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**FINAL REPORT - TESTS TO ASSESS THE EFFECT OF MODEL CONSTRUCTION ON
RESISTANCE**

**Laboratory Memorandum - Unclassified
OCRE-LM-2015-002**

V1.0

Rob Pallard

St. John's, NL

October 2015





National Research Council
Canada

Conseil national de recherches
Canada

Ocean, Coastal and River
Engineering

Génie océanique, côtier et fluvial

FINAL REPORT - TESTS TO ASSESS THE EFFECT OF MODEL CONSTRUCTION ON RESISTANCE

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UNCLASSIFIED

LM-2015-002

V1.0

Rob Pallard

October 2015

Abstract or Executive Summary

This report describes the bare hull resistance experiments carried out on 5 m models of a PANAMAX bulk carrier in April and May of 2015 to assess the effects of proposed changes in model construction techniques on experimental results. Four model options were assessed during this session.

The test results for these four options are compared to the large model originally tested in April 2013 and a repeat test of the large model done as part of this test session.

Repeatability tests were done at multiple speeds to estimate the typical uncertainty of a resistance test done in this laboratory.

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1 INTRODUCTION

This report describes experiments carried out on four 1:45 scale models of a PANAMAX bulk carrier, designated OCRE930-933 in the National Research Council St. John's (NRCSJS) Towing Tank in April and May of 2015. Tests with this bulk carrier were originally done at a scale of 1:31.45 using model OCRE916. The results obtained with model 916, reported in TR-2013-024 (Reference 1), form the basis for the comparison of the test results. In addition, the resistance curve for model 916 was repeated using the test instrumentation developed for this series of tests.

This document includes background information on the project, a description of the instrumentation, facility used, test program, data analysis procedure and discussion of the results. It describes the bare hull resistance and repeatability experiments conducted in the Towing Tank between April 21 and May 13, 2015.

2 BACKGROUND

Over the years, a recurring comment from clients is that our model prices seem high, particularly when they are compared with the prices charged at other facilities. For example, during discussions with Garry Cooke and CSL over the cost of the test program for the revisions to the CSL Metis, it was clear that the major stumbling block was the cost of the model. We were informed that NRC was competitive with other facilities with respect to experimental testing, analysis and reporting costs but our model cost was approximately double that of a European tank.

This prompted NRC-DFS to look at options for model construction that might reduce model cost. New procedures could potentially make it easier to do some of the typical modifications to ship models that arise based on the results of model tests. Examples of these modifications include bilge keel alignment, stabilizer fins and cutaways in way of thruster openings. The present model construction technique requires that potential locations for these appendages be locally strengthened prior to final determination of the best location and has a fairly high up-front design cost. Details of the planned construction procedures and estimates of their relative costs can be found in Reference 2.

Originally, it was proposed that the optional model construction techniques would be applied to models of the same scale as OCRE916. The cost of these relatively large models prompted the idea of using smaller models to assess the construction techniques. Four meter long models were proposed but the estimated resistance of these models at the median speed of the test program was about 13 N and a compromise was reached that would have 5 m long geosims built with an estimated resistance of about 24 N.

For this test, a new piece of resistance test instrumentation was introduced. There was concern after the January test session that the loads measured during this test were too low to be adequately discretized by the Kempf and Remmers R35-I balance which has a nominal range of 0-200 N. Maximum resistance with these 5 m long models was less than 25 N or 12.5% of range,

with most test results between 6 and 17 N or 1.5 - 8.5% of range. This prompted the design and fabrication of a scalable resistance dynamometer using the measurement principles of the R-35-I balance but permitting the use of load cells from 10 to 150 lbs (45 to 670 N) that would be better suited for the estimated load range of a test. For this test, the 10-lb load cell was used. The balance commissioning tests are described in Reference 3.

3 DESCRIPTION OF THE NRCSJS TOWING TANK

NRCSJS Towing Tank has dimensions of 200 m by 12 m by 7 m. The 85 t tow carriage, capable of speeds up to 10 m/s, is used to accommodate models for a wide range of test types carried out in calm water and waves. A 4,000 kg lift capacity moveable overhead crane is available over half of the tank length.

At the west end of the tank is a dual flap hydraulic wave board capable of generating regular waves up to 1 m. in height and irregular waves with a significant wave height of 0.5 m. Waves are absorbed by a parabolic corrugated surface beach with transverse slats at the east end of the tank. Flexible side absorbers deployed over the entire length of the tank absorb the lateral waves and minimize the time between runs.

4 DESCRIPTION OF PHYSICAL MODELS

The models are 1:45 scale, nominally 5 m long, representations of a PANAMAX bulk carrier. They were fitted with a lateral bow thruster opening but no provision was made for rudder, or shafting, nor were there any bilge keels fitted to the model. A photo of OCRE931 as installed in the towing tank is given in Figure 1. Model construction, in general, complied with the provisions contained in the OCRE model construction standard, GM-1 (Reference 4), except as noted below.

Model OCRE930 represents the standard OCRE model construction method (option 1) as described in Reference 1. It uses a plywood box construction at its core. High density polystyrene foam is laminated to the box to approximate the shape of the ship. High density epoxy foam, Renshape™, is used locally for areas requiring reinforcement, like the shafting or bilge keel, or to permit better definition of the shape of the hull in way of a tunnel thruster. The model surface is milled undersize by about 1-1.5 mm depending on the thickness of the fibreglass laminate. It is coated with Duratek high build primer left unsanded for the January phase of the test. For this series of tests, it was sanded, primed and painted with the marine enamel that is the standard finish used for models since late summer 2014.

Model OCRE931 represents option 3 of the DFS model construction plan. The plug was laminated using locally produced expanded polystyrene foam, Trufoam™, without a box structure. The structure of the model consisted simply of two plywood decks. A sprayed on product was intended to produce the finish surface but proved unsuitable for use with the curved and vertical surfaces of a ship model. Two layer of 10 oz fibreglass boat cloth were applied to the plug instead of the “coating” and the model was primed and painted without using the Duratek product.

Model OCRE932 represents option 2 of the DFS model construction plan. The plug was laminated using Renshape™ 5020 high density foam, without a box structure using the Renshape™ recommended adhesive. The structure of the model consisted simply of two plywood decks. The laminated model was CNC machined to 0.010" undercut then lightly sanded and prepped for a final coat of primer and paint on both the external and internal surfaces.

Model OCRE933 represents the wood option of the DFS model construction plan. The plug was laminated using kiln-dried pine with a nominal thickness of two inches using epoxy resin. The lumber was jointed and planed to a final thickness of about 1.75 inches. The laminated model was CNC machined to 0.010" undercut then lightly sanded, coated with polyester resin inside and out and then, prepped for a final coat of primer and paint on the external surfaces.

Turbulence stimulation of the hull was placed in a vertical line 16 cm aft of the forward perpendicular. Turbulence stimulation of the bulb was in a vertical line 5.4 cm forward of the forward perpendicular. Turbulence stimulation consisted of right cylindrical studs, nominally 3 mm in height and diameter spaced at 25 mm intervals along the girth as shown in Figure 2. An eye screw was fitted on centerline at deck level at the transom to permit verification of the resistance measurement system.

In addition to the models described above, the original large scale model, OCRE916, was re-commissioned, as described in Reference 1, and its load displacement resistance curve repeated.

The models were tested at the following full scale displacement condition: 83548 m³ volume displacement, level trim at a draft of 13.5 m full scale. Hydrostatics for the ship and model and details of the Floatation Quality Assurance are given in Appendix A.

5 DESCRIPTION OF INSTRUMENTATION AND DATA ACQUISITION SYSTEM

This section describes the instrumentation and calibration methodology used for each parameter measured on the models. The standard NRCSJS sign convention described in Reference 5 was followed where:

Trim Angle – positive bow up
Sinkage – positive down
Roll Angle – positive starboard down
Tow Force – positive forward

5.1 Standard Resistance Test Instrumentation

Tow force was measured using a 10-lb Interface SM S-type load cell. Nominal accuracy for this instrument is shown below.

Nonlinearity - %FS	±0.03
Hysteresis - %FS	±0.02
Nonrepeatability - %RO	±0.01

Model sinkage and trim was measured using a pair of Celesco PT100 Series cable extension transducers attached to the model nominally at the fore and aft perpendiculars. Dynamic trim was measured using a Heidenhain ROD-250 digital encoder mounted to the pitch pivot of the towing gimbal. Water temperature was periodically measured manually using a hand-held digital thermometer submerged at the nominal mean draft depth.

Several type of verification pull load cell were used including a Cooper 10 lb load cell, a waterproofed 50 lb S-type load and finally, a 10 lb Interface SM S-type load cell similar to the one used to measure tow force in the dynamometer. The Cooper was used because its weight and range were appropriate for the balance validation but was found to be insufficiently accurate to validate the balance performance. It was replaced with a waterproofed 50 lb load cell which has been adequate for balance verification in the past but the pre-load necessary to have the pull line horizontal was more than half the balance measurement range. In the end, an Interface SM load cell was supported by a small piece of aluminum angle which eliminated the need for pre-load during the balance verification tests. This method would not have been suitable if the load cell was mounted closer to the waterline but proved acceptable for this series of tests.

The load cells (resistance and verification pull) were calibrated by applying a series of static weights over the desired measuring range. All NRCSJS calibration weights are verified on precision digital scales. At the beginning of the resistance test, a series of in-line loads were applied to the model stern pull point and the output from the resistance load cell compared to the load cell attached to the stern pull point to verify that the acceleration stops in the gimbal were not attenuating the measured resistance.

The sinkage (heave) displacement sensors were calibrated using a dedicated apparatus whereby the yoyo potentiometer cable was attached to a flat plate such that the cable could be adjusted in discrete increments a known distance from the sensor.

The Heidenhain encoder requires no calibration beyond offsetting its output to match the set condition of the model.

For the repeat test of OCRE916, the SM-10 load cells used in the towing gimbal and the inline pull were replaced with SM-25 load cells.

Carriage Speed: Carriage speed is calibrated periodically by setting up two proximity switches on the ice tank rails at a measured distance apart with companion switches on the tow carriage linked by cable to the carriage data acquisition system. The towing carriage is operated at a constant speed between the two switches and the time between activating the switches recorded on the carriage data acquisition system - thus providing an accurate measure of tow carriage speed. The carriage speed is calibrated over a range of -0.5 to 2.5 m/s.

The list of signals is presented in Table 1 and the instrumentation calibration information is given in Appendix B.

5.2 Data Acquisition System

The GDAC data acquisition application uses the client-server model of computing. Data flows continuously from one or more data sources (e.g. sensors) to an instance of the server component of GDAC, where it is time-stamped and held in memory for a period of time. When the memory allocated becomes full, old data is discarded to make room for new. While data resides in memory, it is available for extraction by an instance of the client component of GDAC. An instance of the client component can simultaneously extract data from multiple instances of the server component. Extracted data is stored in a single DAQ file, which becomes the starting point for data analysis.

Examples of instances of client components are:

- GDAC Acquisition.
- GDAC Calibration.
- GDAC Digital Meter.

Examples of service components used in this test include:

- One that interfaces with an IMC device.
- One that interfaces with the Heidenhain Pitch Encoder.

All acquired analog DC signals were low pass filtered at 10 Hz, amplified as required and digitized at 50 Hz using NRCSJS's standard data acquisition system and software.

6 DESCRIPTION OF THE EXPERIMENTAL SET UP

The towing tank was configured as follows for these experiments:

Water Depth: The water depth is fixed at nominally 7 m.

Model Towing Arrangement: The model was towed using the medium tow post and gimbal modified to accept the scalable resistance dynamometer. The model was towed towards the west end of the Towing Tank. A yaw restraint is fitted forward of the tow post.

