

<b>Quality</b>	<b>X40CrMoV5-1</b>	Supply conditions:	<i>Technical card</i>
According to standards	<b>UNI EN ISO 4957: 2002</b>	Annealed HB max 229	<b>Lucefin Group</b>
Number	<b>1.2344</b>		<i>rev. 2018</i>

### Chemical composition

C%	Si%	Mn%	P%	S%	Cr%	Mo%	V%
0,35-0,42	0,80-1,20	0,25-0,50	max	max	4,80-5,50	1,20-1,50	0,85-1,15
± 0.02	± 0.05	± 0.04	+ 0.005	+ 0.005	± 0.10	± 0.05	± 0.05

Product deviations are allowed

### Temperature °C

Hot-forming	Quenching +Q	Tempering see table +T	Stress-relieving +SR	Stress-relieving must be done after machining and before quenching			
preheating at 800 after 1120-925	heating up to 800, pause, then 1020-1080 oil, polymer, s.b. (HRC ~ 55)	immediately after quenching minimum <b>2 cycles</b>	600-650 furnace cooling to 350, then air				
Soft annealing +A	Isothermal annealing +I	+TH annealing	Pre-heating welding	Stress-relieving after welding			
820 furnace cooling (HB max 229)	880 furnace cooling to 780, pause, then furnace cooling to 750, then air	860-900 cooling 22 °C/h (HB 192-229)	350	650 furnace cooling			
			<b>Ac1</b>	<b>Ac3</b>	<b>Ms</b>	<b>Mf</b>	
			830	915	300	80	

s.b. = salt bath (450-500 °C). Gas nitriding at 510 °C

### Mechanical properties

Tempering table after quenching at 1040 °C in oil. Values on Ø 20 mm

HB	560	543	525	512	504	512	525	543	577	577	512	455	390	301
HRC	55	54	53	52	51.5	52	53	54	56	56	52	48	42	32
R N/mm <sup>2</sup>	2070	2010	1950	1880	1850	1880	1950	2010	2160	2160	1880	1640	1340	1010
Tempering at °C	<b>50</b>	<b>100</b>	<b>150</b>	<b>200</b>	<b>250</b>	<b>300</b>	<b>350</b>	<b>400</b>	<b>450</b>	<b>500</b>	<b>550</b>	<b>600</b>	<b>650</b>	<b>700</b>

### Hardness at elevated temperatures

HRC	55	49	47	42	22
°C	<b>20</b>	<b>315</b>	<b>425</b>	<b>540</b>	<b>650</b>

<b>Thermal expansion</b>	10 <sup>-6</sup> • K <sup>-1</sup> ►	10.0	10.7	10.8	11.3	11.8	12.3	12.7	13.0	13.2		
<b>Modulus of elasticity</b>	long. GPa				210	205	198	191	182	173		
<b>Modulus of elasticity</b>	tang. GPa				80	78	75	73	69	66		
<b>R +QT</b>	N/mm <sup>2</sup>				<b>1600</b>				1400	1300	1100	800
<b>Rp 0.2</b>	N/mm <sup>2</sup>				1460				1200	1100	900	600
<b>R +QT</b>	N/mm <sup>2</sup>				<b>1200</b>				1120	1000	850	580
<b>Rp 0.2</b>	N/mm <sup>2</sup>				1060				900	800	650	420
<b>Specific heat capacity</b>	J/(Kg•K)				460	479	499	517	536	558	587	
<b>Thermal conductivity</b>	W/(m•K)				19.2	20.1	22.4	24.0	25.1	25.8	26.1	
<b>Density</b>	Kg/dm <sup>3</sup>				7.74							
<b>Specific electric resist.</b>	Ohm•mm <sup>2</sup> /m				0.543	0.638	0.705	0.782	0.868	0.96	1.06	
<b>Electrical conductivity</b>	Siemens•m/mm <sup>2</sup>				1.84	1.57	1.42	1.28	1.15	1.04	0.94	
°C		<b>-100</b>	<b>0</b>	<b>20</b>	<b>100</b>	<b>200</b>	<b>300</b>	<b>400</b>	<b>500</b>	<b>600</b>		

The symbol ► indicates temperature between -100 °C and 0 °C, -100 °C and 20 °C ...

