



# The drilling process

## A brief introduction to the subject of deep hole drilling

In the machining world, drilling depths of  $10 \times D$  and deeper are regarded as deep hole drilling operations, whereby smaller drilling depths can naturally also be produced with gun drills. Advantage is taken of the positive side effects, as for example good surface quality, low deviation from concentricity and optimised alignment accuracy.

### High pressure cooling - has become a matter of course.

In recent years, internal cooling has established itself for all drilling tools. Coolants are now living up to their name and being supplied via coolant ducts to where they are urgently required. Considerable improvements in tool life and less breakages have been achieved by this measure for twist drills, taps etc.

Every conventional machine tool currently on the market can be supplied with high pressure internal cooling and is therefore also suitable for deep hole drilling.

The share of gun drills on machining centres, lathes etc. is forever gaining more importance. The process is therefore increasing in popularity in the machining world.



All gun drills must have support for the pilot hole.

Gun drills must never operate at full speed without support in the machine shop.

Deep hole drilling is not a closed book, but can be mastered by anybody as long as certain conditions are adhered to.

Recommended cutting rates for the application of Guhring gun drills can be found on the pages for the individual types!

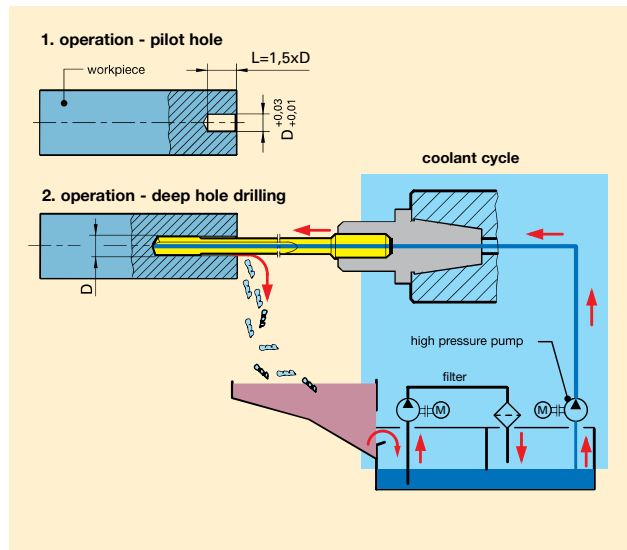
### Typical procedure with all gun drills on conventional machine tools:

- production of pilot hole ( $L = 3 \times D$ , tolerance H8)
- enter at low revolutions, approx. 200 rev./min, feed rate approx. 500 mm/min. With tools for drilling depths in excess than  $40 \times D$  enter the pilot hole revolving in left hand direction.
- At cutting speeds higher than 120 m/min we recommend to advance to final speed in several steps.
- setting of coolant pressure and revolutions
- uninterrupted drilling to required drilling depth without wood pecking. When applying gun drills with increased length-diameter-ratio, we recommend machining with reduced cutting parameters (approx. 75% of the optimal cutting speed) up to a drilling depth of approx. 25 mm.
- switching off coolant supply after reaching the required hole depth
- withdrawal in top gear with stationary spindle

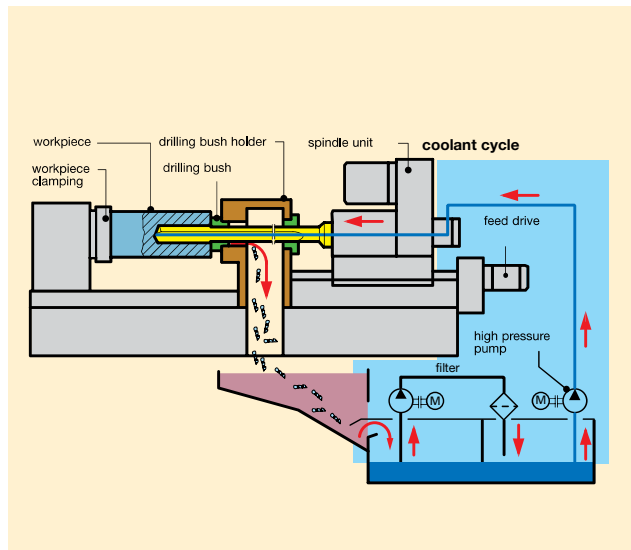
### Application advice

- For drilling depths in excess than  $40 \times D$  we recommend the use of two or more gun drills, e. g.  $\varnothing 10 \times 400$  mm and  $\varnothing 9.95 \times 800$  mm.
- Gun drills for drilling depths of more than  $40 \times D$  should enter the pilot hole revolving in the left hand direction.
- When changing tools for drilling depths of more than  $40 \times D$ , the tool can be damped by switching on coolant supply for just one second.
- For machining of long-chipping materials we recommend the use of gun drills with polished flutes.
- Generally we recommend the use of soluble oil with a minimum oil content of 10 %.
- Single-fluted gun drills for long-chipping aluminium should be supplied with point grind  $180^\circ$  and coolant chamber.

