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SS

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国家标准



日本工业标准

DATA SHEET

Mar-X™ PREMIUM QUALITY STAINLESS MOLD STEEL

APPLICATIONS

Finkl **Mar-X™** is recommended for plastics, glass and other tooling applications that require molds with excellent polishability and corrosion resistance. The polishability of **Mar-X™** increases with increasing hardness and is superior to that of air melted 17-4 precipitation hardening types.

Finkl **Mar-X™** has proven itself in especially demanding applications such as lenses, high-quality optical molds and film forming dies.

Finkl **Mar-X™** is recommended for molding abrasive materials, e.g. thermoplastic, thermosetting and glass-reinforced grades.

Finkl **Mar-X™** is also recommended for plastic injection mold components that are subjected to elevated temperatures such as hot runner manifolds.

MACHINABILITY

Finkl **Mar-X™** is easily machined in the solution treated condition. The cutting speeds and feeds for **Mar-X™** are similar to those used to machine 304 and 420 stainless steels.

The excellent stability of Finkl **Mar-X™** allows a simple low-temperature aging process to increase the hardness and strength of **Mar-X™** with little distortion and a minor amount of shrinkage.

Finkl **Mar-X™** requires a shrinkage allowance of up to .0005 inches-per-inch due to contraction of the mold for aging temperatures below 1000°F and up to .001 inches-per-inch for aging temperatures above 1000°F.

Typical Chemical Analysis - % weight

C	Mn	Si	Ni	Cr	Cu	Other
0.07	<1.0	<1.0	4.50	14.75	3.50	Micro alloying

GENERAL CHARACTERISTICS

Finkl **Mar-X™** is a remarkably tough and long lasting mold steel with excellent corrosion resistance and high temperature physical properties.

Finkl **Mar-X™** resists atmospheric as well as chemical corrosion due to plastic formulation or by-products formed during the plastic injection process. **Mar-X™** has the general corrosion resistance of Type 304 stainless and, in many cases, eliminates the need for chrome plating required with other mold materials.

Mar-X™ is processed in Finkl's vacuum arc remelt (VAR) facility in order to achieve superior cleanliness and minimum segregation, assuring polishability to lens quality standards.

Finkl **Mar-X™** is forged utilizing wide-die techniques, which assure consolidated centers and fine grain structure, resulting in improved properties throughout.

Finkl **Mar-X™** is solution treated using our computer-controlled heat treat furnaces following thermal processing cycles developed to minimize the distortion of the mold during machining.

Finkl **Mar-X™** is 100% sonic tested to the most rigid industry standards and is fully warranted.

DATA SHEET

STAINLESS MOLD STEEL

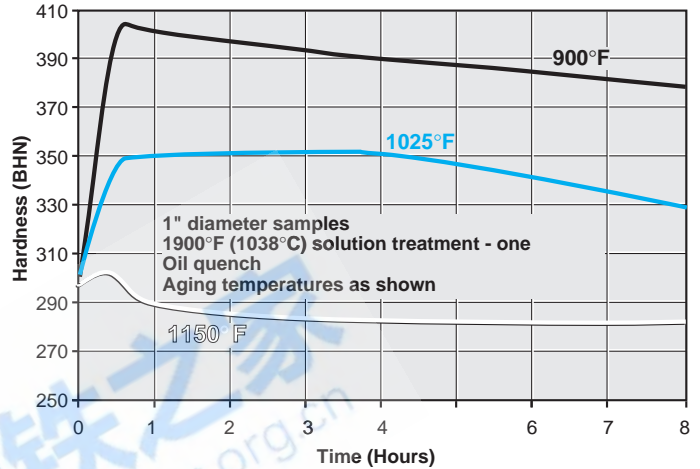
Max-X™

EFFECT OF OVER-AGING ON HARDNESS

Aging cross-sections or Finkl **Mar-X™** greater than 4 inches thick will require additional aging time proportional to the thickness of the mold. This additional time will over-age thinner cross-sections of the mold and result in a decrease of hardness up to 20 BHN. If it is desired to maintain a minimum hardness, the aging temperature should be dropped up to 50°F to compensate for the longer aging time (see graph).