Pull Point: The pull point apparatus used to carry out daily verification of resistance was installed on the outboard edge at the west end of the tow carriage to enable a standard series of weights could be applied to the gimbal load cell at the beginning and end of every test day during the resistance tests. The applied load was verified using an in-line load cell.

Wake Suppression Strategy:

Side Beaches, described in Reference 6, were deployed along the length of both the north and south side of the tank to suppress the model wake generated wave.

7 DESCRIPTION OF THE TEST PROGRAM

7.1 *Bare Hull Resistance*

Bare hull resistance experiments were carried out as per the NRCSJS standard resistance procedure (Reference 7) from 9 to 17 knots full scale (0.692 to 1.304 m/s model scale) with repeat runs included for data verification. One of the speed sets was repeated ten times to determine the variability inherent in the measurement system and to develop a better understanding of the uncertainty of the measurement. As all speeds were low, more than one speed could be acquired for each run down the tank. Data was acquired for the displacement condition described in Section 4.0.

Each model, with the exception of the large model, was tested on at least three different days. At the conclusion of most test days, the model was removed from the tank. Exceptions are noted in the test log. The resistance and repeatability test plan is given Table 2 for the small models and in Table 3 for the large model. The Run Log for all tests in the Towing Tank can be found in Appendix C.

8 ONLINE DATA ANALYSIS PROCEDURE

An analysis of the preliminary data was carried out on the Tow Tank carriage workstation throughout the test program to verify the integrity of the acquired data. The carriage operator was responsible for viewing the time series data for all acquired data using the SWEET software described in Reference 8. In addition, the following data analysis was carried out during the experiments:

8.1 *Bare Hull Resistance*

The data were acquired in GDAC format (*.DAQ files) described in References 9 and 10 and preliminary online analysis done using the SWEET software described in Reference 8 during the test to verify the integrity of the acquired data. Because of the Cyber Intrusion, it is not possible to use the OCRE RSP software for online analysis. The resistance online data analysis was implemented using SWEET and described as follows:

- The basic resistance channels (forward speed, tow force, sinkage AP, sinkage FP and pitch) were plotted on screen in the time domain. Start and end times (T1, T2) were interactively selected for the initial tare segment as well as for each steady state segment. There was more than one steady state segment if more than one forward speed was acquired during a single run up the tank – a common situation for low forward speeds.
- The following three plots are displayed on the same screen:
 - Trim (degrees) vs. Froude Number
 - Sinkage (mm) vs. Froude Number
 - Resistance (N) vs. Froude Number
- Run Designation, Acquire Time, Start and End Times (T1,T2) and mean values of Carriage Speed (m/s), Resistance (N), Sinkage LCB (mm) and Trim (degrees) computed

over each steady state time segment were output in tabular form for all runs completed for the given model configuration up to the given run.

The raw test results for the resistance curve and the repeatability tests are given in Appendix D.

9 OFFLINE DATA ANALYSIS

The following data analysis was carried out after completion of the experimental program to generate the final data products. Because of the Cyber Intrusion, it was not possible to use the VMS based RSP software to perform the offline analysis. Part of this analysis suite generates the blockage correction that must be applied to the data. Scott's blockage correction method (Reference 11), as implemented in the RSP software, corrects the value of CTM and maintains speed but does not lend itself to easy implementation within a spreadsheet. Since speeds were low, the Scott delta V corrector recommended in ITTC procedure 7.5-02-02-01 (Reference 12) was used to compute blockage correction. All test results were corrected to 15 deg. C in fresh water.

The original model 916 dataset was re-analyzed using the same blockage corrector to provide direct comparison. All comparisons are done on the basis of CTM and Resistance corrected to 15 deg C in fresh water. No form factor was applied. The tabulated results of this re-analysis are given in Table 4.

The Model Resistance Coefficients corrected to 15 deg. C in fresh water are tabulated for each runs as follows: Froude number (Fr), Reynold's Number ($10^6 Re_M$), Total Resistance Coefficient ($10^{-3} CT_M$), and Frictional Resistance Coefficient ($10^{-3} CF_M$). In addition, the Resistance corrected to 15 deg. C and the Residuary Resistance Coefficient ($10^{-3} C_R$) are tabulated and given in Appendix E. Statistics for the ten repeat runs are included at the bottom of each table.

Sinkage and Trim are tabulated for each runs as follows: Froude number (Fr), non-dimensional Sinkage at LCB ($10^2 Z_v/LM$), trim (deg) as measured using the Heidenhain encoder and derived from the heave potentiometers (θ_v) and given in Appendix F. Statistics for the ten repeat runs are included at the bottom of each table.

10 QUALITY ASSURANCE

The following measures were taken to ensure the integrity of the acquired resistance data:

ONLINE DATA ANALYSIS: The data were analyzed during the test as described in Section 8.1. Any anomalies in the primary resistance channels were identified. Using the technique of plotting the acquired data against a comparison curve, it was possible to detect and address even minor problems immediately. If the data from a given run was found to vary from what was expected by an unacceptable amount, then the run was repeated. If the variance persisted, the test was halted and an investigation carried out to determine the source of the problem.

DAILY PULLS TO CHECK RESISTANCE LOAD CELL: Every effort was made to verify the integrity of the load cell used to measure the resistance load as it was acknowledged that this was

the single most critical acquired parameter. The resistance gimbal was calibrated prior to the test by applying a series of known static weights to it using the Cussons Technology Horizontal Static calibration device. It was then installed in the model tow gimbal balance such that it remains horizontal with respect to the still waterline independent of model attitude. Mechanical stops were adjusted to prevent inertial carriage acceleration/deceleration induced forces from damaging the load cell. A series of in-situ longitudinal loads was applied to the stern of the model using a dedicated drag verification apparatus fitted on the east end of the towing tank carriage for this purpose. Because the maximum calibration load for these experiments were about 40 N, the usual approach for measurement of inline load proved inadequate. The checks done with the 10 lb Cooper load cell and the waterproofed S-type load cell were unsatisfactory because of catenary effects on the line and the excessive pre-load needed. A bracket was made to mount the spare SM-10 load cell and support it horizontally relative to the deck of the model. This reduced the catenary effect to an acceptable level and since model trim during the load cell verification runs was less than 0.1 degrees, alignment was considered satisfactory. A light line was connected to the opposite end of this load cell and extended to the drag verification apparatus, which was aligned with the longitudinal centerline of the model. This line passed over three low friction sheaves vertically up and over the west end of the carriage deck such that weights could be applied using a weight pan on the carriage deck. The height of the post was vertically adjustable to ensure that the applied load was horizontal. The use of an inline load cell at the model stern, while it adds an extra instrument to the process, mitigates the unknown effects of friction in the sheaves. In-situ checks were carried out at the start and end of each test day. The results of these checks for the small and large models are given in Appendix G.

The residual standard deviation was calculated on the basis of correcting the tow force using the slope and offset to the inline pull load cell. The Standard Uncertainty of Calibration (SEE) (Reference 13) was calculated using the uncorrected measured tow force and the measured inline load. This calculation does not account for the uncertainty in the calibration of the inline load cell. Tables 5 and 6 summarize the Standard Uncertainty of Calibration calculation for Tow Force and the Inline load cell instruments used for the small and large model, respectively.

11 DISCUSSION

11.1 Resistance Curve

The results for the resistance curves with OCRE931, OCRE930b and OCRE933 were extrapolated to the size of model OCRE916 and presented as Resistance at 15 deg C in fresh water in Table 7 and shown in Figure 3. The table and figure also show the results of the repeat test with the large model, OCRE916 using the new towing gimbal. All of the test results are compared to the original running of OCRE 916 in April 2013 in terms of a percentage difference in Table 7 and shown in Figure 3. The mean value and standard deviation of the percentage difference for speeds between 11 and 15.5 knots, full scale, is shown for each individual resistance curve at the top of each column. Table 8 and Figure 4 show the same information for the tests performed in January using the towing gimbal assembled around the Kempf and Remmers R-35I single component balance.

No resistance tests were done with OCRE932 as the model had persistent leaks. Three attempts were made to install this model but as the model was ballasted to its test condition, water appeared in the model. Two attempts to repair the leaks were made but the location of the leaks changed with each installation. After the third attempt, the decision was made to abandon tests with this model.

The bridge model for the two sessions of the tests was OCRE931. This was unfortunate as this was the model that showed the most variability in the measured resistance in January. This was mitigated by the repeat test with the large model, originally tested in April 2013, which showed that the measured resistance repeated within +/- 1% throughout the speed range and between 11 and 15.5 knots, full scale, the mean difference was 0.1%.

For the basic resistance curve, the wooden model (OCRE933) was closest to the large model while the small standard model (OCRE930b) was furthest from the large model. The April runnings of the TRUFOAM model were a little closer to the large model than the January runnings. This is summarized below with information extracted from Tables 7 and 8. Curiously, the variability of the differences, as characterized by the standard deviation, is larger for the wooden model than for the other two model construction techniques and the repeat done with the large model.

April/May Session

	930b-1	930b-2	931-6	931-5	933-1	933-3	933-4	916-2015
	(Pred/Act)	(Pred/Act)	(Pred/Act)	(Pred/Act)	(Pred/Act)	(Pred/Act)	(Pred/Act)	(Pred/Act)
	-1	-1	-1	-1	-1	-1	-1	-1
Mean*	-1.8%	-2.0%	-1.2%	-0.7%	0.1%	0.4%	0.6%	0.1%
StDev	0.4%	0.5%	0.5%	0.6%	0.9%	0.8%	0.7%	0.5%

*Mean and Standard Deviation calculated for speeds from 11 to 15.5 knots

January Session

	930a-1	930a-2	931-2	931-3	931-4
	(Pred/Act)	(Pred/Act)	(Pred/Act)	(Pred/Act)	(Pred/Act)
	-1	-1	-1	-1	-1
Mean*	2.9%	2.9%	-1.0%	-1.8%	-3.0%
StDev	0.5%	0.6%	0.5%	0.3%	0.6%

*Mean and Standard Deviation calculated for speeds from 11 to 15.5 knots

11.2 Repeatability Sets

As was done in January, ten run repeatability sets were done following the resistance curve of the day or in some cases as a stand-alone set. The test log, given in Appendix C, contains the details of the actual test sequence used. The details of the repeatability sets are given in the Model Resistance Coefficient Tables (Appendix E) and summarized in Table 9. The summary table from LM-2005-01, the report on the January tests, is included as Table 10. The variability in the repeatability sets for the three models for which there were multiple sets of tests is illustrated in Figures 5 to 7. These figures illustrate the variability by plotting the normal

distribution of the data derived from the mean and standard deviation of the means of the ten or eleven repeated runs as Probability Density versus Measured Resistance. The actual measured data points are superimposed by interpolating the Probability Density curve at the actual measured value and using that as the abscissa for the point.

The ten repeat runs seem to be a good measure of the uncertainty of the experiment on any given day. Doing the repeats all together produces the lowest degree of variability and since we were trying to assess the effects on model construction techniques, this approach has value as it minimized the effect of run history on the result.

The tables and plots suggest that the wooden model (OCRE933) performs better in terms that there was less variation from day to day with this construction than with the other two construction methods.

The other construction methods showed more variability. For the TruFoam model (OCRE931), this is partly due to it being the bridge model between the two sessions. Two sets from this session (Day 5 and 6) are compared to two sets from the January session (Day 2 and 3). The variability at $Fr = 0.10$ and 0.13 is similar to the wooden model but at $Fr = 0.17$, the results for each day group separately with little overlap. This model was less stiff longitudinally than the other models and displayed more oscillation in the trim and heave time histories. This may be due to difference in the ballast distribution between sessions and individual installations.

