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# Towing Restrictions on Oceanographic Research Vessels

**Sergio Fifi**

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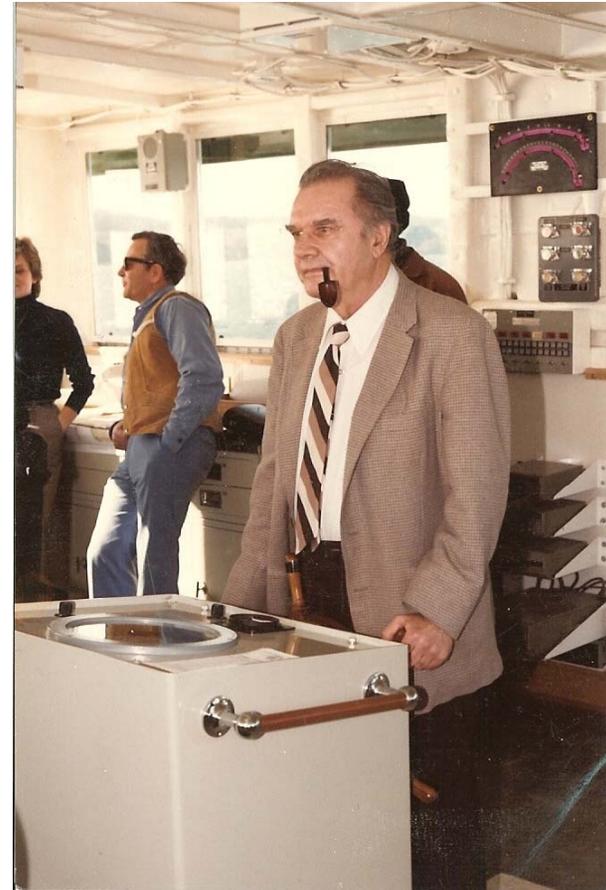
**Jensen Maritime Consultants, Inc.**

**A Crowley Company**

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## JMC History

- 1961 JMC founded (formerly B.F. Jensen & Associates)
  - 1981 – Norwegian Owners
  - 1993 – JMC start buy-back
  - 1998/1999 – 100% American Owned
  - 2008 – Jensen becomes a Crowley Company
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- In the early days fishing vessels were the Firm’s “bread & butter”
  - Today, our projects include more complex design and engineering support for tugs, barges, research/passenger/cruise vessels, off-shore dredges, diving support vessels, dry cargo vessels, patrol and fire boats, and more.



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## Presentation Outline:

- Introduction
- Towing Stability Criteria applicable to ORV's
- Derivation of 46 CFR 173.095(b) and it's suitability to this application.
- JMC suggestion for an alternative towline pull criteria for ORV's.

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## Introduction

- Although weight handling gear and lifting equipment play a significant role in the mission of ORV's NO explicit guidance exists from the Coast Guard or regulatory bodies on the evaluation of towing for ORV's.
- Analysis of an ORV's suitability for towing must by logical interpretation of the regulations employ rules designed for the evaluation of tugboats.

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## Applicable Towing Stability Criteria for both Inspected and Uninspected ORV's

### INSPECTED ORV's:

- These are Motor Vessels  $\geq 300\text{GT}$ , and Non-self-propelled vessels  $\geq 100\text{GT}$ .
- Regulated under CFR Title 46 Chapter I, Subchapter U – Oceanographic Research Vessels:
  - By Reference 46 CFR 189.55-5(c) invokes 46 CFR Subchapter S:
    - “*Subdivision and Stability*. Plans required by part 170 of this chapter.”
- 46 CFR Subchapter S, Subpart E – Towing
  - 173.090 General
    - This subpart applies to each vessel that is equipped for towing.

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## Applicable Towing Stability Criteria for both Inspected and Uninspected ORV's (Con't)

### UNINSPECTED ORV:

- Regulated under Title 46 CFR Subchapter C – Uninspected Vessel
  - No towing restrictions
- If however the vessel is Load Lined, and the assigning authority is the ABS our experience has been that 46 CFR Subchapter S, Subpart E – Towing is invoked.

