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ARCTIC VESSEL AND MARINE
RESEARCH INSTITUTE

LABORATORY TECHNICAL REPORT

LTR - SH - 340

NAVIGATION AIDS VESSEL
RESULTS OF RESISTANCE, PROPULSION
AND WAKE SURVEY EXPERIMENTS
WITH MODEL 349 AND PROPELLERS 76 L, R

W.D. MOLYNEUX

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L'INSTITUT DE RECHERCHE MARITIME
ET SUR LES NAVIRES ARCTIQUES

OCTOBER 1982
OTTAWA, CANADA

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TAB. 21
TABLES 23

REPORT
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(AVMRI)

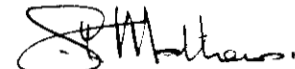
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et sur les navires arctiques
(L'IRMNA)

FOR Saint John Marine Consultants Ltd. PO Box 7777
POUR Saint John, New Brunswick,

REFERENCE Telex of 19th May, 1982 and Letter
REFERENCE of 19th July, 1982

LTR-SH-340
NAVIGATION AIDS VESSEL
RESULTS OF RESISTANCE, PROPULSION
AND WAKE SURVEY EXPERIMENTS
WITH MODEL 349 AND PROPELLERS 76 L, R

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TABLE OF CONTENTS

	<u>Page</u>
LIST OF TABLES	ii
LIST OF FIGURES	iii
LIST OF SYMBOLS	iv
1.0 INTRODUCTION	1
2.0 MODEL DESCRIPTION	1
3.0 MODEL EXPERIMENTS	
3.1 Resistance Experiments	2
3.2 Propeller Open Water Experiments	3
3.3 Propulsion and Overload Experiments	3
3.4 Wake Survey	4
4.0 RESULTS	
4.1 Resistance Experiments	4
4.2 Propeller Open Water Experiments	5
4.3 Self Propulsion and Overload Experiments	5
4.4 Wake Survey	7
5.0 DISCUSSION	
6.0 CONCLUSIONS	10
7.0 REFERENCES	11
APPENDIX I	A-1
RESULTS OF RESISTANCE AND PROPULSION EXPERIMENTS WITH MODEL 338 AND PROPELLERS 71 L, R	

LIST OF TABLES

	<u>Table</u>
Hydrostatic Particulars, Model 349	1
Propeller Particulars, 76 L, R and Location of Wake Survey Rake	2
Results of Resistance Experiments, Model 349, $C_A=0.0000$	3
Results of Resistance Experiments, Model 349, $C_A=0.0004$	4
Results of Open Water Experiments, 76 L, R	5
Powers, Speeds and Propulsion Factors, Model 349, $C_A=0.0000$	6
Propeller Coefficients, Model 349, $C_A=0.0000$	7
Non-dimensional Propulsion Coefficients, Model 349, $C_A=0.0000$	8
Powers, Speeds and Propulsion Factors, Model 349, $C_A=0.0004$	9
Propeller Coefficients, Model 349, $C_A=0.0004$	10
Non-dimensional Propulsion Coefficients, Model 349, $C_A=0.0004$	11
Powers, Speeds, etc., for Overload Tests, 0 to 13.11 knots	12
Powers, Speeds, etc., for Overload Tests, 13.58 to 15.12 knots	13
Propeller Coefficients in Overload Tests, 0 to 13.11 knots	14
Propeller Coefficients in Overload Tests, 13.58 to 15.12 knots	15
Wake Survey, Sign Convention and Velocity components	16
Wake Survey, Flow Velocity Components, $r/R=0.372$	17
Wake Survey, Flow Velocity Components, $r/R=0.540$	18
Wake Survey, Flow Velocity Components, $r/R=0.708$	19
Wake Survey, Flow Velocity Components, $r/R=0.876$	20
Wake Survey, Flow Velocity Components, $r/R=1.044$	21
Estimated Ship Performance with As Fitted Propellers	22
Propulsion Coefficient, As Fitted Propellers	23

LIST OF FIGURES

	<u>Figure</u>
Bodyplan, Model 349	1
Bow Profile (and bow thruster tunnel), Model 349	2
Stern Profile (and bossing design), Model 349	3
Effective Power, Model 349	4
Open Water Experiments, Propeller 76 L, R	5
Delivered Power and revolutions, Model 349	6
Propulsion Factors, Model 349, $C_A=0.0004$	7
Propulsion Factors, Model 349, $C_A=0.0004$	8
Towing Force against RPM, Overload Tests, Model 349	9
Towing Force against Power, Overload Tests, Model 349	10
Thrust Deduction in Overload Tests, Model 349	11
Wake Survey, Axial Flow Component at 15 knots	12
Wake Survey, Radial Flow Component at 15 knots	13
Wake Survey, Tangential Flow Component at 15 knots	14
Wake Survey, Contours of Constant Taylor Wake Fraction	15
Wake Survey, Flow Vectors at 15 knots	16
Comparison of Ship Predictions, 349 and 338	17
Comparison of Bollard Pull Experiments, 349 and 338	18
Comparison of Pull Variation with Speed, 349 and 338	19
Comparison of Open Water Performance with Stock Propellers and Estimated Design	20
Comparison of Axial Flow Velocities, 349 and 338	21

LIST OF SYMBOLS

BP	Taylor's propeller coefficient based on delivered horsepower
CA	Ship model correlation allowance
CDVOL	Power-displacement coefficient
CR	Specific residuary resistance coefficient
CTM(59)	Specific total resistance coefficient for the model at temperature 59° F
CT-R(t_3)	Coefficient of thrust excess in propulsion test at temperature t_3 °F (= applied towing force / $1/2 \rho S v^2$)
CTS	Specific total resistance coefficient for the ship
CTVOL	Resistance displacement coefficient ($R / 1/2 \rho v^2 \nabla^{2/3}$)
D	Propeller diameter
DELTA	Taylor's advance coefficient
ETAD, η_D	Quasi-propulsive coefficient
EHAD, η_H	Hull efficiency
ETAO, η_O	Propeller efficiency in open water
ETAR, η_R	Relative rotative efficiency
FN	Froude number (v/\sqrt{gL})
FNVOL	Speed-displacement coefficient (= $v/\sqrt{g \nabla^{1/3}}$)
FP	Pull or towing force
G, g	Acceleration due to gravity
JOM, J	Advance coefficient of model test propeller in open water test

JOS	Advance coefficient for ship propeller in open water test
JP	Apparent advance coefficient for model in propulsion test
KQOM, KQ	Propeller torque coefficient of model test propeller in open water test
KQOS	Propeller torque coefficient for ship propeller in open water
KQP	Propeller torque coefficient in propulsion test
KTOM, KT	Propeller thrust coefficient of model test propeller in open water test
KTOS	Propeller thrust coefficient for ship propeller in open water
KTP	Propeller thrust coefficient in propulsion test
L	Length on waterline
LCB	Longitudinal position of the centre of buoyancy from midships of L, per cent of L
n	Propeller revolutions per second
NS	Shaft revolutions for ship, RPM
NVOL	Shaft revolution made dimensionless with respect to displacement ($= n \nabla^{1/3} g$)
P	Propeller nominal pitch
PD	Delivered power, horsepower
PDVOL	Delivered power-displacement coefficient (speed eliminated) ($= PD \times 550 / \rho g^{3/2} \nabla^{7/6}$)
PE	Effective power, horsepower
S	Wetted surface area
TH	Thrust
THDF, t	Thrust deduction fraction

TAU	Resistance per unit displacement ($= R/\rho g \nabla$)
TAUR	Residuary resistance per unit displacement
TAUT	Thrust per unit displacement
V	Ship speed, knots
v	Speed
WFT, W_T	Taylor wake fraction
ZETO	Static thrust coefficient ($= KT/(\pi(KO))^{2/3} (2)^{1/3}$)
∇	Volume of displacement
ρ	Mass density of water

1.0 INTRODUCTION

This report describes resistance, propulsion and wake survey experiments carried out by the Arctic Vessel and Marine Research Institute (AVMRI) for Saint John Marine Consultants Ltd. of Saint John, New Brunswick. The model tested represents a design for a Type 1100 Navigation Aids Vessel for the Canadian Coast Guard. Manoeuvring and seakeeping tests were also requested and these are described in a separate report. Reference 1 describes model tests carried out with Model 338, also a design proposal for the same class of ship. Since the production of Reference 1 AVMRI now produces reports S.I units. For convenience, the appropriate tables and figures taken from Reference 1 are reproduced as Appendix I, in S.I. units.

2.0 MODEL DESCRIPTION

The model, 349, was made of wood with a final gloss finish, and was supplied to AVMRI complete with bow thruster tunnel, rudder, shaft bossings and ice horn. The model was also fitted with stabilizer tanks, which were not used during the indoor tests. Tripwires were fitted at stations 9.5 and 9.125, corresponding to 5 percent and 8.75 percent LBP aft of the fore perpendicular throughout the tests.

A body plan, supplied by Saint John Marine Consultants Ltd., drawing number 902-002/B, dated 6 August, 1982 is given in Figure 1. The bow and stern profiles are shown in Figures 2 and 3 together with details of the bossing and rudder design. Hydrostatic particulars interpolated from data given by St. John Marine Consultants Ltd. for the condition tested are given in Table 1.

For propulsion tests the model was fitted with propellers 76 L and R taken from tank stock. These propellers were manufactured to have the same diameter, hub dimensions, pitch at 0.7 radius and number of blades as the proposed design. The section shape and pitch distribution is that of a Wageningen B-Screw design. Details of the stock propeller are given in Table 2.

The propellers were fitted on the model so that when viewed from astern they were outboard turning.

3.0 MODEL EXPERIMENTS

3.1 Resistance Experiments

Model 349 was ballasted to the draught and displacement given in Table 1. For resistance tests the model was fitted with shaft bossings and dummy propeller hubs, bow thruster tunnel, rudder and ice horn.

Resistance tests were carried out over the speed range corresponding to 4.5 to 16.0 knots for the full scale ship.

3.2 Propeller Open Water Experiments

Propellers 76 L and 76 R were tested in open water at a shaft immersion of 1.5 propeller diameters. The propellers were tested to give variation of non-dimensional thrust and torque coefficients (K_T and K_Q) for a range of advance coefficient, J . Advance coefficient was varied by maintaining constant shaft revolutions and varying carriage speed. To ensure no speed effects were present, each propeller was tested at three separate rates of revolutions, covering the range of the propulsion tests.

3.3 Propulsion and Overload Experiments

Model 349, ballasted as described in 3.1 was fitted with propellers 76 L and R, and propelled at the speed of the carriage to cover a range of propeller overloads from ship self-propulsion point to approximately full delivered power for the ship. The model was tested at eleven speeds over a range corresponding to zero to 16 knots for the full scale ship.

3.4 Wake Survey

The wake survey equipment was set up on the starboard propeller shaft. The equipment, described in Reference 1, consisted of five 5-hole pitot tubes and was arranged to cover the propeller disc by rotation about the propeller shaft axis. The rake was set up so that the heads of the probes lay at the position of the propeller centre and could rotate 360° . Details of the radii and location of the pitot heads are given in Table 2.

The wake survey was carried out for a corresponding ship speed of 15 knots at the draught and displacement given in Table 1. Measurements were made in steps of 5° around the projection of the bossings and steps of 15° elsewhere.

4.0 RESULTS

4.1 Resistance Experiments

The results of resistance tests on Model 349 are given in Tables 3 and 4, corrected for blockage effects using the method described by Scott in Reference 2. Table 3 presents variation of faired resistance coefficient, CTM, corrected to 15°C with Froude number. Also given are CTS predictions for the full scale ship, assuming a frictional resistance correction recommended

by the 8th ITTC in 1957, Reference 3, based on the naked wetted surface area. From these CTS values a prediction for effective power (in kW) has been derived.

Table 4 is the same as Table 3, but also includes an additional correlation allowance of $C_A = 0.0004$. Values of effective power taken from Tables 3 and 4 are shown in Figure 4.

4.2 Propeller Open Water Experiments

When the results of the open water experiments for propellers 76 L and R were analyzed, there was no variation of K_T and K_Q against J with either propeller revolutions or left and right-handed propellers. The results were therefore meaned to give an average value of K_T and K_Q for a given J .

Table 5 presents faired values of K_T , $10K_Q$ and $\text{ETA } 0$ with J . The results are shown plotted as Figure 5.

4.3 Self-Propulsion and Overload Experiments

Measured values of K_T , $10K_Q$ and CT-R for Model 349 were faired against J for each speed tested. The resulting curves were then interpolated at a propeller loading equivalent to the ship self-propulsion point, based on the skin friction resistance correction recommended in Reference 3, and also an additional allowance of $C_A = 0.0004$.

These results are presented in Tables 6 to 8 for the standard ITTC skin friction correction and in Tables 9 to 11, including the additional allowance of $C_A = 0.0004$.

Variation of delivered power (kW) and revolutions (rpm) with knots taken from Tables 6 and 9 are shown in Figure 6.

Values for WFT, THDF, ETAR, ETAO, ETAH and ETAD for a correlation allowance of 0.0004 are shown in Figures 7 and 8.

The propulsion experiments were also analyzed to obtain the variation of available towforce with delivered power for a given speed. This analysis was carried out with a correlation allowance of 0.0004 only. The results are shown in Tables 12 to 15. Variation of available towforce with revolutions for constant speed are shown plotted in Figure 9 and variation of towforce with delivered power for constant speed are shown plotted in Figure 10. Values of THDF against delivered power are shown in Figure 11. No allowance was made for possible ice interaction with the hull and/or propeller in the analysis of the overload experiments.

4.4 Wake Survey

The sign convention for the flow components and an explanation for calculating the magnitude of the three velocity components is given in Table 16. The Fourier analysis of the faired axial, radial and tangential flow components is shown in Figures 12 to 14 and tabulated in Table 17 to 21. Figure 15 shows contours of constant axial flow velocity, shown as nominal Taylor Wake fraction over the propeller disc. Figure 16 shows a plot of flow vectors calculated from the radial and tangential velocities.

5.0 DISCUSSION

For comparison purposes a prediction of ship performance with a correlation allowance of 0.0004 for Models 349 and 338 is given in Figure 17. It can be seen that the effective power for Model 349 is higher than Model 338, over the range 12 to 16 knots. However, over the range 14.5 to 15.5 knots the delivered powers for the two proposals are very similar. Values of the predicted speeds and revolutions for a shaft power of 4640 KW, ETAT 0.97, taken from Figure 17 are given here:

Model Number	Propeller Number	Speed (knots)	Revo- lutions (rpm)
349	76 L, R	15.22	185
338	71 L, R	15.24	170

It is interesting to note the difference in revolutions between the two designs. After comparing the pitch ratios at 0.7 R for propellers 76 and 71, it can be seen that propeller 76 has a lower pitch ratio than propeller 71. It should also be noted there is a difference in wake fraction between the two models at 15.2 knots. Both these factors should combine to produce an increase in the required revolutions for propeller 76 over propeller 71, as was observed during the tests. The nett result is an improvement in propulsive efficiency for Model 349 over Model 338 between the speeds of 14.5 and 15.2 knots.

A comparison has also been made between the bollard pull experiments at zero speed. This is shown in Figures 18 as pull (KN) against delivered power (KW). This presentation was chosen, since there was a large difference in revolutions between the two models. It can be seen that Model 349 has a slightly improved bollard pull over the full range of delivered powers.

A similar comparison is made in Figure 19 showing towforce against ship speed for contours of delivered power. This shows that Model 349 has slightly better towforce than Model 338, available up to about twelve knots.

It should be noted that the stock propellers 76 L, R have a very low blade area ratio when compared with the proposed propeller design. It is reasonable to assume that this will have some effect on the overall performance of the ship. The estimated performance of the ship, based on equivalent delivered thrust with a theoretical propeller design based on the as fitted design, is given in Tables 22 and 23. The propeller coefficients given are taken from Reference 4, which presents faired polynomial coefficients for thrust and torque coefficients for interpolating the Wageningen B-Screw series.

A comparison of the performance predictions derived from the model tests and the theoretical analysis, both with a correlation allowance of 0.0004, is shown in Figure 20.

The speed and revolutions predicted for the ship fitted with stock propellers, and propellers with a blade area the same as the proposed design are given below at a shaft power of 4640 KW, ETAT=0.97.

Propellers	Speed (knots)	Revolutions (r.p.m.)
76 L, R	15.22	185
B-Screws, BAR=0.696	15.08	178

Figure 21 shows a comparison of the axial flow velocities measured in wake survey tests in Models 349 and 338. It can be seen that for most angles, velocity components are very similar. However, in the region of the bossings there is some difference in the flow pattern. Whilst Model 349 does have a reduction in flow behind the propeller bossing, the maximum change in velocity is reduced. This would hopefully reduce the possibility of cavitation induced propeller excited vibration occurring.

6.0 CONCLUSIONS

Model 349 offers a very similar open water performance at the design power when compared to Model 338. The speed in open water is virtually identical to Model 338 but the available towforce is higher for a given power, up to about 12 knots. Model 349 also has a more uniform axial wake velocity than Model 338, which should reduce the possibility of cavitation induced propeller excited vibration.

7.0 REFERENCES

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2. Report of Performance Committee
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TABLE 1
LTR-SH-340
LIMITED

TYPE 1100 NAVIGATION AIDS VESSEL
MODEL 349
SUMMARY OF HYDROSTATIC
PARTICULARS
SCALE: 1:20

LENGTH OVERALL (L _{OA})	(M)	:	83.0
LENGTH BETWEEN PERPENDICULARS (L _{BP})	(M)	:	75.0
BEAM MOULDED (B)	(M)	:	16.2
DRAUGHT MOULDED (T)	(M)	:	5.75
TRIM	(M)	:	0
DISPLACEMENT (Δ)	TONNES	:	4662
VOLUME OF DISPLACEMENT (▽)	(M ³)	:	4544
WETTED SURFACE AREA (NAKED)	(M ²)	:	1544.6
WETTED SURFACE AREA (APPENDED)	(M ²)	:	1620.7
LCS (AFT OF MIDSHIPS)	(M)	:	1.09
KG (VERTICAL CENTRE OF GRAVITY)	(M)	:	6.21
KM _T (TRANSVERSE METACENTRIC HEIGHT)	(M)	:	7.54
KM _T (EXCLUDING FLUME TANKS)	(M)	:	1.14
TRANSVERSE RADIUS OF GYRATION 0.43B	(M)	:	6.97
LONGITUDINAL RADIUS OF GYRATION 0.25L _{BP}	(M)	:	18.75
		:	0.650
		:	0.934
		:	0.696
		:	0.857

TABLE 2
LTR-SH-340
LIMITED

PROPELLERS 76 L, R
DESIGN DETAILS
SCALE 1:20

DIAMETER	3600 mm
PITCH AT 0.7R	3050 mm
BLADE AREA RATIO	0.402
NUMBER OF BLADES	4
RAKE	15°
Bossing Length	890 mm
Bossing Forward Diameter	930 mm
Bossing Aft Diameter	810 mm
Propeller Centre	2270 mm fwd of aft perpendicular
Design	Sections and pitch distributions as 0.9 P/D Wageningen B-Screw.
WAKE SURVEY RAKE	
Leading Edge of Pitot Rake	2270 mm fwd A.P.
Fractional Radii	Radius mm
0.372	669.6
0.540	972.0
0.708	1274.4
0.877	1578.6
1.045	1881.0

MODEL NO. 349
 L = 75.00 m
 SHIP PREDICTIONS ARE FOR SALT WATER AT 15 DEG.C.