The small standard model (OCRE930) also showed more variability than expected. This is partly due to the wrong speed being repeated on Day 2 at $Fr=0.17$ and since time did not permit a complete repeat, we decided to amend the test sequence to simply do the repeatability sets without the basic resistance curve. Run sequence has been seen to have an effect on test results in other tests but usually, as a result, of a large amount of energy being put into the tank or an inadequate wait time. This was not the case for these tests, but nonetheless the repeatability sets done without the resistance curve in this session generally displayed higher resistance values. During the January session, time constraint permitted only the repeatability set to be done on one day with the unpainted version of this model but the variability described above did not appear.

11.3 Sinkage and Trim

The variability of the sinkage and trim measurement is shown in the Model Sinkage and Trim tables (Appendix F) in the statistics for the repeat runs and summarized in Table 11. In non-dimensional form, sinkage and trim compare fairly well for most of the repeats with the different small models and with the repeat tests done using the large model, OCRE916. The performance of the Heidenhain encoder as installed in the new resistance gimbal was a disappointment. This type of instrument had been the gold standard when used in the sailboat experiment and the results obtained in this test were not satisfactory. A possible explanation for the poor performance may be the type of coupling that was needed to adapt the Heidenhain encoder to the pitch axle of the gimbal. The poor performance is illustrated by a typical xpull time history shown in Figure 8. Between load 1 and 2, the incremental step in pitch is much larger than all the other ones. Pitch does not return to the initial angle as the load goes back to zero and the offset is approximately equal to the step between loads 1 and 2. While the magnitude of the step is only about 0.02 degrees, the accuracy of this instrument is typically 5 arc-seconds or almost 0.001 degrees. The step did not appear in every test nor did it appear between the same two loadings so it is unlikely that this behaviour is related to the test setup.

There was nothing obviously loose in the connection between the coupling and the gimbal but the small diameter of pitch pivot axle might permit a small amount of movement. The January tests used a Shaevitz inclinometer mounted to the lower deck of the model, a rotary pot attached to the gimbal and displacement transducers at the fore and aft perpendiculars. The trim measured using the inclinometer correlated well with trim measured using the displacement transducers but the rotary pot on the gimbal did not correlate.

11.4 Uncertainty Analysis

ITTC2014 Recommended Procedure 7.5-02-02-02.2, “Best Practice Guideline for Uncertainty Analysis in Routine Resistance Tests” suggests that, for conventional displacement-type mono-hull ship models, the dominant uncertainties only include those from components of the dynamometer calibration and repeatability of tests as shown below.

Source & Component		Uncertainty in resistance	Type
Dynamometer	Calibration (<i>SEE</i>)	$u_2(R_T)$	A
Repeatability	<i>N</i> repeat tests	$u_A(R_T)$	A
Combined	$u_C(\bar{R}_T) = \sqrt{u_2^2 + (u_A / \sqrt{N})^2}$		
Expanded	$U_P(\bar{R}_T) = k_P \cdot u_C(\bar{R}_T)$ ($k_P=2$ for 95% confidence level)		

The following table illustrates the uncertainty report for the small and large model. For the small model, data obtained with the standard model OCRE930B was used to generate the uncertainty report. This dataset was chosen because it displayed the greatest variability within a test session and the model is representative of standard practice at OCRE. This shows that there is little to choose between the resistance results obtained with either the small or the large model. The large model is better particularly below the design speed and this is important when accessing the form factor using the in the ITTC78 method.

Uncertainty Report for OCRE930B and OCRE916

	Small Model (all) OCRE930B			Small Model (worst) OCRE930B - 3			Large Model OCRE916	
Speed (Fr)	0.10	0.13	0.17	0.10	0.13	0.17	0.133	0.166
R_T (N)	6.25	10.52	17.42	6.42	10.68	17.47	28.518	44.607
Dynamometer (SEE) (N)	0.00377			0.00377			0.00545	
Repeatability (N)	0.1501	0.1493	0.1384	0.0920	0.1035	0.0660	0.117	0.145
Samples	42	42	33	10	10	10	11	11
Combined (N)	0.0235	0.0233	0.0244	0.0293	0.0330	0.0212	0.0355	0.0440
Expanded (N)	0.0469	0.0467	0.0488	0.0587	0.0659	0.0424	0.0711	0.0881
Expanded/ R_T	0.75%	0.44%	0.28%	0.91%	0.62%	0.24%	0.25%	0.20%
C_{TM15} [-]	4.5242	4.2891	4.2556	4.6447	4.3535	4.2680	3.9471	3.9635
$U_P(C_T)$ [-]	0.0340	0.0190	0.0119	0.0425	0.0269	0.0104	0.0098	0.0078

No attempt was made to estimate the uncertainty of the sinkage and trim measurement.

12 RECOMMENDATIONS

- The repeatability and uncertainty estimates made in this report should be included in the uncertainty section of the OCRE standard test method.
- The results of the ITTC world-wide facility bias study must also be reviewed and incorporated into the uncertainty section of the OCRE standard test method.
- Resistance and propulsion tests should be done using the Design 18 model built for DRDC. This model has propellers already made and would simply need shafting and dummy hubs fabricated to permit self-propulsion tests to quantify the uncertainty of the resistance and self-propulsion experiment for a typical twin screw combatant vessel. This might serve as a training opportunity for new research and technical staff.
- A lower priority would be uncertainty experiments for self-propulsion with the CSL model. This would be more of a challenge as the propeller used for the original series of tests was borrowed from Hamburg Ship Model Basin (HSVA), but it might be possible to find a propeller of approximately the right diameter as this test would not necessarily have to tie back to the original CSL experiments.
- During the next update of the acquisition software, provision should be made to output the Standard Uncertainty of Calibration (SEE) of each instrument during the calibration rather than having to extract the information after the fact. This would provide a more consistent guide to technical and research staff as to what is an acceptable calibration.
- The Heidenhain encoder did not perform nearly as well as expected. This may be due to the connection of the encoder to the gimbal. Unless an easy way can be found to improve the connection between the encoder and the gimbal, it should be removed from the new towing gimbal. Trim and sinkage would be measured using a pair of displacement mounted at or near the fore and aft perpendiculars, as is recommended in the latest version of the standard. A standard custom processor should be implemented to compute sinkage and trim from these two channels. This custom processor could also do the online resistance and propulsion analysis.
- There is little to choose between the three model construction techniques in terms of a basic resistance experiment. If a client was attempting to assess only the resistance of multiple designs, then the TruFoam option might be acceptable option, particularly if care is taken in obtaining similar ballast distributions between models. The wooden model has better performance in terms of repeatability in this particular test sequence and also has the advantage of being more easily accepting add-ons like bilge keels or other appendages. On the other hand, wooden models have, on occasion, displayed poor structural performance in the Ice Tank and can be particularly vulnerable to problems if there is a leak.

13 ACKNOWLEDGEMENTS

The author thanks all NRC technical staff that assisted with this project.

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TABLES

Table 1: List of Signals
List of Signals

Ch. #	Channel Name	Data Units	Cal Date/Time	Sensor	Calibrated Range		Max Absolute Error	Standard Uncertainty of Calibration (SEE)
					min	max		
1*	Heidenhain Pitch 1	deg	4/21/2015 12:14	Heidenhain ROD-250 Encoder	0	360	0.00140	n/a
1	Tachogenerator	m/s	3/26/2014 16:45	Tacho-generator	1	6	0.00039	0.00025
2	Carriage Speed	m/s	1/7/2015 17:37	Towing Tank Control System	-0.501	2.502	0.00121	0.00087
3	Carriage Position	m	12/9/2014 14:20	Towing Tank Control System	22.155	149.95	0.01961	0.01517
9+	Resistance new	N	4/16/2015 13:07	Interface SM-10	-47.078	47.078	0.00657	0.00377
5	Inline load	N	4/21/2015 10:57	Cooper 10 lb	0	29.424	0.15204	0.09668
14	Inline load 50lb	N	4/21/2015 11:26	9363-D3-50-20P1 50lb S type	4.904	39.232	0.05366	0.03612
13	Inline load	N	4/24/2015 11:42	Interface SM-10	0	39.232	0.00182	0.00127
15	Sinkage AP	mm	4/20/2015 16:25	PT-101-0050-111-1110	0	700	0.17838	0.12877
16	Sinkage FP	mm	4/20/2015 16:34	PT101-0025-111-1110	0	300	0.23687	0.17432
11+	Resistance 25	N	5/14/2015 13:29	Interface SM-25	-117.37	117.38	0.01000	0.00545
14	Inline load 25	N	5/14/2015 13:46	Interface SM-25	0	107.89	0.00336	0.00205

* Server: SJS-DAS33:50001

+ Server: SJS-DAS49:50001

All other channels on TOWDAS

Table 2: Test Plan – Small Model

Resistance and Repeatability Test Plan					
Ship Length		222.71	m		
Scale		45			
Run	VS [knots]	VS [m/s]	Vm [m/s]	Fr [-]	Comment
1	13	6.688	0.9970	0.143	Roughup - full length
2	13	6.688	0.9970	0.143	Roughup - full length
	9	4.630	0.6902	0.099	Accel. rate =0.1 m/s ²
3	12	6.173	0.9203	0.132	
	15.5	7.974	1.1887	0.171	
	10	5.144	0.7669	0.110	
4	13	6.688	0.9970	0.143	
	14.5	7.459	1.1120	0.160	
5	12.5	6.431	0.9586	0.138	
	17	8.746	1.3037	0.187	
6	14	7.202	1.0736	0.154	
	16.5	8.488	1.2654	0.182	
7	11	5.659	0.8436	0.121	
	16	8.231	1.2270	0.176	
8	13.5	6.945	1.0353	0.149	
	15	7.717	1.1503	0.165	
9	14	7.202	1.0736	0.154	Sched Repeat 1
	16.5	8.488	1.2654	0.182	
10	11	5.659	0.8436	0.121	Sched Repeat 2
	16	8.231	1.2270	0.176	
	9	4.630	0.6902	0.099	
11-20	12	6.173	0.9203	0.132	Repeatability Test 1-10
	15.5	7.974	1.1887	0.171	

Table 3: Test Plan – Large Model

Resistance and Repeatability Test Plan					
Ship Length		222.71	m		
Scale		31.45			
Run	VS [knots]	VS [m/s]	Vm [m/s]	Fr [-]	Comment
1	13	6.690	1.193	0.143	Roughup - full length
2	13	6.690	1.193	0.143	Roughup - full length
	9	4.632	0.826	0.099	Accel. rate =0.1 m/s ²
3	13.5	6.943	1.238	0.149	
	10	5.143	0.917	0.110	
4	16	8.233	1.468	0.176	
	11	5.659	1.009	0.121	
5	15.5	7.975	1.422	0.171	
	12	6.174	1.101	0.132	
6	15	7.717	1.376	0.165	
	13	6.690	1.193	0.143	
7	14	7.201	1.284	0.154	
	12	6.174	1.101	0.132	
8-17	15	7.717	1.376	0.165	Repeatability Test 1-10

Table 4: Re-analysis of April 2013 OCRE916 dataset using deltaV corrector

OCRE916
Resistance and CTM15
Re-analyzed using Scott's Delta V Blockage Corrector

Fr [-]	CTM15 [-]	RES15 [N]
0.024	0.004628	0.81
0.042	0.004257	2.72
0.060	0.004103	5.75
0.078	0.004037	9.88
0.099	0.004019	16.23
0.110	0.004037	20.11
0.121	0.003975	23.98
0.132	0.003941	28.27
0.143	0.003931	33.08
0.149	0.003874	35.14
0.154	0.003874	37.78
0.160	0.003891	40.73
0.165	0.003938	44.04
0.171	0.003942	47.14
0.176	0.004076	51.93