### Deep hole drilling on conventional machine tools



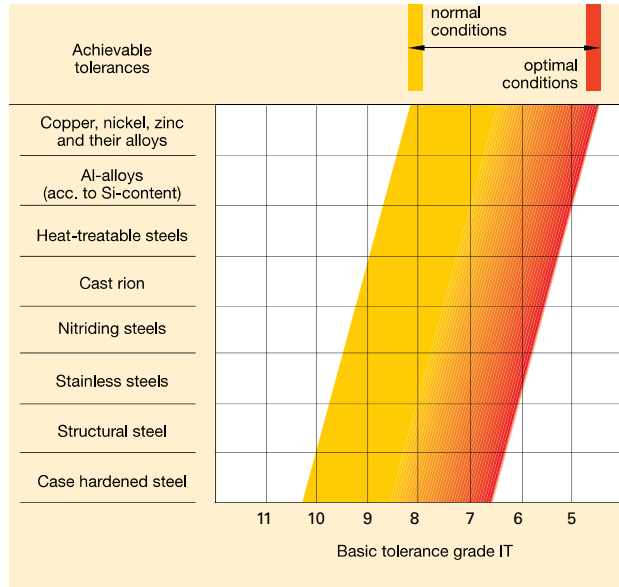
### Deep hole drilling machines



# Precision of single-fluted gun drills

## Basic tolerances\*

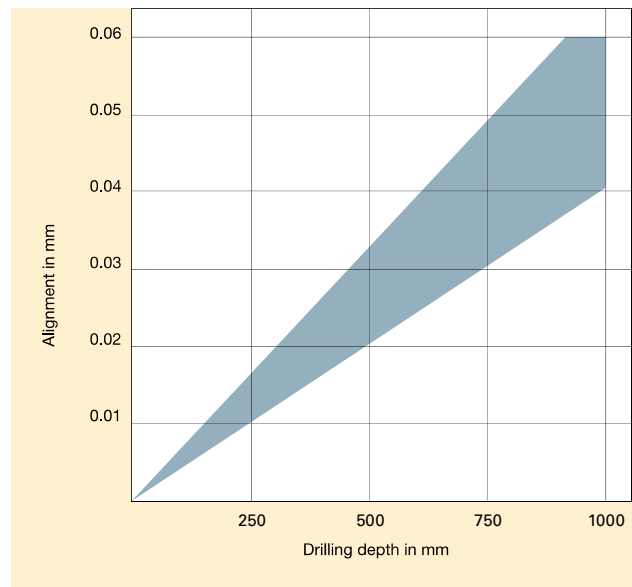
The application of single-fluted gun drills can achieve a lower basic tolerance, as the cutting forces at the cutting edge are absorbed by the guide pads, unlike twist drills where the slightest deviation of the two cutting edges causes a larger hole.



## Alignment accuracy\*

Because brazed single-fluted gun drills always have the precision carbide head brazed on to a flexible tube, the tool achieves very accurate aligned holes remaining unaffected by possible concentricity errors.

However, extreme material fluctuations and other influencing factors can impair the alignment accuracy.

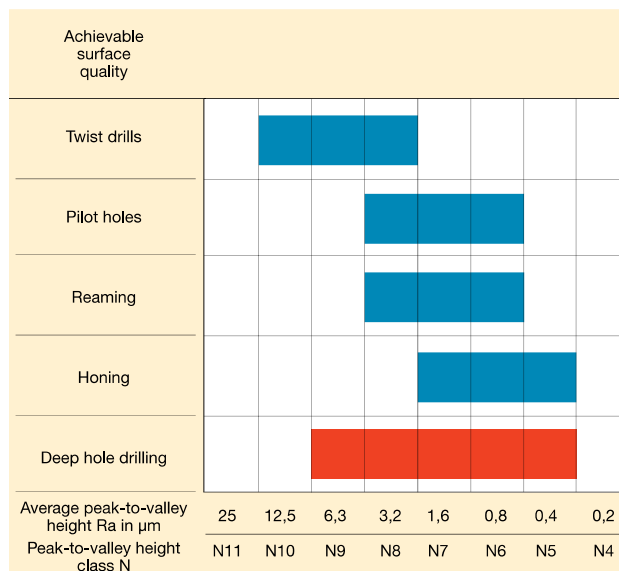


## Surface quality\*

The forces at the cutting edge are absorbed by the support bushes, which in return burnishes the surface.