RESULTS OF RESISTANCE EXPERIMENTS
 5.75M TMLD LEVEL KEEL
 T = 5.75 m

TEST DATE 08-SEP-82
 TRIM = 0.00 m BY THE STERN
 SHIP MODEL CORRELATION ALLOWANCE 0.00000

DIMENSIONAL		COEFF. BASED ON LENGTH				COEFF. BASED ON DISPLACEMENT			
V	FE	FN	CTM(59)	CR	CTS	FNVOL	CTVOL	TAU	TAUR
KNOTS	KW		X1000	X1000	X1000		X100	X100	X100
4.50	48.	0.085	7.063	2.875	4.849	0.182	2.725	0.045	0.027
5.00	59.	0.095	6.553	2.454	4.399	0.202	2.473	0.050	0.028
5.50	74.	0.104	6.216	2.195	4.114	0.222	2.313	0.057	0.030
6.00	96.	0.114	6.154	2.202	4.098	0.242	2.304	0.068	0.036
6.50	120.	0.123	6.066	2.177	4.052	0.262	2.278	0.078	0.042
7.00	148.	0.133	5.957	2.125	3.981	0.283	2.238	0.089	0.048
7.50	179.	0.142	5.863	2.082	3.921	0.303	2.204	0.101	0.054
8.00	215.	0.152	5.792	2.058	3.881	0.323	2.181	0.114	0.060
8.50	256.	0.161	5.743	2.053	3.860	0.343	2.170	0.128	0.068
9.00	307.	0.171	5.750	2.100	3.894	0.363	2.189	0.145	0.078
9.50	367.	0.180	5.791	2.178	3.959	0.384	2.225	0.164	0.090
10.00	435.	0.190	5.830	2.252	4.021	0.404	2.260	0.184	0.103
10.50	512.	0.199	5.882	2.337	4.094	0.424	2.301	0.207	0.118
11.00	597.	0.209	5.918	2.404	4.150	0.444	2.333	0.230	0.133
11.50	685.	0.218	5.914	2.430	4.166	0.464	2.342	0.252	0.147
12.00	785.	0.228	5.934	2.477	4.203	0.485	2.363	0.277	0.163
12.50	920.	0.237	6.070	2.639	4.357	0.505	2.449	0.312	0.189
13.00	1078.	0.247	6.240	2.834	4.542	0.525	2.553	0.352	0.219
13.50	1284.	0.256	6.510	3.128	4.828	0.545	2.714	0.403	0.261
14.00	1566.	0.266	6.950	3.590	5.282	0.565	2.969	0.474	0.322
14.50	1928.	0.275	7.507	4.169	5.853	0.585	3.290	0.564	0.402
15.00	2471.	0.285	8.415	5.098	6.774	0.606	3.808	0.698	0.526
15.50	3114.	0.294	9.367	6.069	7.739	0.626	4.350	0.852	0.668
16.00	3864.	0.304	10.344	7.065	8.728	0.646	4.906	1.024	0.829

Table 3
 LTR-SH-340
 LIMITED

MODEL NO. 349

L = 75.00 m

SHIP PREDICTIONS ARE FOR SALT WATER AT 15 DEG.C.

RESULTS OF RESISTANCE EXPERIMENTS

5.75M TMLD LEVEL KEEL

T = 5.75 m

TEST DATE 08-SEP-82

TRIM = 0.00 m BY THE STERN

SHIP MODEL CORRELATION ALLOWANCE 0.00040

DIMENSIONAL		COEFF. BASED ON LENGTH				COEFF. BASED ON DISPLACEMENT			
V	PE	FN	CTM(59)	CR	CTS	FNVOL	CTVOL	TAU	TAUR
KNOTS	KW		X1000	X1000	X1000		X100	X100	X100
4.50	52.	0.085	7.063	2.875	5.249	0.182	2.950	0.049	0.027
5.00	65.	0.095	6.553	2.454	4.799	0.202	2.697	0.055	0.028
5.50	81.	0.104	6.216	2.195	4.514	0.222	2.537	0.063	0.030
6.00	105.	0.114	6.154	2.202	4.498	0.242	2.528	0.074	0.036
6.50	132.	0.123	6.066	2.177	4.452	0.262	2.503	0.086	0.042
7.00	162.	0.133	5.957	2.125	4.381	0.283	2.463	0.098	0.048
7.50	197.	0.142	5.863	2.082	4.321	0.303	2.429	0.111	0.054
8.00	237.	0.152	5.792	2.058	4.281	0.323	2.406	0.126	0.060
8.50	283.	0.161	5.743	2.053	4.260	0.343	2.395	0.141	0.068
9.00	338.	0.171	5.750	2.100	4.294	0.363	2.413	0.159	0.078
9.50	404.	0.180	5.791	2.178	4.359	0.384	2.450	0.180	0.090
10.00	478.	0.190	5.830	2.252	4.421	0.404	2.485	0.203	0.103
10.50	562.	0.199	5.882	2.337	4.494	0.424	2.526	0.227	0.118
11.00	655.	0.209	5.918	2.404	4.550	0.444	2.558	0.252	0.133
11.50	750.	0.218	5.914	2.430	4.566	0.464	2.566	0.277	0.147
12.00	860.	0.228	5.934	2.477	4.603	0.485	2.588	0.304	0.163
12.50	1004.	0.237	6.070	2.639	4.757	0.505	2.674	0.341	0.189
13.00	1173.	0.247	6.240	2.834	4.942	0.525	2.778	0.383	0.219
13.50	1390.	0.256	6.510	3.128	5.228	0.545	2.938	0.437	0.261
14.00	1685.	0.266	6.950	3.590	5.682	0.565	3.194	0.510	0.322
14.50	2060.	0.275	7.507	4.169	6.253	0.585	3.515	0.602	0.402
15.00	2617.	0.285	8.415	5.098	7.174	0.606	4.033	0.740	0.526
15.50	3275.	0.294	9.367	6.069	8.139	0.626	4.575	0.896	0.668
16.00	4041.	0.304	10.344	7.065	9.128	0.646	5.131	1.071	0.829

Table 4
LFR-SH-340
LIMITED

RESULTS OF OPEN WATER TESTS

Table 5
LTR-SH-340
LIMITED

PROPELLER 76LH,RH

P/D=0.847

TEST DATE: AUG-82

J	KT	10KQ	ETA0
0.000	0.293	0.373	0.000
0.050	0.286	0.360	0.063
0.075	0.281	0.354	0.095
0.100	0.276	0.347	0.127
0.125	0.271	0.340	0.159
0.150	0.266	0.333	0.190
0.175	0.260	0.327	0.222
0.200	0.254	0.320	0.253
0.225	0.248	0.313	0.284
0.250	0.242	0.306	0.315
0.275	0.235	0.299	0.345
0.300	0.229	0.292	0.374
0.325	0.222	0.284	0.403
0.350	0.214	0.277	0.431
0.375	0.207	0.269	0.459
0.400	0.199	0.261	0.486
0.425	0.192	0.253	0.512
0.450	0.184	0.245	0.537
0.475	0.176	0.237	0.561
0.500	0.167	0.228	0.585
0.525	0.159	0.219	0.607
0.550	0.150	0.209	0.628
0.575	0.141	0.200	0.648
0.600	0.132	0.190	0.667
0.625	0.123	0.179	0.683
0.650	0.114	0.168	0.699
0.675	0.104	0.157	0.711
0.700	0.094	0.145	0.721
0.725	0.084	0.133	0.728
0.750	0.073	0.120	0.730
0.775	0.063	0.107	0.725
0.800	0.052	0.093	0.710
0.825	0.041	0.078	0.678
0.850	0.029	0.063	0.618
0.875	0.017	0.047	0.499
0.900	0.005	0.031	0.217

MODEL NO. 349
L = 75.00 m

RESULTS OF PROPULSION EXPERIMENTS
PROPELLER NO. 76 L/R
T = 5.75 m
5.75M TMLD LK

TEST DATE 10-SEP-82
TRIM = 0.00 m BY THE STERN

SHIP PREDICTIONS ARE FOR SALT WATER AT 15 deg C

SHIP MODEL CORRELATION ALLOWANCE 0.00000

POWERS, SPEEDS AND PROPULSION FACTORS PREDICTED FOR MODEL TEST PROPELLER

V KNOTS	FN	PE KW	PD KW	NS RPM	ETA0	WFT	TH0F	ETA0	ETAR	ETAH
12.10	0.230	810.	1195.	132.1	0.678	0.115	0.189	0.720	1.027	0.917
13.11	0.249	1119.	1584.	144.7	0.706	0.117	0.169	0.716	1.046	0.942
13.58	0.258	1324.	1921.	151.2	0.689	0.130	0.183	0.709	1.034	0.940
14.04	0.267	1592.	2499.	158.1	0.637	0.133	0.162	0.704	0.935	0.967
14.59	0.277	2011.	3076.	167.5	0.654	0.142	0.148	0.693	0.949	0.993
15.12	0.287	2621.	4036.	180.4	0.649	0.144	0.147	0.677	0.962	0.997
15.61	0.296	3271.	5220.	193.5	0.627	0.142	0.157	0.662	0.964	0.982
16.15	0.307	4093.	6631.	207.6	0.617	0.136	0.153	0.649	0.969	0.981

MODEL NO. 349
L = 75.00 m

RESULTS OF PROPULSION EXPERIMENTS
PROPELLER NO. 76 L,R
T = 5.75 m
5.75M TMLD LK

TEST DATE 10-SEP-82
TRIM = 0.00 m BY THE STERN

SHIP PREDICTIONS ARE FOR SALT WATER AT 15 deg C

SHIP MODEL CORRELATION ALLOWANCE 0.00000

PROPELLER COEFFICIENTS

FN	CT-R(65.3) X1000	BEHIND MODEL			TEST PROPELLER			SERIES PROPELLER		
		JP	KTP	KQP X10	JOM	KTM	KQM X10	JOS	KTS	KQS X10
0.230	-1.667	0.786	0.096	0.144	0.695	0.096	0.148			
0.249	-1.635	0.778	0.100	0.145	0.686	0.100	0.152			
0.258	-1.622	0.770	0.106	0.154	0.670	0.106	0.159			
0.267	-1.612	0.762	0.110	0.175	0.660	0.110	0.164			
0.277	-1.597	0.747	0.117	0.181	0.641	0.117	0.172			
0.287	-1.584	0.719	0.127	0.190	0.616	0.127	0.183			
0.296	-1.572	0.692	0.135	0.199	0.594	0.135	0.192			
0.307	-1.560	0.668	0.141	0.205	0.577	0.141	0.199			

Table 7
LTR-SH-340
LIMITED

MODEL NO. 349
L = 75.00 m

RESULTS OF PROPULSION EXPERIMENTS
PROPELLER NO. 76 L,R
T = 5.75 m
5.75M TMLD LK

TEST DATE 10-SEP-82
TRIM = 0.00 m BY THE STERN

SHIP PREDICTIONS ARE FOR SALT WATER AT 15 deg C

SHIP MODEL CORRELATION ALLOWANCE 0.00000

NON-DIMENSIONAL PROPULSION COEFFICIENTS PREDICTED FOR MODEL TEST PROPELLER

FN	FNVOL	CDVOL X100	PDVOL X1000	NVOL	TAUT X1000	BP	DELTA
0.230	0.489	3.506	2.046	2.863	3.499	14.09	145.7
0.249	0.529	3.655	2.712	3.135	4.350	14.63	147.7
0.258	0.548	3.989	3.288	3.277	5.056	16.00	151.2
0.267	0.567	4.697	4.278	3.426	5.736	17.73	153.5
0.277	0.589	5.151	5.267	3.629	6.861	19.41	158.0
0.287	0.611	6.069	6.910	3.909	8.613	22.02	164.6
0.296	0.630	7.142	8.937	4.194	10.543	24.66	170.7
0.307	0.652	8.186	11.352	4.498	12.681	26.92	175.7

Table 8
LTR-SH-340
LIMITED

MODEL NO. 349
L = 75.00 m

RESULTS OF PROPULSION EXPERIMENTS
PROPELLER NO. 76 L,R
T = 5.75 m
5.75M TMLD LK

TEST DATE 10-SEP-82
TRIM = 0.00 m BY THE STERN

SHIP PREDICTIONS ARE FOR SALT WATER AT 15 deg C

SHIP MODEL CORRELATION ALLOWANCE 0.00040

POWERS, SPEEDS AND PROPULSION FACTORS PREDICTED FOR MODEL TEST PROPELLER

V KNOTS	FN	PE KW	PD KW	NS RPM	ETA _D	WFT	THDF	ETA _O	ETA _R	ETA _H
12.10	0.230	887.	1317.	134.7	0.673	0.114	0.187	0.715	1.026	0.918
13.11	0.249	1216.	1723.	147.0	0.706	0.117	0.162	0.711	1.045	0.950
13.58	0.258	1432.	2076.	153.6	0.690	0.130	0.175	0.704	1.033	0.949
14.04	0.267	1711.	2724.	161.1	0.628	0.133	0.167	0.697	0.938	0.961
14.59	0.277	2145.	3345.	170.6	0.641	0.142	0.156	0.686	0.950	0.984
15.12	0.287	2771.	4337.	183.3	0.639	0.143	0.149	0.671	0.959	0.993
15.61	0.296	3435.	5453.	195.6	0.630	0.142	0.149	0.657	0.966	0.993
16.15	0.307	4275.	6928.	209.8	0.617	0.136	0.148	0.644	0.970	0.987

MODEL NO. 349
L = 75.00 m

RESULTS OF PROPULSION EXPERIMENTS
PROPELLER NO. 76 L,R
T = 5.75 m
5.75M TMLD LK

TEST DATE 10-SEP-82
TRIM = 0.00 m BY THE STERN

SHIP PREDICTIONS ARE FOR SALT WATER AT 15 deg C

SHIP MODEL CORRELATION ALLOWANCE 0.00040

PROPELLER COEFFICIENTS

FN	CT-R(65.3) X1000	BEHIND MODEL			TEST PROPELLER			SERIES PROPELLER		
		JP	KTP	KQP X10	JOM	KTOM	KQOM X10	JOS	KTOS	KQOS X10
0.230	-1.267	0.771	0.101	0.149	0.683	0.101	0.153			
0.249	-1.235	0.765	0.104	0.150	0.675	0.104	0.157			
0.258	-1.222	0.759	0.110	0.159	0.660	0.110	0.164			
0.267	-1.212	0.748	0.114	0.180	0.648	0.114	0.169			
0.277	-1.197	0.734	0.121	0.187	0.630	0.121	0.177			
0.287	-1.184	0.708	0.130	0.195	0.606	0.130	0.187			
0.296	-1.172	0.684	0.137	0.202	0.587	0.137	0.195			
0.307	-1.160	0.660	0.143	0.208	0.570	0.143	0.202			

Table 10
LTR-SH-340
LIMITED

MODEL NO. 349
L = 75.00 m

RESULTS OF PROPULSION EXPERIMENTS

PROPELLER NO. 76 L,R

T = 5.75 m

5.75M TMLD LK

TEST DATE 10-SEP-82

TRIM = 0.00 m BY THE STERN

SHIP PREDICTIONS ARE FOR SALT WATER AT 15 deg C

SHIP MODEL CORRELATION ALLOWANCE 0.00040

NON-DIMENSIONAL PROPULSION COEFFICIENTS PREDICTED FOR MODEL TEST PROPELLER

FN	FNVOL	CDVOL X100	PDVOL X1000	NVOL	TAUT X1000	BP	DELTA
0.230	0.489	3.862	2.254	2.918	3.821	15.04	148.4
0.249	0.529	3.975	2.950	3.186	4.692	15.51	150.1
0.258	0.548	4.311	3.553	3.328	5.419	16.91	153.6
0.267	0.567	5.120	4.663	3.491	6.205	18.84	156.4
0.277	0.589	5.601	5.727	3.697	7.387	20.61	161.0
0.287	0.611	6.521	7.425	3.972	9.131	23.13	167.1
0.296	0.630	7.460	9.335	4.239	10.964	25.52	172.6
0.307	0.652	8.553	11.861	4.547	13.167	27.83	177.7

RESULTS OF OVERLOAD EXPERIMENTS

MODEL NO. 349
L = 75.00 m

PROPELLER NO. 76 L/R
T = 5.75 m

TEST DATE 09-SEP-82
TRIM = 0.00 m BY THE STERN

SHIP PREDICTIONS ARE FOR SALT WATER AT 15 deg C

SHIP MODEL CORRELATION ALLOWANCE 0.00040

POWERS, SPEEDS AND TOW FORCES PREDICTED FOR MODEL TEST PROPELLER

V KNOTS	FN	PD KW	NS RPM	TH KN	FP KN	ETA0	WFT	THDF	ETA0	ETAR	FP/PD N/KW
0.00	0.000	1388.	100.0	260.3	252.3	0.000	0.000	0.031	0.000	0.973	181.79
0.00	0.000	1832.	110.0	316.8	307.7	0.000	0.000	0.029	0.000	0.981	167.95
0.00	0.000	2361.	120.0	378.9	368.1	0.000	0.000	0.029	0.000	0.988	155.89
0.00	0.000	2983.	130.0	446.6	433.5	0.000	0.000	0.029	0.000	0.994	145.30
0.00	0.000	3706.	140.0	519.9	503.9	0.000	0.000	0.031	0.000	0.999	135.96
0.00	0.000	4538.	150.0	598.8	579.8	0.000	0.000	0.032	0.000	1.004	127.75
0.00	0.000	5488.	160.0	683.3	661.7	0.000	0.000	0.032	0.000	1.007	120.56
4.04	0.077	1092.	100.0	197.5	166.7	0.355	-0.089	0.059	0.462	0.887	152.69
4.04	0.077	1923.	120.0	305.5	263.5	0.306	-0.125	0.075	0.403	0.922	136.99
4.04	0.077	3083.	140.0	436.5	389.2	0.276	-0.151	0.065	0.357	0.951	126.22
4.04	0.077	3804.	150.0	510.7	456.7	0.260	-0.162	0.068	0.337	0.963	120.04
4.04	0.077	4630.	160.0	590.7	533.8	0.249	-0.171	0.064	0.319	0.973	115.30
4.04	0.077	5083.	165.0	632.8	577.4	0.244	-0.174	0.057	0.311	0.978	113.58
4.04	0.077	5321.	167.5	654.4	598.5	0.242	-0.176	0.056	0.307	0.981	112.47
8.01	0.152	1384.	120.0	214.5	131.5	0.563	0.066	0.119	0.615	0.970	94.97
8.01	0.152	2424.	140.0	335.3	244.7	0.514	0.050	0.098	0.553	0.980	100.98
8.01	0.152	3830.	160.0	478.8	377.3	0.468	0.036	0.092	0.500	0.992	98.51
8.01	0.152	4247.	165.0	518.4	414.1	0.458	0.034	0.090	0.488	0.996	97.50
8.01	0.152	4692.	170.0	559.5	451.8	0.447	0.032	0.090	0.476	0.999	96.28
8.01	0.152	5168.	175.0	602.2	488.5	0.435	0.030	0.093	0.465	1.001	94.51
12.10	0.230	1594.	140.0	207.4	27.0	0.662	0.112	0.183	0.703	1.023	16.95
12.10	0.230	2890.	160.0	343.4	149.5	0.629	0.108	0.150	0.651	1.014	51.71
12.10	0.230	3712.	170.0	419.8	223.1	0.613	0.106	0.129	0.625	1.008	60.11
12.10	0.230	4664.	180.0	501.1	298.2	0.588	0.103	0.121	0.600	1.000	63.93
12.10	0.230	5192.	185.0	543.6	334.3	0.572	0.101	0.123	0.589	0.996	64.39
13.11	0.249	2590.	160.0	306.1	76.2	0.668	0.118	0.162	0.680	1.034	29.43
13.11	0.249	3386.	170.0	382.1	142.3	0.643	0.117	0.156	0.655	1.027	42.02
13.11	0.249	4310.	180.0	463.2	222.4	0.630	0.115	0.131	0.630	1.018	51.60
13.11	0.249	4825.	185.0	505.5	263.4	0.621	0.114	0.123	0.619	1.013	54.59
13.11	0.249	5377.	190.0	549.1	302.5	0.606	0.113	0.121	0.607	1.007	56.26

Table 12
LFR-SH-340
LIMITED

MODEL NO. 349
L = 75.00 m

RESULTS OF OVERLOAD EXPERIMENTS
PROPELLER NO. 76 L,R
T = 5.75 m

TEST DATE 10-SEP-82
TRIM = 0.00 m BY THE STERN

SHIP PREDICTIONS ARE FOR SALT WATER AT 15 deg C

SHIP MODEL CORRELATION ALLOWANCE 0.00040

POWERS, SPEEDS AND TOW FORCES PREDICTED FOR MODEL TEST PROPELLER

V KNOTS	FN	FD KW	NS RPM	TH KN	FP KN	ETAD	WFT	THDF	ETAD	ETAR	FP/FD N/KW
13.58	0.258	2527.	160.0	294.0	44.7	0.690	0.130	0.151	0.689	1.027	17.67
13.58	0.258	3319.	170.0	368.4	115.8	0.675	0.127	0.130	0.665	1.018	34.89
13.58	0.258	4231.	180.0	448.8	190.6	0.653	0.126	0.119	0.641	1.012	45.05
13.58	0.258	4736.	185.0	491.1	228.5	0.640	0.125	0.118	0.629	1.009	48.23
13.58	0.258	5278.	190.0	535.2	265.1	0.622	0.124	0.122	0.617	1.006	50.22
14.04	0.267	3452.	170.0	351.0	59.3	0.620	0.132	0.156	0.677	0.942	17.18
14.04	0.267	3904.	175.0	390.2	95.0	0.614	0.131	0.150	0.665	0.944	24.32
14.04	0.267	4387.	180.0	430.6	131.7	0.607	0.130	0.144	0.654	0.944	30.02
14.04	0.267	4900.	185.0	472.3	168.7	0.598	0.128	0.142	0.642	0.946	34.42
14.04	0.267	5441.	190.0	515.5	204.7	0.586	0.127	0.143	0.631	0.947	37.62
14.59	0.277	4219.	180.0	414.4	59.7	0.615	0.142	0.167	0.664	0.953	14.15
14.59	0.277	4467.	182.5	435.5	78.5	0.612	0.142	0.164	0.658	0.955	17.56
14.59	0.277	4721.	185.0	456.9	98.6	0.611	0.142	0.159	0.652	0.956	20.88
14.59	0.277	4982.	187.5	478.7	119.4	0.611	0.142	0.154	0.646	0.958	23.97
14.59	0.277	5252.	190.0	500.9	140.4	0.609	0.142	0.150	0.640	0.960	26.74
15.12	0.287	4410.	184.0	424.1	5.3	0.638	0.143	0.148	0.670	0.958	1.20
15.12	0.287	4624.	186.0	441.1	21.7	0.636	0.143	0.144	0.665	0.957	4.69
15.12	0.287	4844.	188.0	458.6	39.5	0.636	0.143	0.138	0.660	0.957	8.15
15.12	0.287	5068.	190.0	476.5	58.0	0.636	0.143	0.131	0.656	0.956	11.44
15.12	0.287	5291.	192.0	494.7	76.6	0.637	0.144	0.126	0.651	0.958	14.49

