"JET PROPELLED 34'0" S.M.B. RESULTS OF MODEL TESTS CARRIED OUT AT CIVIC OLYMPIC POOL CANBERRA MAY - JULY 1975"

BY. MR. F.G.W. WESTHORPE (FELLOW).

PRESENTED TO R.I.N.A (AUSTRALIAN BRANCH) 5TH MAY. 1976.

The 34' SMB programme commenced with the construction of 2 prototype craft built by Marine Research Contractors in Fremantle WA. The design basis for those vessels was prepared in DNSD and the working drawings were prepared by NA&ME as sub-contractors to MRC.

When the vessels were completed each was taken on trial, the variant A (propeller driven) being tested in the Swan and Canning Rivers in Perth and in Cairns after delivery, and the variant B (jet driven) undergoing its tests in Sydney.

The tests in Perth indicated clearly that the running trim of the vessel was excessive, averaging between 6° and 7° and the vessel achieving a speed over the ground of 15.5 kn ($\frac{V}{\sqrt{L}}$ = 2.82). The required speed was 12 kn minimum The helmsman had "no horizon" from his seat and it was necessary to sit on the arm of the chair provided in order to see ahead sufficiently for safe navigation. As a result of these trials it was decided to fit the craft with trim tabs to reduce running trim. This was done, and the vessel was sent to Cairns where further tests were carried out.

The conditions for testing in Cairns were not as good as in Perth - the course being set in the entrance channel, instead of in a river, and the sea state (up to 3) was in consequence far less favourable. With the trim tabs set at 0° effective the speed made good was 13.1 knots ($\frac{V}{\sqrt{L}}$ =2.38) with corresponding trim of 5.4° and with the trim tab set at the most favourable angle (11½°) the speed was 13.76 knots ($\frac{V}{\sqrt{L}}$ = 2.5) with the trim reduced to 3.8° which offered the

/helmsman

helmsman some chance of seeing ahead. The vessel was very wet in any sea condition being covered in flying spray.

In view of these results it was decided that the variant B (jet propelled) should be similarly fitted and this was done in Sydney. With zero effective trim tab angle the speed was 12.45 knots ($\frac{V}{\sqrt{L}}$ = 2.26) and running trim 5.2°. With the trim tab set at 10° the speed was 14.55 knots ($\frac{V}{\sqrt{L}}$ =2.64) and trim 3.7°.

The results of these trials convinced me that the performance of the boat could be improved over that achieved by the "bare hull" by fitting either trim tabs or wedges to the hull. I would emphasise that the original hull is <u>not</u> considered to be inherently bad - the bad feature really is the speed at which it is required to run, being right on the hump speed where the engine tries to drive the boat skywards - gravity pulls it back, and the horizontal component of these two forces is quite small.

In both the variants A and B the ventilation was very bad - excessive heat in the cabin, and, in addition, both craft were extremely noisy. Temperatures, noise levels and vibration recordings which were made during the trials indicating a necessity to improve these features of the craft. User experience in Northern Waters has amply confirmed these findings.

/I decided

I decided to ask permission to run a series of model tests and upon this being granted the members of D group set to work to construct a 1/10 scale model of the hull.

SLIDES 1-16

I would here like to pay tribute to the work done by the members of D group. This was the first time any of them had undertaken the task of making a model to the exacting requirements of a "test tank" situation and they did very well. The model was constructed in balsa wood, fully glued and has a removeable deckhouse, giving unrestricted access to the interior. Not only did these gentlemen construct the model, but each of them spent long hours at Civil pool assisting in running the tests and, after conclusion of the test programme, many further hours have been spent analysing the results obtained, preparing graphs and comparisons.

It was necessary to seek permission to use the Olympic Pool complex and representations were made to the Dept of Tourism and Recreation. Mr Jack McCauley who is here tonight as our honoured guest, kindly placed the full recourses of the complex at our complete disposal without limit as to time or purpose of usage. For his, and his staff's, full co-operation we are most grateful. The tests could not have been carried out without this facility. Not only the pools themselves, but office and storage accommodation in ample capacity was freely provided and this made our task immeasurably easier. Please accept our thanks Mr McCauley and convey them also to your assistants who also helped us with most cheerful co-operation.

/Since there

Since there are some members and guests here tonight who were not present when the arrangements for testing were described a few weeks ago I ask your indugence to briefly outline the methods and procedures followed.

The model was towed within a wire bridle which attached to towing points near the waterline P & S in a position which experiment showed to have minimal effect upon the trim of model when running. The bridle was towed by a line which passed through lead blocks into a 6 fold purchase, the lower block of which was secured near the base of the diving tower, the upper block floating, and being hauled up the tower by the action of a falling weight attached to the upper block by a rope passing over a pulley on a jib head rigged at the top of the tower.

A ~~series~~ set of calibrated scale weights were hired and used as the motive force, thus ensuring a series of repeatable fixed loads on the towline.

The model was first run "as designed" without modification and in the fully loaded condition. Pre-weighed packets of lead shot represented the weight and position of major items including fuel, so it was an ~~simple~~ easy task to "remove" sufficient fuel from the main tanks to give a "half main tanks consumed" condition, simply by removing the packets representing the full fuel tanks and substituting others equalling the smaller capacity. Later, by similar means, a loading of 90% total fuel consumed was simulated. The vessel was also run at various static trims, level, 6" by the stern and 12" by the stern. ~~and~~ In each of the combinations of condition and trim at least four towing weights were used - sometimes, when one felt very brave we used a fifth weight. The weights were 14,28,42,56 (and 70) pounds. [Movement of weight within the hull allowed variation of static trim without any possibility of weight change taking place.]

After the "as designed" condition runs were completed the hull was modified by the addition of parafin wax shapes to the bottom at the aft end. Since earlier trials had shown the 10° trim tabs angle to be most effecatious it was decided to use this angle in an
SLIDE 17 under bottom wedge. A series of three wedges having depths of 3" 6" and 9" at the aft end and parallel cross sections ~~were~~ prepared. At
SLIDE 18 the same time a series of parabolic hooks of the same depths as the wedges and having the same 10° slope at the aft end and parallel cross sections ~~were~~ also prepared. Each of the 3" and 6" wedges and hooks were tested on the hull in turn in the same manner as the unmodified hull. Because it was found that the 6" hook and wedge were too powerful as lifting appliances and caused marked course instability, the 9" deep units were not used.

A measured distance was set up and marked off on each side of the pool by vertical posts making transit points and an instamtic type camera was used at one end of the measured distance to photograph the run. Another camera was set up in the measured distance and arranged to photograph the model through an inclined mirror on which a horizontal black line was marked. The model had two horizontal waterlines marked on the hull and the photographs of every run made

/via the

via the mirror set up were used to measure the trim of the model when running. Later, underwater photographs of tufts of wool glued to the hull were taken to show up the flow conditions. Our thanks and admiration are due to Mike Powell who braved the icy (if not very deep) water to take these shots.

During the tests the TV news came down and photographed the work and further movies were also taken by the Dept of Defence PR Team and by Mr Ken Brown - altogether a very flattering display of interest.

The model, being loaded and trimmed to the desired condition, was towed up the tank by each of the falling weights in turn, and each run was timed through the measured distance and twice photographed. Later, the slides were projected to larger than life, and the trim angles were measured and correlated with the speed results.

MOVIES 1, 2, & 3.

One word of warning must be given. Due to the physical circumstances of these tests accurate quantitative results could not be obtained, nor were they sought. The object of the exercise was to indicate probable trends of results and give some indication of magnitude. To obtain accurate quantitative results, much finer instrumentation and a completely enclosed, air conditioned and fully calibrated test tank would have been required. Such a facility does not yet exist in Canberra. However I ~~think~~ hope you will agree that worthwhile results were obtained from the tests.

/So now

So now to the results:-

SLIDE 19 FIG 2 SPEED - RESISTANCE - VARIOUS TRIMS - NO MODS TO LINES

This is the basic curve for all that follows in comparisons of speed and trim. Here we see the effects of various static trims upon the vessel loaded to the original design condition. Since the main problem was too much trim by the stern when running it was decided to try the effects of static trim by the head to see if this would reduce running trim. We see here that it certainly reduced speed. Note the level trim line. The maximum rate of increase of power is at 8 knots ($\frac{V}{\sqrt{L}} = 1.45$) and the full planing effect comes in above 12.8 knots ($\frac{V}{\sqrt{L}} = 2.32$). Between 7 and 10 knots the resistance increases from 14lb to 33.9lb drop weight (about 2 to 4.85lb tow rope force). A 43% increase in speed produces 142% increase in resistance. This is quite normal for a planing craft in getting over the hump speed.

SLIDE 20 TRIM - SPEED - LEVEL TRIM - NO MODS TO LINES

SLIDE 20A
SLIDE 20B.

We have here the curves of corresponding trims for all running speeds starting from level static trim. You will note the rapid rise of trim angle in the 8-13 knot area and the continuous flattening out of the curve for "full fuel" above that point. The maximum trim is 8° and this of course is not acceptable.

/Compared

Compared to full scale trial results for this loading condition these trims are within ½° at identical speeds, so it would appear that the jet pump suctions are having very little effect in dragging the stern down.

SLIDE 21 TRIM - SPEED - 6" BY STERN - NO MODS

The effect of 6" static trim by the stern shows up clearly here. The running trim is reduced to 5½° in the full fuel condition and 7¼° in the half fuel condition as compared to 7° in the level static trim.

It is worth stating here that the half fuel condition is in my opinion by far the most important operating condition in any vessel. Even though the tanks may be full at departure they immediately start to run down. We very seldom get to the point of completely drying out a tank in any trip, so the tank spends most i.e. 50% of its time approaching, passing and receeding from the half full condition, as compared to 25% of the time in departing from full or approaching "M". Half full naturally means half nominal capacity, not half sounding, for in the half sounding state we may only have a quarter of the capacity left.

I do not propose to weary you by treating every condition of loading or modification of the bottom shape in this paper, but to show only those conditions of major interest in detail.

/SLIDE 22

SLIDE 22 SPEED - RESISTANCE - 50% MAIN TANKS CONSUMED - NO MODS

These graphs of ~~no modifications~~ the unmodified condition are basic to our programme, so here we see the 50% main tanks consumed condition. Again the maximum rate of resistance increase is in the 8 knot area, but the influence of 6" static trim by the stern is interesting.

SLIDE 23 - SPEED - RESISTANCE - 90% MAIN TANKS CONSUMED - NO MODS

Reducing displacement still further produces much the same type of result - this condition was somewhat affected by wind and speed was lost. I do not think that too much reliance should be placed upon actual values here.

SLIDE 24 - SPEED - RESISTANCE - 5% OVERWEIGHT - NO MODS

REPEAT SLIDE 19

This is a most important comparison, showing very clearly the damaging effect of increased displacement on speed. The best that could be achieved here was about 13 knots using the 56 pound drop weight as compared to 23 knots for the same resistance at designed displacement. Even at 28 pounds drop weight the loss in speed is about a knot. The increase of displacement was 5% above "as designed".

We will now move over to see the effects of adding a 3" deep parabolic hook with parallel cross sections under the stern.

/SLIDE 25

SLIDE 25 - SPEED - RESISTANCE - DESIGN DISPLACEMENT - 3" PARABOLIC HOOK

Two points show up in this graph. The first is that static trim by the stern becomes of increasing value with increasing speed. The second is that the rate of increase of resistance at the hump is reduced. However, when we reduce displacement by consuming fuel:

SLIDE 26 - SPEED - RESISTANCE - 50% FUEL - 3" PARABOLIC HOOK

We obtain a marked increase in speed once the hump has been passed, and, continuing reduction of displacement,

SLIDE 27 - SPEED - RESISTANCE - 10% FUEL - 3" PARABOLIC HOOK

The increase of speed becomes very pronounced after passing the hump.

SLIDE 28 - TRIM - SPEED - 3" PARABOLIC HOOK - LEVEL TRIM

SLIDE 28A

Turning now to the main problem with this vessel - trim - we see that the trim vs speed characteristics have undergone a remarkable change. The maximum trim is reduced to 4° and all the curves are very much flatter than they were in the unmodified hull.

