Hardening and EN ISO 1090

Within the scope of EN ISO 1090, the topic of hardening plays an important role. The more critical the component class is, the less hardening a part of the cutting edge may have. However, any thermal cutting process involves a specific hardening. Thermal cutting processes are inferior in this matter than the water jet cutting; this least affects the hardening of the cut. Cutting companies must demonstrate, within the framework of EN ISO1090, that the procedure it uses complies with the permissible limits.

Effect of thermal cutting processes

Thermal cutting processes bring a high energy into the material, so that the cutting edges forcibly harden and the material structure is changed in the edge zone. This is called the two influences, the hardening and the structural change through the heat affected zone.

Hardening of plasma blanks when underwater cutting

In order to reduce the thermal influence, plasma sections were examined, which were cut under water. A grade S235 steel 50 mm thick was separated with a plasma oxygen-nitrogen mixture plasma cutting machine. The following material tests revealed the following:

Underwater cuts have harder cutting edges, but smaller hardening zones than dry cuts.

Due to the quick additional water cooling, the material hardens harder than during dry cutting. However, in the plasma cutting in the water-burning table or sub-water, the microstructure change is not so pronounced and does not radiate as far into the material as in the plasma dry-cut.

Whether hardening is still permissible in case of dry cutting depends on the individual application and further use.

Weldability of blanks

The structural change in the edge zone area can become a problem if the parts are to be welded subsequently. At the affected areas, the material has different material properties, so that welds in the vicinity of the cutting edge can show undesirable behavior.

Coating of the blanks

The hardening must also be considered from the point of view of corrosion protection, which is of great importance for building parts. **Hardened cutting edges can not be powder coated**. On the other hand, if the chemical pretreatments are maintained and the scale has been removed, the wet paint is not a problem.

ISO 1090 for cutting applications

The standard DIN EN ISO 1090 is known to many metal workers under the name DIN 18800 "Design and manufacture of steel structures". The 1090 standard requires the companies concerned to master all the necessary processes in the production chain and to provide evidence, through appropriate production controls, that all parts have been produced and assembled in accordance with the relevant standards, ensuring corrosion protection and weldability of the components.

What exactly does this mean for cutting companies?

Requirements for cutting

• It must be ensured that the used thermal cutting process is also suitable for the work / task.

• The test method to be used, which is the Vickers hardness test, is specified by the standard by cutting and checking a specific specimen.

• The permissible hardness values of the cutting edges produced by thermal cutting must be demonstrably adhered to.

• The cutting of metals creates burrs. **The standard requires that burrs that can become a hazard and cause injury must be removed**.

ISO 1090 and cutting steel

Separation cuts cause hardening at a depth of approx. 0.2 mm in the base material. In these hardened areas, achieving the required roughness for surface preparation (for further coating) is difficult so that it can lead to adhesion problems between base coat and base material. According to EN ISO 8501-3, Table 1, line 2.3**, the removal of cut surfaces is mandatory for grade P3**. EN 1090-2 states in Section 6.4.4 Table 10 an admissible hardness depending on the steel grade. For example, until to a steel grade of S460, a surface hardness of 380 HV10 is allowed

Type of imperfection	Level of preparation		
	P1 light preparation	P2 thorough preparation	P3 very thorough preparation
Edges made by punching, shearing, sawing or drilling	No part of the edge shall be sharp, the edge shall be free from fins	No part of the edge shall be sharp, the edge shall be free from fins	Edges shall be rounded with a radius of not less than 2 mm (DIN EN ISO 12944-3)
Thermally cut edges	Surface shall be free of slag and loose slag	No part of the edge shall have an irregular profile	Cut face shall be removes and edges shall be rounded with a radius of not less than 2 mm (DIN EN ISO 12944-3)

Table 1: Specification of the preparation levels (source DIN EN ISO 8501-3, Table 1, line 2.3)

Product standards	Steel grade	Hardness
EN 10025-2 to -5	S235 to S460	380
EN10210-1, EN 10219-1		
EN10149-2 and EN 10149-3	S260 to S700	450
EN 10025-6	S640 to S690	
NOTE: THESE VALUES ARE ACCORDING TO ISO 1514-1 FOR STEEL TYPES TO ISO / TR 20172		

Table 2: Permissible highest hardness values (HV 10) (Source EN 1090-2, Section 6.4.4, Table 10)

In practice, therefore, often hard edges of thick sheets are a problem, since the thermal firing process leads to a hardening of the surface and thus the required roughness is difficult or impossible to achieve by means of abrasive blasting. **Remedy here creates a grinding of the burned edges before abrasive blasting.**

Hardening depending on the cutting process:

Certification bodies that check the hardness of the parts find that the hardening can roughly be classified as follows:

• Laser cuts often have the highest degree of hardening.

• Plasma blanks are in the middle range.

• Autogenous cuts often have the lowest hardness.

• Water jet cuts are unproblematic as there is no hardening at the cutting edge.

How is the result to be explained?

The reason is the slower cooling rate of the material. Since the greatest heat is introduced in autogenous, the cooling process takes the longest - thus the hardening is also lower here..

But how does the heat affected zone behave?

Here it is exactly the opposite. The cause is the same reason: The large heat energy, which is introduced by autogenous and plasma into the material, produces a microstructure change in the material, which can be several millimeters up to several centimeters depending on the heat dissipation.
For high strength alloys, critical situations can occur when the welds are close to the cutting zones and the material has lost the required strength in that area.

• Autogenous cuts have the largest heat-affected zone

• Plasma cuts are in the middle field

• Laser parts have the lowest heat affected zone

• Water jet parts have no heat affected zone at all