For general requirements related block-zone systems, see also 5.2.3.6.

For block-zone control systems, see Annex C.

Sufficient water quality shall be achieved and kept.

Compliance with EEC directive 2006/7/EC (32006L0007) is recommended.

5.2.9 Helter skelters, slides, etc.

5.2.9.1 General

The requirements below are in addition to or prevail over those contained in the European Standards for playground equipment EN 1176 (all parts). Slides with a height greater than that mentioned in EN 1176-3 are not excluded from being used as amusement devices.

For water slides refer to EN 1069.

5.2.9.2 Area separation system and access and egress openings

In areas where passengers can walk onto the slide area or run out zones area separation systems for the general public shall comply with J3 requirements as a minimum. Access openings to the loading and run out zones shall comply with K2 requirements, in order to prevent crushing of users. Egress openings shall comply with K1 requirements.

5.2.9.3 Passenger units

Means (sacks, mats, sleds, etc.) shall be provided for the user to sit on during the ride, where additional protection is required to protect against splinters and burns.

5.2.9.4 Restraints

There are no special requirements.

5.2.9.5 Miscellaneous

Channels or troughs shall be smooth throughout their entire length. Overlapping is only permitted in the sliding direction. Channel side walls shall for single channels be at least 0,45 m high and well-rounded at the top upper edge.

The end of the slide shall be built in such a way that the user can complete his ride without assistance.

The longitudinal configuration of the channel shall prevent excessive speeds and account for accelerations exerted on the passenger and the necessary stopping distances. The risk of lift off from the surface shall be reduced to a minimum.

In case of multi-channel slides the internal division (between channels) shall not be less than 10 cm.

5.2.10 Side shows, booths, win-a-prize and sales stands, mazes, halls of mirrors, funhouses, labyrinths, hammers, ring the bell and similar

5.2.10.1 Funhouses

Devices on which users can climb, shall be positioned so that the surroundings take this risk into account. Where falls are foreseeable, e.g. from climbing frames, climbing nets, adventure equipment, in addition to eliminating parts of the structure likely to cause injury, suitable impact absorbing surfaces, shall be provided over a sufficient area.

Where the likelihood of falls is built into the concept, e.g. with inclined rope ladders, especially with swivel retaining devices, then high efficiency absorption material, e.g. deep foam, rubber or inflated mattresses shall be provided.

Smooth and splinter free surfaces (sanded where necessary if wooden) shall be provided to minimize risk of injury. The most favourable materials shall be selected to avoid hostile surfaces, e.g. to avoid material liable to splinter, especially where the body may be in close contact with the surface, such as for slides or divisions of slides.

All nails, screws, sharp angled fixtures and fittings shall be recessed, sunken or otherwise protected. Staples holding punchbags, climbing ropes and nets at floor level shall be covered.

Neither hazardous protruding items nor pinch points are allowed. Wherever possible, smooth surfaces shall be provided.

Certain rotating devices, whether power or non-power driven, shall be regulated so as not to exceed the maximum permitted speed. They shall also be provided with a smooth sliding surface and adequate impact absorbing material at the limiting point of travel e.g. on rotating horizontal wheels and cages as well as inclined axis wheels.

Where users transfer from a standing to a sitting position to prepare to descend a slide or inclined tube, adequate safe hand holds shall be fixed at suitable positions and in such a way that they themselves do not cause injury. Loading platforms shall be installed in such places (If the device is only for the use of children up to 10 years of age, minimum dimensions can be found in the European Standard for playground equipment (EN 1176-1)).

All power driven parts of a device shall be analysed for possible trapping or crushing. Emergency stop devices and close operator supervision shall be provided as required. Risks at transitions from moving to stationary surfaces shall be minimized, e.g. by using comb techniques.

Devices not driven by mechanical power, such as roller walkways, horizontal multiple tier rolls, pyramid rolls and rise and fall sections of floor often spring loaded for return, shall have supplementary supports, such as parallel bars for the participants to support themselves. They shall also be provided with additional safeguards so that a fallen person cannot fall through openings in the floor, down stairwells or under rails protecting a gallery. Any foot or toe traps shall be eliminated, especially at any device which is moving under user load.

