

# CRAFTSMAN CRIBSHEET

## ISO Material Groups: Heat Resistant Alloys

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Heat resistant or super alloys are used in mission-critical applications. When parts can't fail, they are often made from these alloys. This group is one of the most difficult and most expensive to machine. High temperature alloys are typically broken down into 4 categories. (Sometimes 5 because some

manufacturers list titanium and titanium alloys separately.) This list is a good starting point for understanding how to determine suitability for various applications. ISO Material Groups are what we use to identify the material we are machining when selecting carbide inserts.

S	Heat Resistant or Super Alloys	Hardness (HB)	Hardness (HRC)
S1	Iron Based Heat Resistant Alloys- Machinability Range: 18 – 50% Examples: Inconel, Incoloy 801, N-155, A-286	~250 – ~456	25-48
S2	Cobalt Based Heat Resistant Alloys- Machinability Range: 10 – 20% Examples: Haynes 25, Haynes 188, AirResist 213, MAR-M302	~250 – ~456	25-48
S3	Nickel Based Heat Resistant Alloys- Machinability Range: 10 – 70% Examples: Hastelloy, Inconel, Incoloy 901, Nimonic, Udimet, Monel	<456	<48
S4	Titanium and Titanium Alloys Machinability Range: 20 -40% Examples: Grade 2 Ti-99.6, Grade 3 Ti-99.7, Ti5Al2.5Sn, Grade 5 Ti6Al-4V, Grade 23 Ti 6Al-4V ELI	~340 - ~400	<30

\*Machinability is a percentage of 1212

Heat resistant alloys are so varied that it is difficult to give a generalized starting point for speeds and feeds. It is best to work with tooling manufacturers with the latest data to find a starting point. Each cutting operation is different, and it will take experimentation to find the combination of tools, coatings and process variables that best fit your process. **P**