

<b>Quality</b>	<b>16NiCr11</b>
According to standards	<b>UNI 5331:1964</b>
Number	

## Chemical composition

C%	Si% max	Mn%	P% max	S% max	Ni%	Cr%	Deviations allowed for analysis product
0,12-0,18	0,35	0,30-0,60	0,035	0,035	2,50-3,00	0,60-0,90	
± 0.02	± 0.03	± 0.04	+ 0.005	+ 0.005	± 0.07	± 0.05	

## Temperature °C

Hot-forming	Normalizing	Core hardening	Carbonitriding	Carburizing	Hardening carburizing surf.	Tempering
1100-900	850 air	830-860 oil-polymer salt bath		880-900	790-820 oil-polymer salt bath	150 200
Soft annealing	Isothermal annealing	Spheroidizing	End quench hardenability test	Pre-heating welding	Stress-relieving after welding	
680 furnace (HB max 235)	820 furnace cooling to 620, then air (HB 160-200)		850 water	welding must be carried out on the annealed state and before carburizing	150-350 <b>Ac1</b> 715	600 furnace cooling <b>Ms</b> * core ** carburizing surface 360* 170**

## Mechanical and physical properties

**Hot-rolled** values obtained on test blanks after core hardening + stress-relieving UNI 5331: 1964. Use only as reference

size mm test blanks	Testing at room temperature (longitudinal)					
	<b>R</b>	<b>Rp 0.2</b>	<b>A%</b>	<b>C%</b>	<b>Kcu</b>	<b>HB</b>
25	1127-1422	882	9	min.	J min.	339-409

Quenching at 850-860°C in oil  
Tempering at 150-180°C

### Table of tempering values obtained at room temperature on rounds of Ø 10 mm after quenching oil at 840 °C

HB	400	395	395	395	390	381	371	353	336	301	271	240	224	224
<b>HRC</b>	43	42.5	42.5	42.5	42	41	40	38	36	32	28	22.5		
<b>R</b> N/mm <sup>2</sup>	1380	1375	1370	1365	1340	1310	1250	1180	1100	1000	900	800	740	730
<b>Rp 0.2</b> N/mm <sup>2</sup>	1000	1050	1100	1130	1130	1120	1080	1040	960	870	780	690	640	600
<b>A</b> %	14.2	13.8	13.6	13.4	13.4	13.6	13.8	14.2	15.8	17.2	20.0	24.0	25.5	25.0
<b>C</b> %	60	60	60	60	61	62	63	64	65	66	68	70	73	72
<b>Kv</b> J	75	75	75	68	66	54	46	45	64	82	126	155	194	186
<b>HRC carburized layer</b>	63.5	63	61.5	59	58	56								
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>

## 16NiCr11

Cold-drawn					Hot-rolled peeled-reeled				
size		Testing at room temperature			Testing at room temperature				
mm		R	Rp 0.2	A%	HB	R	Rp 0.2	A%	HB
from	to	N/mm <sup>2</sup>	N/mm <sup>2</sup> min	min		N/mm <sup>2</sup>	N/mm <sup>2</sup> min	min	
No indications from reference standards									

## Forged UNI 8550: 1984. Use only as reference

size		Testing at room temperature								
mm		R	Rp 0.2	A% L	A% T	A% Q	Kcu L	Kcu T	HRC	HB
from	to	N/mm <sup>2</sup>	N/mm <sup>2</sup> min	min	min	min	J min	J min	<i>only information</i>	
11	11	1130-1420	880	9			30		36.5-44	339-406
11	25	1030-1280	785	10			35		33-40.5	311-375
25	40	930-1180	735	11			35		29-38	278-354
40	100	835-980	640	11			35		24.5-31	250-295

Mechanical properties obtained on test blanks after core hardening + stress-relieving

L = longitudinal T = tangential Q = radial

## UNI 8550:1984 Jominy test HRC grain size 5 min.

mm distance from quenched extremity

	1.5	3	5	7	9	11	13	15	20	25	30	35	40	45	50
<b>min</b>	39	36.5	34	32	30	28.5	27	26	23.5	21.5	19.5	18	17.5	16.5	16
<b>max</b>	48	46.5	44.5	43	41.5	40	39	37.5	35	32.5	31	29.5	28.5	28	27.5

Temperature	Mod. of elasticity		Thermal expansion	Variation of mechanical properties as a function of the thickness of quenched and tempered bars.			
	GPa			Testing at 1/2 radius according to Traflix experience			
Testing at °C	E long.	G tang.	10 <sup>-6</sup> · K <sup>-1</sup>	thickness mm	R N/mm <sup>2</sup>	Rp 0.2 N/mm <sup>2</sup>	A %
20	210	80		10	1330	930	15.8
100	205	78	11.1	20	1175	830	16.0
200	195	75	12.1	30	1135	715	16.4
300	185	71	12.9	40	960	645	16.6
400				50	900	590	16.8
500	165	63	14.1	60	860	570	17.5
				70	840	550	18.8
				80	830	540	19.6
				90	820	535	20.0
				100	810	520	21.4

EUROPE EN	ITALY UNI	CHINA GB	GERMANY DIN	FRANCE AFNOR	U.K. B.S.	RUSSIA GOST	USA AISI/SAE
16NiCr12	16NiCr11	12CrNi3	14NiCr10	16NC11			3415