Table 5: Standard Uncertainty of Calibration for Small Model

SM-10 Inline Load		Resistance New	
Fit (N)	Residual (N)	Fit (N)	Residual (N)
-0.002	0.0016	39.231	0.0012
4.904	0.0002	-39.229	-0.0027
9.807	0.0008	-47.072	-0.0060
19.614	0.0017	47.083	-0.0042
24.521	-0.0011	3.920	0.0034
29.422	0.0017	7.845	0.0010
34.329	-0.0010	11.768	0.0012
39.233	-0.0007	15.692	0.0012
19.616	-0.0002	19.618	-0.0019
9.810	-0.0018	23.541	-0.0014
29.423	0.0006	27.466	-0.0032
9.809	-0.0014	-31.381	-0.0046
29.423	0.0008	-27.460	-0.0022
19.615	0.0015	-23.540	0.0013
14.714	-0.0016	-19.620	0.0041
14.713	-0.0012	-3.928	0.0052
		-7.851	0.0049
		-11.775	0.0055
		-15.699	0.0057
		-43.151	-0.0037
		-35.309	0.0002
		35.305	0.0038
		43.157	-0.0023
		31.392	-0.0066
SEE	0.00127 N	SEE	0.00377 N
n	16	n	24
Max Absolute Error	0.00182	Max Absolute Error	0.00657

Table 6: Standard Uncertainty of Calibration for Large Model

SM-25 Inline Load		Resistance (25lb)	
Fit (N)	Residual (N)	Fit (N)	Residual (N)
0.000	-0.0001	28.108	0.0000
9.806	0.0018	36.643	-0.0063
19.615	0.0007	47.714	0.0000
29.422	0.0016	62.982	-0.0047
39.233	-0.0006	78.260	-0.0065
58.851	-0.0031	97.694	0.0057
68.659	-0.0034	117.377	0.0028
78.466	-0.0019	-8.570	0.0001
88.271	0.0006	-17.099	0.0000
98.079	0.0014	-28.118	0.0100
107.885	0.0029	-47.711	-0.0028
		-62.984	0.0075
		-78.257	0.0027
		-117.360	-0.0084
SEE	0.00205 N	SEE	0.00545 N
n	11	n	14
Max Absolute Error	0.00336	Max Absolute Error	0.01000

Table 7: Summary of Prediction of Large Model Resistance for April/May session

		3-Apr -2013	23-Apr -2015	24-Apr -2015	22-Apr -2015	21-Apr -2015	5-May -2015	6-May -2015	12-May -2015	Mean* StDev 15-May -2015 916-	-1.8% 0.4%	-2.0% 0.5%	-1.2% 0.5%	-0.7% 0.6%	0.1% 0.9%	0.4% 0.8%	0.6% 0.7%	0.1% 0.5%
		916 Actual	930b-1 Pred	930b-2 Pred	931-6 Pred	931-5 Pred	933-1 Pred	933-3 Pred	933-4 Pred	2015 Pred	*Mean and StDev calculated for speed range of 11 to 15.5 knots							
Model		916 Actual	930b-1 Pred	930b-2 Pred	931-6 Pred	931-5 Pred	933-1 Pred	933-3 Pred	933-4 Pred	2015 Pred	930b-1 (Pred /Act)-1	930b-2 Pred /Act)-1	931-6 Pred /Act)-1	931-5 Pred /Act)-1	933-1 Pred /Act)-1	933-3 Pred /Act)-1	933-4 Pred /Act)-1	916- 2015 Pred /Act)-1
VS	Fr	Res(15)	Res(15)	Res(15)	Res(15)	Res(15)	Res(15)	Res(15)	Res(15)	Res(15)								
9	0.099	16.14	16.16	16.27	16.60	16.51	16.76	16.84	16.82	16.20	0.1%	0.8%	2.8%	2.3%	3.9%	4.4%	4.3%	0.4%
9.25	0.102	17.11	17.02	17.13	17.43	17.39	17.67	17.66	17.79	17.26	-0.5%	0.1%	1.9%	1.6%	3.3%	3.2%	3.9%	0.8%
9.5	0.105	18.09	17.90	18.01	18.28	18.28	18.59	18.51	18.74	18.28	-1.0%	-0.4%	1.1%	1.1%	2.8%	2.4%	3.6%	1.1%
9.75	0.107	19.06	18.79	18.89	19.14	19.18	19.52	19.40	19.69	19.28	-1.4%	-0.9%	0.4%	0.7%	2.4%	1.8%	3.3%	1.2%
10	0.110	20.02	19.70	19.78	20.01	20.09	20.45	20.31	20.63	20.25	-1.6%	-1.2%	-0.1%	0.4%	2.1%	1.4%	3.0%	1.1%
10.25	0.113	20.98	20.62	20.68	20.89	21.02	21.39	21.27	21.56	21.18	-1.7%	-1.4%	-0.5%	0.2%	2.0%	1.4%	2.8%	1.0%
10.5	0.116	21.92	21.56	21.57	21.76	21.94	22.34	22.27	22.46	22.05	-1.7%	-1.6%	-0.7%	0.1%	1.9%	1.6%	2.5%	0.6%
10.75	0.118	22.88	22.51	22.48	22.65	22.89	23.29	23.30	23.37	22.92	-1.6%	-1.7%	-1.0%	0.0%	1.8%	1.9%	2.1%	0.2%
11	0.121	23.86	23.48	23.42	23.59	23.86	24.26	24.33	24.29	23.84	-1.6%	-1.8%	-1.2%	0.0%	1.7%	2.0%	1.8%	-0.1%
11.25	0.124	24.89	24.48	24.40	24.58	24.88	25.24	25.35	25.26	24.85	-1.6%	-2.0%	-1.3%	-0.1%	1.4%	1.8%	1.5%	-0.2%
11.5	0.127	25.94	25.49	25.39	25.60	25.93	26.21	26.35	26.24	25.92	-1.7%	-2.1%	-1.3%	0.0%	1.0%	1.6%	1.1%	-0.1%
11.75	0.129	27.03	26.53	26.42	26.68	27.01	27.20	27.36	27.26	27.03	-1.8%	-2.2%	-1.3%	-0.1%	0.6%	1.2%	0.8%	0.0%
12	0.132	28.15	27.62	27.52	27.80	28.10	28.25	28.42	28.32	28.15	-1.9%	-2.2%	-1.2%	-0.2%	0.4%	1.0%	0.6%	0.0%
12.25	0.135	29.32	28.77	28.72	29.00	29.17	29.42	29.55	29.47	29.26	-1.9%	-2.1%	-1.1%	-0.5%	0.3%	0.8%	0.5%	-0.2%
12.5	0.138	30.56	29.96	29.99	30.26	30.25	30.65	30.73	30.67	30.36	-2.0%	-1.9%	-1.0%	-1.0%	0.3%	0.6%	0.4%	-0.6%
12.75	0.140	31.80	31.09	31.12	31.32	31.31	31.76	31.81	31.92	31.49	-2.2%	-2.1%	-1.5%	-1.5%	-0.1%	0.0%	0.4%	-1.0%
13	0.143	32.96	32.19	32.15	32.24	32.38	32.77	32.81	33.20	32.68	-2.3%	-2.5%	-2.2%	-1.8%	-0.6%	-0.5%	0.7%	-0.8%
13.25	0.146	33.99	33.37	33.33	33.42	33.56	33.97	33.99	34.32	33.98	-1.8%	-1.9%	-1.7%	-1.3%	-0.1%	0.0%	1.0%	0.0%
13.5	0.149	35.03	34.62	34.64	34.85	34.84	35.32	35.34	35.28	35.32	-1.2%	-1.1%	-0.5%	-0.5%	0.8%	0.9%	0.7%	0.8%
13.75	0.151	36.28	35.92	35.88	36.17	36.15	36.59	36.57	36.49	36.55	-1.0%	-1.1%	-0.3%	-0.4%	0.9%	0.8%	0.6%	0.7%
14	0.154	37.65	37.25	37.06	37.40	37.49	37.81	37.70	37.91	37.75	-1.0%	-1.6%	-0.7%	-0.4%	0.4%	0.2%	0.7%	0.3%
14.25	0.157	39.06	38.54	38.32	38.69	38.83	39.04	39.00	39.36	39.14	-1.3%	-1.9%	-0.9%	-0.6%	0.0%	-0.2%	0.8%	0.2%

Model		916	930b-1	930b-2	931-6	931-5	933-1	933-3	933-4	916-2015	930b-1	930b-2	931-6	931-5	933-1	933-3	933-4	916-2015
		Actual	Pred	Pred	Pred	Pred	Pred	Pred	Pred	Pred	(Pred /Act)-1	Pred /Act)-1	Pred /Act)-1	Pred /Act)-1	Pred /Act)-1	Pred /Act)-1	Pred /Act)-1	Pred /Act)-1
VS	Fr	Res(15)	Res(15)	Res(15)	Res(15)	Res(15)	Res(15)	Res(15)	Res(15)	Res(15)								
14.5	0.160	40.55	39.81	39.65	40.03	40.17	40.29	40.43	40.84	40.71	-1.8%	-2.2%	-1.3%	-1.0%	-0.7%	-0.3%	0.7%	0.4%
14.75	0.162	42.22	41.26	41.11	41.51	41.63	41.73	41.97	42.25	42.38	-2.3%	-2.6%	-1.7%	-1.4%	-1.2%	-0.6%	0.1%	0.4%
15	0.165	43.93	42.91	42.68	43.13	43.21	43.37	43.62	43.58	44.06	-2.3%	-2.8%	-1.8%	-1.6%	-1.3%	-0.7%	-0.8%	0.3%
15.25	0.168	45.37	44.48	44.44	44.90	45.04	44.95	45.27	45.08	45.65	-2.0%	-2.1%	-1.0%	-0.7%	-0.9%	-0.2%	-0.7%	0.6%
15.5	0.171	46.92	45.98	46.39	46.81	47.12	46.47	46.92	46.73	47.31	-2.0%	-1.1%	-0.2%	0.4%	-0.9%	0.0%	-0.4%	0.8%
15.75	0.173	49.04	47.90	48.51	48.87	49.28	48.42	48.89	48.72	49.42	-2.3%	-1.1%	-0.4%	0.5%	-1.3%	-0.3%	-0.7%	0.8%
16	0.176	51.61	50.25	50.80	51.07	51.52	50.79	51.18	51.05	51.91	-2.6%	-1.6%	-1.0%	-0.2%	-1.6%	-0.8%	-1.1%	0.6%