Devices like swinging platforms, seesaws etc. shall be safeguarded (i.e. fences, area separation) preventing access to their extreme points of travel. Foreseeable abuse of such measures shall be taken into account. Limitation of the arc of travel may be required as well as padding of the extreme ends.

Trampolines and other bouncing devices shall be sited at locations where the surroundings are not likely to produce injuries.

NOTE Supplementary information for trampolines can be found in ASTM F 381 and for inflatables in EN 14960.

Devices with hinged floors, including those operating by the moving weight of participants require special attention to clearances between their moving edges and the side walls, taking into account the safety of a fallen person, and in particular, children.

Warning notices shall clearly indicate the need to wear footwear on devices such as boardwalks, rocking bridge, stepping stones and steel rollers so as to avoid injuries from splinters, etc.

Warning notices shall clearly indicate “no footwear” devices, such as slides, tubes, rotating barrels, rotating dishes, etc. where hard footwear is undesirable as fellow participants may be struck by flailing footwear.

The following legible notice shall be displayed outside such devices:

“This device is only for the use of users in good physical condition and requires sportive actions”.

An essential element of the safe enjoyment of the Funhouse environment is an adequate alert supervision. Supervisors shall take immediate action to avoid injury e.g. by stopping a device. He shall control unruly

behaviour and warn participants of their unsafe acts. Supervision may be supplemented by remote controls such as closed circuit TV, visual display units or mirrors. Observation points shall be positioned at suitable places which give an overall view of the activities within the funhouse.

5.2.10.2 Hall of mirrors

No steps are permitted in halls of mirrors.

Glass panels shall be made of safety glass.

Neither hazardous protruding items nor pinch points are allowed. Wherever possible, smooth surfaces shall be provided. For additional requirements see also 5.2.10.1.

5.2.10.3 Win-a-prize and sales stands

All installations with a ground area of more than 50 m^2 shall have a minimum of two distinct exits each being at least 1.0 m wide. For more than 100 m^2 there shall be a minimum of two opposite exits.

Throw a Ball and similar installations shall be equipped with safety nets or walls of sufficient strength, so as to protect the general public from injury during operations. The operator's position shall be safeguarded in a similar manner.

5.2.10.4 "The hammer", "Ring the bell" and similar installations

The installation shall be stable or otherwise securely anchored to the ground (see 4.5).

The anvil or striking plate shall be fixed in such a way that it cannot become detached.

The whole attraction shall be fenced off by means of a perimeter fence. Safety distances from the anvil shall be in accordance with 5.1.4.2.2 (general safety distances).

Where percussion caps or similar explosive devices are used adequate protection against splinters and fragments shall be provided around the striking points.

5.2.10.5 Temporary grandstands

Where on an open air temporary grandstand a row of seats has an aisle at one end of the row only, the number of seats shall not exceed 16. Where there is an aisle at both ends of the row, it shall not exceed 32 seats. When the difference in height of the rows is more than 32 cm, then only 11 and 22 places are permitted respectively.

Escape routes shall have a width of at least 1 m per 450 persons in the open air and 1 m per 150 persons in tents. The minimum width of escape routes is 1 m in either case. The walkway of each row shall be at the same level as the corresponding step.

Where there is standing only, the minimum width per person shall be 50 cm and the maximum depth of the row 45 cm. Where there is standing room only, the number of persons (e.g. for the width of exits) shall be calculated according to the available area.

The floor slab of grandstands shall be firmly attached to the supporting structure, so as to prevent sliding (see 4.5).

Where access is possible beneath the grandstand, protection from falling objects shall be provided.

The design of the structure shall prevent the accumulation of rubbish.

Seats shall be at least 44 cm wide and fixed to the supporting structure. Seats within a row shall be fixed to each other or the ground. The minimum distance between seating rows shall be 45 cm.

NOTE Supplementary information can be found in EN 13200.

5.2.10.6 Maneges

The ring in circus tents shall be separated from the seating area by a substantially solid barrier at least 40 cm high. For circus tents contrary to 5.1.6.3, the admissible number of persons shall be based on the number of seats (e.g. on grandstands).

