PARASAILING ENTERPRISE INC.
MAIN OFFICE: 605 OCEAN DRIVE • SUITE 2L • MIAMI, FLORIDA 33149 • 305/361-2101
PLANT: 501 107 ST. GULF • MARATHON, FLORIDA 33050 • 305/743-2314

Lt. Micheal Bechtel
Investigation Officer
U.S.C.G. Marine Safety Office
433 Ala Moana Blvd
Honolulu, Hi 96813

2-28-90

Dear Commander Bechtel,

Please find the enclosed copy of the "Evaluation of Stability for Parasailing Vessels" provided to our company by James S. Krogen and Company.

The contents of the enclosed report is frightening when you consider that all winchboats (approximately 155) currently being operated except 24, would fail the USCG minimum criteria as a towing vessel and would be unseaworthy when applying the relative forces of a parasail in unpredictable winds.

To date, the lack of information and regulations to promote safety regarding passenger carrying towing vessels has never been addressed until now. It is our sincere hope that the results of this evaluation will serve as a starting point to promote stability safety by condemning those who knowingly endanger lifes by operating unsafe parasail towing vessels.

I have already contacted the Merchant Vessel Inspection and Documentation Division in Washington D.C. and the ABYC in Millerville, Maryland to document our evaluation study as well as encourage new safe operating guidelines.

Unfortunately, new regulations almost always are incorporated after its too late. Therefore, as a concerned manufacturer and expert in the field I feel an obligation to provide you with are suggested "Stability Rules and Regulations" that should be mandated immediately to prevent any further unwanted capsizing. The following is our summary of the proposed guidelines:

APPLICANT

The following proposed rules and regulations should apply to any vessel that is manufactured or modified for towing parasails while carrying any number of passengers on onboard.

RECOMMENDED REQUIREMENTS

All operators of any vessel manufactured or modified to provide parasail rides while carrying passengers must provide their local Marine Safety Office an "Evaluation of Stability" study to examine the stability of the vessel and suggest a proper tow line strength to be used. The tow line size and type will be determined by the owner/operator of the vessel. However, the tow line breaking strength would be determined thru proper evaluation of stability of the vessel.

An "Evaluation of Stability" study must be prepared by a license Naval Architects-Marine Engineer or a graduate of NAME from a respectable university. The evaluation must determine the maximum force at 0 degrees to the horizon necessary to heel the vessel to meet a minimum residual righting energy (MRRE) of 2.0 foot-degrees.

For proper verification the study must include lines drawings of the hull shape being considered, the calculation of heeling and righting arms using the USCG 46CFR,Section 173.095C and a graph or chart to illustrate the Residual Righting Energy value.

The maximum force that equals the minimum MRRE criteria for towing vessels will then become the recommended tow line breaking strength that would be required.

LICENSING

Each vessel owner/operator would be required to produce and display a 2" X 4" plaque that states the vessels rated tow line capability The plaque must be mounted near the helm area in plane view .

INSPECTIONS

Any parasail towing vessel can be boarded at any time for the purposes of inspection and/or observation of its use.

PENALTIES

Any owner/operator who knowingly uses a towline that has a breaking strength that exceeds the vessels designed rating or any vessel that has not been rated as a parasail towing vessel would be guilty of negligence and reckless endangerment of life and limb. As a minimum, the pilot or captain in command should lose his license and/or fined.

In conclusion, I am confident your report regarding the capsizing of the Nordic Ascender winchboat will outline your concerns and recommendations to prevent a repeat of the same.

If you have any questions or comments please call or write me at your convenience.

Sincerely,

Mark McCulloh
President

cc. MVID
ABYC

JAMES S. KROGEN AND CO., INC.
NAVAL ARCHITECTS - MARINE ENGINEERS

1515 N.W. 7TH STREET, SUITE 124, MIAMI, FLORIDA 33125 305-642-1368

EVALUATION OF STABILITY FOR PARASAILING VESSELS

INTRODUCTION

At the request of Mark McCulloh, president of Parasailing Enterprises, Inc., a study of the SKYRIDER and NORDIC ASCENDER parasailing vessels' stability, i.e., their ability to remain upright when pulled by a parasail, was completed with two purposes in mind. The first of which was to determine if the SKYRIDER vessel has adequate stability while towing a parasail. Secondly, to suggest a minimum criteria for stability of all parasail vessels.

CREDENTIALS

JAMES S. KROGEN & CO., INC. was established in 1960 and specializes in Naval Architecture and Marine Engineering. Mr. James S. Krogen and myself (David C. Pritchard) have degrees in Naval Architecture and Marine Engineering (NAME) from the University of Michigan with a total of 50 years of working experience, and have collectively worked on this report, along with James M. Krogen, Jr., a NAME graduate of the University of New Orleans. James S. Krogen & Co., Inc. hereby acknowledges that the results of this Evaluation of Stability for Parasailing Vessels are true and accurate.

PARASAILING VESSEL DATA

The vessels used to perform this study were a Para-Nautique also known as SKYRIDER and the NORDIC ASCENDER. First we prepared a lines drawing of each vessel which defines the hull shape. This information is necessary in evaluating a vessel's stability characteristics.

The lines drawing for SKYRIDER (figure 1) was generated from information in our files. The lines drawing for the NORDIC ASCENDER (figure 2) was derived from scaled drawings and photos provided by Parasailing Enterprises, Inc.

PARASAIL CANOPY DATA

The parasail canopy towing data was provided by Parasailing Enterprises, Inc. (PEI) who measured the tow line force necessary to maintain a 250 lb. payload 300' aloft while parasailing. Based on this data PEI concluded that a parasail from 24' to 28' in diameter can exert an average tow line force from 850 to 1,800 lbs. In extreme conditions, the tow line force could reach the breaking strength of the towline which, in this case, is 3500 lbs., according to PEI.

TOW LINE ANGLE AND FORCE ANALYZED

In the worst case, a force of 1800 lbs., (the higher of PEI's towline pull measurements) would be applied directly athwartship, at a 25 degree angle to the horizon, this being the lower of the reported pull angles. In this condition, the 1800 lbs. force can be broken into two components, namely:

1. A vertical component of 761 lbs.

2. A horizontal component of 1631 lbs.

The vertical component tends to lift the vessel slightly higher, whereas the horizontal component, known as the heeling force, tends to make the vessel heel over. In this case (figure 5), the heeling force is applied by the parasail and the vessel starts to experience a drag force on the hull as it is pulled sideways through the water. This drag force is assumed to act at one half the upright draft as generally used by the USCG in stability analysis. The distance between these two forces is called the heeling arm.

