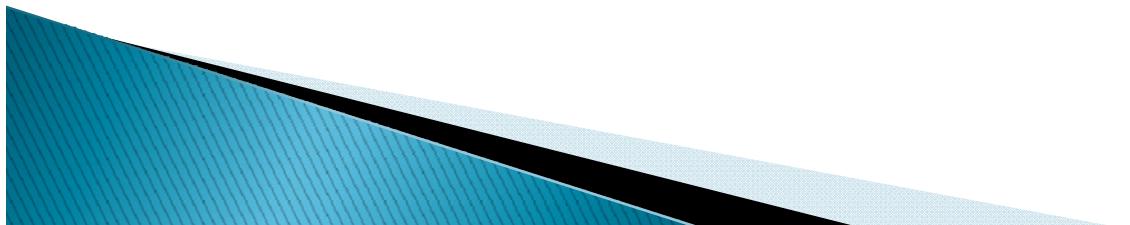


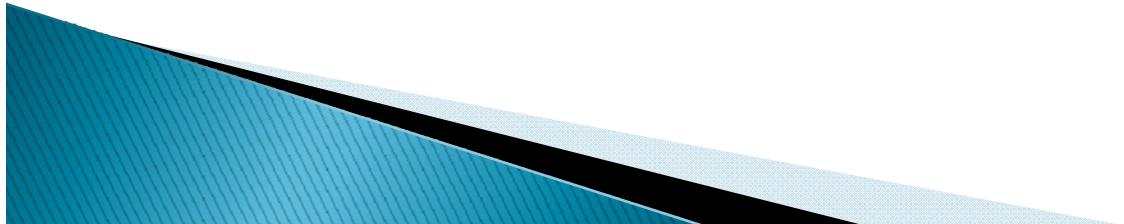
Cavitation; Phenomena and consequences

- ▶ An introduction to cavitation
 - When does it occur
 - Why is it important
- ▶ Which form does it take
 - bubble cavitation
 - sheet cavitation
 - blade root cavitation
 - vortex cavitation
 - Propeller Hull Vortex (PHV) cavitation
 - hub vortex cavitation
- ▶ Cavitation Inception



Introduction

- ▶ When?
- ▶ Why need to know?



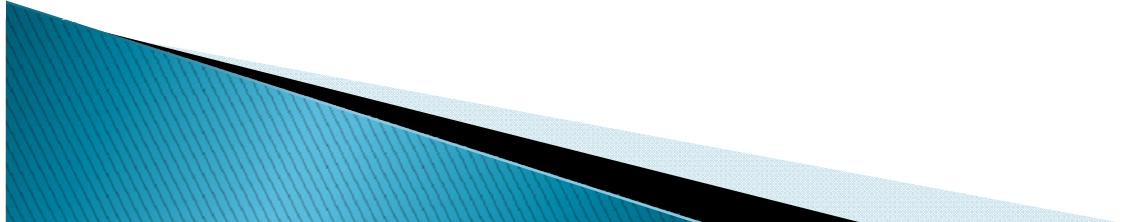
Cavitation basics

- ▶ Cavitation number

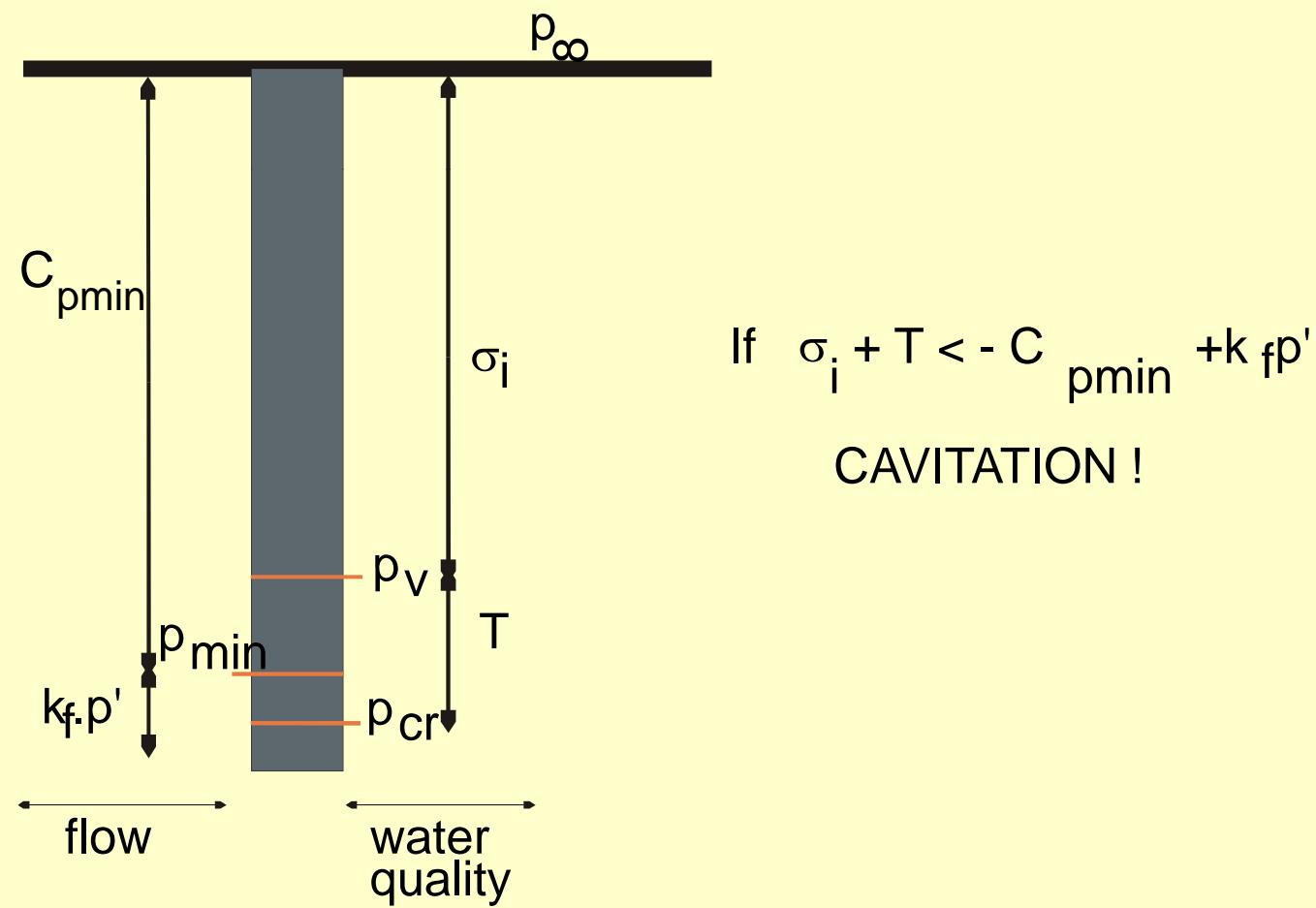
$$\sigma = \frac{P_0 - P_v}{\frac{1}{2} \rho V^2}$$