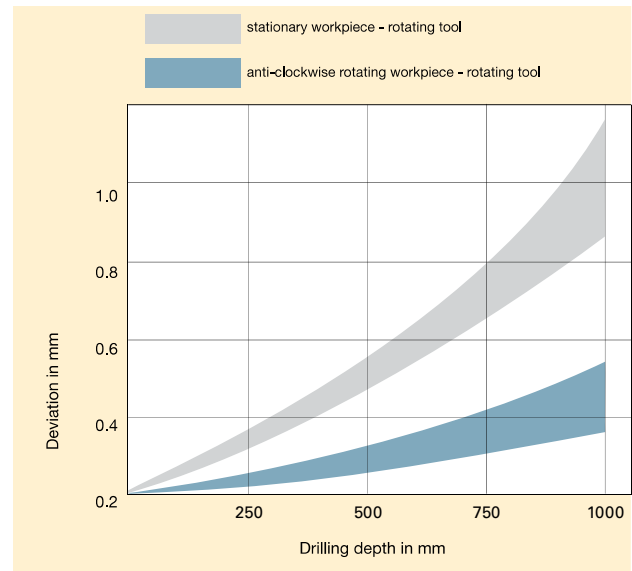
Lubrication between the guide pads and hole surface is therefore very important.

The better the lubricant, the better the surface quality.



## Deviation from concentricity\*

When a hole is produced with, for example, a commercial twist drill, the quality of the point grind affects the concentricity of the hole. An imbalance of forces is created at the cutting edges. With gun drills, these cutting forces are absorbed by the guide pads, resulting in excellent concentricity.



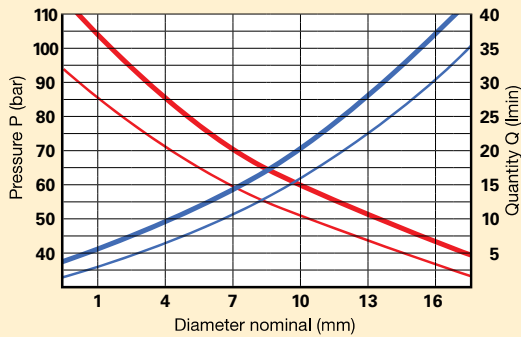
\* gun drills with two cutting edges – straight-fluted as well as spiral-fluted – achieve approx. 50% of the values stated

**Please note:**

- All gun drills must be applied with internal cooling, either air, water or oil. Without internal cooling the chips cannot be evacuated.
- All gun drills can be applied with oil as the medium for internal cooling. However, in this case a 30% higher pressure is required in order to achieve the same coolant volume.
- When MQL is applied with gun drills an increase in pressure may be necessary for smaller nominal diameters dependent on the pressure of the MQL system.
- If the cooling lubricant data is insufficient the cutting parameters may be reduced. Pressure boosting systems are also possible.

**Coolant values EB 100**

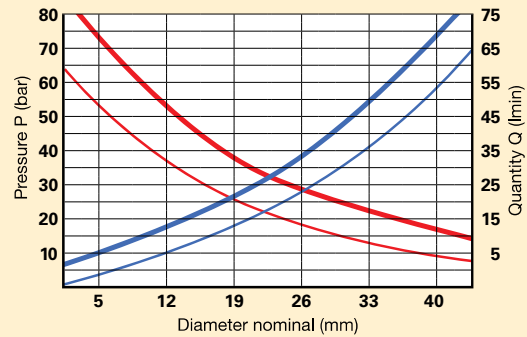
(recommended values for soluble oil)



— max. coolant pressure    — max. coolant quantity  
— min. coolant pressure    — min. coolant quantity

**Coolant values EB 80**

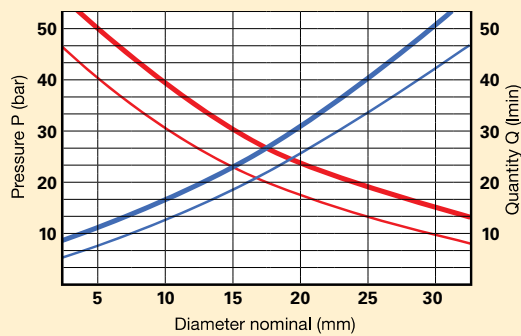
(recommended values for soluble oil)