Table 13
LFR-SH-340
LIMITED

MODEL NO. 349
L = 75.00 m

RESULTS OF OVERLOAD EXPERIMENTS
PROPELLER NO. 76 L,R
T = 5.75 m

TEST DATE 09-SEP-82
TRIM = 0.00 m BY THE STERN

SHIP PREDICTIONS ARE FOR SALT WATER AT 15 deg C

SHIP MODEL CORRELATION ALLOWANCE 0.00040

PROPELLER COEFFICIENTS

FN	CT-R(65.7) X1000	BEHIND MODEL			TEST PROPELLER			
		JF	KTP	KQP X10	ZETO	JOM	KTOM	KQOM X10
0.000	0.000	0.000	0.272	0.384	0.603	0.000	0.294	0.374
0.000	0.000	0.000	0.273	0.381	0.610	0.000	0.294	0.374
0.000	0.000	0.000	0.275	0.378	0.616	0.000	0.294	0.374
0.000	0.000	0.000	0.276	0.376	0.621	0.000	0.294	0.374
0.000	0.000	0.000	0.277	0.374	0.626	0.000	0.294	0.374
0.000	0.000	0.000	0.278	0.372	0.630	0.000	0.294	0.374
0.000	0.000	0.000	0.279	0.371	0.633	0.000	0.294	0.374
0.077	46.737	0.347	0.206	0.302	0.537	0.378	0.206	0.268
0.077	74.918	0.289	0.222	0.308	0.569	0.325	0.222	0.284
0.077	111.506	0.248	0.233	0.311	0.594	0.285	0.233	0.296
0.077	131.170	0.231	0.237	0.312	0.604	0.269	0.237	0.301
0.077	153.610	0.217	0.241	0.313	0.613	0.254	0.241	0.305
0.077	166.313	0.210	0.243	0.313	0.617	0.247	0.243	0.307
0.077	172.448	0.207	0.244	0.314	0.619	0.244	0.244	0.308
0.152	8.327	0.572	0.156	0.222	0.498	0.535	0.156	0.215
0.152	16.748	0.491	0.179	0.245	0.536	0.466	0.179	0.240
0.152	26.603	0.429	0.195	0.259	0.564	0.414	0.195	0.257
0.152	29.335	0.416	0.199	0.262	0.570	0.402	0.199	0.261
0.152	32.139	0.404	0.202	0.265	0.575	0.391	0.202	0.264
0.152	34.863	0.392	0.205	0.267	0.581	0.381	0.205	0.267
0.230	-0.389	0.742	0.110	0.161	0.438	0.658	0.110	0.165
0.230	3.592	0.649	0.140	0.195	0.488	0.579	0.140	0.198
0.230	5.988	0.611	0.152	0.209	0.505	0.546	0.152	0.211
0.230	8.427	0.577	0.162	0.222	0.517	0.517	0.162	0.222
0.230	9.602	0.561	0.166	0.227	0.522	0.505	0.166	0.226
0.249	0.876	0.703	0.125	0.175	0.468	0.620	0.125	0.181
0.249	2.707	0.662	0.138	0.191	0.488	0.584	0.138	0.196
0.249	4.927	0.625	0.149	0.205	0.504	0.553	0.149	0.208
0.249	6.061	0.608	0.154	0.211	0.510	0.539	0.154	0.214
0.249	7.145	0.592	0.159	0.217	0.516	0.525	0.159	0.219

Table 14
LTR-SH-340
LIMITED

MODEL NO. 349
L = 75.00 m

RESULTS OF OVERLOAD EXPERIMENTS
PROPELLER NO. 76 L,R
T = 5.75 m

TEST DATE 10-SEP-82
TRIM = 0.00 m BY THE STERN

SHIP PREDICTIONS ARE FOR SALT WATER AT 15 deg C

SHIP MODEL CORRELATION ALLOWANCE 0.00040

PROPELLER COEFFICIENTS

FN	CT-R(65.3) X1000	BEHIND MODEL				TEST PROPELLER		
		JP	KTP	KQP X10	ZETO	JOM	KTOM	KQOM X10
0.258	-0.071	0.728	0.120	0.171	0.457	0.634	0.120	0.176
0.258	1.766	0.685	0.133	0.187	0.477	0.598	0.133	0.190
0.258	3.699	0.647	0.145	0.201	0.494	0.566	0.145	0.203
0.258	4.676	0.630	0.150	0.207	0.502	0.551	0.150	0.209
0.258	5.622	0.613	0.155	0.213	0.509	0.537	0.155	0.214
0.267	0.222	0.708	0.127	0.195	0.443	0.615	0.127	0.183
0.267	1.083	0.688	0.133	0.202	0.454	0.598	0.133	0.190
0.267	1.971	0.669	0.139	0.208	0.463	0.582	0.139	0.197
0.267	2.864	0.651	0.144	0.214	0.472	0.567	0.144	0.203
0.267	3.735	0.634	0.149	0.220	0.480	0.553	0.149	0.208
0.277	0.139	0.695	0.134	0.200	0.457	0.597	0.134	0.191
0.277	0.558	0.686	0.137	0.204	0.463	0.589	0.137	0.194
0.277	1.008	0.677	0.139	0.207	0.468	0.581	0.139	0.197
0.277	1.474	0.668	0.142	0.209	0.473	0.573	0.142	0.201
0.277	1.944	0.659	0.145	0.212	0.478	0.565	0.145	0.204
0.287	-1.074	0.705	0.131	0.196	0.455	0.604	0.131	0.188
0.287	-0.732	0.698	0.133	0.199	0.458	0.598	0.133	0.191
0.287	-0.362	0.690	0.136	0.202	0.462	0.591	0.136	0.193
0.287	0.024	0.683	0.138	0.205	0.465	0.585	0.138	0.196
0.287	0.412	0.676	0.140	0.207	0.470	0.579	0.140	0.198

Table 15
LFR-SH-340
LIMITED

Table 16
LTR-SH-340
LIMITED

MODEL 349

WAKE SURVEY EXPERIMENTS

FLOW DIRECTION COMPONENTS

AXIAL VELOCITY, V_x/V , Positive bow to stern

RADIAL VELOCITY, V_r/V , Positive towards shaft centre line

TANGENTIAL VELOCITY, T_t/V , Positive Counter clockwise looking
forward from behind the propeller.

SHIP VELOCITY, V , Positive Forwards.

CALCULATION OF VELOCITY COMPONENT FROM FOURIER ANALYSIS.

$$V(\theta)/V = C_0 + \sum C_K \cdot \sin (K\theta + \phi_K)$$

- C_0 = constant
- C_K = constant
- K = integer ≥ 1
- ϕ_K = phase angle

FOURIER ANALYSIS OF WAKE COMPONENTS
 =====

MODEL 349 5.75M TMLD LK 15 KNOTS

R/RMAX = 0.372

K	AXIAL COMPONENT: V_x/V		TANGENTIAL COMPONENT: V_t/V		RADIAL COMPONENT: V_r/V	
	C(K)	PHI(K) (deg)	C(K)	PHI(K) (deg)	C(K)	PHI(K) (deg)
0	0.82782		-0.06103		0.07168	
1	0.14997	-87.13	0.33245	-173.92	0.12526	-103.82
2	0.08039	-65.69	0.06297	-171.16	0.05215	152.84
3	0.06928	-56.52	0.04401	-170.51	0.03476	-178.80
4	0.06030	-35.51	0.03470	-163.09	0.02420	-157.00
5	0.04187	-19.64	0.01762	-150.59	0.01617	-138.81
6	0.02757	-16.63	0.01843	-115.76	0.01036	-105.82
7	0.01434	-10.71	0.01278	-96.33	0.00623	-80.84
8	0.00495	-0.02	0.00600	-92.63	0.00472	-40.03
9	0.00151	-23.72	0.00504	-31.59	0.00497	-6.05
10	0.00281	-97.68	0.00515	-71.46	0.00383	7.54
11	0.00406	-93.07	0.00239	-91.25	0.00373	39.60
12	0.00358	-83.08	0.00205	-70.37	0.00329	59.13
13	0.00248	-78.95	0.00213	-60.84	0.00220	79.47
14	0.00107	-95.66	0.00204	-72.26	0.00157	104.15
15	0.00114	-154.94	0.00108	-64.16	0.00132	126.37
16	0.00182	-161.83	0.00118	-39.36	0.00102	152.06
17	0.00219	-154.91	0.00098	-34.61	0.00096	164.83
18	0.00204	-144.05	0.00073	-19.29	0.00075	173.62
19	0.00153	-131.69	0.00057	0.25	0.00066	-168.94
20	0.00088	-115.76	0.00043	9.08	0.00061	-167.48

FOURIER ANALYSIS OF WAKE COMPONENTS

MODEL 349 5.75M TMLD LK 15 KNOTS

R/RMAX = 0.540

K	AXIAL COMPONENT: V_x/V		TANGENTIAL COMPONENT: V_t/V		RADIAL COMPONENT: V_r/V	
	C(K)	PHI(K) (deg)	C(K)	PHI(K) (deg)	C(K)	PHI(K) (deg)
0	0.85074		-0.03073		0.06467	
1	0.10575	-96.66	0.30274	-156.94	0.18277	-91.80
2	0.04747	-56.83	0.05422	-96.28	0.03544	-172.40
3	0.03259	-10.85	0.03047	-71.19	0.03873	-163.27
4	0.02261	-0.71	0.02040	-40.43	0.03315	-133.92
5	0.01932	29.92	0.01235	-22.81	0.02361	-111.42
6	0.01357	52.83	0.00447	-31.61	0.01594	-79.82
7	0.00539	55.67	0.00368	-14.27	0.01300	-44.06
8	0.00466	25.43	0.00483	-49.18	0.01011	-9.81
9	0.00738	25.37	0.00334	4.24	0.00702	23.32
10	0.00728	49.34	0.00416	15.43	0.00519	59.16
11	0.00699	78.51	0.00317	61.52	0.00280	102.53
12	0.00546	103.01	0.00265	92.99	0.00199	159.03
13	0.00431	139.67	0.00191	125.45	0.00148	-136.77
14	0.00287	175.55	0.00154	179.10	0.00170	-89.64
15	0.00181	-118.39	0.00090	-149.42	0.00158	-44.51
16	0.00144	-43.48	0.00093	-96.41	0.00152	-9.91
17	0.00203	23.55	0.00056	-55.72	0.00115	26.62
18	0.00225	68.37	0.00051	-12.04	0.00082	63.94
19	0.00243	109.49	0.00035	30.30	0.00046	111.53
20	0.00213	146.72	0.00028	80.67	0.00027	-170.24

FOURIER ANALYSIS OF WAKE COMPONENTS

=====

MODEL 349 5.75M TMLD LK 15 KNOTS R/RMAX = 0.708

K	AXIAL COMPONENT: V_x/V		TANGENTIAL COMPONENT: V_t/V		RADIAL COMPONENT: V_r/V	
	C(K)	PHI(K) (deg)	C(K)	PHI(K) (deg)	C(K)	PHI(K) (deg)
0	0.85401		-0.08713		0.01026	
1	0.10314	-90.22	0.27436	-154.59	0.20133	-82.11
2	0.02338	-52.85	0.05869	-78.96	0.00703	-73.29
3	0.01544	16.12	0.04003	-29.81	0.01174	179.60
4	0.01634	63.85	0.02483	-8.10	0.01472	-143.29
5	0.02100	100.08	0.02072	40.29	0.01312	-110.12
6	0.01511	139.98	0.01300	78.21	0.01201	-80.98
7	0.01228	-175.20	0.01001	113.62	0.00756	-48.86
8	0.01126	-130.33	0.00446	151.45	0.00594	-7.49
9	0.01103	-83.98	0.00415	-113.56	0.00423	31.47
10	0.01030	-44.90	0.00515	-88.77	0.00344	84.63
11	0.00903	-5.45	0.00317	-60.65	0.00328	126.11
12	0.00803	37.29	0.00213	-13.10	0.00260	169.28
13	0.00718	79.98	0.00136	25.94	0.00196	-142.75
14	0.00660	121.33	0.00060	111.76	0.00161	-89.81
15	0.00601	160.38	0.00105	165.12	0.00126	-41.31
16	0.00535	-160.87	0.00089	-171.45	0.00099	11.68
17	0.00477	-121.88	0.00057	-137.88	0.00082	59.88
18	0.00430	-82.98	0.00034	-101.58	0.00063	108.80
19	0.00392	-44.24	0.00014	-54.42	0.00050	155.73
20	0.00360	-5.69	0.00010	26.68	0.00039	-157.86

FOURIER ANALYSIS OF WAKE COMPONENTS

=====

MODEL 349 5.75M TMLD LK 15 KNOTS

R/RMAX = 0.876

AXIAL COMPONENT: V_x/V			TANGENTIAL COMPONENT: V_t/V		RADIAL COMPONENT: V_r/V	
K	C(K)	PHI(K) (deg)	C(K)	PHI(K) (deg)	C(K)	PHI(K) (deg)
0	0.84182		-0.03327		0.02034	
1	0.11279	-82.49	0.26459	-158.22	0.21661	-78.43
2	0.02520	-61.60	0.05877	-89.68	0.02381	-15.81
3	0.01320	47.72	0.03368	-40.61	0.01232	63.05
4	0.01892	80.51	0.02481	-5.40	0.00350	145.80
5	0.02018	118.96	0.01217	38.35	0.00480	-149.58
6	0.02108	155.97	0.01199	74.14	0.00519	-69.41
7	0.01900	-168.25	0.00929	121.68	0.00347	-18.09
8	0.01618	-128.58	0.00670	168.39	0.00224	37.88
9	0.01392	-86.20	0.00449	-144.41	0.00157	96.98
10	0.01236	-43.02	0.00301	-99.13	0.00091	161.10
11	0.01121	-1.52	0.00217	-49.76	0.00092	-152.36
12	0.01002	38.26	0.00173	-2.11	0.00076	-101.65
13	0.00862	77.68	0.00151	46.34	0.00079	-71.12
14	0.00716	117.81	0.00129	97.47	0.00063	-36.31
15	0.00576	159.18	0.00110	143.85	0.00062	-5.14
16	0.00459	-157.91	0.00086	-167.18	0.00048	27.76
17	0.00362	-114.51	0.00064	-118.53	0.00042	68.30
18	0.00280	-70.71	0.00044	-66.92	0.00029	105.57
19	0.00210	-25.87	0.00033	-12.42	0.00022	155.80
20	0.00153	21.14	0.00027	45.29	0.00015	-164.26

FOURIER ANALYSIS OF WAKE COMPONENTS

=====

MODEL 349 5.75M TMLD LK 15 KNOTS

R/RMAX = 1.044

K	AXIAL COMPONENT: V_x/V		TANGENTIAL COMPONENT: V_t/V		RADIAL COMPONENT: V_r/V	
	C(K)	PHI(K) (deg)	C(K)	PHI(K) (deg)	C(K)	PHI(K) (deg)
0	0.83080		-0.04688		0.00481	
1	0.16594	-78.78	0.25413	-161.27	0.22582	-77.89
2	0.05673	-56.95	0.05083	-95.15	0.03581	-28.80
3	0.02475	10.80	0.03108	-40.45	0.01903	69.47
4	0.03550	59.28	0.02427	-2.65	0.00819	129.42
5	0.03273	94.46	0.01108	50.66	0.00691	-139.27
6	0.02851	127.18	0.00877	91.87	0.00847	-87.46
7	0.02573	160.30	0.00830	139.97	0.00676	-44.20
8	0.02226	-164.00	0.00462	168.53	0.00649	-0.36
9	0.01947	-125.86	0.00395	-134.86	0.00516	36.27
10	0.01691	-87.24	0.00237	-78.12	0.00463	76.78
11	0.01437	-48.03	0.00241	-33.81	0.00386	112.35
12	0.01203	-7.83	0.00156	20.81	0.00333	148.76
13	0.01009	33.47	0.00133	57.58	0.00259	-175.86
14	0.00850	75.91	0.00076	118.47	0.00202	-137.72
15	0.00722	118.73	0.00058	154.33	0.00145	-97.01
16	0.00619	161.49	0.00038	-132.97	0.00110	-52.49
17	0.00531	-155.48	0.00024	-114.22	0.00079	-5.92
18	0.00459	-112.53	0.00015	-32.68	0.00064	41.73
19	0.00396	-69.63	0.00007	-8.43	0.00051	86.85
20	0.00340	-26.27	0.00005	64.66	0.00041	129.00

Table 21
LTR-SH-340
LIMITED

MODEL NO. 349
L = 75.00 m

RESULTS OF PROPULSION EXPERIMENTS
PROPELLER NO. 76 L/R
T = 5.75 m
5.75M TMLD LK

TEST DATE 10-SEP-82
TRIM = 0.00 m BY THE STERN

SHIP PREDICTIONS ARE FOR SALT WATER AT 15 deg C

SHIP MODEL CORRELATION ALLOWANCE 0.00040

POWERS, SPEEDS AND PROPULSION FACTORS PREDICTED FOR SERIES PROPELLER

F/D = 0.847

B-SCREW SERIES, BAR=0.696
BAR = 0.696

4 BLADES

V KNOTS	FN	PE KW	PD KW	NS RPM	ETA _D	WFT	THDF	ETA _O	ETA _R	ETA _H
12.10	0.230	887.	1435.	132.8	0.618	0.114	0.187	0.656	1.026	0.918
13.11	0.249	1216.	1871.	144.8	0.650	0.117	0.162	0.655	1.045	0.950
13.58	0.258	1432.	2236.	150.9	0.640	0.130	0.175	0.653	1.033	0.949
14.04	0.267	1711.	2920.	158.0	0.586	0.133	0.167	0.651	0.938	0.961
14.59	0.277	2145.	3560.	166.8	0.603	0.142	0.156	0.645	0.950	0.984
15.12	0.287	2771.	4577.	178.6	0.605	0.143	0.149	0.636	0.959	0.993
15.61	0.296	3435.	5718.	189.9	0.601	0.142	0.149	0.627	0.966	0.993
16.15	0.307	4275.	7230.	203.2	0.591	0.136	0.148	0.618	0.970	0.987