- ▶ Pressure coefficient

$$C_p = \frac{P - P_0}{\frac{1}{2} \rho V^2}$$



Effect of flow and water characteristics on cavitation inception



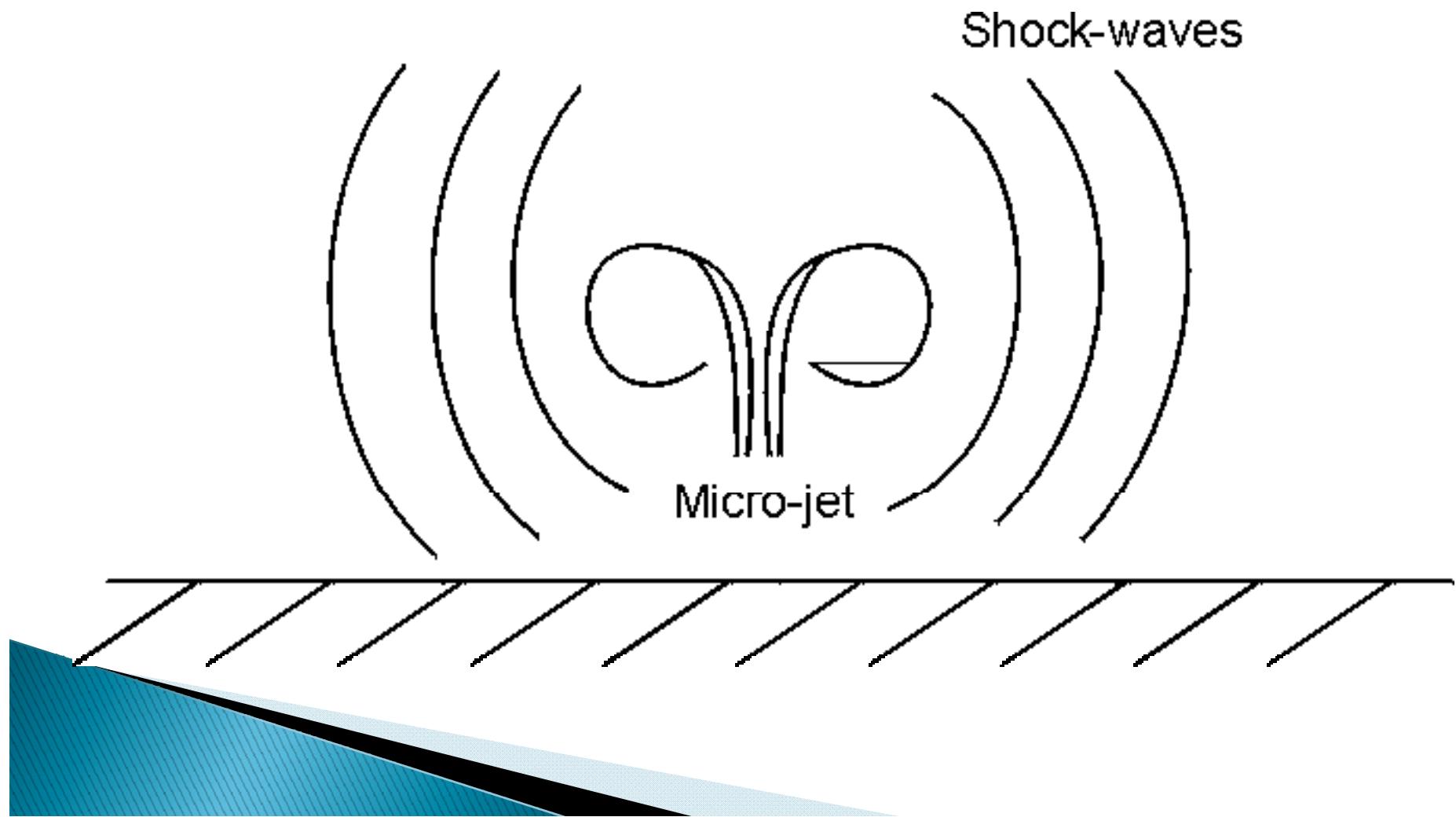
Erosion



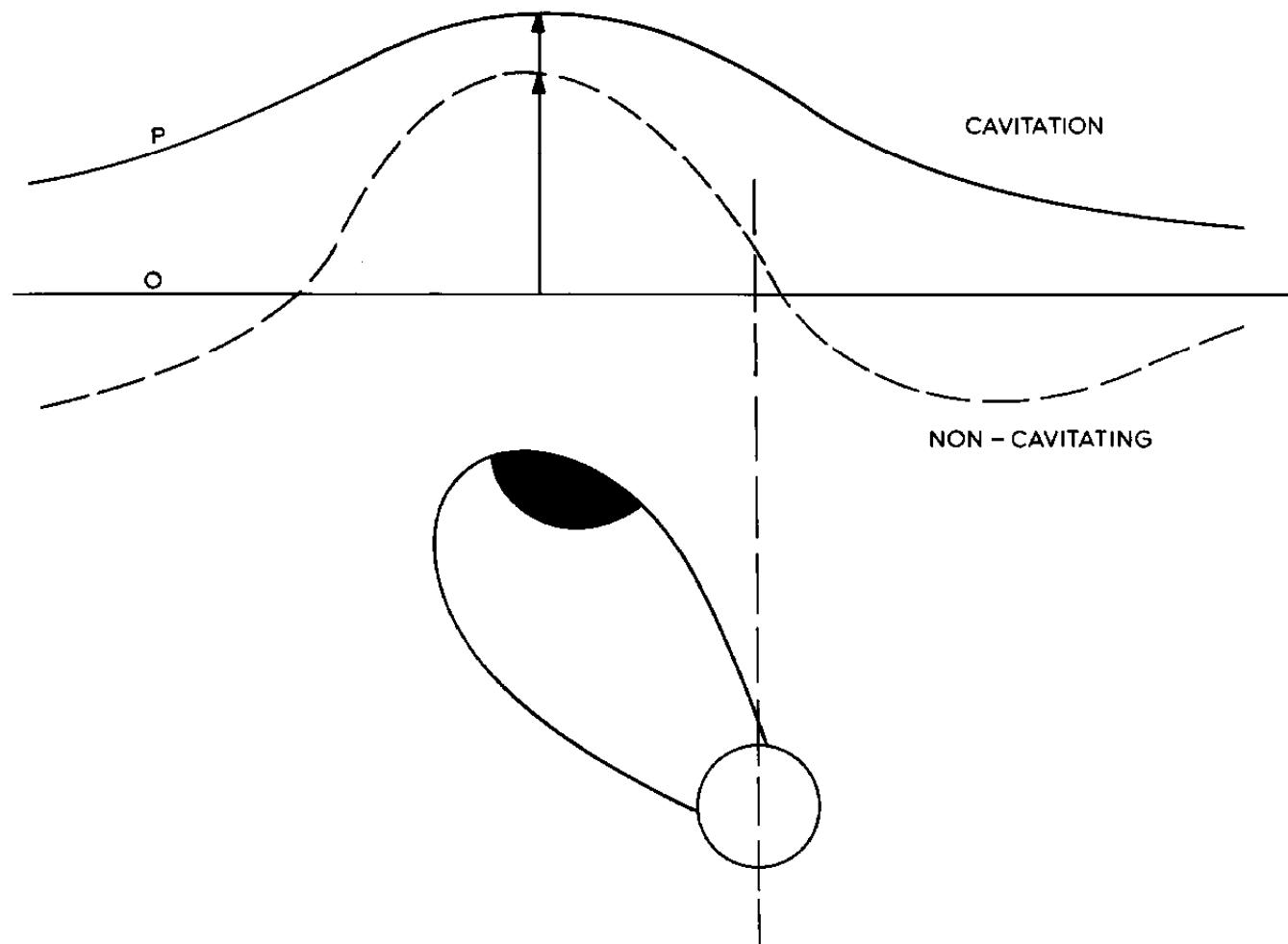
Erosion



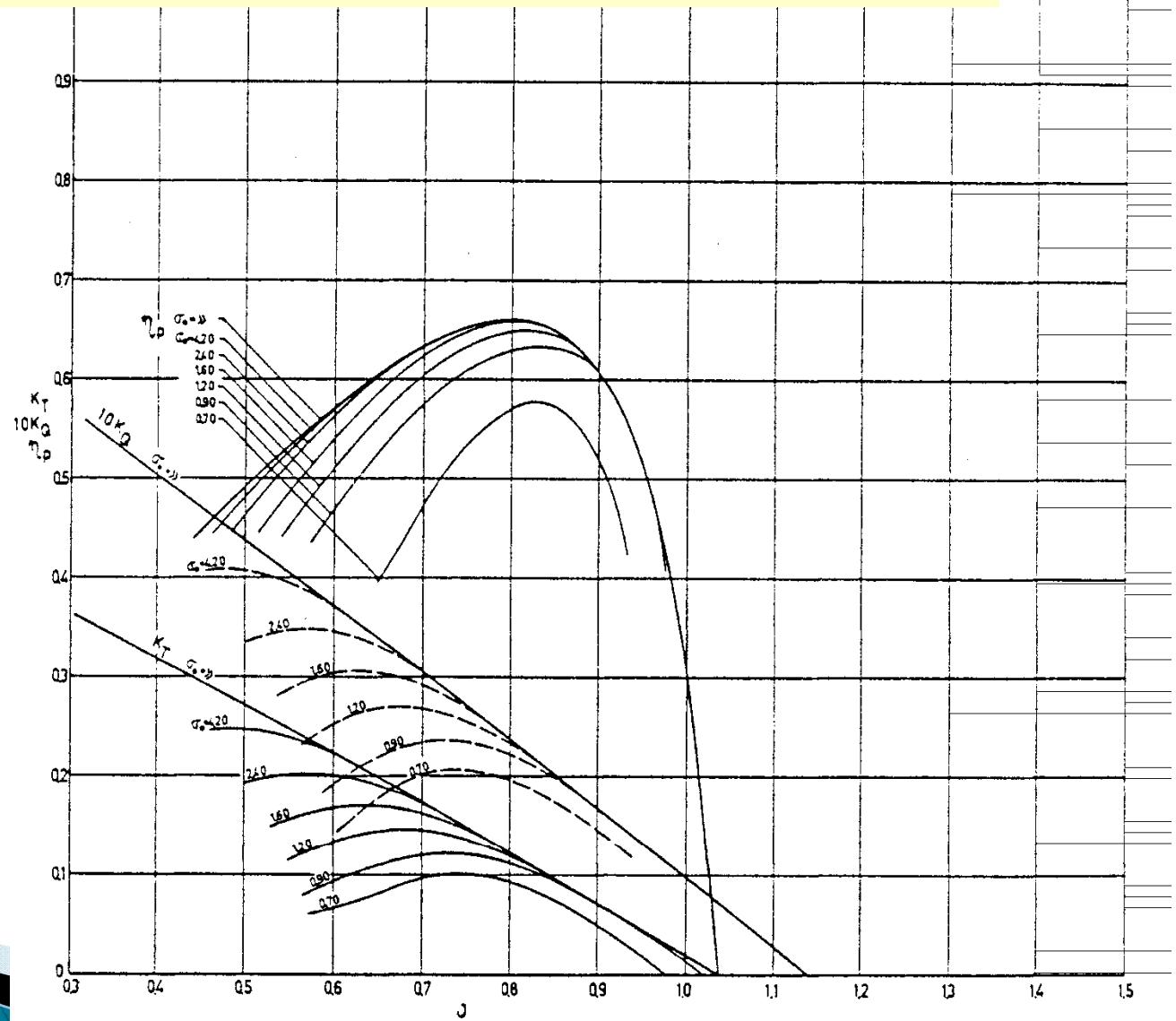
Collapse of a cavity near a wall



Pressure fluctuation due to cavitating and non cavitating propeller blade

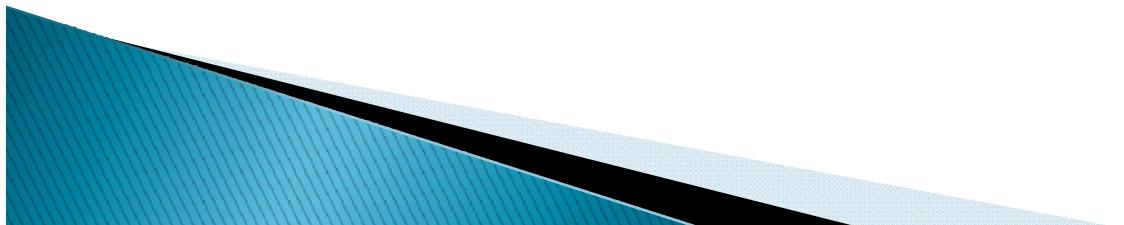


Open water diagram with cavitation effect



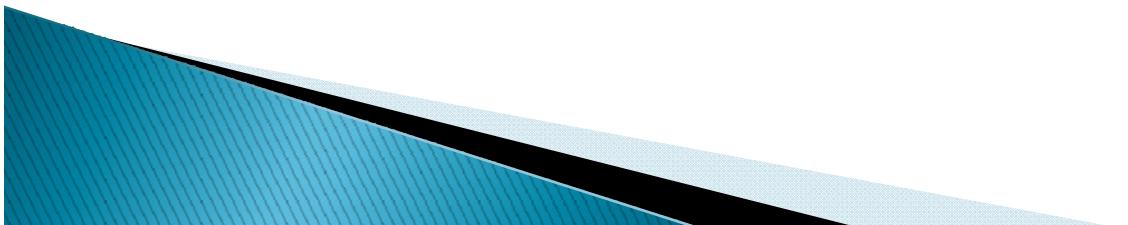
Summary of adverse effects of cavitation

- ▶ Cavitation erosion
 - especially ferocious: cloud cavitation, pressure side cavitation, possibly bubble cavitation
- ▶ Vibrations through pressure fluctuations
- ▶ Radiated noise
- ▶ Thrust breakdown

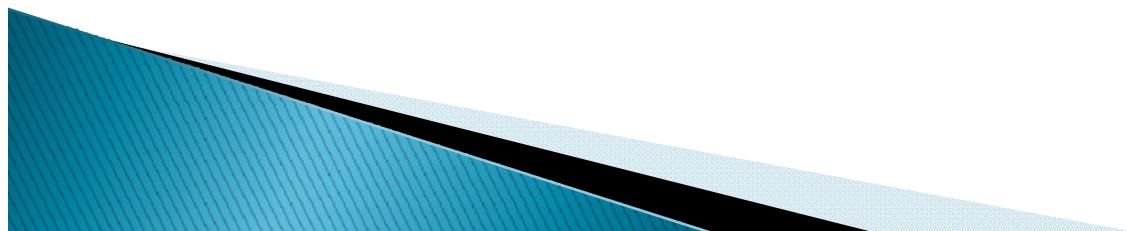


Forms of cavitation

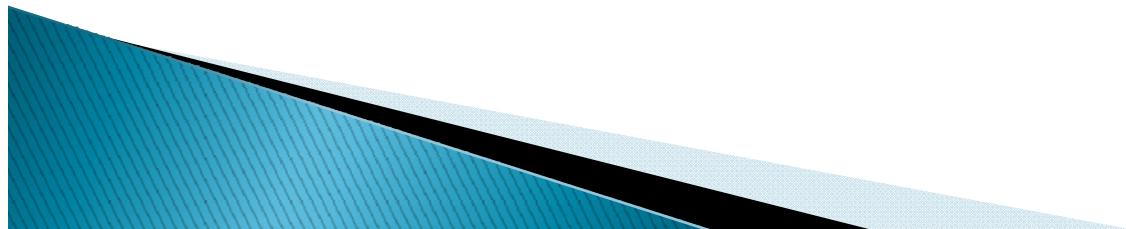
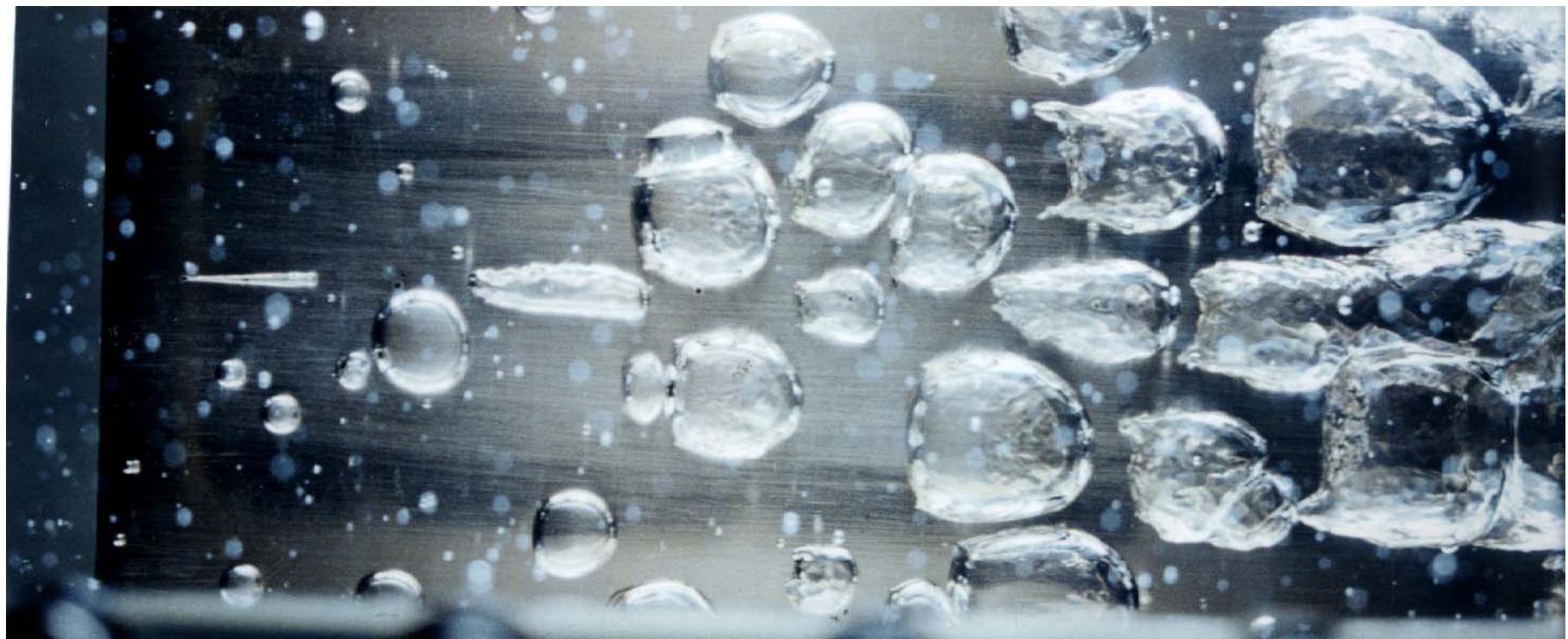
- bubble cavitation
- sheet cavitation
- blade root cavitation
- vortex cavitation
- Propeller Hull Vortex (PHV) cavitation
- hub vortex cavitation