— max. coolant pressure    — max. coolant quantity  
— min. coolant pressure    — min. coolant quantity

**Coolant values ZB 80**

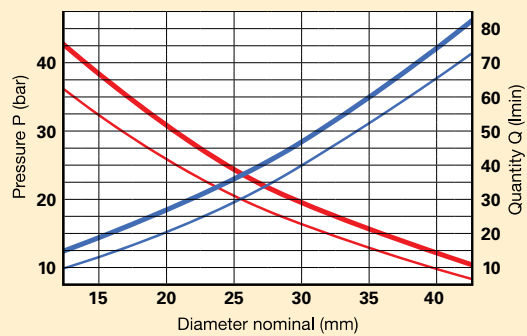
(recommended values for soluble oil)



— max. coolant pressure    — max. coolant quantity  
— min. coolant pressure    — min. coolant quantity

**Coolant values EB 800**

(recommended values for soluble oil)



— max. coolant pressure    — max. coolant quantity  
— min. coolant pressure    — min. coolant quantity

# Gun drills

Drill Ø mm from	Feed column no.									
	11	12	13	14	15	16	17	18	19	20
	f (mm/rev.)									
1.50	0.002	0.004	0.006	0.008	0.012	0.020	0.032	0.045	0.045	0.075
2.00	0.003	0.005	0.007	0.010	0.016	0.028	0.046	0.055	0.050	0.100
2.50	0.004	0.006	0.008	0.012	0.018	0.030	0.054	0.070	0.075	0.125
4.00	0.005	0.007	0.010	0.016	0.025	0.043	0.065	0.085	0.120	0.240
6.00	0.007	0.009	0.013	0.024	0.035	0.061	0.085	0.120	0.180	0.360
8.00	0.010	0.014	0.022	0.032	0.045	0.068	0.100	0.150	0.240	0.480
10.00	0.012	0.016	0.028	0.040	0.055	0.075	0.120	0.160	0.300	0.600
14.00	0.020	0.025	0.035	0.050	0.065	0.085	0.130	0.180	0.420	0.700
18.00	0.025	0.030	0.040	0.055	0.070	0.095	0.145	0.200		
20.00	0.026	0.035	0.045	0.060	0.080	0.110	0.180	0.250		
24.00	0.027	0.036	0.047	0.065	0.085	0.130	0.185	0.300		
28.00	0.028	0.038	0.049	0.068	0.090	0.140	0.195	0.350		
30.00	0.030	0.040	0.050	0.070	0.100	0.150	0.200	0.400		
35.00	0.035	0.045	0.055	0.075	0.120	0.180	0.250	0.450		
40.00	0.040	0.050	0.060	0.080	0.150	0.200	0.300	0.500		

\*The feed rates always relate to tools with the recommended coating. In some cases the successful application of un-coated tools cannot be guaranteed.



All deep hole drills must have support for the pilot hole. Deep hole drills must never operate at full speed without support in the machine shop.

## The sequence of operations for deep hole drilling

- production of pilot hole (L ≈ 3 x D, tolerance H8)
- enter at low revolutions, approx. 200 rev./min, feed rate approx. 500 mm/min. With tools for drilling depths in excess than 40 x D enter the pilot hole revolving in left hand direction.
- at cutting speeds higher than 120 m/min we recommend to advance to final speed in several steps.
- setting of coolant pressure and revolutions
- uninterrupted drilling to required drilling depth without wood pecking. When applying gun drills with increased length-diameter-ratio, we recommend machining with reduced cutting parameters (approx. 75% of the optimal cutting speed) up to a drilling depth of approx. 25 mm.
- switching off coolant supply after reaching the required hole depth
- withdrawal in top gear with stationary spindle
- for EB100 gun drills > 50xD please note: up to drilling depth 50xD the feed has to be reduced to 60%

