyamides are generally resistant to aliphatic and aromatic hydrocarbons (eg, fuel), fats and oils and to many organic solvents. Polyamides are not resistant to organic and inorganic acids, some even in low concentrations, as well as to strong oxidizing agents. Fittings made of polyamide are generally regarded as stress crack resistance.

resistant

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ammonium sulfate	benzene	beer	bio gasoil	bitumen
brake fluids	bromo	butane	butanol	camphor oil
chloramines	chlorobenzene	citric	citrus	cyclohexanol
dibuthylphtalat	gasoil	dibutyl ether	dimethylamine	dioxane
ferricIII chloride (neut.)	petroleum	ether gas	ethane	ether
ethyl acetate	ethylene	ethylene oxide	CFC	fatty alcohols
fats, waxes	fish oils	fixing baths	photo developer	fruit juices
furfural	gelatin	gear oil	glycerol	urea (20%)
heating oil	heptane	hexan	hexachlorobenzene	isocyanate
potassium carbonate	potassium chloride (10%)	isopropanol	isooctane	ketones
co2	carbon fuels (gasoline)	copper sulfate	linseed oil	
seawater	methane	lactic	mineral oils	
sodium carbonate	sodium chloride	sodium sulfide		
sodium hydroxide (10%)	paraffin oil	petroleum ether	lamp oil	phosphates
phosphoric acid (30%)	rapeseed oil	propane	carbon disulphide	
hydrogen sulphide	welding solution (pH 9.5)	silver nitrate(10%)	silicone	soda solution
nitrogen	styrene	tallow (beef fat)	turpentine	
carbon tetrachloride	tetrafluoromethane	ink	toluene	urine
tartaric acid	xylene	benzene hydrogen	sugar solution	

conditionally stable

acetaldehyde	aniline	benzyl alcohol	chloroform	vapor
diethylene glycol	dimethyl formamide	dimethylsuloxid	ferric III chloride, acidic,watery	
acetic acid (5%)	ethanol, conc.	ethylene glycol	formaldehyde (10%)	formamide
glycol	hydraulic fluids	potassium dichromate	potassium hydroxide, conc.	
methyl alcohol	oxalic acid (10%)	phosphoric acid (10%)	sulfur dioxide dry	propanol
sulfuric acid	vinyl chloride	triethanolamine	trichlorethylene vapor	
tin chloride (aqueous)				

unstable

acrylic acid	formic acid (10%)	benzaldehyde	bromide	butyric acid (conc.)
calcium hypochlorite	chloramines	chlorine	hydrochloric	acetic acid (30%)
hydrofluoric	hydrofluoric acid (40%)	iodine	iodide	perchlorate (2%)
potassium	permanganate (10%)	solder liquid	sodium hypochlorite	20 ppm of ozone
nitric acid	perchloric acid (1%)	hydrochloric acid (1%)	oxygen	sulfuric acid(10%)
thionyl chloride	trichloroacetic	trichloroethyl hydrogen peroxide (10%)		cinnamaldehyde
Zinc halides (aqueous)				

soluble

formic acid (85%)	calcium chloride	aniline	alcohol. Chloral hydrate	
dimethylformamide	ethylene glycol	dimethyl	phenol	cresols
hydrochloric acid conc.	sulfuric acid (96%)			

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General operating and safety instructions

Energy chains are technical products, which are constructed as part of an engineering-design for concrete applications according to the state of the art. In dealing with these products the compliance to the operating and safety instructions and general rules of technology is assumed.

Thus, for example, the stay in the work area of an energy chain is only allowed if adequate safeguards are in place to prevent accidental moving of the chain. The accident prevention regulations are strictly to be observed. Further requirements, such as when operating in explosive hazardous areas are - if applicable - to take into account as well.

The intended use has to be in compliance with the design limits of energy chains. The below known from practical experience can lead to considerable functional errors or demage of the energy chain :

- improper handling of the energy chain during transport and assembly
- undue weight load of the energy chain, especially of a free carrying upper strand of the chain
- operating the energy chain out of the limits of the designed travel distance
- introduction of interference contours, components or parts thereof into the operating area
- improper line load

Are the operating conditions such as wear-boundary conditions of abrasive dust entry or plant-vibration and oscillations can not be avoided, so by appropriate constructive steps and inspection intervals, particularly in unsupervised, automated operating systems, unforeseen equipment failures have to be avoid.

