

# Materials Selection

## Selection of Tool Steel

**General Qualities:**

	Poor	Moderate	Excellent
Corrosion Resistance			
Weldability			
Machinability			
Availability			
Price			

**Surface Treatment**

Chrome plating,	
Titanium-Nitriding	

**Hardness Range**

A2	60-62 HRc
H13	48-52HRc
O1	50-52 HRc
S7	56-58 HRc

**Common Alloys:**

Alloy & Treatment	Density lb/in <sup>3</sup>	Modulus of Elasticity (Msi)	Tensile Strength (ksi)	Yield Strength (ksi)	Typical Uses
A2	.284	29.4			Air cooled very stable tough
H13	.282	30.5	289000	239000	Good fatigue
O1	.283	31.0	245000	218000	Thermal shock
S7	.283	30.0			Tough, very stable
					Impact resistant

**Composition:**

AISI#	%C	%Mn	%Si	%Ni	%Cr	Other
A2	0.95-1.05	1	0.5		5.13	1.15 Mo
H13	0.32-0.4		1		5.13-5.25	1 V
O1	0.85-1	1.2	0.5		0.5	0.03 S
S7	0.5	0.7			3.25	1.4 Mo

## Selection of Mild Steel

**General Qualities:**

	Poor	Moderate	Excellent
Corrosion Resistance			
Weldability			
Machinability			
Availability			
Price			

**Surface Treatment**

Carburizing, nitriding, chrome plate	
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**Hardness Range**

1010	60-100
1018	71-100
1020	76-100

**Common Alloys:**

Alloy & Treatment	Density lb/in <sup>3</sup>	Modulus of Elasticity (ksi)	Tensile Strength (ksi)	Yield Strength (ksi)	Typical Uses
1010	0.284	29.7	47.1	26.1	Low strength, good formability (wire, sheet metal parts)
1018	0.284	29.0	58.0	31.9	Good weldability and machinability (Structural steel)
1020	0.284	29.0	65.3	47.9	Shafts and case hardened parts (low strength gears, motor arbors)

**Composition:**

AISI#	%C	%Mn	%Si	%Ni	%Cr	Other
1010	0.08-0.13	0.3-0.6	0	0	0	P.04 S.05
1018	0.14-0.2	0.6-0.9	0	0	0	P.04 S.05
1020	0.17-0.23	0.3-0.6	0	0	0	P.04 S.05

By

Russell Glass, Jacob Klingensmith,  
Rebecca Moffit, Naomi Sanders

## Selection of Stainless Steel

**General Qualities:**

	Poor	Moderate	Excellent
Corrosion Resistance			
Weldability			
Machinability			
Availability			
Price			

### The Branches:

	Defining Element	Notes	Grades
Martensitic	Chromium (>2% C)	Basic stainless steel, magnetic, heat treatable	410,420,440C
Ferritic	Chromium (<2% C)	Magnetic, cannot be hardened with heat treatment	409,430
Austenitic	Nickel	Not magnetic, best corrosion resistance	304,310,316,317
Duplex	Molybdenum	Combination of Ferritic and Austenitic	2205

## Selection of Aluminum

**General Qualities:**

	Poor	Moderate	Excellent
Corrosion Resistance			
Weldability			
Machinability			
Availability			
Price			

### Temper Designations

F	As fabricated
O	Annealed
T	Heat treated

### Heat-Treatable Temper Designations

T3	Solution heat treated, then cold worked
T4	Solution heat treated, then naturally aged
T6	Solution heat treated, then artificially aged

\*Other Designations Exist

### Common Alloys:

Alloy & Temper	Density lb/in <sup>3</sup>	Modulus of Elasticity (Msi)	Tensile Strength (ksi)	Yield Strength (ksi)	Typical Use
6061-T6	.0986	10.0	16	6	Pressure vessels, piping, sheet metal
7075-T6	.1	10.6	68	47	Aircraft, rivets, truck wheels
6061-T4	.0975	10.0	35	21	Railroad cars, furniture, pipelines
7075-T6	.102	10.4	83	73	Structural aircraft components

## Medium Carbon Steel

**General Qualities:**

	Poor	Moderate	Excellent
Corrosion Resistance			
Weldability			
Machinability			
Availability			
Price			

**Surface Treatment**

Carburizing, nitriding, chrome plate	
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**Hardness Range**

1040	201 HRB
1050	229 HRB
4140	179 HRB
4340	217 HRB

### Common Alloys:

Alloy & Treatment	Density lb/in <sup>3</sup>	Modulus of Elasticity (ksi)	Tensile Strength (ksi)	Yield Strength (ksi)	Typical Uses
1040	.283	29000	89.9	60.2	Machine, plow, and carriage bolts, machined parts, U-bolts, concrete reinforcing rods, and forgings
1050	.284	29700	105	60.2	Semifinished products for forging, hot-rolled and cold-finished bars, wire rods, and seamless tubing
4140	.284	29700	95	60.2	high hardenability and good fatigue, abrasion and impact resistance (gears)
4340	.284	29700	108	68.2	Formula car frame?

### Composition:

AISI#	%C	%Mn	%Si	%Ni	%Cr	Other
1040	.37-.44	.6-.9	0	0	0	P .04 S .05
1050	.47-.55	.6-.9	0	0	0	P .04 S .05
4140	.38-.43	.7-1	.15-.3	0	8-1.1	P .035 S .04 Mo .15-.25
4340	.37-.43	.7	.23	1.83	.7-9	P .035 S .04 Mo 2-.3

## Selection of High Carbon Steel

**General Qualities:**

	Poor	Moderate	Excellent
Corrosion Resistance			
Weldability			
Machinability			
Availability			
Price			

**Surface Treatment**

Not necessary	
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**Hardness Range**

1060	241 HRB
1080	293 HRB
9260	184-235 HRB
52100	875 HRB

### Common Alloys:

Alloy & Treatment	Density lb/in <sup>3</sup>	Modulus of Elasticity (ksi)	Tensile Strength (ksi)	Yield Strength (ksi)	Typical Uses
1060	.284	29700	118	70.3	Springs, railroad car wheels,
1080	.284	29700	140	84.8	and the like
9260	.284	29700	112-221	63.8-167	
52100	.284	30500	-	-	To make bearings

### Composition:

AISI#	%C	%Mn	%Si	%Ni	%Cr	Other
1060	.85-.66	.6-.9	0	0	0	P .04 S .05
1080	.74-.88	.6-.9	0	0	0	P .04 S .05
9260	.56-.64	.88	.2	0	0	P .035 S .04
52100	.98-1.1	.35	.23	0	1.45	P .025 S .025

Information from: matweb.com and efunda.com