Table 8: Summary of Prediction of Large Model Resistance for January session

									Mean	2.9%	2.9%	4.0%	-1.0%	-1.8%	-3.0%
									StDev	0.5%	0.6%	3.5%	0.5%	0.3%	0.6%
		Test Date	9-jan	12-jan	13-jan	14-jan	15-jan	16-jan							
		916	930-1	930-2	931-1	931-2	931-3	931-4	930-1	930-2	931-1	931-2	931-3	931-4	
VS	Fr	Actual Res15	Pred Res15	Pred Res15	Pred Res15	Pred Res15	Pred Res15	Pred Res15	(Pred /Act)-1	(Pred /Act)-1	(Pred /Act)-1	(Pred /Act)-1	(Pred /Act)-1	(Pred /Act)-1	
9	0.099	16.14	16.77	16.56	16.43	16.50	16.26	16.06	3.9%	2.6%	1.8%	2.3%	0.8%	-0.5%	
9.25	0.102	17.11	17.65	17.51	17.63	17.30	17.09	16.86	3.1%	2.3%	3.0%	1.1%	-0.2%	-1.5%	
9.5	0.105	18.09	18.55	18.48	18.76	18.13	17.93	17.69	2.6%	2.2%	3.8%	0.2%	-0.8%	-2.2%	
9.75	0.107	19.06	19.49	19.47	19.82	18.99	18.80	18.55	2.3%	2.2%	4.0%	-0.3%	-1.3%	-2.7%	
10	0.110	20.02	20.46	20.48	20.81	19.89	19.69	19.43	2.2%	2.3%	3.9%	-0.7%	-1.7%	-3.0%	
10.25	0.113	20.98	21.46	21.51	21.68	20.82	20.61	20.35	2.3%	2.5%	3.3%	-0.8%	-1.8%	-3.0%	
10.5	0.116	21.92	22.50	22.56	22.40	21.78	21.55	21.29	2.6%	2.9%	2.2%	-0.6%	-1.7%	-2.9%	
10.75	0.118	22.88	23.56	23.62	23.11	22.78	22.51	22.27	3.0%	3.3%	1.0%	-0.4%	-1.6%	-2.7%	
11	0.121	23.86	24.64	24.69	23.95	23.78	23.49	23.26	3.2%	3.5%	0.3%	-0.4%	-1.6%	-2.5%	
11.25	0.124	24.89	25.72	25.77	24.89	24.78	24.47	24.24	3.3%	3.5%	0.0%	-0.5%	-1.7%	-2.6%	
11.5	0.127	25.94	26.81	26.85	25.82	25.77	25.45	25.21	3.3%	3.5%	-0.5%	-0.7%	-1.9%	-2.8%	
11.75	0.129	27.03	27.92	27.94	26.96	26.79	26.47	26.22	3.3%	3.4%	-0.2%	-0.9%	-2.1%	-3.0%	
12	0.132	28.15	29.06	29.04	28.55	27.87	27.56	27.29	3.2%	3.2%	1.5%	-1.0%	-2.1%	-3.0%	
12.25	0.135	29.32	30.24	30.16	30.96	29.04	28.75	28.50	3.1%	2.8%	5.6%	-1.0%	-1.9%	-2.8%	
12.5	0.138	30.56	31.42	31.27	33.62	30.23	30.00	29.79	2.8%	2.3%	10.0%	-1.1%	-1.8%	-2.5%	
12.75	0.140	31.80	32.52	32.32	34.98	31.26	31.14	30.88	2.3%	1.7%	10.0%	-1.7%	-2.1%	-2.9%	
13	0.143	32.96	33.61	33.41	35.49	32.24	32.22	31.80	2.0%	1.4%	7.7%	-2.2%	-2.3%	-3.5%	
13.25	0.146	33.99	34.81	34.78	35.83	33.46	33.36	32.94	2.4%	2.3%	5.4%	-1.6%	-1.8%	-3.1%	
13.5	0.149	35.03	36.09	36.26	36.07	34.82	34.56	34.26	3.0%	3.5%	3.0%	-0.6%	-1.4%	-2.2%	
13.75	0.151	36.28	37.52	37.56	37.10	36.13	35.80	35.56	3.4%	3.5%	2.3%	-0.4%	-1.3%	-2.0%	
14	0.154	37.65	38.99	38.82	38.78	37.42	37.10	36.83	3.6%	3.1%	3.0%	-0.6%	-1.4%	-2.2%	
14.25	0.157	39.06	40.28	40.20	41.30	38.75	38.50	38.02	3.1%	2.9%	5.7%	-0.8%	-1.4%	-2.6%	
14.5	0.160	40.55	41.58	41.69	44.22	40.12	39.96	39.16	2.5%	2.8%	9.0%	-1.1%	-1.5%	-3.4%	
14.75	0.162	42.22	43.25	43.42	45.17	41.64	41.37	40.53	2.4%	2.8%	7.0%	-1.4%	-2.0%	-4.0%	
15	0.165	43.93	45.06	45.27	44.88	43.27	42.78	42.15	2.6%	3.0%	2.2%	-1.5%	-2.6%	-4.1%	
15.25	0.168	45.37	46.56	46.85	45.96	44.82	44.36	43.75	2.6%	3.3%	1.3%	-1.2%	-2.2%	-3.6%	
15.5	0.171	46.92	48.07	48.51	47.97	46.44	46.09	45.35	2.5%	3.4%	2.2%	-1.0%	-1.8%	-3.3%	
15.75	0.173	49.04	50.23	50.94	49.74	48.67	48.13	47.24	2.4%	3.9%	1.4%	-0.7%	-1.9%	-3.7%	
16	0.176	51.61	52.89	53.87	51.55	51.40	50.48	49.45	2.5%	4.4%	-0.1%	-0.4%	-2.2%	-4.2%	

Table 9: Summary of Repeatability Tests –April/May Session**Model Construction Technique Evaluation Repeatability Summary**Standard Model

M1B Summary

		23-Apr-15				24-Apr-15			27-Apr-15			27-Apr-15								
Day/Set		1	RES15 (N)			2	RES15 (N)		3	RES15 (N)		4	RES15 (N)		Mean	StDev	ALL			
Speed	Fr	Mean	StDev	u _A (R _T)	Mean	StDev	u _A (R _T)	Mean	StDev	u _A (R _T)	Mean	StDev	u _A (R _T)	u _A (R _T)		Mean	StDev	Range	n	u _A (R _T)
1	0.1	6.12	0.022	0.007	6.12	0.029	0.009	6.42	0.092	0.029	6.37	0.064	0.020	0.016	0.010	6.25	0.150	0.532	42	0.023
2	0.13	10.39	0.022	0.007	10.39	0.027	0.008	10.68	0.104	0.033	10.64	0.065	0.021	0.017	0.012	10.52	0.149	0.502	42	0.023
3	0.17	17.24	0.037	0.011	17.48	0.031	0.022	17.47	0.066	0.021	17.47	0.066	0.021	0.019	0.005	17.42	0.138	0.451	33	0.024

TruFoam Model

M2 Summary

		21-Apr-15				22-Apr-15											
Day/Set		5	RES15 (N)			6	RES15 (N)			Mean				ALL			
Speed	Fr	Mean	StDev	u _A (R _T)	Mean	StDev	u _A (R _T)			u _A (R _T)	Mean	StDev	Range	n	u _A (R _T)		
1	0.1	6.21	0.056	0.016	6.18	0.053	0.016			0.016	0.000	6.20	0.055	0.206	23	0.012	
2	0.13	10.50	0.045	0.013	10.43	0.040	0.012			0.013	0.000	10.47	0.054	0.208	22	0.011	
3	0.17	17.63	0.067	0.020	17.50	0.063	0.019			0.020	0.001	17.57	0.091	0.324	22	0.019	

Wooden Model

M3 Summary

		5-May-15			6-May-15			7-May-15			12-May-15										
Day/Set		1	RES15 (N)		2	RES15 (N)		3	RES15 (N)		4	RES15 (N)		Mean				ALL			
Speed	Fr	Mean	StDev	u _A (R _T)	Mean	StDev	u _A (R _T)	Mean	StDev	u _A (R _T)	Mean	StDev	u _A (R _T)	u _A (R _T)		Mean	StDev	Range	n	u _A (R _T)	
1	0.1	6.36	0.079	0.024	6.32	0.041	0.012	6.30	0.039	0.012	6.35	0.057	0.017	0.016	0.005	6.33	0.060	0.299	44	0.009	
2	0.13	10.63	0.066	0.020	10.61	0.053	0.016	10.61	0.040	0.012	10.62	0.050	0.015	0.016	0.003	10.62	0.052	0.267	43	0.008	
3	0.17	17.50	0.075	0.023	17.52	0.084	0.025	17.46	0.068	0.020	17.51	0.075	0.023	0.023	0.002	17.49	0.077	0.365	44	0.012	

Values reported above are the means of the 10 or 11 repeats done in each setup

mean/stddev of all runs

max-min of all runs

Table 10: Summary of Repeatability Tests – January Session

Standard Model - Unpainted/unsanded Duratek Finish

M1A Summary

		8-Jan-15	9-Jan-15	12-Jan-15					
Day		1	2	3	$u_A(R_T)$				
Speed	Fr	RTm (N)	RTm (N)	RTm (N)	Mean	StDev	Range	Range/Mean	samples
1	0.1	6.25	6.28	6.28	6.270	0.019	0.129	2.10%	32
2	0.13	10.81	10.77	10.81	10.800	0.023	0.128	1.20%	32
3	0.17	18.02	17.77	17.92	17.900	0.124	0.341	1.90%	32

TruFoam Model

M2 Summary

		13-Jan-15	14-Jan-15	15-Jan-15	16-Jan-15					
Day		1	2	3	4	$u_A(R_T)$				
Speed	Fr	RTm (N)	RTm (N)	RTm (N)	RTm (N)	Mean	StDev	Range	Range/Mean	samples
1	0.10	6.11	6.15	6.14	6.08	6.117	0.052	0.285	4.7%	44
2	0.13	10.48	10.38	10.32	10.25	10.377	0.126	0.817	7.9%	44
3	0.17	17.34	17.25	17.13	17.00	17.211	0.227	1.531	8.9%	44

M2 Summary - Discard Day 1

		13-Jan-15	14-Jan-15	15-Jan-15	16-Jan-15					
Day		1	2	3	4	$u_A(R_T)$				
Speed	Fr	RTm (N)	RTm (N)	RTm (N)	RTm (N)	Mean	StDev	Range	Range/Mean	samples
1	0.10		6.15	6.14	6.08	6.115	0.044	0.161	2.6%	33
2	0.13		10.38	10.32	10.25	10.336	0.059	0.224	2.2%	33
3	0.17		17.25	17.13	17.00	17.158	0.117	0.446	2.6%	33

Values reported above are the means of the 10 or 11 repeats done in each setup

mean/stdev of all runs

max-min of all runs

Table 11: Summary of Repeatability Tests – Sinkage and Trim

Speed	Mean for repeats with each model						Standard Deviation for repeats with each model					
	0.099		0.132/0.133*		0.171/0.165*		0.099		0.132/0.133*		0.171/0.165*	
	n.d.		n.d.		n.d.		n.d.		n.d.		n.d.	
Model	Sinkage	Trim	Sinkage	Trim	Sinkage	Trim	Sinkage	Trim	Sinkage	Trim	Sinkage	Trim
931-5	0.0406	-0.0433	0.0763	-0.0760	0.1259	-0.1307	0.0034	0.0016	0.0037	0.0015	0.0026	0.0013
931-6	0.0358	-0.0406	0.0729	-0.0732	0.1249	-0.1293	0.0036	0.0009	0.0040	0.0006	0.0026	0.0011
930b-1	0.0222	-0.0328	0.0582	-0.0642	0.1089	-0.1185	0.0040	0.0013	0.0057	0.0016	0.0064	0.0020
930b-2	0.0330	-0.0400	0.0685	-0.0715	0.1397	-0.1429	0.0030	0.0008	0.0032	0.0004	0.0028	0.0005
930b-3	0.0311	-0.0398	0.0654	-0.0722	0.1157	-0.1262	0.0039	0.0010	0.0039	0.0007	0.0037	0.0010
930b-4	0.0285	-0.0402	0.0609	-0.0735	0.1095	-0.127	0.0026	0.0018	0.0030	0.0006	0.0029	0.0009
933-1	0.0285	-0.0375	0.0625	-0.0711	0.1133	-0.1219	0.0018	0.0016	0.0039	0.0015	0.0072	0.0023
933-2	0.0391	-0.0432	0.0722	-0.0780	0.1208	-0.1308	0.0022	0.0018	0.0021	0.0011	0.0029	0.0007
933-3	0.0316	-0.0395	0.0706	-0.0716	0.1210	-0.1260	0.0051	0.0013	0.0038	0.0007	0.0030	0.0007
933-4	0.0536	-0.0384	0.0910	-0.0719	0.1434	-0.1271	0.0026	0.0019	0.0027	0.0007	0.0029	0.0014
Mean	0.0344	-0.0395	0.0699	-0.0723	0.1223	-0.1280	0.0032	0.0014	0.0036	0.0009	0.0037	0.0012
StDev	0.0086	0.0030	0.0094	0.0036	0.0117	0.0065	0.0010	0.0004	0.0010	0.0004	0.0017	0.0006
916-2015	0.0390	-0.0394	0.0720	-0.0720	0.1269	-0.1253			0.0039	0.0014	0.0018	0.0008
Difference (916 – Mean (93x))	0.0046	0.0001	0.0022	0.0003	0.0046	0.0027			0.0003	0.0005	-0.0019	-0.0004