/SLIDE 29

SLIDE 29 - TRIM - SPEED - 3" PARABOLIC HOOK - 6" BY STERN

SLIDE 29A

Giving the vessel a 6" static trim by the stern produces a slightly higher running trim as may be expected.

SLIDE 30

The 3" deep 10° parallel section wedge produced results but little inferior to those for the 3" parabolic hook and it is not necessary to go through these in detail. The wedge appears to cause a more abrupt change to the flow lines resulting in a slightly higher drag than does the hook, but it also produces a little more lift.

SLIDES 31, 32, 33

Fitting the 6" deep hooks and wedges produced a situation of high lift aft with resultant flat running attitude, and, consequently, with high speeds. However, they also, most unfortunately, caused marked course instability, the model yawing wildly while running in flat water. It is judged that in these attitudes in any sort of a seaway the full sized vessel would be dangerous. For this reason no further display of the 6" hook or wedge results will be given here, but the full results are available to anyone who wishes to see them. The formation of the water alongside the model is worth study. It appears to me that eddies are being shed in the form of horizontal vortices.

The results of the 3° hook prompted further thought. Both Lindsay Lord and Peter du Cane comment upon the distribution of pressure under a planing hull. Their diagrams show this as rather like an elongated horseshoe of high pressure surrounding an area of pressure reducing as the ℄ of the stern is approached. Burnoulli's relationship indicates that this low pressure area is the area of highest velocity flow, and this caused me to believe that the best lift/drag ratios could be sought in this area. In most cases experience indicated that wedges are usually installed with their greatest depth near the chines, frequently tapering towards the centreline where the depth often is reduced to zero. This leads to a virtual flattening of the rise of floor at and near the transom which seems to be at variance with the modern concept of the deep V hull for sea going planing craft. Since there is higher pressure near the chines, there is slower flow in this area and I felt that this would give a greater lift but also a much greater drag effect with consequent worsening of the lift/drag ratio. Accordingly I decided to continue the experimental investigation to include both wedges and hooks made from the same moulds as those previously used but with one side removed, so tapering the form athwartships, and also to apply these with maximum thickness alternatively near the centreline and near the chines. These we called half hooks or half wedges.

SLIDE 34

SLIDES 35, 36

Experience with other vessels shows that there is sometimes a tendency towards course instability if the wedges or hooks are carried right across the transom in an unbroken surface, and, for this reason,

/I decided

I decided right at the start of the experiments to leave a gap between the port and starboard wedges or hooks equal to the thickness of the centreline skeg or deadwood in all fitments.

The magnitude of the results obtained with the half hook were really quite remarkable and unexpected, producing a speed/resistance relationship totally unlike those obtained earlier and the installation with maximum depth near the centreline caused the model to run so straight that it appeared as if she was glued to the line marked on the bottom of the pool. The trim was satisfactory and the spray was suitably suppressed indicating that we had achieved the principal objectives of the exercise. It is considered that the virtual increase of rise of floor at and near the transom produced a greater lateral plane assisting in achieving improved straight line running. It is also thought that the increase would deflect the underbottom flow toward the high pressure area with consequent loss of velocity and rise of pressure over quite a large area and that area having the longest levers, hence the greatest trimming effect.

SLIDE 37 - 3 x ½ HOOK - FULL LOAD VARYING TRIM - "SPEED - DROPLOAD" CURVES

In the speed/drop load, or resistance, curves the important change is the flattening of the curve right from the origin - there is no longer the usual hump apparent near the 8-10 knot region covering the $\frac{V}{\sqrt{L}}$ = 1.5 to 2.0 range - here it appears that the craft lifts fairly evenly and remains reasonably level at all speeds. With the maximum thickness near the chine tending to zero near the centreline the flattening of the speed/resistance curve was not nearly so marked although better than all other earlier trials.

SLIDE 37A

/SLIDE 38

SLIDE 38 - 3 x ½ HOOK - ½ FUEL VARYING TRIM - "SPEED - DROP LOAD" CURVES

Reduction of load does not adversely affect the nature of the curves with the maximum thickness of the half hook near the centreline.

SLIDE 39 - 3 x ½ HOOK - 1/10 FUEL VARYING TRIM - SPEED - DROP LOAD CURVES

nor does the original static trim appear to have any deleterious effects. The implication of this is that we may not only expect a higher total speed capability if more powerful engines ~~are~~ could be installed, but also that higher speeds are possible for any given resistance right through the range, and including the area near the expected operating speed of the vessel with the present engine installation.

SLIDE 40 - 3 x ½ HOOK - LEVEL TRIM - SPEED - TRIM CURVES

It may be noted that the speed - trim relationship is much flatter throughout the full range, indicating a satisfactory similarity of attitude at all speeds and loads

SLIDE 41 - 3 x ½ HOOK - 6" BY STERN - SPEED - TRIM CURVES

and initial static trim makes little difference to the trim at higher speeds.

/So now

So now for the summary curves which show most clearly ~~the~~ a completely unexpected sharp change of form.

SLIDE 42 - FULL FUEL - CONFIG - SPEED CURVES

Note the very sharp configuration change at the half hook. It was rather difficult trying to determine a reasonable method of showing up the effects of the various bottom configurations. Finally it was decided to use the method adopted here and the plot certainly does show up the changes at the 3" ½ hook position.

SLIDE 43 - ½ FUEL - CONFIG - SPEED CURVES

A similar type of result is still in evidence when the "half fuel in main tanks" condition is achieved and

SLIDE 44 - 1/10 FUEL - CONFIG - SPEED CURVES

when the displacement is reduced to 10% fuel remaining the same type of configuration is apparent.

Within the power output available from the engines already purchased for these vessels, our calculations indicate a probable speed increase in calm water of about 3 knots - but - and this is important - gains are evident right down through the operating speed range. It was this, in conjunction with the straight line running

/which caused

which caused me to decide to adopt this configuration and to accept the approximately 1° greater trim than that which could be obtained by use of the full 3" hook. The trim will be a maximum of 4° which is exactly half that obtained in the "no modification" condition.

SLIDE 45 - TRIM - SPEED CURVES - CONST RESIST

The trim/speed curve indicates a best trim in the expected speed range of about 6" by the stern and moves are in hand to produce a static trim tending toward this figure, but leaving a little in hand to allow for possible pump suction effects.

SLIDE 46

And so, to quote the Armchair travelogue closure, as our ship pulls away from the shore, your questions and comments are awaited.

THE DRAWINGS AND GRAPHS WHICH FOLLOW FROM THIS POINT DOWN TO THE YELLOW SHEET ARE THOSE USED IN THE PRESENTATION OF THE PAPER

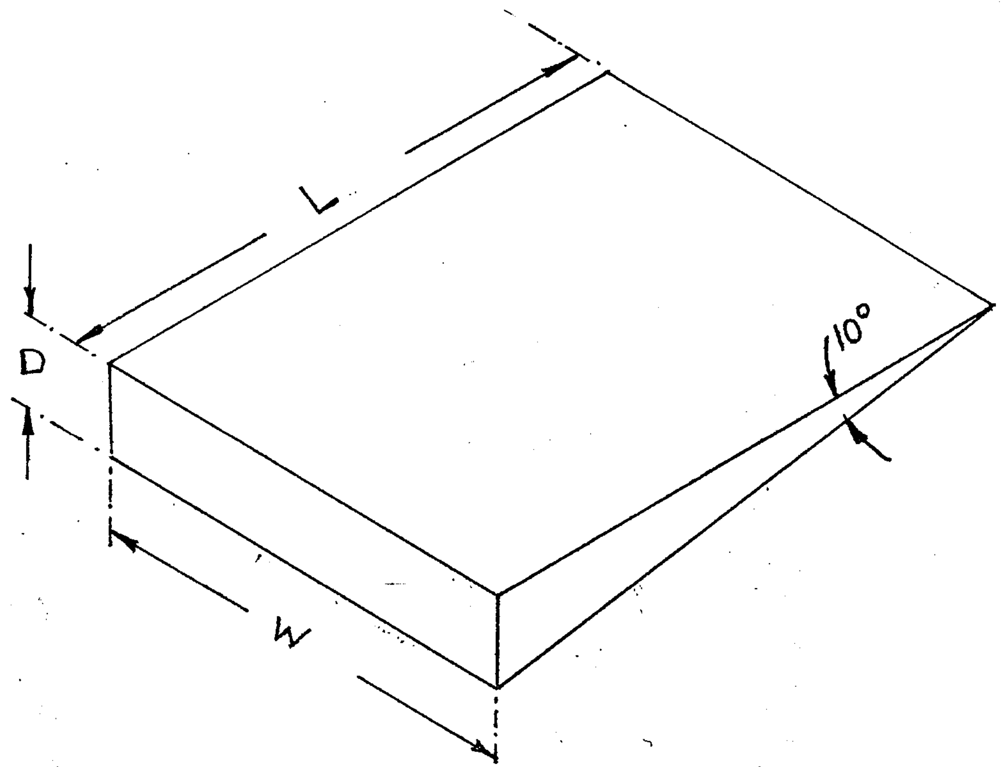
"JET PROPELLED 34'-0" S.M.B.
RESULTS OF MODEL TESTS
CARRIED OUT AT CIVIC OLYMPIC POOL
MAY - JULY 1975"

THOSE WHICH FOLLOW THE YELLOW SHEET WERE NOT USED DURING THE PRESENTATION OF THE PAPER.

THESE DRAWINGS AND GRAPHS WERE SUPPLEMENTED BY PICTORIAL SLIDES OF THE BOAT IN MOTION, AND BY MOVING PICTURE FILMS (3 IN NO.)

THE SLIDES USED BEAR RED INK NUMBERS, AND ARE REPRODUCED ON GLASS IN PLASTIC MOUNTS
THE GRAPHS AND DRAWINGS HAVE ALSO BEEN PHOTOGRAPHED AND MADE INTO SLIDES. THESE ARE ON FILM IN CARDBOARD MOUNTS, NAMED & NUMBERED

A BOOK OF STILL PHOTOGRAPHS ALSO EXISTS SHOWING VARIOUS RUNS AND THE SMOKE TESTS AT CSIRO BLACK MOUNTAIN LAB. WIND TUNNEL.



IN ALL CASES WEDGE ANGLE = 10°

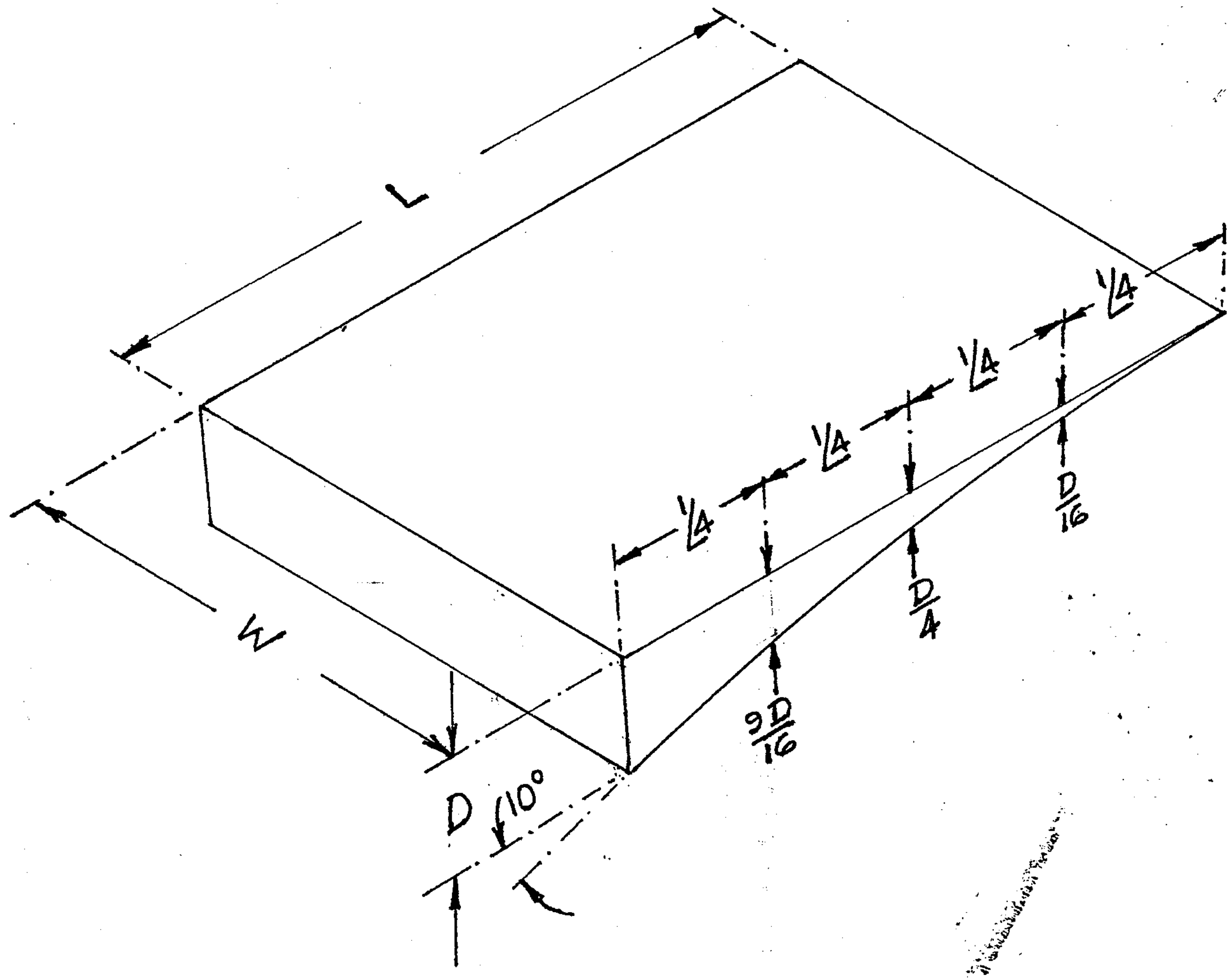
IN ALL CASES W = HALF WIDTH OF TRANSOM LESS HALF WIDTH OF ℄ DEADWOOD

D_1 = 3" L_1 = 17"