Now, if all forces that keep the vessel floating are assumed to act through a single point instead of being distributed over the hull bottom, this point is called the center of buoyancy, "B". Likewise, if all the weight of the vessel is assumed to act at one point, this point is called the center of gravity, "G".

Just like the weight always acts straight down, so buoyancy always acts straight up. As the vessel heels over, the center of buoyancy changes to the new center of the underwater volume off the centerline towards the direction of heel. When the vessel is heeled, the tendency of the weight at "G" is to push the high side down while the buoyancy at "B" tends to push the low side up (see figure 5). The distance between these two forces is therefore called the righting arm.

Just like buoyancy wants to push the low side up, figure 5 shows that the vertical component of the parasail pull tends to do the same thing, i.e., the 761 lbs. shown straight up; therefore, there are two righting forces present that act around the center of gravity and hence two righting arms. These are identified on figure 5, with subscripts B and L for buoyancy and lift respectively.

To get the righting arm, you cannot simply add the two, but must proportion them in accordance with the forces involved. This is the purpose of the equation for RA on the sixth line under the heading "Righting Arm" on figure 5. Note that the righting and heeling arms change for each new heel angle.

DETERMINING SUFFICIENT STABILITY

In determining whether a particular vessel has sufficient stability while towing, the United States Coast Guard (USCG) has developed a method presented in 46CFR, Section 173.095(c) which requires the calculation of both heeling and righting arms. The heeling arm must be adjusted by the ratio of the heeling to the righting forces in order to relate them to the righting arm.

In performing our analysis, we have only considered a worst case scenario, namely each vessel dead in the water, with a total of six persons on board being pulled by a parasail athwartship, creating a force of 1800 lbs. without adding propulsion, hydrodynamic or wave effect. The first intersection of heeling and righting arm curves is the angle to which the vessel would heel under a steady pull of 1800 lbs. For SKYRIDER this angle is 9 degrees, whereas for the NORDIC ASCENDER this angle is 27-1/2 degrees as shown in figures 6 and 7. The 9 degrees of the SKYRIDER is relatively little heel, whereas at 27-1/2 degrees, the NORDIC ASCENDER's passengers, captain and crew could be thrown to one side of the vessel, changing the CG and causing further heel of the vessel. This, in combination with a wave effect of 1-1/2' or more, could allow the lapping of water into the cockpit.

The Coast Guard requires a towing vessel to have a minimum residual righting energy (MRRE) of two (2.0) foot degrees; if less, the vessel is judged to have insufficient stability for towing (or in this case, parasailing). Both heeling and righting arms are compared on the same plot as done on figures 8 and 9 for SKYRIDER and NORDIC ASCENDER respectively. The area between the two curves to the right of the first intersection point is a measure of the residual righting energy. The USCG requires that you calculate this area up to the lower of the following heel angles:

1. Angle of Maximum righting arm.
2. The downflooding angle.
3. 40 degrees.

The residual righting energy for SKYRIDER was found to be 21.18 foot-degrees or ten times the minimum standard set by USCG. The residual righting energy for NORDIC ASCENDER was found to be 0.20 foot-degrees or one tenth the minimum standards set by the USCG for towing.

DOWNFLOODING AND CAPSIZING

Obviously, a prudent operator of a parasail vessel would try to avoid having the parasail pulling directly athwartship in high winds. Unfortunately, in the case of the NORDIC ASCENDER, the tow point is about 8 feet forward of the stern drive propulsion, which would make it relatively easy to turn abeam to the tow cable. Worse yet, in the case of a steering malfunction, the operator would have no control in preventing such a turn.

In the case of SKYRIDER, the propulsion is an inboard with a rudder for steering, more importantly the distance from the tow point to the rudder is only about 5 feet, making the SKYRIDER more difficult, if not impossible, to turn abeam to the tow cable with a line force of 1800 lbs.

Finally, it should be mentioned that the SKYRIDER has self-bailing cockpits, while the NORDIC ASCENDER does not. This is important for any tow vessel in the unlikely event of downflooding or heeling over to the point where water enters the inside of the vessel.

Due to the wider beam and lower deadrise of the SKYRIDER, the angle at which water will lap into the cockpit is 43.7 degrees or 10 degrees less than for the NORDIC ASCENDER. However, the moment (product of heeling arm X heeling force) to flood the cockpit of the SKYRIDER is 23,800 ft-lbs. compared to only 9,138 ft-lbs. for the NORDIC ASCENDER. To put it another way, by applying a tow line pull force of 2500 lbs. at 0 degrees off the horizon to NORDIC ASCENDER, the cockpit would downflood and sink, whereas the SKYRIDER would heel over only 15 degrees, considerably less than the down flooding point.

STABILITY - BEAM AND DEADRISE

Generally speaking, beam and deadrise have a marked impact on stability, more specifically, the greater the beam and lower the deadrise, the more stable the vessel. Figures 3 and 4 are provided to illustrate the basic differences between the two vessels. Note that SKYRIDER carries 9'-11" of beam on the waterline with a very low deadrise, while the NORDIC ASCENDER carries 7'-0" beam at the waterline with 22 degrees of deadrise.

SKYRIDER VS. NORDIC ASCENDER

The SKYRIDER is a vessel specifically designed, i.e. (wide beam, low deadrise, low tow point, inboard propulsion) for towing a parasail. Even at the tow line breaking strength of 3500 lbs., the SKYRIDER would still exceed the USCG criteria with a MRRE of 4.0 foot-degrees.

Based on the evaluation performed and considering all the data provided herein, the NORDIC ASCENDER would not be able to comply with the USCG's criteria, even when applying an 1800 lb. tow line force at a 25 degree angle to the horizon, making it unsuitable for use as a parasailing vessel.