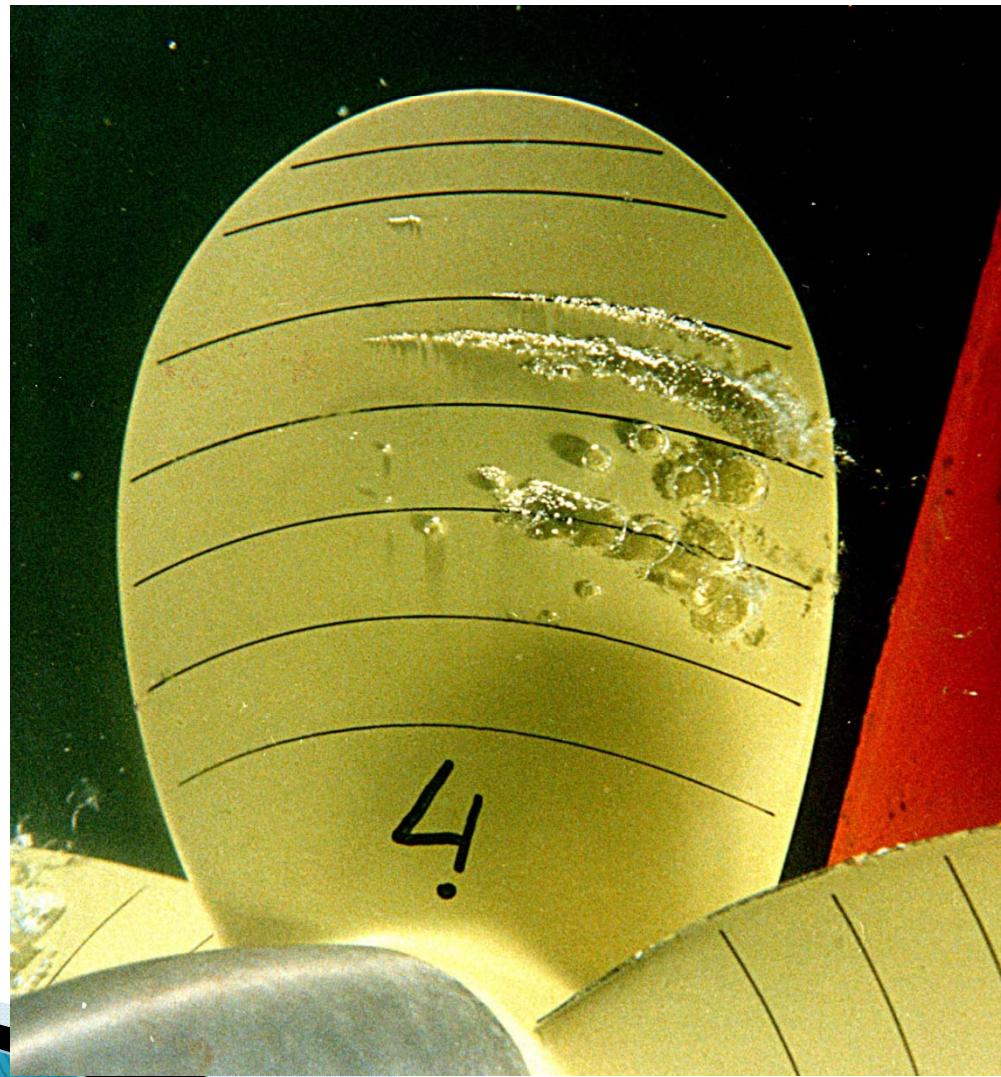
Bubble Cavitation



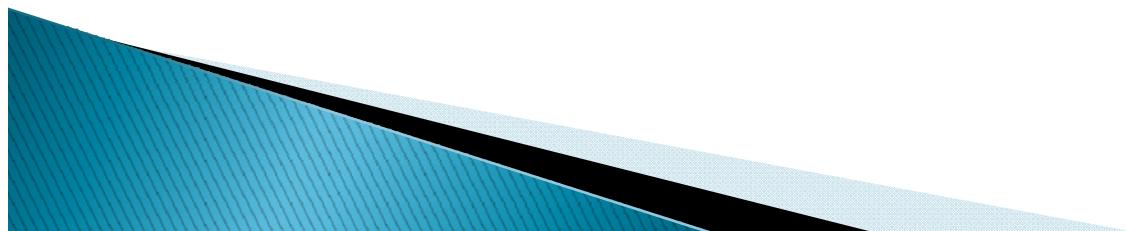
Bubble cavitation on a foil



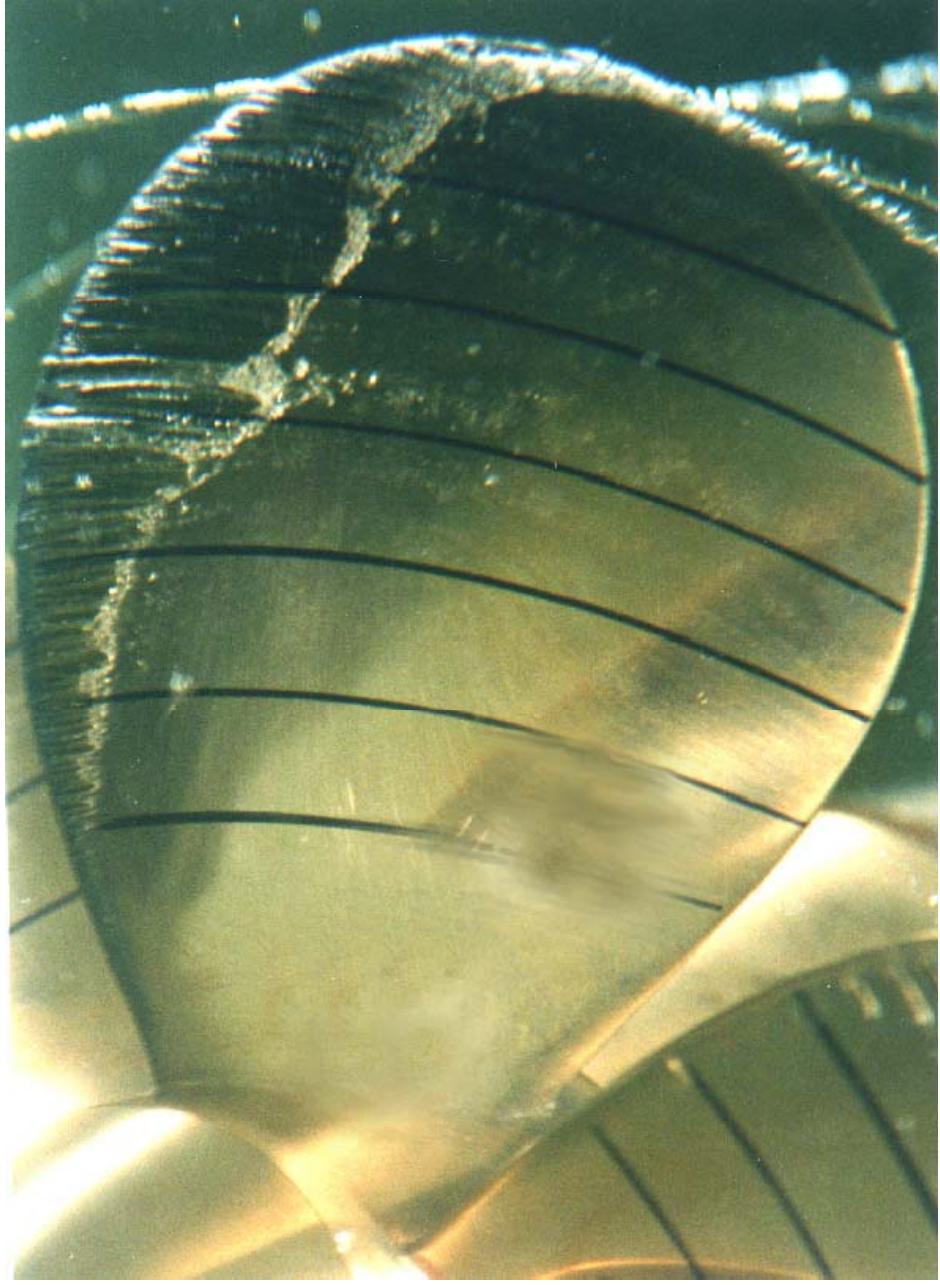
Bubble cavitation on a propeller



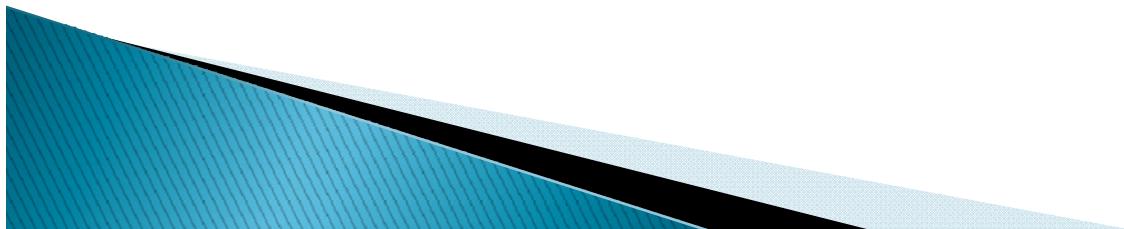
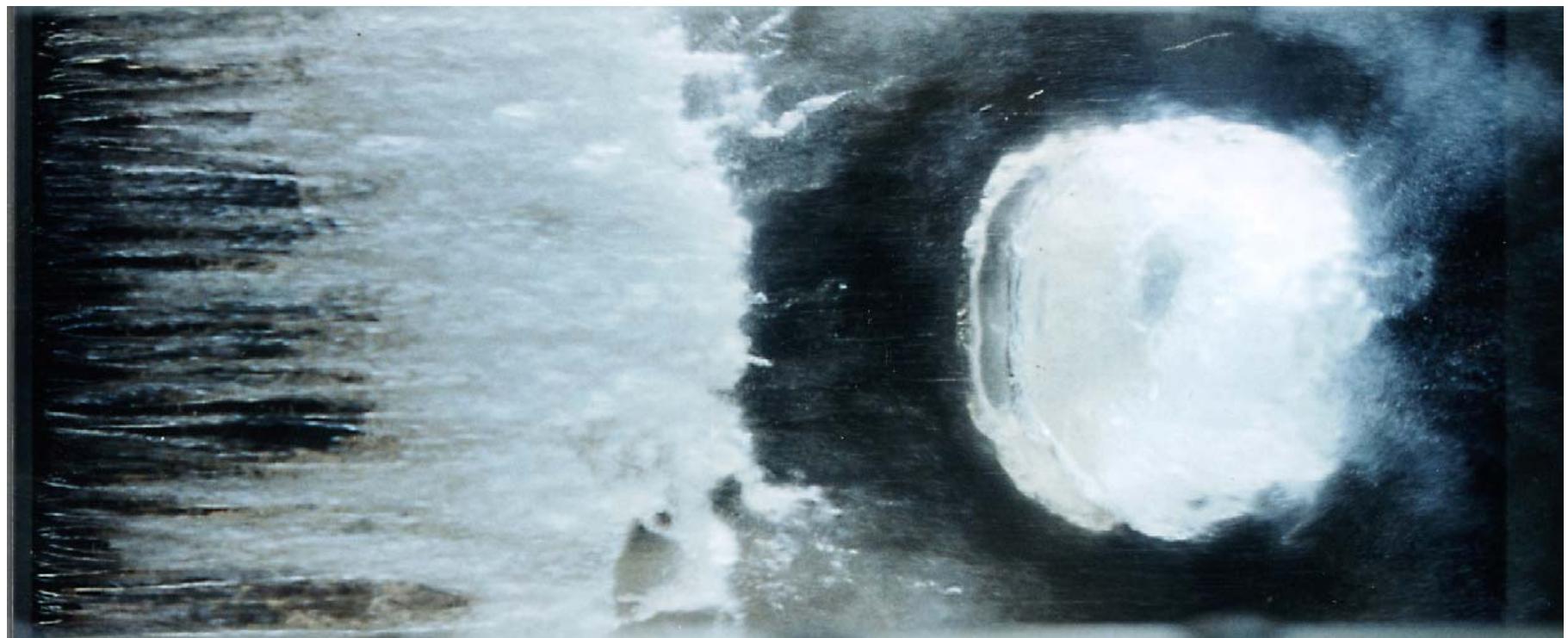
Sheet Cavitation



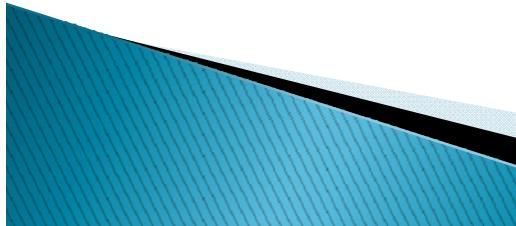
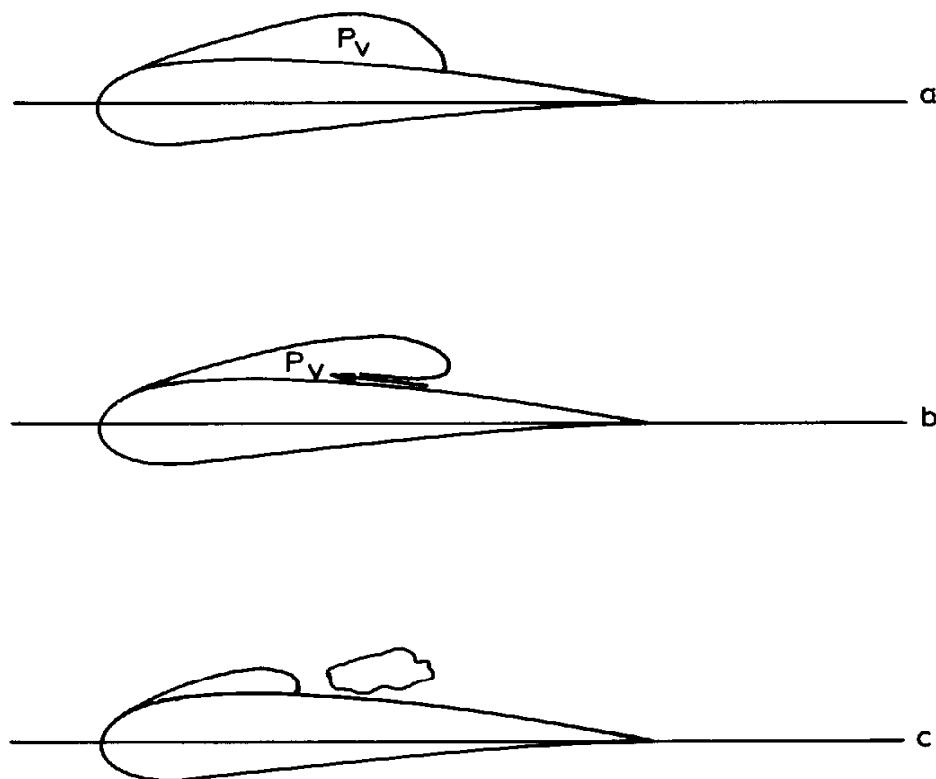
Sheet cavitation