Table 22
LTR-SH-340
LIMITED

RESULTS OF PROPULSION EXPERIMENTS

MODEL NO. 349
L = 75.00 m

PROPELLER NO. 76 L,R
T = 5.75 m
5.75M TMLD LK

TEST DATE 10-SEP-82
TRIM = 0.00 m BY THE STERN

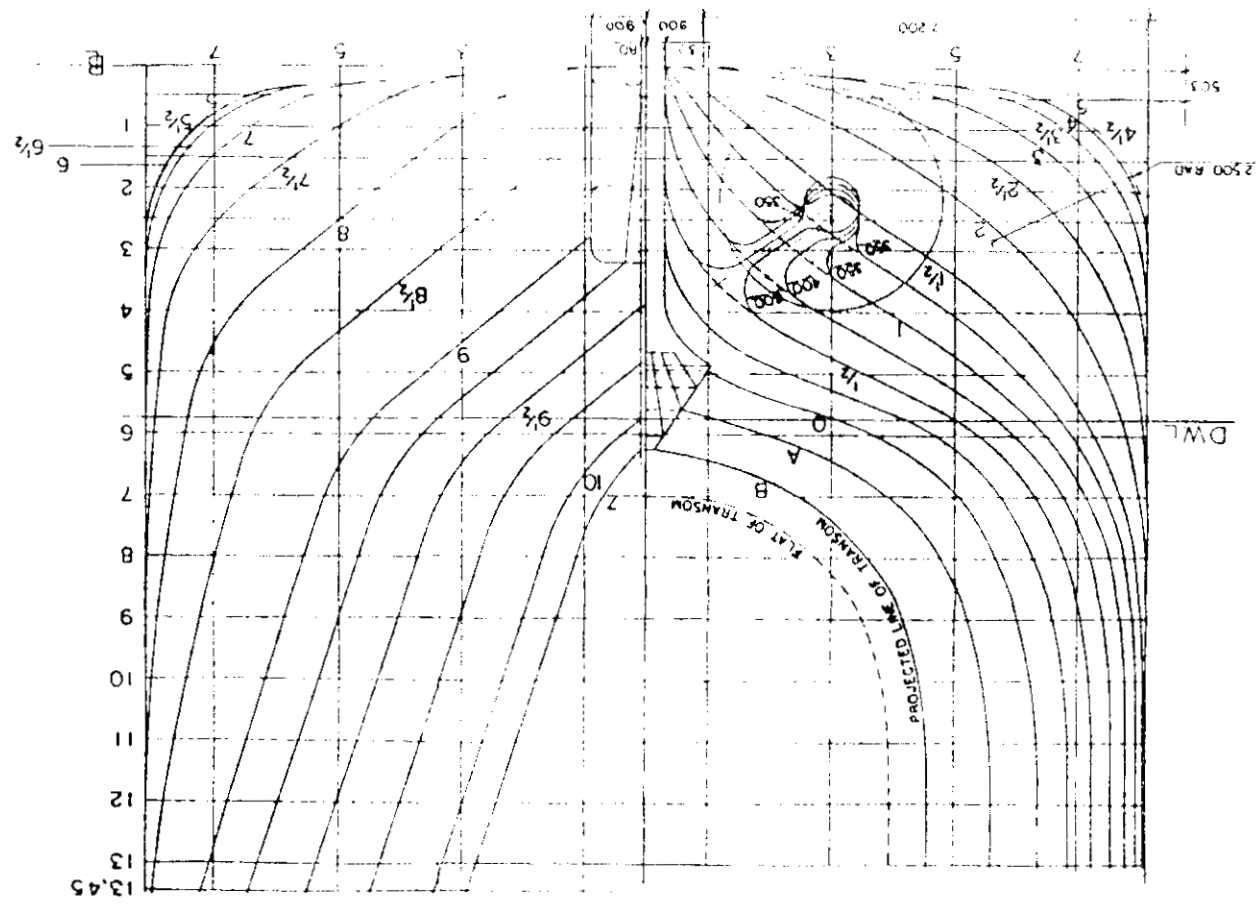
SHIP PREDICTIONS ARE FOR SALT WATER AT 15 deg C

SHIP MODEL CORRELATION ALLOWANCE 0.00040

NON-DIMENSIONAL PROPULSION COEFFICIENTS PREDICTED FOR SERIES PROPELLER
B-SCREW SERIES, BAR=0.696
F/D = 0.847
BAR = 0.696
4 BLADES

FN	FN VOL	CD VOL X100	PD VOL X1000	NVOL	TAUT X1000	BP	DELTA
0.230	0.489	4.210	2.457	2.877	3.821	15.48	146.3
0.249	0.529	4.316	3.202	3.138	4.692	15.91	147.8
0.258	0.548	4.645	3.829	3.270	5.419	17.24	150.9
0.267	0.567	5.489	4.999	3.424	6.205	19.13	153.3
0.277	0.589	5.960	6.094	3.615	7.387	20.79	157.4
0.287	0.611	6.882	7.836	3.870	9.131	23.15	162.8
0.296	0.630	7.823	9.790	4.116	10.964	25.38	167.6
0.307	0.652	8.925	12.377	4.402	13.167	27.53	172.0

