kbtplay.com

Book of knowledge

version: Jan 2022

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Revision notes

Current revision: Jan 2022 (draft)

Revision	Author	What has been changed
nov 2017	FGer	• Addition of corporate information, history, vision, general introductory notes • Adaptation on EU standard EN1176 version 2017 • Adaptation of section on materials and production techniques
Mar 2019	Bart Beerlings	• Update regarding EU standards • Addition of Notified Bodies cf EU Directive
Jan 2021	FGer	• Update summary of standards • Update company structure / logistics • Update info materials and production • Update Q&A
Apr 2021	FGer	• Restructuring of section about legislation, standards & norms • Elaboration of Q&A section – questions about Zipwires, colours, …
Jan 2022	FGer	• General corrections • Best selling products 2021 • Q&A

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1. Contents

2. KBT in a nutshell

2.1. History

1980 | A small rope production facility starts up in the village of Ruisbroek in the Klein-Brabant region in the province of Antwerp specializing gradually in rope based play equipment parts.
1990 | The family business becomes a limited company with the name Klein-Brabantse Touwslagerij (KBT)
1994 | KBT moves its location to Sint-Amands where the first new facility of 1700 m² is built. The main market is Belgium and in the Netherlands an agent is promoting KBT products.
1995 | KBT starts cooperation with CDM trading company (Chris De Mey) and gets its first imports from China. Plastic, metal and rubber items are added to the range of play equipment parts.
1997 | KBT invests in production of plastic slides in Leeuwarden (the Netherlands) through a joint venture with 2 Dutch partners.
2000 | Chris De Mey (CDM nv) acquires KBT in a joint buy out operation with Fortis Private Equity. KBT becomes part of CDM group and Fortis Private Equity acquires 30 % of CDM group. Aramo holding is established representing interests of Chris De Mey in the group of companies.
2001 | KBT develops its sales area further into Europe (France, Germany, UK, …) and the range of products is growing rapidly.
2002 | KBT builds a new 1500 m² warehouse opposite the existing one in Sint-Amands. Meanwhile yearly growth is more than 25 %.
2003 | CDM Ningbo is established as the first joint venture for production in Ningbo (PR China) in cooperation with a local partner.
2004 | KBT Poland is established with a sales office in Warsaw (Poland), with Lukasz Dzienisz in charge to serve Eastern Europe. In the same year KBT wins the “Export Vlaanderen” Export Award for the province of Antwerp. 85 % of the turnover is now for export.
2006 | KBT Australia is established as a joint venture with a local partner in Melbourne (Australia). Meanwhile in Belgium a new warehouse and office building is built by CDM group. Total storage area including warehouses in the Netherlands is now 10.000 m². KBT is present in 35 countries.
2007 | CDM Far East is established as sales office in Hong Kong to serve the Asian market and to handle overseas exports. Ningbo Best Swing is established as a second joint venture in Ningbo (PR China) to acquire 10.000 m² of industrial area with the purpose of building a new factory. Meanwhile in Belgium Aramo holding of Chris De Mey buys out Fortis Private Equity and becomes sole shareholder of the group in Europe.
2008 | KBT Argentina is established as sales office in Buenos Aires (Argentina) with a local partner in order to develop the South-American market.
2009 | CDM Uruguay starts up as a hub with the same joint venture partner from Argentina. KBT Poland moves into a central distribution warehouse in Lodz (Poland).
Lukasz Dzienisz, acquires 25 % of the shares of KBT Polska sp. z o.o. in Poland.
2010 | KBT discontinues production at Sint-Amands (Belgium) and moves it to Piaseczno (Poland) near the capital of Warsaw. Ningbo Best Swing, subsidiary of CDM Far East, opens a 15.000 m² facility in Liyang (Zhejiang) (PR China) for production and assembly of play equipment components. CDM Far East develops further in FOB business overseas.
2011 | Increase bvba is established by Aramo holding as a consulting company within the group with the purpose of product development for the group and for third parties, advisory services regarding standards and certification to the industry and the local authorities.
2012 | Ningbo Best Swing strengthens its management with a local factory manager and a European QA/QC manager.
2013 | Filip Wauters, sales manager Europe, acquires 20 % of the shares of KBT nv in Belgium.
2014 | Aramo holding, CDM and KBT celebrate together with their Chinese long term partner 20 years of presence in China.

2015 | Chris De Mey sells the majority of his shares in Aramo holding in an MBO operation involving 3 key managers in the group. KBT ATW nv is established with 4 shareholders with long standing experience in the market of playground equipment.
2016 | KBT Argentina, CDM Uruguay and KBT Australia are discontinued and these markets are now served by exclusive distributors. An exclusive distribution deal is closed in Japan to serve the Japanese market.
2017 | Blue Rabbit Play, LLC located in Atlanta (Georgia) is established as a distributor for KBT ATW group in the USA. The company is commercialising a range of ASTM certified KBT items customised for the US market.
2018 | KBT ATW group acquires its Australian distributor Quality Play and related companies in Sydney (Australia). Activity Toys Australia Pty Ltd (ATA) is the new KBT ATW group branch distributing the KBT products in Australia and New-Zealand.
2018 | KBT Foundation vzw is incorporated as a charity organisation providing playground equipment for children in developing countries. KBT Foundation is focusing on small scale projects in local communities in Asia, Africa and South-America.
2019 | Management reorganization: Łukasz Dzienisz takes over the role of group CEO, overseeing the management of all departments of KBT group, including KBT nv, KBT Polska, ATA, ... Filip Wauters leaves KBT.
2020 | At the end of 2020, all warehouses in Belgium are closed to consolidate the logistics activities in Poland and create 1 single logistics center in Europe

2.2. Mission, Vision, strategy

KBT found its origin in Belgium about 40 years ago as a rope manufacturer. The company grew out to be a specialist in accessories for play equipment throughout the years; realizing 25 million Euro of consolidated turnover in 80 countries worldwide with 150 motivated employees.

Now KBT manufactures safe and exciting components for residential and commercial playground equipment in its production sites in the Netherlands, Poland and China.

KBT focusses on sustainable growth with respect for social responsibility and attention for long term relationships with customers and suppliers. Our development teams create superior items complying with relevant safety standards, resulting in an ever growing range of over 1000 different components available from stock.

2.2.1. Our Mission - 2019

KBT will innovate in product lines to facilitate emotional and physical development on playgrounds. We aim to be the first-choice partner for current and potential customers. We will provide comprehensive portfolio of product and services for every commercial and residential playground.

Previous mission statement
KBT aims for world market leadership in components and accessories of playground equipment. We want to create the most attractive and safe play equipment components with the best value for money ratio.

2.2.2. Our Vision - 2019

KBT is the innovative leader in safe playgrounds contributing to stimulation of emotional and physical development in the world of play for everyone everywhere.

Previous vision statement

Creating sustainable growth relying on our people and skills and the input of all stakeholders in our market. Designing an extensive range of high quality products evolving with market trends and satisfying the needs of play environments in domestic and commercial situations. Establish a strong worldwide network of customers and suppliers with the purpose to create sustainable added value for all stakeholders. Build a highly efficient, effective and flexible organisation that can adapt swiftly to the ever changing commercial environment of our markets.

2.2.3. Corporate Responsibility statement

KBT operates within the principles of corporate responsibility and good governance involving also external advice and non-executive directors in an advisory role.
KBT is building an environment where its people can be inspired and develop their skills under the best working conditions respectful of labour laws.
KBT applies whenever possible environmentally friendly raw materials and recycling materials and is eager to apply techniques and processes saving energy and reducing the carbon footprint.
KBT is proud to be at the forefront of playground safety and certification by participating in improvement of standards and implementing these improvements in all its products.

Following-up on our ideas about corporate responsibility, KBT and its employees take up active positions within organisations and structures surrounding the playground market:

- KBT is a member of Recreabel, the Belgian trade organisation bringing together all major players in the field of playgrounds and playground accessories.
- KBT team-members are active within the EN/ISO standardisation community, taking part in discussions and meetings of the technical committees and workgroups for the EN71 and EN1176 standards (more info, see part 3 and 4 in this document). We are represented in CEN/TC 52 (/WG10) and ISO/TC 181 developing the EN71 standard and in the future we aim to become a part of CEN/TC 136 (/SC 01) developing the EN1176 standards
- KBT has consequently been supporting the initiatives of Vanakam vzw for more than 10 years. Vanakam is involved in small scale projects in India giving the opportunity to orphans to receive an education and providing medical care to local communities. For more information: www.vanakam.be

- In 2018 Chris De Mey founded KBT Foundation VZW a non-profit charity organisation incorporated in Belgium, providing free playground equipment for projects in developing countries. Funds for KBT Foundation come directly from donations, sponsoring, funding events, crowd funding … A first charity event to gather funds was organized in Belgium on September 8th 2018

2.3. Locations & Facilities

2.3.1. Main offices

KBT nv Hemelrijken 8-12-15 2890 Sint-Amands Belgium	tel +32 (0)52 39 99 20 fax +32 (0)52 39 99 29
KBT Polska Sp. z o.o. Ul. Marii Konopnickiej 6 00-491 Warszawa Poland	tel +48 (22) 339 07 46 fax +48 (22) 339 07 47
CDM Far East Ltd Room 1901, 19/F Lee Garden One 33 Hysan Ave Hong Kong	tel +852 5188 8383

Ningbo best swing – import/export ltd. 7th Floor, Huiyin International building, NO. 77, Baohua street, ZIPCODE: 315040 Yinzhou District, NINGBO.	TEL: 0086-574-87268271 87733890 FAX: 0086-574-87349060 fiona@bestswing.cn sophie@nbyihai.com

2.3.2. Production sites/Key suppliers

Name	Location	Production activities
KBT locations		
KBT Polska	Okulickiego 7 05-500 Piaseczno Poland	• PP-rope products: assembly of rope products (pe. swing seats, nets, …) • Armed rope products: assembly of armed rope sets, nets, pyramid-nets,… • Nest swings: assembly of bird-nest swings • HDPE products: CNC cutting of HDPE panels, finishing, assembly • Welding: Welding and preparation of small and medium sized sub-assemblies (bird-nest interiors, support structures for pyramid-nets • Main European logistics centre
NBS – Nigbo Best Swing	NINGBO BEST SWING co. Ltd 28, Jingang Road South Binhai New Zone Liyang Town, 315600 Ninghai County Zhejiang, PRC Attn : Factory manager : Deng Bin Tel : 0086 139 68312030	• Rope products: cutting and welding of rope, assembly (pe. Blow moulded swing seat) • Wood products: Drying, impregnation, application of varnish (raw preparation of the wood is done at subcontractor site) (pe. Wooden swing seats) • General assembly of plastic products • Preparation of packages, self-assembly kits, Colli's (pe. Blue-rabbit sets)
Main external suppliers		
Yong-Feng Factory	Contact via NBS (YF might be incorporated into NBS in the near future)	• Extrusion blow moulding (pe. Blow moulded swing seats) • Injection moulding of plastic parts
HSV	Marconistraat 3 Postbus 351 NL-6716 AK Ede Tel +31 (0) 318 - 648 991 Fax +31 (0) 318 - 648 996 info-tmp@hsv.nl	• Low pressure injection moulding of large plastic products • Injection of large and thick (uneven) walled plastic products using foaming agent (Pe. Injected plastic slides)
PRM	Jutestraat 22 NL - 7461 TR Rijssen Tel. 0031 (0) 548-515172 info@prm-kunststoffen.nl	• Rotomoulding of large hollow plastic products (Pe. Bronco slides, Ball-catchers)

2.4. Main business model

KBT is specialized in production and trade of components for the playgrounds market, both for residential as well as for commercial use. This means on the one hand that we supply products that are used by playground constructors to furnish their products and on the other hand to distributors for through-sales as for example toy-stores or DIY markets. Generally speaking - with a few exceptions only - KBT does not offer ready-to-use products. Our swing-seats for example will always need a structure to be attached to.

KBT only sells to the trade. Play equipment manufacturers, distributors or other trade partners can contact the sales representative of their country. KBT does not supply products nor information directly to members of the public.

Up till now KBT did not step into the market for public tenders. We don't supply products directly to local governments, schools or similar organisations. Although there are a few exceptions, for example for municipalities, schools and organisations in the Klein-Brabant region or for replacement parts. We don't do any on-site installations as this is the field of our customers.

2.5. The playground market

2.5.1. Who are our most important competitors in the residential market?

Benelux : Hermic, Hapro, Schmit (Jungle-Gym), direct import from China for example to discount chains (Aldi,…)
France : EGT, Trigano, Schmit
Germany : Hermic, Hapro, Schmit, Just Fun, Kleinsorge, Polyfix, Wehncke Friedola, Wemekamp, direct import from China
Southern Europe: ??
Eastern Europe: ??

2.5.2. Who are our most important competitors in the commercial market?

Benelux : R&T, E. Beckmann, Huck, Ullmann, Suttclif
France : R&T, E. Beckmann, EGT, local rope manufacturers
Germany : E. Beckmann, R&T, Ullmann, Seilereien, Huck, Schmitt (Highland), local production by small playground builders. (hout/RVS)
Southern Europe: ??
Eastern Europe: ??

2.5.3. High runners, slow runners, alternative products, market threads???

For reference only. This Boston matrix analysis is a stub and should be developped further in the future. This may help us to define future development plans.

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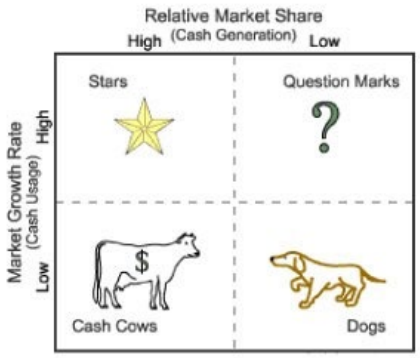

		Relative market share	
		High	**Low**
Market growth rate	**High**	**Stars** • **TPE commercial swing seat: Curve Range (100.x, 101.x,102.x,…)** • **Bronco commercial HDPE slides (444.x)**	**Question Marks** • **Commercial stainless steel slides** • **Pyramid nets** • **…**
	Low	**Cash Cows** • **All residential slides** • **Blowmoulded swingseats (110.x)** • **All residential babyseats (132.x, 133.x, …)** • **Rosette nest swings**	**Dogs** • **Musical instruments** • **(Ready to use) commercial 3D climing nets + poles**

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Best Sellers 18.06.2021

status 18.06.2021
KBT PL and KBT NV

							REVENUE			QTY		
Product ID	Product Desc	Product Group	Product Family	Product Sub-Family	Product Type	Product Category	YTD 2021 REV	FULL prior year REV	%	YTD 2021 QTY	FULL pior year QTY	%
402.015.004.001	slide tsuri 1500 blu	Residential	Slides	Plastic slides	HSV - TSURI	STD	1 576 058 €	1 235 851 €	128%	45 068	35 554	127%
400.012.013.001	slide yulvo 1200 lime grn pms 389u	Residential	Slides	Plastic slides	HSV - YULVO	STD	782 398 €	535 333 €	146%	35 108	22 765	154%
402.015.001.001	slide tsuri 1500 red	Residential	Slides	Plastic slides	HSV - TSURI	STD	716 140 €	1 057 405 €	68%	19 700	29 954	66%
400.012.004.001	slide yulvo 1200 blu	Residential	Slides	Plastic slides	HSV - YULVO	STD	713 045 €	893 551 €	80%	31 157	40 242	77%
402.015.013.001	slide tsuri 1500 lime grn pms 389u	Residential	Slides	Plastic slides	HSV - TSURI	STD	634 055 €	747 756 €	85%	17 257	20 959	82%
400.012.002.001	slide yulvo 1200 grn	Residential	Slides	Plastic slides	HSV - YULVO	STD	574 308 €	422 924 €	136%	23 434	17 268	136%
402.015.002.001	slide tsuri 1500 1500 grn	Residential	Slides	Plastic slides	HSV - TSURI	STD	556 426 €	874 362 €	64%	14 855	23 240	64%
402.015.003.001	slide tsuri 1500 yel	Residential	Slides	Plastic slides	HSV - TSURI	STD	481 843 €	536 545 €	90%	13 520	15 535	87%
189.001.001.001	rosette rnd 1000mm red/blu/blk	Commercial	Seats	Bird nests	PRODPL	STD	285 836 €	496 889 €	58%	899	1 509	60%
189.002.001.001	rosette rnd 1200mm red/blu/blk	Commercial	Seats	Bird nests	PRODPL	STD	271 382 €	375 011 €	72%	736	828	89%

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3. Toy safety, Legislation, standards and certification

3.1. Introduction

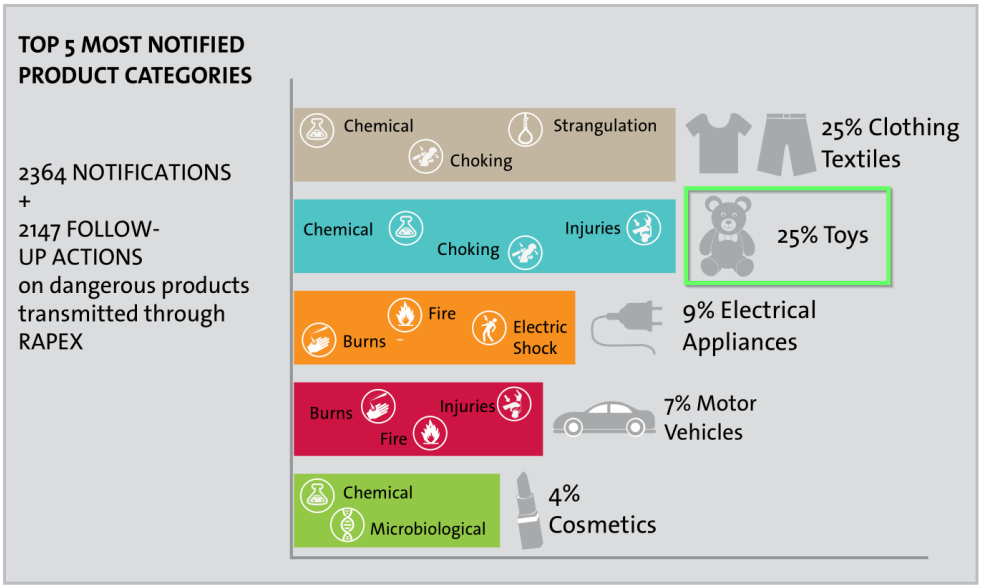
Not only for parents but for society as a whole, the safety of children is an absolute priority. Legislation and safety standards have an important role to play in protecting children and preventing accidents. In particular, they help to ensure that products used by or with children – in our case playground equipment – are as safe as possible.

Standardization is the process of implementing and developing technical standards based on voluntary agreements between parties about a product, service or process. Involved parties are industry, consumer organizations, law-makers, … Standards are not laws, but best practices. Depending on the national situation, standards can become (de-facto) laws.

Standards are created on world level (ISO), on European level (CEN-EN) and on national level. Each country has its own standardization body. DIN in Germany, NEN in The Netherlands, BSI in the UK. ISO and EN standards are mostly implemented in all (European) countries.

3.2. Toy Safety: the need for testing

Below you can find the recall statistics for 2013, indicating common problems per product category. Data provided by RAPEX.



The following serious hazards were found to occur most often:

- Choking
- Small parts
- Expandable toys
- Strangulation

- Microbiological Risk
- Hearing Damage
- Burns
- Electric shock

3.3. Common Risk Categories

3.3.1. Choking Hazard

Why it's dangerous: Small parts of the toy pose a risk of choking by blocking the airway at the back of the child's mouth and upper throat.

How to define small parts: If the product (or separate part) fits completely into the small part cylinder shown as below, it will be defined as a small part.

Exemption: There are exemptions like paper, fabric, elastics, yarn, strings, fuzz, crayons, and chalk as per certain testing methods.

Requirement: According to The European Toys Safety Directive 2009/48/EC, the manufacturer shall place warnings in a clearly visible, easily legible and understandable and accurate manner on the toy, on an affixed label or on the packaging and, if appropriate, within the instructions for use accompanying the toy.

Also, the Toy Safety Directive forbids all kinds of removable or detachable small parts in toys which are intended to be put in the mouth, regardless of the age of the child. Any such small parts are more likely to be inhaled from a mouth-actuated toy, with a serious risk of choking for children of all ages.

3.3.2. Strangulation

Specific risk: The following products may pose a risk of strangulation due to the presence of a fixed noose:

- Cords connected to a self-retraction mechanism
- Cords in pull-along toys
- Toys with cords intended to be strung across a cradle, cot or pram
- Cords and chains with attachments or a free end (i.e. with no attachments)
- Toys with electrical cables
- Straps intended to be worn fully or partially around the neck

Requirement: There are certain requirements on the length of cords, perimeter of loops and self-retracting force (if applicable) depending on the nature and age grading of products. Breakaway feature or warning must be marked on the product label.

Example of warning: "Warning: Not suitable for children under 18 months. Long cord/Long chain. Strangulation hazard."

Exemption: Toys intended to be strung across a cradle, cot, or perambulator, where the cords of such toys are intended to be out of reach of the children.
Other cases: Besides infant toys, yo-yo balls (defined as toy made from elastic material consisting of a tether usually having a loop at one end to place around a finger and a flexible object at the other end)

may also present a potential hazard for strangulation as the elasticated tether may be wound around the neck. There is a particular testing method within EN71- 1 specifically for such items.

3.3.3. Chemical Hazard

Why it's dangerous: Children may ingest carcinogenic, mutagenic and repro-toxic chemical substances from toys. Children have a different metabolism to adults. Chemicals may appear to be more toxic to children than an equivalent amount to adults.

Requirement: The restriction of chemical substances is wide and specific to toys and children's articles, included EN71 Part 3, Nickel Released, Azo Dyes and Phthalate.

Challenge: PAH, REACH Annex XVII entry was entered into force on the 27th of December, 2013 and will be effective on the 27th of December, 2015. The limit value is 0.5mg/kg for EACH restricted PAH. PAHs are classified as carcinogens and can be found in the plastic and rubber parts of a wide range of consumer articles.

3.4. Safety legislations

3.4.1. European legislation on residential toys and commercial playgrounds

Residential play equipment fall within the scope of the European Union's General Product Safety Directive (2009/95/EC) and the Toy Safety Directive (2009/48/EC). The Toy Safety Directive lays down the safety criteria that toys must meet before they can be marketed in the EU. As a manufacturer, importer and distributor of toys intended for children, KBT must comply with the provisions of the Toys Safety Directive. Technical documentation and a description of the conformity assessment method used for each toy must be available. Outdoor play equipment for residential use are generally called "Activity toys".

Commercial play equipment (commonly called playgrounds for public use) are not regulated by European legislation but by national laws. Although most of these laws in different European countries are very similar, there are important variations. Most notable is the Dutch WAS regulation.
Generally speaking, for all European Countries, our products must comply with the EN1176 standard for public playgrounds. Although this is NOT a legal requirement.
For the most part, the burden of proof about the safety of playground equipment, lays with the designer and installer of the equipment on-site and with the playground operator or owner (this is mostly local governments, but can also be schools, organisations or private companies). Design of the site, the surfacing, the landscape and the distances between playground installations, plays a significant role in the overall safety – for which KBT cannot influence the result. Therefore KBT will make sure that our products are designed according to EN1176 and this is about what we can do in terms of safety of public playgrounds.

3.4.2. Main Requirements for residential toys

- Toys must satisfy the 'essential safety requirements' in the regulations (this means de facto that toys must comply with EN71 standard)
- be properly marked to ensure traceability
- bear the CE mark
- be accompanied by instructions for use and warnings where necessary

3.4.3. Main manufacturers obligations for residential toys

- make sure the toy has been designed and manufactured to comply with the essential safety requirements during its foreseeable and normal period of use
- carry out a safety assessment of the toy
- demonstrate that an applicable conformity assessment procedure has been followed
- draw up the EC declaration of conformity and affix the CE marking
- draw up the technical documentation and keep it for 10 years
- apply information identifying the toy and manufacturer on the toy or packaging
- make sure the toy is accompanied by instructions for safe use and safety information where appropriate
- make sure that continuing production runs of the same toy remain in conformity
- carry out sample testing of marketed toys
- investigate and record any complaint made in relation to the toy and keep a register of complaints, non-compliant toys and recalled toys
- bring non-conforming toys into compliance and tell authorities if there is a safety risk and provide information to authorities on request
- identify the other economic operators in the supply chain

3.5. Conformity assessment, CE-marking and Certification

All manufacturers of residential toys are legally required to make sure their toys are designed to be safe, to test and analyse the safety of the toys and to report about this to national governments on request.

