# Sonoston propeller alloy

## Introduction

Sonoston is an alloy based on manganese which combines a high damping capacity with mechanical properties which make it suitable for engineering purposes. Developed in 1960's, Sonoston has been used to make propellers for many types of vessels including military ones.

Materials of high damping are invaluable for use where freedom from vibration and noise are at a premium, and where structural damping cannot be employed. Its specific damping capacity can be varied, but is generally of the order of approximately 20% at high strains. This is about twice the damping capacity of grey cast iron, and more than 20 times greater than most engineering alloys.

## Mechanical Properties

The mechanical properties of the Sonoston are given in the table below, and are comparable with those of manganese bronze.

The stress strain curve shows marked strain hysteresis on unloading, the magnitude of which is greater, the greater the damping capacity of the alloy.

Proof stress, tensile strength and damping capacity are maintained in heavy sections, although ductility is reduced. Impact tests showed a gradual fall in energy as the test temperature was reduced from 100°C to -180°C, although even at the lowest temperatures the fractures were ductile.

| | Sonoston | |
|---|---|---|
| Property | Range | Typical |
| 0.1 % proof stress $N/mm^2$ | 250 – 280 | 270 |
| Tensile strength $N/mm^2$ | 540 – 590 | 565 |
| Elongation, % on $5.65\sqrt{So}$ | 13 – 30 | 25 |
| Hardness, Brinell | 130 – 170 | 150 |
| Izod J | 25 - 55 | 40 |

## Fatigue Resistance

Fatigue strength is one of the most important properties of a propeller material, particularly when contemplating the use of propellers for high powered or fast vessels, where fluctuating stresses can be very high. Extensive investigations of the fatigue characteristics of Sonoston over a range of conditions has been performed by Stone Manganese Marine. The fatigue strength of specimens from small castings tested in air is 140MPa at 100 megacycles and in 3% sodium chloride solution 75 MPa.

The effect of section size on the corrosion fatigue strength of Sonoston appears to be less than in the case with other propeller alloys. Nevertheless it is expected that material from thick sections will have

corrosion fatigue strengths lower then of small castings.

## Corrosion Resistance

Sonoston is not heavily oxidized in air at temperatures up to 500°C and can be heat treated at higher temperatures.

Corrosion in sea water takes place by a process similar to the dezincification of brasses with little or no surface loss even with very high velocities.

Sonoston is anodic to copper base alloys and stainless steels. It is cathodic to mild steel, aluminium alloys and zinc by any of which it can be protected against corrosion, even under conditions of severe impingement.

It has been found that Sonoston is susceptible to stress corrosion cracking. However, the composition of the alloy has been selected to give the best resistance to this attack consistent with the other properties required of the alloy.

Resistance to stress corrosion cracking is better in thick than thin cast sections and that cracking can be avoided by suitable cathodic protection.

## Repair

Repair by welding and straightening presents difficulty and much care should be employed in either process.

The MIG or TIG processes are preferred for welding Sonoston using Superston type filler wire material. Stress relief heat treatment is essential after repair work has been carried out.

For best results it is strongly advised to employ the services of suitably trained and qualified engineers for the repair of propellers manufactured in Sonoston material.

## Physical Properties

| Property | Unit | Sonoston |
|---|---|---|
| Melting range | °C | 940 - 1080 |
| Specific gravity | | 7.1 |
| Coefficient of thermal expansion | per °C | $16.5 \times 10^{-6}$ (0-100°) |
| Estimated specific damping capacity | % | 10 - 30 |
| Electrical conductivity At 20°C | % I.A.C.S | 1.5 |
| Modulus of elasticity | $kg/cm^2$ | $0.8 \times 10^6$ |