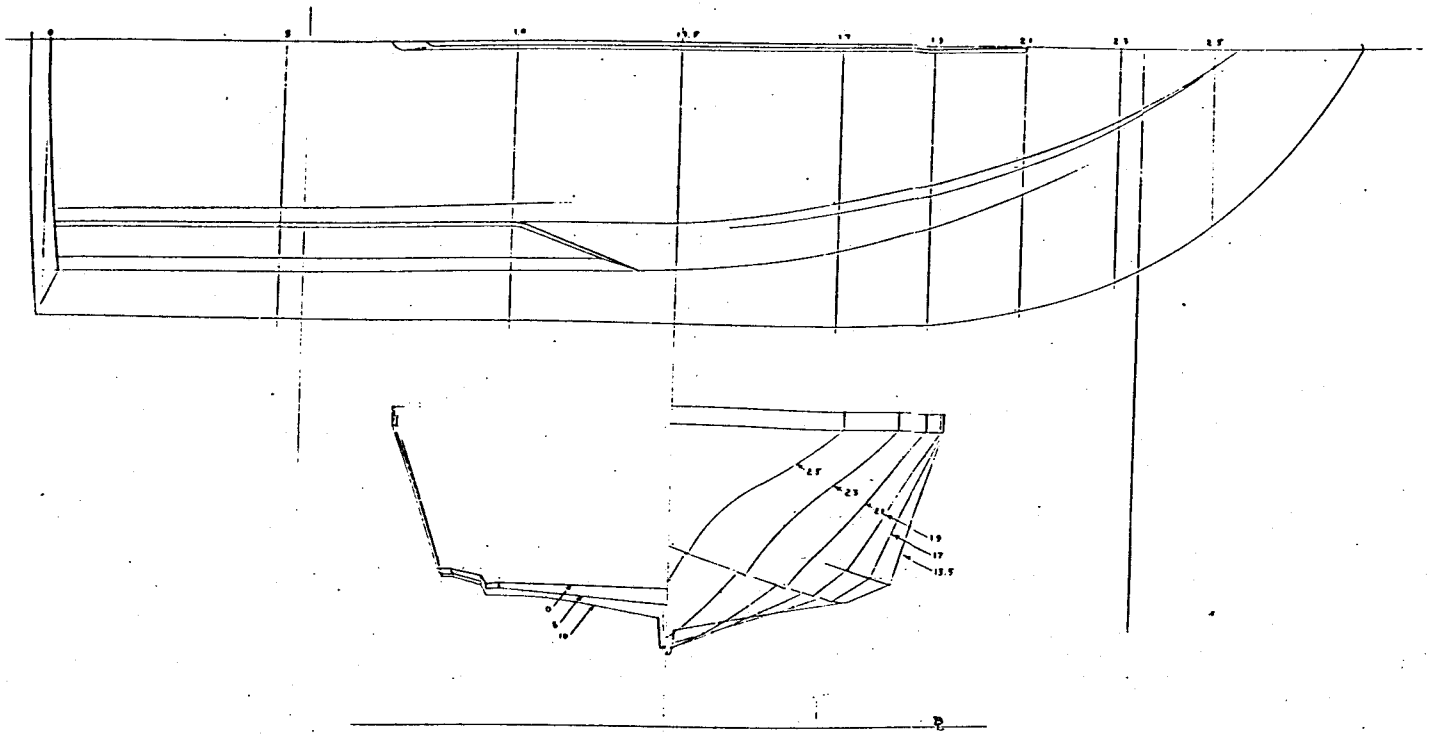
Since a parasailing vessel's stability is essential for passenger safety, in our professional opinion, only those vessels meeting a certain minimum stability standard should be allowed to operate. In the absence of specific regulations for parasailing vessels, we believe it would be reasonable to apply the USCG's MRRE criteria, using a force equal to the towline breaking strength acting at 0 degrees above the horizon. This would allow a comfortable safety factor during unpredictable wind and sea conditions.

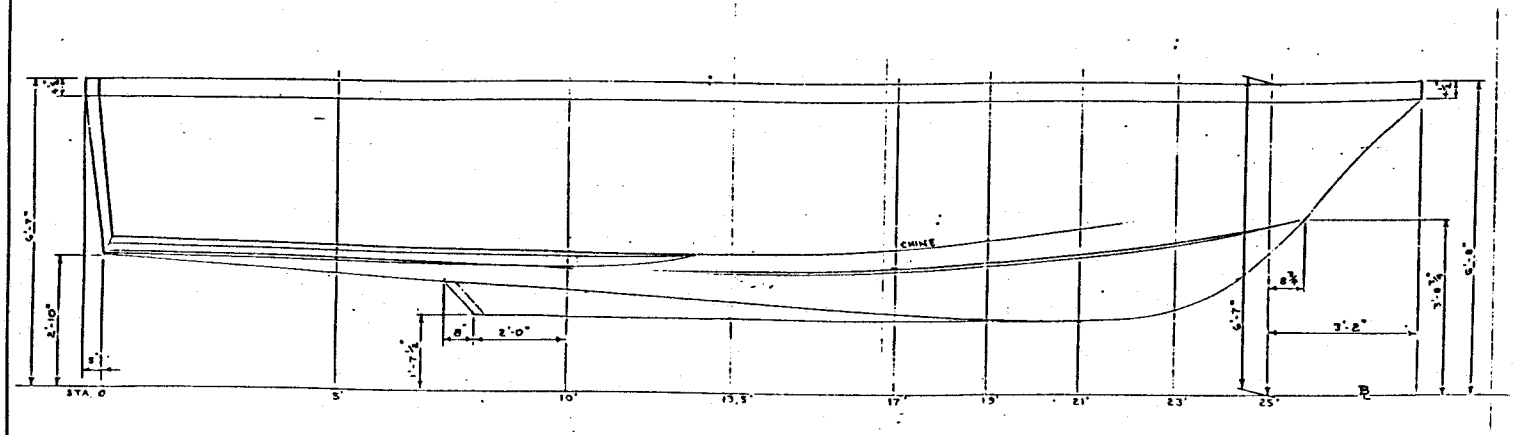
Respectfully submitted,

David C. Pritchard

David C. Pritchard
Chief Engineer

DCP/cdg





NOTES:

