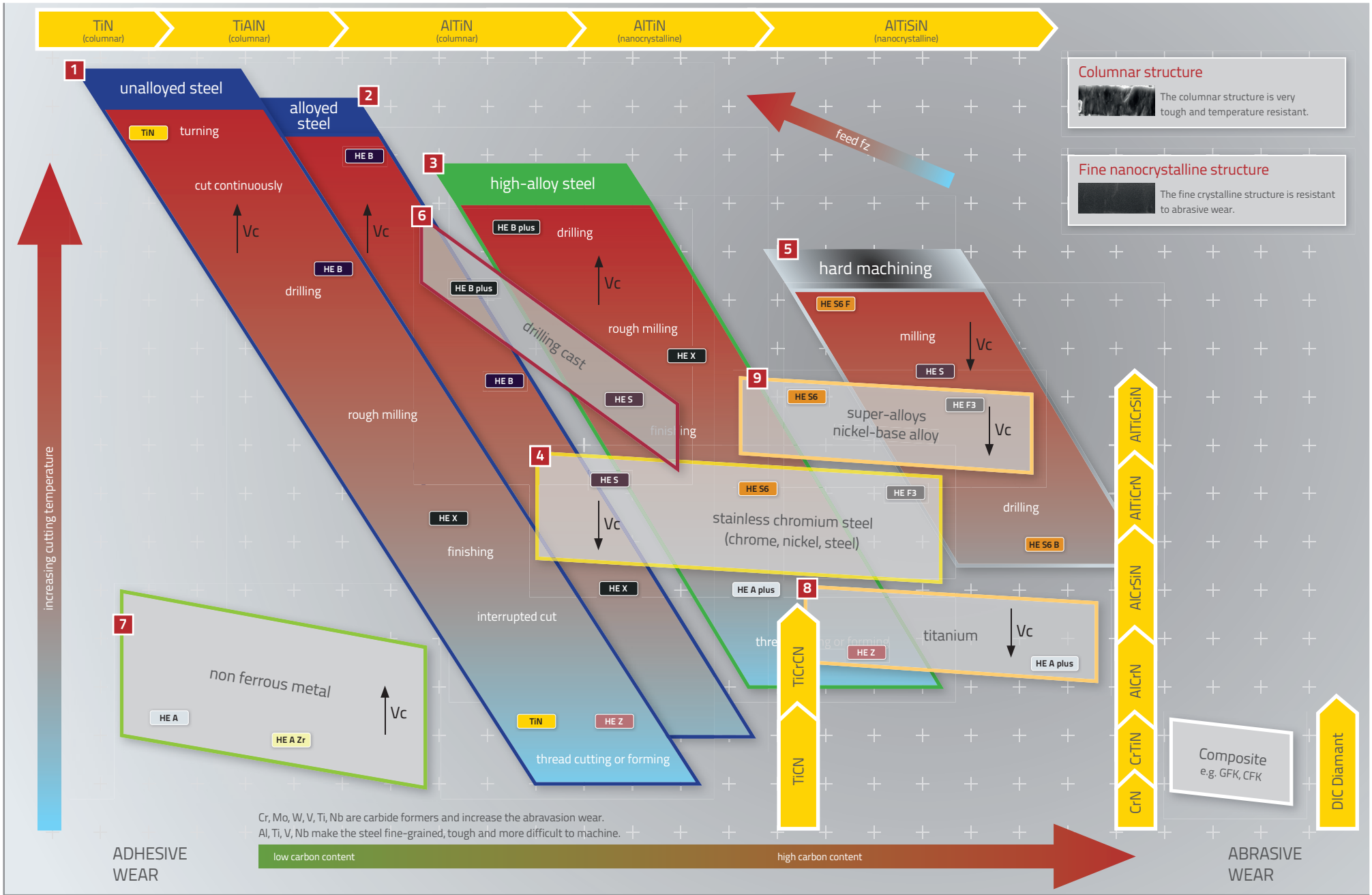
Coating Guideline

PLASMA plus | coating



general machining, punching, forming	aluminium machining	aluminium machining	general machining, punching, forming	machining with inserts	drilling and milling	milling and general machining	drilling and milling	milling hard machining / stainless steel	drilling	sliding coating as top layer	steel/stainless steel thread machining	titanium machining	hard machining thin coating for small tools	drilling and milling alloy steels
TiN	**HE A Zr**	**HE A**	**HE B**	**AlTiN 4 M**	**HE B plus**	**HE X**	**HE S**	**HE S6 F**	**HE S6 B**	**ZrN**	**HE Z**	**HE A plus**	**HE F2**	**HE F3**
TiN	CrTiAlN + ZrN	CrTiAlN	AlTiN Multilayer	AlTiN Nanolayer	AlTiSiN Multilayer	AlTiCrN	AlTiSiN	AlTiSiN + TiSiN	AlTiSiN + TiSiN	ZrN	TiCN	TiCCrN based	AlTiN + AlCrSiN	AlTiN + AlCrSiN

Coating overview

	description		colour	hardness [GPa]	application-temperature	thickness standard	thickness thin coating
general machining, punching, forming	TiN	TiN	gold	25	650°C	3,5 µm ± 0,5	1,2 µm ± 0,2
machining with inserts	AlTiN 4 M	AlTiN Nanolayer	grey-black	35	1100°C	8 µm ± 2	4 µm ± 1
sliding coating as top layer	ZrN	ZrN	zirkon	22	600°C	0,5 µm	
general machining, punching, forming	HE B	AlTiN Multilayer	black-violett	33	850°C	3,5 µm ± 0,5	1,3 µm ± 0,3
drilling and milling	HE S	AlTiSiN	purple	36	1100°C	3,0 µm ± 0,5	1,2 µm ± 0,3
drilling and milling	HE B plus	AlTiSiN Multilayer	grey-black	37	1000°C	3,5 µm ± 0,5	
milling hard machining / stainless steel	HE S6 F	AlTiSiN + TiSiN	golden reddish	38	1100°C	2,5 µm ± 0,5	
drilling	HE S6 B	AlTiSiN + TiSiN	golden reddish	38	1100°C	4 µm ± 0,5	
