

Propeller Cavitation Damage



Figure 1: Left: Typical cavitation damage to the stainless steel ducted propeller from a personal watercraft. Right: Close-up of cavitation damage to a marine propeller tip.

Cavitation bubbles grow when "nuclei" are convected into regions where the pressure is at or below the vapor pressure of the liquid involved. Cavitation damage occurs when those bubbles are convected out into regions of higher pressure and therefore collapse. The rate of damage depends on the hardness of the material from which the propeller is made. Even very hard materials are susceptible to cavitation damage. Figure 1 (left) shows cavitation damage to a stainless steel marine personal watercraft propeller. It provides a good example of typical cavitation damage. Note the extensive surface damage at the mid-chord near the propeller tip. Note also the crystalline appearance of this damage that is so typical of the surface fatigue failure which cavitation causes. The damage is the result of the collapse of a tip vortex originating at the sharp corner where the propeller leading edge meets the propeller tip. When that corner is rounded off the vortex is less intense and the damage is reduced. Figure 1 (left) also shows similar but lesser damage at the root due to the root vortex in the junction of the blade and the hub.

Figure 1 (right) provides an example with more extensive damage to the tip of a bronze propeller. This example clearly shows how both the performance and structural integrity of the propeller may be impaired by the cavitation.