FIGURE 1
LTR SH 340
LIMITED



BODY PLAN
M 349

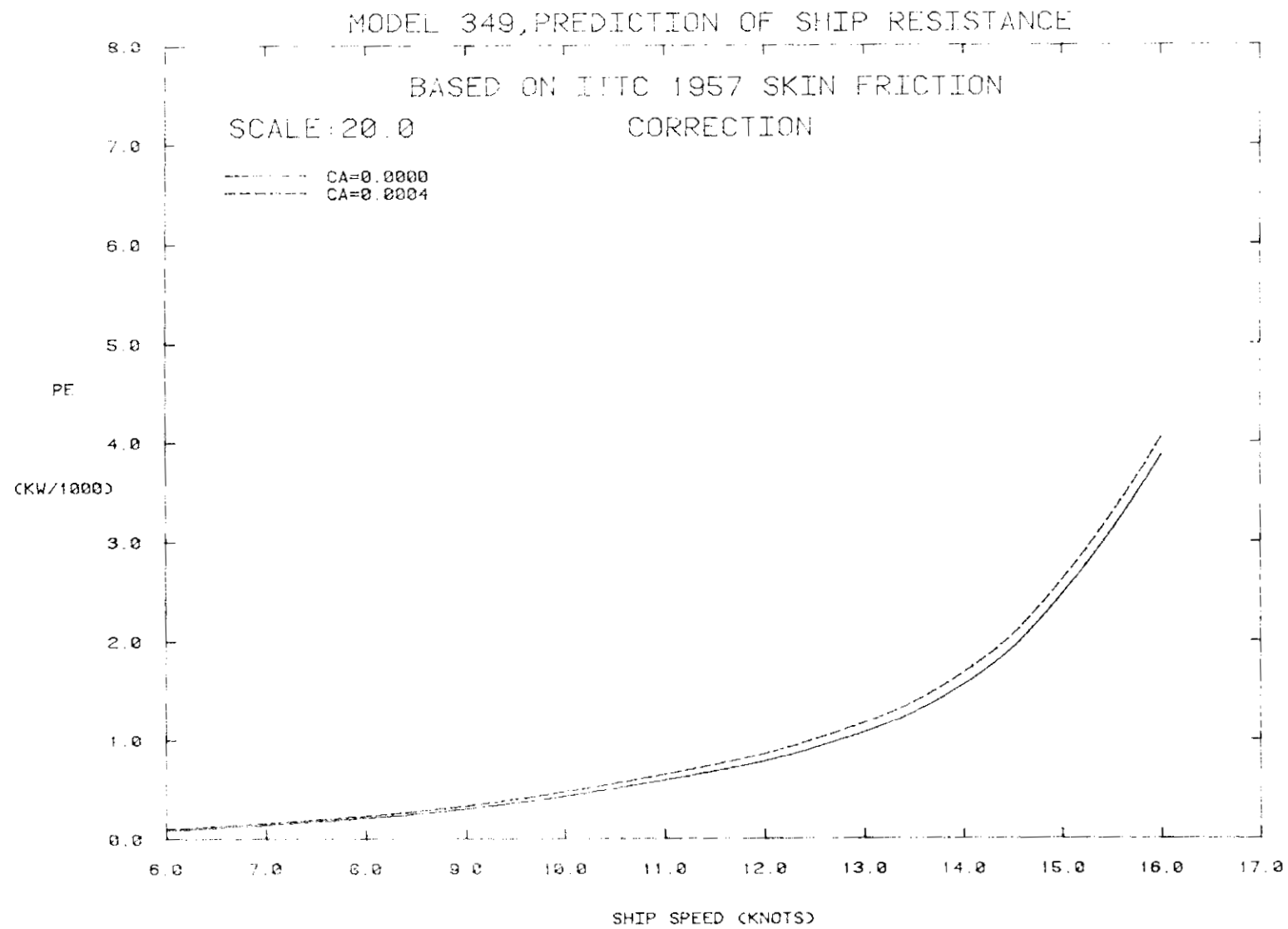


FIG. 4
 LR-340
 LIMITED

PROPELLERS 76 LH,RH OPEN WATER EXPERIMENTS

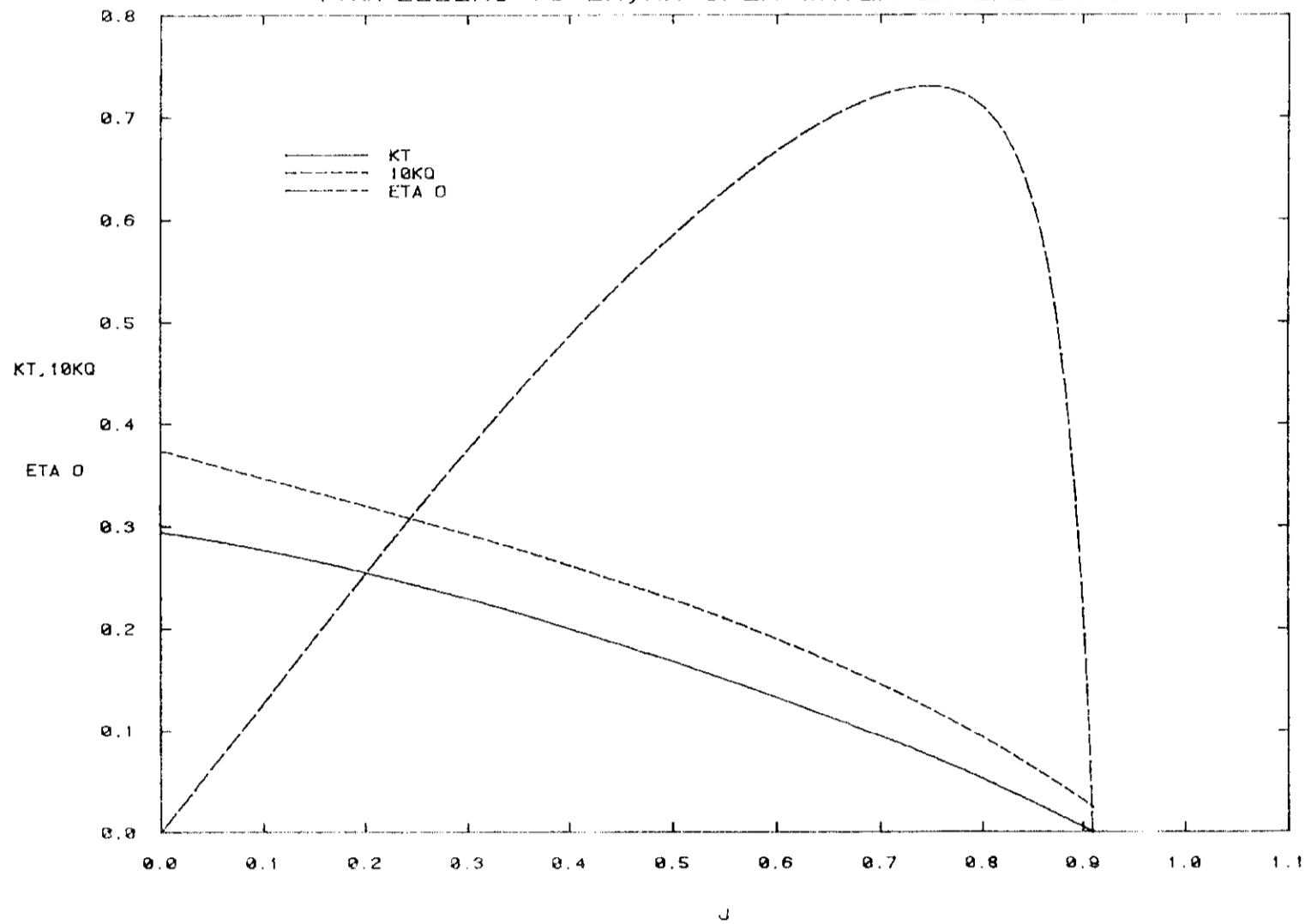


FIG. 5
LIR-SH-340
LIMITED

MODEL 349, PREDICTION OF SHIP PERFORMANCE

BASED ON ITTC 1957 SKIN FRICTION CORRECTION

SCALE: 20.0

CA=0.0000
CA=0.0004

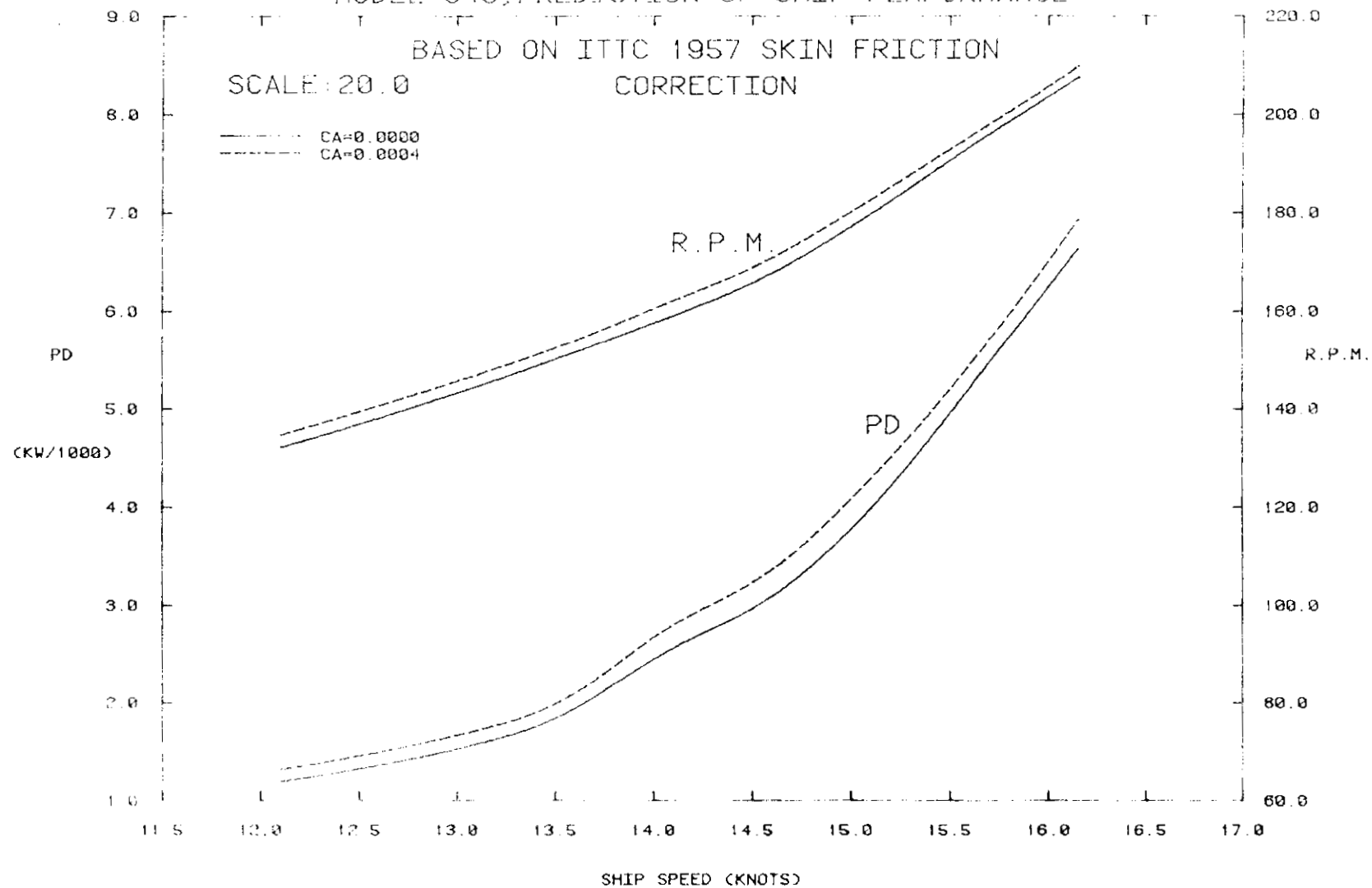


FIG. 6
LIR-SH-340
LIMITED

MODEL 349, PROPULSION FACTORS AT SHIP PROPULSION POINT

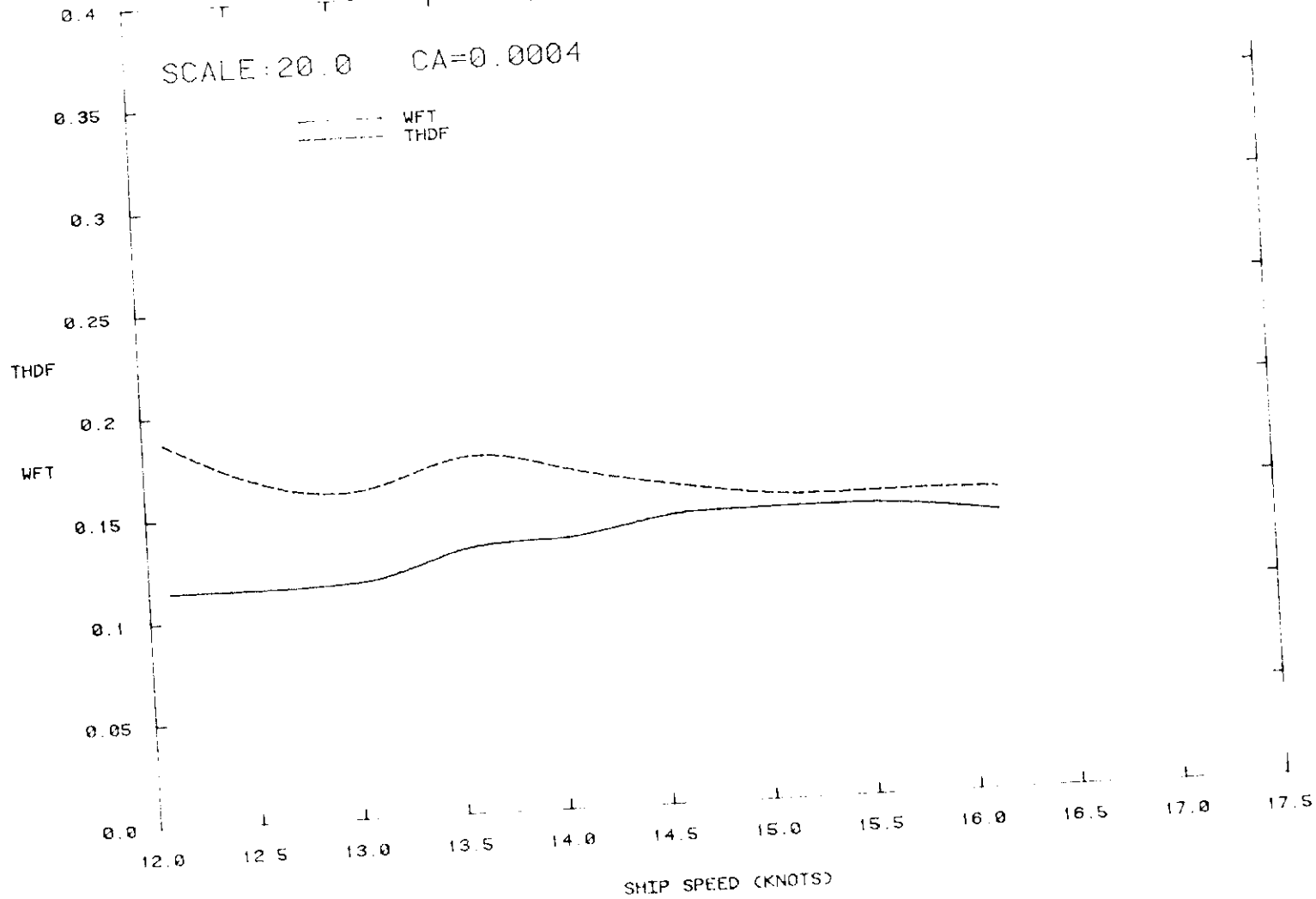


FIG. 7
LTR-SH-340
LIMITED

MODEL 349, PROPULSION FACTORS AT SHIP PROPULSION POINT

SCALE: 20.0 CA=0.0004

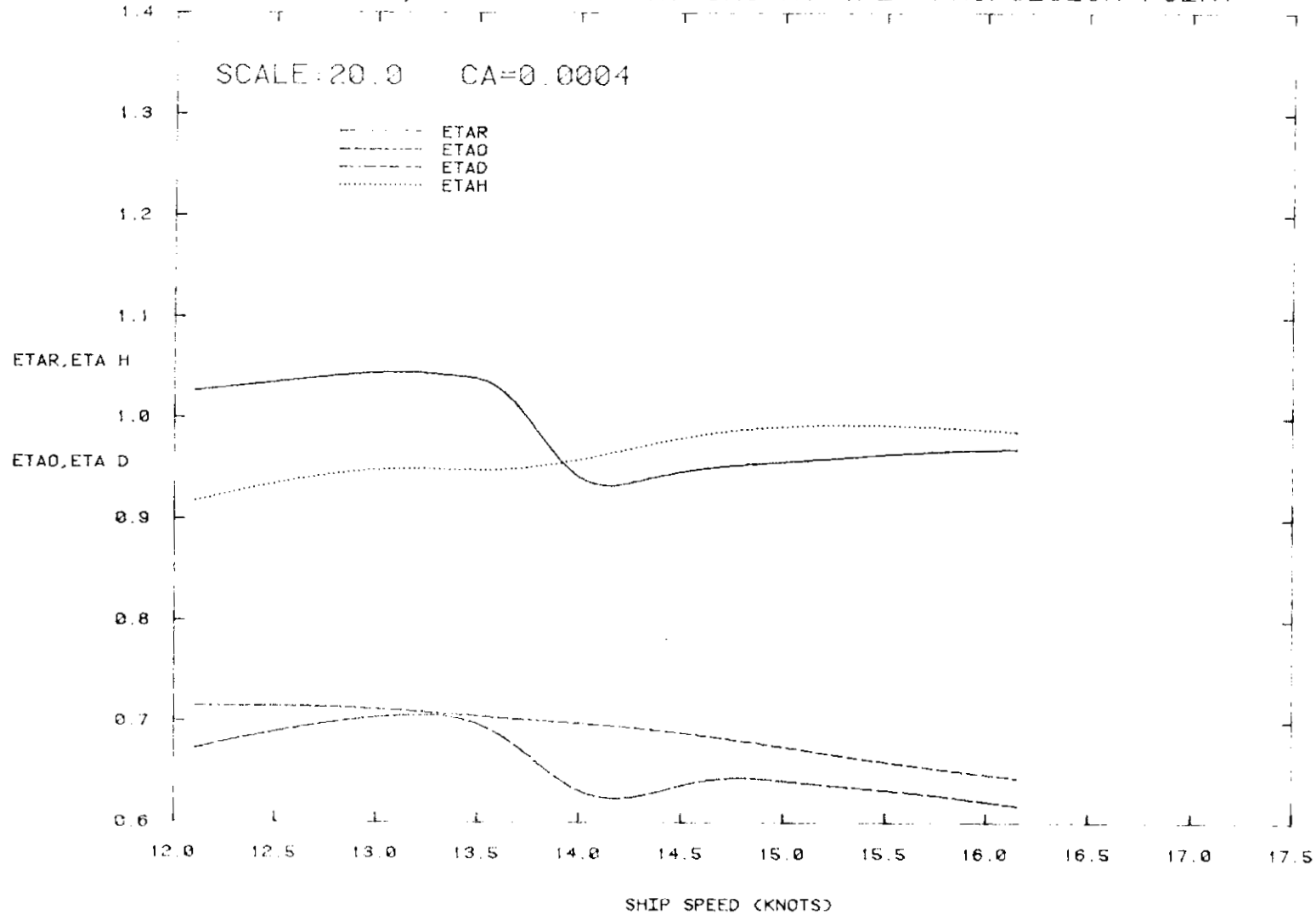


FIG. 8
LTR-SH-340
LIMITED

MODEL 349, OVERLOAD EXPERIMENTS IN CLEAR WATER

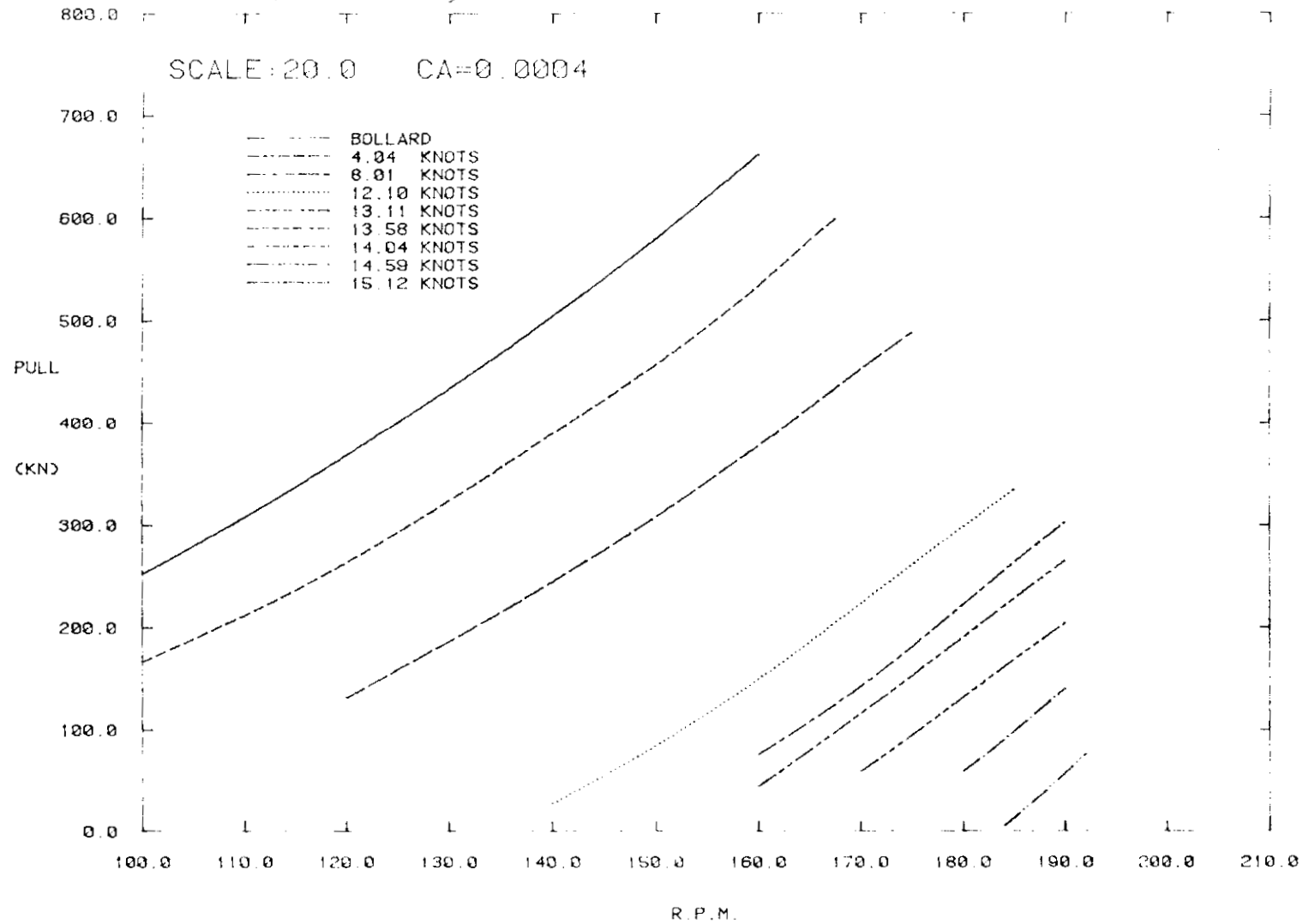


FIG. 9
LIR-SH-340
LIMITED

MODEL 349, OVERLOAD EXPERIMENTS IN CLEAR WATER

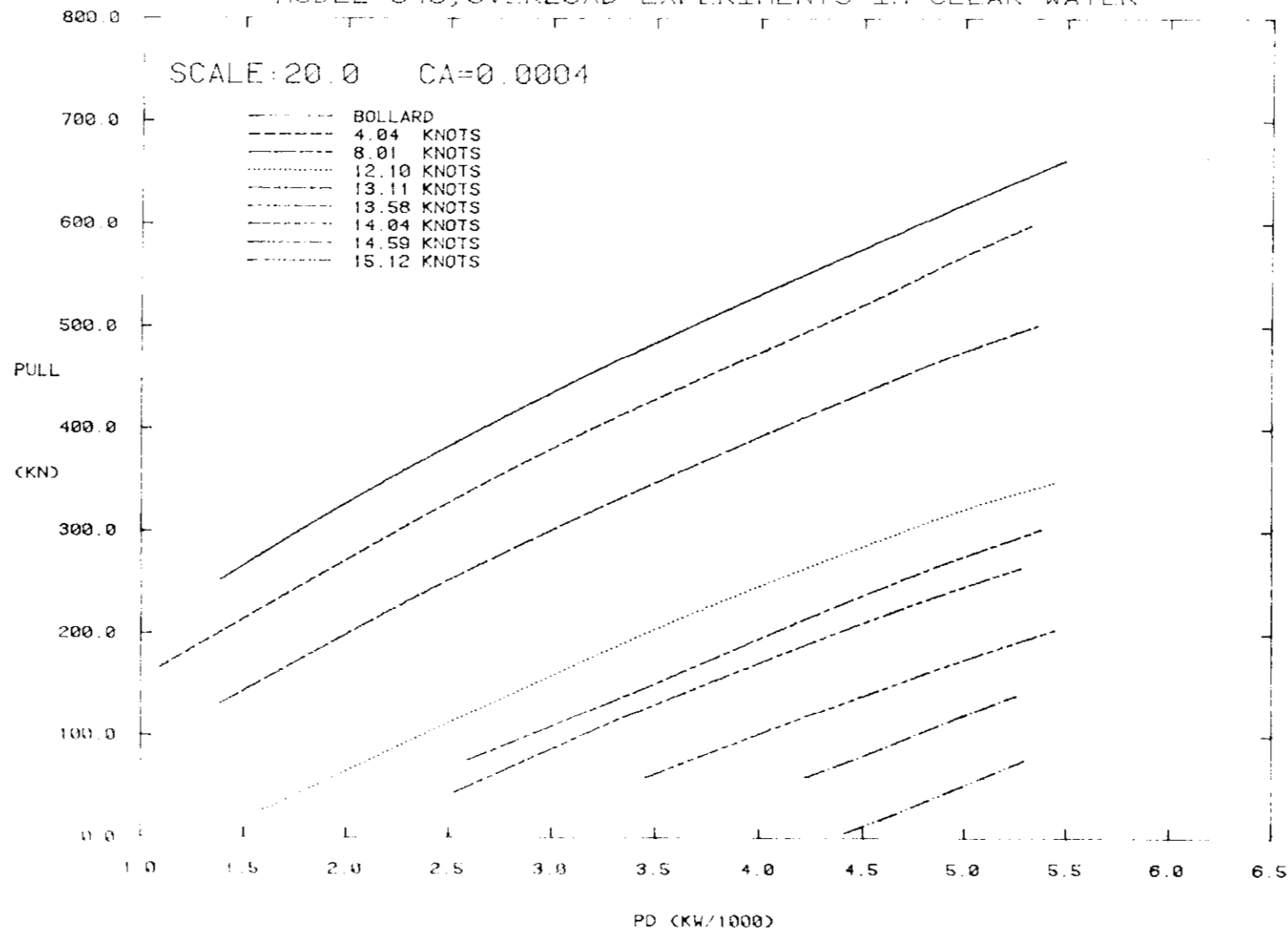


FIG. 10
LTR-SH-340
LIMITED

MODEL 349, OVERLOAD EXPERIMENTS IN CLEAR WATER

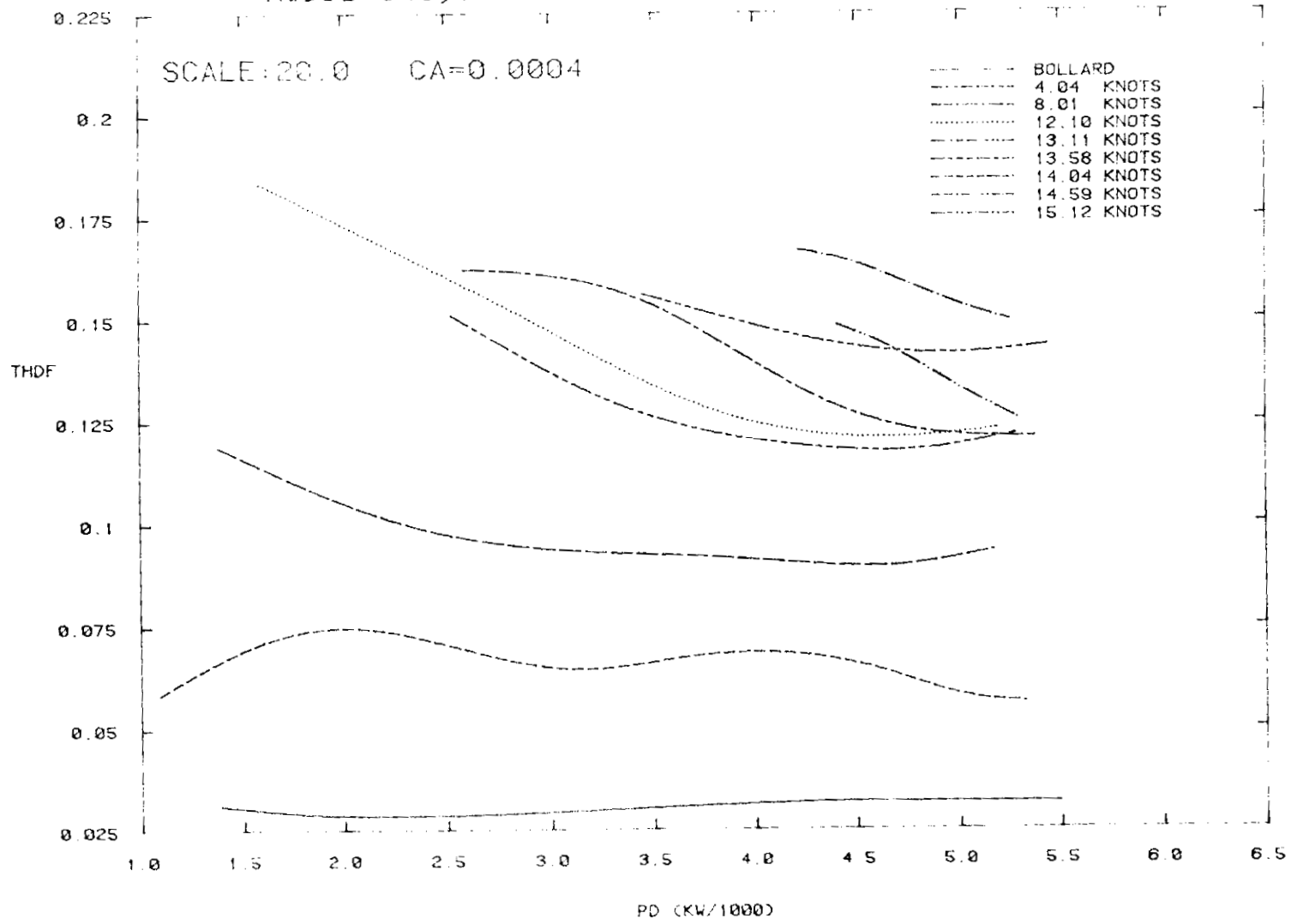


FIG. 11
 TR-SH-340
 LIMITED

MODEL 349, WAKE SURVEY EXPERIMENTS

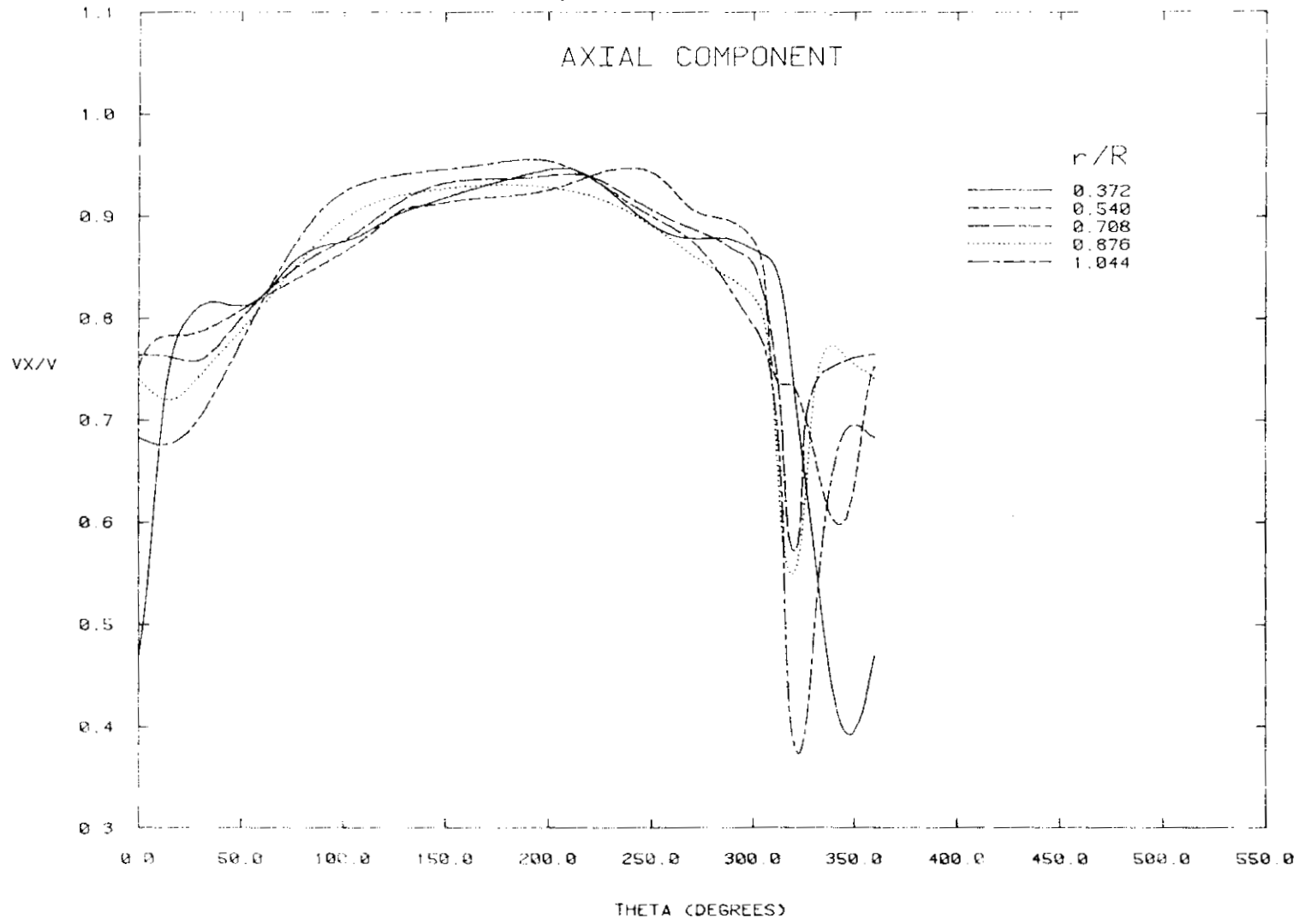


FIG. 12
FIR-SH-340
LIMITED

MODEL 349, WAKE SURVEY EXPERIMENTS

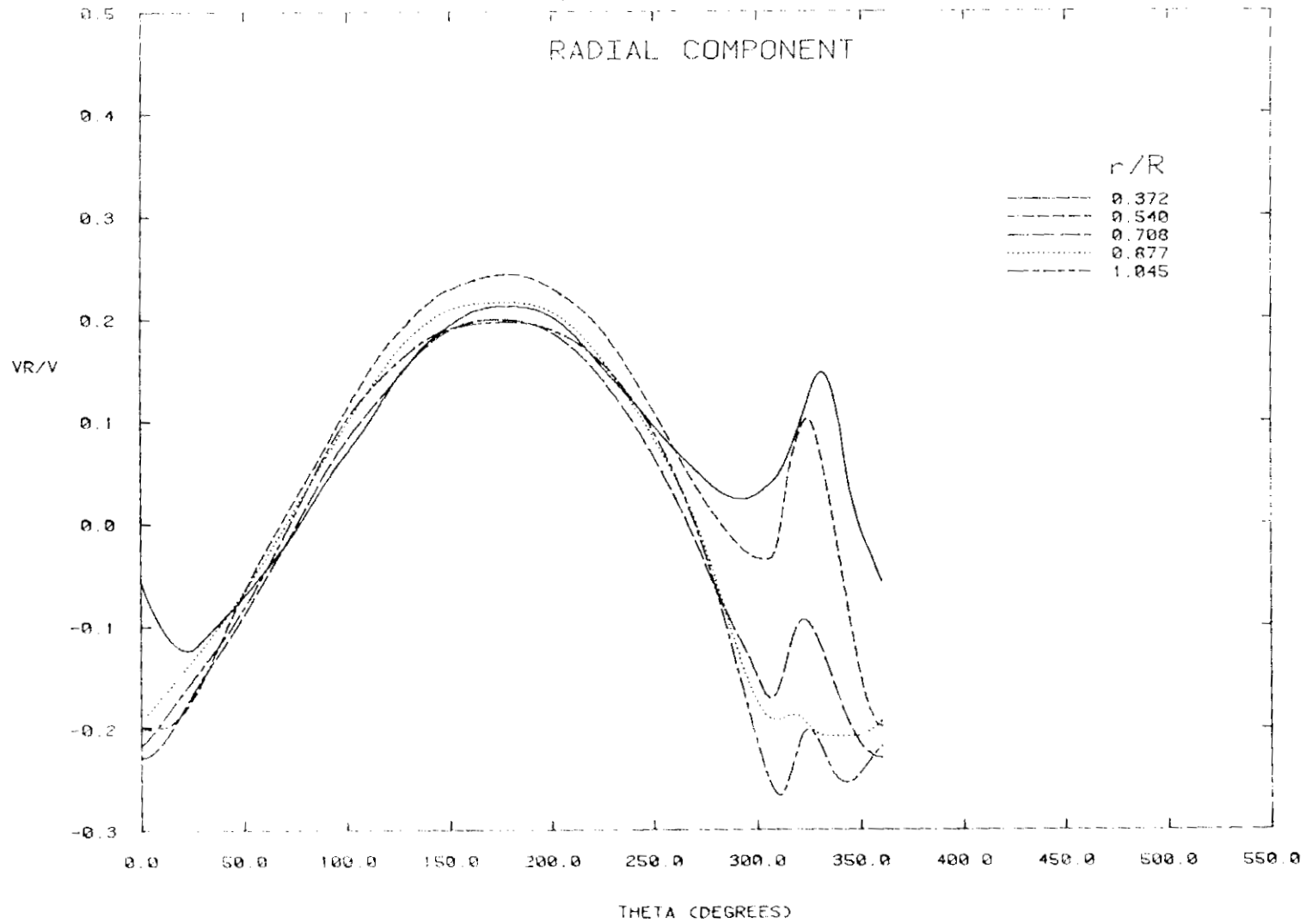


FIG. 13
LTR-SH-340
LIMITED

MODEL 349, WAKE SURVEY EXPERIMENTS

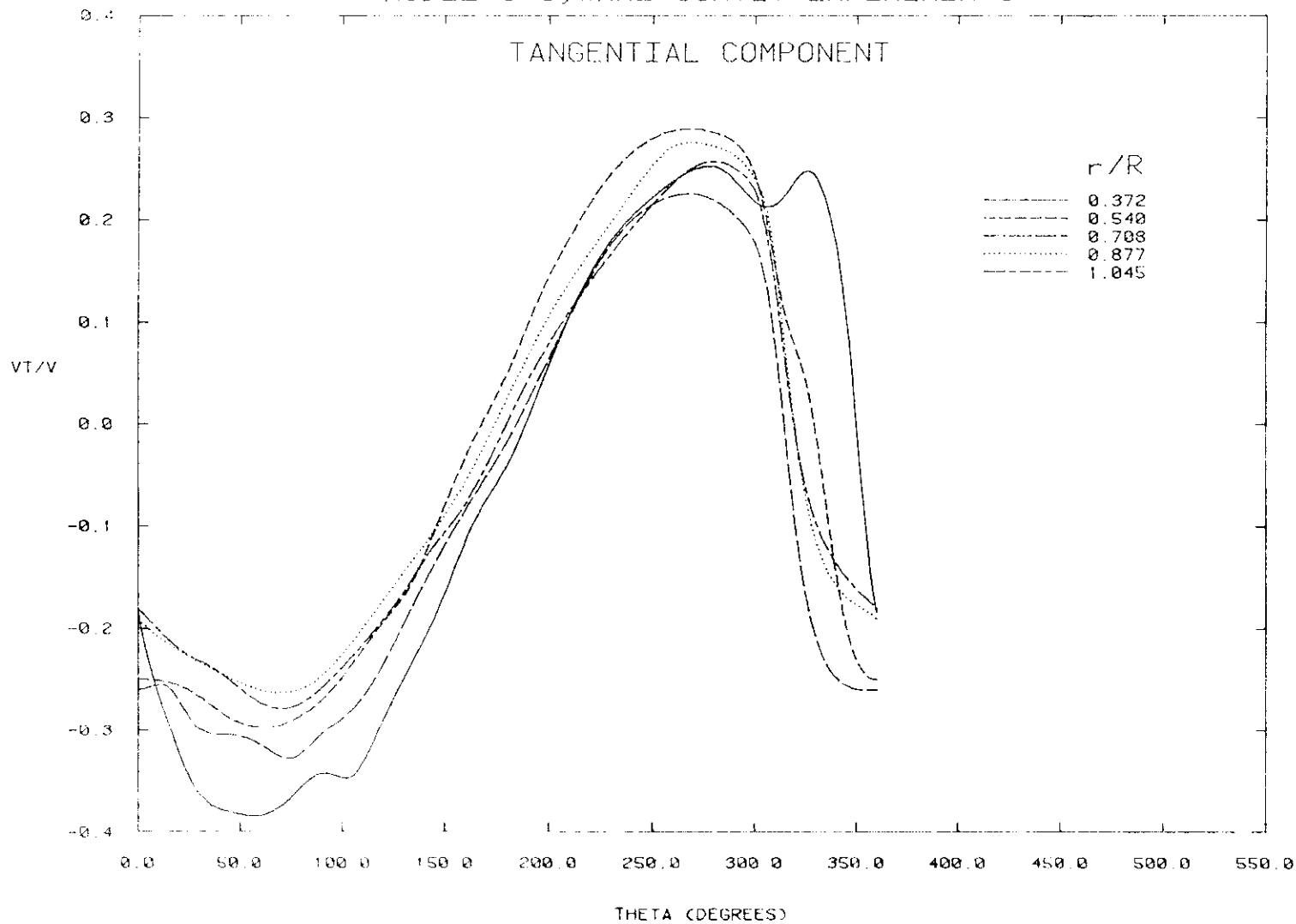


FIG. 14
LIR-SH-340
LIMITED

MODEL 349
 5.75M TMLD LK
 15 KNOTS
 PORT SHAFT
 CONTOURS OF CONSTANT
 TAYLOR WAKE FRACTION

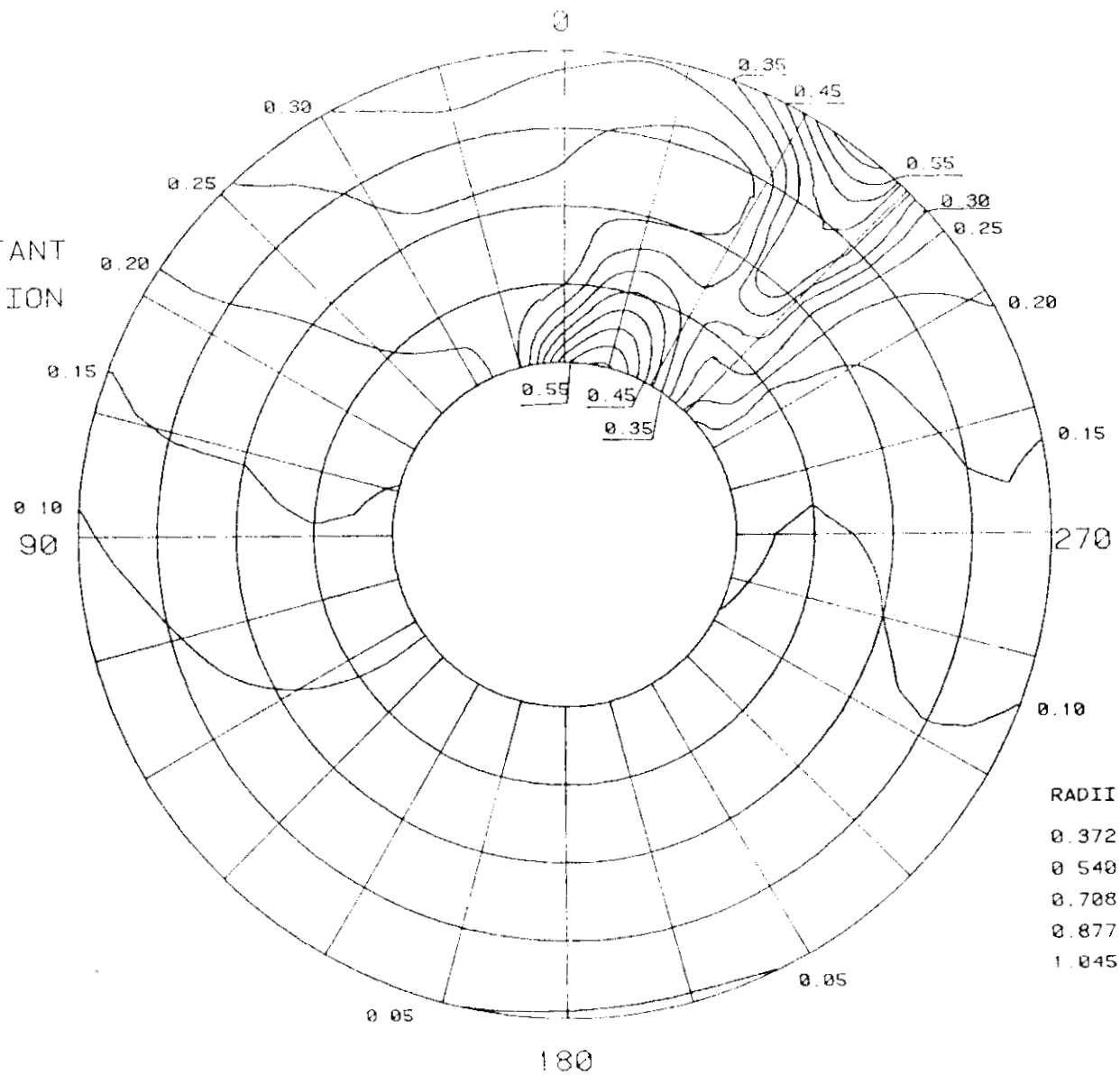


FIG. 15
 SH-340
 DIMITED

MODEL 349
 5.75 M TMLD LK
 15 KNOTS
 FLOW VECTORS

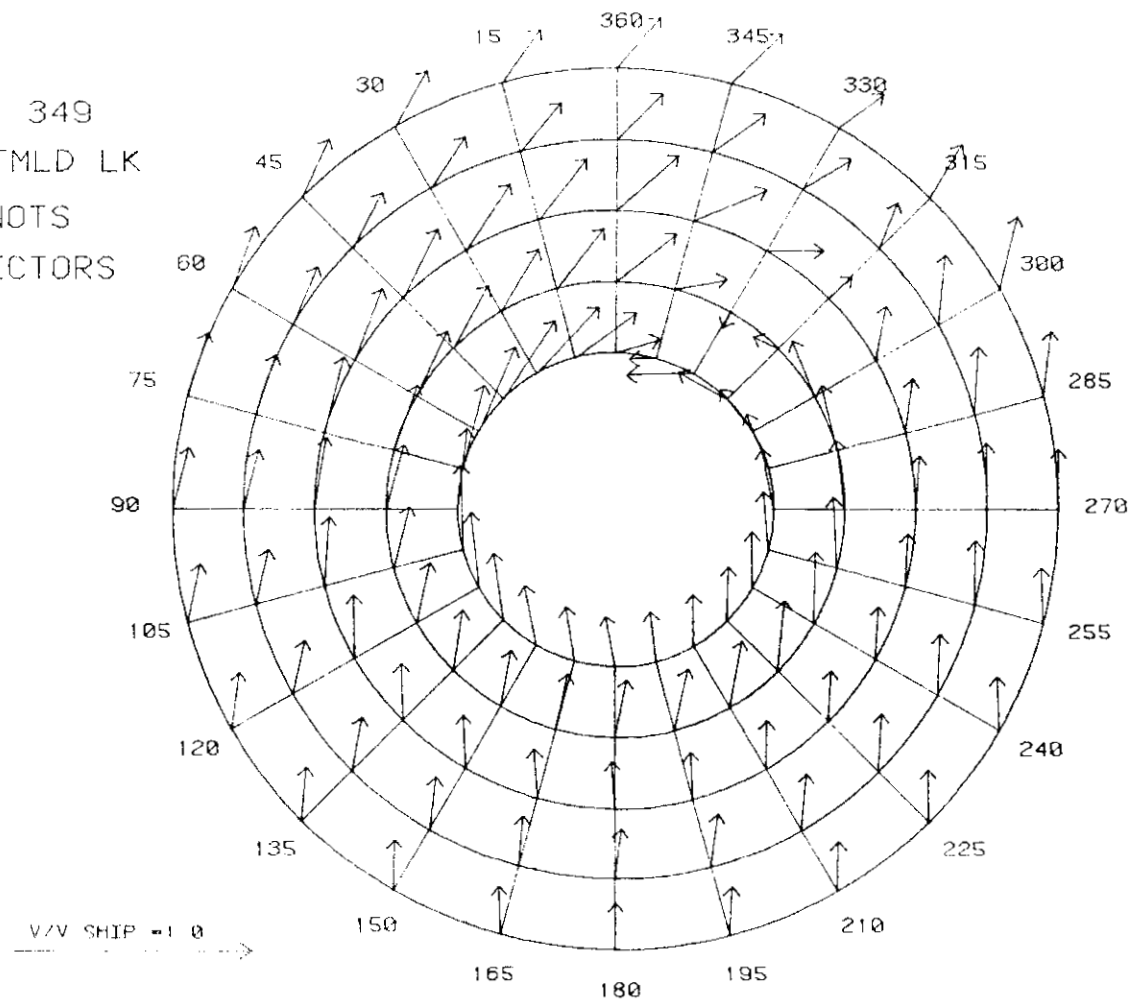


FIG. 16
 AIR-SEA-340
 LIMITED

TYPE 1100 NAVIGATION AIDS VESSEL

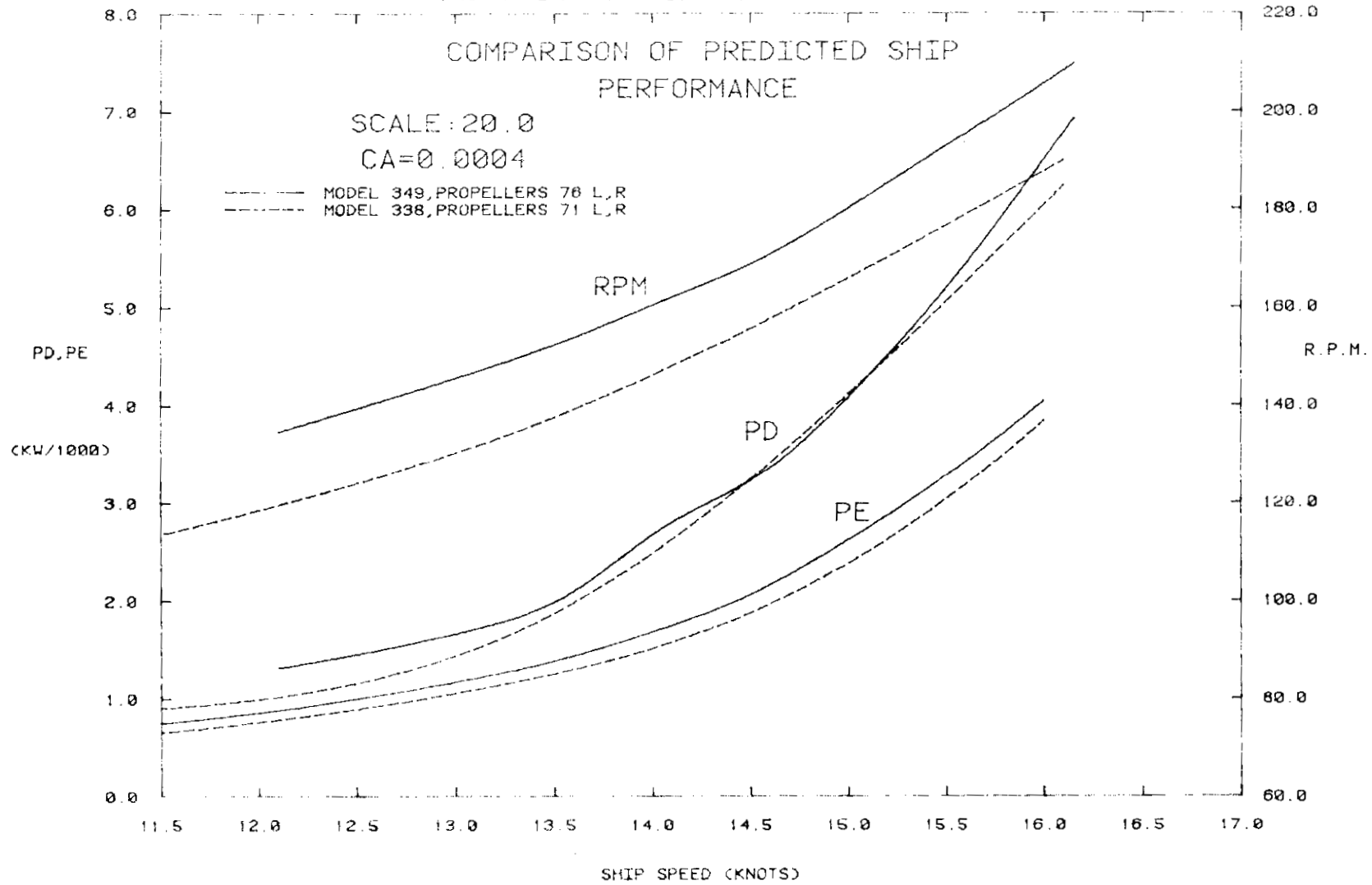


FIG. 17
LIR-SH-340
LIMITED

TYPE 1100 NAVIGATION AIDS VESSEL

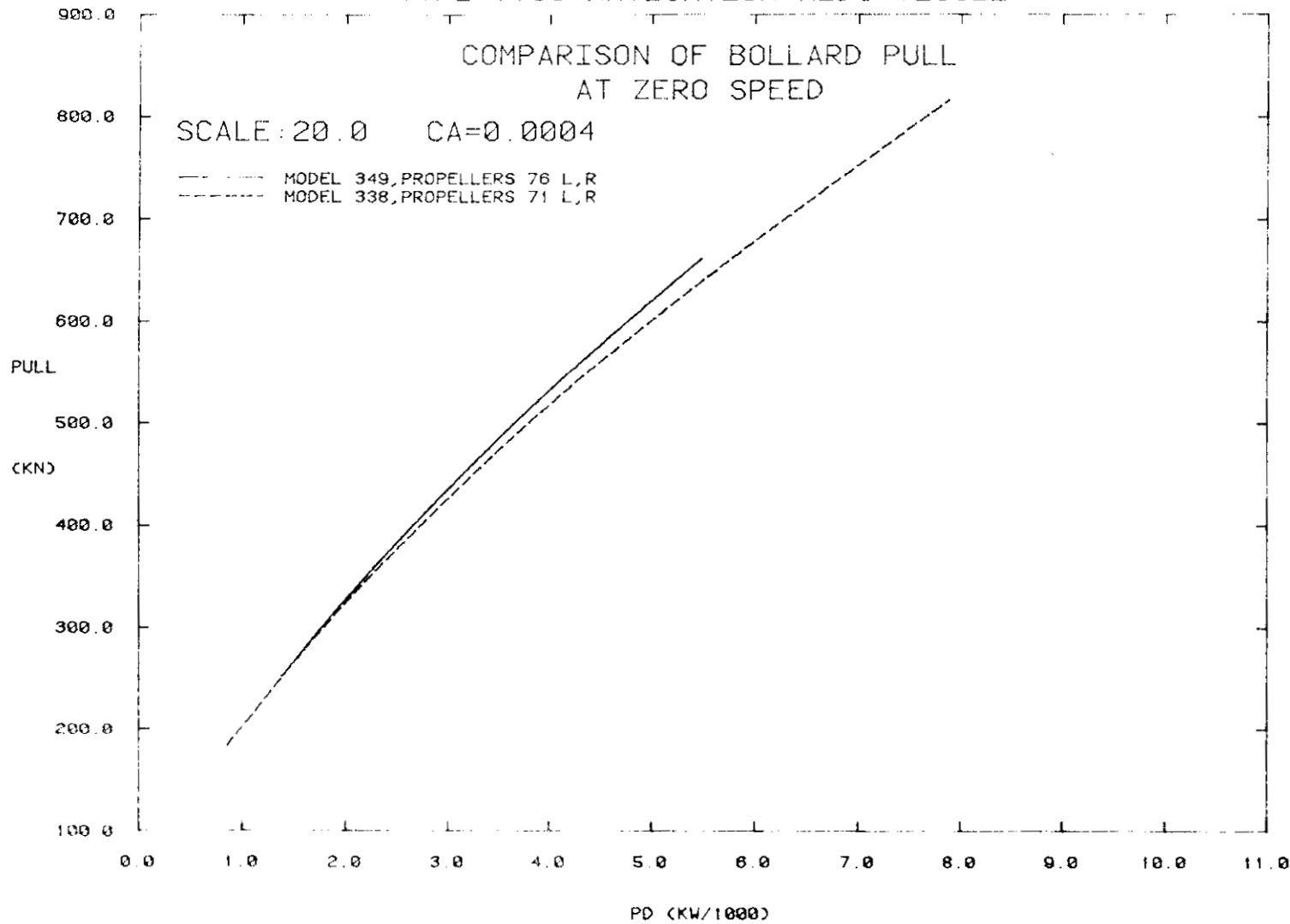


FIG. 18
LTR-SH-340
LIMITED

TYPE 1100 NAVIGATION AIDS VESSEL
COMPARISON OF PULL AGAINST SPEED
FOR GIVEN DELIVERED POWER

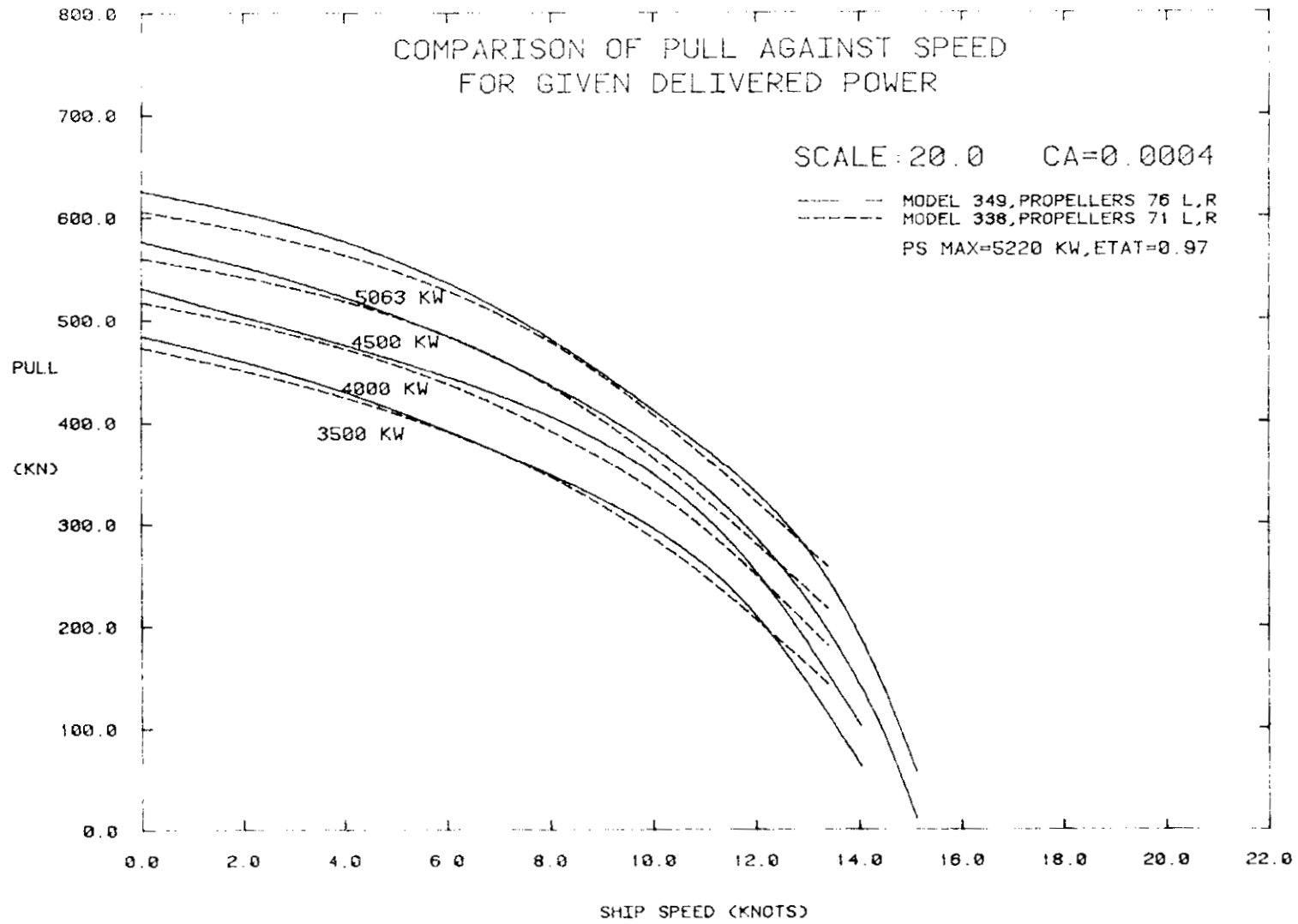


FIG. 19
LFR-SH-340
LIMITED

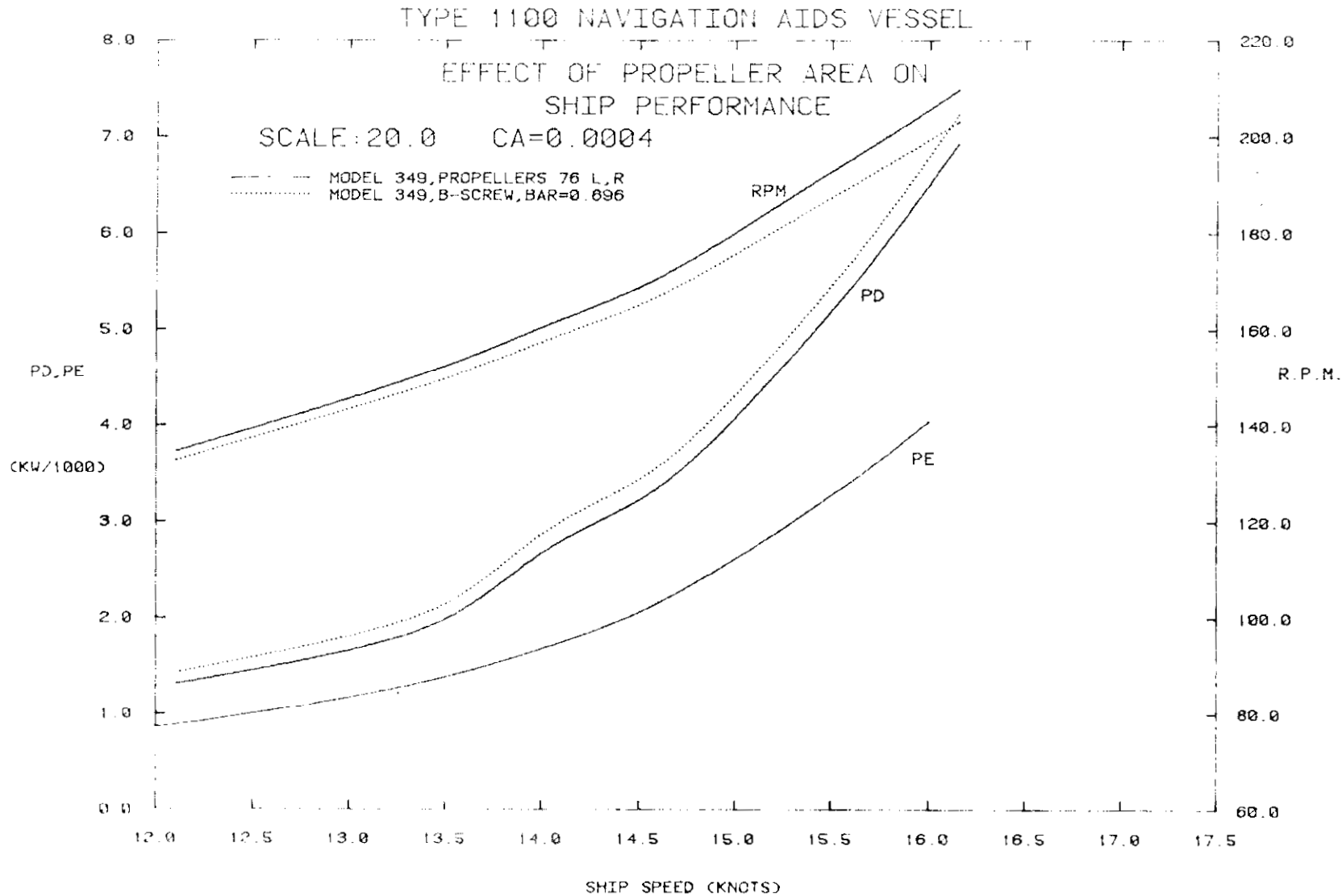


FIG. 20
 LTR-SH-340
 LIMITED

TYPE 1100 NAVIGATION AIDS VESSEL

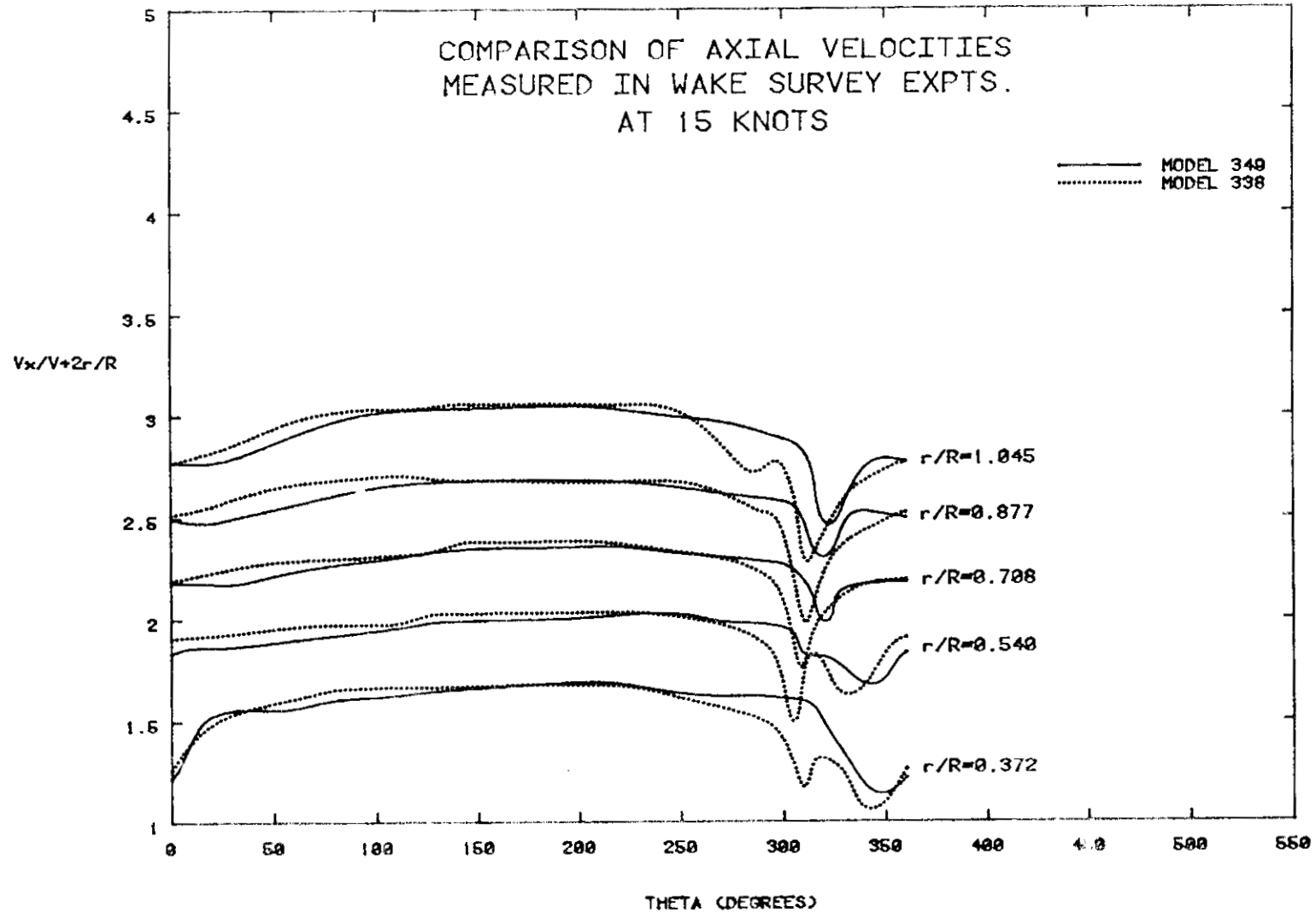


FIG. 21
LFR-SH-340
LIMITED

APPENDIX I

RESULTS OF RESISTANCE AND PROPULSION
EXPERIMENTS WITH MODEL 338 AND
PROPELLERS 71 L, R

It is now the policy of AVMRI to prepare reports in S.I. units. In order to facilitate the comparison of results of experiments with Model 338 and 349, the results described in Reference 1 are represented here in S.I. units.

References

1. Michailidis, M. Resistance, Propulsion, Wake Survey Manoeuvring and Seakeeping Tests with Model 338 and Propellers 71 L & R "Navigation Aids Vessel." AVMRI, NRC LTR-SH-321, December 1981.