Plastic energy chains

ekd plastic energy chains are manufactured from high quality polyamide. In addition the series PLE with stays of seawater resistant aluminum and chains made of the plastic Kolibri and PKK are in the product range.

The standard material is polyamide 6 reinforced with 35% glass fibres (PA 6 GF 35). The continuous service temperature range for energy chains made of this material is -20 ° C to 100 ° C. Outside these limits a significant decrease in the mechanical strength characteristics must be expected. A detailed design is then essential.

The resistance to environmental influences is generally very good except for concentrated acids and bases, see chapter chemical resistance.
Depending on the order, polyolefins can be used that provide chemical resistance in a wide range of applications.

RoHS

For special applications, the material in modified:

High impact (HI), food applications (FDO), flame retardant (V-0), for explosion-endangered areas (EX) or against electrostatic discharges (ESD).

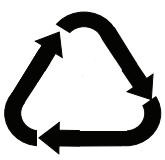
CE 0102 Ex II 2 GD

To optimize the flexibility energy chains they are manufactured from non-reinforced polyamide 6 and polyamide 66, and thermoplastic elastomers (SYSTEM ALLROUND).

With a combination of special construction and material properties in particular for clean room applications excellent technical results are achieved (SYSTEM REINTEC).

IPA Fraunhofer TESTED DEVICE
Energieführungsketten
EKD Gelenkrohr
Report No. EK 0604-345

All components of the plastic energy chains are made of thermoplastic materials that are recyclable.



Plastic energy chains are suitable for operating temperatures from -20 ° C to 100 ° C.

MATERIAL DATA SHEET
PA 6 GF35 (standard)

Listed properties are guide values and may be used as knowledge base. The ekd material specifications may differ from this values and are under reservation of necessary technical changes.

Property	(standard)	Test condition	Value d.a.m.	Value conditioned	Unit
Mechanical properties					
Yield stress	(ISO 527)	5 mm/min	170	120	MPa
Yield strain	(ISO 527)	5 mm/min	3,0	7,0	%
Tensile modulus	(ISO 527)	1 mm/min	10000	7000	MPa
Charpy impact strength	(ISO 179u)	23 °C	100	110	kJ/mm^2
Charpy impact strength	(ISO 179u)	-30 °C	85	85	kJ/mm^2
Flexural modulus	(ISO178)	2 mm/min	9000	5500	MPa
Flexural strain at flexural strength	(ISO 178)	2 mm/min	4,0	6,0	%
Thermal properties					
Melting temperature	(ISO 11357-1, -3)	10 °C/min	213		°C
Temperature of deflection	(ISO 75-1, -2)	1,8 MPa	ca. 200		°C
Coeff. of linear therm. exp., paralle	(ISO 11359)	23 to 55°C	0,2		10^{-4}/K
Coeff. of linear therm. exp., transv.	(ISO 11359)	23 to 55°C	0,9		10^{-4}/K
Thermal conductivity	(ISO 8302)	23°C	0,3		W/(mK)
Burning behavior	(UL 94)	1,6 mm	HB		-
Electrical properties					
Relative permitivity	(IEC 60250)	100 Hz	4,0	10	-
Relative permitivity	(IEC 60250)	1 Hz	4,0	5,0	-
Volume resistivity	(IEC 60093)		1E13	1E10	Ohm m
Surface resistivity	(IEC 60093)		1E14	1E12	Ohm
Other properties (23°C)					
Water absorption (saturation value)		water at 23°C	ca. 6,5		%
Water absorption (equilibrium value)		23°C, 50% r.h.	ca. 1,8		%
Density	(ISO1183)		1400		kg/m^3
Glass fibre content	(ISO 3451)		35		%

MATERIAL DATA SHEET
PA 66 (HIGH IMPACT)

ekd gelenkrohr energy drag chains

Listed properties are guide values and may be used as knowledge base. The ekd material specifications may differ from this values and are under reservation of necessary technical changes.