aluminium machining	HE A Zr	CrTiAlN + ZrN	zirkon	28	800°C	1,5 µm ± 0,2	
aluminium machining	HE A	CrTiAlN	light - silver	28	800°C	1,5 µm ± 0,2	
titanium machining	HE A plus	TiCCrN based	light - silver	32	700°C	2,5 µm ± 0,5	1,2 µm ± 0,2
steel/stainless steel thread machining	HE Z	TiCN	pink	31	750°C	2,5 µm ± 0,5	
milling and general machining	HE X	AlTiCrN	grey-black	33	850°C	3,5 µm ± 0,5	1,2 µm ± 0,2
hard machining thin coating for small tools	HE F2	AlTiN + AlCrSiN	grey	38	900°C		1,2 µm ± 0,2
drilling and milling alloy steels	HE F3	AlTiN + AlCrSiN	grey	36	900°C	3,0 µm ± 0,5	

1 Unalloyed steels (C < 0,8%)

Strengths 200 HB | **Examples:** 1.0503 (C45), 1.0501 (C35), 1.0037 (ST37), 1.0540 (C50)
Coating: Carbon content is low - risk of built-up edges (adhesive wear).
With large cutting capacities, comparatively high temperatures arise. Tough and temperature-resistant coatings are necessary, columnar structured TiAlN or AlTiN coatings, with moderate cutting data TiN or TiCN
-> Recommended coating: HE B, TiN, HE Z

2 Alloyed steels / tempered steels (C < 1,7%, alloying elements < 5% (Ni, Cr, Mo, V, W))

Strengths: 200 HB to approx. 400 HB (1300 N/mm²) (34-40 HRC) Machining generally good, hardness must be taken into account.
Examples: 1.7225 (42CrMo4), 1.7227 (42CrMoS4)
Coatings: the coating must be temperature-resistant and have a high toughness. Columnar structured AlTiN layers with a high aluminium content are particularly suitable for this, in order to achieve good oxidation resistance.
-> Recommended coatings: HE B, AlTiN 4M, with high cutting data HE B plus