LIST OF TABLES

	<u>Table</u>
Results of Resistance Experiments, Model 338, CA 0.0000	A-1
Results of Resistance Experiments, Model 338, CA 0.0004	A-2
Results of Propulsion Experiments, Model 338, CA 0.0000	A-3
Results of Propulsion Experiments, Model 338, CA 0.0004	A-4
Results of Overload Experiments, Model 338, CA 0.0004	A-5
Results of Overload Experiments, Model 338, CA 0.0004	A-6
Results of Overload Experiments, Model 338, CA 0.0004	A-7
Results of Overload Experiments, Model 338, CA 0.0004	A-8

LIST OF FIGURES

	<u>Figure</u>
Results of Overload Experiments, Pull against rpm	A-1
Results of Overload Experiments, Pull against P_D	A-2

MODEL NO. 338
L = 76.00 m

RESULTS OF RESISTANCE EXPERIMENTS

1
T = 5.30 m

TEST DATE 0V-81

TRIM = 0.00 m BY THE STERN

SHIP PREDICTIONS ARE FOR SALT WATER AT 15 DEG.C.

SHIP MODEL CORRELATION ALLOWANCE 0.00000

DIMENSIONAL		COEFF. BASED ON LENGTH				COEFF. BASED ON DISPLACEMENT			
V	PE	FN	CTM(59)	CR	CTS	FNVOL	CTVOL	TAU	TAUR
KNOTS	KW		X1000	X1000	X1000		X100	X100	X100
4.50	31.	0.085	5.200	1.023	2.993	0.182	1.761	0.029	0.010
5.00	42.	0.094	5.144	1.056	2.997	0.202	1.763	0.036	0.013
5.50	57.	0.104	5.156	1.146	3.061	0.223	1.801	0.045	0.017
6.00	76.	0.113	5.199	1.258	3.150	0.243	1.854	0.055	0.022
6.50	99.	0.123	5.219	1.340	3.212	0.263	1.890	0.065	0.027
7.00	124.	0.132	5.185	1.363	3.215	0.283	1.892	0.076	0.032
7.50	151.	0.141	5.123	1.351	3.187	0.304	1.875	0.086	0.037
8.00	181.	0.151	5.067	1.342	3.162	0.324	1.860	0.097	0.041
8.50	217.	0.160	5.033	1.351	3.156	0.344	1.857	0.110	0.047
9.00	259.	0.170	5.020	1.379	3.170	0.364	1.865	0.124	0.054
9.50	308.	0.179	5.029	1.426	3.203	0.384	1.885	0.139	0.062
10.00	365.	0.189	5.057	1.489	3.254	0.405	1.915	0.157	0.072
10.50	430.	0.198	5.097	1.561	3.315	0.425	1.951	0.176	0.083
11.00	504.	0.207	5.137	1.632	3.376	0.445	1.986	0.197	0.095
11.50	586.	0.217	5.181	1.705	3.438	0.465	2.023	0.219	0.109
12.00	685.	0.226	5.263	1.814	3.538	0.486	2.081	0.245	0.126
12.50	809.	0.236	5.403	1.981	3.695	0.506	2.174	0.278	0.149
13.00	961.	0.245	5.595	2.198	3.903	0.526	2.296	0.318	0.179
13.50	1148.	0.255	5.838	2.464	4.161	0.546	2.448	0.365	0.216
14.00	1393.	0.264	6.190	2.839	4.528	0.567	2.664	0.427	0.268
14.50	1739.	0.273	6.737	3.407	5.088	0.587	2.993	0.515	0.345
15.00	2228.	0.283	7.522	4.213	5.887	0.607	3.463	0.638	0.457
15.50	2867.	0.292	8.491	5.201	6.868	0.627	4.040	0.795	0.602
16.00	3653.	0.302	9.567	6.296	7.956	0.647	4.681	0.981	0.776

Table A-1
LFR-SH-340
LIMITED

RESULTS OF RESISTANCE EXPERIMENTS

MODEL NO. 338

1

TEST DATE 09-81

L = 76.00 m

T = 5.30 m

TRIM = 0.00 m BY THE STERN

SHIP PREDICTIONS ARE FOR SALT WATER AT 15 DEG.C.