5.2.11 Shooting stands and trailers, shooting devices

5.2.11.1 Area separation system and access and egress openings

Shooting stands shall be completely closed off at the sides and overhead as well as in the direction of shooting. Care shall be taken, by way of structural measures, to ensure that nobody is injured as a result of a shot going astray.

The rear wall of the shooting gallery shall be vertical and of sheet steel at least of 1,5 mm thick.

The side walls and overheads of shooting galleries shall be made from material which can retain the bullets within the gallery.

Steel sheeting shall be firmly fixed to the base on which it is set, and shall show no evidence of being able to move backwards or forwards; screws or nails with domed heads shall not be used. The heads of nails or screws used for fixing the coverings of steel sheet shall be of the countersunk type. Where steel angle is being used, it shall not be inserted in the side turned towards those who are shooting.

For each shooter, a width of at least 80 cm shall be provided. Further area separation systems are not required if the booths or trailers are enclosed as mentioned in the above clauses.

Any access and egress doors in the side walls shall be designed as lockable doors with the same requirements as for the side walls. The maximum angle of opening shall be 90°.

5.2.11.2 Miscellaneous

The lighting shall be adequately protected against erratic or ricochet bullets.

If there are devices for fixing targets in front of the rear wall, means shall be provided to prevent the projectiles from ricocheting (e.g. freely suspended layers of woollen material, tenting material (twill or jute)).

If, however, the target objects are fixed directly onto the rear wall, or there is some other reason why loose layers of material cannot be suspended between the target objects and the rear wall, then the rear wall shall be constructed in such a manner, (e.g. using thick steel sheeting, padding at the rear) that dangerous ricochets cannot occur.

Any objects which are suspended, for decorative purposes between the shooting rest and the target, shall be designed or deployed in such a manner that they cannot lead to ricochets; they shall be at a distance of at least 2,5 m from the side of the shooting rest which is turned towards the person who is shooting.

5.2.11.3 Weapons

Only the following types of weapon, which are neither semi-automatic nor fully automatic, shall be used:

— Weapons with a calibre of up to 5,5 mm for which the muzzle energy shall not be more than 7,5 Nm. The trigger shall not be fitted with a hair spring and shall be designed in such a way that the weapon will not be discharged as a result of an impact on the barrel or the spring mechanism, or through a relatively small vibration. In the case of those weapons where the gun does not have to be cocked and loaded by hand before further shots can be discharged, the operating personnel shall be able to interrupt the shooting by means of some suitable device.

— Rifles designed for indoor use using rim-firing cartridges of up to 4,5 mm.

— Pistols and other weapons with a length of up to 60 cm may only be used where they are restricted to some fixed field of fire.

— Crossbows for which the kinetic energy of the bolt is not more than 2 Nm.

Weapons may be subject to prevailing national laws.

5.2.11.4 Ammunition

Only the following type of ammunition may be used:

— commercially available soft lead shot, round shot, or diablo shot;

— a 4,5 mm shot rim-fire cartridge with a medium charge as a maximum;

— air rifle ammunition;

— feathered bolts for cross bows.

Ammunition may be subject to prevailing national laws.

5.2.11.5 Targets

Where camera covers and flash bulbs are used in "photo shooting" stands, these shall be designed and fitted in such a way that they cannot burst and so that the shooting pieces cannot ricochet.

The targets shall be at least 2,8 m from the shooting rests when using weapons of the compressed air type, and 5,5 m when using live ammunition.

Fittings in shooting galleries onto which tubes for the insertion of flowers and the like are affixed, shall be mounted so that their upper horizontal surfaces are either horizontal or sloped to the rear side. The vertical front side shall be tilted at an angle of at least 20° to the vertical towards the rear, and, where the fitting is not made of steel, it shall be covered with steel sheeting of at least 2 mm in thickness. The distance between the brackets which support them, shall be such that if they are hit by a shot, no vibration will occur.

Fittings in shooting galleries for the purpose of holding targets and the "hit" indicator shall be designed and fitted in such a manner that they can only be brought into action from the shooting rest. The brackets holding the figures used as targets and the devices for supporting these shall be protected from "hits" by suitable constructional measures. The funnel shall be fashioned in such a way that shots which strike it cannot ricochet, even when they strike at an angle. Disc targets and moving targets shall be designed and manufactured in such a manner that shots are not able to ricochet from them, even when they strike at an angle. The targets for feathered bolts shall be of knot free white wood or of a material of equivalent effectiveness.

