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TechSupport

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#44

Punching of HARDOX and WELDOX.

Punching is the most effective method for making holes. The technique is quite commonly used when producing sieves made of mild steel (MS) but could also be applied for martensitic steel like HARDOX wear plate and WELDOX structural steel. In the present TechSupport practical punching operations have been performed on HARDOX 400 and WELDOX 700 to show the potential of this technique. Both HARDOX and WELDOX can be successfully punched achieving good quality holes at a very low cost.

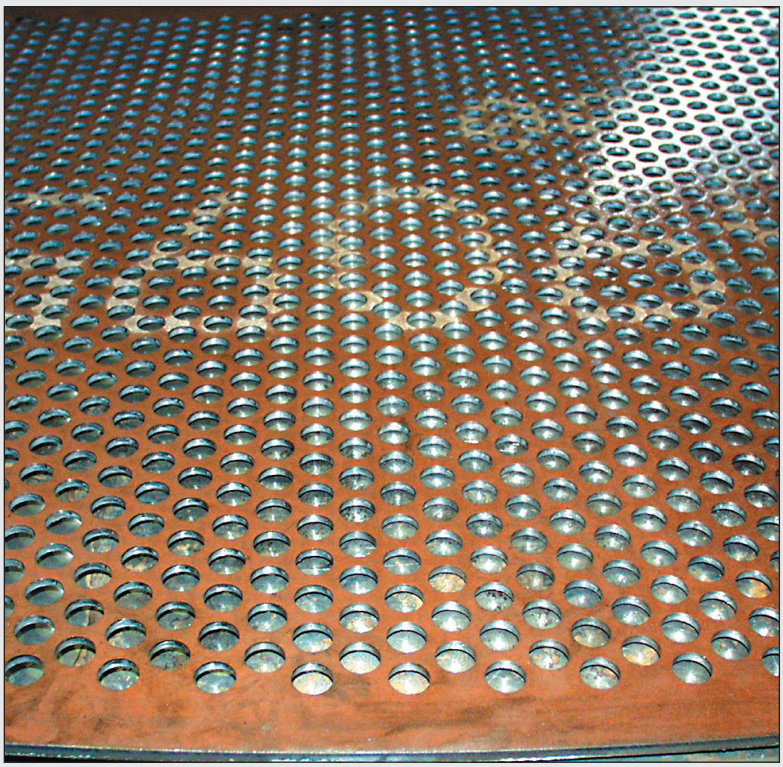
Background

The most cost effective methods for production of multi hole components like sieves is punching. Sieves of different types can be assembled for crushers and grinding mills, for screening of crushed material. An absolute condition for a successful punching performance is to have a sufficient punching force. It is also very important to consider the choice of die and punch material used for punching holes in quenched high strength steels.

For punching to be an option for making holes in HARDOX and WELDOX there are some aspects to consider before pushing the button.

• **Dimension of circular and square holes:** The size of a punched hole has an upper limit determined by the maximum punching force capacity. Downwards the diameter is limited by the plate thickness. The minimum diameter for punching HARDOX 400 is expected to be 1.5 times plate thickness.

• **Punching force:** The force required depends mainly on hole diameter, shear strength and plate thickness.



Sieve made in HARDOX 400 t= 6 mm, punched with a hole diameter of 15 mm.

The punching force can be estimated as follows:

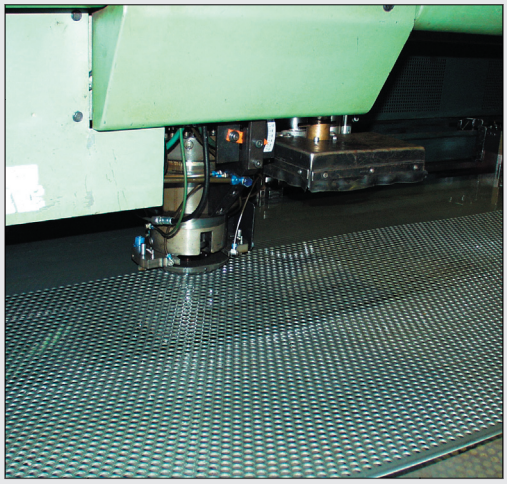
Cylindrical holes: $F\ [N] = k \cdot \pi \cdot \tau \cdot D \cdot t$

where
F = Punching force, N
k = Factor depending on the design of the punch.
(For a punch with leaning edge (wisper) of 7°, k = 0.85)
D = Punch diameter, mm
τ = Shear strength of plate, MPa
t = Plate thickness, mm