D_2 = 6" L_2 = 34"

D_3 = 9" L_3 = 51"

DETAIL OF WEDGES.



IN ALL CASES TANGENT TO CURVE OF BOTTOM AT AFT END = 10°

IN ALL CASES W = HALF WIDTH OF TRANSOM LESS HALF WIDTH OF ℄ DEADWOOD.

D_1 = 3" L_1 = 34"

D_2 = 6" L_2 = 68"

D_3 = 9" L_3 = 102"

DETAIL OF PARALLEL CROSS SECTION PARABOLIC **HOOK**

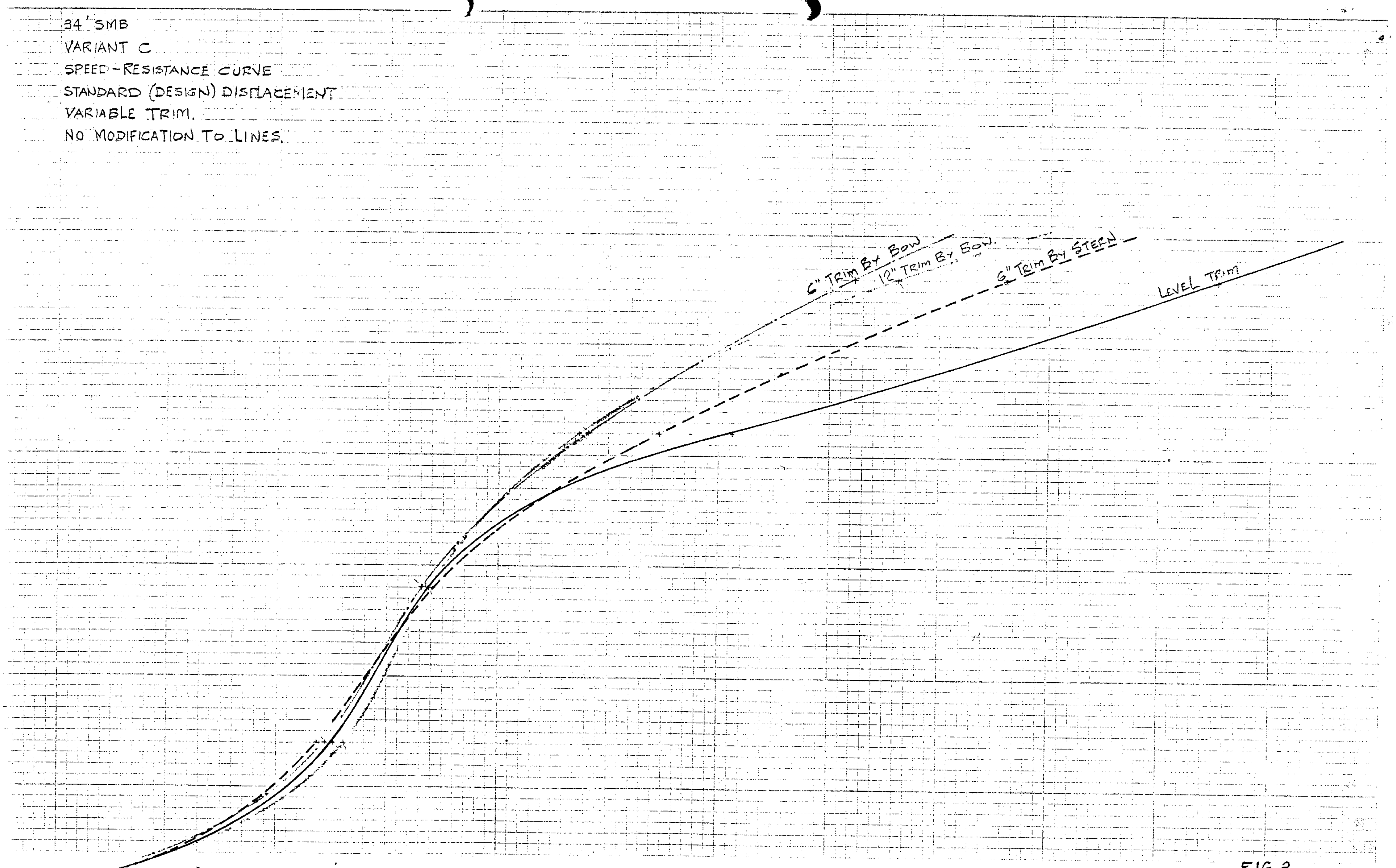
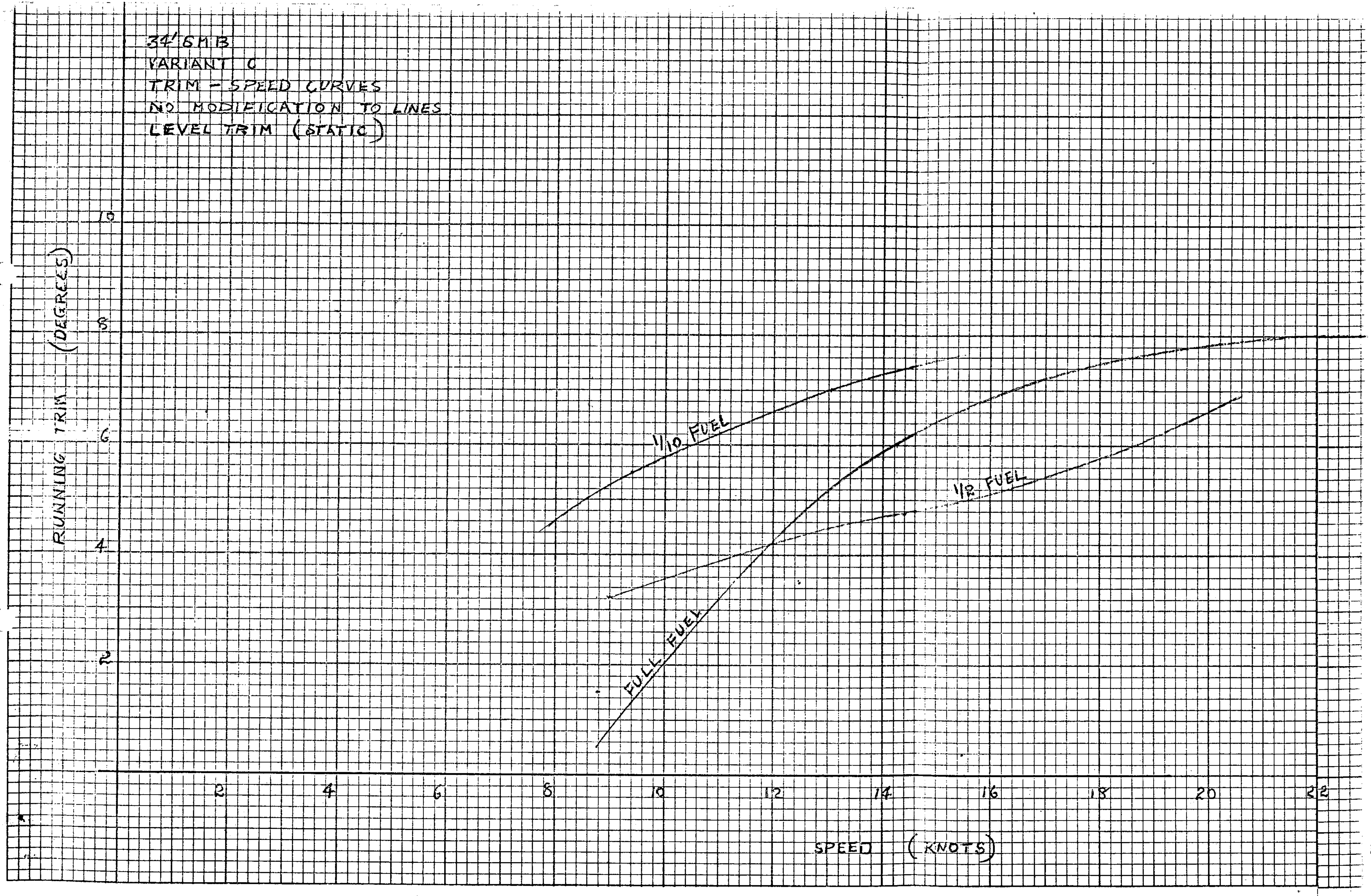
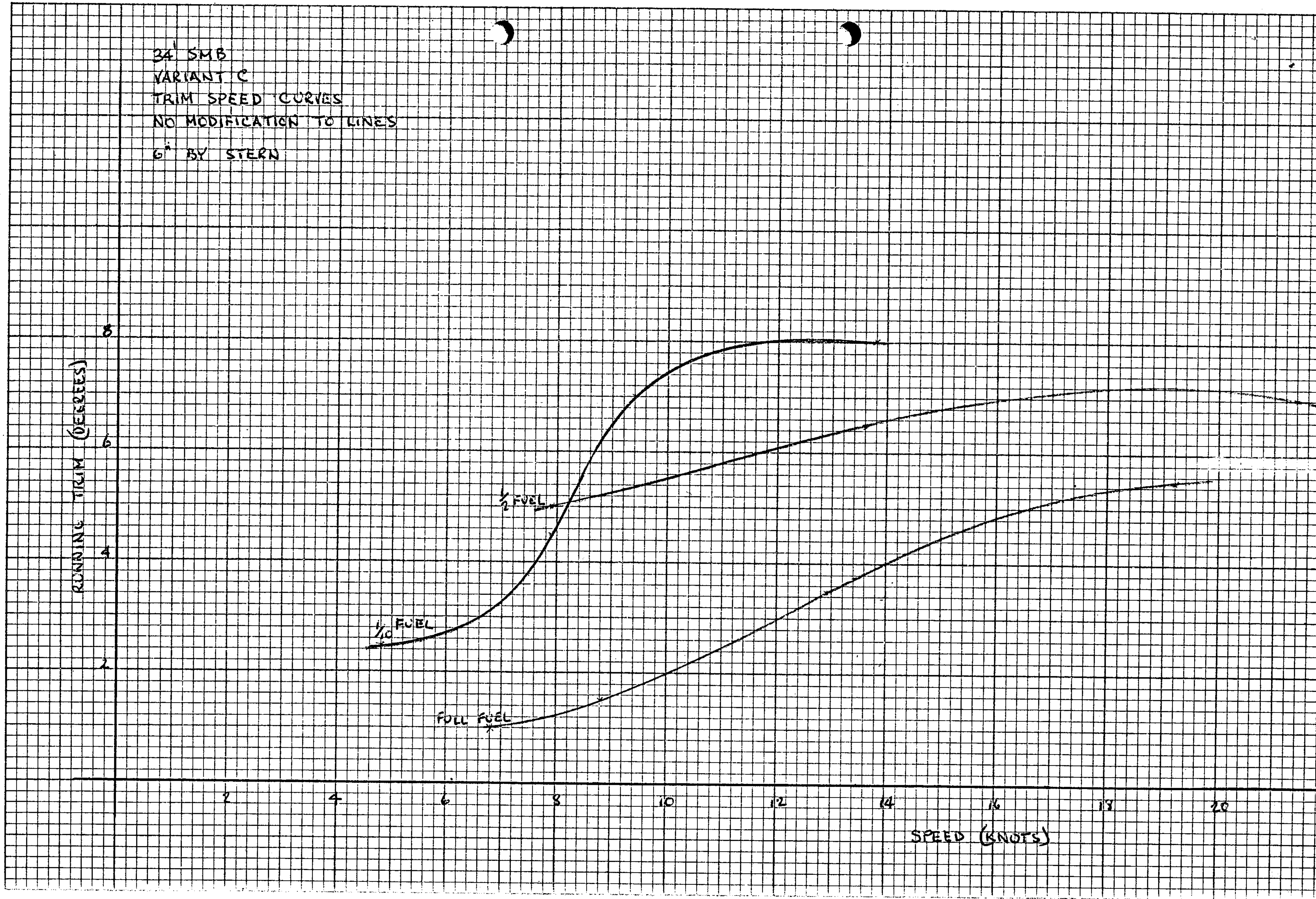

