

WM 4% NI

WM 4% NI is an alloy tool and die steel furnished in the annealed condition. It is used for dies where very high compressive strength and resistance to softening at elevated temperatures are required.

This tool steel has also been known as **Typlex** in the past.

Carbon	.47
Manganese	.50
Silicon	.60
Chromium	1.50
Molybdenum	.75
Vanadium	.15
Nickel	4.30

TYPICAL APPLICATIONS

Forging dies, shear blades, extrusion dies and trim dies.

PHYSICAL PROPERTIES

Density, lb/cu in	0.280
Modules of elasticity, psi	29-30 x 10 ⁶
Coefficient of Thermal Expansion /°1:	
80 - 400°F	6.0 x 10 ⁻⁶ in/in/°F
80 - 800°F	7.2
80 -1450°F	8.1
800 - 1450°F	8.9

Heat Treatment

ANNEALING - Heat slowly to 1300°F, hold at temperature until heated through, cool slowly to 500°F, reheat to 1220°F, hold at temperature for 2 hours per inch of cross section. Furnace cool to 1180°F, hold at 1180°F for 2 hours per inch of cross section. Furnace cool to 500°F then air cool.

HARDENING – It is recommended that, in order to minimize scaling or decarburization, the finish-machined surfaces of dies and tools be protected against oxidizing atmospheres by heating the steel in a controlled atmosphere furnace. If this is not available, the steel may be heated in a neutral salt bath or in a conventional furnace with the steel completely packed in spent pitch coke, or similar material.

When only the impression-machined face of a die is to be protected, a convenient and inexpensive method is to immerse the die, impression face down, sufficiently deep into a packing material such as wood charcoal or spent pitch coke supported on a steel plate. The assembly may then be heated in an open-fired furnace.

Charge the steel into a furnace at not over 500°F. When the steel is packed, charge into a furnace at not over 1000°F. (It is recommended that a thermo-couple be inserted in the box when pack heating.) When the steel is to be oil quenched, heat slowly and evenly to 1670°F at a rate not exceeding 200°F per hour. When the steel is to be cooled in still air or by an air

blast, heat to 1650-1670°F. Hold at this temperature for approximately half an hour per inch of cross section. Cool small, thin and intricately shaped sections in still air to 350°F. Cool heavier sections of deep impression and intricate design, under uniformly applied dry air blast to 350°F.

Cool heavy sections with simple impressions and regular design to 350°F by complete impression face down. Hold the die beneath the surface of the oil until the shank has chilled below the fire point of the oil. Partially withdraw the die to a level about half an inch below the shank line, and maintain in this position until the impression face has cooled to approximately 350°F. A low melting temperature salt crayon may be advantageously used to determine the quench point.

Immediately after air cooling or quenching to 350°F, place the steel into a tempering furnace maintained at 400°F to 500°F and thoroughly equalize at 500°F temperature. Then heat slowly and evenly to the necessary tempering temperature to give the desired hardness as shown in the following tables.

Hold a tempering temperature for two hours per inch of greatest thickness up to and including 3-inch section. Increasing one hour for each one inch of increase over 3 inches. Air cool to room temperature.

Double tempering is recommended. Hold at temperature one half of the required single temper time and air cool to room temperature. Reheat to same temperature, hold same period of time and air cool to room temperature. The following chart is a guide to what hardness may be expected.

Typical Hardness Data

(1 x 1 bars, oil quenched from 1650°F & Tempered)

Tempering Temperature °F	Rockwell Hardness "C"
As Quenched	56-58
600	50-52
1000	48-50
1050	47-40
1100	46-38
1150	44-46
1200	42-46
1250	40-42
1300	38-40

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