1. STATION NUMBERS ARE DISTANCE IN FEET FORWARD OF STA. 0
2. SMALL SPRAY DEFLECTOR AT STA. 13.5' HAS BEEN OMITTED.

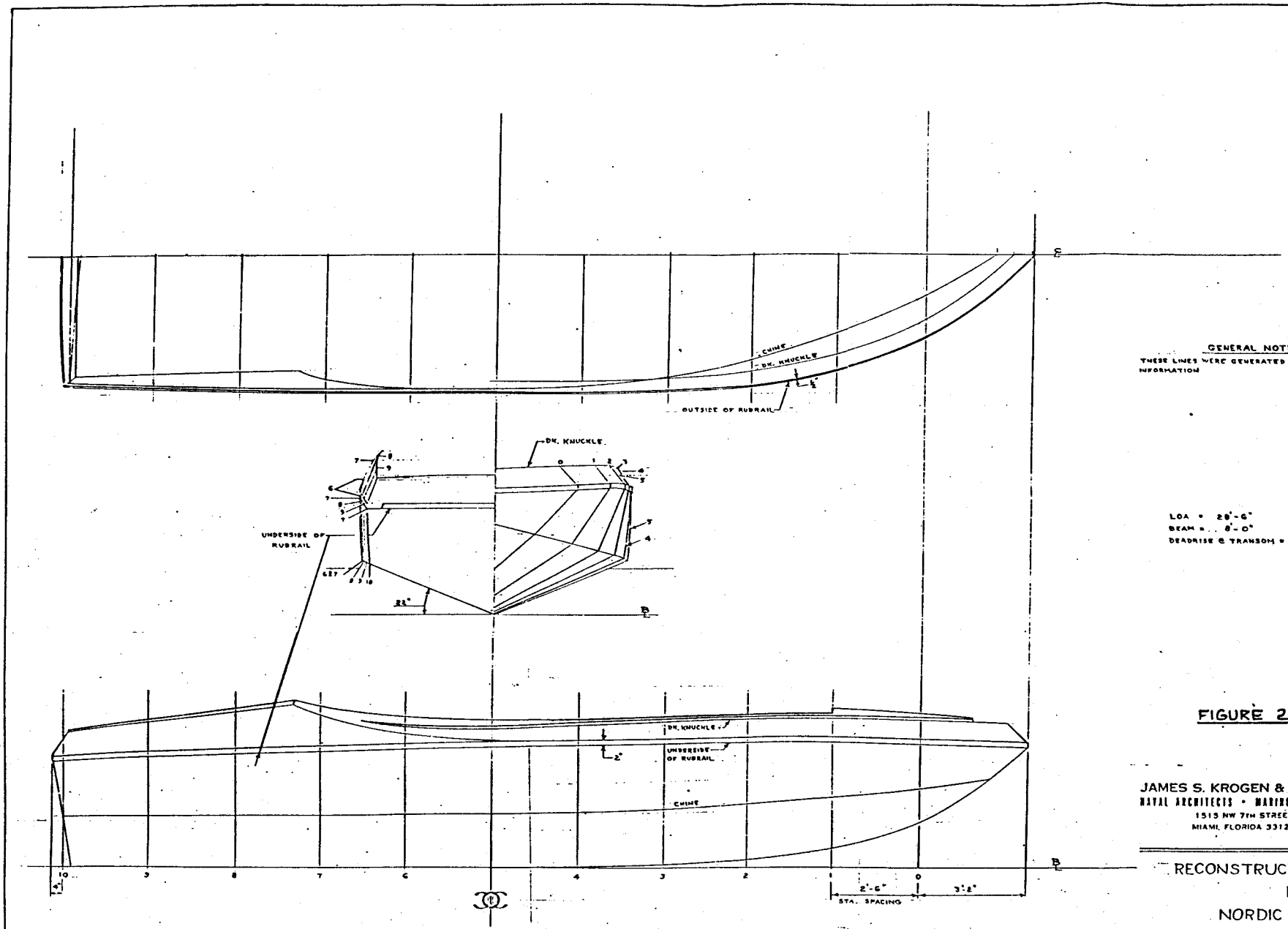
O.A.L. (MOLDED)	29' - 7"
O.A. WIDTH (MOLDED)	11' - 10½"