The minimum aging temperature should not be less than 900°F.

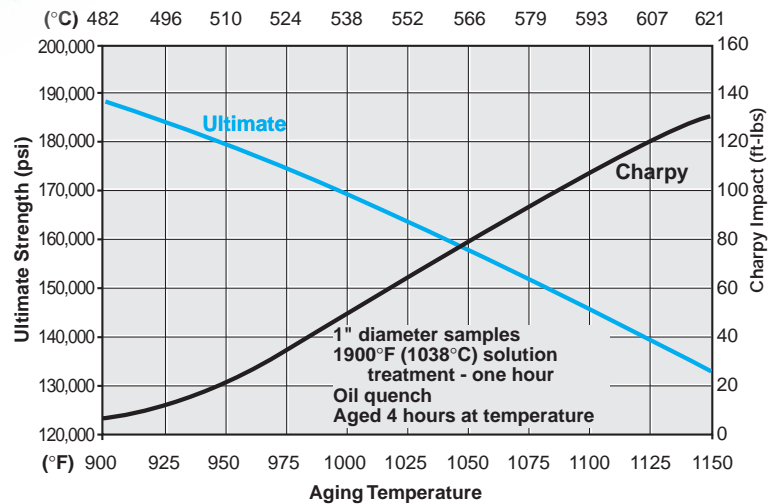
Typical Mar-X™ Aging Response Versus Time



STRENGTH AND TOUGHNESS

Finkl **Mar-X™** is a remarkably strong and tough mold material. The best balance of properties occur when **Mar-X™** is aged above 1000°F (see graph).

Typical Mar-X™ Strength and Toughness after 4 Hour Aging



PROPERTIES Mar-X™

• Cleanliness:

Method	A	B	C	D
ASTM E45	≤ 0.5	≤ 0.5	≤ 0.5	≤ 0.5
DIN 50602	K0 ≤ 10			

DATA SHEET

STAINLESS MOLD STEEL

Max-X™

RECOMMENDED HEAT TREATMENT PRACTICE

PROCESS	TEMPERATURE	COOLING
Preheating for welding	Typically not required under 4" thick; 300°F (150°C) for intricate or thicker sections	
Solution treatment	1900°F (1040°C) soaking 30 min. per inch	Air or oil; to 90°F (32°C)
Aging	See figure; hold 1 hour per inch (25 min. per cm) of thickness - 4 hours minimum	Air
Stress Relieving	50°F (28°C) below final aging temp.	Air

HEAT TREATMENT

Mar-X™ is stocked in the solution treated condition. The hardness of **Mar-X™** in the solution treated condition is approximately 311 BHN (33HRc). **Mar-X™** is typically rough machined in the solution treated condition, aged to the desired hardness, and then machined to the final sizes. Another advantage of this processing route is the stress relieving effect of the aging process.

An additional aging treatment should be performed if a lower hardness or increased corrosion resistance is required.

If a higher strength or hardness is required after the initial aging process, repeating the solution treatment and aging process is required. Allowances should be made to accommodate the distortion introduced by the solution treatment process.

Solution Treatment

1. Charge into a furnace that is at 600°F or lower.
2. Heat evenly at a rate of 200°F per hour to 1900°F.
3. Soak at this temperature for 30 minutes per inch of least dimension or a maximum of 6 hours.
4. Air or oil quench (sections above 3" thick should be air-cooled) to 90°F. Air quenching introduces the least residual thermal stress into the mold and minimizes distortion. Oil quenching provides for the lowest hardness and best machinability but produces the greatest distortion and highest probability of cracking, especially in complex and large molds.