3 High-alloy steels / hot-work steels (alloying elements> 5%)

Strengths: 40-50 HRC (1300 N/mm² - 1700 N/mm²) | **Examples:** 1.2343 (X37CrMoV5-1), 1.2344 (X40CrMoV5-1), 1.2365 (32CrMoV12-28)
Coatings: Machinability decreases with increasing hardness and alloy components. With the decrease in cutting data, the focus of the coating is on a coating that counteracts abrasive wear. For finishing, AlTiSiN layers with high silicon contents are therefore sensible to use. AlTiN or AlTiSiN combinations are useful for rough milling and drilling. With AlTiN, the structure should change from a columnar structure to a fine nanocrystalline structure. AlTiSiN coatings at high application temperatures.
AlCrN based coatings at more moderate application temperatures.
-> Recommended coatings: HE X, HE S, HE S6, HE F

4 Stainless steel / chrome nickel steel

Examples: of ferritic steels: 1.4003, 1.4005, 1.4057, 1.4021, 1.4108
Machining: with adhesion wear, depending on hardness, similar to tempered steels
-> Recommended coatings: HE X, HE B or HE Z with moderate cutting speed

Examples: of austenitic steels approx. 18% Cr / 8% Ni - 1.4301 (Typ 304), 1.4305, 1.4306, 1.4541 or 1.4307 (V2A without Mo)
Machining with moderate cutting data with AlCrN or AlCrSiN based layers
-> Recommended coatings: HE F3

Examples: of austenitic steels with higher alloys: 1.4401, 1.4404, 1.4405, (V4A) | Machining becomes more difficult due to high Cr, Ni, Mo and Ti content. Machining preferably AlTiSiN coatings, the thermal conductivity and temperature resistance of the coating should increase.
-> Recommended coatings: HE S6 or HE S

Examples: (steels containing carbide): 1.4436, 1.4435, 1.4539, 1.3952, 1.3964, 1.4571, 1.4362, 1.4501, 1.4507, Duplex steel Cr 23- 26%, high Ni content
Machining increases more difficult, the high Cr content leads to carbides with high cutting forces and abrasive wear
Coating combination of AlTiN and AlCrSiN
-> Recommended coatings: HE F3, HE S, HE S6

5 Hardened steels / cold work steels

Strengths: > 2000 N/mm² (600 HV, 55 HRC) to (840 HV, 65 HRC) | **Examples:** 1.0401, 1.2162, 1.2379 Martensitic stainless steels or C content> 0.3%
High cutting angle on the tools | **Coating:** Nano crystalline layers based on AlTiSiN
->Recommended coatings: HE S or HE S6F

6 Cast iron

Cast iron is a short-chipping material, but can contain silicon carbide, so layers should be resistant to abrasion
-> Recommended coatings: HE B plus or HE S

7 Iron-free soft metals

Aluminium, bronze: brass, magnesium alloys
Coatings: As a rule, smooth, thinner coating based on TiCrN are used.
-> Recommended coatings: HE A, HE A Zr, HE W

8 Titanium alloys

Examples: 3.7164 TiAl6V45b, Titanium alloys soft annealed < 900 N/mm²
->Recommended coatings: HE Z or HE A plus
3.7164 TiAl6V45c, Titanium alloys hardened 900-1250 N/mm²
->Recommended coatings: HE S or HE S6 with ZrN non-stick coating

9 Nickel based alloy

Examples: 2.4668 (Inconel or Alloy718)
work hardening occurs during machining, the tool should remain in engagement,
at low cutting speeds Vc and relatively large feed fz
Coatings: Due to the high cutting forces, the cutting edge can overheat and local overload occurs, so the coating should be a good heat conductor and have good abrasion resistance.
-> Recommended coatings: HE F3 or HE S6