*0.171/0.165 – 0.171 is small model speed, 0.165 is large model speed

FIGURES

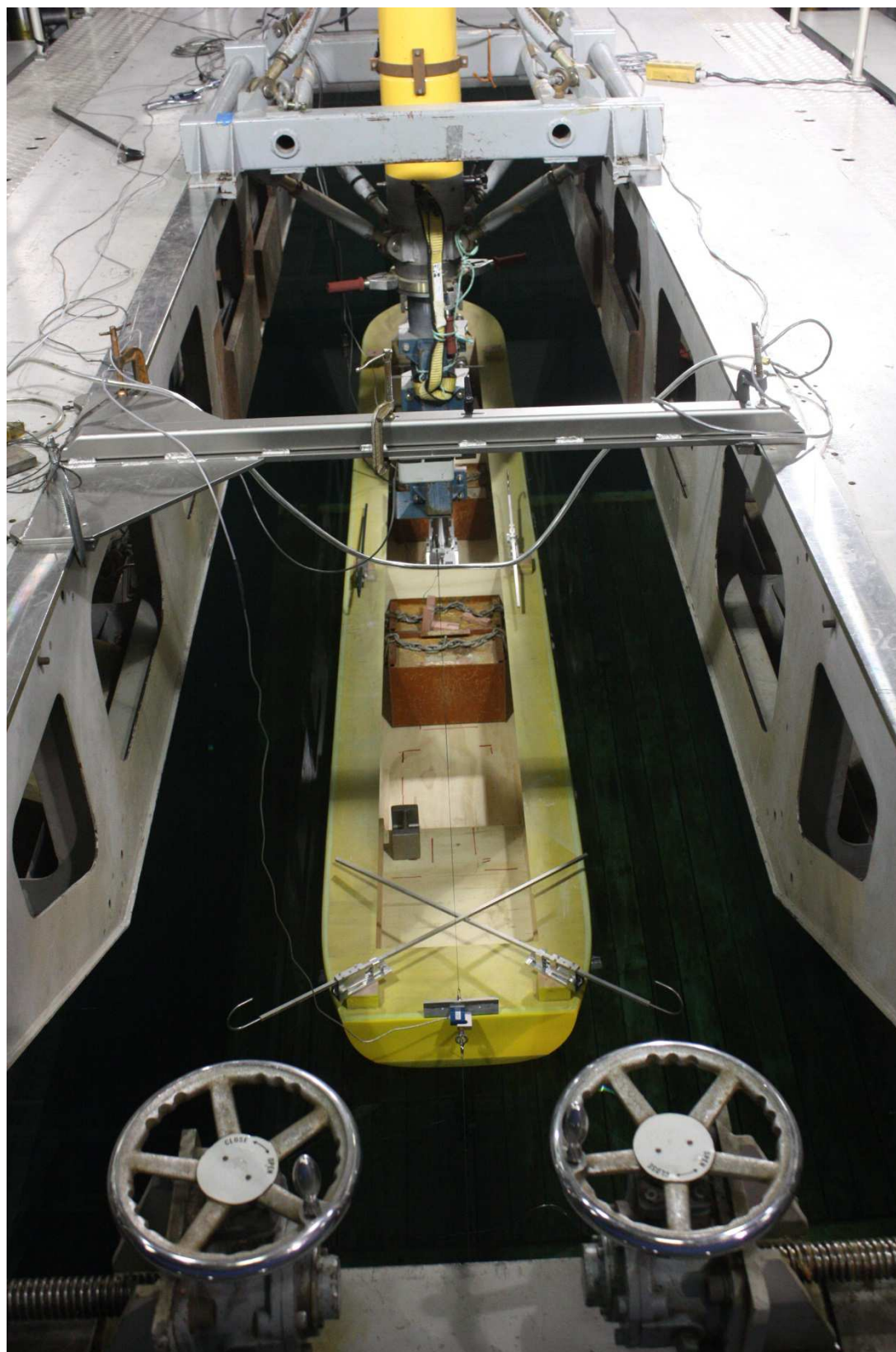
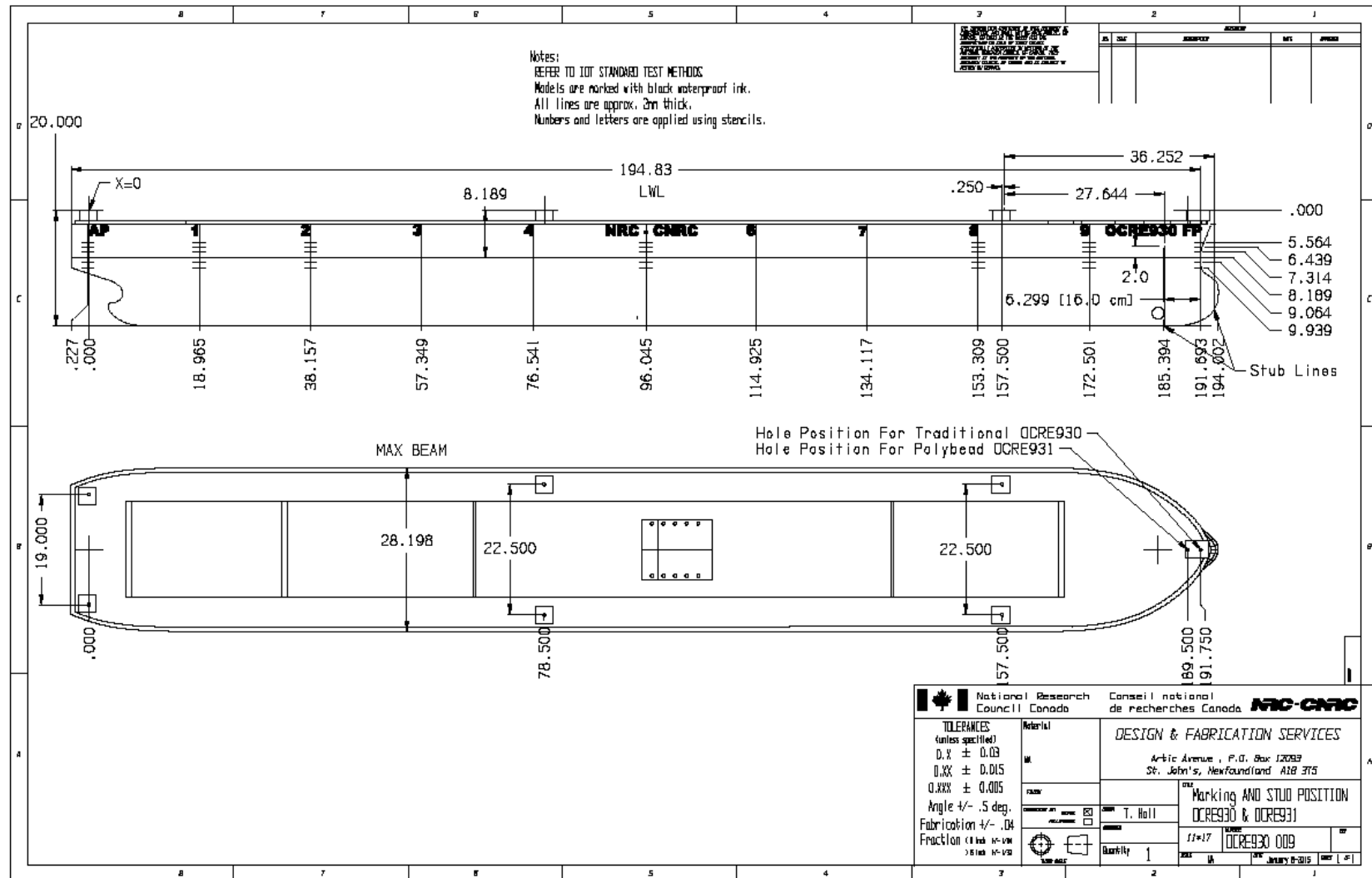


Figure 1: OCRE 931 as installed in the Towing Tank



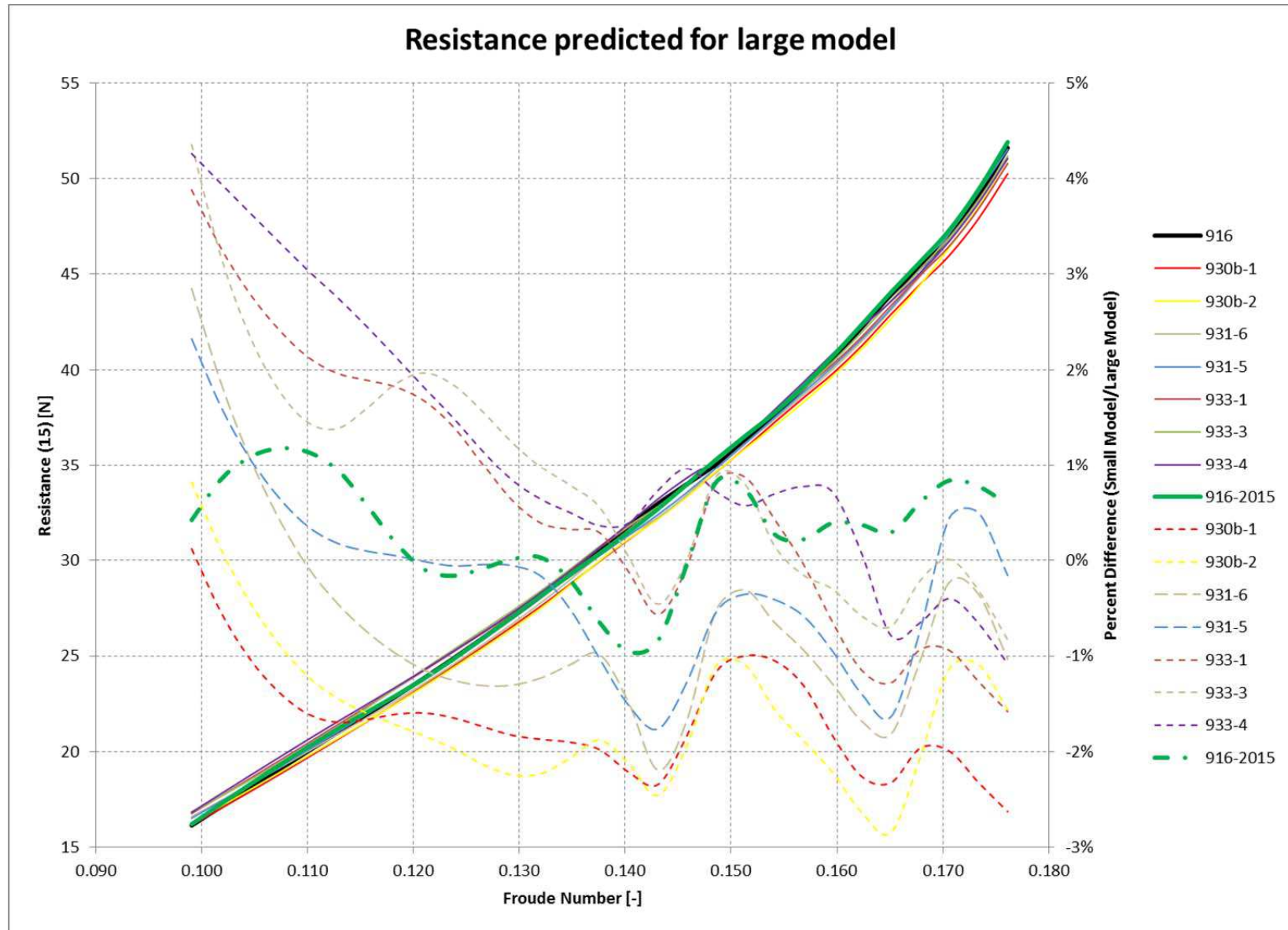


Figure 3: Resistance at 15 deg C in Fresh Water – prediction at size of large model (OCRE916) April-May 2015