Property	(standard)	Test condition	Value d.a.m.	Value conditioned	Unit
Mechanical properties					
Yield stress	(ISO 527)	5 mm/min	60	40	MPa
Yield strain	(ISO 527)	5 mm/min	8,0	12,0	%
Tensile modulus	(ISO 527)	1 mm/min	2100	1100	MPa
Charpy imp. strength (notched)	(ISO 179/1eA)	23 °C	18	100	kJ/mm^2
Charpy impact strength	(ISO 179/1eU)	23 °C	n.b.	n.b.	kJ/mm^2
Flexural modulus	(ISO178)	2 mm/min	2000	1000	MPa
Flexural strain at flexural strength	(ISO 178)	2 mm/min	80	40	%
Thermal properties					
Melting temperature	(ISO 11357-1, -3)	10 °C/min	258		°C
Temperature of deflection	(ISO 75-1, -2)	1.8 MPa	ca. 80		°C
Coeff. of linear therm. exp., transv.	(ISO 11359)	23° bis 85°C	0,7		$10^{-4}/K$
Thermal conductivity	(ISO 8302)	23 °C	k.A.		W/(mK)
Burning behavior	(UL 94)	1,6mm	HB		-
Electrical properties					
Volume resistivity	(IEC 60093)		1E17	1E14	Ohm m
Surface resistivity	(IEC 60093)		2E13	2E12	Ohm
Other properties (23°C)					
Water absorption		24h,23°C	ca. 0,75		%
Density	(ISO1183)		1080		kg/m^3
Glass fibre content	(ISO 3451)		0		%

CHEMICAL RESISTANCE PA

The following list of substances and compounds are reference values for the resistance of polyamides. Polyamides are generally resistant to aliphatic and aromatic hydrocarbons (eg, fuel), fats and oils and to many organic solvents. Polyamides are not resistant to organic and inorganic acids, some even in low concentrations, as well as to strong oxidizing agents. Fittings made of polyamide are generally regarded as stress crack resistance.

resistant

acetone	acetylene	allyl alcohol	ammonia	ammonium nitrate
ammonium sulfate	benzene	beer	bio gasoil	bitumen
brake fluids	bromo	butane	butanol	camphor oil
chloramines	chlorobenzene	citric	citrus	cyclohexanol
dibuthylphtalat	gasoil	dibutyl ether	dimethylamine	dioxane
ferricIII chloride (neut.)	petroleum	ether gas	ethane	ether
ethyl acetate	ethylene	ethylene oxide	CFC	fatty alcohols
fats, waxes	fish oils	fixing baths	photo developer	fruit juices
furfural	gelatin	gear oil	glycerol	urea (20%)
heating oil	heptane	hexan	hexachlorobenzene	isocyanate
potassium carbonate	potassium chloride (10%)	isopropanol	isooctane	ketones
co2	carbon fuels (gasoline)	copper sulfate	linseed oil	
seawater	methane	lactic	mineral oils	
sodium carbonate	sodium chloride	sodium sulfide		
sodium hydroxide (10%)	paraffin oil	petroleum ether	lamp oil	phosphates
phosphoric acid (30%)	rapeseed oil	propane	carbon disulphide	
hydrogen sulphide	welding solution (pH 9.5)	silver nitrate(10%)	silicone	soda solution
nitrogen	styrene	tallow (beef fat)	turpentine	
carbon tetrachloride	tetrafluoromethane	ink	toluene	urine
tartaric acid	xylene	benzene hydrogen	sugar solution	

conditionally stable

acetaldehyde	aniline	benzyl alcohol	chloroform	vapor
diethylene glycol	dimethyl formamide	dimethylsuloxid	ferric III chloride, acidic,watery	
acetic acid (5%)	ethanol, conc.	ethylene glycol	formaldehyde (10%)	formamide
glycol	hydraulic fluids	potassium dichromate	potassium hydroxide, conc.	
methyl alcohol	oxalic acid (10%)	phosphoric acid (10%)	sulfur dioxide dry	propanol
sulfuric acid	vinyl chloride	triethanolamine	trichlorethylene vapor	
tin chloride (aqueous)				

unstable

acrylic acid	formic acid (10%)	benzaldehyde	bromide	butyric acid (conc.)
calcium hypochlorite	chloramines	chlorine	hydrochloric	acetic acid (30%)
hydrofluoric	hydrofluoric acid (40%)	iodine	iodide	perchlorate (2%)
potassium	permanganate (10%)	solder liquid	sodium hypochlorite	20 ppm of ozone
nitric acid	perchloric acid (1%)	hydrochloric acid (1%)	oxygen	sulfuric acid(10%)
thionyl chloride	trichloroacetic	trichloroethyl hydrogen peroxide (10%)		cinnamaldehyde
Zinc halides (aqueous)				

soluble

formic acid (85%)	calcium chloride	aniline	alcohol. Chloral hydrate	
dimethylformamide	ethylene glycol	dimethyl	phenol	cresols
hydrochloric acid conc.	sulfuric acid (96%)			

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The resistance to environmental influences is generally very good except for concentrated acids and bases, see chapter chemical resistance.
Depending on the order, polyolefins can be used that provide chemical resistance in a wide range of applications.