According to European Directive 2009/48/EG on the safety of toys, Conformity assessment and CE marking is mandatory for all toys placed on the market in the European Community. For this, the responsibility lies not only with the importer or manufacturer; all economic operators are also expected to act responsibly and comply with all applicable legal requirements. For example, a distributor may be required by the market surveillance authorities to take the corrective measures necessary to bring that toy into conformity, to withdraw it or recall it.

The CE marking is the visible result of a whole process comprising conformity assessment with the 'essential' and 'particular' safety requirements described in the European Directive 2009/48/EG. These requirements include physical and mechanical properties, rules on flammability, and an extensive part on chemical properties.

There are two applicable conformity assessment procedures for the manufacturer to demonstrate the safety requirements are met. Both methods should be documented extensively.
(1) Toys which are in conformity with harmonized European Standards shall be presumed to be in conformity with the requirements covered by the Toy Safety Directive.
(2) Toys can alternatively be submitted to EC-type examination in cases where harmonized standards do not exist, where these standards are applied only in part, or when the manufacturer considers it necessary. EC-type examination is performed exclusively by an authorized conformity assessment body.

The importer or manufacturer has to comply with the European Standards – EN 71 parts 1,2,3,8 and 9 – or when this is not the case, has to pass an EC-type examination performed by third parties. In both

cases the importer or manufacturer has to supply the so-called 'technical documentation' as requested by the market surveillance authorities.

3.5.1. Conformity assessment

Source: https://ec.europa.eu/growth/single-market/goods/building-blocks/conformity-assessment_nl

A manufacturer can only place a product on the EU market when it meets all the applicable requirements. The conformity assessment procedure is carried out before the product can be sold. The European Commission's main objective is to help ensure that unsafe or otherwise non-compliant products do not find their way to the EU market.

What is conformity assessment

- The conformity of a product is assessed before it is placed on the market.
- It needs to demonstrate that all legislative requirements are met.
- It includes testing, inspection and certification.
- The procedure for each product is specified in the applicable product legislation.

Objectives of the conformity assessment procedure

- To demonstrate that a product being placed on the market complies with all legislative requirements.
- The procedure should ensure confidence of consumers, public authorities and manufacturers regarding the conformity of products.

3.5.2. In practice: certificates and test-reports

Product legislation describes the conformity assessment procedures for each product. Manufacturers may choose between different conformity assessment procedures. The assessment can be carried out by the manufacturer themselves or can be done by an external agency.

In principle, an importer or manufacturer can document himself why he declares to comply with the European Standards. However, in order to test whether various rules and regulations are met, testing equipment (as defined by the standards) and a thorough knowledge on how to understand these standards are required. As far as the chemical properties and possible regulations about flammability are concerned, the services of an external laboratory need to be used anyway, given the magnitude and specificity of the matter. **EN certification by a European certification body** ensures that all legislation is met; and that this is guaranteed by an independent third party.

If the applicable legislation requires it or by the manufacturers own choice, a conformity assessment body is involved in the conformity assessment process – see Notified bodies. In most cases KBT involves external certification agencies like TUV Nord, TUV Sud Benelux, SGS, Bureau Veritas,… to execute conformity assessment. **External conformity assessment usually results in some sort of certificate or test-report.** All reports or certificate can be found on the KBT fileserver.

Conformity assessment is complementary to market surveillance (see topic RAPEX). Both procedures help ensure the smooth functioning of the internal market.

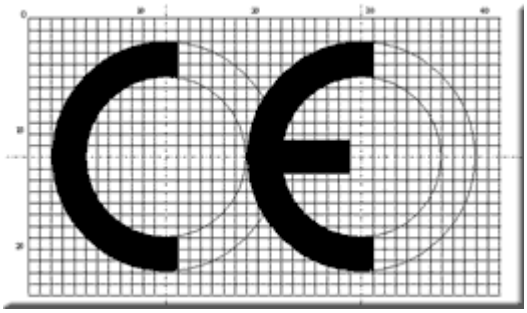
3.5.3. Declaration of Conformity

As part of conformity assessment, the manufacturer or the authorised representative must draw up an Declaration of conformity (DoC). The declaration should contain all information to identify:

- the product
- the legislation according to which it is issued
- the manufacturer or the authorised representative
- the notified body if applicable
- a reference to harmonised standards or other normative documents, where appropriate.

3.5.4. CE-marking

The CE mark that is visible on our products is the end result of the conformity assessment procedure. By affixing the CE marking to a product, a manufacturer declares that the product meets all the legal requirements for CE marking and can be sold throughout the EEA. This also applies to products made in other countries that are sold in the EEA.



More information

The so-called Blue Guide (2 MB), contains guidance on the application of all aspects of the implementation of EU products rules, including conformity assessments.

3.5.5. Notified bodies

Source: https://ec.europa.eu/growth/single-market/goods/building-blocks/notified-bodies_en

A notified body is an organization designated by an EU country to assess the conformity of certain products before being placed on the market. These bodies carry out tasks related to conformity assessment procedures set out in the applicable legislation, when a third party is required. The European Commission publishes a list of such notified bodies.
The Commission strives to maintain an up-to-date list of bodies notified by EU countries and make the necessary information available to all interested parties. Lists of Notified Bodies can be found on the NANDO website (New Approach Notified and Designated Organisations).

It is important to understand that, since conformity assessment may be done by a manufacturer themselves, and thus external certification is NOT mandatory, that it is also not mandatory to only work with recognised notified bodies to do any certification work. Basically any organisation in any country is allowed to do conformity assessments, only in specific cases or in case of legal dispute, a recognised notified body may need to be consulted. In practice for residential products we often work with TUV Nord, which is in fact also a Notified Body!

Short list of Notified Bodies

NB 0044	TÜV NORD CERT GmbH – toys residentieel	**Germany**
NB 0123	TÜV SÜD Product Service GmbH Zertifizierstellen – commercieel	Germany
NB 0158	DEKRA Testing and Certification GmbH – impact testing	Germany
NB 0197	TÜV Rheinland LGA Products GmbH	Germany
NB 0406	BUREAU VERITAS CONSUMER PRODUCTS SERVICES - FRANCE – Fransen hebben dit graag	France
NB 0905	INTERTEK DEUTSCHLAND GMBH	Germany
NB 1237	INTERTEK FRANCE	France
NB 1417	ÉMI-TÜV SÜD MINŐSÉGÜGYI ÉS BIZTONSÁGTECHNIKAI KFT.	Hungary
NB 1637	SGS-TÜV Saar GmbH	Germany

3.6. Standards and norms

3.6.1. European standard for residential toys

According to the Toy Safety Directive, Toys which conform to the relevant harmonized standards which have been published in the Official Journal of the European Union are presumed to conform to the essential safety requirements described in the Toy Safety Directive (2009/48/EC).

The relevant harmonized standard in this case mostly refers to EN71. For some specific cases, like electronic toys, there are other regulations.

EN 71 - Safety of toys

- EN 71 - Part 1: Mechanical and physical properties
- EN 71 - Part 2: Flammability
- EN 71 - Part 3: Migration of certain elements
- EN 71 - Part 6: Graphical symbol for age warning labeling
- EN 71 - Part 7: Finger paints
- EN 71 - Part 8: Activity toys for domestic use

For megaphones (511.) and eventual future electronic products: NEN-EN-IEC 62115/A2 Electric toys - Safety (IEC 62115)

3.6.2. European standard for commercial equipment

For publicly accessible playgrounds, there is the harmonized standard EN1176 and EN1177.

EN 1176 - Playground equipment and surfacing

- EN 1176 - Part 1: General safety requirements and test methods
- EN 1176 - Part 2: Additional specific safety requirements and test methods for swings
- EN 1176 - Part 3: Additional specific safety requirements and test methods for slides
- EN 1176 - Part 4: Additional specific safety requirements and test methods for cableways
- EN 1176 - Part 5: Additional specific safety requirements and test methods for carousels
- EN 1176 - Part 6: Additional specific safety requirements and test methods for rocking equipment
- EN 1176 - Part 7: Guidance on installation, inspection, maintenance and operation
- EN 1176 - Part 10: Additional specific safety requirements and test methods for fully enclosed play equipment
- EN 1176 - Part 11: Additional specific safety requirements and test methods for spatial network

EN 1177 - Impact attenuating playground surfacing - Methods of test for determination of impact attenuation

3.6.3. USA Legislation: ASTM

3.6.3.1. ASTM : AMERICAN SOCIETY FOR TESTING AND MATERIALS

- F963 - Standard Consumer Safety Specification for Toy Safety
  Standard for toys which is a mandatory standard for all the toys sold in America
- F1148 - Standard Consumer Safety Performance Specification for Home Playground Equipment
  An applicable standard for the swings and slides.
- F1487 - Standard Consumer Safety Performance Specification for Playground Equipment for Public Use

3.6.3.2. CPSIA (Consumer Product Safety Improvement Act)

CPSIA is a passed law in the US that governs the environmental safety of chemicals in user products being manufactured, distributed and/or imported in(to) the United States.

Relevant to KBT: it defines Phthalates (= dangerous chemical compound) content for two types of toys.

- Any children's toy or child care article (that cannot be placed inside the child's mouth)
  Phthalates concentration: Maximum 0.1 % Mass for: DEHP, DBP, BBP.

- Any children's toy or child care article (that can be placed inside the child's mouth)
  Phthalates concentration: Maximum 0.1 % Mass for: DINP, DIDP, DnOP.

3.7. RAPEX

The **Rapid Exchange of Information System** (**RAPEX**) is the EU rapid alert system for unsafe consumer products and consumer protection. RAPEX covers products such as clothing, shoes, cosmetics, jewelry or toys with potentially harmful ingredients or quality or products with technical faults. It does not encompass food and pharmaceutical products and drugs.

RAPEX allows a quick exchange of information on measures such as repatriation or product recalls, whether carried out by national authorities or by voluntary action of manufacturers and distributors.

How does RAPEX work? The system relies on close cooperation between the Commission and the national authorities of the participating members - EU countries, Norway, Iceland and Liechtenstein. When a product (e.g. a toy, a childcare article or a household appliance) is identified as dangerous, the responsible business or the competent national authority takes relevant measures to eliminate the risk.

Possible actions include:

- withdraw the product from the market;
- recall the product from consumers;
- issue warnings.

As a next step, the RAPEX national contact point informs the European Commission (Directorate-General for Health and Consumers) about the product, the risks it poses and the measures taken to prevent risks or accidents. The European Commission disseminates the received information to other national contact points in all participating countries and publishes an overview of dangerous products and actions taken every week.

The RAPEX national contact points ensure that the responsible authorities check whether the newly notified risky product is present on their market. If so, the authorities take the necessary steps to eliminate the risk.

3.7.1. “RAPEX-CHINA” system

Due to a significant amount of products imported to the EU from China, a special information exchange system between EU and China was created. RAPEX-CHINA enables regular and rapid transmission of data between the EU and China product safety administration.

The European Commission provides the Chinese authorities with information on dangerous consumer products originating from China that have been banned or withdrawn from the European market and notified via RAPEX. Chinese authorities investigate all the notifications and, when necessary, adopt measures which prevent or restrict further export of those products to the EU.

More info and reports can be found here
https://ec.europa.eu/consumers/consumers_safety/safety_products/rapex/alerts/

4. Summary of EU standards on residential play equipment: EN71

4.1.1. Scope

EN71-1 applies to toys for children, toys being any product or material designed or intended whether or not exclusively, for use in play by children of less than 14 years.

EN71-8 specifies requirements and test methods for activity toys for domestic use and similar toys intended for children under 14 years to play on or in and often intended to bear the mass of one or more children. This European Standard also specifies requirements for separately sold accessories for, and components of activity toys.

Activity toys are defined as any toy for domestic use, in which the support structure remains stationary while the activity is taking place and which is intended for the performance by a child of any of the following activities: climbing, jumping, swinging, sliding, rocking, spinning, paddling, crawling and creeping, or any combination thereof. Examples of such toys are swings, slides, carousels, climbing frames, rigid playhouses, paddling pools. In contrast, ride-on vehicles are not considered as activity toys.

The scope of this European Standard excludes playground equipment intended for public use dealt with in the EN 1176 series;

4.1.2. Main requirements

4.1.2.1. Packaging and labelling

EN71-1 states specific instructions for packaging, use of plastic bags,… Plastic bags and sheets must have a minimum average thickness of 0,038 mm.

All products or packaging must contain the appropriate warnings. warnings must meet several requirements to ensure the appropriate and safe use of toys. Formulation and translation of warnings must be exactly as stated in the EU directive. The directive describes:

- Location of warnings
- Specific warnings – minimum and maximum ages and weights for users, if a toy needs to be used under supervision of an adult
- ‘Not suitable for children under 36 months’ specific criteria
- Visibility and legibility of warnings

4.1.2.2. Entrapment

Holes or openings in a playground construction must be made in such a way to avoid parts of the body being trapped or getting stuck, especially when the rest of the body is making a (forced) movement. Entrapment can happen with the full body, the head, fingers, or hair and parts of clothing. It can happen with fixed or moving equipment.
Potential entrapment hazard can be detected by means of specifically designed test probes

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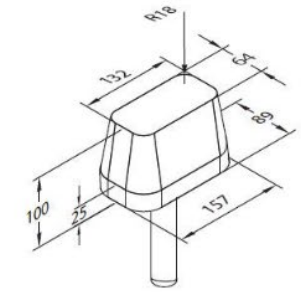
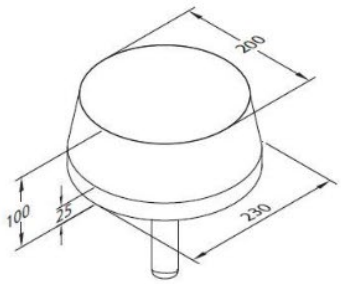
Entrapment of head and neck

Activity toys shall be constructed so that any openings do not create head and neck entrapment hazards either by head first or feet first passage.

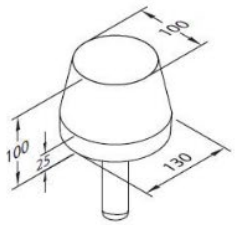
Accessible completely bound openings with a lower edge more than 600 mm above ground, or above any other surface which is of such a size that it will support a child, shall be tested using probes C, D and E. Probes C or E shall not pass through any opening unless it also allows the passage of the large head probe D.



PROBE C TORSO



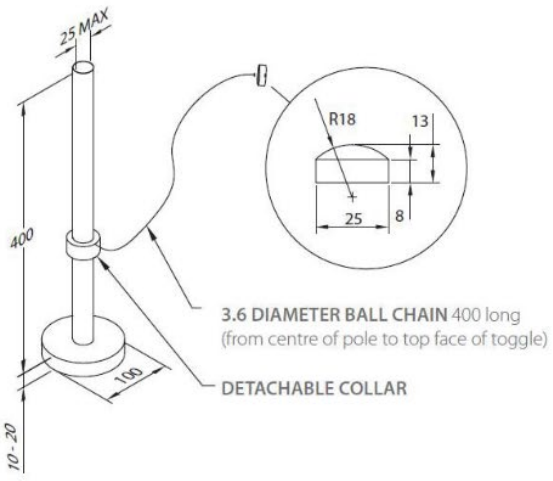
PROBE D LARGE HEAD

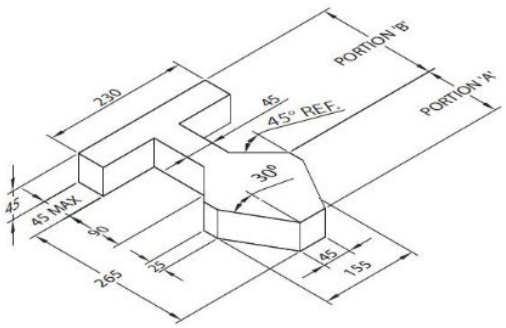


PROBE E SMALL HEAD

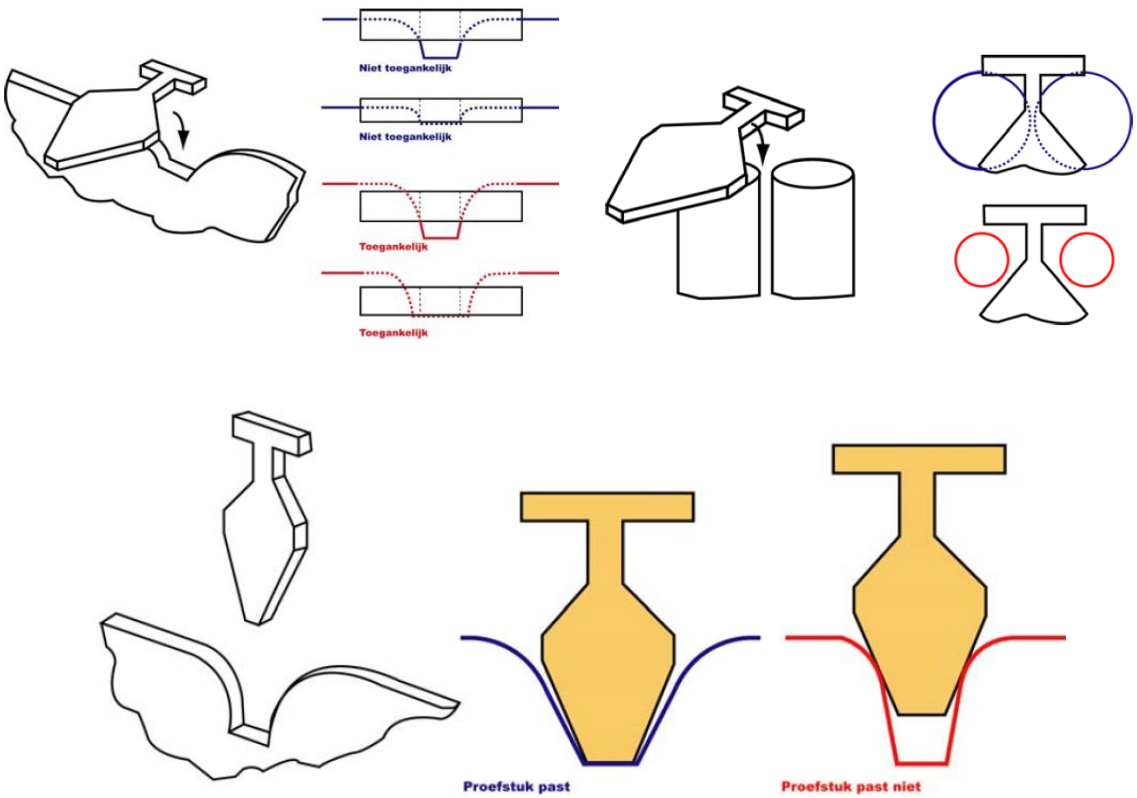
Partially bound and V-shaped openings with an entrance at 600 mm or more above the ground, or above any other surface which is of such a size that it will support a child, shall be constructed so that either:

A. the opening is not accessible by the "B" portion of probe F when applied horizontally, or
B. the “A” portion will completely fit inside the opening when applied vertically





HEAD AND NECK TEMPLATE
PARTIALLY BOUND & 'V'
SHAPED OPENINGS



Entrapment of clothing and hair

Slides, fireman's poles and roofs shall be constructed so that hazardous situations in which clothing or hair can be entrapped are not created. Such situations may be created by:

2) gaps or V-shaped openings in which parts of clothing can become entrapped while, or immediately before, the user is undergoing a forced movement;
3) protrusions; and
4) spindles/rotating parts.

When tested using the toggle test, entrapment of the toggle or chain shall not occur. Application of the toggle test, is restricted to the free space, as practical experience has shown that natural material and connections between different parts can vary over time.

Entrapment of fingers

Circular holes at a height of more than 1 000 mm from the supporting surface in any rigid material that are within the reach of a child during use of the toy, when there is a risk of finger entrapment combined with the risk of falling down, shall not allow a 7 mm diameter rod to be inserted to a depth of 10 mm or more, unless a 12 mm diameter rod can also be inserted.

Holes, slots and gaps in any rigid material that are within the reach of a child during use of the toy, when the body of the child is in a forced movement shall not allow a 7 mm diameter rod to be inserted to a depth of 10 mm or more, unless a 12 mm diameter rod can also be inserted.

If an activity toy is intended for children under 36 months use a rod of 5 mm diameter instead of a rod with 7 mm diameter.

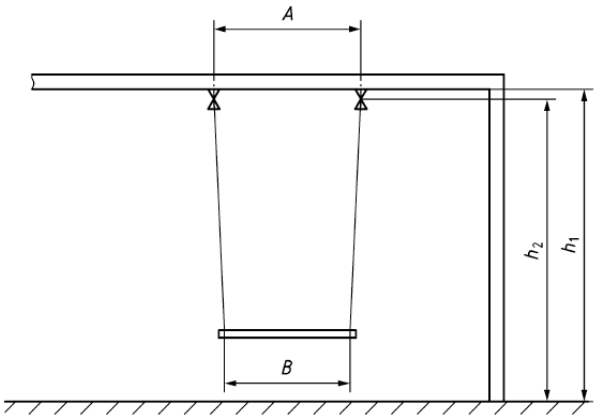
The requirements do not apply to weather-induced dry cracks in solid wood.

4.1.3. Requirements for specific toys

4.1.3.1. Swings

- Swings must be stable
- Swingseats must have a specific geometry and/or be made from a soft, light or impact attenuating material to avoid injury from a collision between a swingseat and a child's head. When residential swingseats are lighter than 1kg, there is no need for additional impact test
- The minimal distance between a swingseat and the surface below is 35cm
- The distance between the attachment points of a swing must be larger at the top, compared to the distance at the height of the seat. This is to avoid twisting of the ropes or to help keep the swing in a straight line. The specification is: A = 0.04 h_2 x B. The distance between a seat and the frame must be minimal 30cm. The distance between 2 seats must either be 30 or 45 cm depending on the type of swingseat.
- Ropes have a minimal thickness of 10mm

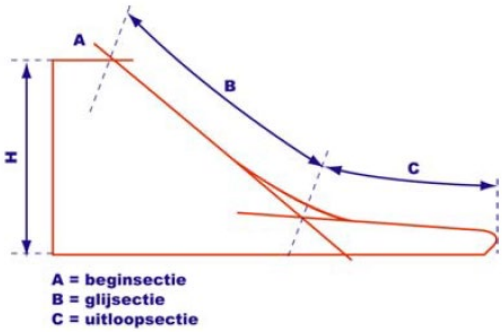
- There is a maximum of 2 swingseats per swing bay
- A swingset must be placed over an appropriate impact attenuating surface, stretching out in all directions. No specifications are given in EN71-8, but there is a recommendation to place the activity toy on a level surface at least 2 m from any structure or obstruction such as a fence, garage, house, overhanging branches, laundry lines or electrical wires. activity toys shall not be installed over concrete, asphalt or any other hard surface



4.1.3.2. Slides

A slide is a toy meant to slide off. Inclined planes, roofs and such constructions are not considered slides. A slide is made up out of 3 sections:

- Starting section
- Sliding section
- Run-out section



For each of the sections there are specific rules, but listing all the rules will take us too far. The below remarks are a few important topics.

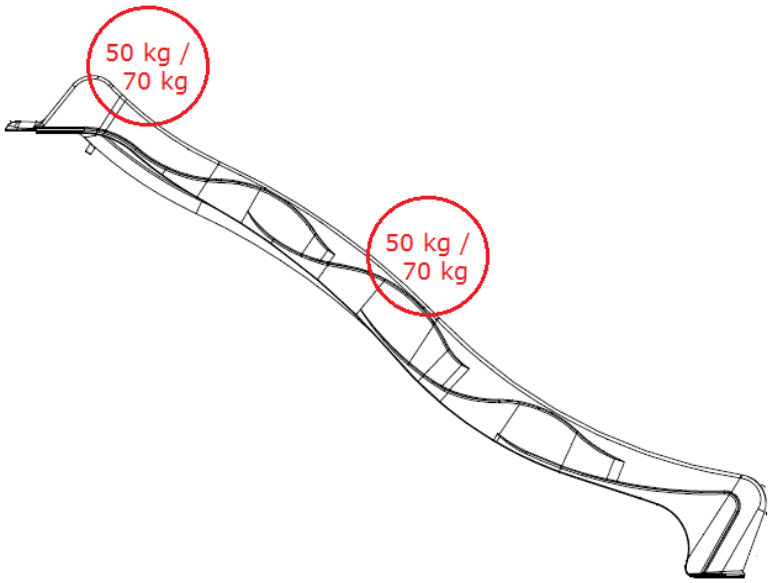
- Retaining sides for slides shall comply with the following requirements: for slides with a starting section height of more than 1 000 mm, the height of the retaining sides shall be 100 mm or more; for slides with a starting section height of 1 000 mm or less, the height of the retaining sides shall be 50 mm or more. Retaining sides are not required for the run-out section of slides.
- the starting section shall have at least the same width as the sliding section; for slides with a starting section height of less than 1 000 mm the starting section has a length of 150 mm or more; 250 mm or more for slides higher than 1000 mm; and an inclination of between 0° and 10° to the horizontal.
- the run-out section of the slide shall have a length of 150 mm or more. The inclination of the run-out section shall be between 0° and 10° to the horizontal
- A slide must be designed and installed so that there is no risk of entrapment of clothing, hair, or parts of the body
- A slide must be placed over an appropriate impact attenuating surface, stretching out sideways and from the end of the run-out section. No specifications are given in EN71-8, but there is a recommendation to place the activity toy on a level surface at least 2 m from any structure or

obstruction such as a fence, garage, house, overhanging branches, laundry lines or electrical wires.
activity toys shall not be installed over concrete, asphalt or any other hard surface

4.1.4. Product test methods

4.1.4.1. Loading test residential slides

According EN71; slides are tested with a test load of 50kg placed at the top and at the middle (at the same time) and fixed to the slide. This weight has to hold for 5min.
KBT usually asks the testing agency to test slides with a weight of 2 x 70kg instead of 50kg.