Nitriding in gaseous ammonia. The material should be hardened and tempered at min. 580 °C before nitriding

°C	Time h	Depth of hardening mm	Surface hardness HV
<b>525</b>	10	0,125	1000 - 1250
<b>525</b>	20	0,180	1000 - 1250
<b>525</b>	40	0,250	1000 - 1250
<b>525</b>	60	0,300	1000 - 1250

Europe	Germany	China	Japan	India	R. of Korea	Russia	USA
EN	DIN	GB	JIS	IS	KS	GOST	AISI/SAE
X40CrMoV5-1	X40CrMoV5-1	4Cr5MoSiV1	SKD 61	XT35Cr5MoV1	STD 61	4Ch4VMFS	H 13

## 1.2344 X40CrMoV5-1 ASM Vol. 8 - H13 Steel

**Typical long. room-temperature mechanical properties.** Round bars, oil quenched from 1010 °C and double tempered

tempering temperature °C	Tensile strength N/mm <sup>2</sup>	Yield strength N/mm <sup>2</sup>	Elongation %	Reduction %	Kv J	Hardness HRC
527	1960	1570	13,0	46,2	16,0	52 <sup>a)</sup>
555	1835	1530	13,1	50,1	24,0	50
575	1730	1470	13,5	52,4	27,0	48 <sup>a)</sup>
593	1580	1365	14,4	53,7	28,5	46
605	1495	1290	15,4	54,0	30,0	44 <sup>a)</sup>

Tensile tests at elevated temperatures on the bars in a)

Hardness HRC	Test temperature		Tensile strength N/mm <sup>2</sup>	Yield strength N/mm <sup>2</sup>	Elongation %	Reduction %
	°C	°F				
52 (duble tempered at 527 °C)	425	800	1620	1240	13,7	50,6
	540	1000	1305	1000	13,9	54,0
	595	1100	1020	825	17,5	65,4
	650	1200	450	340	28,9	88,9
48 (duble tempered at 575 °C)	425	800	1400	1150	15,0	59,9
	540	1000	1160	960	17,1	62,4
	595	1100	940	750	18,0	68,5
	650	1200	455	350	33,6	89,0
44 (duble tempered at 605 °C)	425	800	1200	1005	17,0	64,1
	540	1000	995	820	20,6	70,0
	595	1100	827	690	22,6	74,0
	650	1200	450	350	28,4	87,6

Longitudinal **Impact properties** of bar tempered at different temperatures

HRC of the bars at room t.	Tempering temp. °C	Kv (J)				
		-73 °C	21 °C	260 °C	540 °C	595 °C
54	524	7	14	37	31	-
52	565	7	14	30	34	-
47	607	8	24	41	45	43
43	615	9.5	24	52	60	57

Resistance to combinations of heat, pressure and abrasion to softening by forming operations at high temperatures

Exposure at °C	Hardness, HRC after 100 hours of exposure to heat					
	480	540	595	650	705	760
Hardness at room temp. HRC = 50.2	48.7	45.3	29.0	22.7	20.1	(13.9)

### Tool steel for high-working temperatures

- good resistance to thermal shock and heat cracking
- good mechanical characteristics and toughness in hot condition, constant hardness throughout the production cycle
- excellent machinability, high micro-purity level, good suitability for polishing and photo-engraving
- possibility to carry out welding operation with TIG (Tungsten Inert Gas) or MMA (Manual Metal Arc) methods
- possibility of coating with PVD or PA/CVD methods, flame/induction hardening and nitriding
- applications: *dies for aluminium die-casting, dies subject to low pressure, chill moulds for gravity casting, containers for die-casting presses, dies for aluminium extrusion, extrusion press blocks, sleeves for extrusion, injection moulds*

Mechanical properties at elevated temperature R 1370 N/mm<sup>2</sup>