Shooting stands in which feathered bolts as well as weapons firing soft shots are used, shall be separated into different firing areas by dividing walls.

5.3 Mechanical systems

5.3.1 Hydraulic and pneumatic devices

5.3.1.1 General requirements

The adequate safety of the hydraulic and pneumatic equipment shall be demonstrated by means of construction drawings, calculations, the relevant circuit diagrams and a functional description of the plant.

In case of failure, the devices shall go to a safe state when required by risk assessment (DRA). A first failure of the system shall be detected. In this case a subsequent failure need not be considered (see ISO 4413, ISO 4414).

5.3.1.2 Design

All rams, cylinders and associated pipework and fittings which are subjected to pressure shall be designed to withstand twice the maximum working pressure for hydraulic equipment and 1,5 times for pneumatic equipment without sustaining permanent distortion or failure. Brittle material shall not be used for cylinders or connecting links. Rams and cylinders shall be mounted so that they are subjected to axial loads only.

Purchased parts off the shelf (e.g. valves) shall be designed in accordance with ISO 4413 and ISO 4414.

5.3.1.3 Travelling limits

Effective means shall be provided to prevent rams from travelling beyond the limits of the cylinder.

5.3.1.4 Piping

Piping shall be supported so that undue stresses are eliminated. Particular attention shall be paid to joints, bends and fittings, and at any section of the system subject to vibration.

Piping shall be mounted in such a way as to allow as much as possible the inspection of the pipe and particularly the joints.

5.3.1.5 Hoses

Pressure hoses shall be able to withstand five times the maximum operating pressure. Hydraulic hoses shall be suitable for the type of hydraulic fluid used in the system.

Hoses shall be installed so as to prevent sharp bends and chafing or trapping due to moving parts of the machine. The manufacturer shall specify the intervals at which the hoses should be replaced.

5.3.1.6 Reservoir

Reservoirs for hydraulic fluid shall be of rigid construction, having adequate and effective venting to the atmosphere. The inner covering of the reservoir shall withstand the chemical characteristics and temperature range of the fluid.

An air filter, a fluid strainer and a level indicator shall be provided. The reservoir for normal operation shall have at least 10 % more capacity than that necessary to guarantee an uninterrupted flow of the fluid to the pump. A label showing the correct type of hydraulic fluid shall be clearly displayed on the system.

5.3.1.7 Venting

The hydraulic circuits shall permit the release of air and as such may require a purging system.

5.3.1.8 Pressure limits

The hydraulic or pneumatic system shall incorporate a pressure relief valve fitted between the pump and the non-return valve. The relief valve shall be set to a pressure of not more than 10 % (pneumatic) or 20 % (hydraulic) higher than the highest normal working pressure but at a pressure higher than that required to prevent the relief valve blowing off during normal working conditions. The strength of the cylinders shall be calculated using 1,4 times the working load. There shall be a fatigue calculation for cylinders.

5.3.1.9 Fail to safe

If due to the failure of piping or hoses a dangerous situation can occur, a non-return valve, a flow control valve or a pipe break valve shall be fitted directly to the cylinder.

5.3.1.10 Checking

Provisions shall be made in the hydraulic system for the fitting of a pressure gauge to facilitate checking of the working pressure and the setting of the pressure release valve.

5.3.1.11 Lowering

In the event of failure or malfunction of the hydraulic or pneumatic system the maximum lowering speed shall not exceed 0,5 m/sec for any part of the passenger-carrying equipment, unless shock absorbing devices or other equivalent systems are installed to prevent undue shocks to passengers.

5.3.1.12 Protection

All safety related valves shall be protected against unauthorized resetting.

5.3.1.13 Emergency

Where necessary a manually operated emergency system shall be fitted, in order to facilitate the recovery of passengers from a dangerous position in the case of system power supply failure.