5. Summary of EU standard on commercial equipment: EN 1176

5.1.1. Scope

EN 1176 specifies general safety requirements for permanently installed public playground equipment and surfacing. Additional safety requirements for specific pieces of playground equipment are specified in subsequent parts of this standard.

This part of EN 1176 covers playground equipment for all children. It has been prepared with full recognition of the need for supervision of young children and of less able or less competent children. The purpose of this part of EN 1176 is to ensure a proper level of safety when playing in, on or around playground equipment, and at the same time to promote activities and features known to benefit children because they provide valuable experiences that will enable them to cope with situations outside the playground. Excessive focus on safety may not get in the way of the need of experiencing risk and challenging play.

This part of EN 1176 is applicable to playground equipment intended for individual and collective use by children. It is also applicable to equipment and units installed as children's playground equipment although they are not manufactured as such, but exclude those items defined as toys in EN 71 and the Toys Safety Directive.

It is not applicable to adventure playgrounds with the exception of those items which have been commercially sourced. Adventure playgrounds are fenced, secured playgrounds, run and staffed in accordance with the widely accepted principles that encourage children's development and often use self-built equipment.

5.1.2. Main requirements

5.1.2.1. Labelling

Unlike residential activity toys, publicly accessible playground equipment must be regularly inspected, maintained and of these activities a log-book should be kept. The way this must be done is mostly depending on national legislation. Some aspects are also incorporated in EN1176.

The equipment shall be marked legibly, permanently and in a position visible from ground level with at least the following:

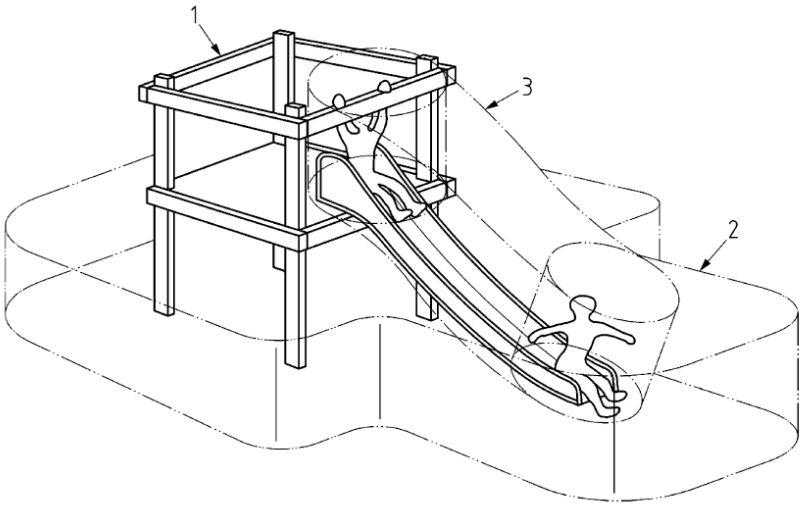
a) name and address of manufacturer or authorized representative;
b) equipment reference and year of manufacture; and
c) the number and date of this European Standard, i.e. EN 1176-1:2017.

Basic level mark: Equipment shall be marked legibly and permanently with the basic level mark

5.1.2.2. Spacing

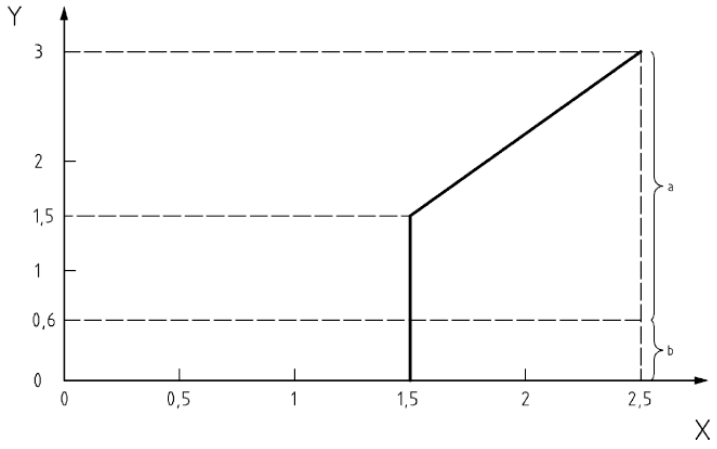
- **free space:** space in, on or around the equipment that can be occupied by a user undergoing a movement forced by the equipment. The free space is a series of cylindrical spaces representing the user, originating from and perpendicular to the body bearing surface, along the forced path of the user.
- **falling space:** space in, on or around the equipment that can be passed through by a user falling from an elevated part of the equipment. Unless otherwise specified, the extent of the falling space shall be at least 1 500 mm around elevated parts of the equipment, measured horizontally and extending from the vertical projection plane below the equipment. The falling space shall increase for free heights of fall above 1 500 mm together with the extent of the impact area

- **free height of fall:** greatest vertical distance from the clearly intended body support to the impact area below
- **impact area:** area that can be hit by a user after falling through the falling space
- **playing surface:** surface of a playground from which the use of the playground equipment commences and which comprises at least the impact area



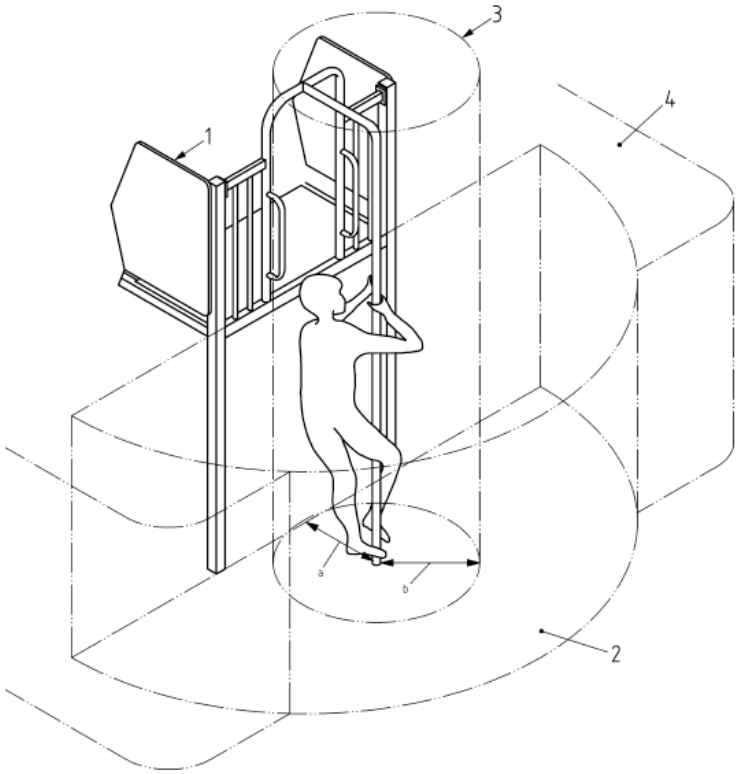
Key
1 space occupied by equipment
2 falling space
3 free space

Dimensions in metres



Key
Y free height of fall
X minimum dimension of impact area
a impact attenuating surfacing with requirements (4.2.8.5.2)
b surface with no impact attenuation test requirements, unless there is forced movement (4.2.8.5.3)
If $0 \leq Y \leq 1,5$ then $X = 1,5$ (in metres)
If $Y > 1,5$, then $X = 2/3\ Y + 0,5$

Figure 17 — Extent of the impact area



Key

1 space occupied by the equipment
2 falling space of the fireman's pole
3 free space of the fireman's pole
4 falling space of platform
a fireman's pole minimum clearance (see 4.2.8.3)
b free space radius (see 4.2.8.2.3)

Figure 19 — Example of falling space and free space of a fireman's pole

5.1.2.3. Protection against falling

Different types of protection against falling from elevated platforms are required. The type of protection required will depend on the free height of fall and on the type of equipment, whether it is easily accessible or not

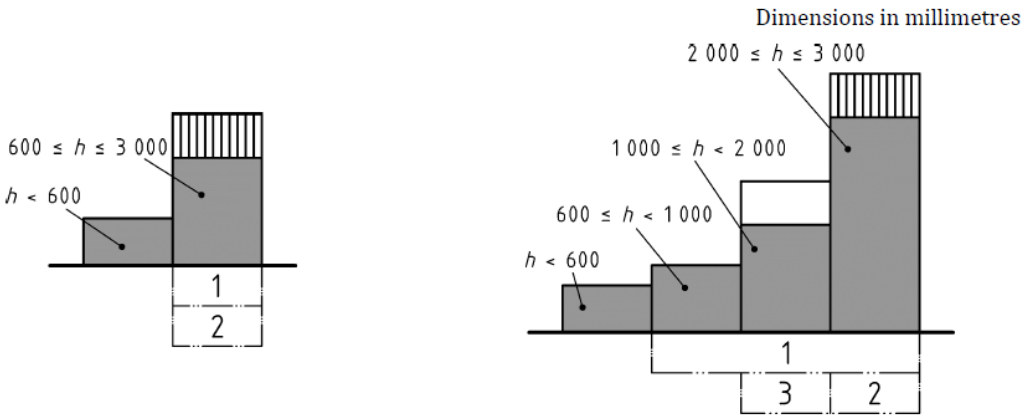
B. Impact attenuating surfacing

Beneath all playground equipment with a free height of fall of more than 600 mm and/or equipment causing a forced movement on the body of the user (e.g. swings, slides, rocking equipment, cableways, carousels, etc.), there shall be impact attenuating surfacing over the entire impact area. The type of impact attenuating surface and its properties should be determined and tested according to EN177.

C. Barriers and guardrails

Guardrail: rail intended to prevent a user from falling
Barrier: device intended to prevent the user from falling and from passing beneath

easily accessible equipment: equipment that is requiring only basic skills to access it, allowing users to move freely and quickly onto/within the equipment, without further considerations about the use of hands and feet. Basics skills should control the ability of a child to use a means of access. If the user needs to consider where or how to use their hands and feet when negotiating a means of access the access should generally be considered not easy as it slows down the movement and provides time for intervention.



a) Protection against falling for easily accessible equipment

b) Protection against falling for not easily accessible equipment

Key

1 impact attenuating surfacing in accordance with 4.2.8.5

2 barriers required

3 guardrail required

5.1.2.4. Entrapment

Holes or openings in a playground construction must be made in such a way to avoid parts of the body being trapped or getting stuck, especially when the rest of the body is making a (forced) movement. Entrapment can happen with the full body, the head, fingers, or hair and parts of clothing. It can happen with fixed or moving equipment.

Potential entrapment hazard can be detected by means of specifically designed test probes

The entrapment procedures are more or less the same as in the case of residential activity toys, except for the finger probes and procedure.

Entrapment of head and neck

Playground equipment shall be constructed so that any openings do not create head and neck entrapment hazards either by head first or feet first passage.

Accessible completely bound openings with a lower edge more than 600 mm above ground, or above any other surface which is of such a size that it will support a child, shall be tested using probes C, D and E. Probes C or E shall not pass through any opening unless it also allows the passage of the large head probe D.

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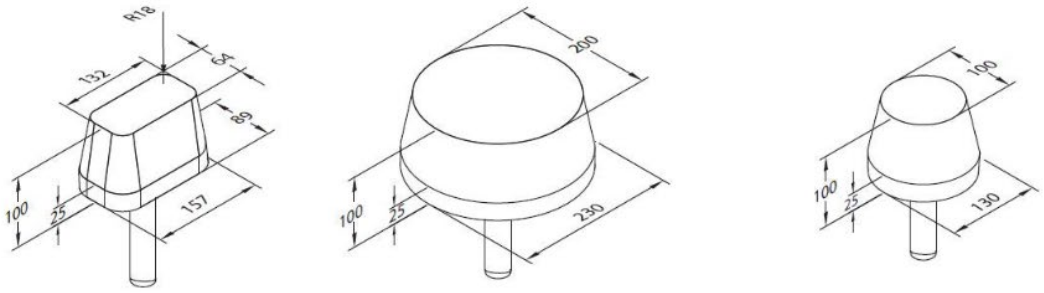
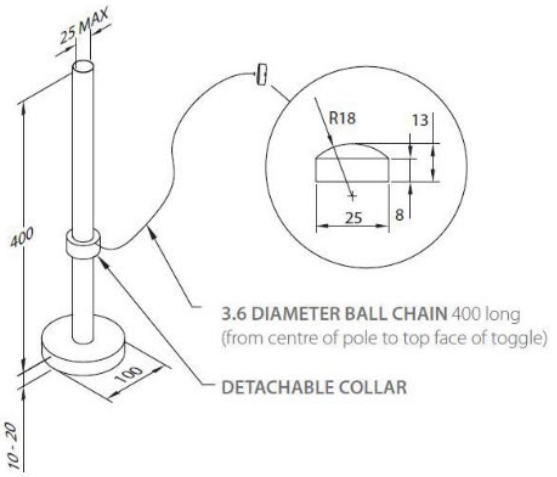
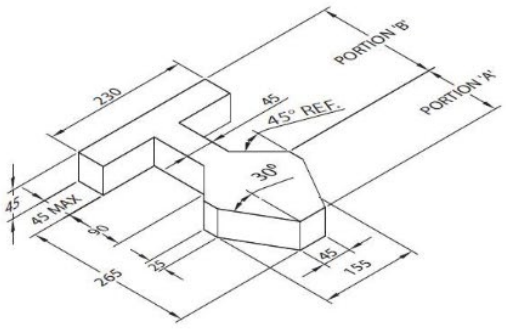


PROBE C TORSO PROBE D LARGE HEAD PROBE E SMALL HEAD

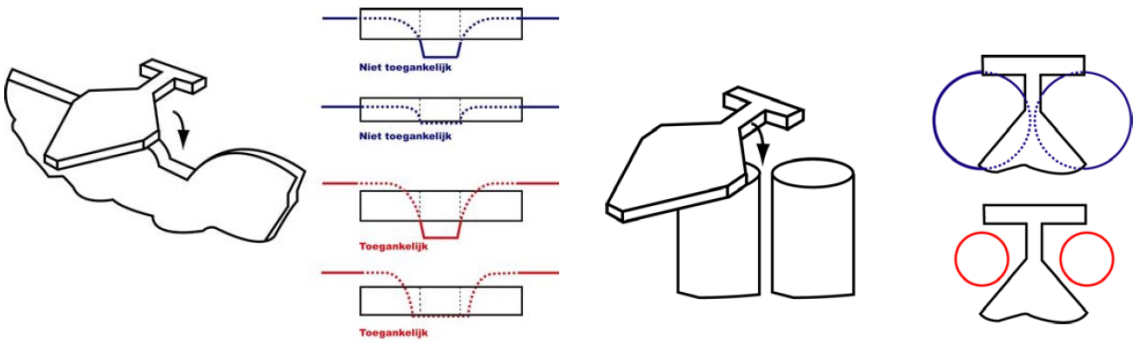
Partially bound and V-shaped openings with an entrance at 600 mm or more above the ground, or above any other surface which is of such a size that it will support a child, shall be constructed so that either:

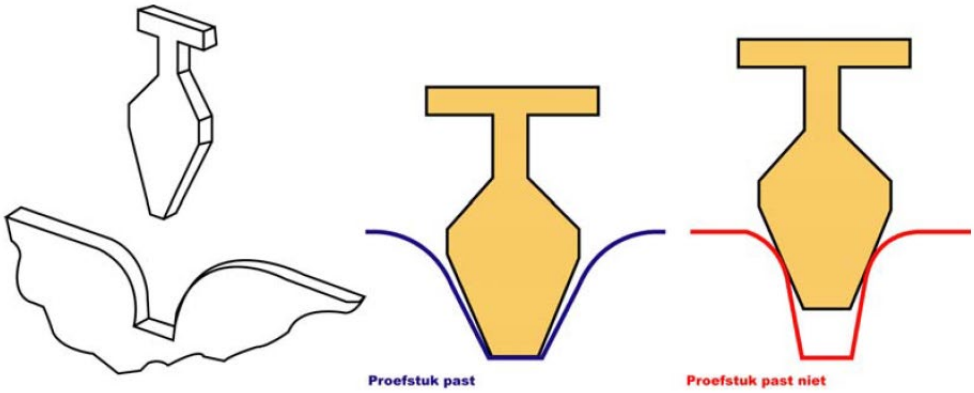
D. the opening is not accessible by the "B" portion of probe F when applied horizontally, or
E. the “A” portion will completely fit inside the opening when applied vertically





HEAD AND NECK TEMPLATE
PARTIALLY BOUND & 'V'
SHAPED OPENINGS





Entrapment of clothing and hair

Slides, fireman's poles and roofs shall be constructed so that hazardous situations in which clothing or hair can be entrapped are not created. Such situations may be created by:

2) gaps or V-shaped openings in which parts of clothing can become entrapped while, or immediately before, the user is undergoing a forced movement;
3) protrusions; and
4) spindles/rotating parts.

When tested using the toggle test, entrapment of the toggle or chain shall not occur. Application of the toggle test, is restricted to the free space, as practical experience has shown that natural material and connections between different parts can vary over time.

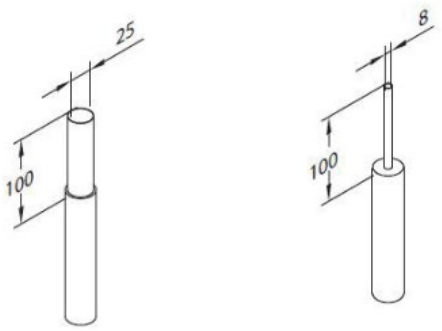
Entrapment of fingers

Equipment should be constructed so that the following hazardous situations, are not created:

a) gaps in which fingers can be trapped whilst the remainder of the body is moving or continues in forced movement, for example sliding, swinging; and
b) variable gaps (excluding chains)

Openings within the free space, where the user is subjected to forced movement, and/or holes which have a lower edge more than 1 000 mm above the potential impact area, shall conform to one of the following requirements:

c) the 8 mm finger rod (see Figure D.10a)) shall not pass through the minimum cross-section of the opening and the profile of the opening shall be such that the rod cannot be locked in any position when set in motion; or
d) if the 8 mm finger rod passes through the opening, the 25 mm finger rod shall also pass through the opening, provided that the opening does not permit access to another finger entrapment site.



25 DIAMETER FINGER ROD 8 DIAMETER FINGER ROD

Please note: *the finger rods are hemispherical at the ends*

The procedure to check for finger entrapment is to apply the 8 mm rod to the opening at a 45° angle and make a full cone shaped movement. If the rod gets stuck or cannot move around the full conical space, then the 25mm rod should be applied to check if it fits the hole too. If the 25 mm rod does not fit, then there is finger entrapment.

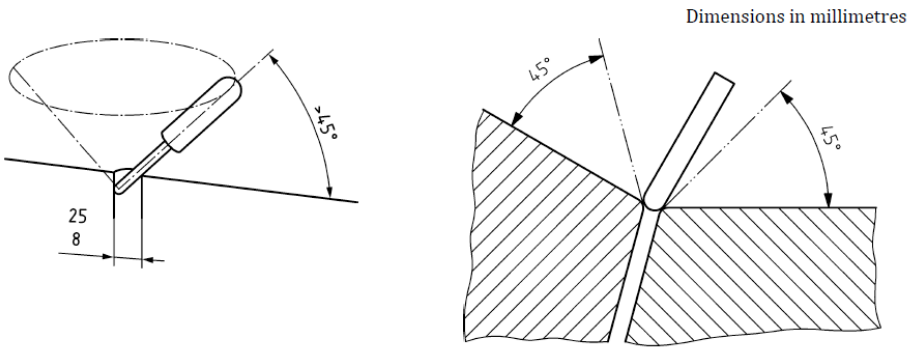
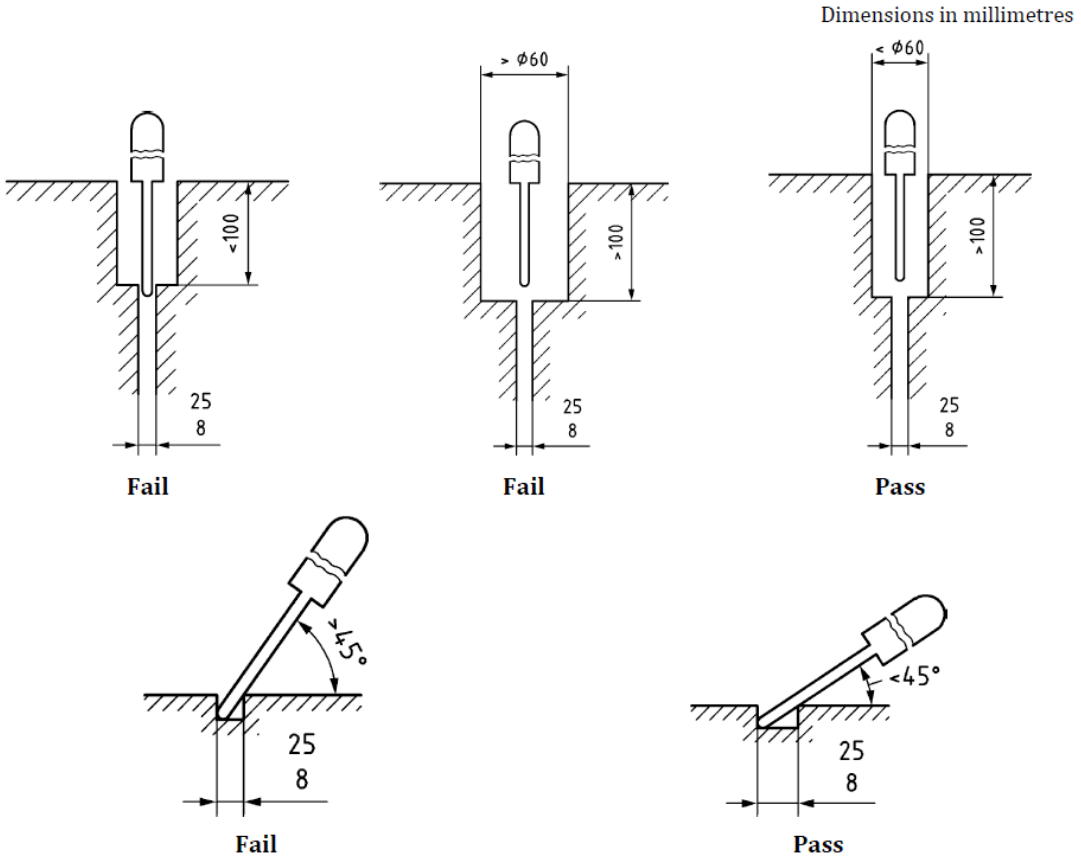


Figure D.11 — Rotation of the 8 mm diameter finger rod



5.1.3. Requirements for specific equipment

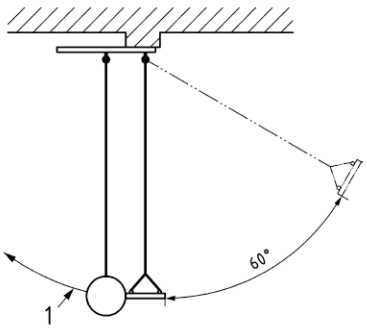
5.1.3.1. Swings

Impact test

Swingseats must be made from a soft or impact attenuating material to avoid injury from a collision between a swingseat and a child's head. This requirement is tested for all commercial swingseats by means of the 'impact test'. During the test a swingseat is made to collide with a spherical metal probe, while measuring 2 aspects: the acceleration of the test-probe after impact and the deformation of the seat itself.