RoHS

For special applications, the material in modified:

High impact (HI), food applications (FDO), flame retardant (V-0), for explosion-endangered areas (EX) or against electrostatic discharges (ESD).

CE 0102 Ex II 2 GD

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Energieführungsketten
EKD Gelenkrohr
Report No. EK 0604-345

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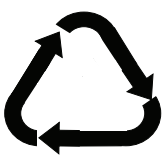

Plastic energy chains are suitable for operating temperatures from -20 ° C to 100 ° C.

MATERIAL DATA SHEET
PA 6 GF35 (standard)

Listed properties are guide values and may be used as knowledge base. The ekd material specifications may differ from this values and are under reservation of necessary technical changes.

Property	(standard)	Test condition	Value d.a.m.	Value conditioned	Unit
Mechanical properties					
Yield stress	(ISO 527)	5 mm/min	170	120	MPa
Yield strain	(ISO 527)	5 mm/min	3,0	7,0	%
Tensile modulus	(ISO 527)	1 mm/min	10000	7000	MPa
Charpy impact strength	(ISO 179u)	23 °C	100	110	kJ/mm^2
Charpy impact strength	(ISO 179u)	-30 °C	85	85	kJ/mm^2
Flexural modulus	(ISO178)	2 mm/min	9000	5500	MPa
Flexural strain at flexural strength	(ISO 178)	2 mm/min	4,0	6,0	%
Thermal properties					
Melting temperature	(ISO 11357-1, -3)	10 °C/min	213		°C
Temperature of deflection	(ISO 75-1, -2)	1,8 MPa	ca. 200		°C
Coeff. of linear therm. exp., paralle	(ISO 11359)	23 to 55°C	0,2		10^{-4}/K
Coeff. of linear therm. exp., transv.	(ISO 11359)	23 to 55°C	0,9		10^{-4}/K
Thermal conductivity	(ISO 8302)	23°C	0,3		W/(mK)
Burning behavior	(UL 94)	1,6 mm	HB		-
Electrical properties					
Relative permitivity	(IEC 60250)	100 Hz	4,0	10	-
Relative permitivity	(IEC 60250)	1 Hz	4,0	5,0	-
Volume resistivity	(IEC 60093)		1E13	1E10	Ohm m
Surface resistivity	(IEC 60093)		1E14	1E12	Ohm
Other properties (23°C)					
Water absorption (saturation value)		water at 23°C	ca. 6,5		%
Water absorption (equilibrium value)		23°C, 50% r.h.	ca. 1,8		%
Density	(ISO1183)		1400		kg/m^3
Glass fibre content	(ISO 3451)		35		%

MATERIAL DATA SHEET
PA 66 (HIGH IMPACT)

ekd gelenkrohr energy drag chains

Listed properties are guide values and may be used as knowledge base. The ekd material specifications may differ from this values and are under reservation of necessary technical changes.

Property	(standard)	Test condition	Value d.a.m.	Value conditioned	Unit
Mechanical properties					
Yield stress	(ISO 527)	5 mm/min	60	40	MPa
Yield strain	(ISO 527)	5 mm/min	8,0	12,0	%
Tensile modulus	(ISO 527)	1 mm/min	2100	1100	MPa
Charpy imp. strength (notched)	(ISO 179/1eA)	23 °C	18	100	kJ/mm^2
Charpy impact strength	(ISO 179/1eU)	23 °C	n.b.	n.b.	kJ/mm^2
Flexural modulus	(ISO178)	2 mm/min	2000	1000	MPa
Flexural strain at flexural strength	(ISO 178)	2 mm/min	80	40	%
Thermal properties					
Melting temperature	(ISO 11357-1, -3)	10 °C/min	258		°C
Temperature of deflection	(ISO 75-1, -2)	1.8 MPa	ca. 80		°C
Coeff. of linear therm. exp., transv.	(ISO 11359)	23° bis 85°C	0,7		$10^{-4}/K$
Thermal conductivity	(ISO 8302)	23 °C	k.A.		W/(mK)
Burning behavior	(UL 94)	1,6mm	HB		-
Electrical properties					
Volume resistivity	(IEC 60093)		1E17	1E14	Ohm m
Surface resistivity	(IEC 60093)		2E13	2E12	Ohm
Other properties (23°C)					
Water absorption		24h,23°C	ca. 0,75		%
Density	(ISO1183)		1080		kg/m^3
Glass fibre content	(ISO 3451)		0		%