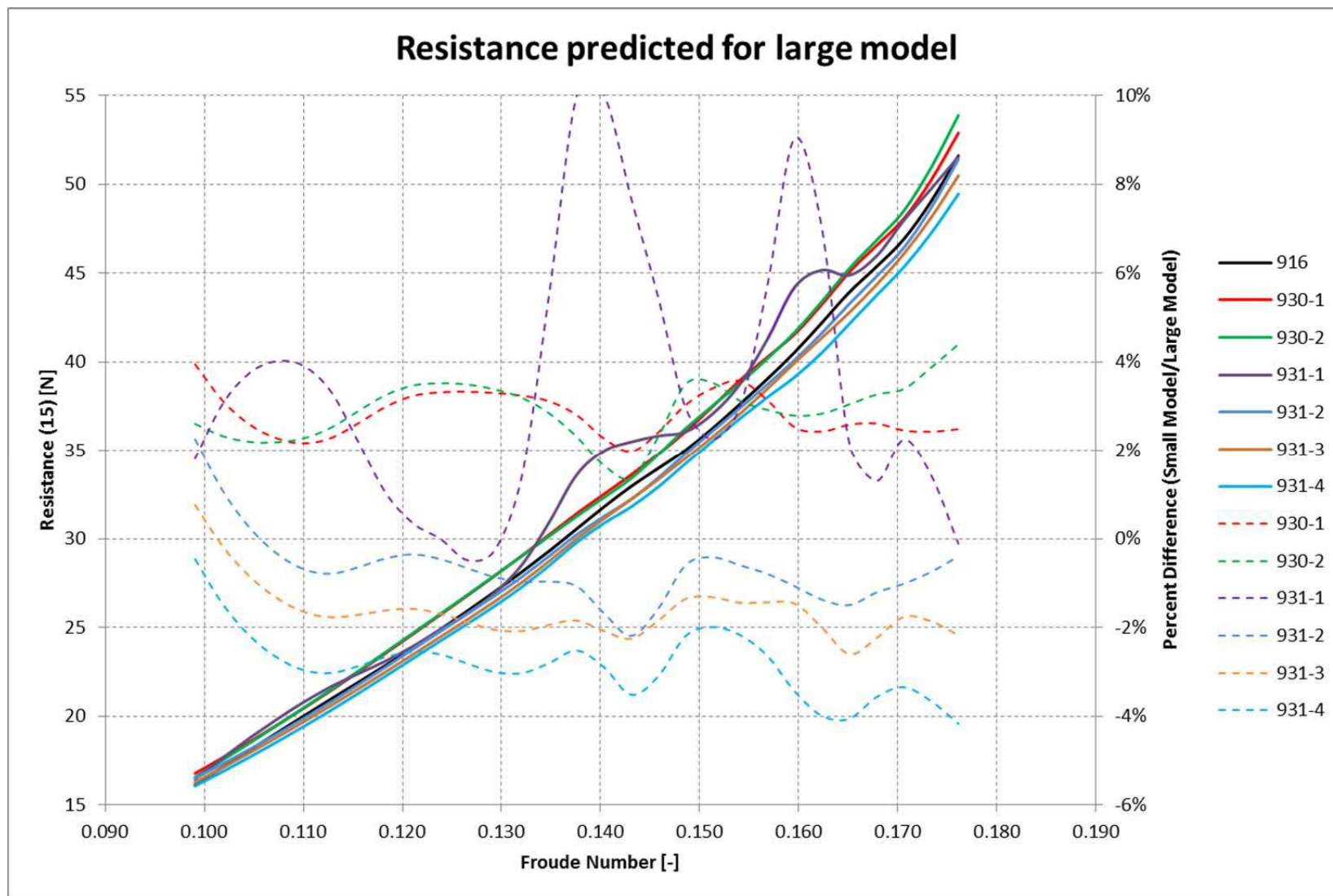


Figure 4 : Resistance at 15 deg C in Fresh Water – prediction at size of large model (OCRE916) January 2015