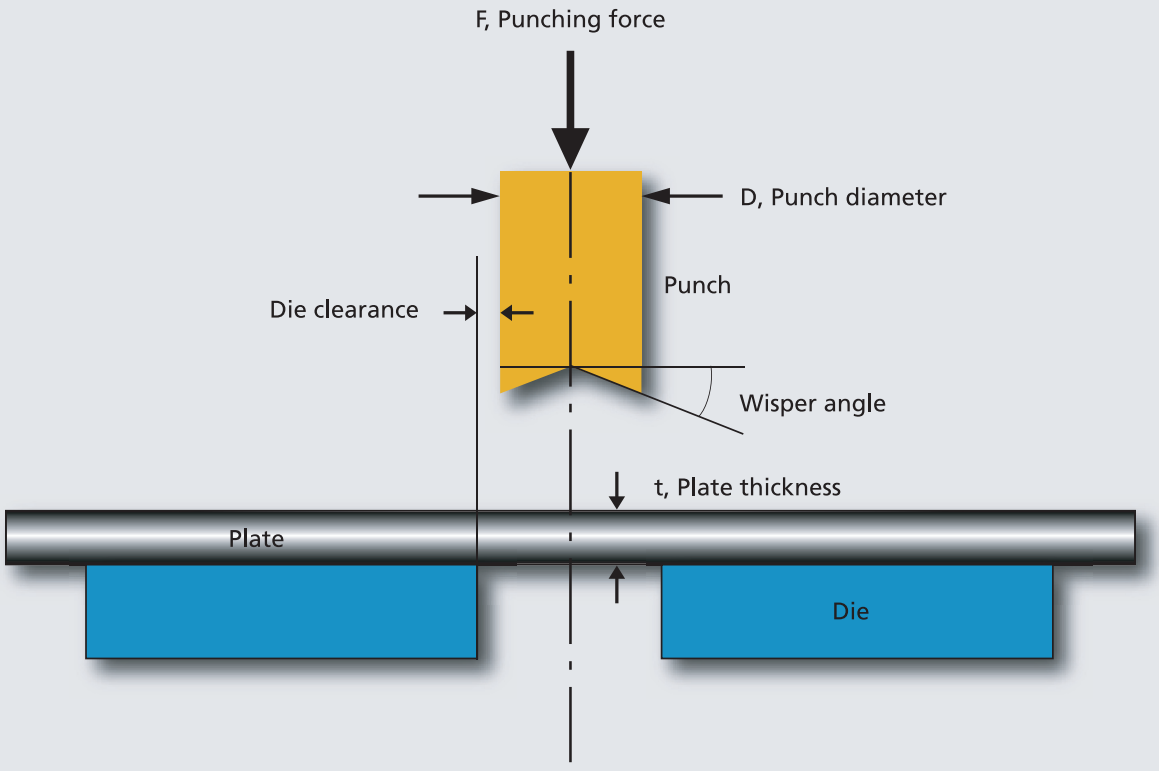
Rectangular holes: $\pi \cdot D$ is exchanged by length x width of punch

Calculated punching force for making a specific hole size in HARDOX 400, t= 4, 5 and 6 mm.

Thickness [mm]	Hole diameter [mm]	Punching force [kN]
4	8	100
4	10	157
4	15	188
4	20	251
5	15	236
6	15	283



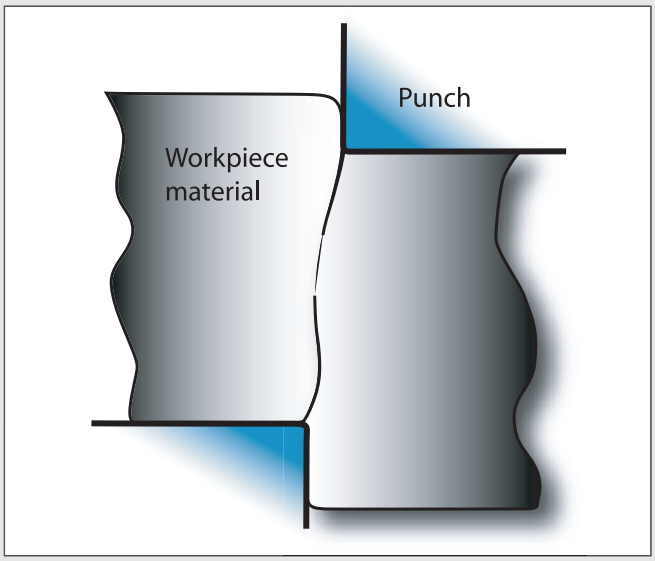
Punching of WELDOX 700 in 8 mm plate thickness.