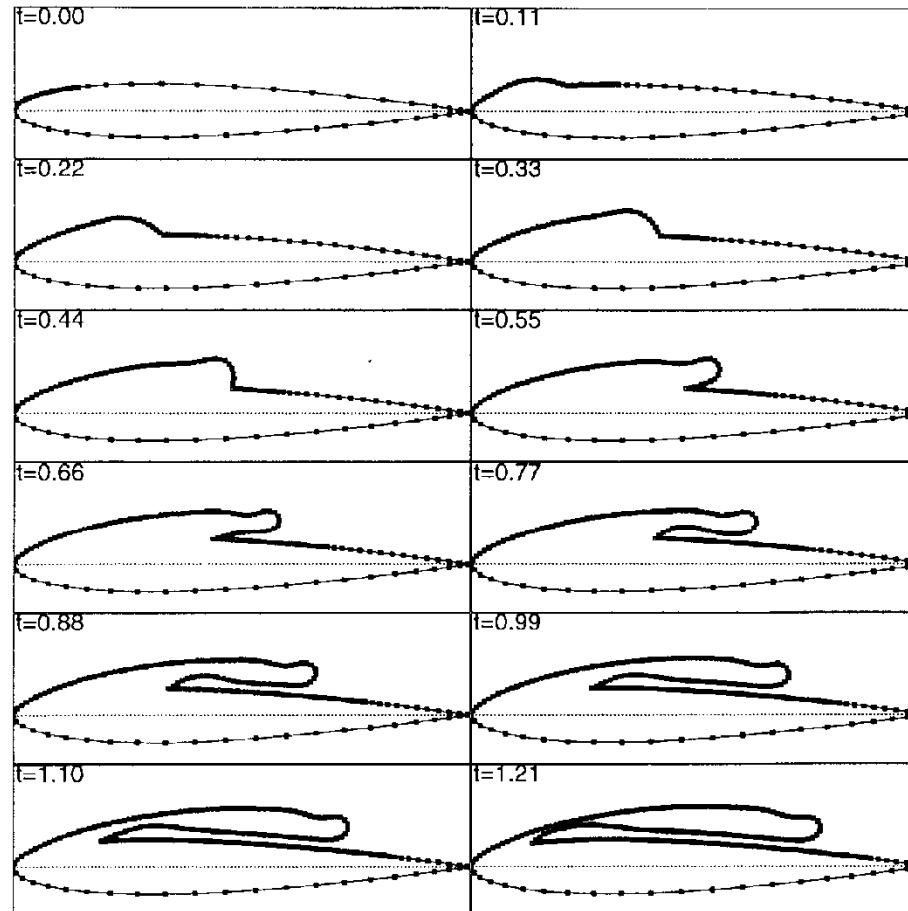
Oscillating cavity sheet on a profile



Development of cloud cavitation through a reentrant jet

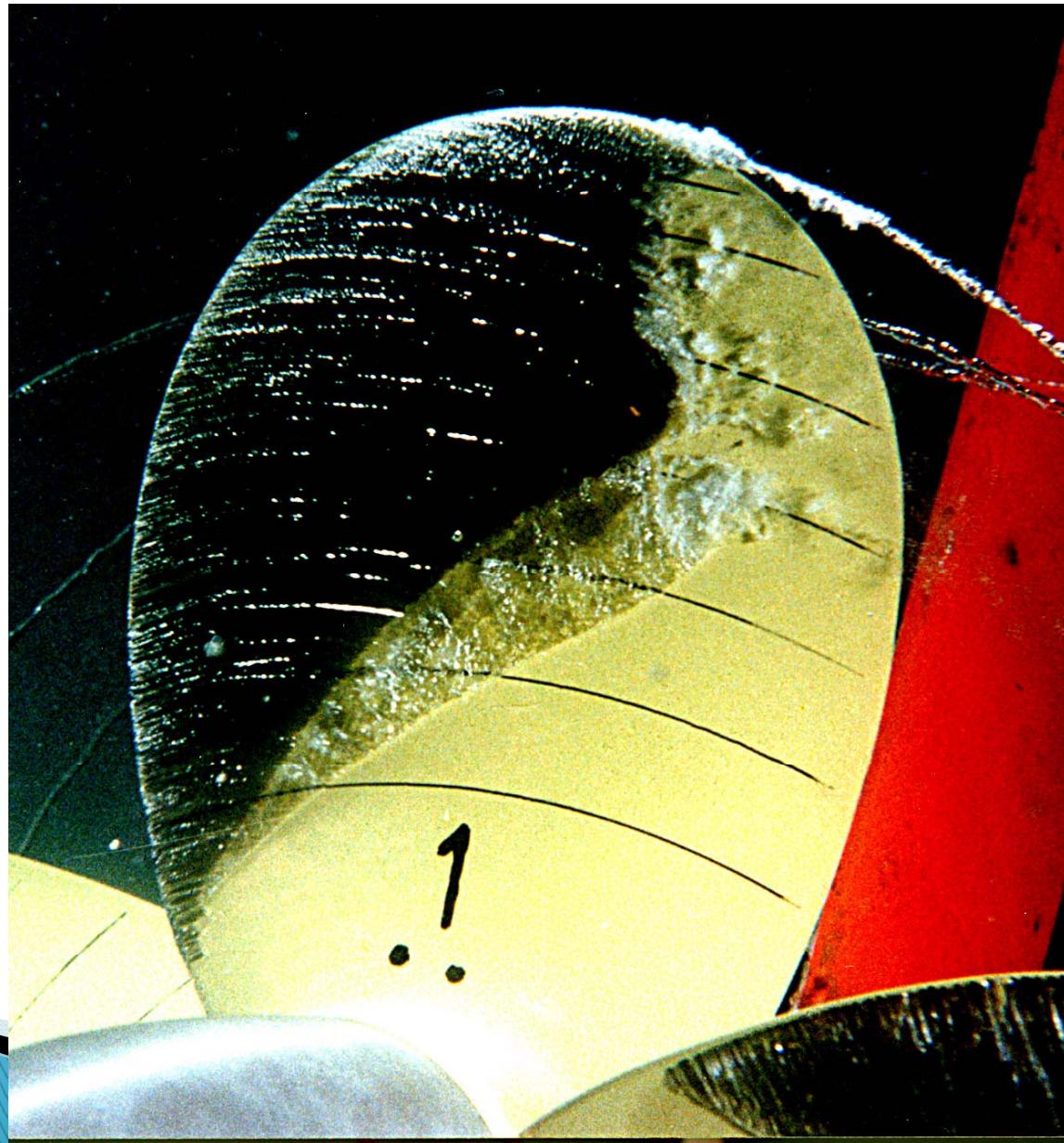


Sheet Cavitation

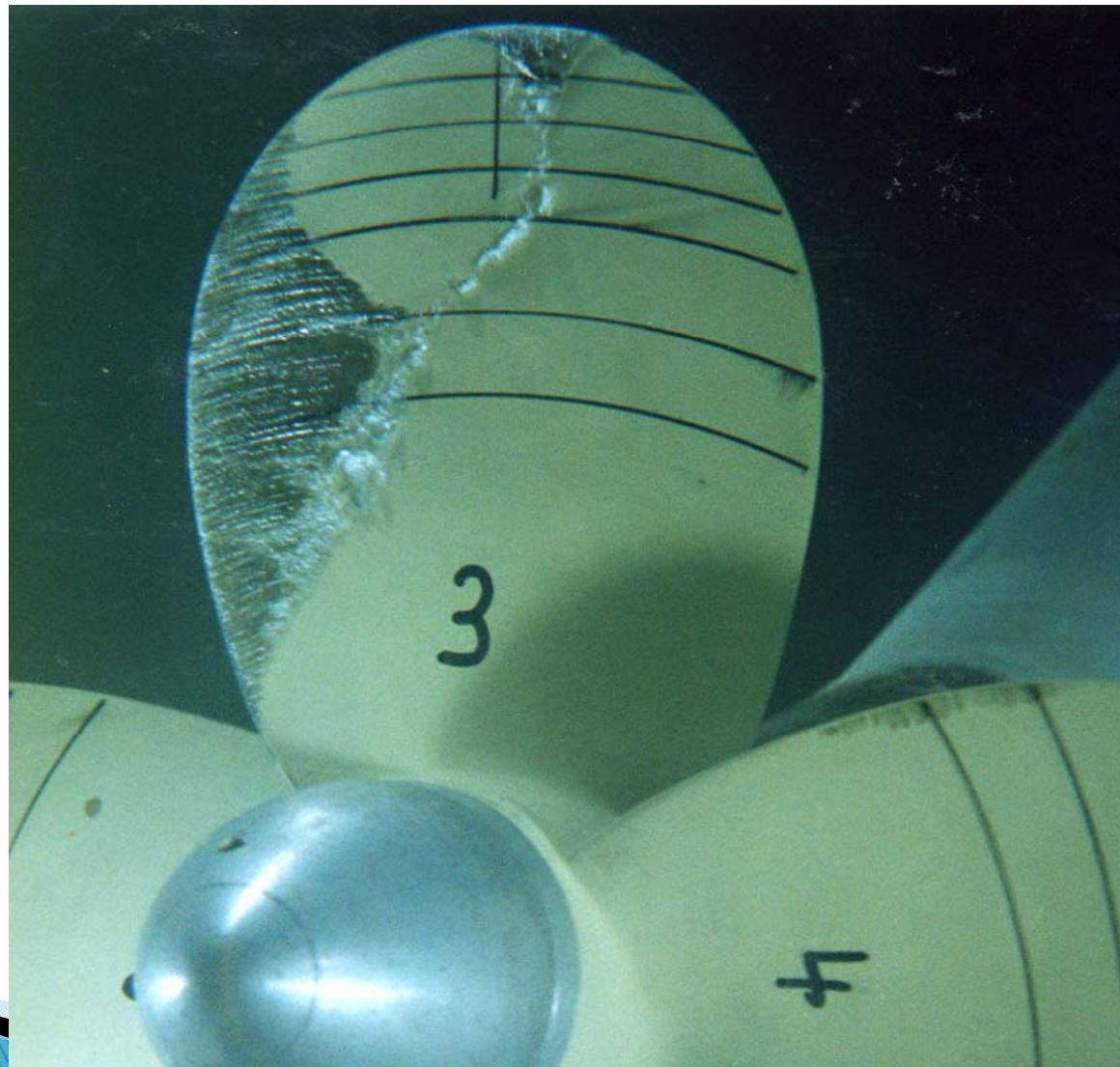


Cavity growth: The test case using the alternative function approximation.

