

<b>Quality</b>	<b>X37CrMoV5-1</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>1.2343</b>		<i>rev. 2018</i>

### Chemical composition

C%	Si%	Mn%	P% max	S% max	Cr%	Mo%	V%
0,33-0,41	0,80-1,20	0,25-0,50	0,030	0,020	4,80-5,50	1,10-1,50	0,30-0,50
± 0.02	± 0.05	± 0.04	+ 0.005	+ 0.005	± 0.10	± 0.05	± 0.04

Product deviations are allowed

### Temperature °C

Hot-forming	Quenching +Q	Tempering see table +T	Stress-relieving +SR <sup>1)</sup>	Stress-relieving must be done after machining and before quenching			
preheated at 800 after 1120-925	heating up to 800, pause, then 1000-1040 oil, polymer, s.b. (HRC ~ 54)	immediately after quenching minimum <b>2 cycles</b>	650-675 furnace cooling to 350 after, air				
Soft annealing +A	+TH annealing	Stress-relieving +SR	Pre-heating welding	Stress-relieving after welding			
800-810 furnace cooling 20-25°/h to 600, then air (HB max 229)	845-885 cooling 22 °C/h (HB 192-229)	50° under the temperature of tempering	350	<sup>1)</sup>			
			<b>Ac1</b>	<b>Ac3</b>	<b>Ms</b>	<b>Mf</b>	
			830	890	310	80	

s.b. = salt bath (450-500 °C). Nitrided at temperatures of about 525 °C

### Mechanical properties

In order to obtain good tenacity (Kv) two tempers are advised

Tempering table after quenching at 1020 °C in oil. Values on test Ø 20 mm

HB	543	525	518	512	512	518	534	550	568	577	512	432	362	286
HRC	54	53	52.5	52	52	52.5	53.5	54.5	55.5	56	52	46	39	30
R N/mm <sup>2</sup>	2010	1950	1915	1880	1880	1915	1980	2040	2115	2160	1880	1520	1220	950
Rp 0.2 N/mm <sup>2</sup>	-	-	-	-	-	-	-	-	-	1740	1570	1300	850	700
A %	-	-	-	-	-	-	-	-	-	6	9.5	13.5	14	16
Kv +20 °C J	16	16	16	18	20	20	22	20	18	16	18	48	62	-
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>510</b>	<b>550</b>	<b>600</b>	<b>650</b>	<b>700</b>

