SSS **476/K110®** Colour Code: White & Black **D2** **1.2379**

HIGH DUTY TOOL STEEL AISI WERKSTOFF No

C	Si	Mn	Cr	Mo	W	V	Co
1.55			12.0	0.85		0.28	

Features and Uses
Being of the high carbon, high chromium type this steel offers very high wear resistance, yet it is tough and machinable. It hardens in air up to large sections with a low order of movement and offers a measure of corrosion resistance when polished.

"**476**" is used for tools operating under conditions of severe wear and abrasion or as an alternative to oil hardening tool steels when longer runs are required.

Applications include blanking dies and punches for steel sheet and plate, high silicon transformer materials, stainless steel and iron, brass, copper, zinc and hard abrasive metals generally. Deep drawing dies, cupping dies, forming dies. Sheet metal forming rolls, shear blades for strip and sheet including flying shears. Circular cutters for cold rolled strip. Trimmer dies, thread rolling dies, cold extrusion dies. Broaches, plug gauges, ring gauges, special taps, staybolt taps. Brick and tile mould liners. Master hobs for cold hobbing, plastic moulds. Cut moulds for plastics.

Working and Heat Treatment
Forging
Pre-heat at 900ºC / 950ºC. then raise temperature to 1050º / 1100ºC. Soak until uniformly heated. This steel is relatively hard at elevated temperatures, therefore, initial hammer blows must be light and the temperature must not be allowed to fall below 1020ºC. until the metal begins to flow. Final forging should not be done below 900ºC.
Annealing
"476" is supplied in the annealed and machinable condition. Re-annealing will only be necessary if the steel has been forged by the toolmaker or if it is desired to machine a hardened tool. To anneal, heat slowly and uniformly to 900ºC. in a protective gas atmosphere. Soak for three to four hours and allow to cool in the furnace to shop temperature. Then, without removing the steel from the furnace, re-heat to 800°C and again soak for three to four hours. Allow to cool in the furnace to shop temperature.

Stress relieving
When tools are heavily machined, ground or otherwise subjected to cold work, the relief of internal strains is advisable before hardening to minimize the possibility of distortion. Stress relieving should be done after rough machining. To stress relieve, heat carefully at 600° / 650°C. Soak well and cool in the furnace or in air. The tools may then be finish-machined before hardening.

Hardening
It is preferable to heat the tools in a controlled atmosphere. This material is ideal for vacuum hardening and also suited to salt bath hardening. If this is not possible, pack hardening is recommended. A reducing atmosphere is desirable. Pre-heat slowly to 750° / 800°C. and allow to soak at this temperature. The tools may then be brought up to 1000° /1020°C. for air-cooling, or 980°C. for oil quenching. Soak thoroughly at the temperature for twenty to thirty minutes per inch of ruling section, then cool or quench accordingly. It is important not to exceed 1020°C. when heating for hardening. Exceeding this temperature will cause indifferent hardening. A deterioration in magnetic properties indicates that the steel has been overheated in hardening. Tempering will always be necessary.

Martempering
Martempering is an alternative hardening procedure, which may be used when suitable salt bath equipment is available. By this method internal strain, distortion and risk of quench cracking are reduced to the minimum. Pre-heat dry at 300°/400°C. Pre-heat in salt at 800º / 850°C. holding in the salt for ten minutes per 25 mm of ruling section. Raise to the hardening temperature of 1000° /1020°C. holding in the salt for ten minutes per 25 mm of ruling section.

Marquench in salt at 230° / 250°C. , holding in the bath for twenty minutes per 25 mm of ruling section. Cool in still air. Tempering will be necessary.

Tempering
Double tempering is recommended. Tempering should be done with the least possible delay after hardening, preferably when the tools are still hand warm. Refer to the tempering curve and select a suitable temperature bearing in mind the service requirements. Heat slowly and uniformly. When the tool has reached the desired temperature, soak for at least sixty minutes, withdraw from the furnace and allow to cool in air. The second tempering should be a repetition of the first.

Guide to Tempering Temperatures
TOOLS FOR LIGHT SHOCK APPLICATIONS when maximum wear resistance is required, e.g. moulding dies, thin sheet-punching dies. Temper 190° - 250°C. Hardness Rockwell C60-63.

MEDIUM DUTY APPLICATIONS slitting cutters, plate punching dies, master hobbing tools, trimming dies, cold extrusion dies. Temper 500°-520°C. Hardness Rockwell C57-60.

MEDIUM TO HEAVY DUTY APPLICATIONS slitting cutters, shear blades, punching tools, forming tools, trimming dies, cold extrusion dies, and bolt cutters. Temper 520°-540°C. Hardness Rockwell C55-58.

HEAVY DUTY APPLICATIONS heavy sheer blades, flying shears, heavy plate punching tools, punching and forming tools. Temper 540°-560°C. Hardness Rockwell C52-56.

Final Grinding
Select the correct grade of wheel in consultation with the grinding wheel manufacturer. Keep the wheel in good condition by means of a suitable dressing tool. Wet grinding is preferable using a copious supply of coolant. If dry grinding is resorted to, use a very soft wheel.