How to avoid entrapping risks

Annamaria Franz

September 2020

Which is a really **important danger** associated with furniture products? One of the most difficult dangers to assess is fingers entrapment. It can be generated by moving parts or by simply applying the weight of the user to the product. In a risk analysis, the resulting risk is usually not acceptable, because the severity of the damage is never negligible, as it implies injuries to the fingers or hands, resulting from crushing, compression, actual cuts, or even fingers being severed. Effective risk management will therefore have to eliminate the probability of this scenario. This is exactly what the technical standards on the safety of furniture products require.

To date there are many standards, each aimed at a specific type of product and intended use, in the field of furniture, which report this same requirement each time with a different nuance, because each standard has been discussed by a different group of people and in a different period. For such important documents, whose content is the result of widespread sharing, this can happen, but it can also be improved. In fact, CEN TC 207, the technical committee that deals with writing the standards for furniture valid in Europe, published in 2018 the TR (Technical Report) 17202 entitled *Furniture - General safety guidelines - Entrapment of fingers* and is working to make it a real standard, which transversely and more completely will deal with this risk on all furnishing products. In our opinion this document is a precious source of information and clarifies, deeply explaining it, the same requirement that in the current reference standards is expressed in a paragraph of a few lines. Let's keep this in mind while we are designing our new chair model.

How can we access the dangerous part? The TR defines, in general, the various types of possible contact between the user and the dangerous part of the product and what the designer should do in each situation.

- If the dangerous part of the product is within reach from the intended position of use, with a high probability of contact, it must be absolutely addressed in the risk analysis.
- If it can be reached by the user, beyond the intended position of use, perhaps by passing/moving around the product or contorting the body to touch the hazardous part, the risk of damage will be less likely but also in this case it must be analyzed and reduced;
- If the dangerous part can be reached by a person other than the user, with the product in the intended position of use, also in this case the danger will be analyzed and reduced.
- If the dangerous part exists but it is out of reach of the user, no problem.

How do we calculate the risk index?

If a product can be a source of damage, that is a physical injury or to the health of people, or damage to property or the environment, then the associated risk is given by the multiplication of two factors: the severity of the damage and the probability that such damage occurs.

RISK = SEVERITY x PROBABILITY of damage

By assigning a numerical index to severity (e.g. 1 = negligible, 2 = mild, 3 = serious, 4 = critical / fatal) and probability (e.g. 1 = unlikely, 2 = remote, 3 = occasional, 4 = probable), we can compose a risk matrix in which each situation corresponds to a numerical risk value. At this point we decide which risk values are acceptable and which are not (for example, acceptable from 1 to 3, not acceptable from 4 to 16) and we're done. Usually we will accept non-negligible damages only if unlikely and non-unlikely damages only if negligible ...

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Obviously each product must be evaluated on its own, but the standard gives us some examples:

- for seats, the accessible zone should be 120 mm from the sides and front of the seat;
- for tables, the accessible zone should be 500 mm in from the edges users are likely to sit at and 200 mm from all other edges;
- in storage furniture, the accessible zone should be any part that is less than 1,000 mm (this is the data for access by children of 36 months or older, taken from EN 1176-1, the European standard that defines safety requirements for playground equipment) above any surface on which a child could stand.

If any adjustment device requires the user to move outside the recommended access zone, the mechanism must also be considered part of the accessible zone, even if to reach it we will have to stretch or bend, as well as the whole 50 mm area around the zone where the fingers interact with the adjustment device.

Then the standard analyzes the risk of finger entrapment, dividing it into three cases:

- finger entrapment;
- hazards from moving parts;
- sharp edges.

Firstly, the case where fingers are entrapped in **static openings and gaps** (i.e. not generated by the movement of parts of the product). The risk is that of reduced flow of blood to the fingertips or dislocation of a finger joint. What to do? Reduce the depth of the hole; change its section (a slot is better than a round or equilateral section); change material, soft materials are better than rigid ones, because usually a soft material is more flexible and it will be easier to extract your fingers. That said, there should be no accessible holes 8 mm to 12 mm in diameter on the final product, unless the depth is less than 10 mm. These dimensions refer to the fingers of a 36 month child.

Then the standard moves on to the dangers of **moving parts**. Here we are talking about components that move during use. The danger concerns users' fingers which can be cut, crushed or even severed if they become trapped between the moving parts of a product.

When parts move relative to each other in a scissor motion they can cause cuts or amputations. When components move relative to each other in compression, they can cause crushing resulting in bruising, fractures, etc.

Here, accessibility could be reduced by using protective elements or by changing the position of moving parts. The flexibility of the material (for example plastic frames, foam, small metal bars, etc.) and the use of soft materials such as fabric and foam can help. The magnitude of the forces applied in all positions must also be assessed, how the moving parts are operated and whether the design of the parts causes the movement to be obscured (e.g. a fabric cover that hides the movement). Finally, you need to know the user abilities, the speed of movement, the shape and material of the parts, e.g.: rounded tubes, foam around rigid parts, flat steel plates, etc.

In most cases, doors, flaps and extension elements, including their hardware, are not considered a significant risk due to the low level of closing forces and speeds. The motorized closing mechanisms of doors and drawers, on the other hand, can pose a higher risk.

If there is also a risk to the user's thumb, the minimum allowable space to be considered becomes 25 mm. On the other hand, when the risk concerns only the fingers, excluding the thumb, the minimum space allowed is 18 mm.

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The shear and compression points generated by erecting, adjusting or folding away a foldable product are acceptable provided the user is in control of the movements and is able to cease applying the force immediately on experiencing pain.
In the case of **motorized mechanisms** (electric motors, mechanical springs, gas columns), there should be no areas where the distance between two accessible parts moving relative to each other can be less than 25 mm and more than 8 mm in any position that could present a risk to the user during movement. The risk of thumb injuries is considered greater with motorized mechanisms: better consider 25 mm.
For shear and compression points created during normal use (excluding motorized mechanisms),
there must be no areas where the distance between two accessible parts moving relative to each other may be less than 18 mm and more than 8 mm in any position that may present a risk to the user, created by loads applied during normal use.
Accident data shows that the risk of injury to the thumb is low in most furniture and therefore it is recommended to use 18mm for cutting and compression points. Why 18 mm? The 95th percentile figure for men is indicated as 20 mm, but 18 mm is the value historically used in standards for home furniture without known issues.
Sharp edges and corners can also cause cuts, lacerations and abrasions to the user. Therefore all accessible edges, surfaces and protrusions should be rounded or chamfered and free from burrs and sharp edges.
The technical report has also an attachment with all the anthropometric data relating to the fingers of children, adults, males and females, useful when you want to analyze a specific type of user.

Let's come to the **role of Catas**. Certainly we cannot say that we have little experience on the subject. In the last 10 years we have issued about 20,000 (19,237 to be exact) test reports relating to the safety requirements of furniture products. We participated in the drafting of the reference standards and in the choice of requirements (including this technical report). We are accredited by Accredia. Despite this, we prefer to perform this test in a team: two or more technicians do the verification separately and then compare each other. There is no lack of discussions. Sometimes it also happens that we disagree with our customers. Unfortunately, for some products, the definition of the accessible area can remain a fairly subjective evaluation. Having to choose, our point of view is always to protect the consumer and therefore, in front of two paths, we will always take the one that leads us to safeguard against risk. In this way we believe we are also protecting the interest of the manufacturer, who will avoid unpleasant surprises during the life of his/her product.

For info:
Annamaria Franz
+39 0432 747241
franz@catas.com