CHEMICAL RESISTANCE PA

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resistant

acetone	acetylene	allyl alcohol	ammonia	ammonium nitrate
ammonium sulfate	benzene	beer	bio gasoil	bitumen
brake fluids	bromo	butane	butanol	camphor oil
chloramines	chlorobenzene	citric	citrus	cyclohexanol
dibuthylphtalat	gasoil	dibutyl ether	dimethylamine	dioxane
ferricIII chloride (neut.)	petroleum	ether gas	ethane	ether
ethyl acetate	ethylene	ethylene oxide	CFC	fatty alcohols
fats, waxes	fish oils	fixing baths	photo developer	fruit juices
furfural	gelatin	gear oil	glycerol	urea (20%)
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potassium carbonate	potassium chloride (10%)	isopropanol	isooctane	ketones
co2	carbon fuels (gasoline)	copper sulfate	linseed oil	
seawater	methane	lactic	mineral oils	
sodium carbonate	sodium chloride	sodium sulfide		
sodium hydroxide (10%)	paraffin oil	petroleum ether	lamp oil	phosphates
phosphoric acid (30%)	rapeseed oil	propane	carbon disulphide	
hydrogen sulphide	welding solution (pH 9.5)	silver nitrate(10%)	silicone	soda solution
nitrogen	styrene	tallow (beef fat)	turpentine	
carbon tetrachloride	tetrafluoromethane	ink	toluene	urine
tartaric acid	xylene	benzene hydrogen	sugar solution	

conditionally stable

acetaldehyde	aniline	benzyl alcohol	chloroform	vapor
diethylene glycol	dimethyl formamide	dimethylsuloxid	ferric III chloride, acidic,watery	
acetic acid (5%)	ethanol, conc.	ethylene glycol	formaldehyde (10%)	formamide
glycol	hydraulic fluids	potassium dichromate	potassium hydroxide, conc.	
methyl alcohol	oxalic acid (10%)	phosphoric acid (10%)	sulfur dioxide dry	propanol
sulfuric acid	vinyl chloride	triethanolamine	trichlorethylene vapor	
tin chloride (aqueous)				

unstable

acrylic acid	formic acid (10%)	benzaldehyde	bromide	butyric acid (conc.)
calcium hypochlorite	chloramines	chlorine	hydrochloric	acetic acid (30%)
hydrofluoric	hydrofluoric acid (40%)	iodine	iodide	perchlorate (2%)
potassium	permanganate (10%)	solder liquid	sodium hypochlorite	20 ppm of ozone
nitric acid	perchloric acid (1%)	hydrochloric acid (1%)	oxygen	sulfuric acid(10%)
thionyl chloride	trichloroacetic	trichloroethyl hydrogen peroxide (10%)		cinnamaldehyde
Zinc halides (aqueous)				

soluble

formic acid (85%)	calcium chloride	aniline	alcohol. Chloral hydrate	
dimethylformamide	ethylene glycol	dimethyl	phenol	cresols
hydrochloric acid conc.	sulfuric acid (96%)			

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- introduction of interference contours, components or parts thereof into the operating area
- improper line load

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The resistance to environmental influences is generally very good except for concentrated acids and bases, see chapter chemical resistance.
Depending on the order, polyolefins can be used that provide chemical resistance in a wide range of applications.

RoHS

For special applications, the material in modified:

High impact (HI), food applications (FDO), flame retardant (V-0), for explosion-endangered areas (EX) or against electrostatic discharges (ESD).

CE 0102 Ex II 2 GD

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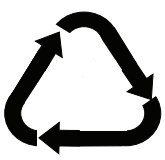

Plastic energy chains are suitable for operating temperatures from -20 ° C to 100 ° C.