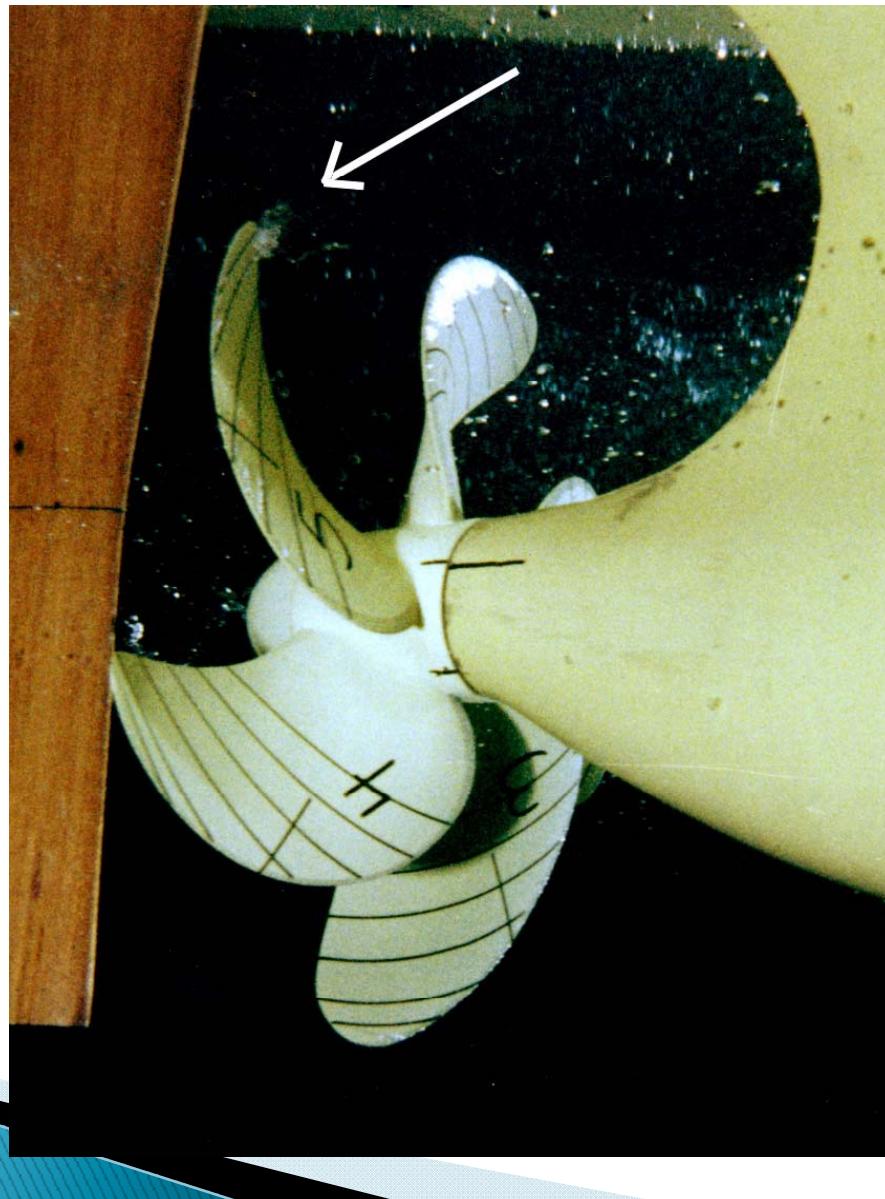
Sheet cavitation with unloaded tip



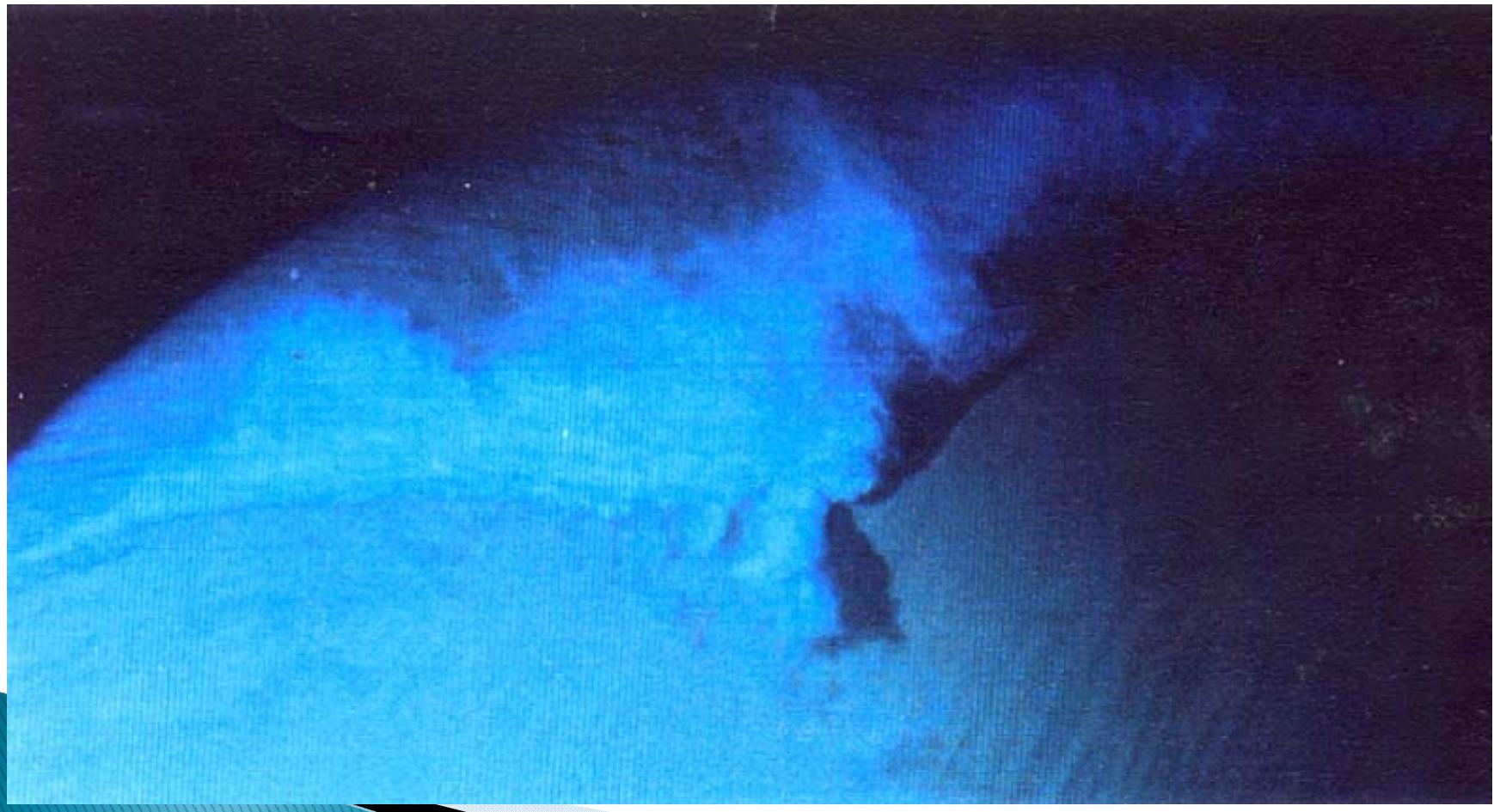
Imploding sheet on a propeller



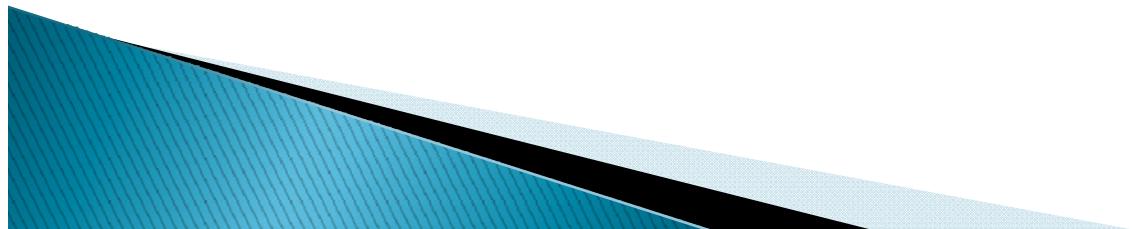
Imploding sheet on a propeller



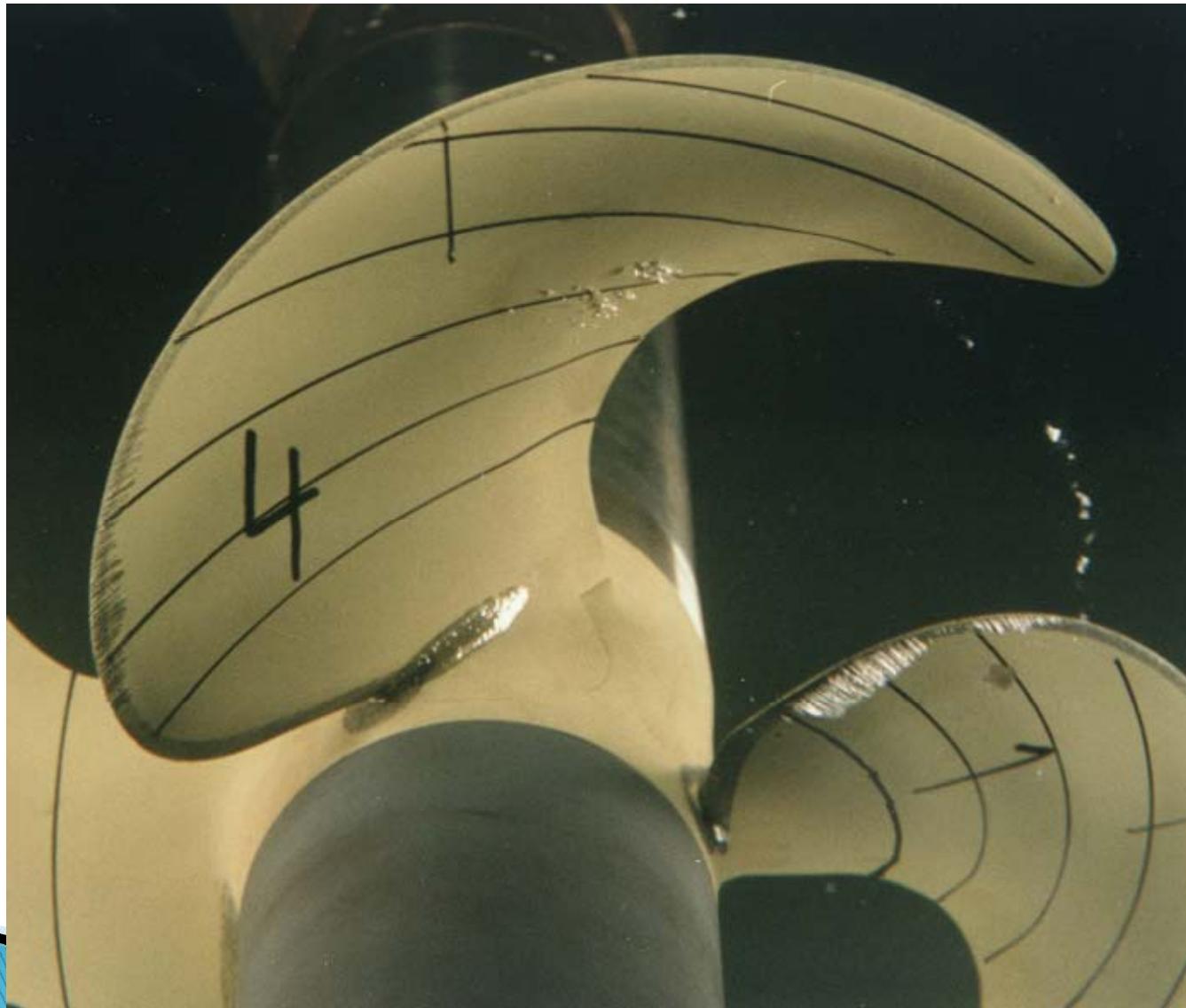
Development of detached cavitation on the propeller of a containership (full scale)



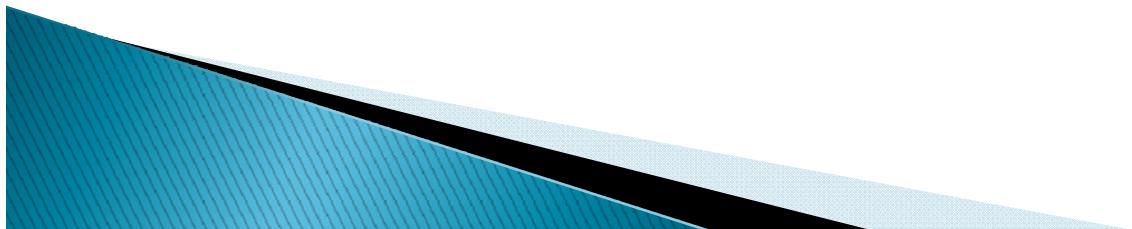
Blade Root Cavitation



Blade root cavitation

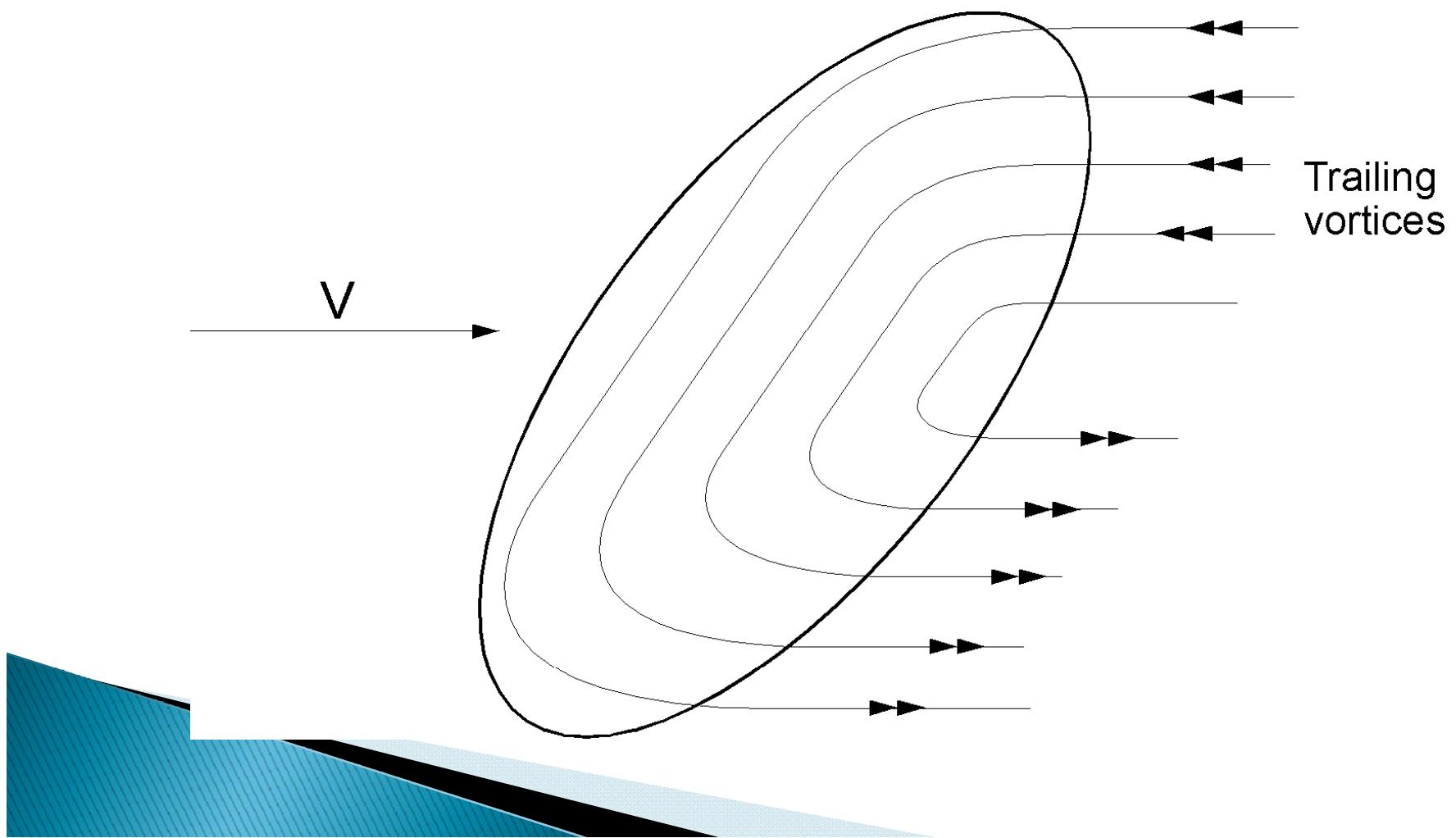


Vortex Cavitation

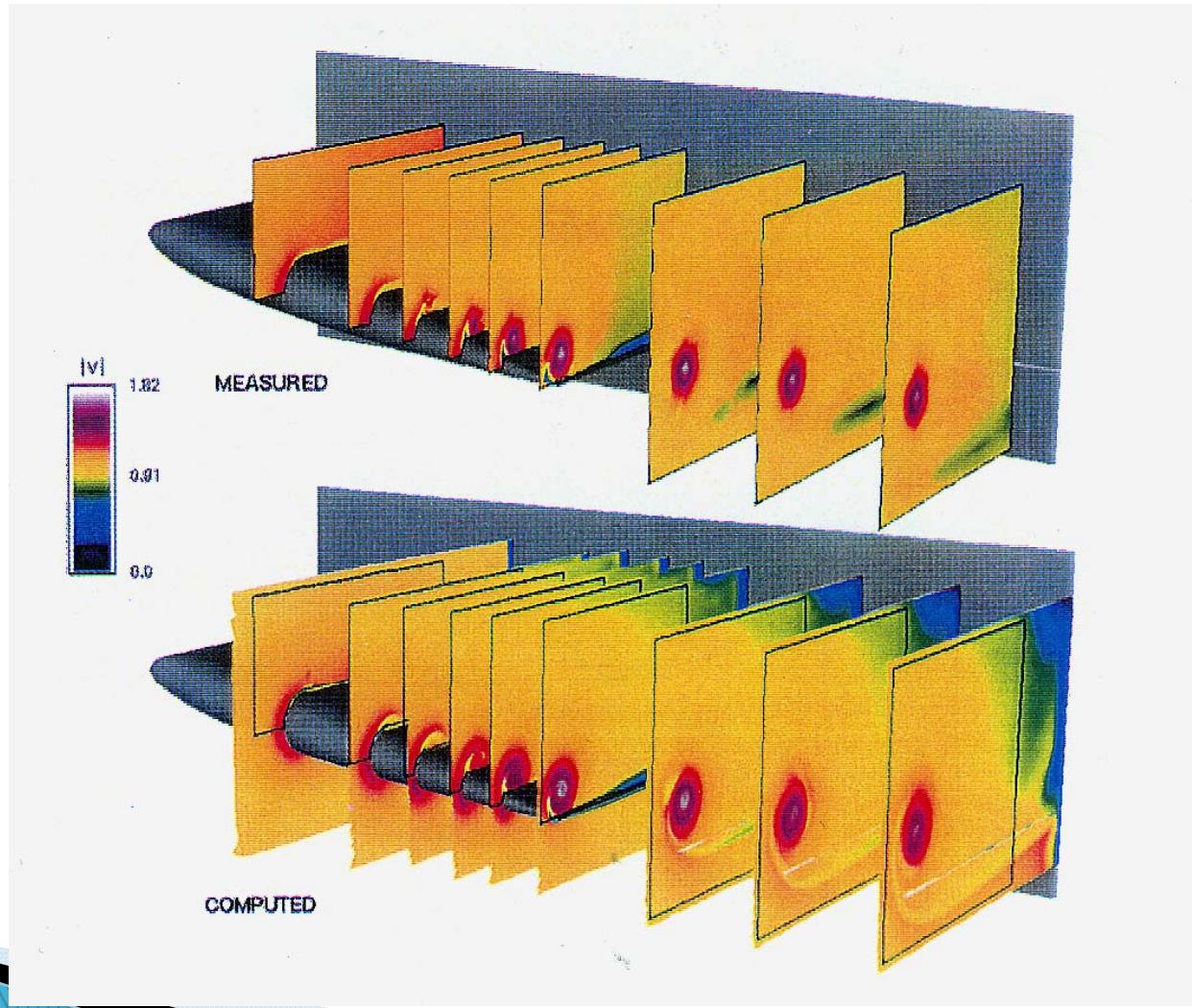


VORTEX CAVITATION

Lifting Surface Theory (Analysis)