FIGURE 1

JAMES S. KROGEN & CO., INC.
NAVAL ARCHITECTS • MARINE ENGINEERS
1515 NW 7TH STREET
MIAMI, FLORIDA 33125

HULL LINES FOR 29 FT. SKYRIDER

DATE 9/26/89 • CHECKED • DWG NO 606-1
SCALE ⅜" = 1'-0" • APPROVED • ALT NO



GENERAL NOTES

THESE LINES WERE GENERATED FROM PICTURES AND WRITTEN INFORMATION

LOA = 28'-6"
BEAM = 8'-0"
DEADRISE @ TRANSOM = 22°

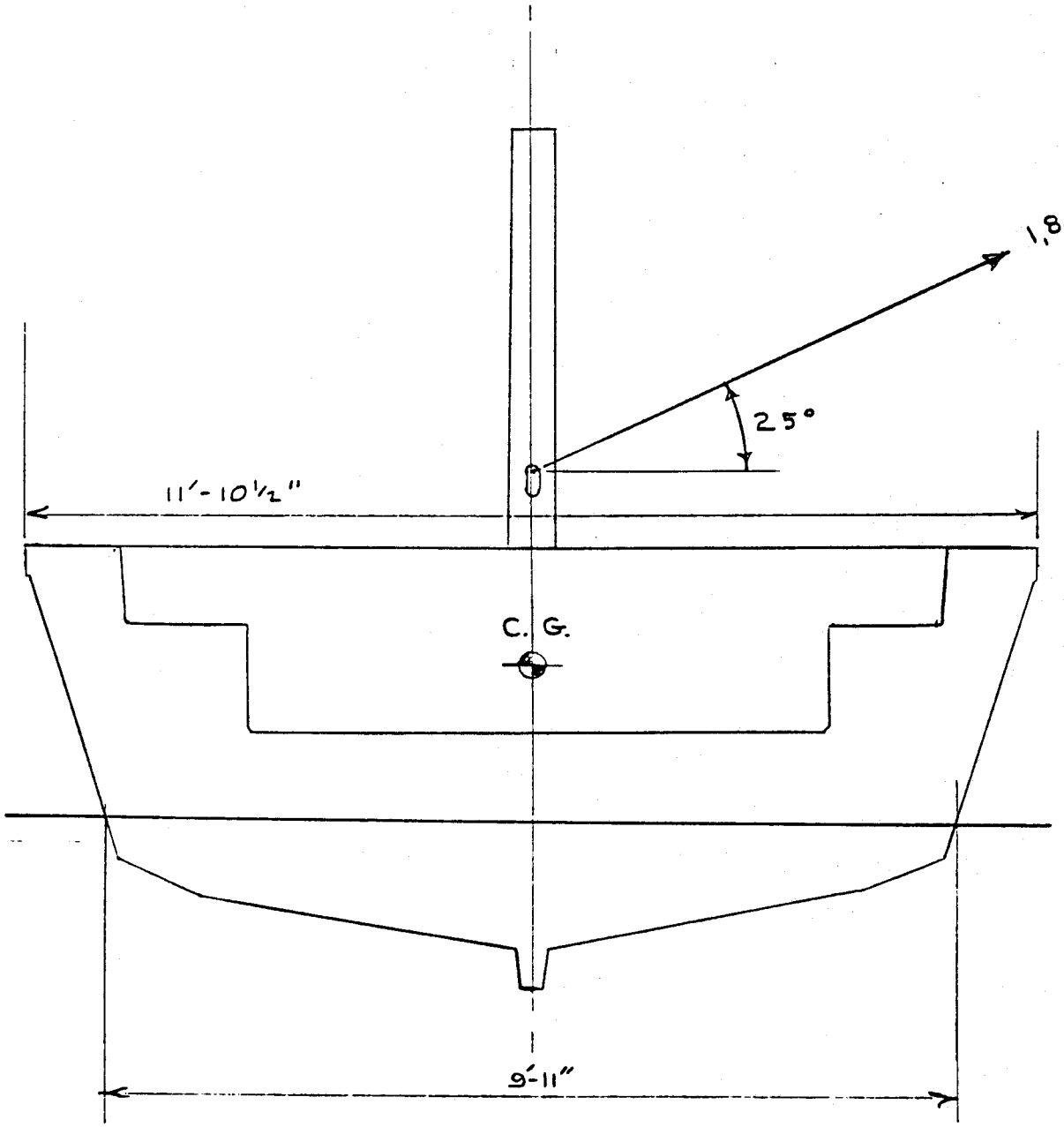
FIGURE 2

JAMES S. KROGEN & CO., INC.
NAVAL ARCHITECTS • MARINE ENGINEERS
1515 NW 7TH STREET
MIAMI, FLORIDA 33125

- FOR MR. MARK McCULLO
- PARASAILING
- ENTERPRISES, INC.
- ALSO REF. DWG. NO. 606

RECONSTRUCTED HULL LINES FOR NORDIC ASCENDER

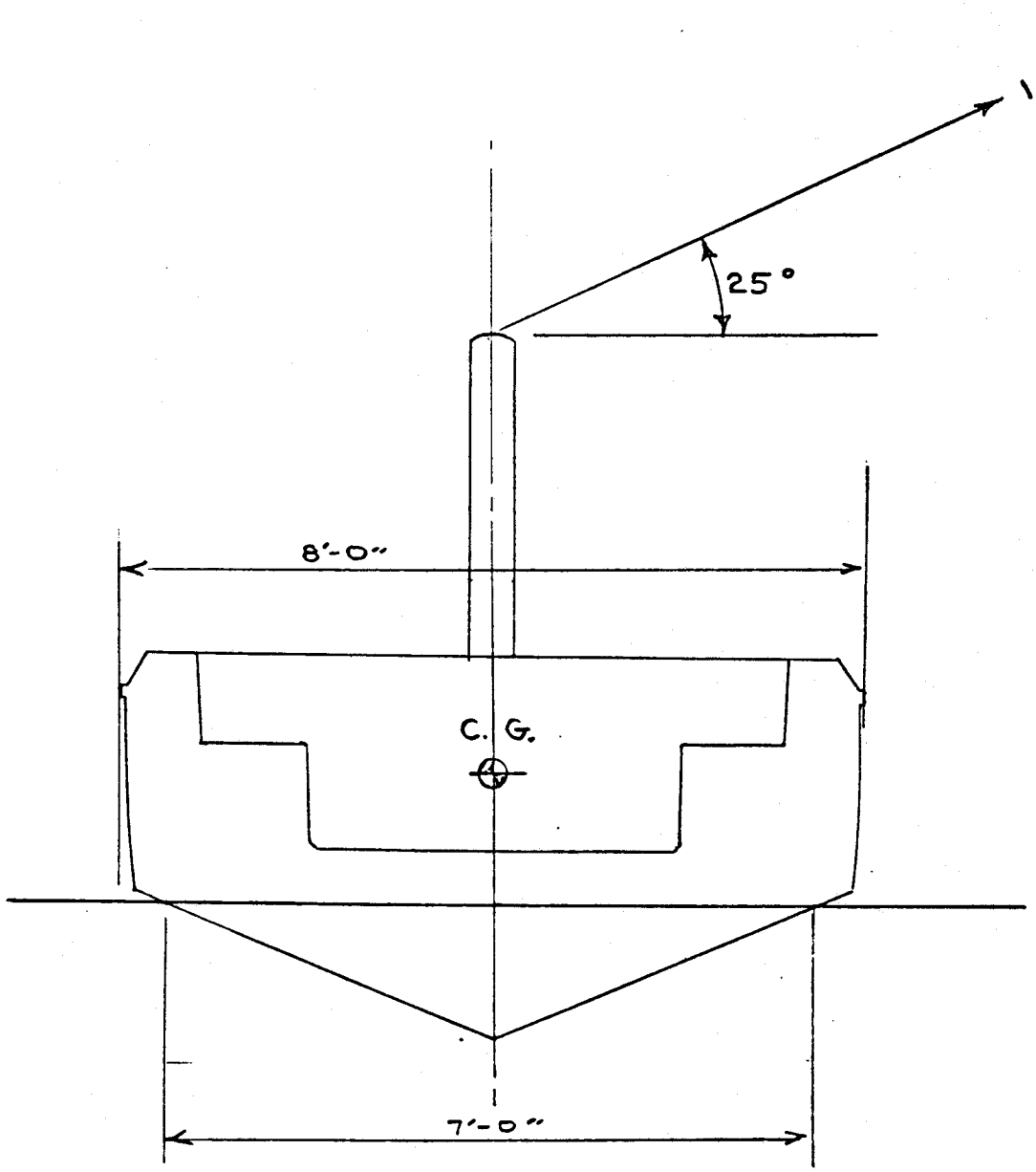
DATE DEC. 20, 1989 • CHECKED • DWG NO 624-1
SCALE 3/8"=1'-0" • APPROVED • ALT. NO. (REF. 606)



SKYRIDER CROSS SECTION

FIGURE 3

SCALE: 1/2" = 1'-0"



NORDIC ASCENDER CROSS SECTION

FIGURE 4

SCALE : 1/2" = 1'-0"

RIGHTING ARMS

W - LOADED WEIGHT OF VESSEL INCLUDING PASSENGERS

L - PARACHUTE LIFT (761 LBS.)