## EB100

single-fluted gun drill

solid carbide

0.9 ... 12.0



### Material dependent coolants

- air
- neat oil
- soluble oil

Material group	Material examples Figures in bold = material no. to DIN EN	Tens.str. Hardness N/mm <sup>2</sup>	Cool- ant	rec. coating*	≤50xD		>50xD	
					v <sub>c</sub> m/min	Feed col. no.	v <sub>c</sub> m/min	Feed col. no.
Common structural steels	<b>1.0035</b> S185, <b>1.0486</b> P275N, <b>1.0345</b> P235GH, <b>1.0425</b> <b>1.0050</b> E295), <b>1.0070</b> E360, <b>1.8937</b> P500NH	≤500	<input type="radio"/>		100	15	100	15
Free-cutting steels	<b>1.0718</b> 11SMnPb30, <b>1.0736</b> 11SMn37	≤850	<input type="radio"/>		85	15	85	15
Unalloyed heat-treatable steels	<b>1.0727</b> 46S20, <b>1.0728</b> 60S20, <b>1.0757</b> 46SPb20	≤1000	<input type="radio"/>		90	15	90	15
Alloyed heat-treatable steels	<b>1.0402</b> C22, <b>1.1178</b> C30E	≤700	<input type="radio"/>		80	15	80	15
Alloyed case hard. steels	<b>1.0503</b> C45, <b>1.1191</b> C45E	≤850	<input type="radio"/>		80	14	80	14
Alloyed case hardened steels	<b>1.0601</b> C60, <b>1.1221</b> C60E	≤1000	<input type="radio"/>		75	14	75	14
Nitriding steels	<b>1.5131</b> 50MnSi4, <b>1.7003</b> 38Cr2, <b>1.7030</b> 28Cr4	≤1000	<input type="radio"/>		75	14	75	14
Tool steels	<b>1.5710</b> 36NiCr6, <b>1.7035</b> 41Cr4, <b>1.7225</b> 42CrMo4	≤1400	<input type="radio"/>		65	14	65	14
High speed steels	<b>1.0301</b> , <b>1.1121</b> C10E	≤850	<input type="radio"/>		80	15	80	15
Spring steels	<b>1.7276</b> 10CrMo11, <b>1.5125</b> 11MnSi6	≤1000	<input type="radio"/>		75	14	75	14
Stainless steels, sulphured	<b>1.5752</b> 15NiCr13, <b>1.7131</b> 16MnCr5, <b>1.7264</b> 20CrMo5	≤1400	<input type="radio"/>		65	14	65	14
Stainless steels, austenitic	<b>1.8504</b> 34CrAl6	≤1000	<input type="radio"/>		75	14	75	14
Stainless steels, martensitic	<b>1.8519</b> 31CrMoV9, <b>1.8550</b> 34CrAlNi7	≤1400	<input type="radio"/>		65	14	65	14
Hardened steels	<b>1.1750</b> C75W, <b>1.2067</b> 102Cr6, <b>1.2307</b> 29CrMoV9	≤850	<input type="radio"/>		75	13	75	13
Special alloys	<b>1.2080</b> X210Cr12, <b>1.2083</b> X42Cr13, <b>1.2419</b> , <b>1.2767</b>	≤1400	<input type="radio"/>		65	13	65	13
Cast iron	<b>1.3243</b> S 6-5-2-5, <b>1.3343</b> S 6-5-2, <b>1.3344</b> S 6-5-3	≤1400	<input type="radio"/>		55	12	55	12
Spheroidal graphite iron and malleable cast iron	<b>1.5026</b> 55Si7, <b>1.7176</b> 55Cr3, <b>1.8159</b> 51CrV4	≤350 HB	<input type="radio"/>		65	13	65	13
Chilled cast iron	<b>1.4005</b> X12CrS13, <b>1.4104</b> X14CrMoS17, <b>1.4105</b>	≤900	<input type="radio"/>		40	14	40	14
Ti and Ti-alloys	<b>1.4301</b> X5CrNi18-10, <b>1.4541</b> X6CrNiTi18-10, <b>1.4571</b>	≤1100	<input type="radio"/>		35	14	35	14
Aluminium and Al-alloys	<b>1.4057</b> X20CrNi172, <b>1.4122</b> X39CrMo17-1, <b>1.4521</b>	≤1500	<input type="radio"/>		35	14	35	14
Al wrought alloys	-	≤48 HRC	<input type="radio"/>		30	13	30	13