34' SMB
VARIANT C
SPEED - RESISTANCE CURVE
STANDARD (DESIGN) DISPLACEMENT
VARIABLE TRIM.
NO MODIFICATION TO LINES.
6" TRIM BY BOW
12" TRIM BY BOW
6" TRIM BY STERN
LEVEL TRIM

FIG 2



34' SMB
VARIANT C
TRIM - SPEED CURVES
NO MODIFICATION TO LINES
LEVEL TRIM (STATIC)
RUNNING TRIM (DEGREES)
2
4
6
8
10
SPEED (KNOTS)
2
4
6
8
10
12
14
16
18
20
22
1/10 FUEL
1/2 FUEL
FULL FUEL


34' SMB
VARIANT C
TRIM SPEED CURVES
NO MODIFICATION TO LINES
6" BY STERN
RUNNING TRIM (DEGREES)
8
6
4
2
1/2 FUEL
1/10 FUEL
FULL FUEL
2
4
6
8
10
12
14
16
18
20
SPEED (KNOTS)

34' SMB
VARIANT C
SPEED - RESISTANCE CURVE
50% MAIN FUEL TANKS CONSUMED.
VARIABLE TRIM
NO MODIFICATION TO LINES.

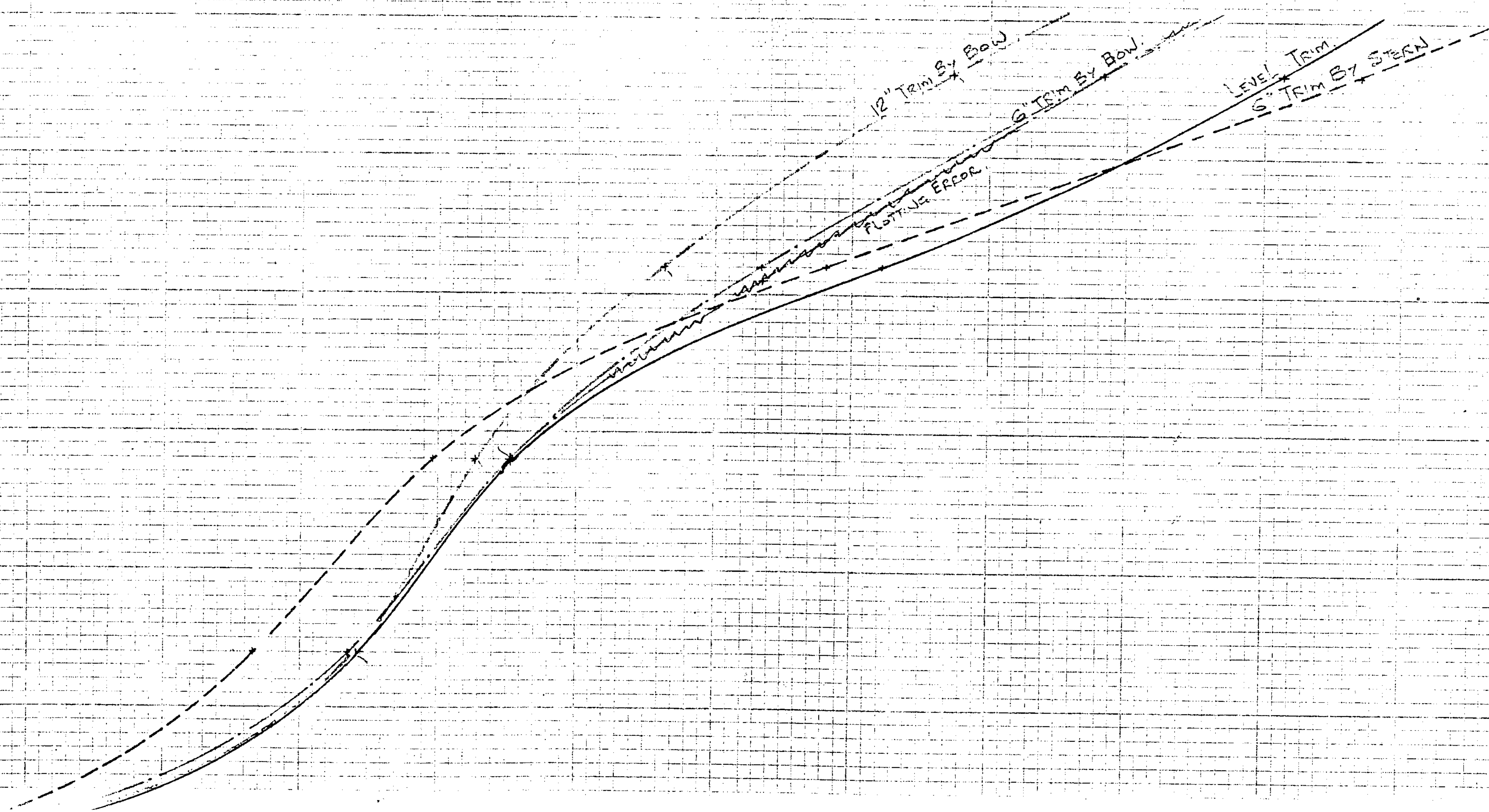


FIG 3

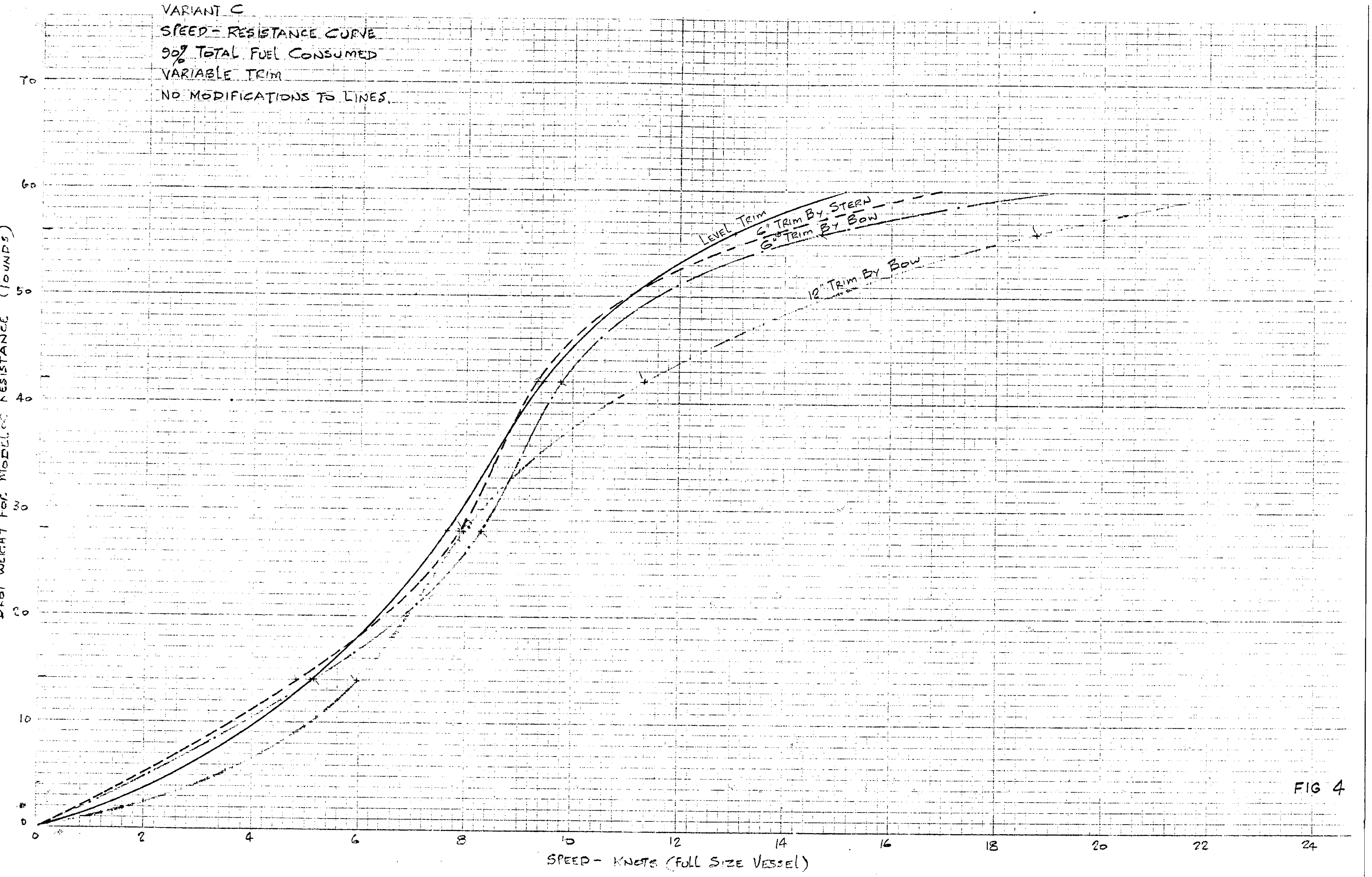
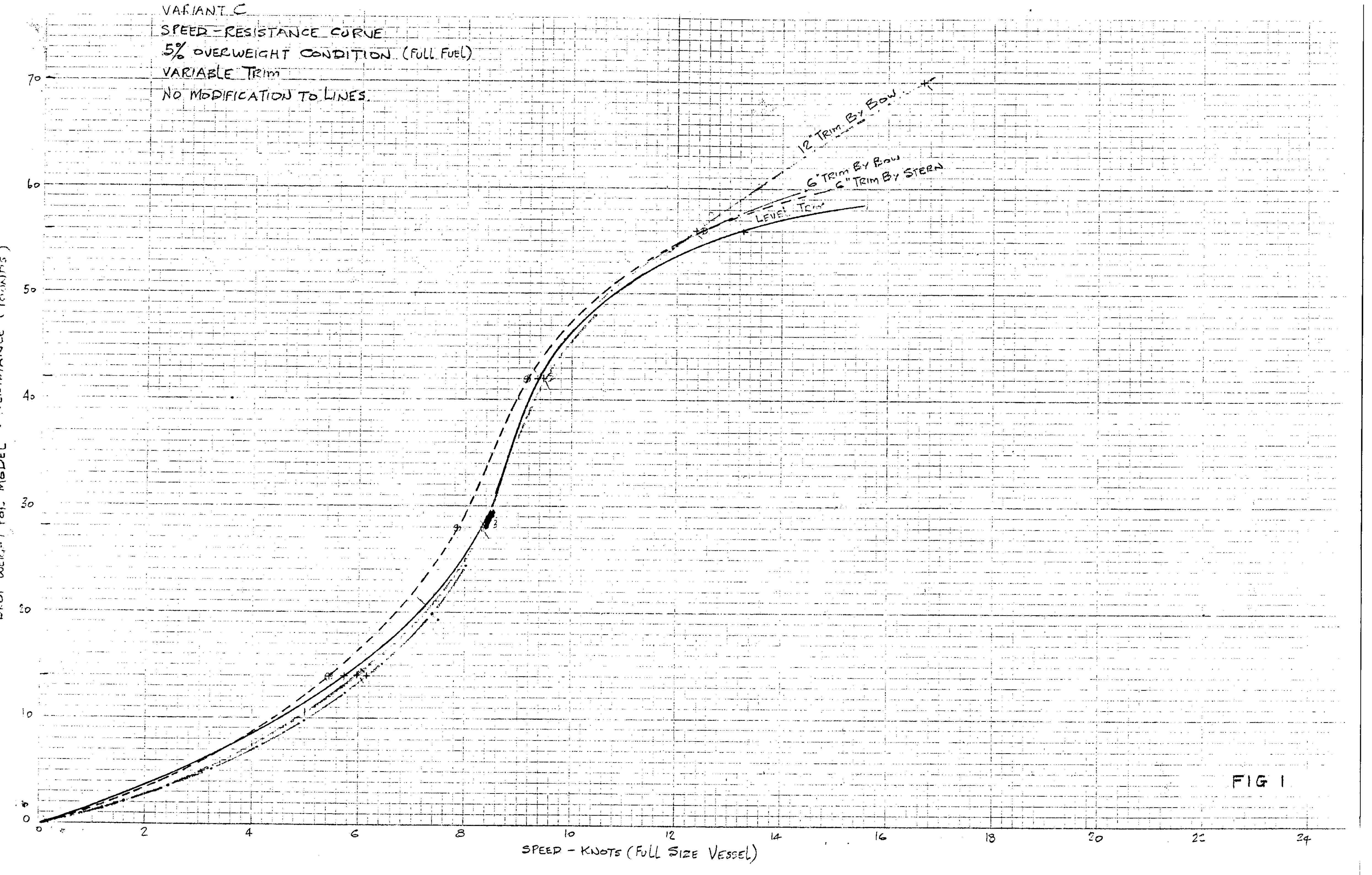