B - BOUYANCY OF IMMERSED VOLUME (W-L)

RA_B - RIGHTING ARM OF BOUYANCY (FROM SHCP OUTPUT @ Δ = B)

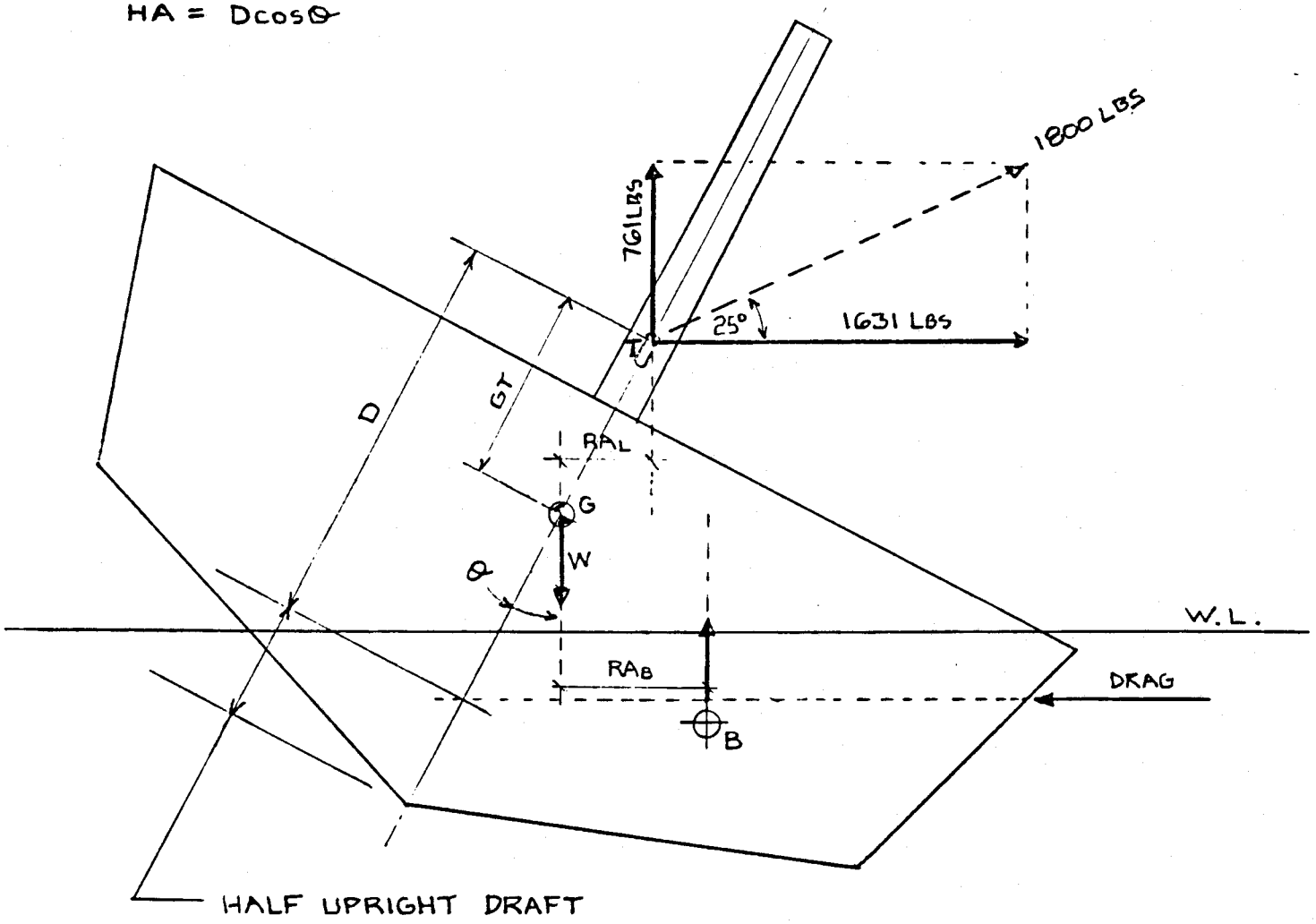
RA_L - RIGHTING ARM OF LIFT ($GT_{SIN}\Theta$)