5.3.1.14 Cleanliness

All filters shall have a sufficient degree of filtration and shall be mounted on the pressure side of the pump. The mounting of a filter in the piping returning to the reservoir shall be avoided, when a safe position of the system is dependent on an unrestricted flow of the medium back into the reservoir. All fluids shall be filtered, when put into the system. Each system put into operation, shall be of a cleanliness commensurate with the components

5.3.2 Lifting and elevating units being integral part of an amusement ride

These lifts are an integral part of the amusement rides and devices and cannot be used for general lift purposes.

5.3.2.1 Hoist units — Brakes

Hoist units (rope and chain hoists) shall be equipped with effective brakes or other equivalent devices, capable of stopping the movements of the equipment and its loads safely at its rated speed and maintaining it in its stopped position.

In case of power loss all brakes shall adopt a safe state. This could be closed or open, depending on risk assessment.

The hoist unit shall be arranged so that the connection between the brake and the drum or sprocket cannot be interrupted.

5.3.2.2 Limitation of the lifting and lowering movement

To guard against malfunction of the control system, devices according to IEC 60204-32 shall be provided, and shall include:

— preliminary switches for initiating a controlled stop towards the upper and lower hoist limits;

— operational limit switches which prohibit incorrect hoist drive direction at the hoist travel limits;

— ultimate limit switches of the safety type with direct mechanical actuation, which disconnect the main electrical supply from the hoist. The actuators of these switches shall be independent of other switches;

— mechanical top and bottom limit stops.

5.3.2.3 Overload protection

If there is danger due to overloading, machines shall be equipped with appropriate overload protection systems. This is not applicable when the number of persons is limited or fixed by the number of seats, rests or places provided.

5.3.2.4 Slack rope or chain protection

The machine shall be equipped with a slack rope or chain detection device which, when actuated, cuts out all operational movement except at creep speed, unless it can be shown that a slack cable cannot occur under any operational condition.

5.3.2.5 Safety system

Machines with a lifting carriage which is intended to carry person(s) and which can be raised more than 1,5 m shall be equipped with a safety system(s) against over speed caused by failure of the suspension and mechanical units (chain, rope, drive gear, counterweight, etc.), shall be designed as detailed below or a redundant system for the lifting device shall be designed:

— The safety system shall operate, by means of an over speed governor, at a speed no higher than 1,4 times the rated speed.

— When there is more than one safety system, their actuators shall be mechanically connected to ensure they operate simultaneously.

— Operation of the safety system shall interrupt power to the hoist unit.

— Slackening or breaking of the over speed governor rope or chain, shall interrupt power to the hoist unit.

For hoist units using power screws, rack and pinion drives, directly acting hydraulic or pneumatic drives equivalent safety means shall be provided (see 5.3.2.7 to 5.3.2.10).

The structural, fatigue, control and operational issues and properties of all involved components need to be verified.

5.3.2.6 Suspension elements

Hoist units using rope or chain systems shall be dimensioned in accordance with the load spectrum and operating time class. The ratio between the minimum breaking load of a rope or chain and the maximum force in the rope or chain shall be at least 6 for hoist units intended to carry person(s) and at least 5 for other hoist units.

If a detailed fatigue life calculation taking into account the realistic chain/rope parameters is performed and a sufficient partial safety factor against the minimum discard period of a minimum of one year is achieved, the partial safety factor of the above sentence need not be observed. The application of this method requires visual and non-destructive inspections as determined by the life calculation.

All ropes or chains of one lifting unit shall be of the same size, quality and construction.

The tensile strength of the wires of suspension ropes shall not be less than that of a nominal strength category of 1570 N/mm^2.

Rope drums shall be provided with grooves. At least two turns of rope shall still be on the drum when the lifting carriage is in its lowest position.

The ratio of the diameter of pulleys and drums measured at the centre line of the rope and the nominal diameter of a rope is expressed as (D/d).

Existing wire rope standards shall only be used if the conditions of application can be shown to be valid for the intended use. In all other cases fatigue calculations shall be made to justify (D/d), taking into

account effects including: rope speed, type of rope, dynamic performance, stress range spectrum and number of load cycles.