For single user seats, after the test there shall be no peak values measured of acceleration greater than 50 g. the average surface compression shall not exceed 90 N/cm2.
For group swings, if the diameter of the swing seat is greater than 900 mm, there shall be no peak values of acceleration greater than 120 g and the average surface compression shall not exceed 90 N/cm2. If the diameter is less than 900 mm it shall conform to the requirements of single user seats.

An impact test report is required for all swingseats and customers regularly request to see these reports

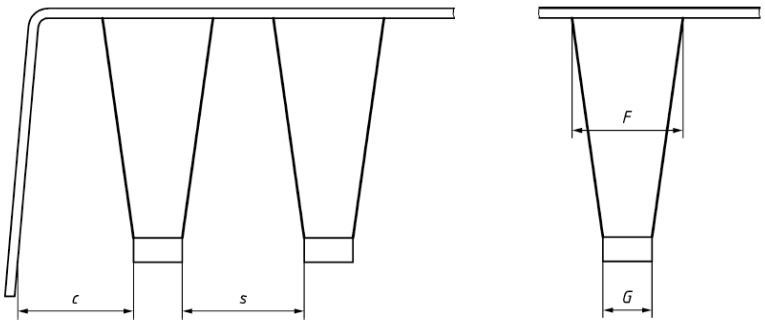


Construction

The minimum ground clearance for single-use swings at rest position shall be 350 mm. For group swing seats, the minimum ground clearance at rest position shall be 400 mm.

The minimum horizontal dimension, C, between the side (see Figure 8a)) of a swing seat and the adjacent structure in the rest position shall be: ≥ 20 % length of the suspension member (+200 mm).
For group swing seats, the minimum horizontal dimension, C, between the side (see Figure 8a) of a swing seat and the adjacent structure in the rest position shall be: ≥ 20 % length of the suspension member (+400 mm).
The minimum horizontal dimension, S, between adjacent swing seats (see Figure 8a) in the rest position shall be: ≥ 20 % length of the suspension member (+300 mm).

Swing frames with more than two seats shall be divided by construction parts (i.e. supporting leg(s)) into bays so that there are no more than two seats per bay. A swing bay containing one group swing seat shall not contain any other seats.



a) Minimum space between the seats of swings and an adjacent structure

b) Lateral stability of swing seats

The distance between the suspension members F shall be: ≥ G + 5 % length of the suspension member.
For group swing seats, the distance between the suspension members F shall be: ≥ G + 30 % length of the suspension member.

Impact surfacing

A swingset must be placed over an appropriate impact attenuating surface. The free height of fall D of a swing shall be determined from the middle of the seat surface vertically to the ground when the swing seat is raised by 60°.

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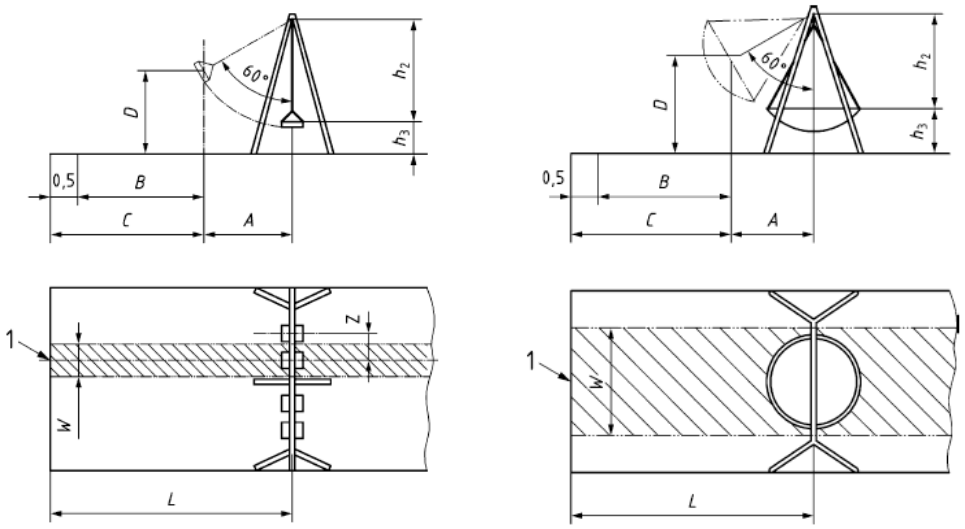
The falling space shall correspond to the impact area extended to a height equivalent to the free height of fall (D).

For all swings the extent of the impact area shall be calculated by taking the point A reached horizontally by the centre of the swing seat when it has travelled through an arc of 60° and adding a fixed distance B or C. In the case of an impact area that is level with the surrounding surface (normally synthetic) the fixed additional length B shall be 1,75 m and in the case of surface that is contained (normally loose fill) the fixed additional length C shall be 2,25 m.

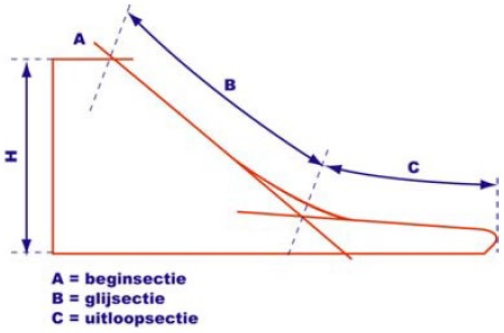
For swing seats with a width not greater than 500 mm, the impact area shall have a minimum width of 1,75 m. If the seat is greater than 500 mm the width of the impact area shall be increased by the difference between 500 mm and the actual width of the seat.



5.1.3.2. Slides

A slide is a toy meant to slide off. Inclined planes, roofs and such constructions are not considered slides. A slide is made up out of 3 sections:

- Starting section
- Sliding section
- Run-out section



For each of the sections there are specific rules, but listing all the rules will take us too far. The below remarks are a few important topics.

The sliding section shall have solid lateral protection of height 100mm (slides with free height of fall < 120 cm), 150mm (slides with free height of fall 120 < H < 250 cm), 500mm (slides with free height of fall > 250 cm), 500mm (slides with free height of fall < 200 cm that are easily accessible), when measured perpendicular to the sliding section surface. The lateral protection of the starting section shall be a continuous unbroken extension of the lateral protection of the sliding section.

The length of the initial straight sliding section shall not exceed 7 000 mm. The angle of declination to the horizontal of the sliding section shall not exceed 60° at any point and shall not exceed an average of 40°.

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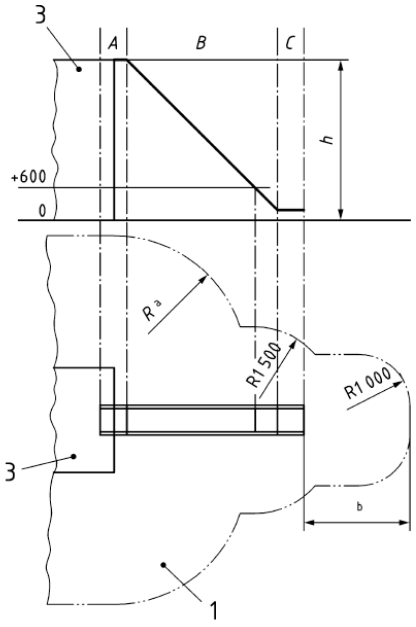
All slides shall include a run-out section, either Type 1, where the run-out section is short with a long impact area, or Type 2, where the run-out section is long with a short impact area. All KBT slides are type 2.

A slide must be designed and installed so that there is no risk of entrapment of clothing, hair, or parts of the body

A slide must be placed over an appropriate impact attenuating surface. Different to the requirements given in EN 1176-1, the impact area shall be provided to a distance of at least 1 000 mm from the outer edge of the run-out section of the slide. End corners can be rounded off with a radius of maximum 1 000 mm
The surface of the impact area around the run-out section shall have an adequate level of impact attenuation at least equivalent to a free height of fall of 1 000 mm.

Dimensions in millimetres



b) Attachment slide

6. Materials and chemical restrictions: ECHA, REACH, SVHC

6.1.1. Summary: What is important for KBT

1. REACH Annex XVII: Restricted Substances: for these substances there are specific rules to what content is allowed in what type of product

    - PAH content: REACH Annex XVII: entry 50 & AfPS GS 2014: 01 PAH (de Duitse regelgeving voor het verkrijgen van een TUV GS certificaat is nog strenger dan de Europese REACH regels!)
    - Heavy metals: REACH Annex XVII: entry23, 27, 63, ...
    - ... (the restriction list is quite long, but these are the most relevant for us)

2. REACH Article 57: SVHC's: If any of these materials is present in our product (>0.1% w/w):

    - We have the duty to communicate this the the ECHA
    - We have the duty to mark this on the product
        - ➔ in any case our products should be free of SVHC's!

6.1.2. ECHA

The European Chemicals Agency is an agency of the European Union which manages the technical, scientific and administrative aspects of the implementation of the European Union regulations in regard to chemical substances. More specifically the legislation called 'Registration, Evaluation, Authorization and Restriction of Chemicals' or REACH.
ECHA is the driving force among regulatory authorities in implementing the EU's chemicals legislation. ECHA helps companies to comply with the legislation, advances the safe use of chemicals, provides information on chemicals and addresses chemicals of concern. ECHA is based in Helsinki, Finland.

ECHA regulates chemicals and biocides on the EU market. It processes files on chemicals from industry and examines them to see if they comply with legislation. Together with the EU national governments, ECHA focuses on the most hazardous substances, in cases where further risk management might be needed to protect people and the environment. In specific areas, it takes its own decisions; in others, it gives opinions and advice to help the European Commission take decisions. It provides dedicated support to small and medium-sized companies.

The main responsibilities of ECHA are:

- Help companies comply with specific EU legislation on chemicals or biocides:
    - REACH
    - Classification, Labelling & Packaging (CLP)
    - Biocidal Products Regulation (BPR)
    - Prior Informed Consent Regulation (PIC).
- Cooperate with international organisations & stakeholders to promote safe use of chemicals
- Provide information on chemicals & their safe use through a unique free database
- Work with the European Commission & EU governments to identify substances that give cause for concern & take decisions on EU-level risk management
- Encourage innovation in the chemical industry by replacing substances that give cause for concern.

6.1.3. REACH

REACH is a regulation of the European Union, adopted to improve the protection of human health and the environment from the risks that can be posed by chemicals, while enhancing the competitiveness of the EU chemicals industry. It also promotes alternative methods for the hazard assessment of substances in order to reduce the number of tests on animals.
REACH stands for Registration, Evaluation, Authorisation and Restriction of Chemicals. It entered into force on 1 June 2007.

In principle, REACH applies to all chemical substances; not only those used in industrial processes but also in our day-to-day lives, for example in cleaning products, paints as well as in articles such as clothes, furniture and electrical appliances. Therefore, the regulation has an impact on most companies across the EU.
REACH places the burden of proof on companies. To comply with the regulation, companies must identify and manage the risks linked to the substances they manufacture and market in the EU. They have to demonstrate to ECHA how the substance can be safely used, and they must communicate the risk management measures to the users.
If the risks cannot be managed, authorities can restrict the use of substances in different ways. In the long run, the most hazardous substances should be substituted with less dangerous ones.

6.1.4. REACH Article 57: Substances of very high concern (SVHC)

A substance of very high concern (SVHC) is a chemical substance (or part of a group of chemical substances) for which it has been proposed that the use within the European Union be subject to authorisation under the REACH Regulation.[1] Indeed, listing of a substance as an SVHC by the European Chemicals Agency (ECHA) is the first step in the procedure for restriction of use of a chemical. The first list of SVHCs was published on 28 October 2008 and the list update many times to include new candidates.

The criteria are given in article 57 of the REACH Regulation. A substance may be proposed as an SVHC if it meets one or more of the following criteria:

- it is carcinogenic
- it is mutagenic
- it is toxic for reproduction
- it is persistent, bioaccumulative and toxic according to the criteria set out in Annex XIII to the REACH Regulation (PBT substances)
- there is "scientific evidence of probable serious effects to human health or the environment which give rise to an equivalent level of concern"; such substances are identified on a case-by-case basis.

Simply because a substance meets one or more of the criteria does not necessarily mean that it will be proposed as an SVHC. Many such substances are already subject to restrictions on their use within the European Union, such as those in Annex XVII of the REACH Regulation. SVHC's are substances for which the current restrictions on use (where these exist) might be insufficient. There are three priority groups for assessment

- PBT substances and vPvB substances;
- substances which are widely dispersed during use;
- substances which are used in large quantities.

6.1.5. REACH Annex XVII : Restricted substances

Because the list of restricted chemicals is very long, and because this list contains a lot of substances that are irrelevant for KBT, we give a short overview of important substances and numbers.

6.1.5.1. Phthalates

Phthalates are a family of chemical compounds developed to be used in the manufacture of plastics, solvents, and personal care products. They are colourless, odourless, oily liquids that do not evaporate easily and do not chemically bind to the material they are added to. Phthalates are often used as an additive to PVC (polyvinyl chloride) products to make them more flexible or soft. Phthalates are NOT commonly used on other plastics such as PE, PP, …

Phthalates can be released from a product by heat, agitation, and prolonged storage. The release can occur during all the stages of the product lifecycle - from production, through use, to disposal.
Phthalates are readily absorbed into the human body and are converted quickly to their respective metabolites. research has linked phthalates to asthma, attention-deficit hyperactivity disorder, breast cancer, obesity and type II diabetes, low IQ, neurodevelopmental issues, behavioural issues, autism spectrum disorders, altered reproductive development and male fertility issues. Phthalates can interact with each other and increase the exposure effect.

In 2010, the market was still dominated by high-phthalate plasticizers; however, due to legal provisions and growing environmental awareness and perceptions, producers are increasingly forced to use non-phthalate plasticizers.
The use of some phthalates has been restricted in the European Union for use in children's toys since 1999. DEHP, BBP, and DBP are restricted for all toys; DINP, DIDP, and DNOP are restricted only in toys that can be taken into the mouth. The restriction states that the amount of these phthalates may not be greater than 0.1% mass percent of the plasticized part of the toy.
Generally the high molecular weight phthalates DINP, DIDP and DNOP have been registered under REACH (see below) and have demonstrated their safety for use in other applications. They are not classified for any health or environmental effects.

Following limits are based upon EC Directive 1907/2006 Annex XVII:

Phthalates	
DEHP (Di-2-ethylhexylphthalate)	**maximum : 0,10 % (mass percent)**
DBP (Dibutylphthalate)	
BBP (Benzylbutylphthalate)	
DINP (Di-iso-nonylphthalate)	
DIDP (Diisodecylphthalate)	
DnOP (Di-n-octylphthalate)	
Other Phthalates	

6.1.5.2. Heavy metals (EN71-3: 2013 - Migration of certain elements)

The toy safety directive specifies the limits for 3 categories of materials used in toys. The limits for migration of certain elements is counted in mg/kg. The goal of these limits is to minimize the contact for children to certain chemical compounds.

While the RoHS regulation (see below) states the maximal amount of certain heavy metals in products, EN71-3 states the maximal migration levels. Chemical compounds of materials are not always strictly bond to the main materials, some compounds tend to be released easily. This process is called migration. Generally it is the migrating part of the chemical compounds that the human body will be exposed to.

Element Limit	(mg/kg)
Aluminium	70000
Antimony	560
Arsenic	47
Barium	18750
Boron	15000
Cadmium	17
Chromium (III)	460
Chromium (VI)	0,2
Cobalt	130
Copper	7700
Lead	23
Manganese	15000
Mercury	94
Nickel	930
Selenium	460
Strontium	56000
Tin	180000
Organic tin	12
Zinc	46000

6.1.5.3. Poly Aromatic Hydrocarbons (PAH)

Polycyclic aromatic hydrocarbons or PAH's, are hydrocarbons—organic compounds containing only carbon and hydrogen—that are composed of multiple aromatic rings. PAHs are found in coal and in tar deposits. They are also produced by the incomplete combustion of organic matter (e.g. in car-engines or when biological materials burn in forest fires). Cancer is the primary human health risk of exposure to PAH's. Exposure to PAH's has also been linked with cardiovascular disease and poor fetal development.

The European Commission has restricted concentrations of a series of carcinogenic PAH's in consumer products that contact the skin or mouth. The limits on the PAH Content of Consumer Articles is regulated by EU 1272/2013 amending REACH Annex XVII. For the 2nd category is stated: "*Toys, including activity toys, and childcare articles, shall not be placed on the market, if any of their rubber or plastic components that come into direct as well as prolonged or short-term repetitive contact with the human skin or the oral cavity, under normal or reasonably foreseeable conditions of use, contain more than 0.5 mg/kg (0.5 ppm) of any of the listed PAHs* "

Because children often play bare footed and crawl on structures on their hands and knees, a lot of our products fall into this scope. An example of a concerned KBT product potentially containing PAH's are our rubber tiles.

PAH	≤ 0,5 mg/kg
Benzo(a)pyrene	**Acenaphthene**
Benzo(e)pyrene	**Acenaphthylene**
Benzo(a)anthracene	**Anthracene**
Chrysen	**Benzo(g,h,i)perylene**

Benzo(b)fluoranthene	**Fluoranthene**
Benzo(j)fluoranthene	**Naphthalene**
Benzo(k)fluoranthene	**Phenanthrene**
Dibenzo(a,h)anthracene	**Fluorene**
Indeno(1,2,3-cd)pyrene	**Pyrene**

Requirements acc. to. AfPS GS 2014:01 PAH / 1907/2006, Annex XVII No. 50

Parameter	Category 1	Category 2		Category 3		Limit value acc. to EC regulation 1907/2006, Annex XVII No. 50 (will be enforced 12/2015)	
	Materials which come into direct as well as prolonged or short-term repetitive contact with the human skin or the oral cavity, under normal or reasonably foreseeable conditions of use	Materials, not covered by category 1, for intended skin contact of more than 30 s or repeated short-term skin contact		Materials, not covered by category 1 or category 2, with foreseeable skin contact up to 30 seconds (short term skin contact)		Toys, including activity toys, and childcare articles – Components rubber or plastic components that come into direct as well as prolonged or short-term repetitive contact with the human skin or the oral cavity, under normal or reasonably foreseeable conditions of us	Articles shall not be placed on the market for supply to the general public, if any of their rubber or plastic components that come into direct as well as prolonged or short-term repetitive contact with the human skin or the oral cavity, under normal or reasonably foreseeable conditions of us
		Toys acc. to Directive 2009/48/EC	other products acc.to ProdSG	Toys acc. to Directive 2009/48/EC	other products acc.to ProdSG		
Benzo[a]pyrene mg/kg	< 0.2 mg/kg	< 0.2 mg/kg	< 0.5 mg/kg	< 0.5 mg/kg	< 1 mg/kg	0.5 mg/kg	1 mg/kg
Benzo[e]pyrene mg/kg	< 0.2 mg/kg	< 0.2 mg/kg	< 0.5 mg/kg	< 0.5 mg/kg	< 1 mg/kg	0.5 mg/kg	1 mg/kg
Benzo[a]anthracene mg/kg	< 0.2 mg/kg	< 0.2 mg/kg	< 0.5 mg/kg	< 0.5 mg/kg	< 1 mg/kg	0.5 mg/kg	1 mg/kg
Benzo[b]fluoranthene mg/kg	< 0.2 mg/kg	< 0.2 mg/kg	< 0.5 mg/kg	< 0.5 mg/kg	< 1 mg/kg	0.5 mg/kg	1 mg/kg
Benzo[j]fluoranthene mg/kg	< 0.2 mg/kg	< 0.2 mg/kg	< 0.5 mg/kg	< 0.5 mg/kg	< 1 mg/kg	0.5 mg/kg	1 mg/kg
Benzo[k]fluoranthene mg/kg	< 0.2 mg/kg	< 0.2 mg/kg	< 0.5 mg/kg	< 0.5 mg/kg	< 1 mg/kg	0.5 mg/kg	1 mg/kg
Chrysene mg/kg	< 0.2 mg/kg	< 0.2 mg/kg	< 0.5 mg/kg	< 0.5 mg/kg	< 1 mg/kg	0.5 mg/kg	1 mg/kg
Dibenzo[a,h]anthracene mg/kg	< 0.2 mg/kg	< 0.2 mg/kg	< 0.5 mg/kg	< 0.5 mg/kg	< 1 mg/kg	0.5 mg/kg	1 mg/kg
Benzo[ghi]perylene mg/kg	< 0.2 mg/kg	< 0.2 mg/kg	< 0.5 mg/kg	< 0.5 mg/kg	< 1 mg/kg	-	-
Indeno[1'2,3-cd]pyrene mg/kg	< 0,2 mg/kg	< 0.2 mg/kg	< 0.5 mg/kg	< 0.5 mg/kg	< 1 mg/kg	-	-
Acenaphthylene, Acenaphthen, Fluorene, Phenanthrene, Pyrene, Anthracene, Fluoranthene, mg/kg	< 1 mg/kg – Sum	< 5 mg/kg – Sum	< 10 mg/kg – Sum	< 20 mg/kg – Sum	< 50 Sum	-	-
Naphthalene mg/kg	< 1 mg/kg	< 2 mg/kg		< 10 mg/kg		-	-
Sum 18 PAH	<1 mg/kg	< 5 mg/kg	< 10 mg/kg	< 20 mg/kg	< 50 mg/kg	-	-

6.1.6. RoHS

The Restriction of Hazardous Substances Directive 2002/95/EC, (RoHS 1), short for Directive on the restriction of the use of certain hazardous substances in electrical and electronic equipment, was adopted in February 2003 by the European Union.

The RoHS 1 directive is required to be enforced and became a law in each member state. This directive restricts (with exceptions) the use of six hazardous materials in the manufacture of various types of electronic and electrical equipment. It is closely linked with the Waste Electrical and Electronic Equipment Directive (WEEE) 2002/96/EC which sets collection, recycling and recovery targets for electrical goods and is part of a legislative initiative to solve the problem of huge amounts of toxic electronic waste.

The original directive has been replaced by the RoHS 2 directive (2011/65/EU) and became law on 21 July 2011 and took effect 2 January 2013. It addresses the same substances as the original directive while improving regulatory conditions and legal clarity.

RoHS	max. values
Lead	0,1%
Mercury	0,1%

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Cadmium	0,01%
Hexavalent chromium	0,1%
Polybrominated biphenyls (PBB)	0,1%
Polybrominated diphenyl ethers (PBDE)	0,1%

7. Materials and production techniques

7.1. Plastics

"Plastic" is the general term for a wide range of synthetic or semi-synthetic materials used in a large range of applications. Plastics are made from various materials found in nature, such as natural gas, oil, coal, minerals and plants.

All plastics are polymers. A polymer is a very large molecule made up of many smaller units, joined together to create a long chain. Plastics can be moulded, extruded, cast and blown into seemingly limitless shapes and films, foams or even drawn into fibres for textiles or ropes. Many types of coatings, sealants and glues are actually plastics, too. Although there are many different polymers, plastics in general are lightweight but have significant degrees of strength. Combined with a relative cheap price (for raw material and production technique), this makes them an interesting alternative for many other materials.

The polymer used to make a plastic is almost always mixed with **additives**, including colorants, plasticizers, stabilizers, fillers, and reinforcements. These additives affect the chemical composition, chemical and mechanical properties of a plastic and also affect its cost. The combination of different additives and colorants, added to the plastic virgin material is often called Masterbatch.

One important classification of plastics is by the permanence of their form, or whether they are: thermoplastics or thermosetting polymers.

Thermoplastics are the plastics that, when heated, do not undergo chemical change in their composition and so can be moulded again and again. Examples include: polyethylene (PE), polypropylene (PP), polystyrene (PS) and polyvinyl chloride (PVC).

Thermosets can melt only once. After they have solidified, they stay solid. In the thermosetting process, a chemical reaction occurs that is irreversible. The vulcanization of rubber is an example of a thermosetting process: before heating with sulphur, the polyisoprene is a tacky, slightly runny material; after vulcanization, the product is rigid and non-tacky.

Plastic granules

7.1.1. Plastics recycling

Thermoplastic materials can usually be recycled, because it is possible to re-melt the material and mould it again into a new shape. The most common problem for this technique is the mixing of different types of plastics with different characteristics, colours and additives. To obtain a nice new recycled plastic product, it is important to collect different kinds of plastic separately and additionally separate them by colour/additive.

we use recycled materials to produce our slides. The recycled material mostly comes from the market of discarded beverage crates. Because recycled material never comes from the same source exactly, there often

are differences in composition, most notably of colour. This variation in colour of the source material is the origin of the small variations in colour we have in our final products. This is mostly visible in light colours like our lime green.

Some years ago, the KBT policy was to not inform our customers about this aspect of the business, because (1) the public might think that recycled materials would be less strong or technically inferior (which is partly true: we say that PE loses about 20% of its strength after multiple recycling loops) and (2) because we are never exactly sure about chemical composition and possible pollutions which may make our slides non-REACH compliant (Which is also true, because for example, beverage crates that have been stored close to a highway, may contain higher levels of PAH's).