- Subpart E – Towing

173.095(b):

$$GM_{REQ} \geq \frac{(N)(P \times D)^{2/3}(s)(h)}{K\Delta(f/B)} \quad (1)$$

- N = Number of Props
- P = Shaft Power per Shaft [HP]
- D = Propeller Diameter [ft]
- s = The fraction of the propeller intercepted by the rudder.
- h = Vertical distance from propeller shaft centerline at ruder to towing bitts. [ft]
- $\Delta$  = Displacement [LT]
- f = Minimum Freeboard along the length of the vessel [ft]
- B = Molded beam. [ft]
- K = 38 [English units]

## Derivation of 46 CFR173.095(b)

$$KG = \frac{\sum (w_i \times kg_i)}{\Delta}$$

Therefore ,

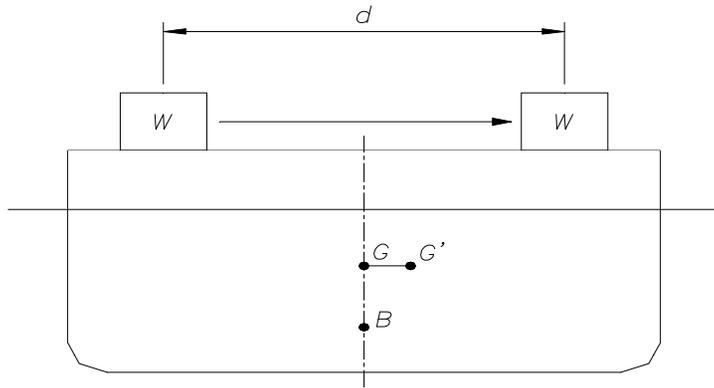
$$\Delta \times GG' = w_i \times d_i = \text{applied moment (HM)}$$

$$GG' = \frac{w_i d_i}{\Delta} = \frac{HM}{\Delta}$$

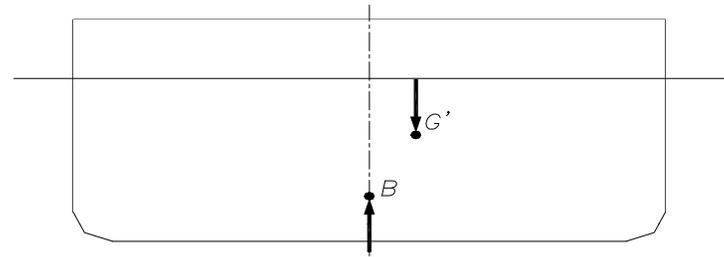
$$\tan(\phi) = \frac{GG'}{GM} = \frac{HM}{\Delta GM}$$

Re arranging ,

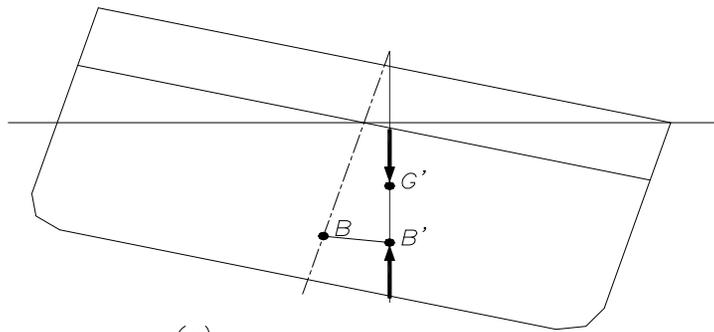
$$GM = \frac{HM}{\Delta \tan(\phi)} \quad (2)$$



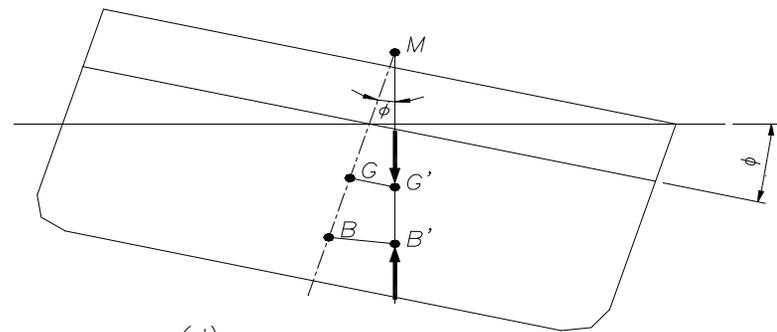
(a)



(b)



(c)



(d)

## Derivation of 46 CFR173.095(b) Con't

$$HM = N \times \frac{(P \times D)^{2/3}}{K} \times (s) \times (h)$$

$$\tan (\phi) = \frac{f}{\frac{1}{2} B}$$

$$\tan (\phi) = 2 \left( \frac{f}{B} \right)$$

Therefore ,

$$GM = \frac{HM}{\Delta \tan (\phi)} = \frac{(N)(P \times D)^{2/3}(s)(h)}{2 \times K \left( \frac{f}{B} \right)} \quad (3)$$

## Suggested alternative towline pull criteria for ORV's

$$GM_{REQ'd} = \frac{(BS)(h)}{2\Delta\left(\frac{f}{B}\right)} \quad (4)$$

BS = Breaking Strength of the towline [LT]

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