### Hardness at elevated temperatures

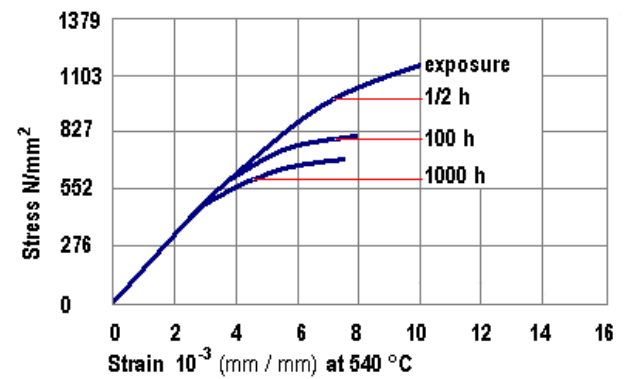
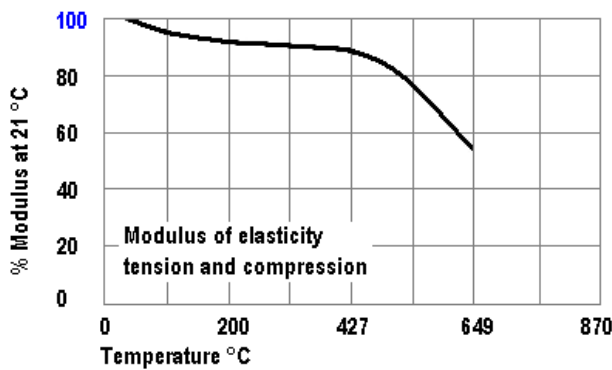
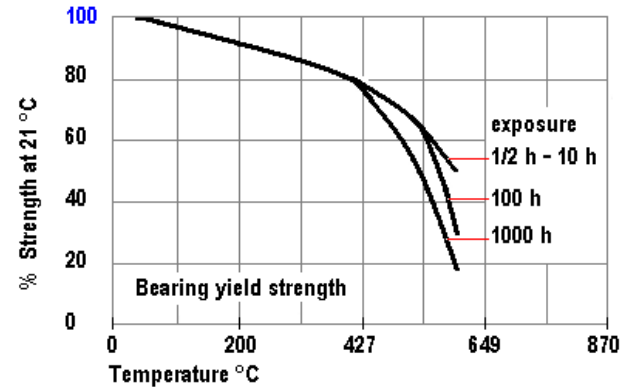
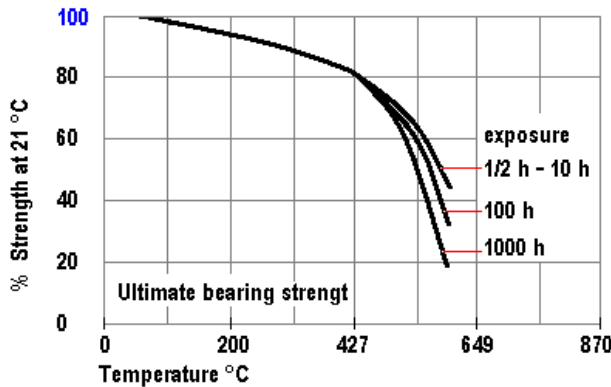
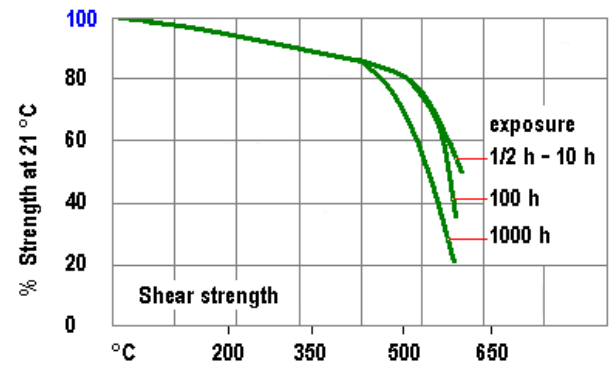
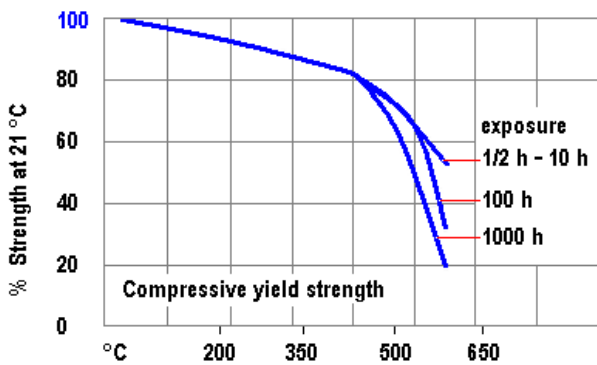
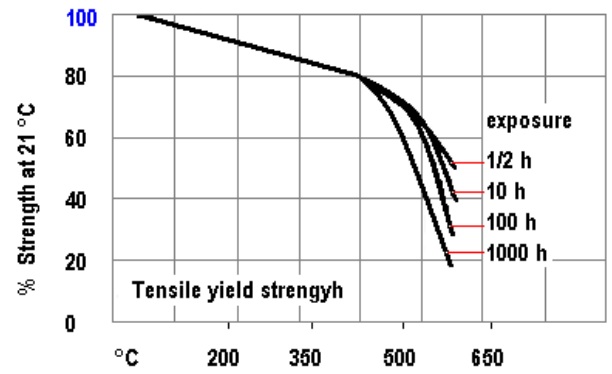
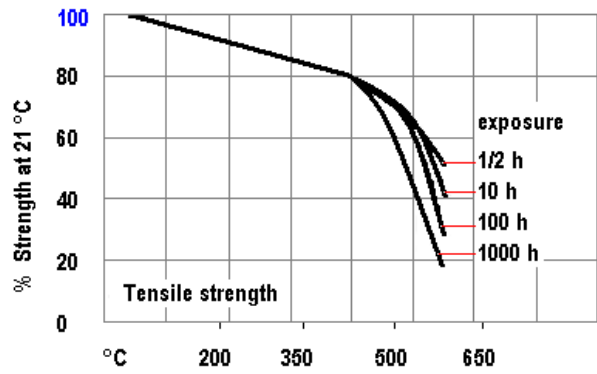
HRC	54	49	47	42	22
°C	<b>20</b>	<b>315</b>	<b>425</b>	<b>540</b>	<b>650</b>