SHIP MODEL CORRELATION ALLOWANCE 0.00040

DIMENSIONAL		COEFF. BASED ON LENGTH				COEFF. BASED ON DISPLACEMENT			
V	PE	FN	CTM(59)	CR	CTS	FNVOL	CTVOL	TAU	TAUR
KNOTS	KW		X1000	X1000	X1000		X100	X100	X100
4.50	35.	0.085	5.200	1.023	3.393	0.182	1.996	0.033	0.010
5.00	48.	0.094	5.144	1.056	3.397	0.202	1.999	0.041	0.013
5.50	65.	0.104	5.156	1.146	3.461	0.223	2.037	0.050	0.017
6.00	86.	0.113	5.199	1.258	3.550	0.243	2.089	0.062	0.022
6.50	111.	0.123	5.219	1.340	3.612	0.263	2.125	0.074	0.027
7.00	139.	0.132	5.185	1.363	3.615	0.283	2.127	0.085	0.032
7.50	170.	0.141	5.123	1.351	3.587	0.304	2.110	0.097	0.037
8.00	204.	0.151	5.067	1.342	3.562	0.324	2.096	0.110	0.041
8.50	245.	0.160	5.033	1.351	3.556	0.344	2.092	0.124	0.047
9.00	292.	0.170	5.020	1.379	3.570	0.364	2.100	0.139	0.054
9.50	346.	0.179	5.029	1.426	3.603	0.384	2.120	0.157	0.062
10.00	410.	0.189	5.057	1.489	3.654	0.405	2.150	0.176	0.072
10.50	482.	0.198	5.097	1.561	3.715	0.425	2.186	0.197	0.083
11.00	563.	0.207	5.137	1.632	3.776	0.445	2.221	0.220	0.095
11.50	655.	0.217	5.181	1.705	3.838	0.465	2.258	0.245	0.109
12.00	763.	0.226	5.263	1.814	3.938	0.486	2.317	0.273	0.126
12.50	897.	0.236	5.403	1.981	4.095	0.506	2.409	0.308	0.149
13.00	1060.	0.245	5.595	2.198	4.303	0.526	2.532	0.350	0.179
13.50	1258.	0.255	5.838	2.464	4.561	0.546	2.684	0.400	0.216
14.00	1516.	0.264	6.190	2.839	4.928	0.567	2.899	0.465	0.268
14.50	1876.	0.273	6.737	3.407	5.488	0.587	3.229	0.556	0.345
15.00	2379.	0.283	7.522	4.213	6.287	0.607	3.699	0.681	0.457
15.50	3034.	0.292	8.491	5.201	7.268	0.627	4.276	0.841	0.602
16.00	3837.	0.302	9.567	6.296	8.356	0.647	4.916	1.030	0.776

Table A-2
LTR-SH-340
LIMITED

RESULTS OF PROPULSION EXPERIMENTS

MODEL NO. 338

PROPELLER NO. 71LH & RH

TEST DATE 25-NOV-81

L = 76.00 m

T = 5.29 m

TRIM = 0.00 m BY THE STERN

SINGLE RUDDER

SHIP PREDICTIONS ARE FOR SALT WATER AT 15 deg C

SHIP MODEL CORRELATION ALLOWANCE 0.00000

POWERS, SPEEDS AND PROPULSION FACTORS PREDICTED FOR MODEL TEST PROPELLER

V KNOTS	FN	PE KW	PD KW	NS RPM	ETA _D	WFT	THDF	ETA _O	ETA _R	ETA _H
8.09	0.153	187.	311.	79.0	0.601	0.146	0.212	0.700	0.933	0.922
10.77	0.203	468.	737.	104.7	0.635	0.161	0.195	0.698	0.949	0.959
13.41	0.253	1108.	1616.	133.7	0.685	0.175	0.163	0.688	0.981	1.015
16.10	0.304	3817.	5875.	187.3	0.650	0.217	0.150	0.611	0.980	1.086

PROPELLER COEFFICIENTS

FN	BEHIND MODEL			TEST PROPELLER			SERIES PROPELLER			
	CT-R(59.4) X1000	JP	KTP	KQP X10	JOM	KTOM	KQOM X10	JOS	KTOS	KQOS X10
0.153	-1.896	0.879	0.096	0.176	0.751	0.096	0.164			
0.203	-1.767	0.883	0.100	0.179	0.741	0.100	0.169			
0.253	-1.677	0.861	0.112	0.188	0.710	0.112	0.185			
0.304	-1.605	0.738	0.162	0.249	0.578	0.162	0.244			