Of course in current more modern times minds have shifted about recycling materials, we can better control the characteristics and even the chemical composition of the recycled materials.

7.1.2. Biodegradable plastics and bioplastics

Biodegradable plastics are plastics that degrade, or break down, upon exposure to sunlight, ultra-violet radiation, water or dampness, bacteria, enzymes or wind abrasion. Some modes of degradation require that the plastic be exposed at the surface (aerobic), whereas other modes will only be effective if certain conditions exist in landfill or composting systems (anaerobic). Classic petroleum based plastics can take anything from 25 up to 1000 years to decompose, while – given the right conditions – biodegradable plastics can decompose completely within months.

Whilst most plastics are produced from petrochemicals, **bioplastics** are made substantially from renewable plant materials such: as cellulose and starch. Due both to the finite limits of the petrochemical reserves and to the threat of global warming, the development of bioplastics is a growing field.

It is important to know that bioplastic materials are not always biodegradable!

7.1.3. Good to know:

Plastic colour masterbatch

- The first completely synthetic plastic was bakelite, which was made in 1907 by the Belgian chemist Leo Baekeland. Baekeland also coined the word "plastics".
- The word *plastic* comes from the Greek word plastikos, which means *able to be shaped or moulded*.
- Approximately a third of plastic that is produced is used to make packaging. Another third is used for siding (wall coverings) and piping.
- Pure plastics are generally insoluble in water and non-toxic. However, many of the additives in plastics are toxic and may leach into the environmental. Examples of toxic additives include phthalalates. Nontoxic polymers may also degrade into chemicals when they are heated.
- However plastics can be non-toxic in their solid state, some plastics release very toxic chemicals during their production phase. One important example is PVC, which releases large quantities of very toxic Chloride-gas during production. That's one of the reasons why it is advisable to limit or reduce the use of PVC in new products and look for alternatives.

7.1.4. Types and characteristics

7.1.4.1. Common plastics

- *Polyamide* (PA) or nylon: fibers, toothbrush bristles, tubing, fishing line and low-strength machine parts such as engine parts or gun frames
- *Polycarbonate* (PC): compact discs, eyeglasses, riot shields, security windows, traffic lights and lenses
- *Polyester* (PES): fibers and textiles
- *Polyethylene* (PE): a wide range of inexpensive uses including supermarket bags and plastic bottles
    - *High-density polyethylene* (HDPE): detergent bottles, milk jugs and moulded plastic cases
    - *Low-density polyethylene* (LDPE): outdoor furniture, siding, floor tiles, shower curtains and clamshell packaging
    - *Polyethylene terephthalate* (PET): carbonated drinks bottles, peanut butter jars, plastic film and microwavable packaging
- *Polypropylene* (PP): bottle caps, drinking straws, yogurt containers, appliances, car fenders (bumpers) and plastic pressure pipe systems
- *Polystyrene* (PS): (stryro-)foam packaging, food containers, disposable cups, plates, cutlery,…
    - *High impact polystyrene* (HIPS): refrigerator liners, food packaging and vending cups
- *Polyvinyl chloride* (PVC): plumbing pipes and guttering, shower curtains, window frames and flooring (Vinyl)
- *Acrylonitrile butadiene styrene* (ABS): electronic equipment cases (e.g. computer monitors, printers, keyboards) and drainage pipe
    - Polycarbonate/Acrylonitrile Butadiene Styrene (PC/ABS): a blend of PC and ABS that creates a stronger plastic used in car interior and exterior parts, and mobile phone bodies
    - Polyethylene/Acrylonitrile Butadiene Styrene (PE/ABS): a slippery blend of PE and ABS used in low-duty dry bearings
- *Polyurethanes* (PU): cushioning foams, thermal insulation foams, surface coatings and printing rollers. Currently the most commonly used plastic in cars.

Plastics used by KBT	
PA	
HDPE	

PP	
HIPS	

7.1.4.2. Specialist or high-performance plastics

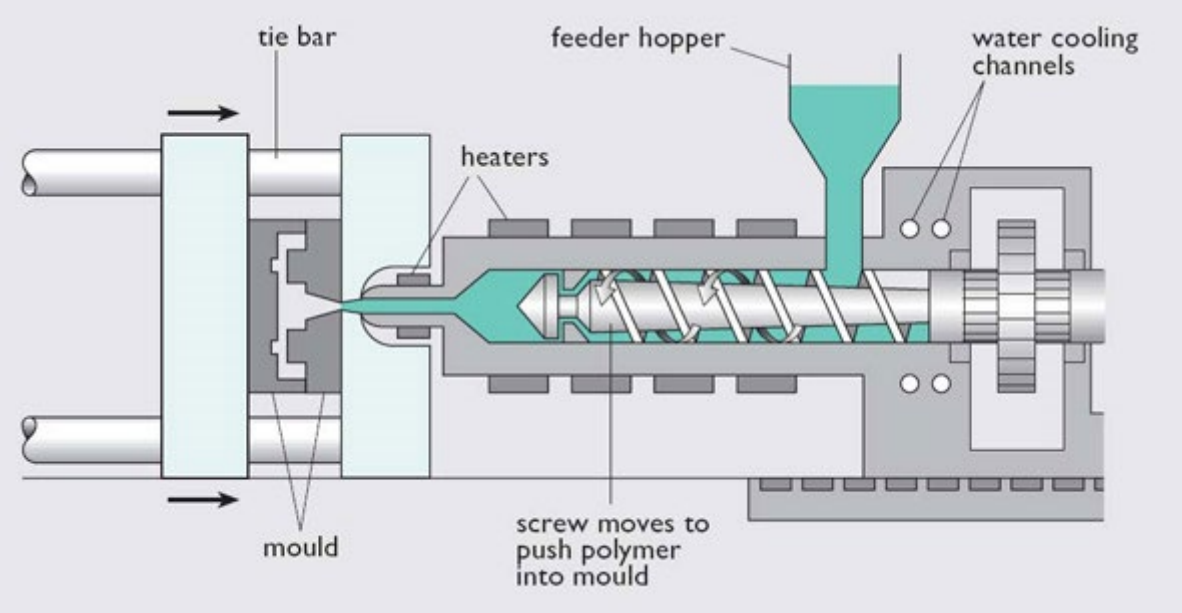
- Polyepoxide (epoxy): used as an adhesive, potting agent for electrical components, and matrix for composite materials. In eastern and southern Europe Epoxy is still often used as a materials for slides as it offers great flexibility in shapes. But it is also very work-intensive and therefore more expensive.
- Polymethyl methacrylate (PMMA) is best known by its various trade names around the world; e.g. Perspex, Plexiglas,... It's a mostly amorphous material, which makes it very transparent. That's why it's mainly used for glazing (), aglets, fluorescent light diffusers, rear light covers for vehicles and contact lenses (of the original "hard" variety),. It forms the basis of artistic and commercial acrylic paints when suspended in water with the use of other agents.
- Polytetrafluoroethylene (PTFE), or Teflon: heat-resistant, low-friction coatings, used in things like non-stick surfaces for frying pans, plumber's tape and water slides, but also in lubricants (PTFE-oil).

7.1.5. Production methods

7.1.5.1. Injection Moulding

One of the most common plastic manufacturing methods, injection moulding lends itself to mass production of products ranging from cell phone stands to toys. The injection moulding process melts small plastic pellets (granulate) inside the injection machine with a heated barrel. A plunger moves the plastic forward and ensures an even mix of melted plastic. The machine then drives the melted plastic into a metal mould. The plastic fills the mould and results in a solid plastic part or product.

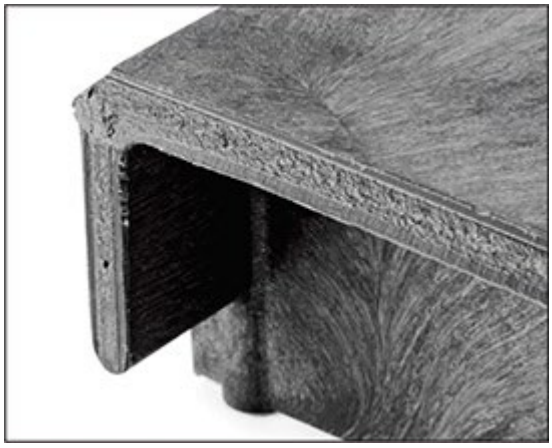
KBT uses injection moulding for small and medium sized products such as bolt covers, and swing seats like 'Trix' and 'Luxe'.



Plastic injection moulding process

A simple Plastic injection mould with a produced product

7.1.5.2. Gas assisted injection: KBT slides



KBT slides are produced with a technique called 'gas assisted-injection moulding'. This is for 95% the same as common injection moulding, but a gas is added to obtain better flow of the material in the mould. For this gas we use a foaming agent that is pre-mixed in the molten plastic. The gas assures that during injection, the pressure is more or less even in the mould and we can inject the molten plastic with a lower injection pressure and lower closing force on the mould. It will also help to fully form the part because the molten plastic will be pushed by the gas into the extremities of the mould. This technique is used, because slides are long and narrow products that can be hard to produce using conventional techniques.

The result is what is commonly known as a structural foam product. If you would cut a slide, you would see small air bubbles on the inside of the material. This makes the products more light, while still having relatively thick walls. See image attached for a visual.

The gas is what creates the specific visual appearance and functional 'sliding properties' of the slide. On the surface of the slides you will notice a pattern of very fine white lines. This is known in the plastics industry as 'silver streak' (look in Google: "Silver streak injection moulding"). Usually it is seen as a problem-to-be-solved, but in our case this is actually the core strength of the slides.
During the injection of the molten plastic in the mould, the gas will be pushed outwards towards the walls of the mould. There it will come into contact with the hot surface of the mould. Because of the pressure and the movement of the melt, the small gas bubbles will be stretched out in the direction of the flow. This creates the fan-shaped patterns of small white lines, emerging from the injection points.

Next to the visual appearance, the gas injection will also create the functional sliding properties of our slides. The white lines will create a microscopic surface texture that is responsible for the fact that the surface is extremely slippery. This seems contradictory, but it's not. When a surface would be totally smooth, you would actually stick to it very easily. You can compare this to a glass object. Glass is extremely smooth and when you strike your finger over a glass surface, you finger will slightly stick to it. So, because this slippery surface of our slides is very difficult to recreate using conventional moulding techniques, the gas injection technique is the best way to produce our slides.

One question that often pops up is, why this effect is more visible for Yulvo and Tsuri compared to our old Classic slides. This is caused by the different wall thicknesses. When products have a thinner wall, the gas has less room to spread out and will be pressed faster against the wall. This will make the fan-shaped pattern more clear. So the thinner the slide, the more clear the pattern. Also for darker colours, the white pattern will be more visible.

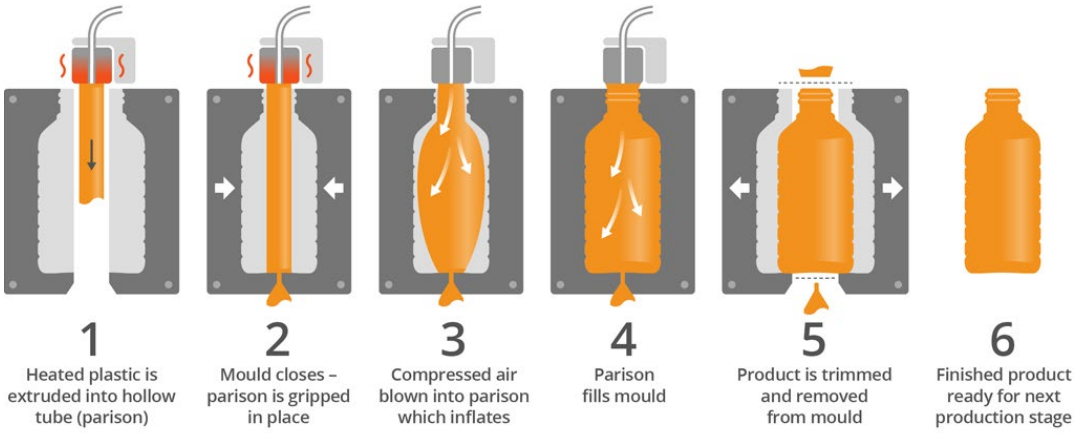
7.1.5.3. Extrusion

Extrusion moulding uses a very similar process as injection moulding. The machine still melts the plastic. Rather than filling a mould with the plastic, to produce piece by piece, the machine presses the melted plastic continuously through a die that gives the plastic a fixed shape. The extrusion moulding process functions well in the production of a wide range of 'lengthwise shaped' products, such as tubes, pipes, door frames (profiles) and seals.
Extrusion moulding is the first step in the production of PP ropes.

Typical plastic extruded profiles and tubes

7.1.5.4. Blow Moulding

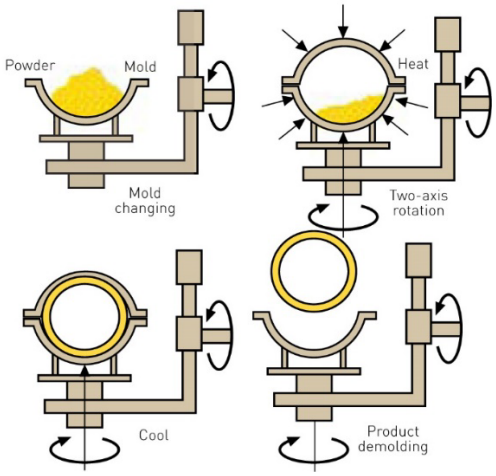
Several variations of the blow moulding process exist. The essential process calls for the production of a hollow, pre-shaped length of melted thermoplastic, known as a parison. A mould closes around the parison. Air pressure forces the hollow plastic to expand into the mould shape, leaving the interior of the object hollow.
Variations on the blow moulding process include injection and extrusion blow moulding as well as stretch blow moulding. Manufacturers employ blow moulding processes to make bottles and other containers.
Blow moulding tools (moulds) are generally cheaper than injection moulding tools due to the limited detailing and finishing options of the technique and the lower pressure they have to withstand. That's why this method is generally used for cheaper products with less technical functionality, that run in large quantities.
The best example for this method is our classic blow-moulded swing seat.



Extrusion blow moulding process steps

7.1.5.5. Rotational Moulding

Rotational moulding is an option for manufacturing (very) large hollow objects. During the rotational moulding-process, a plastic powder goes in the mould before heating. The closed mould enters a furnace and rotates, which allows the plastic powder to coat the entire interior of the mould. The heat melts the plastic into a single layer that conforms to the shape of the mould cavity, while leaving the interior of the final product hollow. Manufacturers use rotational moulding to create products and components for a wide range of uses, including automotive components, toys and furniture.
KBT uses rotational moulding for large products such as the Bronco slide and the Octopus ball-catcher.



Rotational moulding process steps

7.2. Elastomer & rubber

Rubber-like solids with elastic properties are called elastomers. Elastomers are essentially also a form of plastic polymers, but due to their specific mechanical behaviour they deserve a separate category.
Polymer chains are held together in elastomers by weak intermolecular forces. These weak binding forces permit the polymers to be stretched. Natural rubber, neoprene rubber and ethylene- propylene-diolefin-monomer (EPDM) are all examples of elastomers.

Rubber is used extensively in many applications and products, either alone or in combination with other materials. In most of its useful forms, it has a large stretch ratio and high resilience, and is extremely waterproof. Natural rubber is harvested in the form of latex from the rubber tree. While synthetic rubber, like other polymers, is made from various petroleum-based monomers. Although it exhibits many excellent properties in terms of mechanical performance, natural rubber is often inferior to certain synthetic rubbers, especially with respect to its thermal stability and its compatibility with petroleum products (like oils or paints).

Elastomers are usually **thermosets** (requiring vulcanization) but may also be **thermoplastic**. Thermoplastic elastomers (TPE), are a physical mix of polymers which consist of materials with both thermoplastic and elastomeric properties. Thermoplastic elastomers are relatively easy to use in manufacturing, for example, by injection moulding.

TPE materials have the potential to be recyclable since they can be moulded, extruded and reused like plastics. Natural rubbers are usually not recyclable owing to their thermosetting characteristics. Thermosetting rubbers also require compounding. This means they are mixed according to a recipe during production, before they are put into shape. TPE's on the other hand are bought as a ready-to-use raw-material, with no need to add reinforcing agents, stabilizers or cure systems. This leads to TPE's having better consistency in both raw materials and fabricated articles. TPEs consume less energy to produce, can be coloured easily by most dyes, and allow economical quality control.

Rubber types used by KBT	
TPE	
EPDM	
SBR	

7.2.1. Types and characteristics

- *Natural rubber* has a wide variety of uses. It is naturally air and water tight, which makes it suitable for applications such as garden hoses, rubber boots, balls and balloons. It also has a high resistance to abrasion, which is ideal for use in conveyor belts and car tires. The coefficient of friction of rubber, which is high on dry surfaces and low on wet surfaces, leads to its use for power-transmission belting and for water-lubricated bearings (for example in water pumps)
- *styrene-butadiene rubber* (SBR) is a commodity material which competes with natural rubber. These materials have good abrasion resistance and good aging stability when protected by additives. About 50% of car tires are made from various types of SBR. Other uses include shoe heels and soles, gaskets (seals), and even chewing gum.
- *Ethylene-propylene-diolefin-monomer* (EPDM) is most commonly used in seals, tubes, drive-belts or electrical insulators (cables). The main properties of EPDM are its outstanding heat, ozone, and weather resistance which makes it suitable for outdoor use in roofing materials. Coloured EPDM granules are mixed with polyurethane binders to create a non-slip, soft, porous safety surface for wet-deck areas such as pool decks and as safety surfacing under playground equipment, such as our rubber tiles.
- *Neoprene rubber* is used in a wide variety of applications, such as laptop sleeves, orthopaedic braces (wrist, knee, etc.), electrical insulation... It is highly resistant to heat and chemicals such as oil and gasoline, and is therefore used in fuel hoses and as an insulating material in machinery. A foamed neoprene containing gas cells is used as an insulation material, most notably in wetsuits.
- Thermoplastic polyurethane (TPU) is one of the most commonly used types of thermoplastic elastomers. TPU's have an interesting combination of properties, including good elasticity, transparency, and resistance to oil, grease and abrasion. TPU has many applications including automotive instrument panels (dashboards), caster wheels, handgrips for power tools, soles for

footwear, inflatable rafts, and a variety of extruded film, sheet and profile applications. TPU is also a popular material found in outer cases of mobile electronic devices, such as mobile phones. Depending on its composition, TPU's can have a more or less rubber like behaviour.

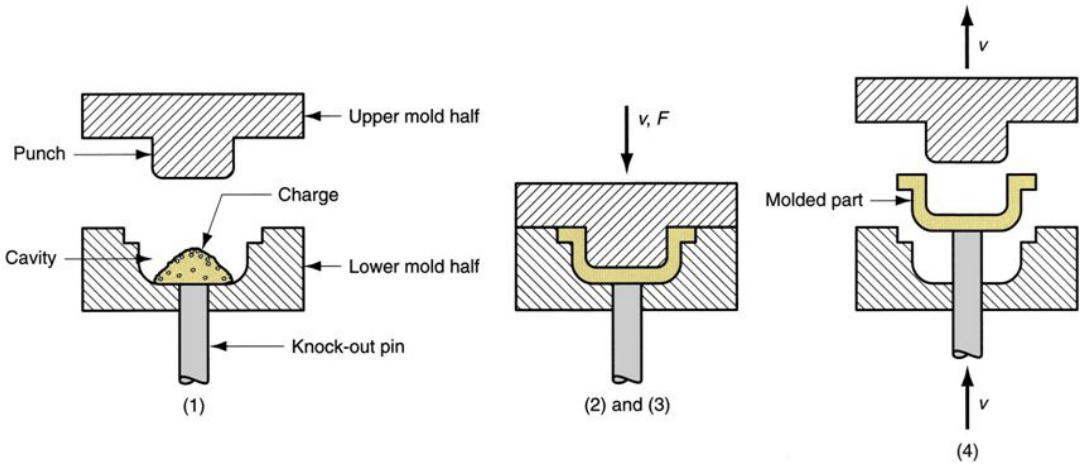
Other examples of elastomers are silicone-rubber used in kitchenware and elastane (spandex) used in the textile industry to make fabrics more elastic.

7.2.2. Production methods

Production methods for thermoplastic elastomers are mostly the same as for other polymer materials. This includes injection moulding, extrusion,…

Thermosetting rubbers are shaped, using casting or moulding techniques related to the above, but because of their thermosetting characteristics, they require additional compounding and curing steps. First the base material is prepared, or compounded out of various ingredients. This can be a manual process of mixing different powders or liquids together, or it can be a pre-fabricated piece of uncured rubber that has been formed to a controlled weight and shape in advance.

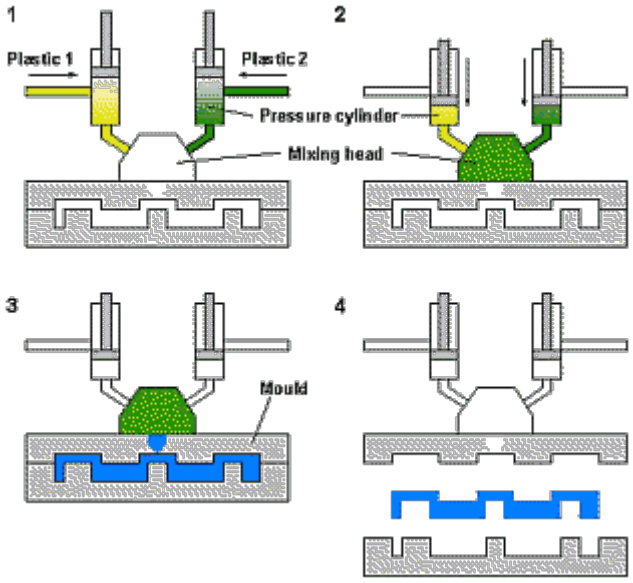
The 'charge' is loaded into a (heated) mould. The mould closes, melting the base materials and pressing the charge into shape. The material is cured and the mould opens again, the finished product is ejected and can be removed.



7.2.2.1. Reaction Injection Moulding (RIM)

Reaction injection moulding is similar to injection moulding and can be used for thermosetting polymers. The two (or more) reacting components of the polymer are mixed together, usually by injecting them under high pressure into an impinging mixer. Then the mixture is injected under lower pressure into a mould. The mixture is allowed to sit in the mould long enough for it to expand and cure. Unlike other (manual) casting techniques, the RIM process can run automatically. This is a huge benefit in terms of cycle times, quality and costs.

RIM is used in many industries and for many materials like thermosetting PUR or different types of rubber.



The RIM process steps

7.3. Ropes

It's clear that ropes are an important part of the business of KBT and also the origin of the company. KBT uses ropes in all swing-seats, climbing nets, armed rope products,…

7.3.1. Types and characteristics

KBT uses 4 main types of ropes. **twisted PP-rope, Poly-hemp rope, braided PP-rope and armed PP-rope**. The main component for all 4 types is PP or Polypropylene. PP consists of very long polymers which – during an extrusion process - will be oriented in the direction of the material flow, for example when the material is spun into long strands. This makes the material very strong and tough, especially when loads are applied in the length-wise direction (of long objects like ropes). PP is easy to work with, is very light-weight and has very little moisture absorption. On the other hand, PP has limited resistance to ultraviolet light, so all PP ropes must be made from PP materials with additional UV stabilizers.

Poly-hemp and classic PP rope with black injection moulded rope-welds and metal rings

Natural hemp-rope has the disadvantage that it will absorb water, is sensitive to impact from bacteria and will easily rot, it is relatively expensive and has a lower breaking strength than PP-rope. On the other hand, its natural look is appealing to many people. For this reason, a synthetic hemp was developed, that we know as **Poly-hemp**. From the outside, poly-hemp looks a lot like natural hemp, but it is made from PP material and has more-or-less

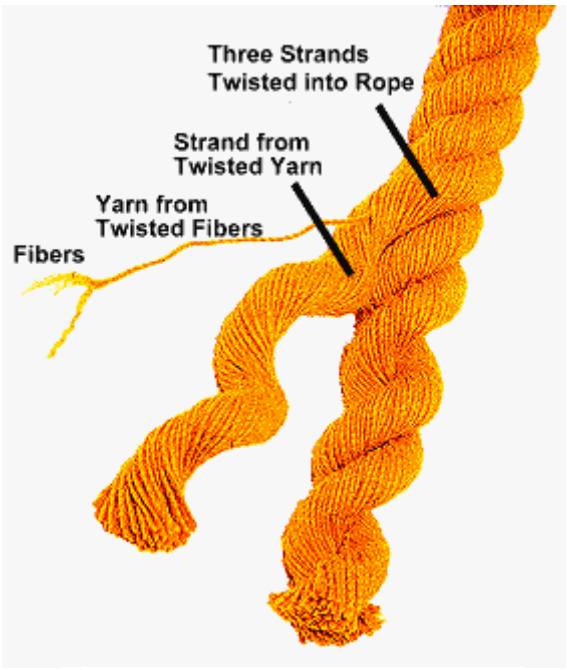
the same characteristics as classic PP-rope. Surprisingly, poly-hemp ropes feel softer to the hands than natural hemp-ropes. Because of additional production steps, poly-hemp rope is more expensive than classic PP-rope.