$$RA = \frac{RA_B * B + RA_L * L}{W}$$

HEELING ARM

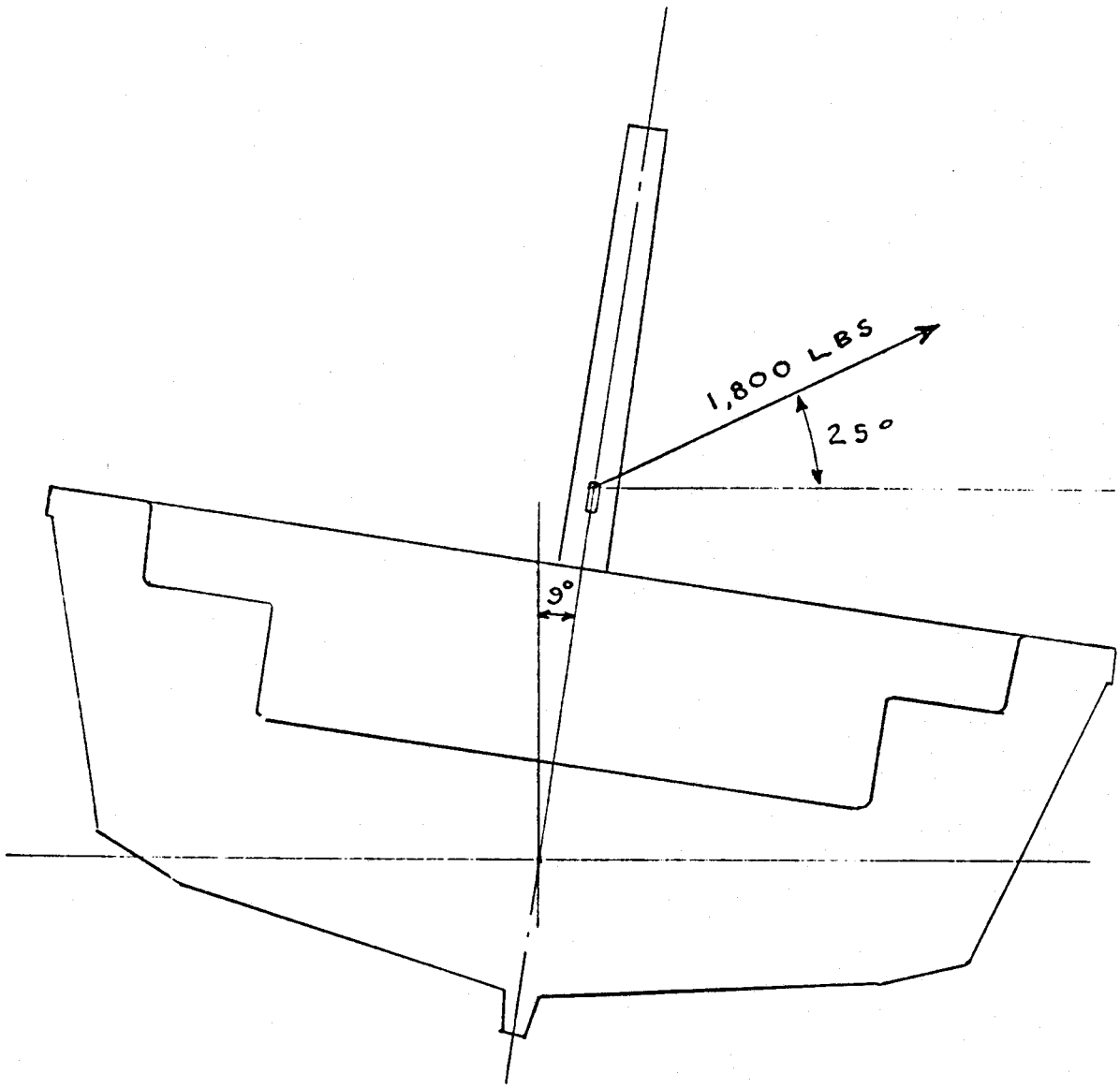
Θ - HEEL ANGLE

$HA = D\cos\Theta$



FORCE AND ARM DIAGRAM

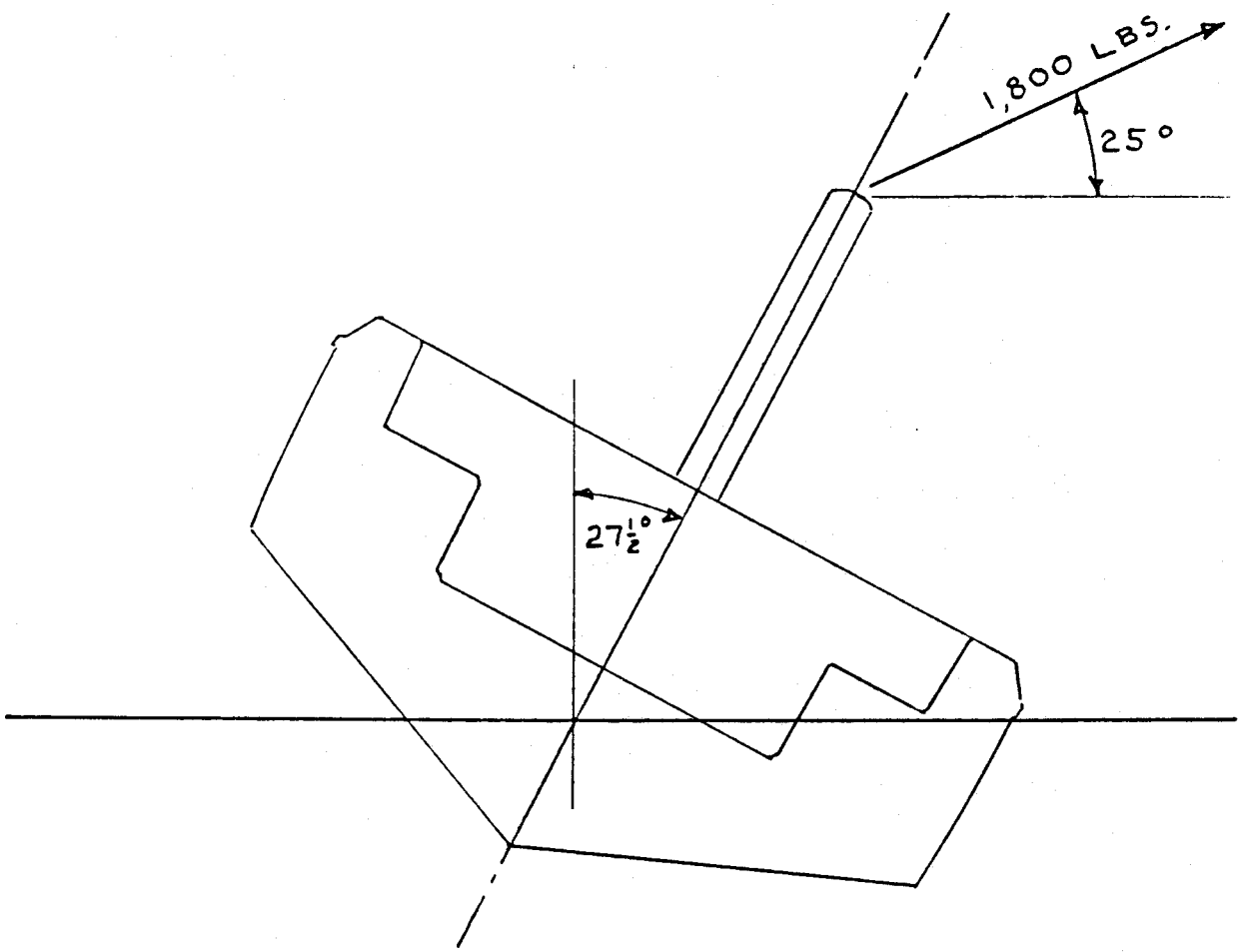
FIGURE 5



EQUILIBRIUM HEEL ANGLE UNDER STEADY PULL OF 1800 LBS. AT 25° TO HORIZON FOR SKYRIDER

FIGURE 6

SCALE: 1/2" = 1'-0"



EQUILIBRIUM HEEL ANGLE UNDER STEADY PULL OF 1800 LBS. AT 25° TO HORIZON FOR NORDIC ASCENDER

FIGURE 7

SCALE: 1/2" = 1'-0"

