



## KETOS® (AISI O1)

**CRUCIBLE DATA**

Ketos is an oil-hardening tool steel which may be hardened from fairly low temperatures with little size change. This grade combines deep-hardening qualities with a fine-grained structure, affording good initial production runs, and good continued production after grinding.

### Typical Chemistry

Carbon	0.90%
Manganese	1.25%
Silicon	0.30%
Chromium	0.50%
Tungsten	0.50%

### Typical Applications

Blanking Dies	Jewelers Hobs
Engraving Tools	Paper Knives
Forming Tools	Taps (Hand)
Gauges	Trim Dies

### Hardening

Note: Full hardness will only be attained in sections less than about 3 inches thick.

**Critical Temperature:** 1370F(745C).

**Preheat:** 1250/1350F(675/730C)

**High Heat:** 1450/1500F(790/815C), hold 10/30 minutes at temperature.

Quench: Quench in oil to hand warm, 150F(65C).

**Temper:** 350/600F(175/315C); hold one hour per inch of thickness, two hours minimum, four hours preferred.

**Cryogenic treatments:** Refrigeration treatments may improve long-term dimensional stability by transforming retained austenite. Refrigeration treatments should be performed after at least one temper, to minimize risk of cracking, and should always be followed by a temper.

### Typical Properties

Hardness and Impact Toughness Data  
Oil Quenched from 1475F(800C).

**Chemistries  
& Properties  
Table**

**Heat  
Treatments  
Table**

Tempering Temp.		Hardness HRC	Toughness, Charpy C-notch	
°F	°C		ft-lbs	Joules
	AQ	63-65	—	—
300	150	63-65	14	19
350	175	62-64	28	38
400	205	61-63	30	41
450	230	60-62	—	—
500	260	58-60	30	41
600	315	55-57	32	43
700	370	51-53	—	—
800	425	48-50	—	—
900	480	43-45	—	—
1000	540	39-41	—	—

### Size Change During Hardening

Hardening Temp.		Tempering Temp.		HRC	Longitudinal Size Change %
°F	°C	°F	°C		
1475	800	300	150	64	+.12
1475	800	400	205	62	+.14
1475	800	450	230	61	+.18

## Surface Treatments

Ketos can be given standard surface treatments such as hard chrome plating if desired. Nitriding is not generally practical due to a substantial loss of core hardness.

## Annealing

A. Heat to 1425/1450F(775/790C), hold two hours, cool slowly, 50F(30C) per hour maximum, to below 1000F(540C), then air cool.

OR

B. Heat to 1425/1450F(775/790C), hold 2 hours, cool to 1275F(690C) 6 hours, then air cool.

**Typical annealed hardness:** 187/221 BHN

## Stress Relieving

**Annealed Material:** 1100/1300F(595/740C), hold 2 hours, cool in still air.

**Hardened Material:** 50F(30C) below last tempering temperature, hold two hour, cool in still air.

## Welding

Use oil-hardening (O1) tool steel filler material.

**Annealed material:** Preheat to 400/600F(205/315C). Maintain over 400F(205C) during welding. Allow to cool to hand warm (150F(65C) after welding. Reanneal, or temper 1250/1300F(675/705C) for 6 hours.

**Hardened material:** Preheat to 50F(30C) below tempering temperature (300F(150C) minimum). Maintain over 300F(150C) during welding. Allow to cool to hand warm (150F(65C) after welding. Retemper twice at 25/50F(15/30C) below original tempering temperature.

## Physical Properties

**Modulus of Elasticity** .....30 psi x 10<sup>6</sup>  
(207 GPa)

**Density** .....0.283 lb/in<sup>3</sup>  
(7850 kg/m<sup>3</sup>)

**Specific gravity** .....7.85

**Thermal Conductivity** ..... 20 BTU/hr/ft/°F(200F) 34.5  
W/m°K(95C)

**Thermal Expansion**

Temperature Range		Coefficient of Thermal Expansion	
°F	°C	in/in/°F $\times 10^{-6}$	mm/mm/°C $\times 10^{-6}$
RT/400	RT/205	7.0	12.6
RT/800	RT/425	7.4	13.3
RT/1000	RT/540	7.8	14.0

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