



# Uddeholm Skolvar®

## Tool steel for soft zone dies in press hardening

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Press hardening, a thermomechanical manufacturing process, used to produce high strength structural components from advanced high strength steels (AHSS). It enables the manufacturing of complex geometries with minimal springback while achieving tensile strengths up to 2000 MPa. [1] This process has become a key technology in the automotive and transport sectors, where weight reduction and crash performance are critical.

In traditional hot stamping, a blank from a steel sheet is heated to its austenitization temperature, typically around 880°C, then rapidly transferred to a die where it is simultaneously formed and quenched. The rapid cooling, over 27°C/s, transforms the austenite into a mainly martensitic microstructure, significantly increasing the material's hardness and yield strength. [1] This results in a uniform mechanical property across the entire finished product.



FIGURE 1 Illustration of a press hardening tool for B-pillars

From a metallurgical perspective, the success of press hardening depends on precise control of heating, forming and cooling, all parameters to ensure the desirable form and structure, and to avoid undesirable phase transformations in the finished product. A common sheet material used in this process is 22MnB5, which is designed to receive its mechanical properties after quenching. Sheet material can be both coated and uncoated.

In press hardening we see failure mechanisms like wear, plastic deformation, cracking and temper back, which puts a high

demand on the die material. Therefore, it is crucial to have tool steels with tailored compositions in combination with precise production to extend the tool life. As a global leader in tool steel development, Uddeholm focuses on high performance solutions to meet these demanding requirements to prolong the tool life.

For more information about press hardening and choosing the right steel grade, see Uddeholms white paper: "Die materials for Press hardening of High Strength Steels"

### SOFT ZONE DIES

In advanced press hardening applications, tailored tempering has been developed to improve the crash performance and reduce the weight in a vehicle. By using tailored tempering, it is possible to keep a single part manufacturing and use the design freedom to increase safety and reduce weight.

By implementing dies kept at elevated temperatures called soft zone, in the press hardening process, it is possible to produce components with tailored mechanical properties by controlling the cooling rate in specific areas. This is achieved through localized thermal management in the die-set, often by incorporating actively heated zones.

Actively heated zones are a die insert with electric heating elements installed below the surface. This will ensure that the die is kept at elevated temperature, in a controlled way. To reduce cross heat transfer between the die sets, insulation plates can be used between the soft zone and cold zone. The insulation plates usually consist of lower thermal conductive materials, for example ceramic or steel, and will ensure a better transition of mechanical properties in the finished part.

These heated areas reduce the cooling rate during quenching, promoting the formation of softer bainitic or ferritic-martensitic microstructures, instead of the fully martensitic that has higher hardness. Slower quenching will lower the hardness locally, which will improve the elongation, hence better ductility. This will result in a component with high strength in critical areas, but still have areas with improved ductility for e.g., impact energy absorption during a crash, or post-forming operations like joining or forming.

However, the introduction of heated dies increases the thermal and mechanical demands on the tool steel. Soft zone dies typically run between 550°C and 630°C. This puts a high demand on the die material. The most common failure mechanism is wear and plastic deformation, as a result of temper back. This happens when tool steel is exposed to elevated temperatures during a long period of time, which will lower the hardness in the surface. A lower hardness in the die surface will increase the risk of failure, causing more maintenance or even scrapped dies.

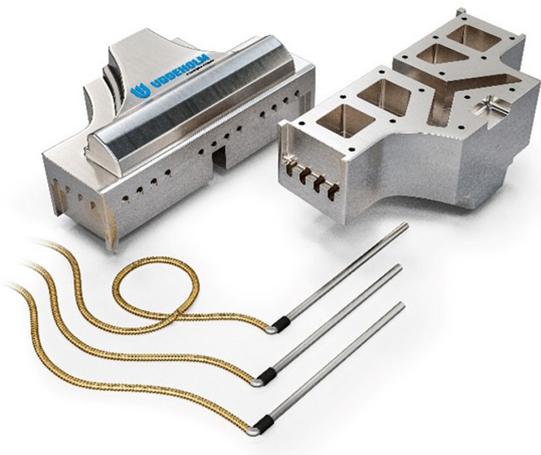
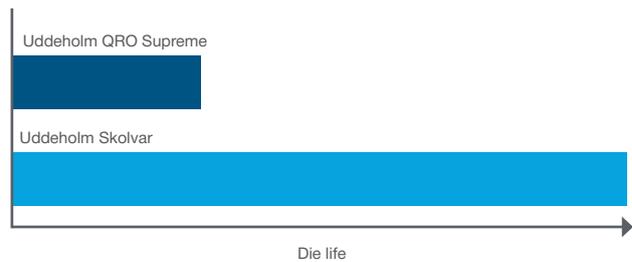


FIGURE 2 Die insert for soft zone, with heating elements

**TOOL STEEL SELECTION FOR SOFT ZONE DIES**

Uddeholm QRO 90 Supreme has historically been the industry benchmark for soft zone die applications, primarily due to its superior resistance to temper back. This property allows the die to retain its hardness and desirable mechanical properties even under long exposure to elevated temperatures. Our latest launched material Uddeholm Skolvar is specifically developed for hot forming applications, it has shown great results in press hardening for soft zone dies.

