

# MAIN DIFFERENCES IN THE MECHANICAL PROPERTIES OF HOT FINISHED AND COLD FINISHED HOLLOW SECTIONS

## WELDING PROPERTIES

The differences in the mechanical/technical properties of hot finished sections (EN 10210) and untreated cold formed sections become more important when jointing various parts or surfaces by welding.

Joint welding is an operation which is often carried out on this type of product as it is mainly used for the construction of metal structures. This is a critical operation and must be carried out in total safety to avoid procedure induced stresses which can lead to mechanical failure. The hollow sections produced using hot finishing process offer an opportunity to carry out welding operations on every surface of the product, INCLUDING CORNERS, with excellent welding properties, thereby offering the best mechanical results and maximum reliability for the finished material structure.

Cold forming, on the other hand, is one of the main culprits for mechanical failure due to "fragility" (see impact properties), and the regulations governing cold formed section welding not only include advice to use specific groups of suitable special quality steels, but also specify clearly that "welding is not recommended" on many surface areas of the product, and in particular on the corners. Regarding this, we quote here below paragraph 4.14 of Eurocode 3 (EN 1993-1-8) regulation that concerns "Design of steel structures - Part 1-8: General - Design of joints".

### 4.14 Welding in cold-formed zones

- (1) Welding may be carried out within a length  $5t$  either side of a cold-formed zone, see Table 4.2, provided that one of the following conditions is fulfilled:
- the cold-formed zones are normalized after cold-forming but before welding;
  - the  $r/t$ -ratio satisfies the relevant value obtained from Table 4.2.

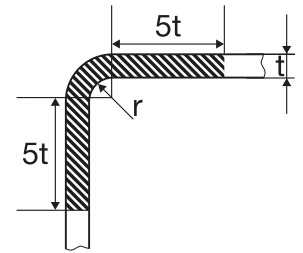


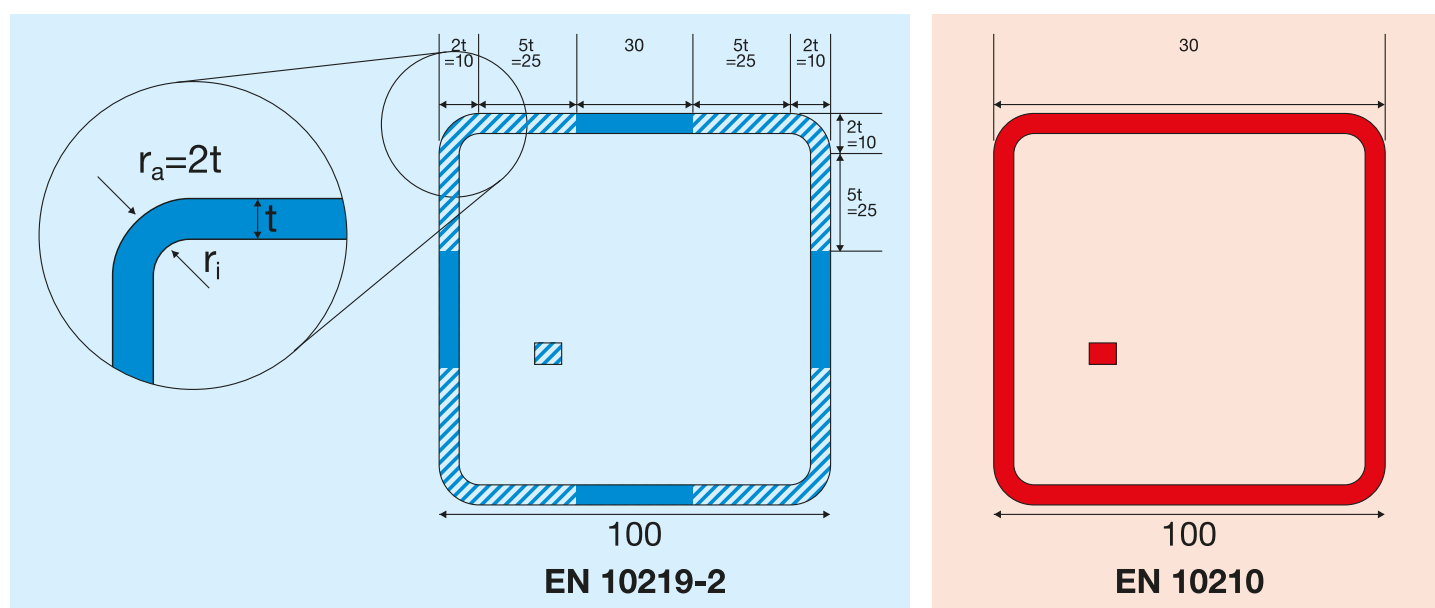
Table 4.2 conditions for welding cold-formed zones and adjacent material

r/t	Strain due to cold forming (%)	Maximum thickness (mm)		
		Predominantly static loading	Where fatigue predominates	Fully killed steel Aluminium killed steel (Al $\geq$ 0,02%)
$\geq 25$	$\geq 2$	Any	Any	Any
$\geq 10$	$\geq 5$	Any	16	Any
$\geq 3,0$	$\geq 14$	24	12	24
$\geq 2,0$	$\geq 20$	12	10	12
$\geq 1,5$	$\geq 25$	8	8	10
$\geq 1,0$	$\geq 33$	4	4	6



The welding limits stated above are for cold formed products (EN 10219). These limits are not applicable to hot finished products (EN 10210), where 100% of the surface area, including the corners, can be welded.

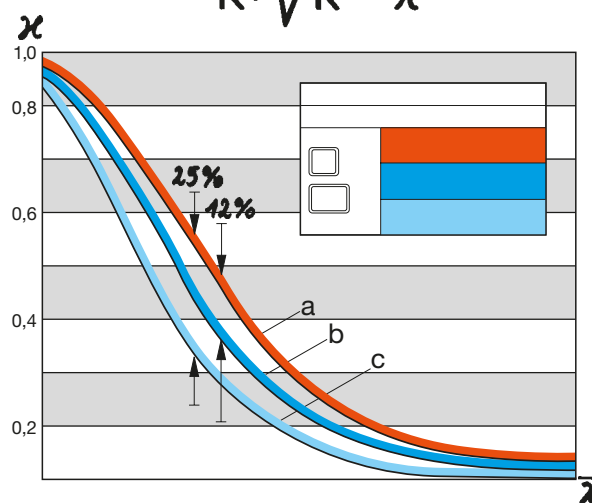
The following table shows the requirements of Eurocode 3.



## STRESS OF FLEXURE

Because of their favourable static values, hollow sections are particularly suitable for structural elements subject to flexure loads (columns, metal structures and frames). The different properties of cold formed and hot finished hollow sections have their effect on the design rules and calculations for realization of structures. The following Table taken from Eurocode 3 shows the classification of the various types of hollow sections into European of flexure stress diagrams (a). Hot finished hollow sections are characterized by the better flexure curve (a), cold finished hollow sections corresponds to curves "b" or "c" depending on the buckling stress used for calculation. This means that hot finished sections can tolerate higher stress of flexure.

$$\chi = \frac{1}{K + \sqrt{K^2 - \bar{\lambda}^2}}$$



The values for the flexure curve (a) are up to 25% higher than those from the curve (c) and up to 12% higher than those from the curve (b).