VARIANT C
SPEED - RESISTANCE CURVE
90% TOTAL FUEL CONSUMED
VARIABLE TRIM
NO MODIFICATIONS TO LINES.
LEVEL TRIM
6" TRIM BY STERN
6" TRIM BY BOW
12" TRIM BY BOW
0
10
20
30
40
50
60
70
0
2
4
6
8
10
12
14
16
18
20
22
24
SPEED - KNOTS (FULL SIZE VESSEL)

FIG 4


VARIANT C
SPEED-RESISTANCE CURVE
5% OVERWEIGHT CONDITION (FULL FUEL)
VARIABLE TRIM
NO MODIFICATION TO LINES.
12" TRIM BY BOW
6" TRIM BY BOW
6" TRIM BY STERN
LEVEL TRIM
SPEED - KNOTS (FULL SIZE VESSEL)
0
2
4
6
8
10
12
14
16
18
20
22
24
10
20
30
40
50
60
70
FIG I

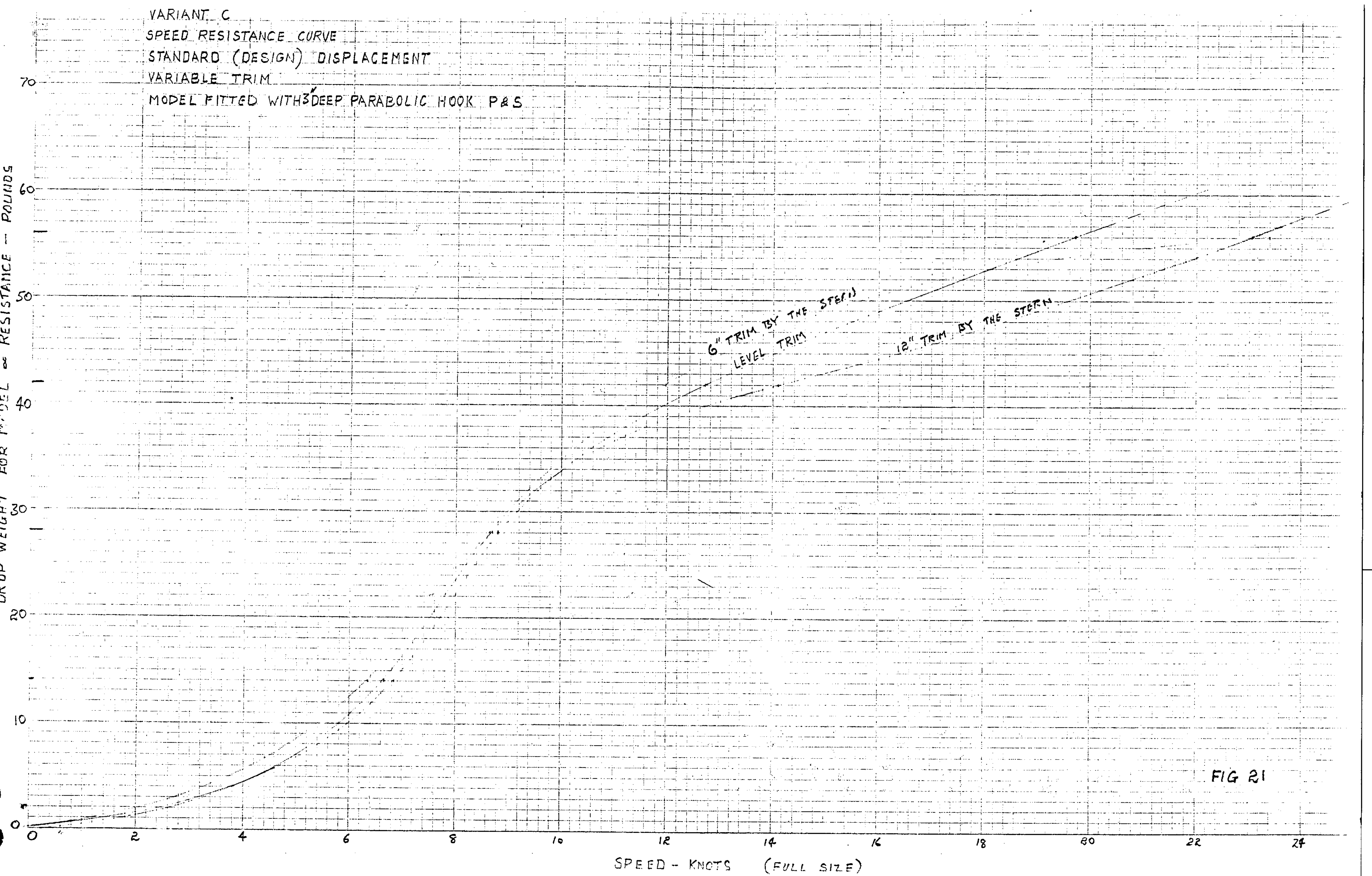
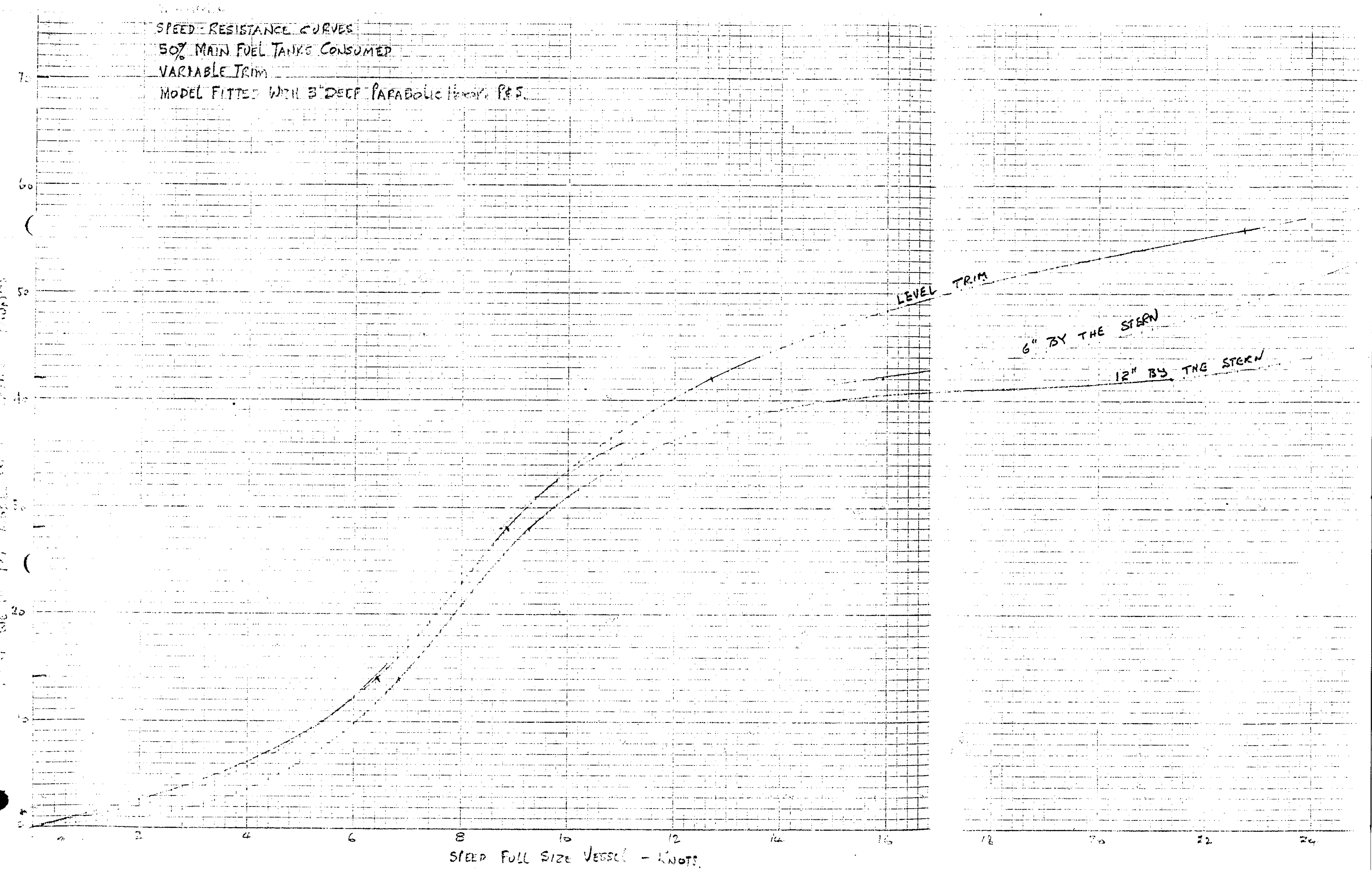
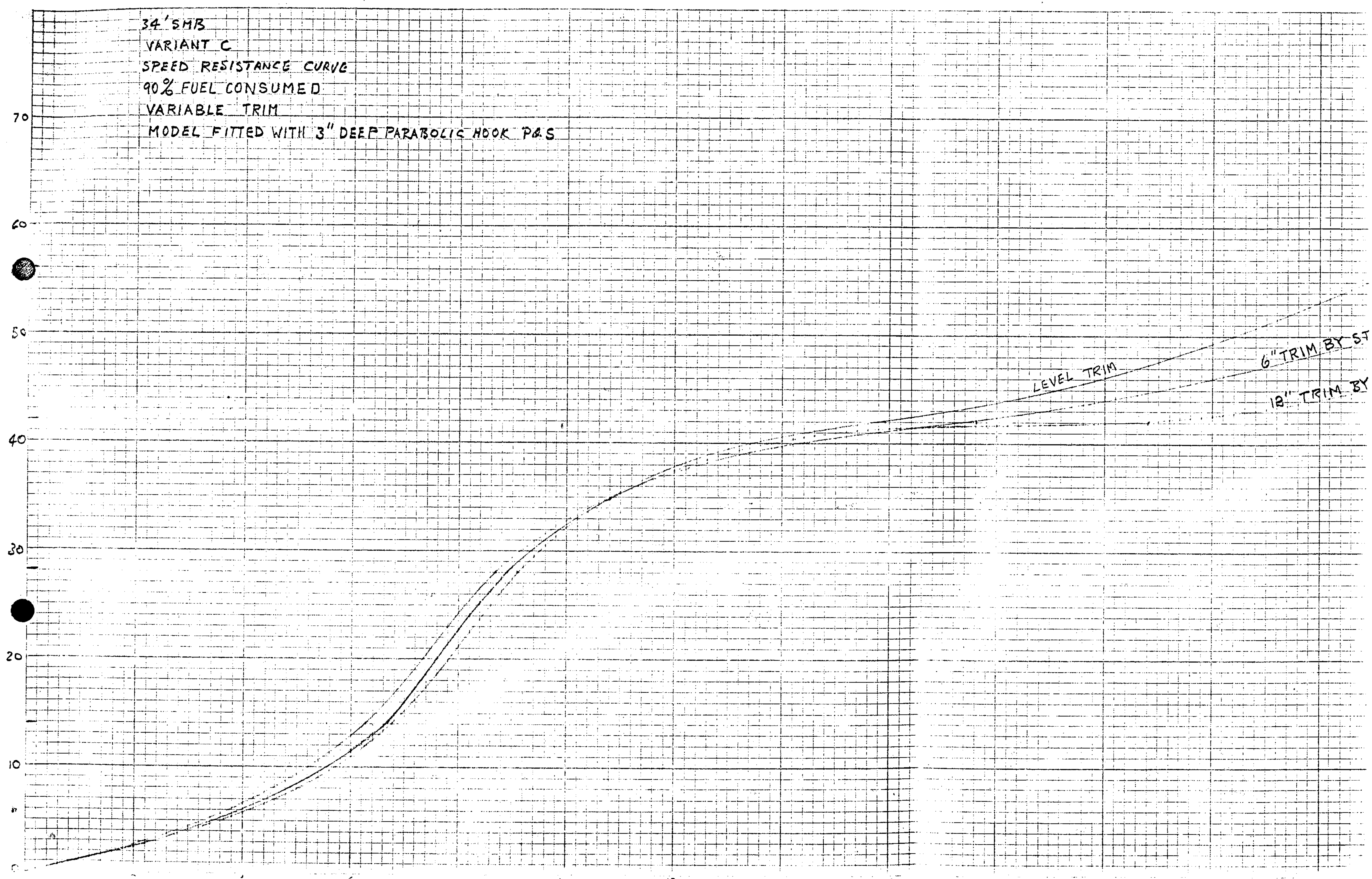
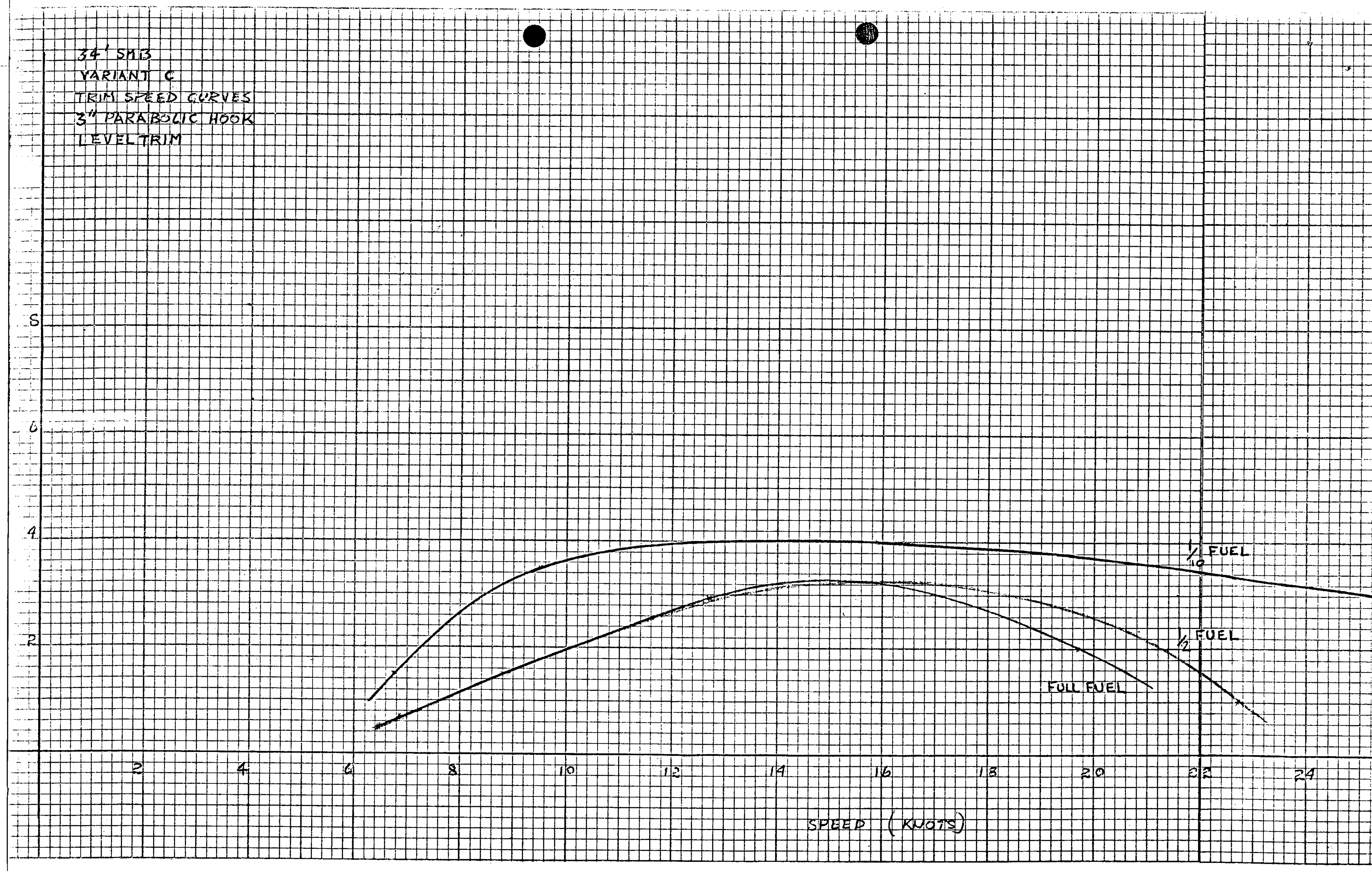