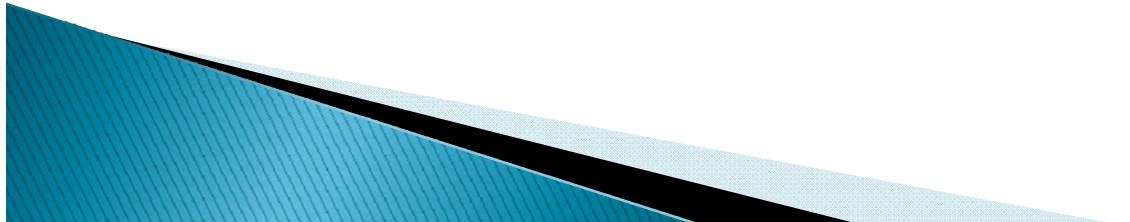


Tip Vortex Flow



Types of Vortex Cavitation

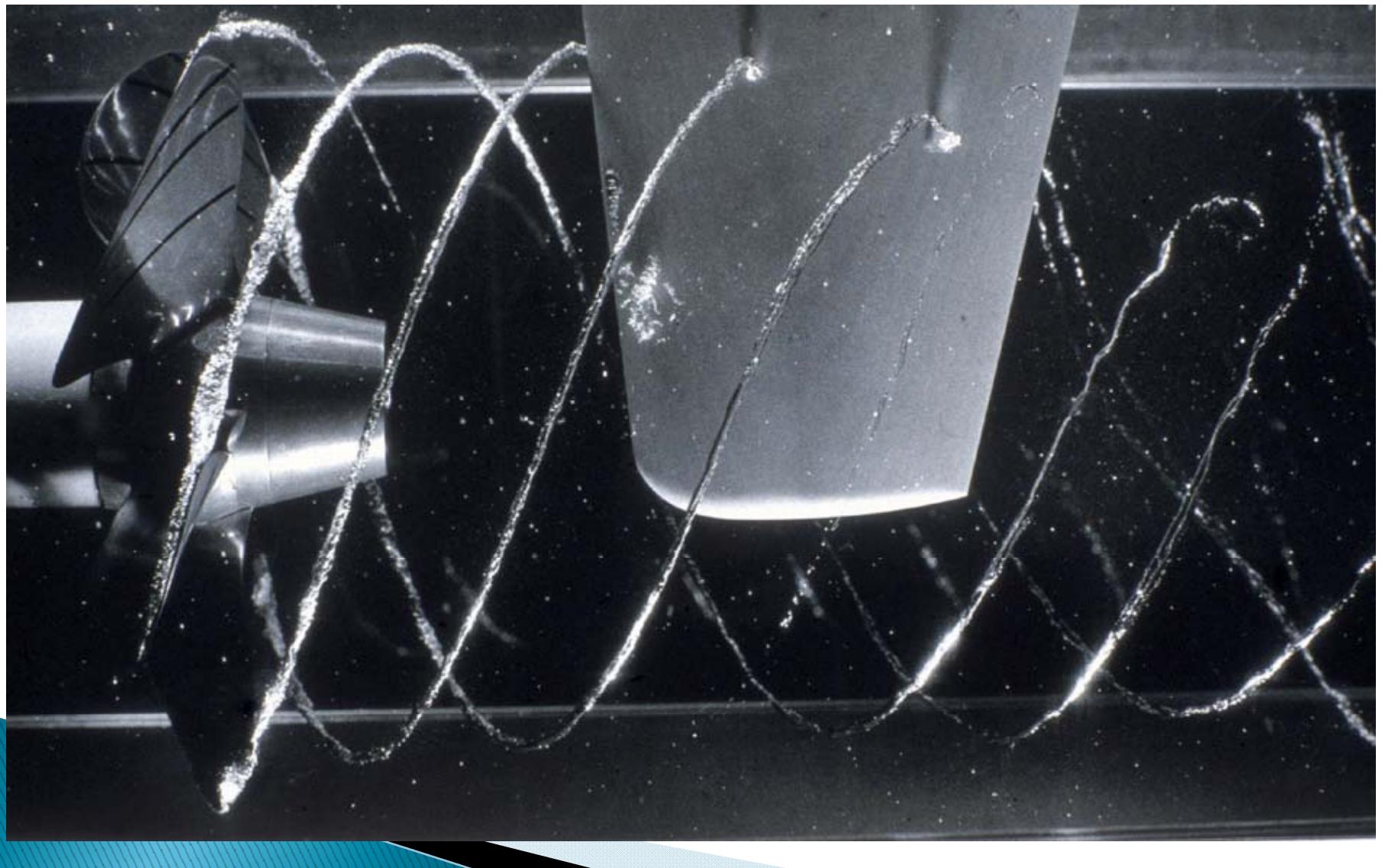
- Trailing vortex cavitation
- Local Tip Vortex cavitation
- Leading Edge Vortex cavitation
- Propeller Hull Vortex (PHV) cavitation
- Hub Vortex cavitation



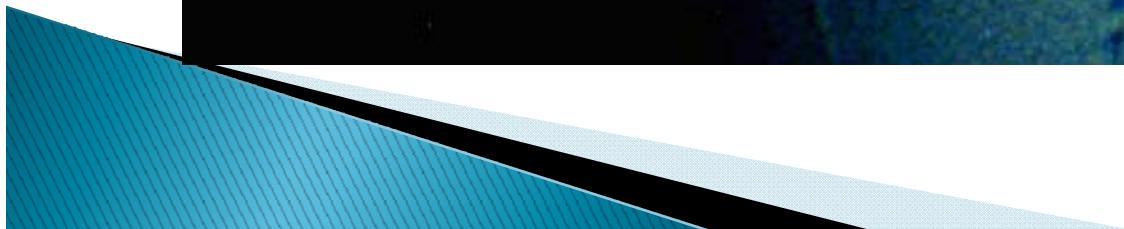
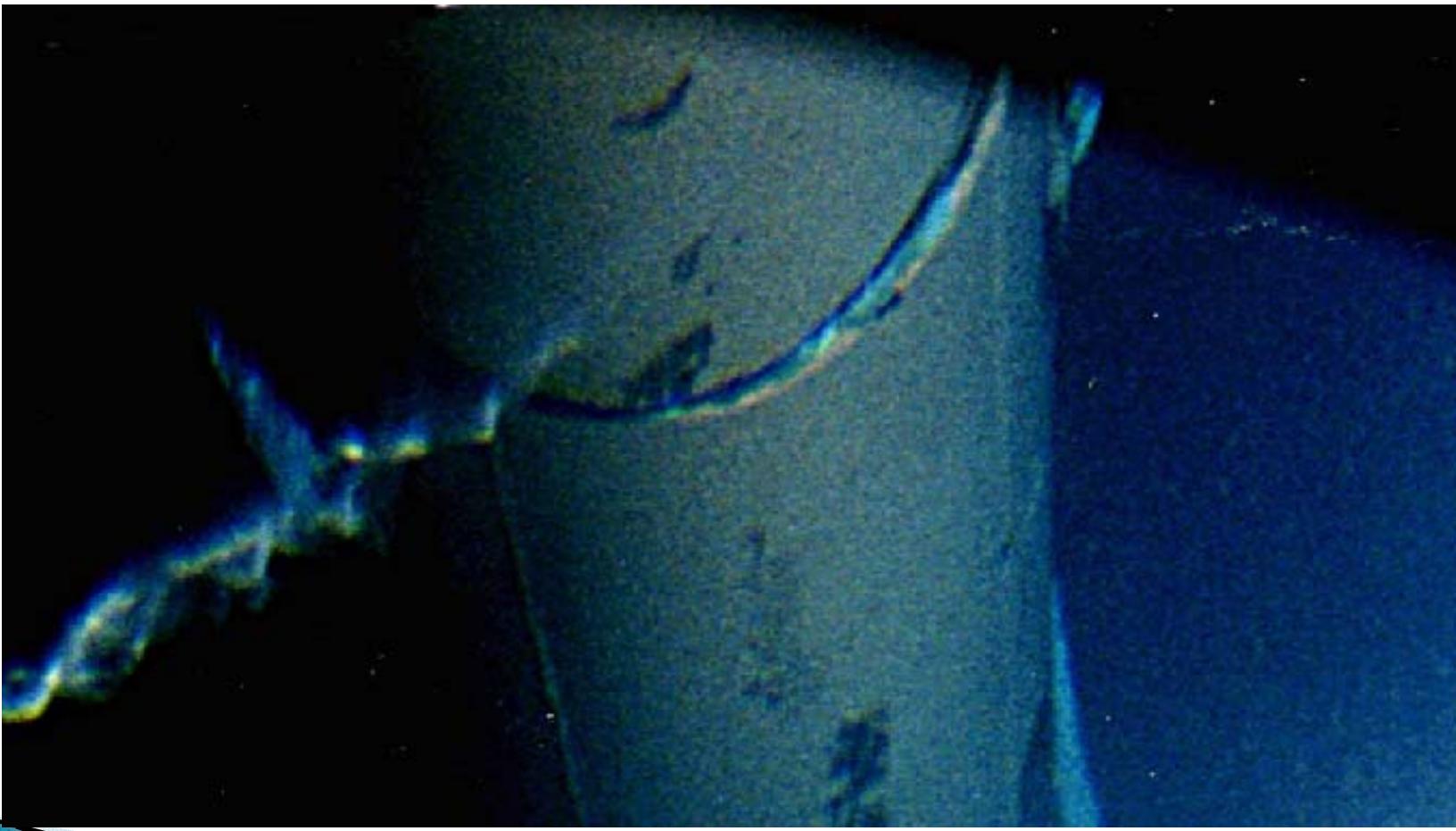
Tip Vortex Cavitation



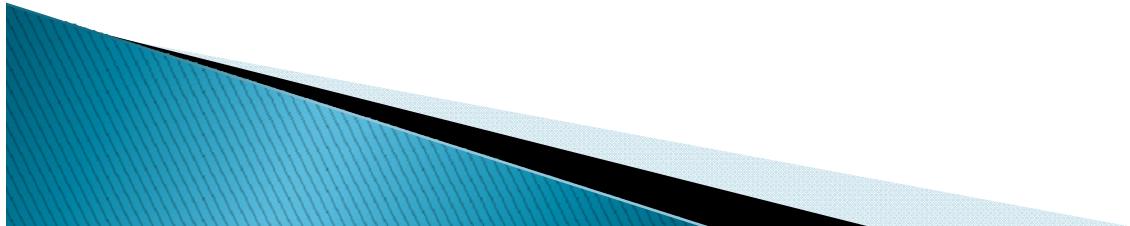
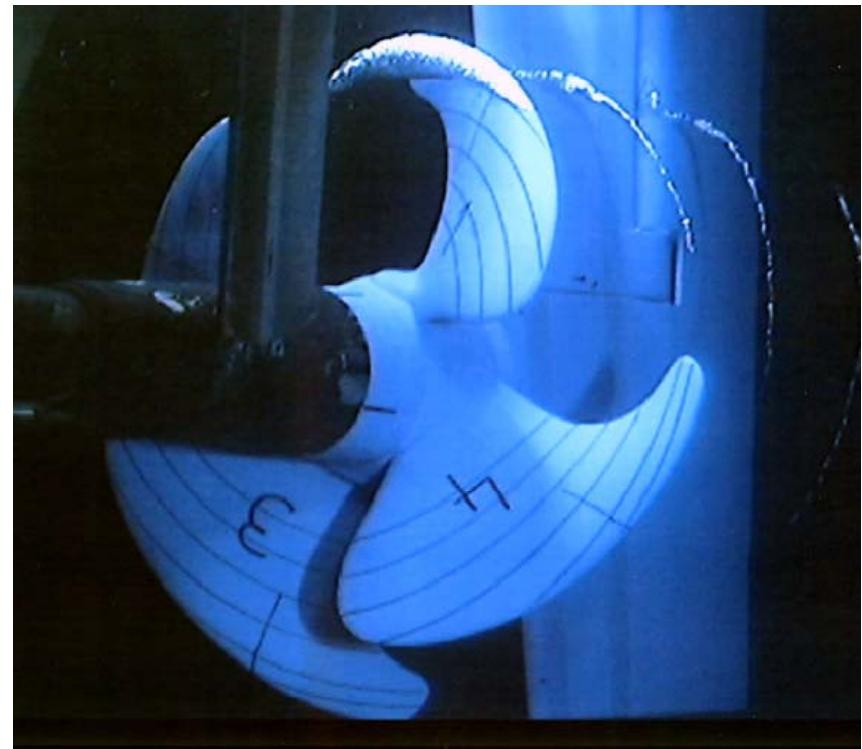
Developed Tip Vortex Cavitation



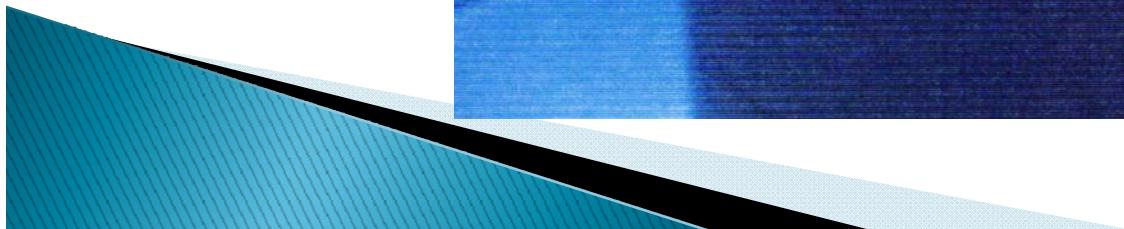
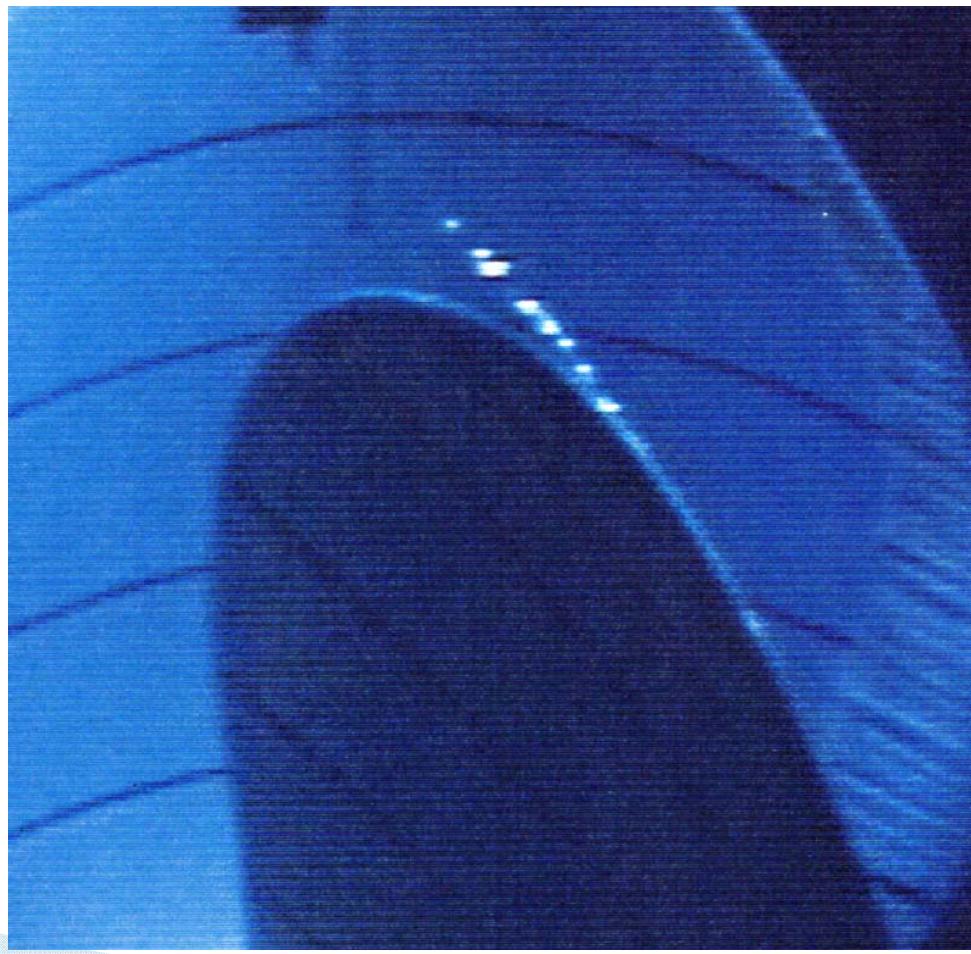
Tip Vortex Cavitation