Although there are different variations of steel reinforced ropes available, using various layouts and materials, for our **armed rope**, KBT uses a 6 strand, 16mm PP based rope, twisted around a PP core. The 6 outer strands have a steel inner core. Armed ropes are used in all pyramid nets, firries and rope structures for commercial use.

Armed (Steel reinforced) rope

7.3.2. Production methods

Twisted rope, also called laid rope, is historically the prevalent form of rope. Common twisted rope generally consists of three or four strands and is normally right-laid, or given a final right-handed twist.
Twisted ropes are built up in three steps. First, fibres are produced using an extrusion technique. These fibres are gathered and spun into yarns. A number of these yarns are then formed into strands by twisting. The strands are then twisted together to lay the rope. The twist of the yarn is opposite to that of the strand, and that in turn is opposite to that of the rope. It is this counter-twist, introduced with each successive operation, which holds the final rope together as a stable, unified object.
Poly-hemp has mostly the same production steps, but the yarns are artificially damaged first, to mimic the look of natural hemp. Before the yarns are twisted into strands, they are run over a range of pinned rolls to break the outer structure and split some of the fibres. The slightly damaged fibres give the rope its natural look and soft feeling.
Modern **braided rope** consists of a braided (tubular) jacket over strands of fiber (these may also be braided). Braided rope have particular advantages over twisted rope. Most of all because braided rope cannot be split or kinked. Ropes that can split give a higher risk of finger entrapment. Furthermore, braided ropes do not impart an additional twisting force when they are stressed, which means a load can be suspended in a stable position, using only 1 rope. This is useful, for example in ropes used for rock-climbing or abseiling.



Twisted rope (left) vs. Braided rope

7.3.3. Good to know:

- Twisted ropes have a preferred direction for coiling. Normal right-laid rope should be coiled clockwise, to prevent kinking. Coiling this way imparts a twist to the rope. Rope of this type must be bound at its ends by some means to prevent untwisting.
- One property of laid rope is partial untwisting when used. This can cause spinning of suspended loads, or stretching, kinking, or hockling of the rope itself.

7.4. Metals

The word metal is quite a broad and vague term, and not something you can define precisely. But when we talk about metals, we're usually referring to chemical elements that are solid, have a relatively high melting points, are hard, strong, durable, shiny, silvery gray in color, good conductors of electricity and heat, and easy to work into various different shapes and forms (such as thin sheets and wires).

Quite a lot of the metal-like materials around us are actually alloys: metals that have been mixed with other materials (metals or non-metals) to make them stronger, harder, lighter, or superior in some other way.
An **alloy** is a mixture of two or more elements in which the main component is a metal. Most pure metals are either too soft, brittle or chemically reactive for practical use. Combining different ratios of metals as alloys modifies the properties of pure metals to produce desirable characteristics. Of all the metallic alloys in use today, the alloys of iron (steel, stainless steel, cast iron…) make up the largest proportion. Iron alloyed with various proportions of carbon gives low, mid and high carbon steels, with increasing carbon levels reducing ductility and toughness. The addition of silicon will produce cast irons, while the addition of chromium, nickel and molybdenum to carbon steels (more than 10%) results in stainless steels.

Metals are usually sold in the form of semi-finished products such as sheet-metal plates, strips, various sized tubes, wires, rods and bars.

7.4.1. Types and characteristics

7.4.1.1. Ferrous-metals

The term "ferrous" is derived from the Latin word meaning "containing iron". This can include pure iron, such as casted iron, or an alloy such as steel. Ferrous metals are often magnetic, but not exclusively.
Ferrous metals include mild steel, carbon steel, stainless steel, cast iron, and wrought iron. These metals are primarily used for their tensile strength and durability, especially mild steel which helps hold up the tallest skyscrapers and the longest bridges in the world.
Due to the high amounts of carbon used when creating them, most ferrous metals and alloys are vulnerable to rust when exposed to the elements. An exception to this rule is stainless steel, which is protected thanks to its high chromium content. Nonetheless it’s a good rule of thumb that, if you see rust, it’s probably a ferrous metal.

7.4.1.2. Non-ferrous metals

Ferrous metals and alloys contain iron; non-ferrous materials do not. Non-ferrous metals include aluminum, brass, copper, nickel, tin, lead, and zinc, as well as precious metals like gold and silver. While non-ferrous metals can provide strength, they are primarily used where their differences from ferrous metals can provide an advantage.

Copper alloys such as bronze, have been known since prehistory—bronze gave the Bronze Age its name—and have many applications today, most importantly in electrical wiring. The alloys of aluminium, titanium and magnesium have been developed relatively recently. Their main characteristic is their low weight compared to a relatively high tensile strength. Aluminium, for example is both stronger and has a higher elasticity that common steel. They are often used in situations where high strength-to-weight ratio is more important than material cost, such as in aerospace and some automotive applications.

Ancient bronze tools and weapons

Non-ferrous metals are much more malleable than ferrous metals. For instance aluminum can easily be moulded, just like plastics.

Because they contain no iron, non-ferrous metals have a higher resistance to rust and corrosion, which is why you'll find these materials in use for gutters, water pipes, roofing, and road signs. Finally, they are also non-magnetic, which makes them perfect for use in small electronics and as electrical wiring.

Various die-casted aluminium parts

7.4.2. Production and processing methods

7.4.2.1. Welding

Welding is a process that joins metals, by melting the material and causing fusion. In addition to melting the base metal, a filler material is typically added to the joint to form a pool of molten material (the weld pool) that cools to form a joint that is usually stronger than the base material. Many different energy sources can be used for welding, including a gas flame, an electric arc, a laser, an electron beam, friction, and ultrasound.
Welding is a hazardous undertaking and precautions are required to avoid burns, electric shock, vision damage, inhalation of poisonous gases and fumes, and exposure to intense ultraviolet radiation.

Welding is distinct from lower temperature metal-joining techniques such as brazing and soldering, which do not melt the base metal. Although less common, there are also solid state welding processes such as friction welding in which metal does not fully melt to a liquid state. Welding is commonly used for metals, but some types of welding are also used for plastics.

There are various types of welding, each having their own characteristics and possibilities.

- **Gas-welding:** uses fuel gases and oxygen to weld and cut metals.
- **Shielded electrode welding:** uses an electrode and electric current to melt the metal. The electrode has 'flux' around it that turns into a gas, that will protect the weld puddle and electric arc during the welding process. The electrode is a consumable as it slowly melts away during welding. Electrodes are fairly thick and while welding 'slag' is created on top of the weld-pool, that needs to be removed when the weld has cooled down. This creates a more-or-less rough weld. The process is difficult to automate and control and is therefore mostly used in small (private) workshops and for small series.
- **TIG-welding** (tungsten, inert gas), uses a non-consumable tungsten electrode to produce the weld. The weld area is protected from atmospheric contamination by an inert shielding gas such as argon or helium. A filler material is added separately from the electrode in the form of a clean metal wire. The electrode can be made very thin and the shielding gas creates a stable arc. This makes the TIG process suitable for very small and precise jobs.
- **MIG-welding** (metal, inert gas), also called semi-automatic welding is the most commonly used welding method. MIG uses a wire feeding gun that feeds wire at an adjustable speed and flows an inert shielding gas such as argon or helium over the weld-arc to protect it from atmospheric contamination. Because the electrode and the filler material are one and the same and the arc is protected by an externally added shielding gas, this process is easy to automate and creates a clean and finished weld in one go. Unlike electrode welding, no slag is created. Due to the relative thickness of the wire it is less usable for precise work than TIG welding
- **Electric resistance welding** is a welding process where heat to form the weld is generated by the electrical resistance of the base material. It is usually used to join thin sheets. 2 resistance electrodes are pressed on both sides of the sheets and electric current flows through the electrodes. The current creates heat in between the sheets to fuse them locally. In general it is an efficient and clean method, but it is limited to relatively thin materials. This process is used in different forms such as **spot welding**, where the weld has the shape of small dots, **roll-welding** where the weld forms a thin line.

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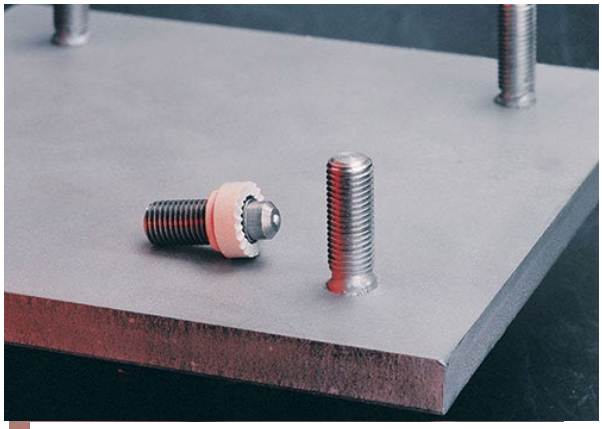


Threaded studs can be fused to a plate using Electric resistance welding

Robot operated spot welding is used to build car bodies

Examples of welded KBT products

7.4.2.2. Forming processes: Punching, bending, cutting

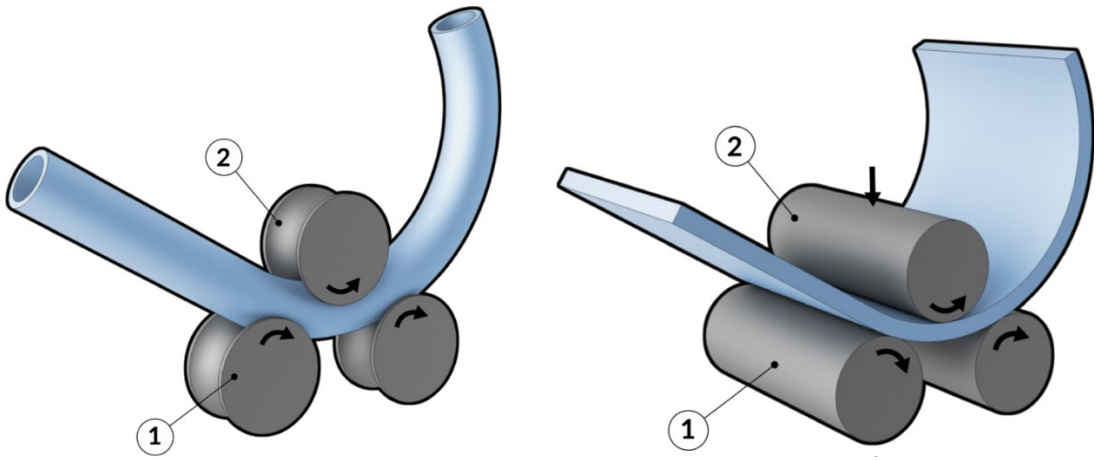
Forming, metal forming, is the metalworking process of fashioning metal parts and objects through mechanical deformation; the workpiece is reshaped without adding or removing material, and its mass remains unchanged. Forming operates on the materials science principle of plastic deformation, where the physical shape of a material is permanently deformed.

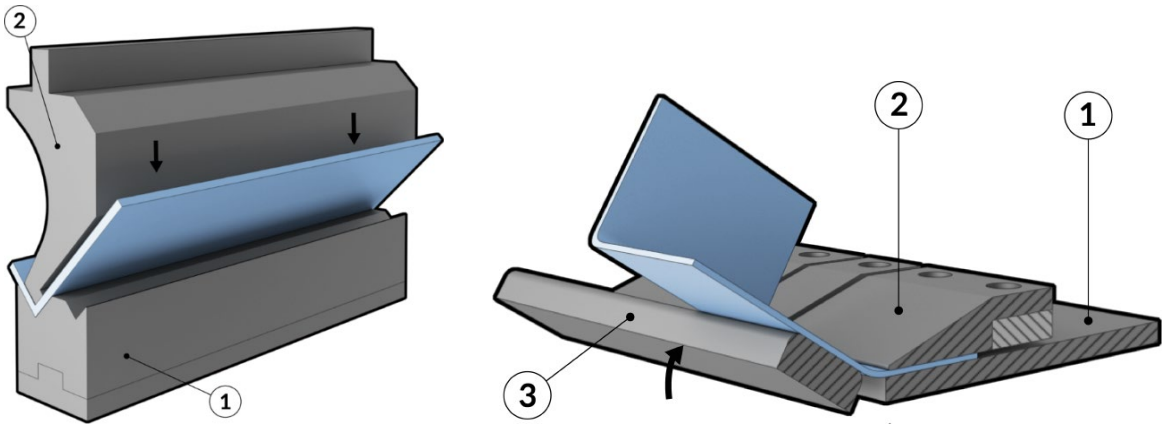
On the industrial scale, forming is characterized by:

- Very high loads and stresses required, between 50 and 2500 N/mm²
- Large, heavy, and expensive machinery in order to accommodate such high stresses and loads
- Production runs with many parts, to maximize the economy of production and compensate for the expense of the machine tools

Examples of forming processes include:

- Rolling, where the material is passed through a pair of rollers
- Extrusion, where the material is pushed through an orifice
- Die forming, where the material is stamped by a press around or onto a die
- Stretching, where a tensile load is applied along the longitudinal axis of the workpiece
- Expanding, where the circumference of a hollow body is increased by tangential loading
- Bending





7.4.2.3. Cutting/machining processes: Milling, turning

Machining is any of various processes in which a piece of raw material is cut into a desired final shape and size by a controlled material-removal process. The processes that have this common theme, controlled material removal, are today collectively known as subtractive manufacturing, in distinction from processes of controlled material addition, which are known as additive manufacturing.

The three principal machining processes are classified as turning, drilling and milling. Other operations falling into miscellaneous categories include shaping, planing, boring, broaching and sawing.

- Turning operations are operations that rotate the workpiece as the primary method of moving metal against the cutting tool. Lathes are the principal machine tool used in turning.
- Milling operations are operations in which the cutting tool rotates to bring cutting edges to bear against the workpiece. Milling machines are the principal machine tool used in milling.
- Drilling operations are operations in which holes are produced or refined by bringing a rotating cutter with cutting edges at the lower extremity into contact with the workpiece. Drilling operations are done primarily in drill presses but sometimes on lathes or mills.

More recent, advanced machining techniques include precision CNC machining, electrical discharge machining (EDM), electro-chemical erosion, laser cutting, or water jet cutting to shape metal workpieces.

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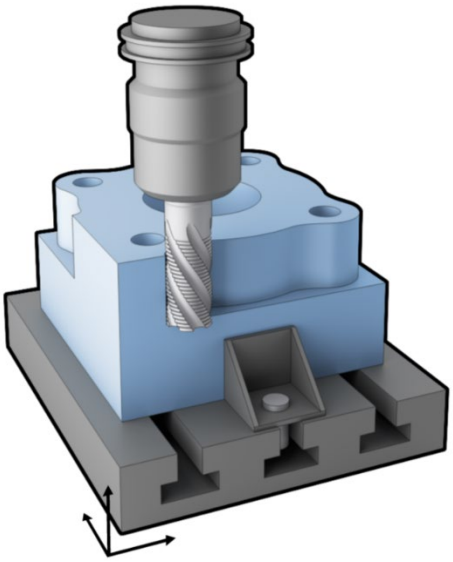
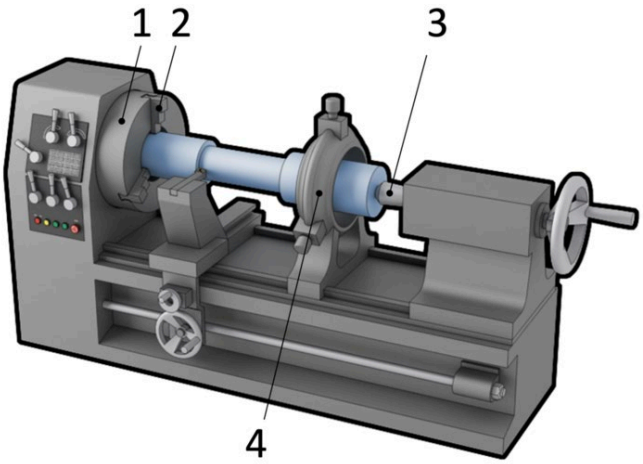
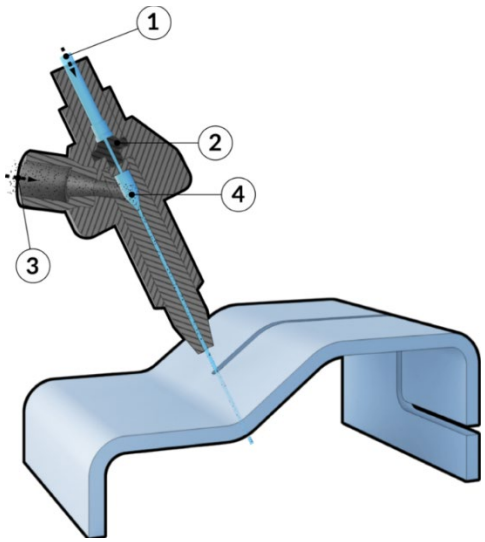
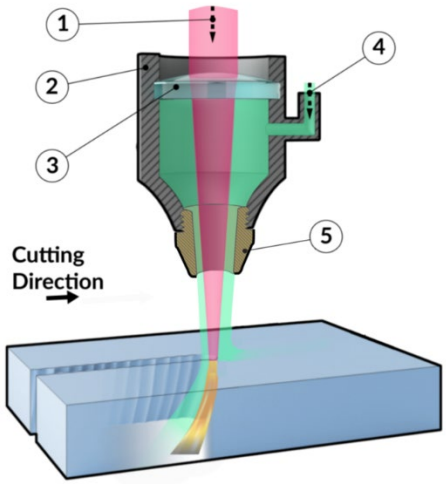




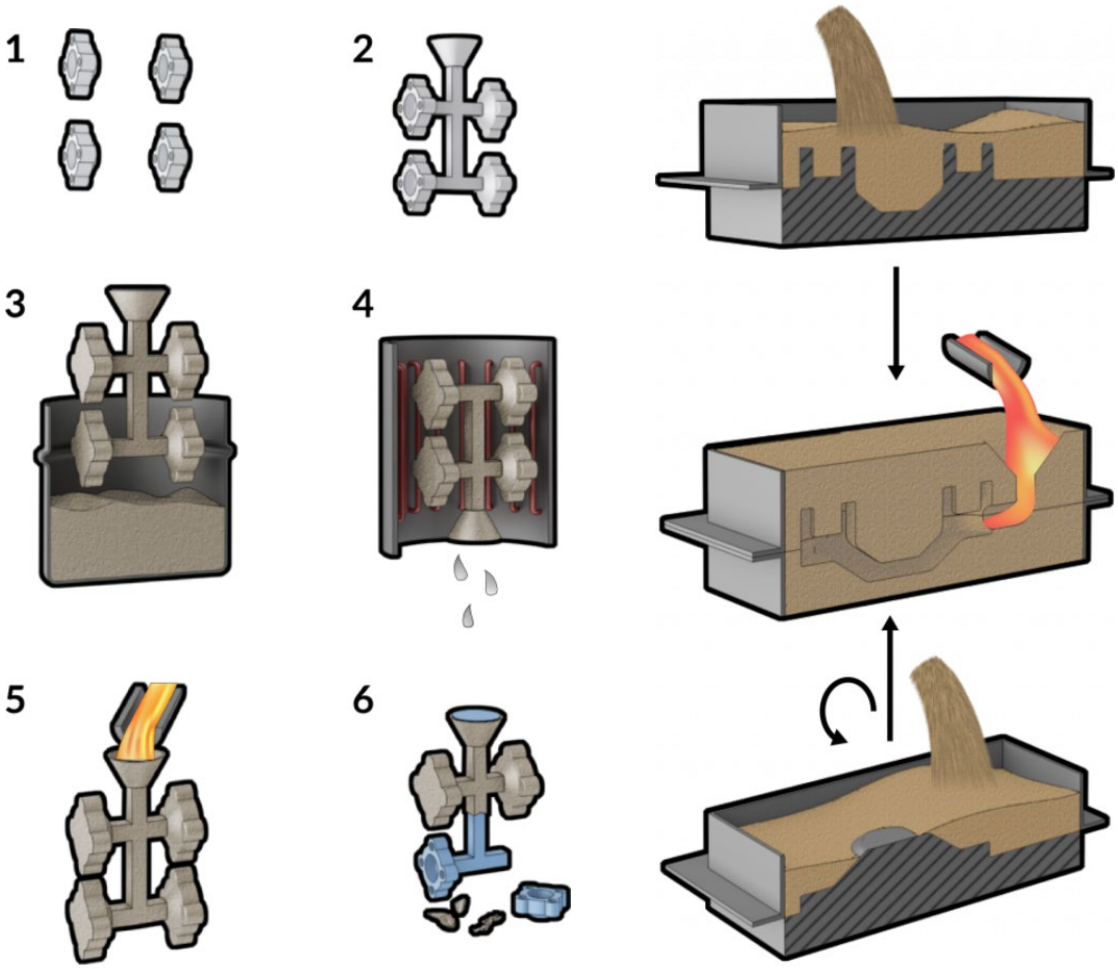




7.4.2.4. Casting and moulding

Casting is a manufacturing process in which a liquid metal is poured into a mould that contains a negative impression (i.e., a three-dimensional negative image) of the intended shape. The metal and mould are then cooled, and the metal part (the casting) is extracted. Casting is most often used for making complex shapes that would be difficult or uneconomical to make by other methods.

Casting processes have been known for thousands of years, and have been widely used for sculpture (especially in bronze), jewellery in precious metals, and weapons and tools. Traditional techniques include lost-wax casting , plaster mould casting and sand casting. The modern casting process is subdivided into two main categories: expendable and non-expendable casting, based on wether the mould can be reused multiple times. It is further broken down by the mould material, such as sand or metal, and pouring method, such as gravity, vacuum, or low pressure.



Lost wax casting

Forming process with one-time form that is created around a wax model where the wax is then melted away to be replaced by molten metal.

The molding process comprises a number of steps where the first is to create a mold intended to produce the exact details of wax copies [1]. The mold is again used to create the sought number of wax copies, further treatment is done to remove any burrs and other inaccuracies.
Wax copies are then fitted to the cast and aeration channels of wax [2] and a cone is also added to the top.
The wax pattern is then dipped into a liquid mixture of silica sand [3].
The wax pattern covered with the mixture is then inserted into a furnace for the mixture to solidify and for the reusable wax to flow out [4].
When the mixture has solidified, the mold is created [5]. It's then preheated and possibly placed in a sand vat to avoid defects when molten metal is poured into the mold.
Once the metal has solidified, the mold is removed with a hammer or a vibrating table. The channels and the metal models [6] are removed, which are then processed to remove any surface irregularities.

Sand casting

Forming process where a sand mold made of green sand is used to create a molded product.

Two separate mold halves are made by covering two master molds with green sand. The dies are then assembled to complete the form and cores are added if required. Then the mold is filled with molten metal, which on solidification is freed from the sand mold usually with a shaker or vibratory rod.

KBT products having casted components

Various casted, welded, machined parts that together make out the pole-twister

7.4.3. Metal coatings

When a metal is exposed to air and humidity, it will (in time) start to rust or corrode. All metals will corrode to some extent, although some types, like aluminium and stainless steel, will stop corroding after a first thin layer of oxidation has formed on the surface. Common steel will not start corroding and will in fact completely disappear over time.
To avoid corrosion in common steel, a protective layer or coating will have to be applied.

The most common types of corrosion protection are hot-dip galvanisation, electro galvanisation, painting and powder coating.

7.4.3.1. Hot dip galvanisation

Hot-dip galvanization is the process of coating iron and steel with zinc. The zinc is applied by immersing the metal in a bath of molten zinc at a temperature of around 449 °C (840 °F). When exposed to the atmosphere, the pure zinc (Zn) reacts with oxygen (O_2) to form zinc oxide (ZnO), which further reacts with carbon dioxide (CO_2) to form zinc carbonate ($ZnCO_3$), a usually dull grey, fairly strong material that protects the steel underneath from further corrosion in many circumstances. Galvanized steel is widely used in applications where corrosion resistance is needed without the cost of stainless steel, and is considered superior in terms of cost and life-cycle. It can be identified by the crystallization patterning on the surface

7.4.3.2. Electro galvanisation

Electro galvanizing is a process in which a thin layer of zinc is bonded to steel involving electroplating by running a current of electricity through a saline/zinc solution with a zinc anode and steel conductor.