VARIANT C
SPEED RESISTANCE CURVE
STANDARD (DESIGN) DISPLACEMENT
VARIABLE TRIM
MODEL FITTED WITH 3" DEEP PARABOLIC HOOK P&S
6" TRIM BY THE STERN
LEVEL TRIM
12" TRIM BY THE STERN
DROP WEIGHT FOR MODEL ∝ RESISTANCE – POUNDS
SPEED – KNOTS (FULL SIZE)
0
10
20
30
40
50
60
70
0
2
4
6
8
10
12
14
16
18
20
22
24

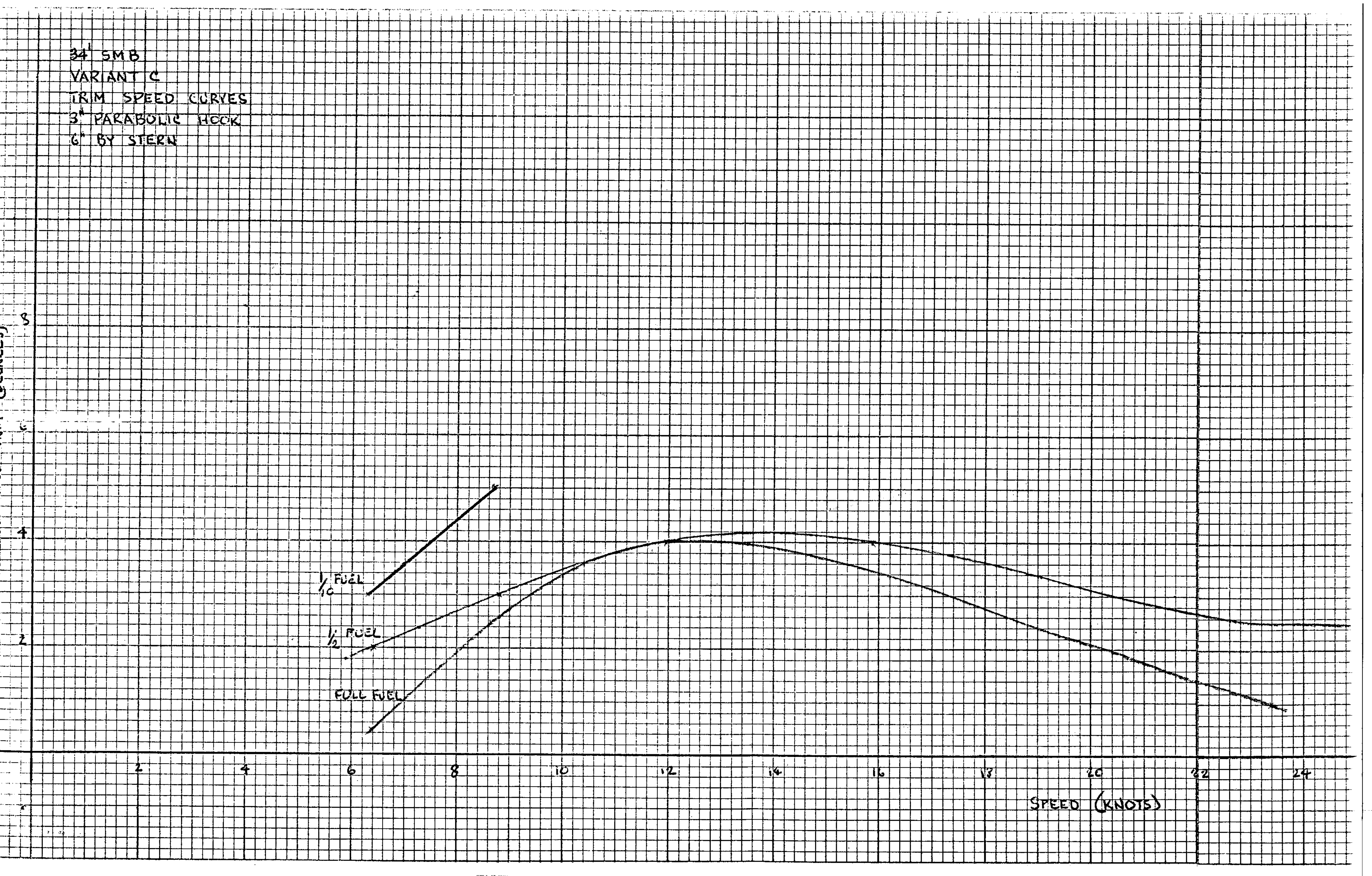
FIG 21


SPEED - RESISTANCE CURVES
50% MAIN FUEL TANKS CONSUMED
VARIABLE TRIM
MODEL FITTED WITH 3" DEEP PARABOLIC [illegible] P&S.
LEVEL TRIM
6" BY THE STERN
12" BY THE STERN
SPEED FULL SIZE VESSEL - KNOTS.