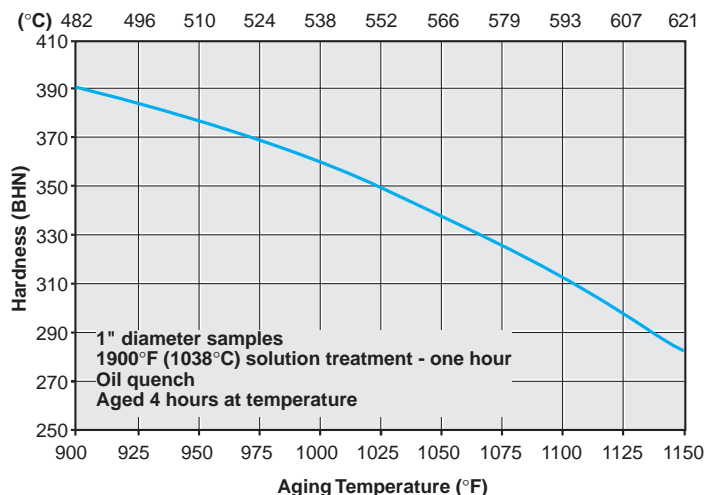
Aging

1. Allow temperature of mold to equalize at 400°F.
2. Heat mold uniformly to aging temperature.
3. Soak at aging temperature for 1 hour per inch of least dimension, 4 hours minimum. Since part size, furnace and quenching media affect the final hardness, only approximate aging temperatures can be recommended as a guide for specific hardness (see graph).

Stress Relieving

1. Allow temperature of mold to equalize at 400°F.
2. Heat mold uniformly to 50°F below the previous aging temperature.
3. Soak at aging temperature for 1 hour per inch of least dimension.

Typical Mar-X™ 4 Hour Aging Response



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STAINLESS MOLD STEEL

Mar-X™

WELDING

Mar-X™ is easily welded using conventional techniques used for other types of martensitic precipitation hardening stainless steels, such as 17-4PH. **Mar-X™** has superior weldability over 17-4PH due to its balanced chemistry, which virtually eliminates δ -ferrite. **Mar-X™** does not require preheating before welding for sections less than 4" thick because of the low carbon content.

The highest quality welds can be obtained with gas-tungsten arc welding with AMS 5826 filler wire. For less critical applications, where the final polish or texture quality is not paramount, shielded metal arc welding using type AWS E630 (17-4PH) covered electrodes is satisfactory.

All welds must be aged 1 to 4 hours if hardness, texture or polish matching to the parent material is desired.

Care must be taken to avoid partial penetration welds or stress raisers in order to avoid crack initiation at the root of the weld. The user assumes all liability for damage to the mold, risk of injury to persons, or damage to property, attributable to welding.

POLISHING

The excellent cleanliness and low segregation of Finkl **Mar-X™** permit its use in many critical applications such as optical lens molds and film dies. The best combination of physical properties and polishability are achieved when **Mar-X™** is aged between 950° and 1050°F.

TEXTURING

Finkl **Mar-X™** will texture more consistently than other martensitic precipitation hardening mold steels such as 17-4PH due to the very low segregation and high cleanliness developed after the vacuum arc remelt (VAR) process.

Due to the excellent resistance to chemical attack, the special texturing procedures that have been developed for stainless mold steels should be used for **Mar-X™**.

CORROSION RESISTANCE

The corrosion resistance of Finkl **Mar-X™** is similar to that obtained by austenitic stainless steels such as Type 304 stainless. This feature is especially important to high quality molds used in humid conditions or when a mold set is used infrequently and is stored for extended periods of time.

Finkl **Mar-X™** also has excellent resistance to attack from acids, bases and corrosive by-products resulting from the plastic injection forming process. Highest resistance to corrosion is obtained when **Mar-X™** is aged at temperatures higher than 1000°F.

Note: Provided technical data and information in this data sheet are typical values. Normal variations in chemistry, size and conditions of heat treatment may cause deviations from these values. We suggest that information be verified at time of enquiry or order. For additional data or metallurgical assistance, please contact us.