Recent industrial trials have identified Uddeholm Skolvar as a next generation alternative that significantly outperforms Uddeholm QRO 90 Supreme. In customer applications, Uddeholm Skolvar has shown more than a threefold increase in tool life, driven by its ability to withstand the harsh thermal and mechanical demands of soft zone forming.



Uddeholm Skolvar maintains the high temper back resistance equivalent to Uddeholm QRO 90 Supreme, but also introduces two key improvements: higher achievable hardness (up to 61 HRC) and enhanced abrasive wear resistance. These properties result not only in a higher starting hardness with phenomenal softening resistance, but also the ability to withstand abrasive wear even after softening.

Due to its patented chemical composition, Uddeholm Skolvar is a unique Elektro-slag remelted (ESR) tool steel, containing vanadium enriched carbides, performing like a cold work tool steel in abrasive wear resistance but with good machinability and weldability. Making it well suited for maintenance when localized damage or wear occurs. This ensures predictable and longer die life, reducing the total cost of the finished part.

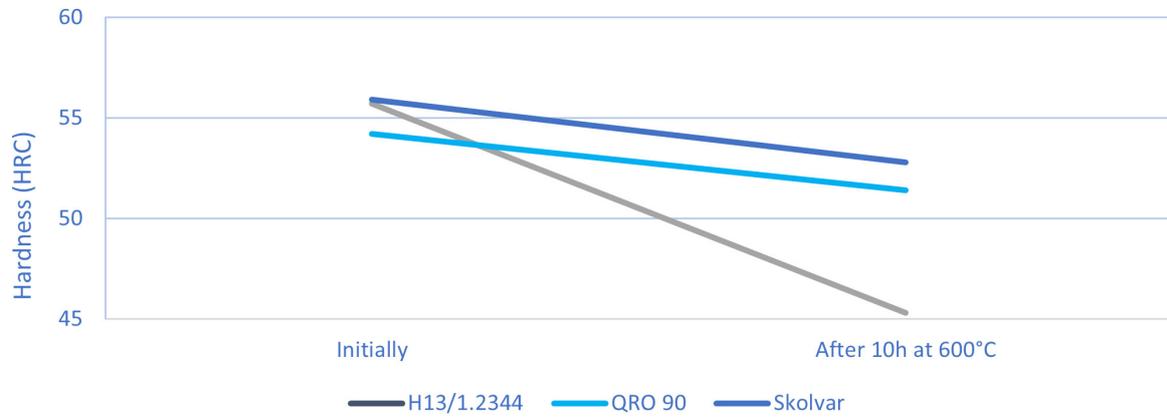


FIGURE 3 Softening of the material after 10h at 600°C, showing temper back resistance

Figure 3 shows the temper back resistance at elevated temperatures for Uddeholm Skolvar and Uddeholm QRO 90 Supreme, in comparison with AISI H13/W-Nr. 1.2344 as a reference steel grade.

For these reasons, we recommend Uddeholm Skolvar as the preferred choice in soft zone dies for high volume production. An excellent choice when tool performance, uptime and maintenance efficiency are critical to overall process stability, and the importance of making production more cost effective.

**REFERENCES**

[1] E. Billur, Hot Stamping of Ultra High-Strength Steels, 1st ed. Cham: Springer, 2018. ISBN: 978-3-319-98870-2.

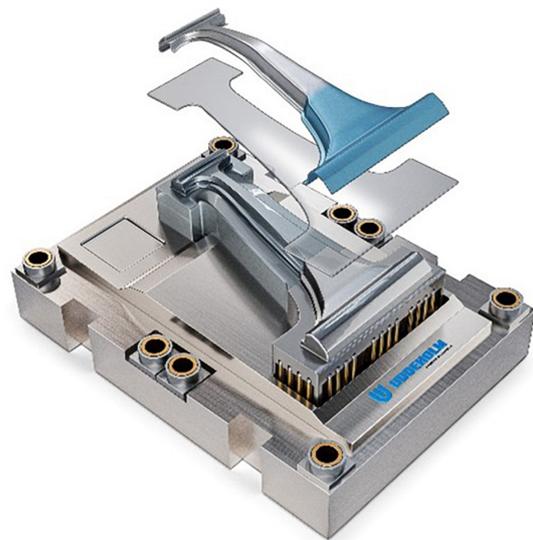


FIGURE 4 Illustration of a die-set with a soft zone insert