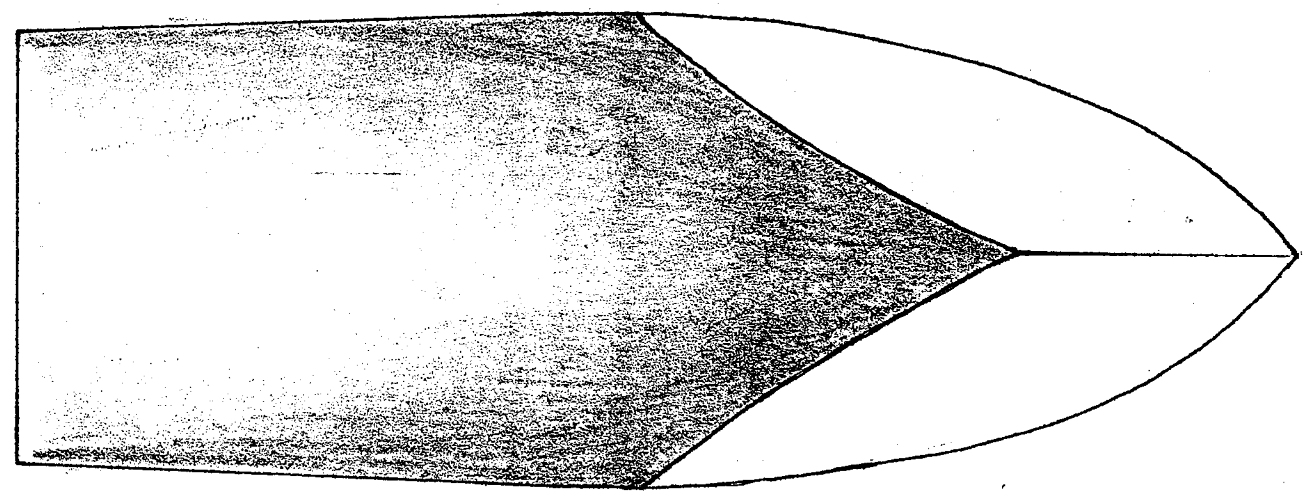

34' SMB
VARIANT C
SPEED RESISTANCE CURVE
90% FUEL CONSUMED
VARIABLE TRIM
MODEL FITTED WITH 3" DEEP PARABOLIC HOOK P&S
LEVEL TRIM
6" TRIM BY ST
12" TRIM BY
0
10
20
30
40
50
60
70



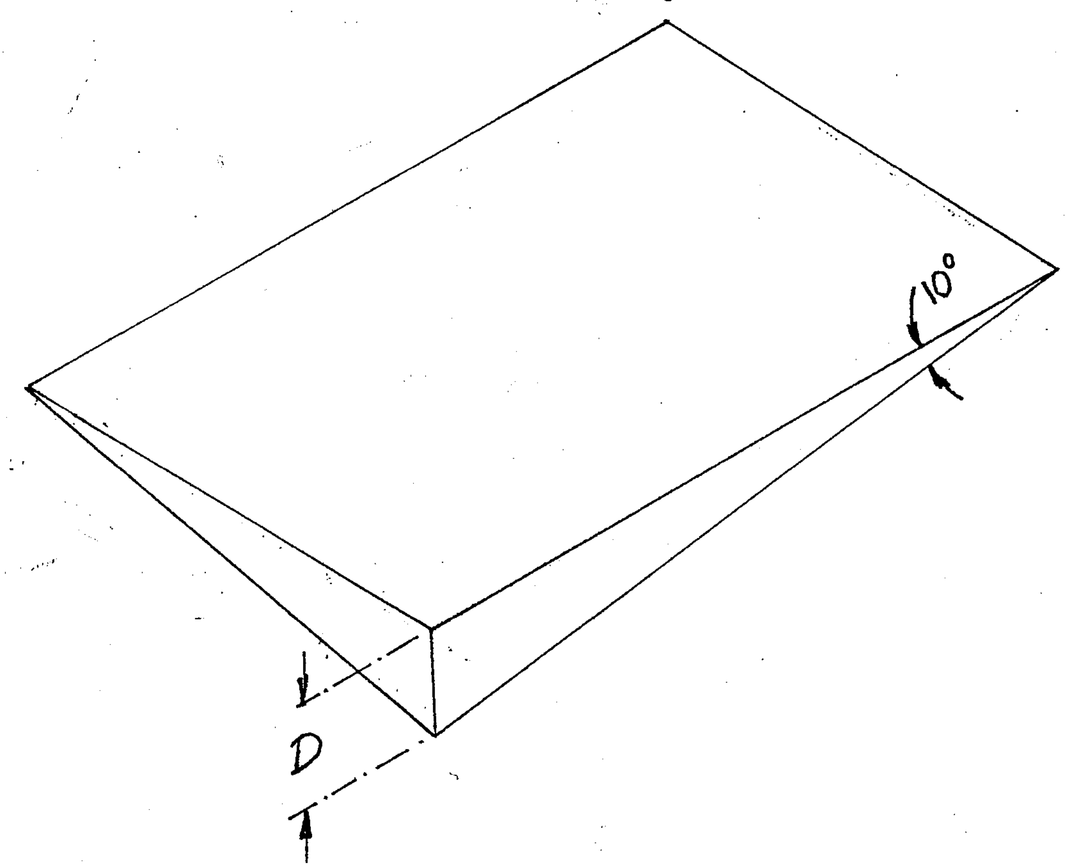
34' SMB
VARIANT C
TRIM SPEED CURVES
3" PARABOLIC HOOK
LEVEL TRIM
S
6
4
2
1/10 FUEL
1/2 FUEL
FULL FUEL
2
4
6
8
10
12
14
16
18
20
22
24
SPEED (KNOTS)



34' SMB
VARIANT C
TRIM SPEED CURVES
3" PARABOLIC HOOK
6" BY STERN
1/10 FUEL
1/2 FUEL
FULL FUEL
2
4
6
8
2
4
6
8
10
12
14
16
18
20
22
24
SPEED (KNOTS)



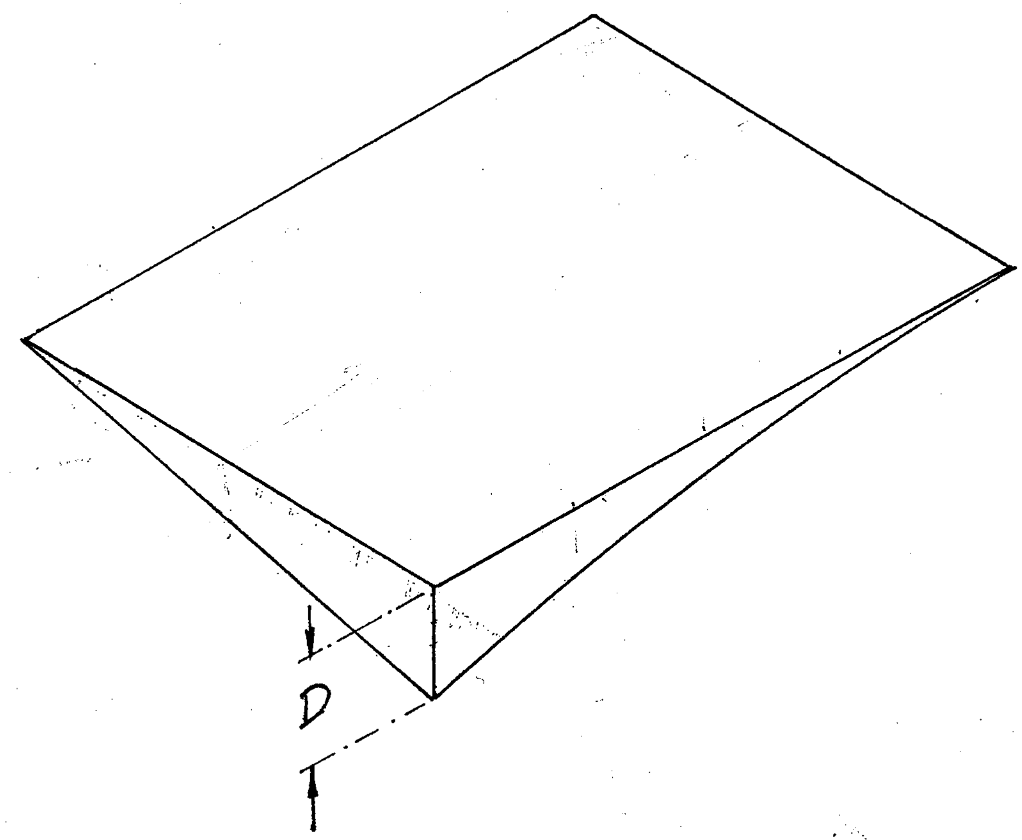
PRESSURE PATTERN UNDER A PLANING HULL



HALF WEDGE D = 3" ONLY.

OTHER DIMENSIONS AS FULL WEDGE

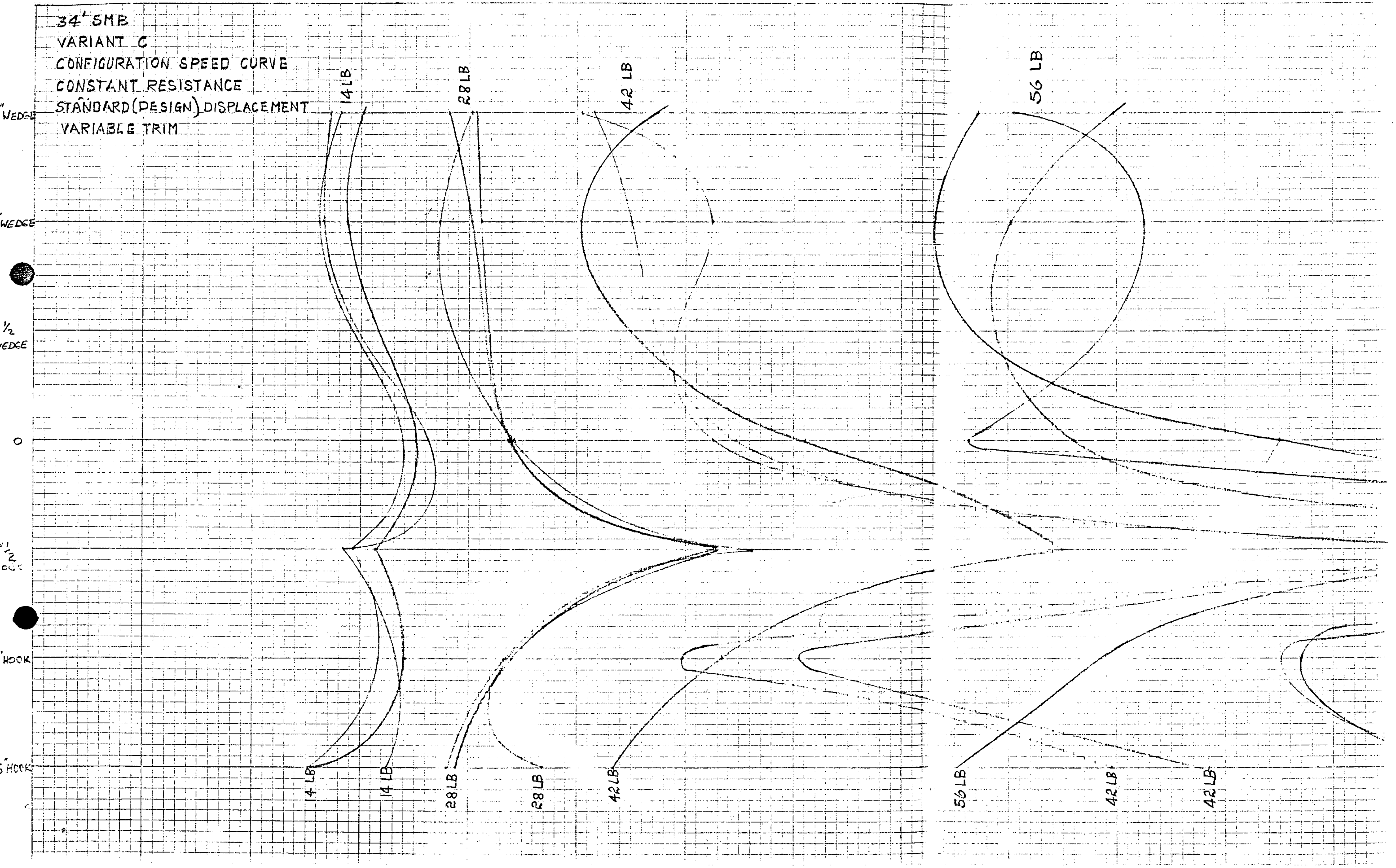
DEPTH D ARRANGED NEAR ℄ FOR ONE SERIES OF RUNS AND NEAR CHINES FOR ANOTHER SERIES OF RUNS.



HALF HOOK D = 3" ONLY

OTHER DIMENSIONS AS FULL HOOK

DEPTH D ARRANGED NEAR ℄ FOR ONE SERIES OF RUNS
AND NEAR CHINES FOR ANOTHER SERIES OF RUNS.