MATERIAL DATA SHEET
PA 6 GF35 (standard)

Listed properties are guide values and may be used as knowledge base. The ekd material specifications may differ from this values and are under reservation of necessary technical changes.

Property	(standard)	Test condition	Value d.a.m.	Value conditioned	Unit
Mechanical properties					
Yield stress	(ISO 527)	5 mm/min	170	120	MPa
Yield strain	(ISO 527)	5 mm/min	3,0	7,0	%
Tensile modulus	(ISO 527)	1 mm/min	10000	7000	MPa
Charpy impact strength	(ISO 179u)	23 °C	100	110	kJ/mm^2
Charpy impact strength	(ISO 179u)	-30 °C	85	85	kJ/mm^2
Flexural modulus	(ISO178)	2 mm/min	9000	5500	MPa
Flexural strain at flexural strength	(ISO 178)	2 mm/min	4,0	6,0	%
Thermal properties					
Melting temperature	(ISO 11357-1, -3)	10 °C/min	213		°C
Temperature of deflection	(ISO 75-1, -2)	1,8 MPa	ca. 200		°C
Coeff. of linear therm. exp., paralle	(ISO 11359)	23 to 55°C	0,2		10^{-4}/K
Coeff. of linear therm. exp., transv.	(ISO 11359)	23 to 55°C	0,9		10^{-4}/K
Thermal conductivity	(ISO 8302)	23°C	0,3		W/(mK)
Burning behavior	(UL 94)	1,6 mm	HB		-
Electrical properties					
Relative permitivity	(IEC 60250)	100 Hz	4,0	10	-
Relative permitivity	(IEC 60250)	1 Hz	4,0	5,0	-
Volume resistivity	(IEC 60093)		1E13	1E10	Ohm m
Surface resistivity	(IEC 60093)		1E14	1E12	Ohm
Other properties (23°C)					
Water absorption (saturation value)		water at 23°C	ca. 6,5		%
Water absorption (equilibrium value)		23°C, 50% r.h.	ca. 1,8		%
Density	(ISO1183)		1400		kg/m^3
Glass fibre content	(ISO 3451)		35		%

MATERIAL DATA SHEET
PA 66 (HIGH IMPACT)

ekd gelenkrohr energy drag chains

Listed properties are guide values and may be used as knowledge base. The ekd material specifications may differ from this values and are under reservation of necessary technical changes.

Property	(standard)	Test condition	Value d.a.m.	Value conditioned	Unit
Mechanical properties					
Yield stress	(ISO 527)	5 mm/min	60	40	MPa
Yield strain	(ISO 527)	5 mm/min	8,0	12,0	%
Tensile modulus	(ISO 527)	1 mm/min	2100	1100	MPa
Charpy imp. strength (notched)	(ISO 179/1eA)	23 °C	18	100	kJ/mm^2
Charpy impact strength	(ISO 179/1eU)	23 °C	n.b.	n.b.	kJ/mm^2
Flexural modulus	(ISO178)	2 mm/min	2000	1000	MPa
Flexural strain at flexural strength	(ISO 178)	2 mm/min	80	40	%
Thermal properties					
Melting temperature	(ISO 11357-1, -3)	10 °C/min	258		°C
Temperature of deflection	(ISO 75-1, -2)	1.8 MPa	ca. 80		°C
Coeff. of linear therm. exp., transv.	(ISO 11359)	23° bis 85°C	0,7		$10^{-4}/K$
Thermal conductivity	(ISO 8302)	23 °C	k.A.		W/(mK)
Burning behavior	(UL 94)	1,6mm	HB		-
Electrical properties					
Volume resistivity	(IEC 60093)		1E17	1E14	Ohm m
Surface resistivity	(IEC 60093)		2E13	2E12	Ohm
Other properties (23°C)					
Water absorption		24h,23°C	ca. 0,75		%
Density	(ISO1183)		1080		kg/m^3
Glass fibre content	(ISO 3451)		0		%

CHEMICAL RESISTANCE PA

The following list of substances and compounds are reference values for the resistance of polyamides. Polyamides are generally resistant to aliphatic and aromatic hydrocarbons (eg, fuel), fats and oils and to many organic solvents. Polyamides are not resistant to organic and inorganic acids, some even in low concentrations, as well as to strong oxidizing agents. Fittings made of polyamide are generally regarded as stress crack resistance.