7.4.3.3. Powder coating

Powder coating is a type of coating that is applied as a free-flowing, dry powder. Unlike conventional liquid paint which is delivered via an evaporating solvent, powder coating is typically applied electrostatically and then cured under heat or with ultraviolet light. The powder may be a thermoplastic or a thermoset polymer. It is usually used to create a hard finish that is tougher than conventional paint.
The main advantage of powder coating, over galvanisation is the possibility to add colour.

8. Q&A

8.1. Bearing capacity of KBT swings and other products

8.1.1. What is the load bearing capacity for polyhemp and polypropylene rope?

The 12 mm polyhemp rope itself can bear about 13000N in new condition which degrades to about 10000N after 5-6 years. However failure will always happen mostly on the plastic welds used to connect the ropes. We ensure by thorough QC on every production run, that it can hold at least 200 kgs per connection. That means a swing seat with ropes at both sides can certainly hold 400 kgs.

8.1.2. What is the load bearing capacity of swingseats and swinghooks

The recommended user weight for kbt swings is:

- Max user weight of single user swing - commercial: 100-150 kg
- Max user weight of single user swing - residential: 75-100 kg
- Max user weight of multi-user swing - commercial: 600 kg
- Max user weight of multi-user swing - residential: 150 kg

When we do quality testing and development of new swings, we test the swings with a test weight that is at least more than double the recommended user weight for swings. This is to compensate for dynamic forces that will act on a swing when in use.
For safety reasons a test is always applied with static load. Afterall, swinging around a weight of 1200 kg on a swing, is actually dangerous for the people executing the test, especially when you're not sure the swings will be strong enough.
Typical testing loads are like this:

- single user swing - commercial (2 attachments): Max load: 600 kg - load per swinghook: 300 kg (type premium, American,…)
- single user swing - residential (2 attachments): Max load: 200 kg - load per swinghook: 100 kg (type around, through, …)
- Multi-user swing - commercial (2 attachments): Max load: 1200 kg - load per swinghook: 600 kg (type heavy duty,…)
- Multi-user swing - commercial (1 attachment): Max load: 1200 kg - load per swinghook: 1200 kg (type single point SW)
- Multi-user swing - residential (2 attachments): Max load: 300 kg - load per swinghook: 150 kg (type around, through,…)

These values are used for load testing of finished swings. When testing swinghooks separately, we take 600kg/200kg/1200kg/300kg per 1 swinghook as an additional safety factor. All these values are constantly under consideration of context, type of product, reason for testing, commercial evolutions,… So this is not a 100% fixed thing.

8.1.3. How many children can play on a pyramid net?

Our Pyramids (especially the 2.7m) are 4 sided climbing nets. (not special networks). So the allowed number of users can be calculated according to EN1176-A.3.4 “Number of users on an area”

For planes with inclination greater than 60° (this is the case for the average of the net): N = A / 0.72 (N: number of users, A: surface of the net)

A = ((2.5m x 2.8m) / 2) x 4 sides = 14 m² (triangle shape of 1 side x 4 sides)

N = 14m² / 0.72 = 19.4 → 20 children

“20 children” is the number that is used to calculate and test the stability and strength of the pyramid net. This is about the maximum safety load bearing capacity. If your customer asks “how many children can play nicely together on one pyramid”, I would say not more than 5-6 at the same time.

8.1.4. How many children can play on a Firry?

The calculation is similar as the oe above, but now you need to take into account that the firry is shaped like a truncated cone.

The number of children used for calculating and testing the structural capacity → 13 children
Number of children during normal use → maximum 4-5 children.

8.2. Wood products

8.2.1. Why do you place stickers on wooden parts? When you remove it, it will always leave bad mark to the product?

The batch number sticker and TUV label sticker with our address, are supposed to stay on the product for its entire lifecycle.
The supplier of each product must be traceable (a European requirement of the Toy Directive 2009/48/EC) so we place the transparent sticker with product main article code and our address.
In case of product failure we like to know the production batch number to facilitate tracing back the origin of the problem, who else received it, to block stock articles etc. From a personal point of view it’s understandable you want to remove the stickers for aesthetic reasons. From a legal and business point of view we cannot agree with this.

8.2.2. What type of wood is used for wooden products ?

Treated pinewood swingseat (120.x);	Pinewood	masson pine Pinus sylvestris	Origin: China, Origin: Russia
Hardwood swing seat (121.x; 119.x)	Hardwood	Castanopsis Hystrix Kembat	Origin: China
Multiplex monkey swing (152.x); multiplex gym rings (238.x)	Poplar	poplar	Origin: China
Canvas babyswing (001.090.103.003	Hardwood	beech	Origin: US.

Fun pack (226.x)	Hardwood	Kembat	Origin: China
Wooden trapeze (210.x; 211.x; 225.x; 220.x)	Hardwood	Castanopsis Hystrix White Mahogany maple	Origin: China

8.2.3. What type of wood preservation do we use?

We use a wood preservation method based on dipping the raw wood in a wood preservation agent. First we need to make preservatives. ACQ-D wood preservative is mainly composed of copper and DDAC(quaternary ammonium salt).the ratio of ACQ-D wood preservative to water is 1 to 20 .then soak the raw material of pinewoods in preservatives for ten minutes ,and let it dry naturally. when its surface humidity is lower than 16 degrees, it can be used for production.
The ACQ-D wood preservatives we use have the qualification certificate provided by preservative Supplier. It meets standard of SB/T 10404-2006.We also sent preservative treated products to the Laboratory.

8.2.4. What is the main component in chemicals for timber treatment, causing the green colour?

Copper

8.3. Metal products

8.3.1. What type of steel/ stainless steel/ aluminium do you use for products?

Common steel: standard A360 / S235 construction steel

Stainless steel: We use only type 304 (EN 1.4301) stainless steel. This is the most commonly available. Other types of steel are more expensive, not available everywhere and Chinese quality is debatable

Aluminium: All aluminium, unless otherwise specified, is ALU6061.

8.3.2. What is the thickness of the galvanisation layer?

Hot-dip galvanisation: The thickness of the galvanisation layer > 80µm at any place.
Electro galvanisation: The average thickness of the galvanisation layer shall be > 15µm

8.4. Chemical compliance and safety standards

8.4.1. What is the function of Phthalates in plastics ?

Weakeners in plastic are used to make the material softer or rubber-like. Used only in Vinyl holding materials like PVC. It was in the past often used in soft gripping and biting toys for toddlers. KBT products are free from Phthalates

8.4.2. Which children are most likely to come in contact with phthalates and why ?

< 36 months : take the product in the mouth

8.5. Physical compliance and safety standards

8.5.1. What is the maximum opening (for finger entrapment) in chains?

Chains for public playground equipment shall conform to ISO 1834 as a minimum and shall have a maximum opening of 8,6 mm in any one direction except where connections are made, where the maximum opening shall be greater than 12 mm or less than 8,6 mm.

Maximal opening in chains residential products is 5mm, according to EN71-8.

8.6. Colours

8.6.1. Why do we have colour differences in different batches of one colour of our slides ?

A large part of the material is RECUPERATION or RECYCLED material. Our slides are mostly made from recycled beverage crates. Because there are different brands of beverages, with different colours, it can happen that a batch of recycled plastic has slightly varying colours.

All batches of recycled plastic are tested for chemical and physical compliance and colour variations are kept between certain boundaries. Because colour is not a 1 dimensional feature (colours can vary in hue, tone, saturation and intensity), defining exact boundaries is not possible and it is very difficult to examine on a finished product. Therefore it is possible that colours vary significantly between production batches. We do our best though to keep this to a minimum.

8.6.2. Why is there a colour variation on the surface of the slides? Why is there a white-ish texture on the slides?

KBT slides are produced with a technique called ‘gas assisted-injection moulding’. For this ‘gas’ we use a foaming agent that is mixed in the molten plastic. The gas assures that during injection, the pressure is more or less even in the mould and we can inject the molten plastic with a lower injection pressure and lower closing force on the mould. It will also help to fully form the part because the molten plastic will be pushed by the gas into the extremities of the mould. This technique is used, because slides are long and narrow products that can be hard to produce using conventional techniques.

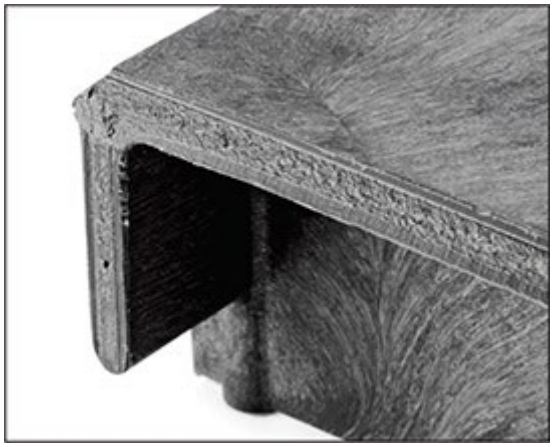
The result is what is commonly known as a structural foam product. If you would cut a slide, you would see small air bubbles on the inside of the material. This makes the products more light, while still having relatively thick walls. See image attached for a visual.

This gas is what creates the specific visual appearance and functional ‘sliding properties’ of the slide. On the surface of the slides you will notice a pattern of very fine white lines. This is known in the plastics industry as ‘silver streak’ (look in Google: “Silver streak injection moulding”). Usually it is seen as a problem-to-be-solved, but in our case this is actually the core strength of the slides.

During the injection of the molten plastic in the mould, the gas will be pushed outwards towards the walls of the mould. There it will come into contact with the hot surface of the mould. Because of the pressure and the movement of the melt, the small gas bubbles will be stretched out in the direction of the flow. This creates the fan-shaped patterns of small white lines, emerging from the injection points.

Next to the visual appearance, the gas injection will also create the functional sliding properties of our slides. The white lines will create a microscopic surface texture that is responsible for the fact that the surface is extremely slippery. This seems contradictory, but it's not. When a surface would be totally smooth, you would actually stick to it very easily. You can compare this to a glass object. Glass is extremely smooth and when you strike your finger over a glass surface, you finger will slightly stick to it.
So, because this slippery surface of our slides is very difficult to recreate using conventional moulding techniques, the gas injection technique is the best way to produce our slides.

One question that often pops up is, why this effect is more visible for Yulvo and Tsuri compared to our old Classic slides. This is caused by the different wall thicknesses. When products have a thinner wall, the gas has less room to spread out and will be pressed faster against the wall. This will make the fan-shaped pattern more clear. So the thinner the slide, the more clear the pattern. Also for darker colours, the white pattern will be more visible.



8.6.3. What do we do to keep these differences to a minimum ?

Colour tolerances have been agreed with the production department, based on samples. Colour master batches are added to the mass material, to correct the colour variation of the recycled material and to acquire the desired colour.

8.6.4. What is the specific colour of our products?

KBT colour description	Product category	Colour system code
RED	Swingseats, imagination,slides, powder coating	RAL 3020
RED	Climbing stones	RAL 3000
RED	Rubber tiles	RAL 3009
RED	Armed ropes	PMS 1795 C

ORANGE	Swingseats, Imagination items	RAL 2009
YELLOW	Slides, Swingseats, imagination, Armed ropes	RAL 1023
YELLOW	Climbing stones	RAL 1003
LIME GREEN	Slides, Swingseats, imagination	PMS 389U
APPLE GREEN	Slides	RAL 6018
OLIVE GREEN	Slides	PMS 383C
GREEN	Swingseats, imagination, Climbing stones, Slides	RAL 6005
GREEN	Armed ropes	PMS 3288 C
TURQUOISE	Swingseats, imagination, Slides	RAL 5021
BLUE	Armed ropes	PMS 300 C
BLUE	Swingseats, imagination, Slides	RAL 5002
BLUE	Climbing stones	RAL 5003
BLUE	Blue Rabbit	RAL 5010
BLUE (ROTOMOULDED)	various (spec needs, bronco …)	RAL 5005
PURPLE	Swingseats, imagination, Slides	RAL 4006
GREY	telescope	RAL 7010
ANTRACITE	Slides	RAL 7016
BROWN	Armed ropes	RAL 075 70 20
BLACK	Swingseats, nest swings, construction, Armed ropes	PMS PROCESS BLACK

8.7. Slides

8.7.1. Why do our KBT slides have a more smooth look without visual compartments compared to slides of the competition where you can see clearly the mould compartments ?

Because we use a low pressure injection system with multiple injection points and different timing of injection

8.7.2. Which system does KBT use to reach this result and how does it work ?

We use the Cascade system : injection is done in multiple points but NOT at the same time creating a “cascade” of injection into the mould and a better distribution of the plastics. Each injection point is activated at a different moment in time.

8.7.3. Why has KBT never communicated about the fact that slides are made from recycled plastics?

Some years ago, the KBT policy was to not inform our customers about this aspect of the business, because (1) the public might think that recycled materials would be less strong or technically inferior (which is partly true: we say that PE loses about 20% of its strength after multiple recycling loops) and (2) because we are never exactly sure about chemical composition and possible pollutions which may make our slides non-REACH

compliant (Which is also true, because for example, beverage crates that have been stored close to a highway, may contain higher levels of PAH's).

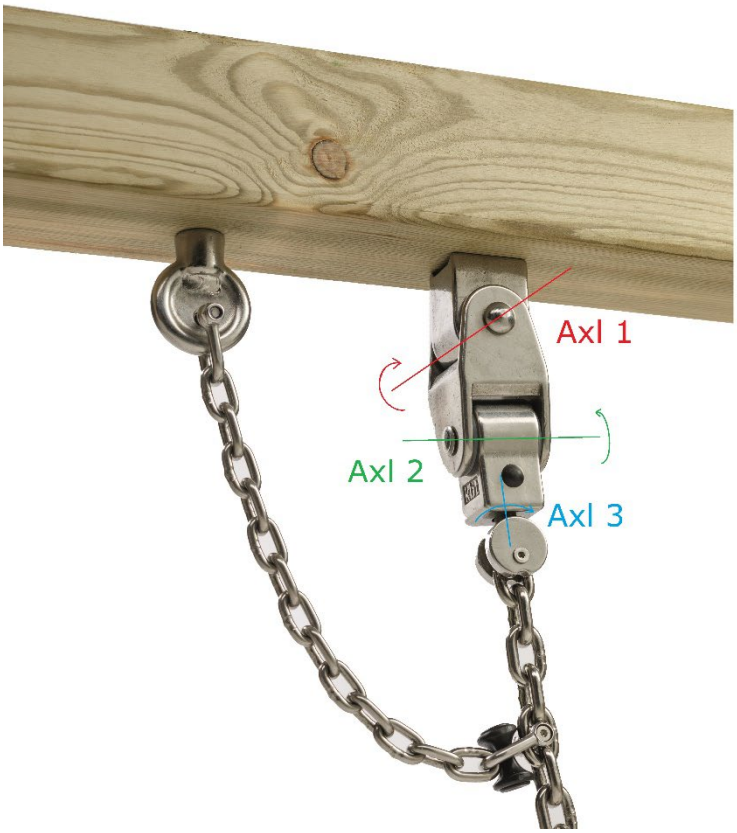
Of course we are now 2019 and minds have shifted about recycling materials. KBT and HSV have adopted new techniques to test recycled materials for chemical compliance and safety (using a infra-red spectroscopy devise), so nowadays we are more confident in the quality and compliance of our products.

We still leave it up to you to know your market and your customers and to decide what to do with this info.

8.8. Swings

8.8.1. What is the function of the cardan-joint for groupswings

The function of the cardan joint is to adjust the orientation of the primary swing-joint (Axl-2) in the direction of the chains. The direction of the chains for groupswings, can have very different orientations, depending on the type of swing that is used; for example for Nest swings, Thick-rope swings (Goliath) or Hammocks the position of the swing-hooks and chains is different.
The function of each of the joints of the cardan-swinghook is explained below.



Axl 1: Adjusts the hook, so that Axl 2 is oriented perpendicular to the direction of the chain.

Axl 2: Is the actual swinging movement. This axle is perpendicular to the direction of the chain, so that the wear in the bearing is balanced and there are no point-loads, that will reduce the lifetime of the set.

Axl 3: This axle can turn freely, but has no bearing. The function is to reduce tension on the chain (that occurs when it is twisted) and to adjust to "small" variations in the movement of the swing (pe. sideways movement or unbalanced torsional movement).

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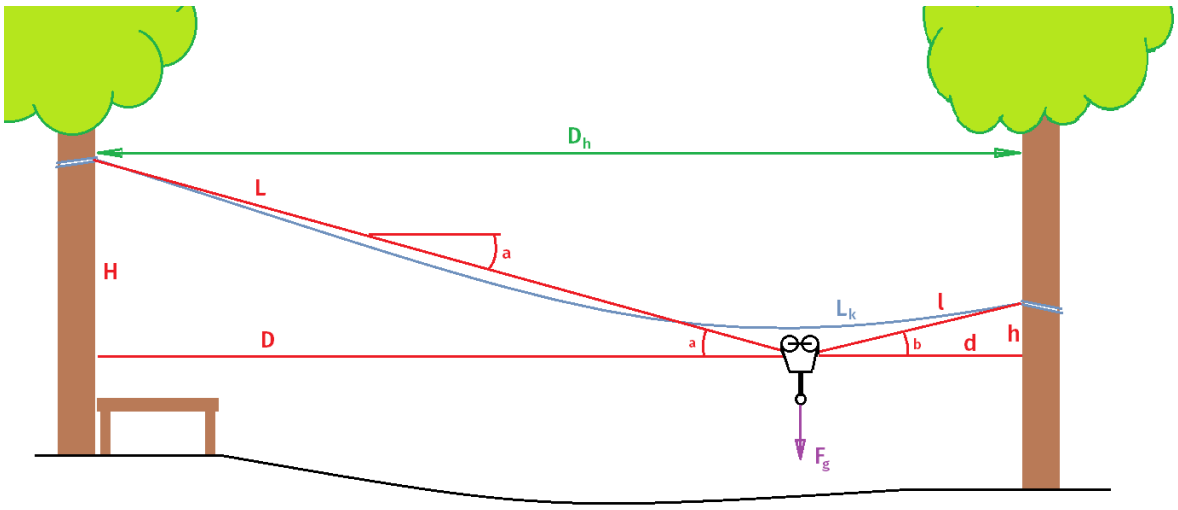
8.9. Zip-wires

8.9.1. Do you have any documentation on what type of material the cable holding device and cable tension device need to be attached to?

The design of the posts and surrounding constructions/landscape is under the responsibility of the playground designers. As KBT we offer the components as standard items, but (like you can see in the field) the possibilities of design of the frames/landscape are endless. This is your designer freedom and will determine the look and feel of your playground. This is why, as KBT, we don't offer a strict design solution for the frames.
If a customer wants a custom design or specialised support in the design of the frames, we can recommend to contact Yves from Increase (www.Increase.be). He can guide you through the whole process of custom design and certification of the complete playground structure and landscaping. Of course this comes at a cost.
As a quick guideline, I can tell you that you can use wood or steel posts. Round wood can be between 15-20cm diameter and must be durable for outside use. Steel posts can be for example around 12cm diameter and have a 2-3mm wall thickness. Steel must be properly treated in a way that is fit for the specific situation. For example powder coated.

8.9.2. What is the force that attachments of a zip-wire installation need to be able to withstand?

The forces on the cable and the structure depend on the specific design of the zip-wire installation. More specifically on the length (distance between connection points of the cable), the principal downward slope (hight difference between connection points) and the cable sag. Because it is dependent on the specific design of the installation, KBT cannot give a definitive answer to this question. Designers will need to calculate the forces and the dimensions of the installation themselves.



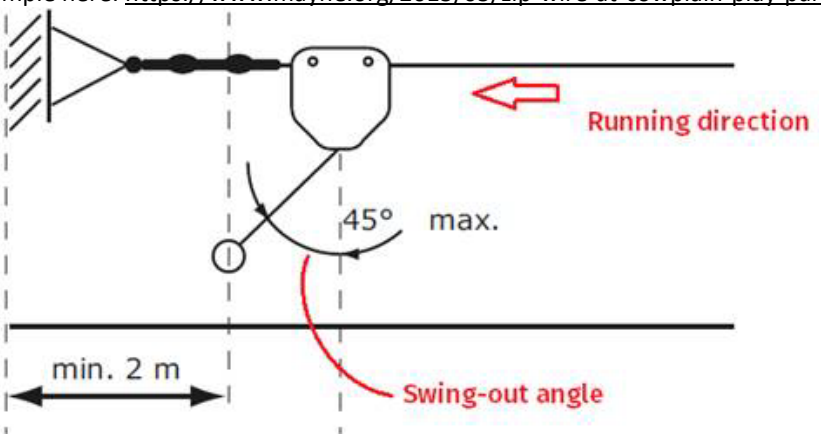
There is an elaborate calculation example available in EN1176 annex A. The table below gives an indication for different standard situations.
FYI: 28,0 kN = 28000 Newtons = 2800 kg. This is the actual realistic load in the cable on both ends, thus also the load on the structure.

Table B.2 — Maximum dynamic tensile cable force in kN

Span m	Initial deflection				
	1 %	2 %	3 %	4 %	5 %
20	28,0	23,6	19,5	16,2	13,6
30	28,3	23,8	19,7	16,4	13,8
40	28,6	24,1	20,0	16,6	14,0
50	29,0	24,3	20,0	16,8	14,1
60	29,3	24,6	20,4	17,0	14,3

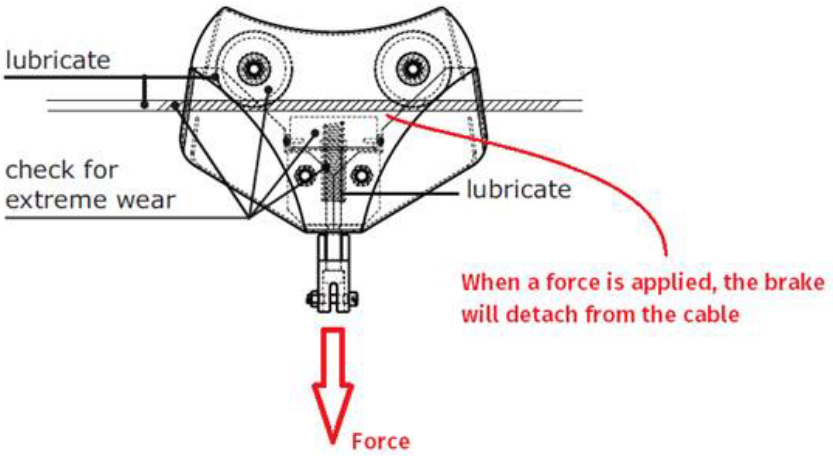
8.9.3. can the cable tensioning device be turned 90deg and used on a vertical round post (rather than horizontal as per instructional diagram)

Yes you can, but I would recommend to always mount the tensioner at the backside of the pole. You will always have to make sure that the (loaded) seat can swing out at the end of the run, so that the user do not smack against the pole.
You can see an example here: https://www.mayne.org/2015/05/zip-wire-at-cowplain-play-park/



8.9.4. How does the Trolley Brake work? What approximate downward seat force/weight is required to release the brake ?

The brake works like indicated in the image below. You would need around 20-30 kg to release the brake.



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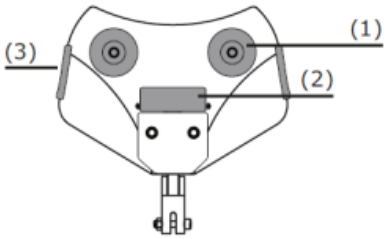
8.9.5. Do you keep stock of the spare parts such as trolley wheels/bearings, trolley brake, and finger protection blocks ?

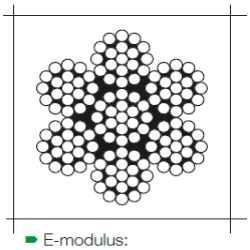
In theory: yes. But as you may know, last week somebody announced that the warehouses in Belgium will be shut down and logistics will be centralised in Poland form January onwards. In this operation 6 of our Belgian colleagues were fired collectively. Some of them had worked for KBT for 15 or more years… But in theory, yes we should have these items in stock.