Thermal expansion	10 <sup>-6</sup> • K <sup>-1</sup>	▶	11.5	12.0	12.2	12.5	12.9	13.0	13.2		
Modulus of elasticity long.	GPa		215			183	176	165			
Modulus of elasticity tang.	GPa		82			70	68	63			
R hardened and tempered	N/mm <sup>2</sup>		<b>1600</b>			1400	1300	1100	800	600	
Rp 0.2	N/mm <sup>2</sup>		1450			1200	1100	900	600	400	
R hardened and tempered	N/mm <sup>2</sup>		<b>1200</b>			1120	1000	850	580	400	
Rp 0.2	N/mm <sup>2</sup>		1060			900	800	650	420	250	
Specific heat capacity	J/(Kg•K)		460				550	590			
Thermal conductivity	W/(m•K)		25.0				28.5	29.3			
Density	Kg/dm <sup>3</sup>		7.80				7.64	7.60			
Specific electric resist.	Ohm•mm <sup>2</sup> /m		0.52				0.86	0.96			
Electrical conductivity	Siemens•m/mm <sup>2</sup>		1.92				1.16	1.04			
°C			<b>20</b>	<b>100</b>	<b>200</b>	<b>300</b>	<b>400</b>	<b>500</b>	<b>600</b>	<b>650</b>	<b>700</b>

The symbol ▶ indicates temperature between 20 °C and 100 °C, 20 °C and 200 °C ...

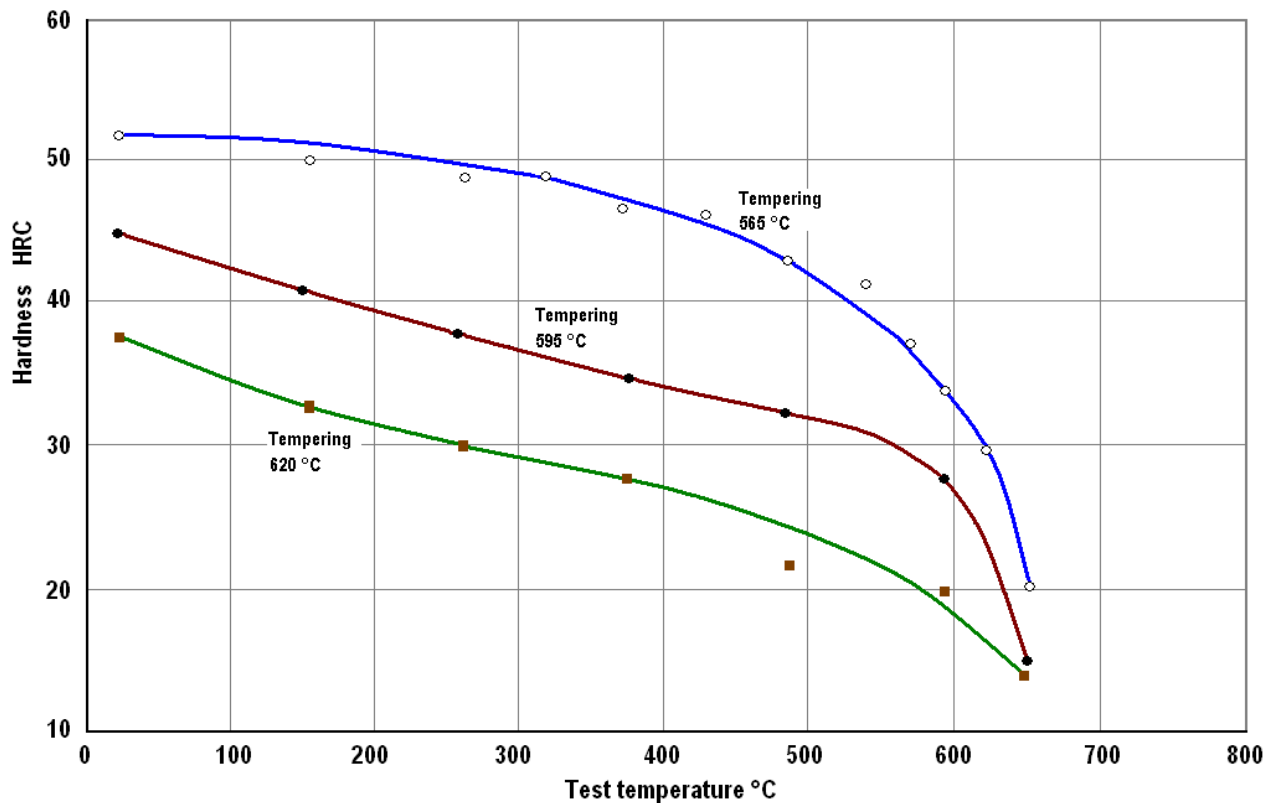
Europe	Germany	China	Japan	India	R. of Korea	Russia	USA
EN	DIN	GB	JIS	IS	KS	GOST	AISI/SAE
X37CrMoV5-1	X38CrMoV5-1	4Cr5MoSiV	SKD 6	XT35Cr5Mo1V3	STD 6	4Ch5MFS	H 11