Tip Vortex Cavitation



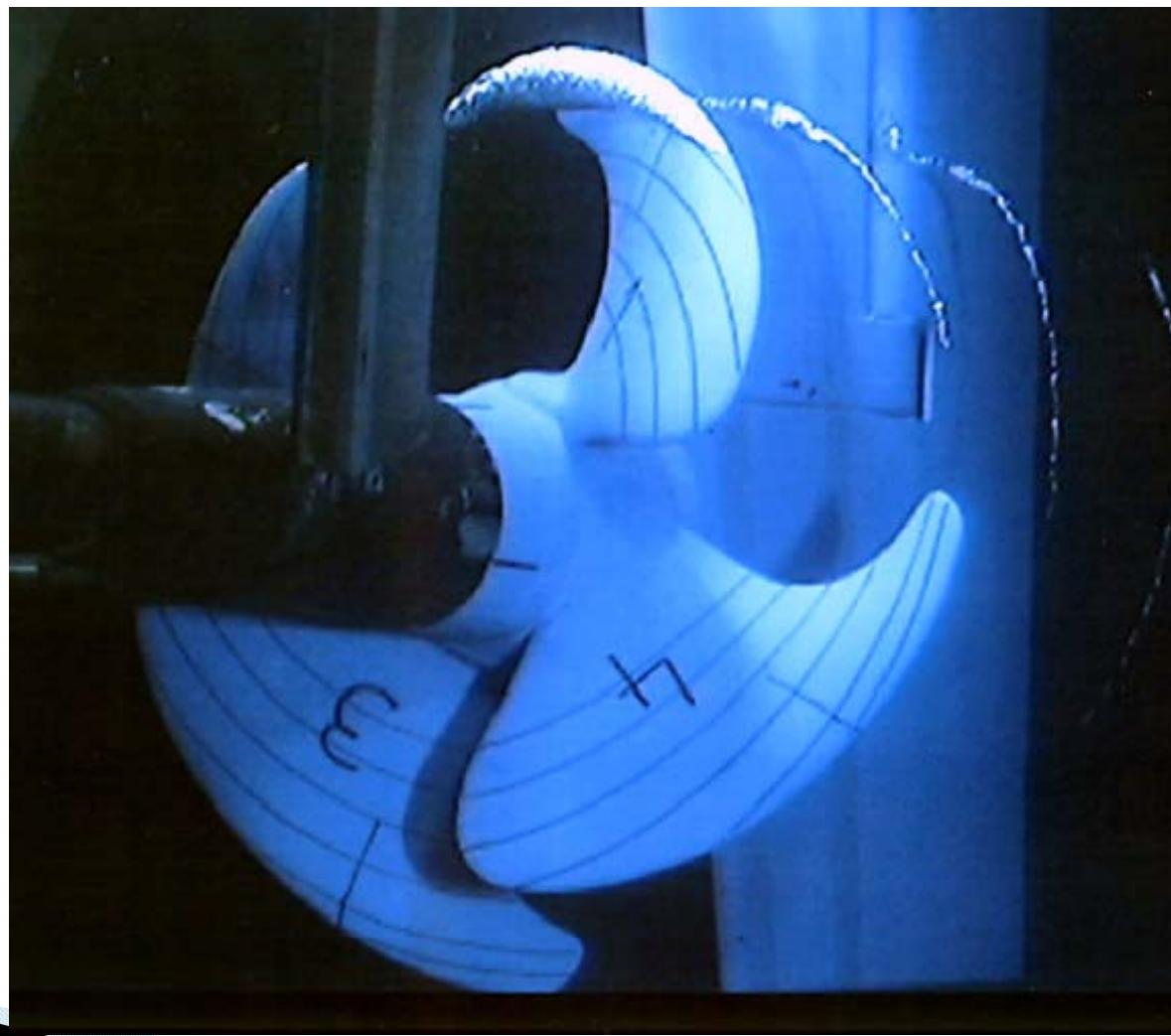
Tip Vortex Inception



Appearance of vortex cavitation



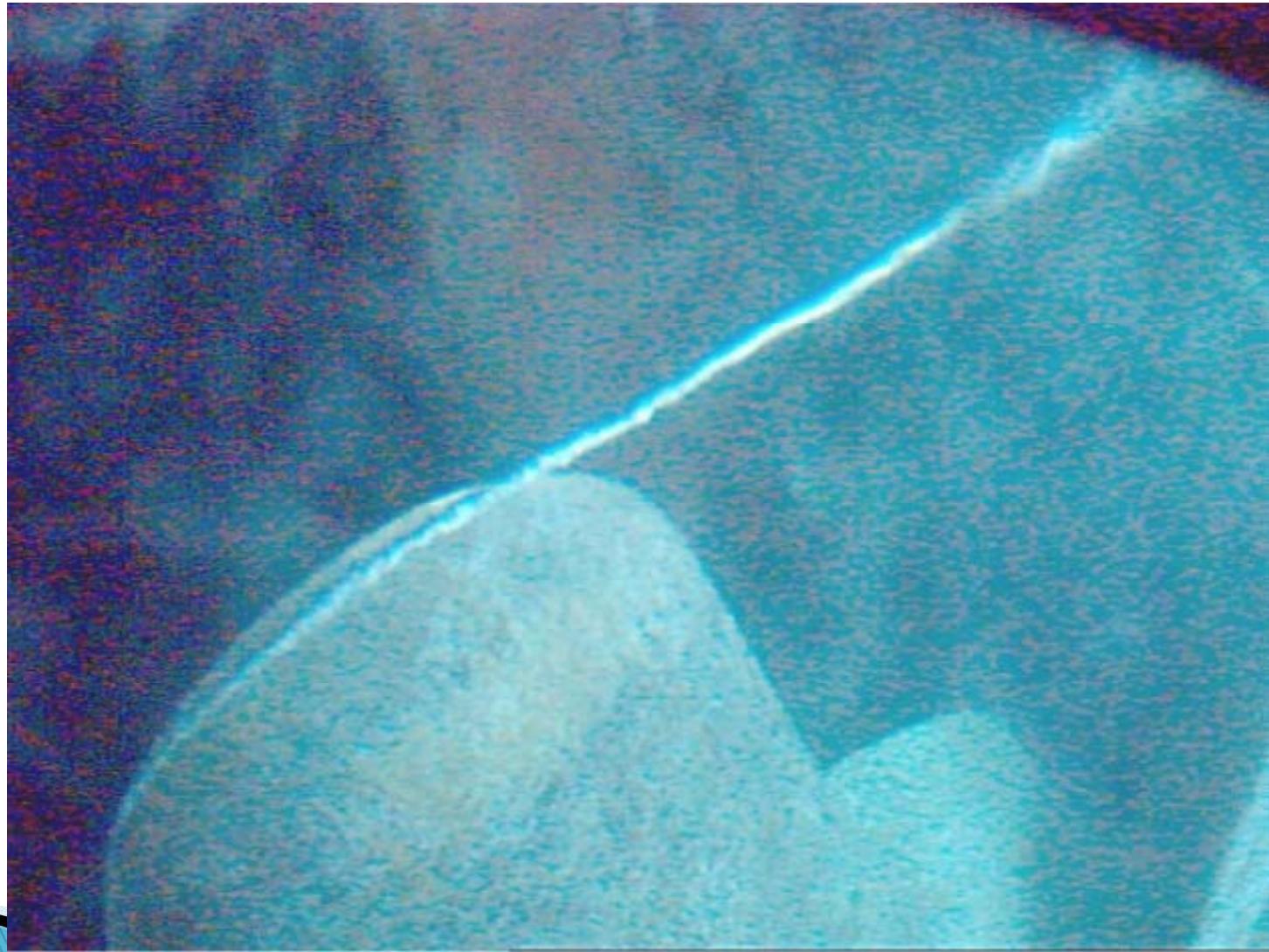
Broadband Noise



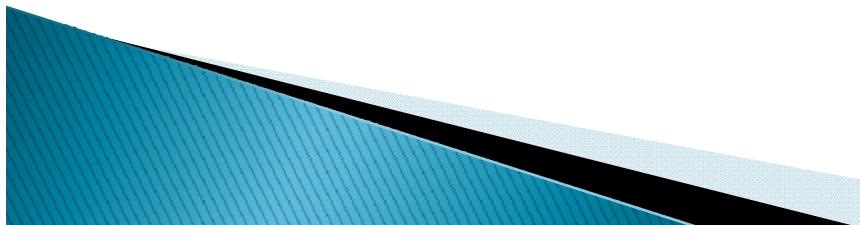
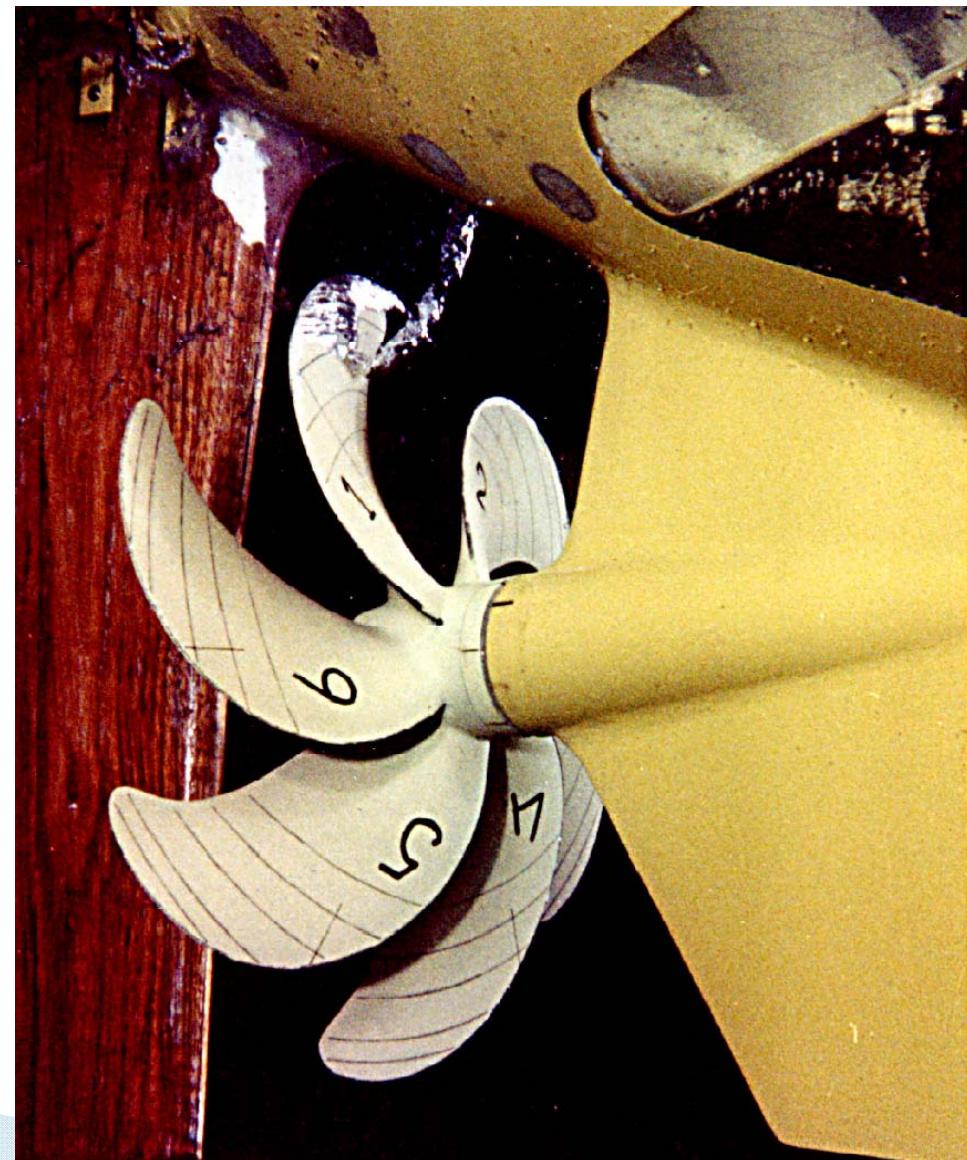
Full Scale Observations