Available spare parts
1. wheels with ball bearings
2. trolley brake
3. finger protection blocks



8.9.6. What are the specifications of the zip-wire cable offered by KBT?

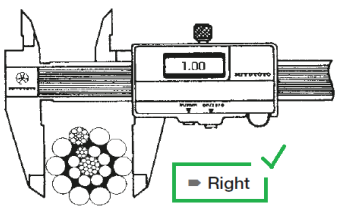
Cable diameter	10 mm
Cable construction	6x19 + WSC (or 7x19)
direction of lay	right hand
type of lay	ordinary
core	Steel core - WSC
surface protection	galvanised
Material tensile strength	steel: 1960 N/mm²
Min. Breaking load cambe	64 kN
Commercially available reference product	RANDERS-REB: E19-0100-203D

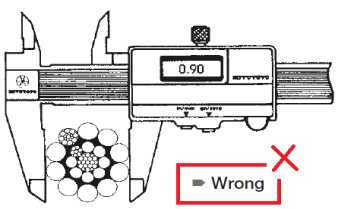


- E-modulus: E = ± 115.000 N/mm²
- Modulus of elasticity: E = ± 115.000 N/mm²

- 7 x 19
- 7 x 19

Diameter / Diameter	Draad diameter / Wire diameter	Sectie / Section	Gewicht/m Weight/m	Breekkracht / Breaking load 1.770 N/mm²	Breekkracht / Breaking load 1.960 N/mm²
mm	mm	mm²	kg	kN	kN
10	0,64	44	0,38	64	71





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9. Picked topics

> The playground is a place of encounters and communication, a place to develop and practice social skills, to experience acceptance and rejection, to develop friendships, and to learn about cooperation. (Hudson & Thompson, 2001)

A glossary of interesting reads about playing, playground design and the playground market can be found here. In the bottom there are some more resources to discover. Off course, this selection of articles is hand-picked by myself as the author of this Book-of-Knowledge. There is much more material available online, in all languages and proposing different points of view. In any case, I think it is important to keep an open mind when reading, try to filter the good and meaningful information from the pseudo-scientific or anecdotal sources. Read a lot and then make up your own mind!

9.1. Play in children's development, health and well-being (jeffrey goldstein)

Why play is important

Play has been defined as any activity freely chosen, intrinsically motivated, and personally Directed. It stands outside 'ordinary' life, and is non-serious but at the same time absorbing the player intensely. It has no particular goal other than itself. Play is not a specific behaviour, but any activity undertaken with a playful frame of mind. Psychiatrist Stuart Brown writes that play is 'the basis of all art, games, books, sports, movies, fashion, fun, and wonder – in short, the basis of what we think of as civilization.' (Brown 2009). As the noted play theorist Brian Sutton-Smith remarked, the opposite of play is not work, but depression.

All types of play, from fantasy to rough-and-tumble, have a crucial role in children's development. Play is the lens through which children experience their world, and the world of others. If deprived of play, children will suffer both in the present and in the long-term. With supportive adults, adequate play space, and an assortment of play materials, children stand the best chance of becoming healthy, happy, productive members of society.

Play and child development

Play is essential to development because it contributes to the cognitive, physical, social, and emotional well-being of children and youth. Play also offers an ideal opportunity for parents to engage fully with their children. Despite the benefits derived from play for both children and parents, time for free play has been markedly reduced. Children today receive less support for play than did previous generations in part because of a more hurried lifestyle, changes in family structure, and increased attention to academics and enrichment activities at the expense of recess or free play.

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YOU CAN DISCOVER MORE ABOUT A PERSON IN AN HOUR OF PLAY THAN IN A YEAR OF CONVERSATION.

Plato

What are the benefits of play in a child's life? According to play therapist O. Fred Donaldson, a child who has been allowed to develop play resources receives many enduring advantages. She develops a universal learning skill. Play maximizes her potential by developing creativity and imagination. Play promotes joy, which is essential for self-esteem and health. The learning process is self-sustained based as it is on a natural love of learning and playful engagement with life.

The role of toys

In addition to being purpose-built for children's play, toys invite play and prolong play. Children will play longer when suitable playobjects are available, and stand to gain the greatest benefits that play has to offer. According to research conducted in homes, the two most powerful factors related to cognitive development during infancy and the preschool years are the availability of play materials and the quality of the mother's involvement with the child. The availability of toys in infancy is related to the child's IQ at three years of age. Children with access to a variety of toys were found to reach higher levels of intellectual achievement, regardless of the children's sex, race, or social class (Bradley 1985, Elardo 1975). In one study, the availability of toys intended for social play increased social interaction by disabled children in an inclusive preschool (Driscoll 2009).

It is abundantly clear that play is of vital importance in children's health and development, and in becoming responsible citizens. Yet despite the wide spread belief that play is beneficial to children, opportunities and encouragement for free play are increasingly limited. Among child development experts and education professionals there are growing calls for reintroducing play into early childhood education (Elkind 2007, Fisher 2011).

Why toys are important

Play contributes directly to children's education and development. But it is toys that stimulate and prolong play. If children are to discover what they are good at, what they like, and what they are like, then they will need variety in their play, and a broad assortment of toys to make it possible. Variety is the key. Children play longer when a variety of toys is available. The careful selection of toys can lead children to play with others, to cooperate, or to develop particular skills. For example, dress-up clothes, toy wagons, balls and a puppet stage are more likely to be played with in co-operative social play than are puzzles or pull toys, which were used primarily in solitary play. Toys are important, but they are no substitute for warm, *loving, dependable relationships. You are the most important play equipment. Parents, teachers and government bodies all recognise the value of play. Yet opportunities for play continue to diminish, with fewer play spaces, less freedom to roam outdoors, and decreasing school time for free play (Guldberg 2009). The case for play is clear, now the question is how to promote it.*

All types of play, from fantasy to rough-and-tumble, have a crucial role in children's development

Source:

- *Play in children's development, health and well-being; jeffrey goldstein; february 2012*

Article commissioned by TIE - toy industries of Europe
http://www.ornes.nl/wp-content/uploads/2010/08/Play-in-children-s-development-health-and-well-being-feb-2012.pdf

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9.2. Six golden rules of playground design (Günter Beltzig)

Children play everywhere, at all times, with everything they can find; therefore children actually need no playgrounds. But because they are not allowed to play everywhere with everything at any time we need playgrounds to entice children away from dangers, disturbances and the wrong things.

Playing means: „activities of an individual to adjust to the environment“, with other words – playing means sampling all possibilities, go to the borders, sample experiences, search, learn – and it just does not mean children alone, but artists, researchers and many creative human beings play.

There is no defined „value of play“ but many particular play functions like climbing, balancing, coordinating, sliding, to train social conduct, to sustain oneself within the group, but also the experience of wind, rain, sun, these are only few of the possibilities in functional play.

They can overlap, can support one another; but also can block up, prevent play or lead to aggressive behaviour. Therefore it is of special importance to consciously select and search for and set in special play functions on playgrounds on special play equipment.

A playground is a highly complex sociologically functioning place.

Big pyramid tower, design by G. Beltzig for Richter Spielgeräte

The 6 golden rules for a perfect playground

It is difficult to define the perfect playground because its success depends on a vast range of issues, from the design to the group dynamics of the children who play there and the attitudes of the neighbours. Nevertheless, the designer has formulated six golden rules.

"First, the place needs an atmosphere that invites people to linger." It should be neither a training ground nor a "landscape decorated to the taste of adults", as Beltzig puts it.

Second, a perfect playground "gives room for exploration". It works like a theatre stage, where you can change the scenery and - more importantly - discover what lies behind the curtain. This can mean hiding a slide behind a grassy slope or installing toys with functions that are not obvious at first sight. "Of course, us adults, we like a beautifully handcarved, wooden motorbike," says Beltzig. "But what if the child prefers a pony or a unicorn? The more room there is for interpretation the better."

Far from being dangerous, the ideal playground "offers visible, manageable risks, as playing is all about testing and transcending one's limits." Therefore, the designer points out, there should always be the possibility of retreating without losing face. A climbing frame from which the only way down is a slide might force a child to go down, even when he or she is actually scared, Beltzig explains. "Better if a rope bridge offers an alternative route."

Apart from being shielded from wind, sight (of overly anxious parents) and city noise, a successful playground has to cater for different groups and moods. There will always be more aggressive children who want to prove their power, says Beltzig. It is important to offer ways for them to expend their energy, but also to protect the weaker ones, for example by avoiding having one dominant structure. "Otherwise there will always be fighting."

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PLAY IS THE HIGHEST FORM OF RESEARCH.
Albert Einstein

"Reserved for children aged eight to 12", "No ball play", "Improper use of equipment prohibited": most playgrounds feature signs spelling out these or similar rules. Ideally, though, says Beltzig, it should be built in a fashion that makes specific bans unnecessary. If the compound is spacious enough there should be play zones for younger and older kids as well as meeting points for mums and dads - "Many parents actually come to the playground primarily to chat to other parents" - and areas where teenagers can chill out and share secrets. In Beltzig's opinion, vandalism is a consequence of a lack of alternatives.

He has derived his rules from from decades of listening to children and watching them play – at best, undetected. "If I talk to children, they will tell me what they think will impress me. If they see me watching, they might even be inclined to do more dangerous stuff, just to prove their bravery." In his own vast garden in the picturesque Bavarian village of Hohenwart, he builds new structures for his grandson to try out - who must be pleased that Grandad's job is safe for the foreseeable future.

A good playground should:
1. Offer atmosphere, impart sense of well-being, invite to abidance.
2. Have possibilities for discovery, provide only searcher with its full potentials.
3. Allow controllable risk, cognizable risk, manipulable risk.
4. Offer differing possibilities for different moods, interests, needs.
5. Supply wind-, sight- and sound-shelter.
6. Make „special“ bans dispensable.

A bad playground is:
1. A parcours for dressage.
2. A landscape decoration.
3. A use of residual areas.
4. A centralist mono-structure for only one specific user-group.
5. Not enough room, not enough choices, too uniform, not enough stability, too unkind.
6. Too safe, too similar to an enclosure, too regulated.

Sources:

- *“How to design the perfect playground”; The Guardian, Lena Jakat; 8/11/2012*

https://www.theguardian.com/lifeandstyle/2012/nov/08/how-to-design-perfect-playground

- *“Children play! At any time! With everything! Everywhere! All over!“, Günter Beltzig*

http://www.beltzig-playdesign.de/indexe.html

9.3. Report on the current status, trends and competitiveness of the toy industry (ECSIP consortium) (anno 2013)

The toy retail market

The EU has the largest single market for goods and services worldwide. This study estimates that the EU market for traditional toys and games, including Croatia, was worth EUR 15.8 bn in 2011 at retail selling prices. In comparison, the US market follows at EUR 14 bn. The Chinese market represented sales of EUR 4.8 bn. and has a high potential if income levels continue to rise.

Several external factors may influence demand for traditional toys. One is the ageing of society in mature markets, witnessed already by a more or less stable number of children in the EU and the US. One-child policy and rising incomes have even led to a sharp decline in the child population in China. Another factor is the increased competition of new ICT products that become close substitutes for traditional toys. Not only video games, but more generally smart phones, tablets and other entertainment products compete for the preference and spending of children in mature and emerging markets. Electronic toys, such as applications for tablets, are direct and cheap substitutes for pre-school toys.

At a macroeconomic level, uncertainty about recovery of the EU and US from the global crisis and implications for demand conditions in emerging economies imply that growth forecasts are highly uncertain. Still, global toy consumption is projected to rise by about 7.5% annually until 2016.

The toy industry

The EU toy industry generates about EUR 5.8 bn. in production value. Our estimate for direct employment in traditional toys is about 51,000 for the EU, including Croatia. Indirect employment, excluding retail, is estimated at about the same total for the EU. The EU exceeds toy production and employment in the US, estimated at EUR 4.4 bn. and 35,000 workers respectively. Most toy production takes place in China, at a production value of EUR 16 bn. The employment estimate provided in this study for China, though uncertain, indicates that some 128,000 employees are involved in production of traditional toys.

Although demand is highly seasonal, with one major and a few localized but somewhat smaller peaks, seasonal employment is not a major issue in production. During peak times, production teams work longer hours. Seasonal employment is, however, more important in retail and warehousing. For offshore production, higher seasonal fluctuations are more likely, according to information from one interview.

Regulatory and framework conditions

We identified various framework conditions that impact the toy sector. The most important framework conditions are toy safety regulation and counterfeiting.

Toy safety

In Europe, toy safety is governed by the Toy Safety Directive (TSD; Directive 2009/48/EC). The TSD obliges manufacturers, importers and suppliers to ensure that their products meet the requirements in the field of toy safety, including mechanical, physical and chemical safety. Each toy to be placed on the market is submitted to a conformity assessment procedure. When a toy is placed on the market, the manufacturer must draw up an EC declaration of conformity (DoC). By doing so, the manufacturer certifies and assumes responsibility for the compliance of the toy with the essential requirements of the TSD.

Both the conformity assessment procedure and the mandatory DoC incur costs on producers. The additional costs do not distort the competitive playing field between domestic (EU) and foreign (non-EU) producers. However, the increased costs do negatively impact the competitive situation of small toy producers, as the additional costs are more difficult to bear for SMEs, who generally do not have the resources to provide the required documentation and testing in-house and therefore need to seek the required capacity externally, which means increased costs.

Toy safety also impacts the competitiveness of European producers aiming to export outside Europe. The main reason is the existence of local safety requirements in non-EU countries. These safety requirements

often also include the need for local testing, which forms one of the major trade barriers for the EU toy industry.

Counterfeiting

The second most important framework condition is the protection of IPR. Toy manufacturers face counterfeit toys. In the period 2010 / 2011, DG TAXUD registered 872 infringement cases for toys with a retail value of € 16 million and 2,585 infringement cases for games with a retail value of € 20 million. The two main countries of origin are China (88%) and Hong Kong (10%). The issue of counterfeiting was identified by various interviewees as a problem, while others hardly see counterfeiting as a serious problem, claiming that IPR-protection works properly in Europe and the degree of counterfeiting is comparable to other industries. A potential issue in IPR protection is the possible lack of financial capacity of SMEs to initiate litigation measures. No extensive information on this issue has been identified.

Market performance and competitiveness

The traditional toys and games market shows moderate growth rates in Europe and the US and strong growth rates in China and especially in the rest of the world. Growth levels for traditional toys and games sales are higher than for the economy as a whole, offering a positive outlook for the toy sector with opportunities for expansion, especially for European toy producers, who are the second most important toy exporters after China. In 2011, exports of the EU as a whole were worth EUR 5.3 billion, of which intra-EU trade amounted to EUR 4.2 bn.

EU production of traditional toys is cost competitive when transportation costs from China are high. Also in cases where management can better stay in control of production processes by keeping production close to the main markets, several interviewed companies indicate that EU production increases flexibility in serving changing markets and may lower quality assurance costs. Production in the EU includes low priced small plastic items, where order volumes are often below the amount needed to outweigh transport cost from Asia effectively; bulky low weight items such as board games for which transport costs per item would be too high; and wooden toys at the high price end. Toys produced in the EU in highly automated factories can also be price competitive, especially if the relevant inputs can be sourced locally.

Some firms deliberately choose to produce in the EU for these reasons. Examples include LEGO and Playmobil. Other firms choose to design and develop toys close to their home markets, and link up with large Asian production facilities and Hong Kong liaison offices to increase capacity for fast response to changing product specifications, and to implement and further develop technical aspects of the production process and manage quality and safety effectively. Although there are examples of firms re-shoring their production to the EU, interviews with industry do not suggest a definite trend in one or the other direction.

Consumers are fairly price sensitive. In combination with a low concentration in the market, this means that producers face cost and price competition to a significant extent. This competition on costs is reflected in the production strategy of producers, with many producers offshoring and outsourcing production to China to reduce production costs. In toy production, margins in the entire sector are under pressure with long-term profit margins around 6% for the top 100 firms in terms of size. The margins are lower for small and medium sized (SME) firms than for large firms. Also, the profit margin for retail is lower than for manufacturing of toys.

The short product life cycle of toys drives the need for innovation and research and development (R&D). Innovation is widely acknowledged in the sector as essential to maintaining a competitive position. In addition, it allows manufacturers to experience (temporarily) reduced price competition for the innovative toys. Nonetheless, R&D expenditures in the sector may seem modest, with actual R&D expenditure amounting to 0.6% to 2.6% of total turnover. This range, however, is in line with the R&D intensity of total manufacturing industry in the EU. Also marketing strategies are very important to the toy sector. The key is market research and introduction of novelties.

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Market outlook

Competition on price and innovativeness are likely to remain intense in a dynamic market. Despite overall positive growth forecasts, traditional toys and games will face increased competition from video games and the recent trend in the use of tablets and smart phones for entertainment purposes.

In terms of product segments, construction toys and outdoor and sports toys show the highest growth forecast among traditional toys.

Several trends reinforce the outlook of increased competition for traditional toys and games. First, the number of children between 0-14 years in mature markets is likely to stabilize or decrease in the near future. Second, as children mature at earlier age, the playing period will be shorter. Hence, producers will face more competition from substitutes for traditional toys and games such as video games, tablets and smart phones that tend to drive preference more as children mature.

On the positive side, there are developments that warrant the continued outlook of growth for the market of traditional toys and games. First, purchasing power is increasing in emerging markets. For example, the expected growth in the Chinese market is in double digits for the 2012-2016 period. Also in other emerging markets, growth is high. These markets drive the overall expected growth of 7.5% annually until 2016. A second development with high potential for traditional toys and games is the rise of cross-over toys and games, that allow traditional games to be played on electronic platforms and interaction between physical toys and games and applications on tablets and smart phones. Several examples show that EU producers of games and toys are entering these new platforms, often in collaboration with digital entertainment industry. To keep up with the cross-over market and optimize its potential for traditional toys and games, EU toy suppliers will have to keep up with US and Asian competitors in this fast developing field.

In terms of product segments, construction toys and outdoor and sports toys show the highest growth forecast among traditional toys. Board games and puzzles show stable market share forecasts, as they face most direct competition from video games, tablets and smart phone applications. The market for plush toys appears to have low growth forecasts.

Licensed toys remain a large and stable source of turnover in the traditional toys and games industry. They are trendy but also offer stable demand and reduce the risk of successful adoption of new products into the market, due to the link to the established entertainment industry. Moreover, parents may associate licensed toys and other toys under established brand names with high quality and safety.

Trends that provide room for niche markets and may have potential for a position more at the core of traditional toys are fair trade toys and eco-design toys. These toys, often wooden toys, link to the theme of sustainability and its dimensions of labour conditions and the environment. These niches also show potential for linking design and product development in the EU to production offshore, thus combining the best of competitive conditions of the EU and offshore locations.

The main trend in retail of traditional toys and games across the EU is the rise of the online retail outlet channel. Internet sales show double digit growth rates, and reach market shares of almost 20% already in some mature markets. Southern European markets were less oriented to online shopping, but this appears to be changing rapidly.

Source:

- *"Study on the competitiveness of the toy industry, Final Report"; 30/08/2013; ECSIP Consortium*

Report of study ordered by Dir. Gen. Enterprise and Industry of the European Commission
http://ec.europa.eu/DocsRoom/documents/6653/attachments/1/translations/en/renditions/native

9.4. Accessible vs. inclusive playgrounds: playing for all

New Equipment Trends Lead to More Inclusive Playgrounds

Inclusion occurs when children with disabilities unconditionally participate in regular recreation opportunities in their own community. In terms of playgrounds this means that a family who is raising a child with disabilities should be able to go to the park where the neighborhood children are playing. It means they should not have to go to a playground that is designed for "special needs" nor should they have to travel a long distance out of their community to reach a facility that can accommodate their child.

Sometimes inclusion feels like a very difficult goal for a parks and recreation department. There is a belief that to be inclusive, a playground must be large and cost a great deal more than other playgrounds. However, some current trends in equipment design will be making this goal more attainable by developing new products that will fit people's budgets as well as serving all children.

Open-Ended Play

When most people are asked to describe a neighborhood playground, they describe a module structure that has climbers going up and slides coming down; sometimes there is a theme, monkey bars, or swings to make the playground more interesting. This type of design is very didactic – children know that there is a right way and a wrong way to play. Climb up a climber, run over to the slide, go down, run around to another climber and do it again.

When there is a right way and a wrong way to play, children whose bodies do not support that type of play are left out. What if instead of this type of module structure, there are big pieces of equipment that a child looks at and says, "How do you play on that?" The child has to look and explore it and figure out how to play on it, and any way that she finds fun on it is the "right way" to play.

When "anyway you play" is the right way to play, it is much easier for a child who plays "differently" to fit in. When watching children on the Rushmore by Playworld Systems, observers found the children creating group games and activities. It was simple and automatic for them to include all of the children.

New Types of Swings and Movement Experiences

Swinging has always been a big part of playground play. Often today parks have added an accessible swing seat to their swing sets, automatically opening the swinging experience up to more children. Another easy addition to a playground is a group swing. It was once difficult to find a group swing due to safety concerns in the United States, but they have been around a long time in Europe and Australia. Now it is much simpler to find a group swing in America. Examples include the Biggo Swing from Dynamo, the Oodle Swing from Landscape Structures, and the Elephant Swing from Elephant Play.

These larger swings allow a child to decide whether they would like to sit up or lie down. It is fairly easy to transfer a child from a mobility device on to the swing, and the design of the swing provides them enough support so that they can swing. They can handle several children at one time or an adult holding a child.

According to Bec Ho of Touched by Olivia in Australia, "The Bird Nest swings are loved by all children on our inclusive playgrounds. Children of all abilities get the chance to play and we love that it is a social experience." These types of swings are not a huge financial investment and realize a great reward in terms of play value.

In addition to the "Bird Nest" type of big swing, there is new movement equipment that children of all abilities can easily play on and love. There is the Cruise Line from Playworld Systems, which is something like a combination of a zip line and a big swing. Children play together to get the seat to move, while other

children are standing, sitting or lying down enjoying the movement. Landscape Structures has a zip line called the ZipKrooz that comes with a harnessed seat which is great fun.

Group Play

The module structure that is in many playgrounds today encourages individual play. A child climbs and slides down by himself. He might find a friend and they parallel play, but for the most part it is an individual challenge. See-saws are typically designed for only 2-4 children to play on at one time. Some of the new equipment on the market, encourages groups of children to play together to accomplish a goal.

There are now see-saws the support 6-8 children at one time. Recently, Playworld Systems announced the creation of their Teeter Tunnel that can have 20 children play on it at the same time. The Ion X-Wave 2 by Xccent Play can accommodate an entire classroom. Children sit on it and it goes up and down in a wave like motion. On this piece, an adult may need to help support a child with balance issues.

This type of group play is important for children with autism and developmental delays. They often do not know the social cues to play in a group. These pieces of equipment can allow a child to practice being with others in a non-threatening environment.

Electronic Play

Electronic play will not be the solution for every neighborhood park, but for those who can afford the equipment and the space, they can be the most inclusive activity in a park. Games like NEOS 360 from Playworld Systems and Pulse from Landscape Structures attract people of all ages and abilities. In parks with these pieces, it is not unusual to see teenagers playing each other, grandparents playing against their grandchildren, and people using mobility devices actively playing.

These games help people create social inclusion, the ability to gain social acceptance in positive interactions with peers. Because they attract people of all ages from toddlers to grandparents, it helps build this social acceptance. People gather around and cheer for the players regardless of their playing ability. It is rare that a child with a disability gets cheered by their peers in a typical setting, making the electronic play an even more positive experience. When given the chance and the right environment, children are creative in devising ways for everyone to play.

In one instance at a playground in Ohio, a group of 8-year-olds were playing NEOS when they noticed a girl, Angela, not playing. Angela has cerebral palsy, which affects her ability to move most of her muscles and requires she use a wheelchair to get around. The other children asked Angela if she would like to play. Her eyes lit up and she nodded yes. The kids pushed her right into the middle of the game. Angela added more challenge to the game as the children needed to get around her wheelchair to hit the buttons. Angela watched and laughed and the kids circled around her. It was a case of true inclusion.

Conclusion

Playground manufacturers should be encouraged to continue to push the envelope in playground design. By thinking beyond the typical climber, slide, and swing, they can help communities succeed in creating inclusive environments where everyone benefits.

Source:

New Equipment Trends Lead to More Inclusive Playgrounds; Mara Kaplan; 12/22/2014; https://www.playgroundprofessionals.com/playground/playstructures/new-equipment-trends-lead-more-inclusive-playgrounds112

About the author: Mara Kaplan is the driving force behind Let Kids Play, a consulting firm working to ensure that all children have excellent play opportunities…

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9.5. More sources worth exploring:

Benefits of play; Ralph Waldo Emerson;

http://voiceofplay.org/benefits-of-play/

Designing for Social Interaction in Open-Ended Play Environments; Linda de Valk*, Tilde Bekker, and Berry Eggen; Department of Industrial Design, Eindhoven University of Technology; 30/04/2015

https://pure.tue.nl/ws/files/12652875/ValkDesigning2015.pdf