NON-DIMENSIONAL PROPULSION COEFFICIENTS PREDICTED FOR MODEL TEST PROPELLER

FN	FN _{VOL}	CD _{VOL} X100	PD _{VOL} X1000	N _{VOL}	TAUT X1000	BP	DELTA
0.153	0.328	3.091	0.543	1.708	1.265	12.85	134.9
0.203	0.436	3.103	1.285	2.264	2.324	13.42	136.8
0.253	0.543	3.525	2.817	2.889	4.248	15.31	142.7
0.304	0.652	7.402	10.241	4.048	12.000	29.49	175.4

Table A-3
LFR-SH-340
LIMITED

MODEL NO. 338
L = 76.00 m

RESULTS OF PROPULSION EXPERIMENTS
PROPELLER NO. 71LH & RH
T = 5.30 m
SINGLE RUDDER

TEST DATE 25-NOV-81
TRIM = 0.00 m BY THE STERN

SHIP PREDICTIONS ARE FOR SALT WATER AT 15 deg C

SHIP MODEL CORRELATION ALLOWANCE 0.00040

POWERS, SPEEDS AND PROPULSION FACTORS PREDICTED FOR MODEL TEST PROPELLER

V KNOTS	FN	PE KW	PD KW	NS RPM	ETAD	WFT	THDF	ETAO	ETAR	ETAH
8.09	0.153	211.	342.	80.4	0.617	0.146	0.194	0.697	0.938	0.944
10.77	0.203	525.	818.	106.7	0.642	0.162	0.184	0.694	0.950	0.974
13.41	0.253	1217.	1780.	136.2	0.684	0.177	0.158	0.683	0.980	1.022
16.10	0.304	4009.	6233.	189.8	0.643	0.218	0.149	0.604	0.978	1.089

PROPELLER COEFFICIENTS

FN	BEHIND MODEL				TEST PROPELLER			SERIES PROPELLER		
	CT-R(59.4) X1000	JF	KTP	KQP X10	JOM	KTOM	KQOM X10	JOS	KTOS	KQOS X10
0.153	-1.496	0.863	0.102	0.182	0.737	0.102	0.171			
0.203	-1.367	0.866	0.106	0.187	0.725	0.106	0.177			
0.253	-1.277	0.845	0.118	0.196	0.696	0.118	0.192			
0.304	-1.205	0.728	0.165	0.253	0.569	0.165	0.247			

NON-DIMENSIONAL PROPULSION COEFFICIENTS PREDICTED FOR MODEL TEST PROPELLER

FN	FN VOL	CD VOL X100	PD VOL X1000	NVOL	TAUT X1000	BP	DELTA
0.153	0.327	3.393	0.595	1.739	1.392	13.74	137.5
0.203	0.436	3.437	1.422	2.308	2.566	14.46	139.7
0.253	0.542	3.878	3.096	2.944	4.637	16.43	145.7
0.304	0.651	7.842	10.838	4.103	12.570	30.84	178.0

Table A-4
LFR-SH-340
LIMITED

MODEL NO. 338
L = 76.00 m

RESULTS OF OVERLOAD EXPERIMENTS
PROPELLER NO. 71LH & RH
T = 5.30 m

TEST DATE 25-NOV-81
TRIM = 0.00 m BY THE STERN

SHIP PREDICTIONS ARE FOR SALT WATER AT 15 deg C

SHIP MODEL CORRELATION ALLOWANCE 0.00040

POWERS, SPEEDS AND TOW FORCES PREDICTED FOR MODEL TEST PROPELLER

V KNOTS	FN	PD KW	NS RPM	TH KN	FP KN	ETA _D	WFT	THDF	ETA _O	ETA _R	FP/PD N/KW
0.00	0.000	854.	80.0	183.1	183.1	0.000	0.000	0.000	0.000	0.939	214.45
0.00	0.000	1632.	100.0	289.9	281.7	0.000	0.000	0.028	0.000	0.959	172.61
0.00	0.000	2796.	120.0	420.1	406.4	0.000	0.000	0.033	0.000	0.967	145.35
0.00	0.000	4417.	140.0	573.9	552.9	0.000	0.000	0.037	0.000	0.972	125.18
0.00	0.000	6574.	160.0	751.4	721.7	0.000	0.000	0.040	0.000	0.975	109.77
0.00	0.000	7878.	170.0	849.1	816.8	0.000	0.000	0.038	0.000	0.976	103.67
5.42	0.102	862.	90.0	160.5	129.5	0.490	0.142	0.056	0.494	0.902	150.23
5.42	0.102	1231.	100.0	212.5	177.0	0.451	0.150	0.063	0.446	0.917	143.71
5.42	0.102	2244.	120.0	334.9	279.5	0.375	0.163	0.100	0.372	0.937	124.57
5.42	0.102	3681.	140.0	482.1	418.8	0.334	0.175	0.086	0.316	0.952	113.76
5.42	0.102	5618.	160.0	654.2	579.8	0.299	0.188	0.080	0.274	0.964	103.21
5.42	0.102	6795.	170.0	749.5	654.4	0.278	0.194	0.097	0.256	0.968	96.30
5.42	0.102	8125.	180.0	851.0	744.6	0.263	0.201	0.099	0.240	0.973	91.64
8.09	0.153	899.	100.0	152.0	88.5	0.645	0.155	0.084	0.617	0.964	98.47
8.09	0.153	1811.	120.0	267.2	190.5	0.555	0.164	0.097	0.532	0.966	105.14
8.09	0.153	3148.	140.0	407.0	310.6	0.478	0.170	0.112	0.463	0.966	98.65
8.09	0.153	4986.	160.0	571.2	458.2	0.425	0.174	0.109	0.408	0.966	91.90
8.09	0.153	6117.	170.0	662.5	539.4	0.402	0.176	0.109	0.385	0.966	88.19
8.09	0.153	7402.	180.0	759.9	625.6	0.381	0.178	0.110	0.364	0.966	84.51
8.09	0.153	8106.	185.0	810.9	673.6	0.372	0.179	0.107	0.354	0.966	83.10

Table A-5
LFR-SH-340
LIMITED

MODEL NO. 338
L = 76.00 m

RESULTS OF OVERLOAD EXPERIMENTS
PROPELLER NO. 71LH & RH
T = 5.30 m

TEST DATE 25-NOV-81
TRIM = 0.00 m BY THE STERN

SHIP PREDICTIONS ARE FOR SALT WATER AT 15 deg C

SHIP MODEL CORRELATION ALLOWANCE 0.00040

POWERS, SPEEDS AND TOW FORCES PREDICTED FOR MODEL TEST PROPELLER

V KNOTS	FN	PD KW	NS RPM	TH KN	FP KN	ETA _D	WFT	THDF	ETA _O	ETA _R	FP/PD N/KW
10.77	0.203	952.	110.0	133.8	16.8	0.650	0.164	0.167	0.685	0.951	17.66
10.77	0.203	1421.	120.0	192.1	69.3	0.640	0.169	0.146	0.653	0.953	48.79
10.77	0.203	2661.	140.0	326.2	181.2	0.575	0.177	0.154	0.584	0.959	68.11
10.77	0.203	4354.	160.0	483.6	336.3	0.549	0.181	0.109	0.522	0.966	77.24
10.77	0.203	5390.	170.0	571.1	422.5	0.532	0.181	0.095	0.495	0.970	78.37
10.77	0.203	6563.	180.0	664.5	505.9	0.507	0.181	0.096	0.471	0.975	77.07
10.77	0.203	7204.	185.0	713.3	545.5	0.493	0.181	0.103	0.460	0.977	75.72
10.77	0.203	7881.	190.0	763.6	583.5	0.477	0.181	0.112	0.449	0.979	74.03
13.41	0.253	2037.	140.0	236.6	23.8	0.678	0.179	0.154	0.673	0.979	11.68
13.41	0.253	3659.	160.0	391.2	155.6	0.626	0.188	0.151	0.615	0.974	42.53
13.41	0.253	4665.	170.0	477.2	228.7	0.599	0.191	0.151	0.587	0.973	49.03
13.41	0.253	5811.	180.0	569.2	312.1	0.580	0.194	0.142	0.560	0.973	53.71
13.41	0.253	6440.	185.0	617.3	356.1	0.571	0.195	0.137	0.547	0.973	55.29
13.41	0.253	7107.	190.0	666.9	399.9	0.560	0.197	0.136	0.534	0.974	56.27
13.41	0.253	7814.	195.0	718.0	442.7	0.547	0.197	0.138	0.522	0.974	56.65
16.10	0.304	6263.	190.0	570.4	1.9	0.643	0.218	0.148	0.604	0.978	0.30
16.10	0.304	6953.	195.0	619.6	46.1	0.632	0.218	0.145	0.592	0.975	6.63
16.10	0.304	7678.	200.0	669.3	92.7	0.622	0.217	0.139	0.581	0.973	12.07

Table A-6
LTR-SH-340
LIMITED

MODEL NO. 338
L = 76.00 m

RESULTS OF OVERLOAD EXPERIMENTS
PROPELLER NO. 71LH & RH
T = 5.30 m

TEST DATE 25-NOV-81
TRIM = 0.00 m BY THE STERN

SHIP PREDICTIONS ARE FOR SALT WATER AT 15 deg C

SHIP MODEL CORRELATION ALLOWANCE 0.00040

PROPELLER COEFFICIENTS

FN	CT-R(59.4) X1000	BEHIND MODEL				TEST PROPELLER		
		JP	KTP	KQP X10	ZETO	JOM	KTOM	KQOM X10
0.000	0.000	0.000	0.299	0.462	0.586	0.000	0.315	0.434
0.000	0.000	0.000	0.303	0.452	0.603	0.000	0.315	0.434
0.000	0.000	0.000	0.305	0.449	0.610	0.000	0.315	0.434
0.000	0.000	0.000	0.306	0.446	0.614	0.000	0.315	0.434
0.000	0.000	0.000	0.307	0.445	0.617	0.000	0.315	0.434
0.000	0.000	0.000	0.307	0.445	0.618	0.000	0.315	0.434
0.102	18.561	0.516	0.207	0.328	0.511	0.443	0.207	0.296
0.102	25.987	0.465	0.222	0.341	0.533	0.395	0.222	0.313
0.102	42.027	0.387	0.243	0.360	0.563	0.324	0.243	0.337
0.102	63.826	0.332	0.257	0.372	0.583	0.274	0.257	0.354
0.102	89.011	0.291	0.267	0.380	0.597	0.236	0.267	0.366
0.102	100.684	0.273	0.271	0.383	0.602	0.220	0.271	0.371
0.102	114.797	0.258	0.274	0.386	0.607	0.206	0.274	0.376
0.153	4.713	0.694	0.159	0.249	0.470	0.586	0.159	0.240
0.153	11.863	0.578	0.194	0.291	0.518	0.484	0.194	0.281
0.153	20.287	0.496	0.217	0.318	0.546	0.412	0.217	0.307
0.153	30.644	0.434	0.233	0.337	0.564	0.358	0.233	0.326
0.153	36.342	0.408	0.240	0.345	0.571	0.336	0.240	0.333
0.153	42.383	0.386	0.245	0.352	0.577	0.317	0.245	0.340
0.153	45.751	0.375	0.248	0.355	0.579	0.308	0.248	0.343

Table A-7
LFR-SH-340
LIMITED

MODEL NO. 338
L = 76.00 m

RESULTS OF OVERLOAD EXPERIMENTS
PROPELLER NO. 71LH & RH
T = 5.30 m

TEST DATE 25-NOV-81
TRIM = 0.00 m BY THE STERN

SHIP PREDICTIONS ARE FOR SALT WATER AT 15 des C

SHIP MODEL CORRELATION ALLOWANCE 0.00040

PROPELLER COEFFICIENTS

FN	CT-R(59.4) X1000	BEHIND MODEL				TEST PROPELLER		
		JF	KTF	KQP X10	ZETO	JOM	KTOM	KQOM X10
0.203	-0.702	0.840	0.116	0.198	0.399	0.702	0.116	0.188
0.203	1.378	0.770	0.139	0.228	0.438	0.640	0.139	0.217
0.203	5.808	0.660	0.174	0.269	0.490	0.543	0.174	0.258
0.203	11.949	0.577	0.197	0.295	0.523	0.473	0.197	0.285
0.203	15.359	0.544	0.207	0.304	0.535	0.445	0.207	0.295
0.203	18.661	0.513	0.214	0.312	0.546	0.420	0.214	0.304
0.203	20.231	0.499	0.218	0.315	0.551	0.409	0.218	0.308
0.203	21.734	0.486	0.221	0.319	0.556	0.398	0.221	0.312
0.253	-0.669	0.822	0.126	0.206	0.424	0.675	0.126	0.201
0.253	2.699	0.719	0.160	0.248	0.475	0.584	0.160	0.241
0.253	4.567	0.677	0.173	0.263	0.493	0.547	0.173	0.256
0.253	6.698	0.639	0.184	0.276	0.508	0.515	0.184	0.269
0.253	7.822	0.622	0.188	0.282	0.514	0.500	0.188	0.274
0.253	8.941	0.605	0.193	0.287	0.520	0.486	0.193	0.280
0.253	10.033	0.590	0.197	0.292	0.526	0.473	0.197	0.285
0.304	-1.172	0.727	0.165	0.253	0.484	0.569	0.165	0.248
0.304	-0.389	0.708	0.170	0.260	0.490	0.554	0.170	0.253
0.304	0.437	0.691	0.175	0.266	0.496	0.541	0.175	0.259

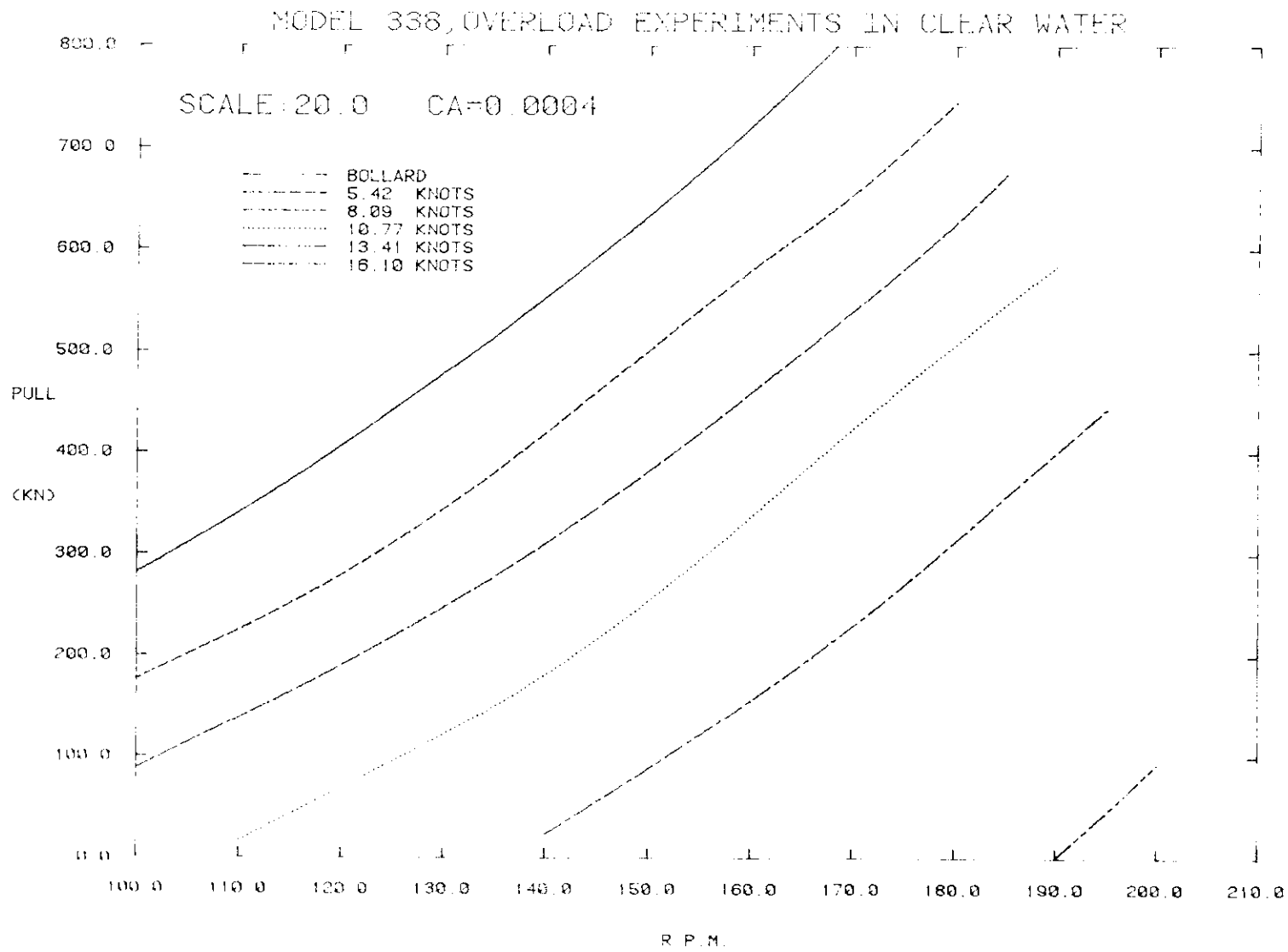


Figure A-1
 LTR-SH-340
 LIMITED

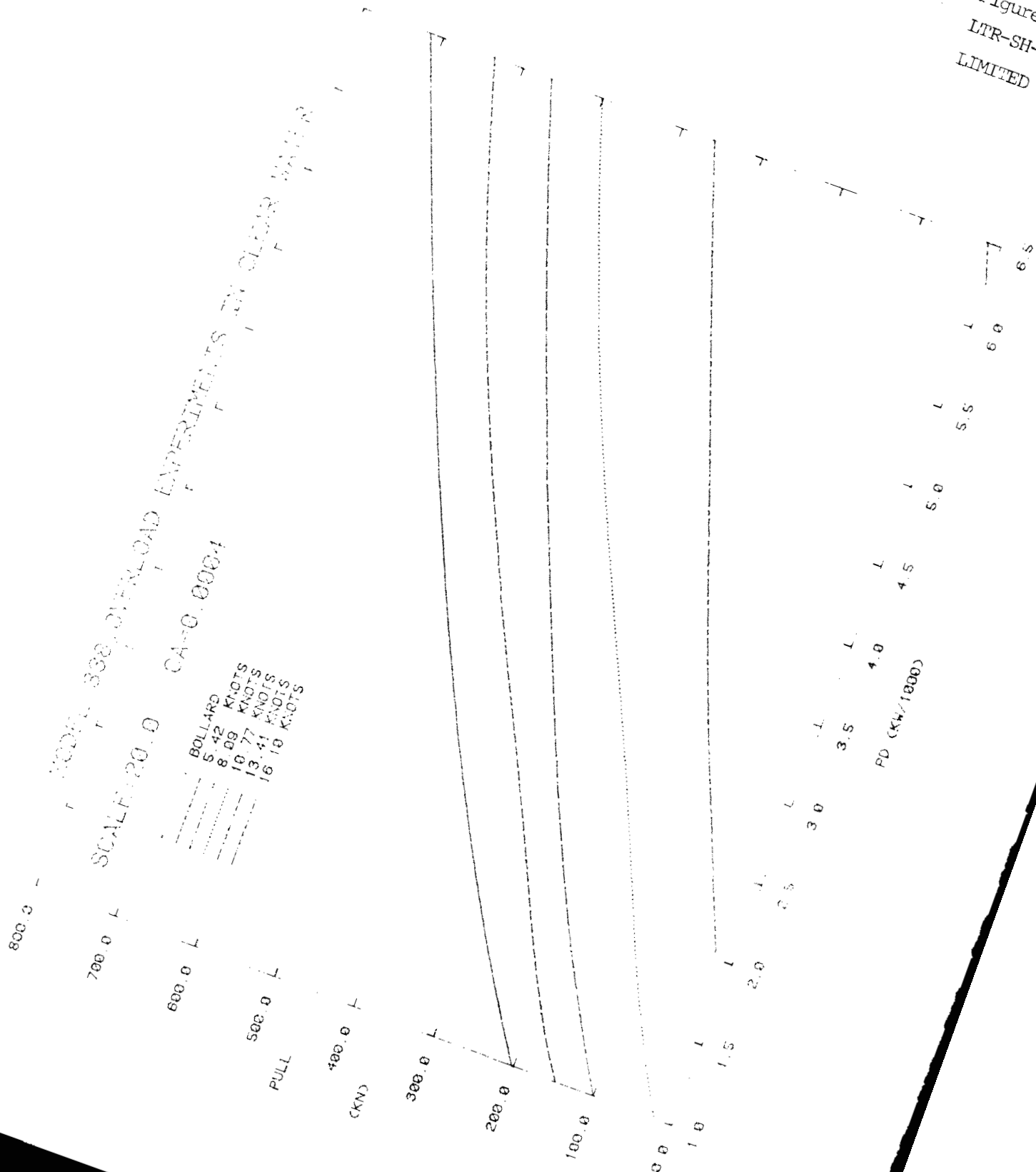


Figure A-2
 LTR-SH-340
 LIMITED