34' SMB
VARIANT C
CONFIGURATION SPEED CURVE
CONSTANT RESISTANCE
STANDARD (DESIGN) DISPLACEMENT
VARIABLE TRIM
14 LB
28 LB
42 LB
56 LB
WEDGE
WEDGE
1/2 WEDGE
0
1/2 HOOK
HOOK
HOOK
14 LB
14 LB
28 LB
28 LB
42 LB
56 LB
42 LB
42 LB

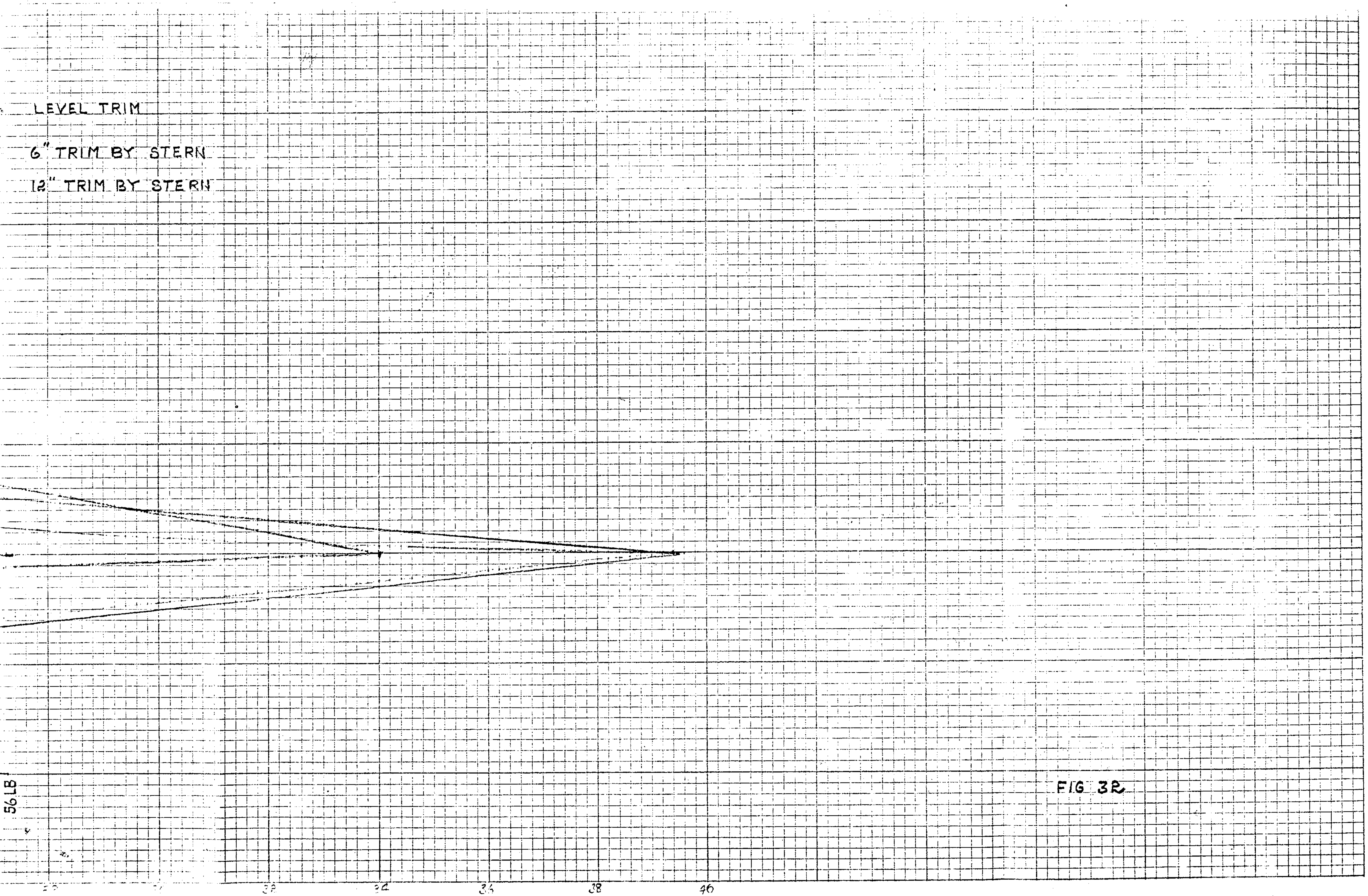
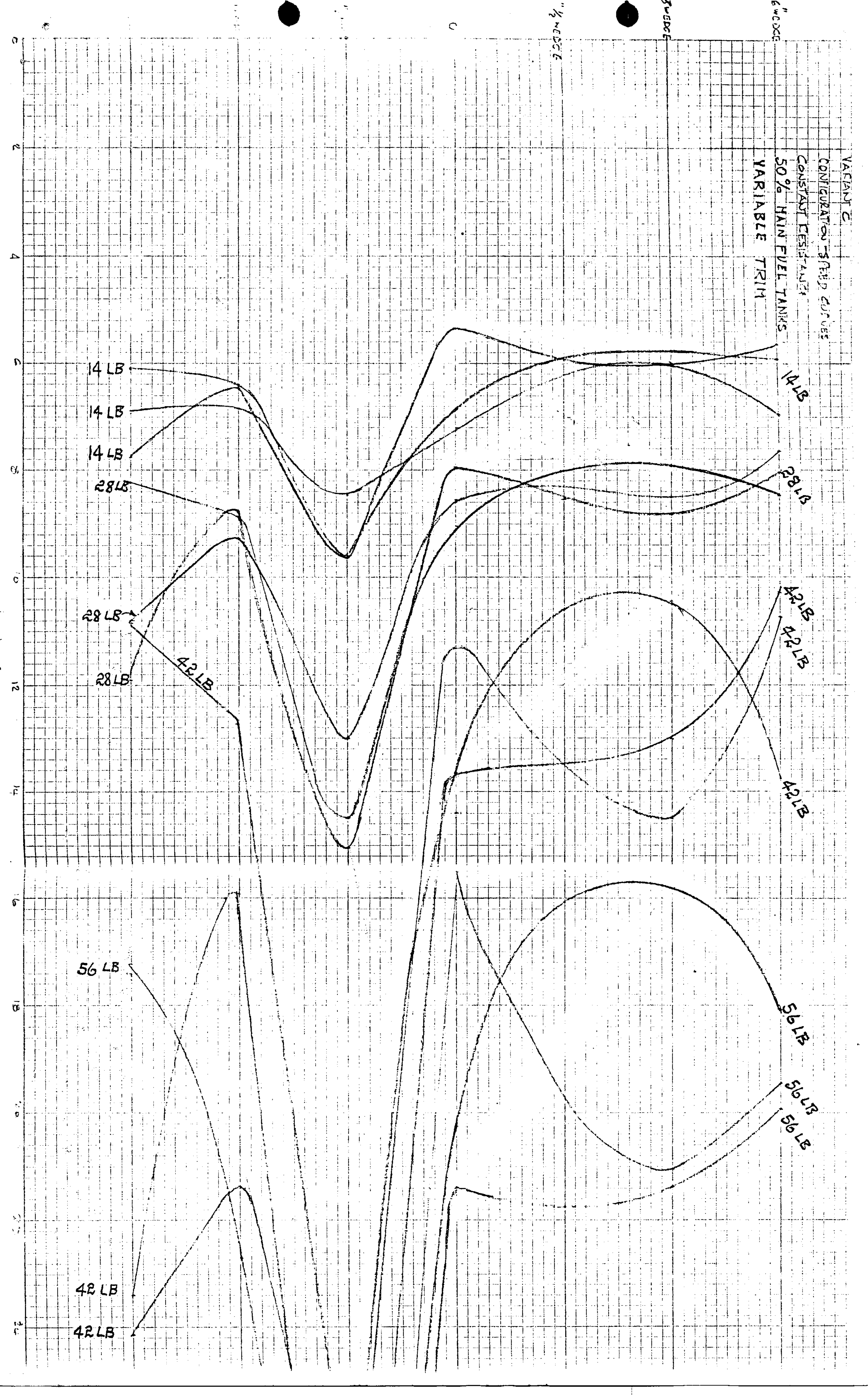
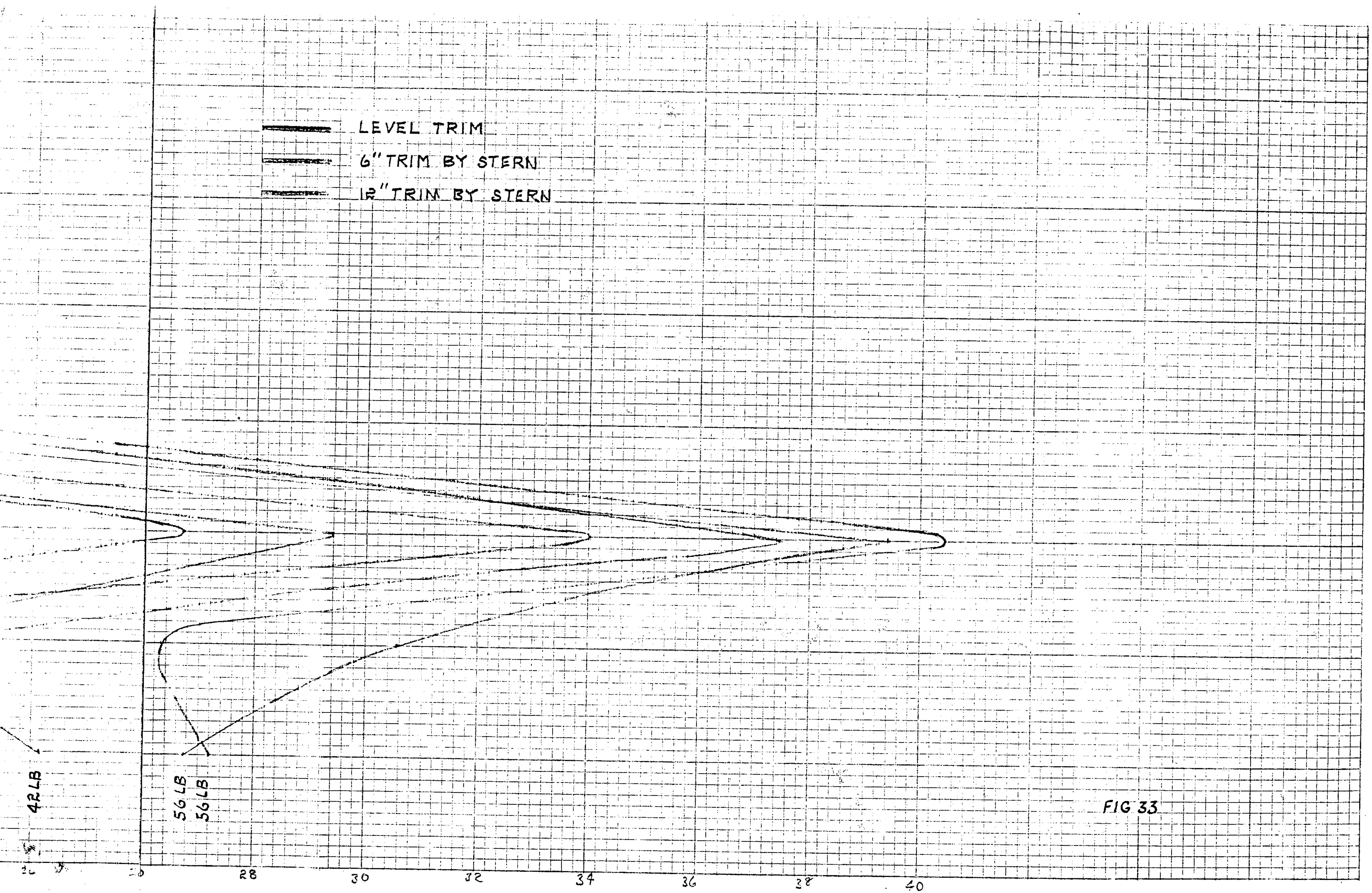


FIG 32


VARIANT C
CONFIGURATION SPEED CURVES
CONSTANT RESISTANCE
50% MAIN FUEL TANKS
VARIABLE TRIM
14 LB
14 LB
14 LB
14 LB
28 LB
28 LB
28 LB
28 LB
42 LB
42 LB
42 LB
42 LB
56 LB
56 LB
56 LB
56 LB
42 LB
42 LB



LEVEL TRIM
6" TRIM BY STERN
12" TRIM BY STERN
42 LB
56 LB
56 LB
28
30
32
34
36
38
40

FIG 33