resistant

acetone	acetylene	allyl alcohol	ammonia	ammonium nitrate
ammonium sulfate	benzene	beer	bio gasoil	bitumen
brake fluids	bromo	butane	butanol	camphor oil
chloramines	chlorobenzene	citric	citrus	cyclohexanol
dibuthylphtalat	gasoil	dibutyl ether	dimethylamine	dioxane
ferricIII chloride (neut.)	petroleum	ether gas	ethane	ether
ethyl acetate	ethylene	ethylene oxide	CFC	fatty alcohols
fats, waxes	fish oils	fixing baths	photo developer	fruit juices
furfural	gelatin	gear oil	glycerol	urea (20%)
heating oil	heptane	hexan	hexachlorobenzene	isocyanate
potassium carbonate	potassium chloride (10%)	isopropanol	isooctane	ketones
co2	carbon fuels (gasoline)	copper sulfate	linseed oil	
seawater	methane	lactic	mineral oils	
sodium carbonate	sodium chloride	sodium sulfide		
sodium hydroxide (10%)	paraffin oil	petroleum ether	lamp oil	phosphates
phosphoric acid (30%)	rapeseed oil	propane	carbon disulphide	
hydrogen sulphide	welding solution (pH 9.5)	silver nitrate(10%)	silicone	soda solution
nitrogen	styrene	tallow (beef fat)	turpentine	
carbon tetrachloride	tetrafluoromethane	ink	toluene	urine
tartaric acid	xylene	benzene hydrogen	sugar solution	

conditionally stable

acetaldehyde	aniline	benzyl alcohol	chloroform	vapor
diethylene glycol	dimethyl formamide	dimethylsuloxid	ferric III chloride, acidic,watery	
acetic acid (5%)	ethanol, conc.	ethylene glycol	formaldehyde (10%)	formamide
glycol	hydraulic fluids	potassium dichromate	potassium hydroxide, conc.	
methyl alcohol	oxalic acid (10%)	phosphoric acid (10%)	sulfur dioxide dry	propanol
sulfuric acid	vinyl chloride	triethanolamine	trichlorethylene vapor	
tin chloride (aqueous)				

unstable

acrylic acid	formic acid (10%)	benzaldehyde	bromide	butyric acid (conc.)
calcium hypochlorite	chloramines	chlorine	hydrochloric	acetic acid (30%)
hydrofluoric	hydrofluoric acid (40%)	iodine	iodide	perchlorate (2%)
potassium	permanganate (10%)	solder liquid	sodium hypochlorite	20 ppm of ozone
nitric acid	perchloric acid (1%)	hydrochloric acid (1%)	oxygen	sulfuric acid(10%)
thionyl chloride	trichloroacetic	trichloroethyl hydrogen peroxide (10%)		cinnamaldehyde
Zinc halides (aqueous)				

soluble

formic acid (85%)	calcium chloride	aniline	alcohol. Chloral hydrate	
dimethylformamide	ethylene glycol	dimethyl	phenol	cresols
hydrochloric acid conc.	sulfuric acid (96%)			

About this catalogue

Descriptions and technical informations which are shown in this catalog are purely informative and provide only the general Information. An assurance of properties for certain applications is denied. The catalog reflects the technical state of the art at the time of the edition. Changes to the products remain at any time. The in the order and contract agreed properties of the product is binding.

General operating and safety instructions

Energy chains are technical products, which are constructed as part of an engineering-design for concrete applications according to the state of the art. In dealing with these products the compliance to the operating and safety instructions and general rules of technology is assumed.

Thus, for example, the stay in the work area of an energy chain is only allowed if adequate safeguards are in place to prevent accidental moving of the chain. The accident prevention regulations are strictly to be observed. Further requirements, such as when operating in explosive hazardous areas are - if applicable - to take into account as well.

The intended use has to be in compliance with the design limits of energy chains. The below known from practical experience can lead to considerable functional errors or demage of the energy chain :

- improper handling of the energy chain during transport and assembly
- undue weight load of the energy chain, especially of a free carrying upper strand of the chain
- operating the energy chain out of the limits of the designed travel distance
- introduction of interference contours, components or parts thereof into the operating area
- improper line load

Are the operating conditions such as wear-boundary conditions of abrasive dust entry or plant-vibration and oscillations can not be avoided, so by appropriate constructive steps and inspection intervals, particularly in unsupervised, automated operating systems, unforeseen equipment failures have to be avoid.