

# [Material selection for drive shaft engineering essay](https://assignbuster.com/material-selection-for-drive-shaft-engineering-essay/)

The drive shaft is a rod or tube used to carry rotational force from the engine to the four bladed fans to provide sufficient airflow to reduce the temperature of the pump and the generator to a sufficient level when they both are working at maximum output and operating in an ambient temperature of up to 50°C.

In this selection of the three different materials, there are compared based on different properties to choose the suitable material to be used for the drive shaft.

http://media. noria. com/sites/archive\_images/articles\_200711\_Case\_-Study-Figure5. gif

Figure 1- Fan and motor assembly with belt drive

3. 1 Aluminium Alloy

3. 1. 1 Introduction

Aluminum Alloy is a medium to high strength heat treated alloy with higher strength than 6005A. It is commonly used for heavy-duty structure in the railway coach, truck frames, shipbuilding, and bridges the military, aerospace applications including helicopter rotor shell, tubes, pylons and towers, transportation, boiler making, motorboats and rivets [1].

3. 1. 2 Grade 6061-T6

It has very good corrosion resistance and excellent weld ability although reduced strength in the weld zone. It has medium fatigue strength. It has good cold formability in temper T4, but limited in temper T6. Not suitable for very complex cross parts.

T6- Solution heat treated and artificially aged

Supplied forms- Extrusions

Light weight & very good corrosion resistance

British/ ISO Standard

AA 6061-T6

Tensile Yield Strength (MPa)

310

Shear Strength (MPa)

190

Proof Stress (MPa)

270

Elongation over 50mm (%)

12

Hardness Vickers (HV)

100

Density (kg/m³)

2700

Thermal Conductivity (W/m. K)

166

Melting Point ( °C )

650

Electrical Resistivity (â„¦. m)

0. 040 x 10â» â¶

Table 1- Property for Aluminium Alloy Grade 6061-T6

3. 2 Stainless Steel

3. 2. 1 Introduction

Stainless steel is also known as grades 304 and 304L respectively. Stainless steel 304 is the most versatile and widely used. Type 304 stainless steel are austenitic grades can be severely deep drawn. This property has led 304 became the dominant grade used in applications such as sink and cook.

3. 2. 2 Grade 304

Type 304 stainless steel is an austenitic grade that can be severely deep drawn. This property has resulted in 304 being the dominant grade used in applications like sinks and saucepans and has excellent corrosion resistance in many environments and when in contact with different corrosive media. Pitting and crevice corrosion can occur in environments containing chloride. Pressure corrosion cracking can occur above 60°C.

Good machinability

Supplied forms- Strip & bar

Excellent corrosion resistance

British/ ISO Standard

BS 970 Grade 304

Tensile Yield Strength (MPa)

520 to 720

Compressive Strength (MPa)

210

Proof Stress (MPa)

210

Elongation over 50mm (%)

45

Modulus of elasticity (GPa)

193

Density (kg/m³)

7780

Thermal Conductivity (W/m. K)

16. 2

Melting Point ( °C )

1450

Electrical Resistivity (â„¦. m)

0. 072 x 10â» â¶

Table 2- Property for Stainless steel Grade 304

3. 3 Carbon steel

3. 3. 1 Introduction

Steel is a metal alloy consisting mainly of iron and contains 0. 2 to 2. 1 percent carbon. All steel contains carbon, but the term “ carbon steel” applies specifically to steel containing carbon as the main alloying constituents. Medium carbon steel is carbon steel that contains between 0. 30 and 0. 60 percent carbon. It also has a manganese content of between 0. 6 and 1. 65 percent. This type of steel provides a good balance between strength and ductility, and it is common in many kinds of steel parts [5].

3. 3. 2 Grade 080M30

It can provide a better combination of toughness, strength and hardness. It also provides a counterbalance weight during for low-oscillation rotary process. Despite its relatively limited corrosion resistance, carbon steel is used in large tonnages in marine applications, fossil fuel power and nuclear power plants, transportation, chemical processing, petroleum production and refining, pipelines, mining, construction and metal-processing equipment[6].

Material cost economy

Supplied forms- Strip & bar

Limited corrosion resistance

British/ ISO Standard

BS970 080M30

Tensile Yield Strength (Mpa)

550

Ultimate Tensile Strength (Mpa)

930

Elongation over 50mm (%)

16%

Hardness (HB)

269

Density (kg/m3)

7820

Young’s Modulus (Gpa)

205

Thermal Conductivity (W/m-K)

46. 6

Specific Heat Capacity (J/g-°C)

0. 475

Electrical Resistivity (nâ„¦-m)

234

Table 3- Property for Medium Carbon Steel Grade 080M30

3. 4 Final selection of material based on design and material specification

British/ ISO Standard

Aluminium Alloy AA 6061-T6

Stainless steel

BS 970 Grade 304

Carbon steel

BS970 080M30

Tensile Yield Strength (MPa)

310

520 to 720

550

Elongation over 50mm (%)

12

45

16

Density (kg/m3)

2700

7780

7820

Thermal Conductivity (W/m-K)

166

16. 2

46. 6

Electrical Resistivity (nâ„¦-m)

0. 040 x 10â» â¶

0. 072 x 10â» â¶

234

Price per tonne (USD)

2220

4450

740

Table 5- Comparison between three selected materials

For this drive shaft, Aluminium Alloy is chosen. The reason material Aluminium Alloy is production by extrusion, has good mechanical properties and exhibits good weldability. Aluminium alloys are widely used in engineering components where light weight and very good corrosion resistance. A low torsion was needed for the design of drive shaft, the tensile yield strength of the Aluminium Alloy 310 MPa was enough for the requirement. The Aluminium Alloy cost USD2220 per tonne which was lower than Stainless Steel which cost USD4450 per tonne.

Aluminium alloy surfaces will keep their apparent shine in a dry environment due to the formation of a clear, protective layer of aluminium oxide. In a wet environment, galvanic corrosion can occur when an aliminium alloy is placed in electrical contact with other metals with more negative corrosion potentials than aluminium[7].

Element

% Present

Carbon (C)

0. 0 – 0. 07

Chromium (Cr)

17. 50 – 19. 50

Manganese (Mn)

0. 0 – 2. 00

Silicon (Si)

0. 0 – 1. 00

Phosphorous (P)

0. 0 – 0. 05

Sulphur (S)

0. 0 – 0. 02

Nickel (Ni)

8. 00 – 10. 50

Iron (Fe)

Balance

Table 6- Chemical composition for Aluminium alloy