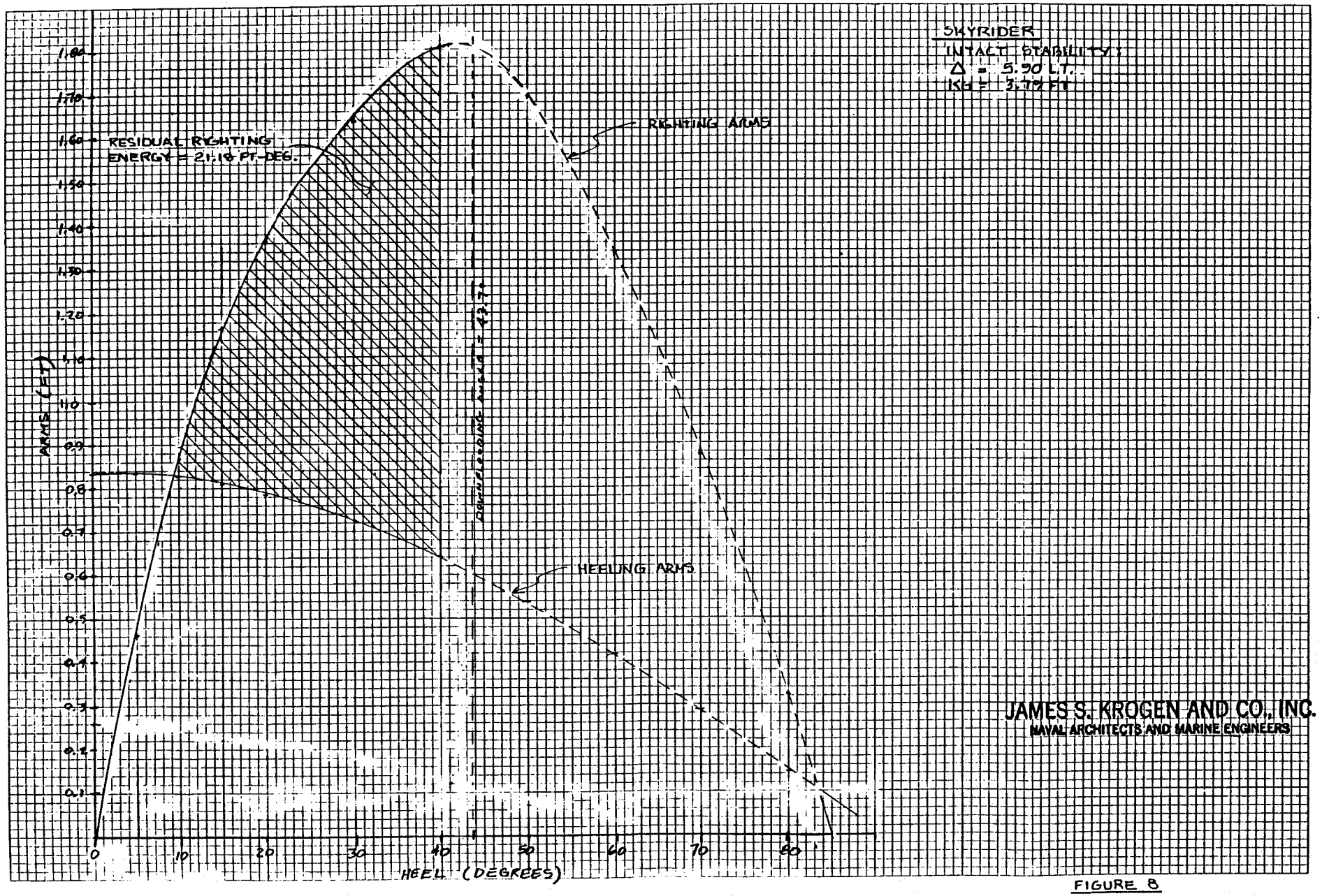


FIGURE 8

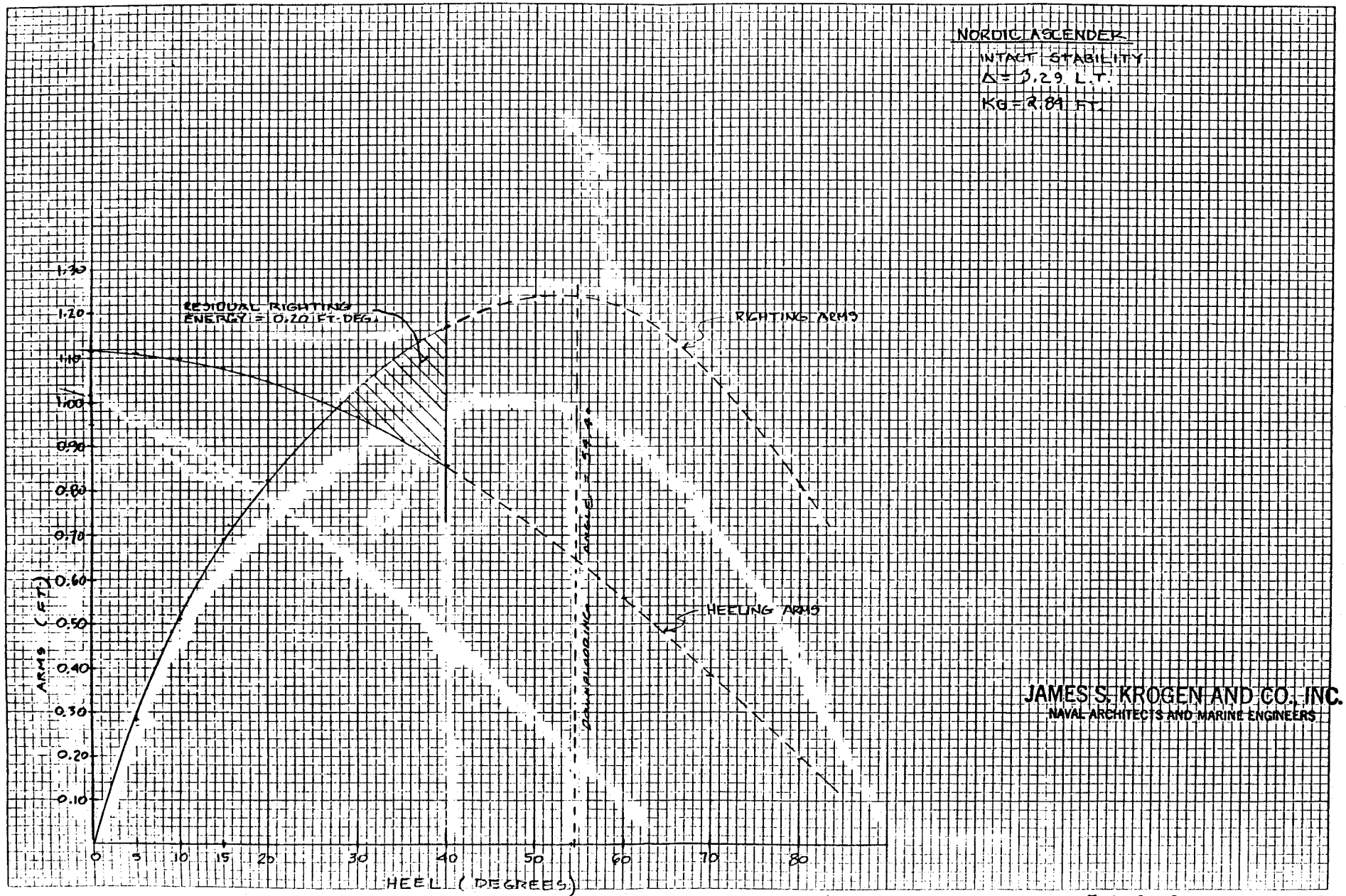


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FIGURE 9