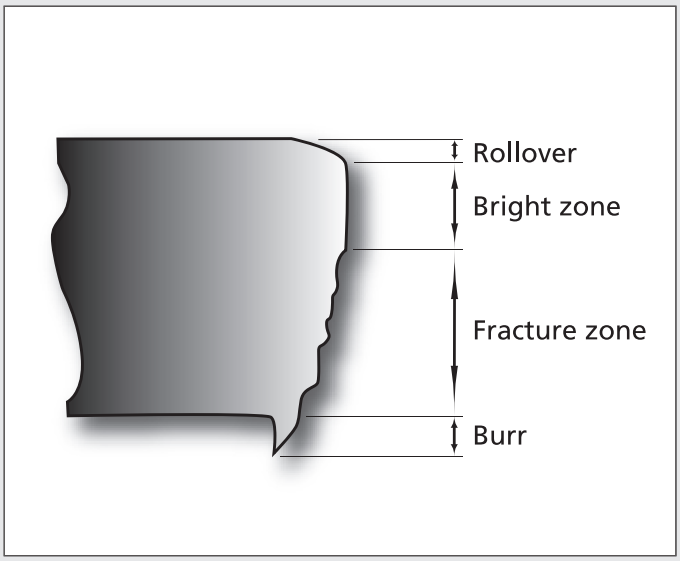
Normally a punch is cylindrical but rectangular punching is also possible.

Die clearance

A correct die clearance is important for the shear lips grooving from the cutting edges to meet. A too small/large die clearance will result in a poor cut quality in the centre of the plate.
The higher the hardness of the plate to be punched the larger the optimal die clearance for a good quality of the punched hole. For commercial steel grades as well as for WELDOX 700 a die clearance of 0.2 x plate thickness is recommended. For HARDOX 400 a die clearance of 0.3 x plate thickness is recommended.



Optimal die clearance. The shear lips meet at the plate centre.



Schematic description of a punched edge. The higher the strength of the plate, the smaller the height of the burr.

Case: Punching at Zikl-Trading

The company Zikl-Trading, in the Czech Republic, is a big producer of sieves, crushers and mills of various types. In order to keep production costs low and productivity high, making holes by punching has become a necessity. By using a TRUMPF TRUMATIC 300 PW punching machine with a maximum punching force of 300 kN, punching holes in HARDOX 400 and WELDOX 700 is not much of a problem.

Economy
The operation cost for punching at Zikl-Trading stays around 0.8 Euro/minute. This means that the cost per punched hole is approximately 0.013 Euro.
Note: Price refers to the costs in the Czech Republic.

Another advantage with this specific machine is that it can combine plasma cutting with punching.

Cost comparison

Hole making of HARDOX 400, in 6 mm plate thickness with a hole diameter of 15 mm.

Method	Number of holes /min.	Cost per hole [EURO]
Drilling	35	0.05
Laser cutting	20	0.24
Abrasive water jet cutting	2	1.0
Punching	60	0.013

Operation costs for alternative hole making methods to punching refer to the production cost level in Sweden.

A cost comparison of the various methods shows that punching by Zikl-Trading will cost about a fourth of the second cheapest method as well as boosting the productivity by about 50%.

Summary

By utilizing punching for making holes in HARDOX and WELDOX the following advantages can be achieved:

- Low production costs
- High productivity
- Good quality holes and tolerances
- Retained material hardness (machining without heat influence)

The potential for punching is presently limited by the available punching force of present commercial punching machines.

For more information on punching of HARDOX and WELDOX, contact our technical customer service at SSAB Oxelösund AB. www.ssabox.com.

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