Al cast alloys ≤ 10 % Si	Nimonic, Inconel, Monel, Hastelloy	≤2000	<input type="radio"/>		25	10	25	10
Al cast alloys ≤ 24 % Si	<b>0.6010</b> EN-GJL-100, <b>0.6020</b> EN-GJL-200	≤240 HB	<input type="radio"/>		20	12	20	12
Magnesium alloys	<b>0.6025</b> EN-GJL-250, <b>0.6035</b> EN-GJL-350	≤350 HB	<input type="radio"/>		85	16	85	16
Copper, low-alloyed	<b>0.7050</b> EN-GJS-500-7, <b>0.8035</b> EN-GJMW-350-4	≤240 HB	<input type="radio"/>		80	16	80	16
Brass, short-chipping	<b>0.7070</b> EN-GJS-700-2, <b>0.8170</b> EN-GJMB-700-2	≤350 HB	<input type="radio"/>		80	15	80	15
Brass, long-chipping	-	≤350 HB	<input type="radio"/>		70	15	70	15
Bronze, short-chipping	<b>3.7024</b> Ti99.5, <b>3.7114</b> TiAl5Sn2.5, <b>3.7124</b> TiCu2	≤850	<input type="radio"/>		55	14	55	14
Bronze, long-chipping	<b>3.7154</b> TiAl6Zr5, <b>3.7165</b> TiAl6V4, <b>3.7184</b>	≤1400	<input type="radio"/>		35	12	35	12
Duroplastics	<b>3.0255</b> Al99.5, <b>3.2315</b> AlMgSi1, <b>3.3515</b> AlMg1	≤400	<input type="radio"/>		30	12	30	12
Thermoplastics	<b>3.0615</b> AlMgSiPb, <b>3.1325</b> AlCuMg1, <b>3.3245</b> , <b>3.4365</b>	≤650	<input type="radio"/>		150	17	150	17
New cast materials GGV	<b>3.2131</b> G-AlSi5Cu1, <b>3.2153</b> G-AlSi7Cu3, <b>3.2573</b> G-AlSi9	≤600	<input type="radio"/>		120	19	120	19
New cast materials ADI	<b>3.2581</b> G-AlSi12, <b>3.2583</b> G-AlSi12Cu, - G-AlSi12CuNiMg	≤600	<input type="radio"/>		120	20	120	20
Kevlar	<b>3.5200</b> MgMn2, <b>3.5812.05</b> G-MgAl8Zn1, <b>3.5612.05</b>	≤400	<input type="radio"/>		130	18	130	18
Glass, carbon concentr. plastics	<b>2.0070</b> SE-Cu, <b>2.1020</b> CuSn6, <b>2.1096</b> G-CuSn5ZnPb	≤500	<input type="radio"/>		110	17	110	17
	<b>2.0380</b> CuZn39Pb2, <b>2.0401</b> CuZn39Pb3, <b>2.0410</b>	≤600	<input type="radio"/>		75	15	75	15
	<b>2.0250</b> CuZn20, <b>2.0280</b> CuZn33, <b>2.0332</b> CuZn37Pb0.5	≤600	<input type="radio"/>		120	18	120	18
	<b>2.1090</b> CuSn7ZnPb, <b>2.1170</b> CuPb5Sn5, <b>2.1176</b>	≤600	<input type="radio"/>		90	18	90	18
	<b>2.0790</b> CuNi18Zn19Pb	≤850	<input type="radio"/>		95	17	95	17
	<b>2.0916</b> CuAl5, <b>2.0960</b> CuAl9Mn, <b>2.1050</b> CuSn10	≤850	<input type="radio"/>		75	17	75	17
	<b>2.0980</b> CuAl11Ni, <b>2.1247</b> CuBe2	≤1000	<input type="radio"/>		70	17	70	17
	Bakelīt, Resopal, Pertinax, Moltopren	≤150	<input type="radio"/>		60	17	60	17
	Plexiglas, Hostalen, Novodur, Makralon	≤100	<input type="radio"/>		75	15	75	15
	<b>EN-GJV250</b> (GGV25), <b>EN-GJV350</b> (GGV35)	≤220 HB	<input type="radio"/>		70	15	70	15
	<b>EN-GJV400</b> (GGV40), <b>EN-GJV500</b> (GGV50), SiMo 6	≤300 HB	<input type="radio"/>					
	<b>EN-GJS-800-8</b> (AD1800), <b>EN-GJS-1000-5</b> (AD11000)	≤1000	<input type="radio"/>					
	<b>EN-GJS-1200-2</b> (AD11200), <b>EN-GJS-1400-1</b> (AD11400)	≤1400	<input type="radio"/>					
	Kevlar	≤1000	<input type="radio"/>		60	14	60	14
	GFK/CFK	≤1000	<input type="radio"/>		50	14	50	14

**A** TiAlN SuperA

**C** TiCN

**F** FIRE

**S** TiN