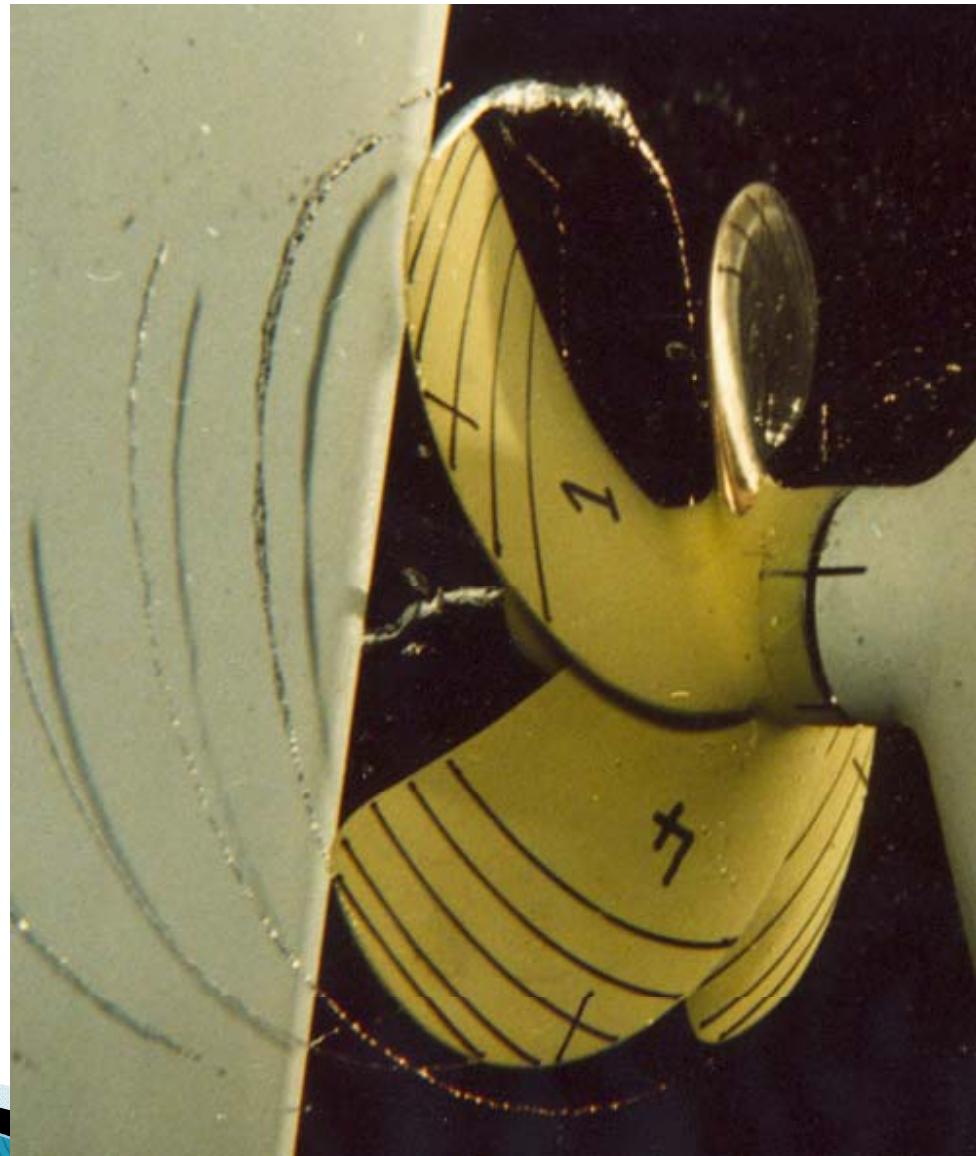
Full Scale Observations



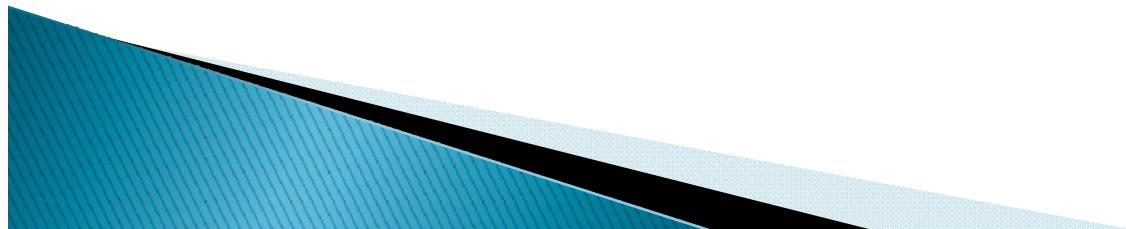
Propeller Hull Vortex (PHV) Cavitation



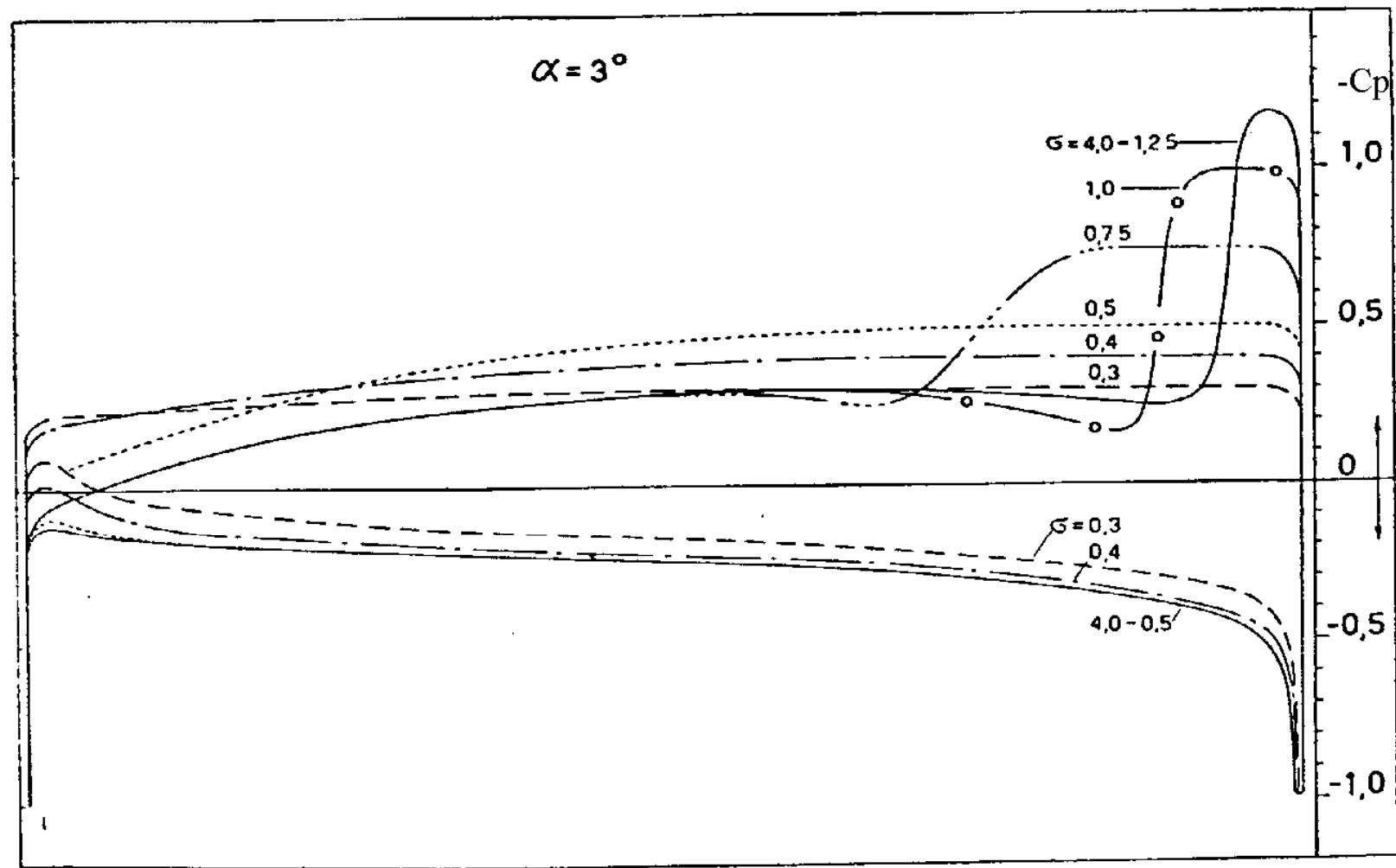
Hub Vortex Cavitation



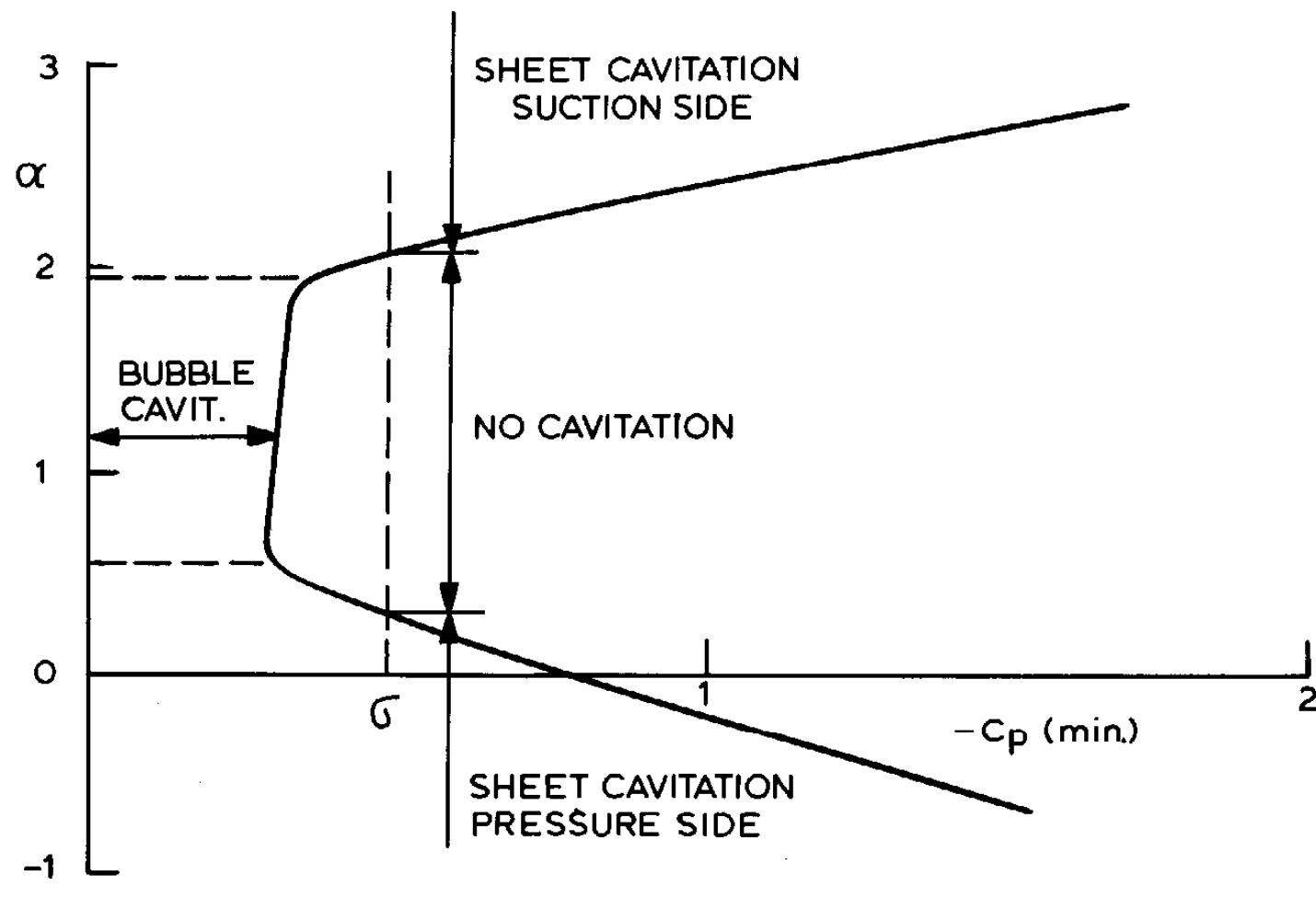
Cavitation Inception



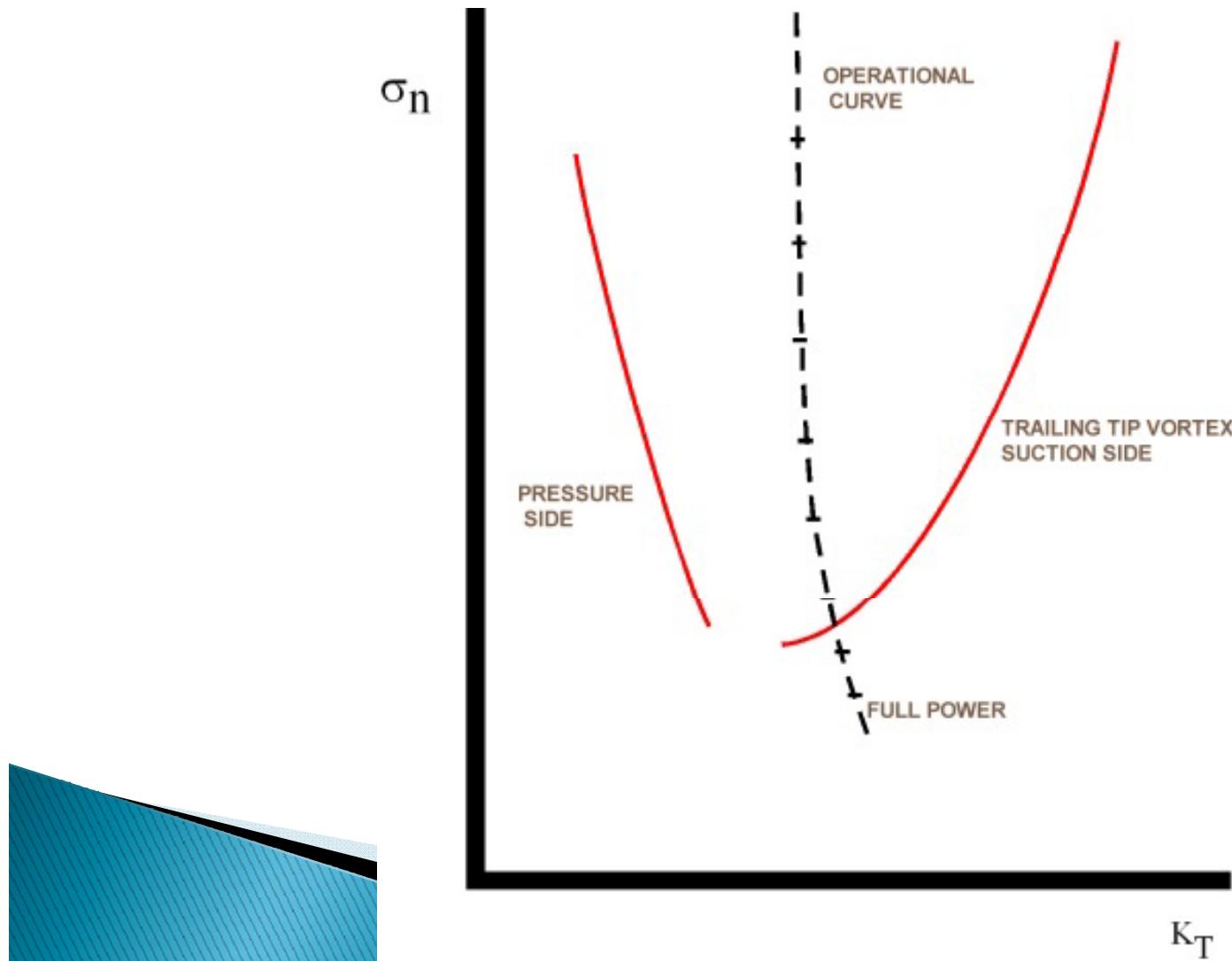
Pressure distribution on a profile at various cav. numbers



Cavitation bucket of a profile



Cavitation inception diagram of a propeller



Exam for instruction on Friday Oct. 21

Jan 24, 2008