(D/d) can be determined for the following categories:

Category A — lifting device without passengers or persons exposed to it;

Category B — lifting device with passengers with a speed $v \leq 1$m/s and a lift height less than 2 m;

Category C — lifting device with passengers or persons exposed to it and speed $v > 1$m/s or a lift height more than 2 m.

Lifting devices in category A and category B (D/d) shall be calculated to appropriate standards taking into account the relevant parameters.

In category C a detailed fatigue calculation shall be performed and the ratio (D/d) shall be not less than 30.

Means shall be provided to equalize the tension of the ropes or chains where more than one rope or chain is fixed to one suspension point.

Only leaf or roller type chains shall be used as suspension elements.

Wire rope pulleys, chain wheels or sprocket wheels shall be provided with guards to prevent the ropes or chains from leaving the grooves or teeth.

Rope or chain termination shall have a minimum breaking load of at least 80 % of the minimum breaking load of the rope or chain.

5.3.2.7 Hydraulic drives

For these types of elevating units see also 5.3.1. The lifting units shall be designed such that in the event of hydraulic leakage, no dangerous situation may occur.

For hoist units directly operated by cylinders, valves shall be fitted to prevent uncontrolled lowering in case of pipe or hose failure.

5.3.2.8 Power screw drives

To evaluate the design stresses in power screws and nuts, a fatigue and static calculation shall be performed for the material used in accordance with 4.7.

The power screw mechanism shall be designed to prevent separation of the lifting carriage from the mechanism during normal use.

Each power screw shall have a safety nut of equivalent material and size to the load bearing nut. The safety nut shall only be loaded if the load bearing nut fails. It shall not be possible to raise the lifting carriage from its access position when the safety nut is under load. The power screw shall have higher wear resistance than the nuts.

It shall be possible to inspect the wear of the load bearing nuts without major disassembly.

Power screws shall be fitted with devices at both ends to prevent the load bearing and safety nuts from travelling beyond either end.

5.3.2.9 Rack and pinion drives

To evaluate the design stresses in rack and pinion drives, a fatigue and static calculation shall be performed for the material used in accordance with 4.7.

Any driving or safety pinion shall always be engaged with the rack with at least 2/3 of the tooth width and 1/3 of the tooth depth.

Visual examination of the pinions shall be possible with neither the removal of the pinions nor major disassembly of structural components.

5.3.2.10 Pneumatic drives

For these types of elevating units see also 5.3.1. The lifting units shall be designed such that in the event of pneumatic leakage, no dangerous situation may occur.

For hoist units directly operated by pneumatic devices, appropriate means shall be fitted to prevent uncontrolled lowering in case of pipe or hose failure.

5.4 Manufacture and supply

5.4.1 Manufacturer

The manufacturer shall ensure that all requirements within the design specification are fully incorporated into the completed amusement device, and the quality of the construction meets the design specification.

The manufacturer of welding construction shall have an appropriate welding qualification according to suitable international or national accepted standards, e.g. ISO 3834-2 and ISO 3834-3.

5.4.1.1 Subcontracting and supply

Safety-related materials, parts, assemblies, or components shall be made in accordance with the design specification and quality requirements of appropriate ISO Standards or national equivalents.

Such parts shall be clearly defined by manufacturers, subcontractors and suppliers.

There may be a need to be individually identified to enable them to be traced throughout the manufacturing process, including the identification of the raw material.

The identification marks position on the parts shall be clearly specified, authorized by the designer and agreed between the ordering and supplying parties. The marking method and the areas where the marks should be executed shall not affect in any case the fatigue life of the component.

5.4.1.2 Documentation

The manufacturer shall provide quality documentation in accordance with international or national standards. These documents will be part of the technical dossier.

5.4.2 Quality assurance — Quality plan

5.4.2.1 General

Only competent persons shall be engaged in the manufacture of amusement devices. Particular attention shall be paid to the inspection of components and raw material, including consumables, both when manufactured in-house and subcontracted. Where the design review or specification indicates that certain parts are safety-related and has specified certain tests, the manufacturer shall ensure that all the requirements of the tests are fulfilled.

Non-destructive testing (NDT) techniques will be required for certain aspects of manufacture. The manufacturer shall attain the specified level of quality required for each component of the ride and determine the standard of manufacture necessary to achieve this, in accordance with design specification.