Effect of time on high-temperature mechanical properties of H11 die steel



Example. Tensile strength behaviour

If we fix at room temperature as 100% a value of  $R = 1520 \text{ N/mm}^2$ , after exposure for 10 hours to  $550^\circ \text{C}$  heat, the tensile strength will decrease by 40% obtaining a value of  $R = 608 \text{ N/mm}^2$



Hot hardness of 1.2343 steel (converting R N/mm<sup>2</sup> at high temperatures), air cooled from 1010 °C and double tempered at 565°C, 595 °C e 620 °C.

**Longitudinal room-temperature tensile properties** after exposure to elevated temperature for 10 or 100 h

Air quenching °C	Double tempering °C	Exposure temperature °C	Exposure time, h	R N/mm <sup>2</sup>	Rp 0.2 N/mm <sup>2</sup>	Elongation %	Reduction area %	
1010	540	510	100	1790	1760	11,5	42,8	
			10	1650	1410	12,4	49,9	
	565	540	100	1450	1300	13,7	52,9	
			10	1385	1190	14,1	52,4	
		595	540	100	1300	1100	15,2	58,2
				10				

**Chrome-molybdenum-vanadium alloyed tool steel** (designed for matrix, moulds and punches for high-working temperatures)

- high resistance to thermal shock and to hot cracking
- good mechanical characteristics and toughness in hot condition
- good resistance to tempering
- very low segregation and excellent machinability
- applications: *dies for aluminium die-casting HRC 46-50 and HRC 41-46 for copper, dies subject to low pressure, chill moulds for gravity casting, containers and dies for extrusion, dies for aluminium extrusion, extrusion press blocks, injection moulds*

ASM Vol. 1 – **Typical properties at elevated-temperature**; quenched steel at 1010 °C air cooled and double tempered <sup>1)</sup>

Tempered at °C <sup>1)</sup>	Test temperature °C	Tensile strength N/mm <sup>2</sup>	Yield strength N/mm <sup>2</sup>	Elongation %	Impact Kv a +20 °C J
540	260	1860	1520	9,9	-
	315	1840	1490	10,3	-
	425	1670	1440	12,0	-
	480	1580	1365	12,323	-
	540	1480	1255	13,7	-
	650	610	582	24,8	-
565	20	1810	1480	9,8	-
	150	1700	1365	10,1	29
	260	1610	1340	10,2	41
	315	1600	1330	10,3	43
	425	1500	1270	11,4	40
	480	1420	1140	12,2	40
	540	1240	970	12,2	41
	595	980	720	12,8	45
650	590	440	19,0	80	
595	260	1340	1130	10,0	44
	315	1310	1100	10,0	-
	425	1230	1010	12,4	41
	480	1130	900	13,5	-
	540	980	790	15,5	-

Typical properties; quenched steel at 1010 °C air cooled and double tempered <sup>2)</sup>

Tempered at °C <sup>2)</sup>	Tensile strength N/mm <sup>2</sup>	Yield strength N/mm <sup>2</sup>	Elongation %	Reduction %	Impact Kv a +20 °C J
510	2120	1710	5,9	29	14
540	2005	1675	9,6	31	21
565	1855	1565	11,0	34	26
595	1540	1320	13,1	39	31
650	1060	855	14,1	41	40
705	940	700	16,4	42	90

Mechanical properties at elevated temperature R 1270 N/mm<sup>2</sup>

**Acciaio bonificato a 1270 N/mm<sup>2</sup> / Hardened and Tempered steel on 1270 N/mm<sup>2</sup>**