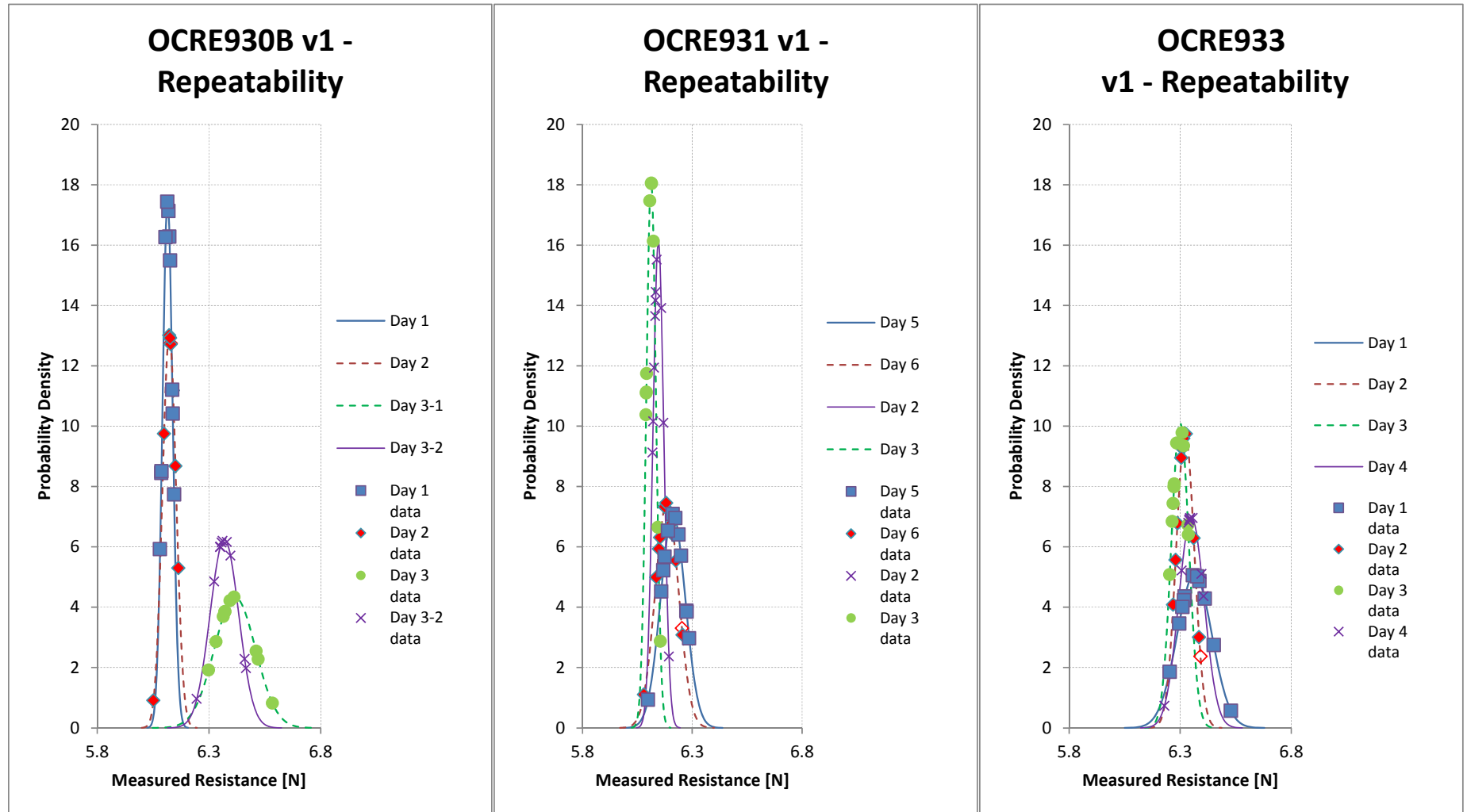


Figure 5: Repeatability at Fr=0.10

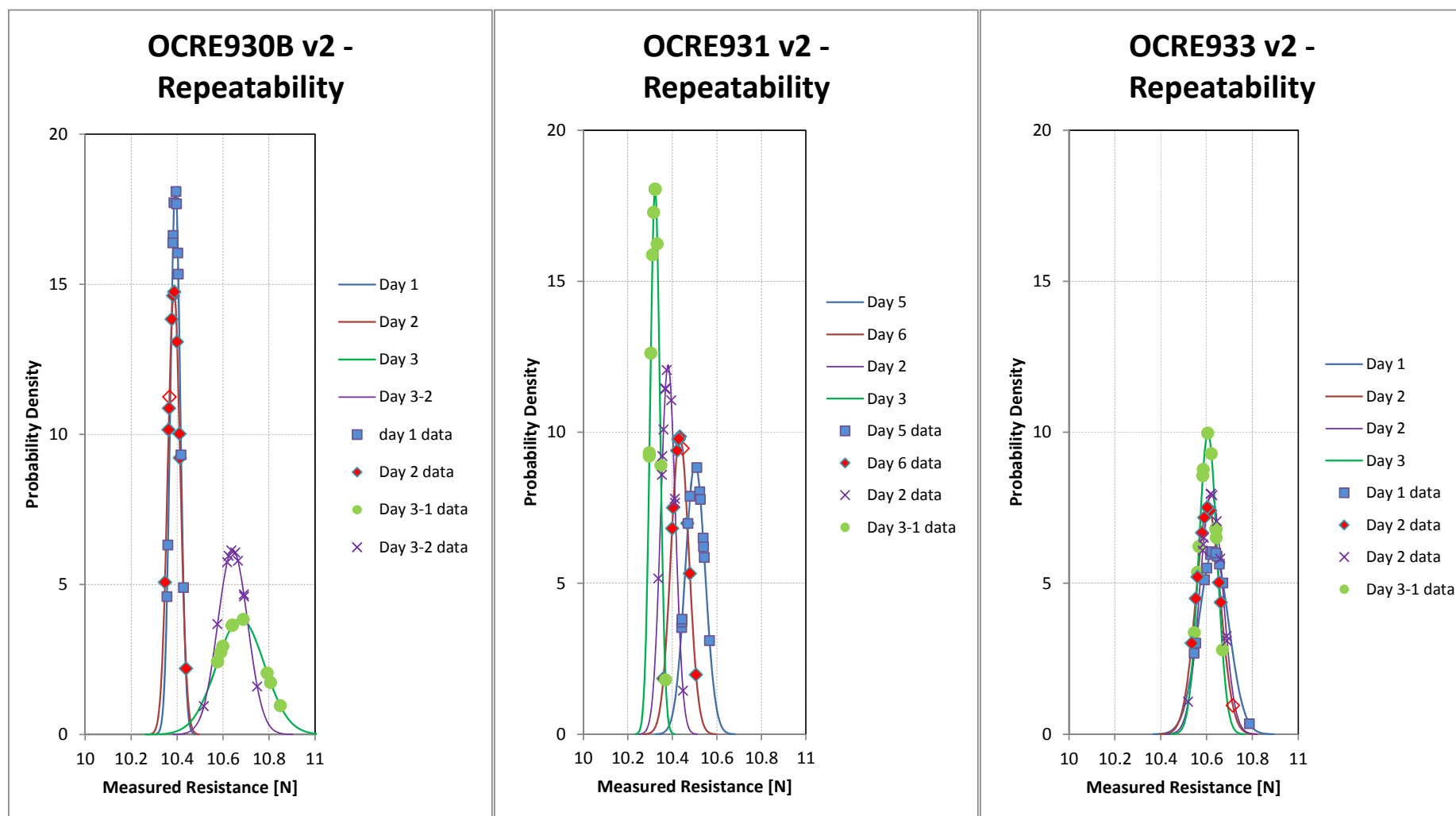


Figure 6: Repeatability at Fr=0.13

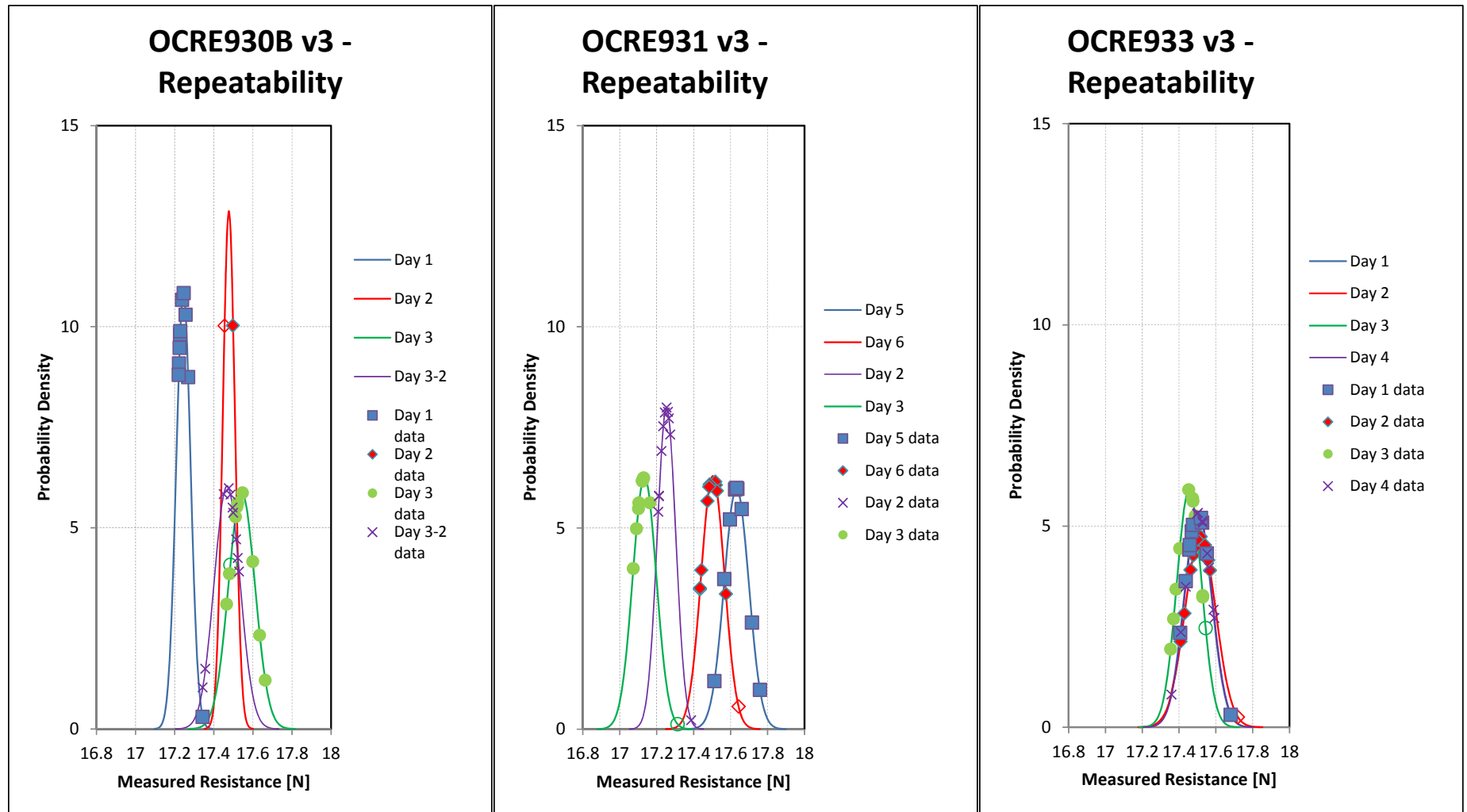


Figure 7: Repeatability at Fr=0.17

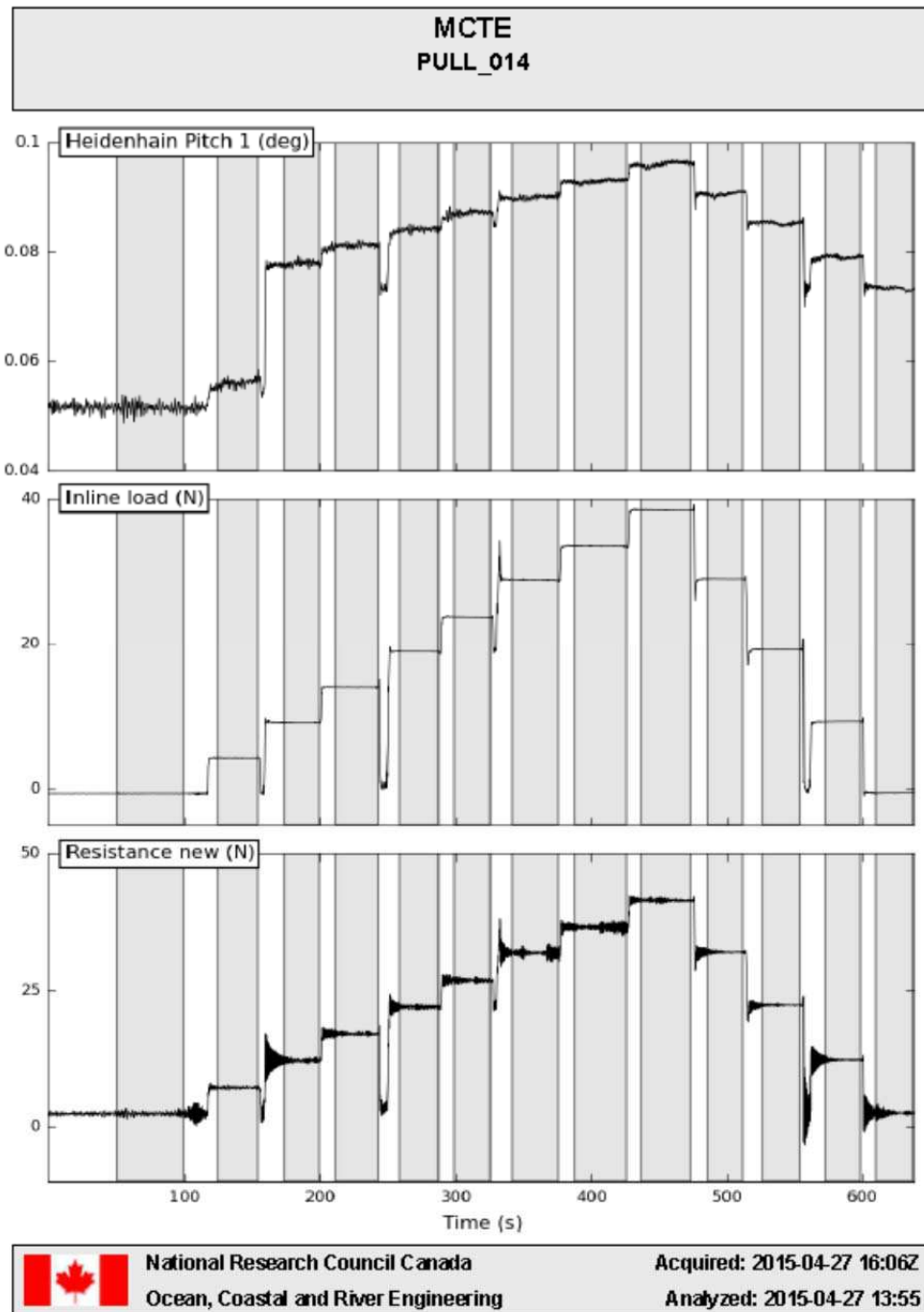


Figure 8: Illustration of non-linear performance of Heidenhain encoder installation

Appendix A – Model Hydrostatics and Floatation QA

Table A12: Summary Hydrostatics

HYDROSTATICS WITHOUT APPENDAGES	1	Scale	
		31.45	45
	Ship	Model	Model
LENGTH BETWEEN PERPENDICULARS, m	219.37	6.9750	4.8748
LENGTH ON THE WATERLINE, m	222.71	7.0812	4.9490
LENGTH OVERALL, m	226.20	7.1923	5.0266
MAXIMUM WATERLINE BEAM, m	32.24	1.0251	0.7164
DRAFT AT MIDSHIPS, m	13.50	0.4293	0.3000
TRIM, deg.	0.00	0.0000	0.0000
WETTED SURFACE AREA, sq.m	11702	11.8306	5.7786
WETTED SURFACE AREA, (EXCLUDING TRANSOM) sq.m	11672	11.8003	5.7638
VOLUME OF DISPLACEMENT, cu. m	83548	2.6858	0.9168
DISPLACEMENT, (tonnes @ FS in SW)(kg @ MS in FW)	85637	2682.7	915.8

Table A13: Float QA – OCRE930B – Day 1

Model:	OCRE930		Standard construction								
Date:	April 23, 2015										
Condition:	1										
Description:	Load										
Trim	0		deg								
Scale	45										
Test Temp	15.6		deg C								
Rho	998.75		kg/m^3								
Volume of Displacement	0.9168		m^3								
Displacement	915.70		kg FW								
			install		removal						
Model as launched	126.71		kg		283.0	lb	199.6	model with slings			
Lifting Bar	0		kg		0.0	lb	6.6	wet slings			
Levelling Mass	0		kg								
Model Lightship	126.7		kg		283.0	lb	193.0	lb			
Tow Post	13.8		kg		30.4	lb					
Target Ballast	775.2		kg		1709.0						
Actual Ballast	775.1		kg		775.1						
					217.1661	221.644	225.5845	100	0.21		
						5	5	0.21	0.325		
Actual Displacement	915.64		kg								
Displacement Error	0.06		kg		0.01%						
Start of Test	Draft		Freeboard								
			target		actual		Average		Variance		
					Port	Stbd			Port	Stbd	
Location	m FS	m MS	mm MS		mm MS	mm MS	mm MS	mm MS	mm MS		
FP	13.5	0.3000	208		207	207	207	-1	-1		
Midship	13.5	0.3000	208		209	208.5	208.75	1	0.5		
AP	13.5	0.3000	208		208	207.5	207.75	0	-0.5		
End of Test	Draft		Freeboard								
			target		actual		Average		Variance		
					Port	Stbd			Port	Stbd	
Location	m FS	m MS	mm MS		mm MS	mm MS	mm MS	mm MS	mm MS		
FP	13.5	0.3000	208								
Midship	13.5	0.3000	208								
AP	13.5	0.3000	208								

Table A14: Float QA – OCRE930B – Day 2

Model:	OCRE930		Standard construction						
Date:	April 24, 2015								
Condition:	1								
Description:	Load		Model left in overnight - change insitu pull arrangement						
Trim	0	deg	estimate added 0.2 kg - removed 0.2 kg ballast.						
Scale	45		trim looked close.						
Test Temp	15.6	deg C	Actual load cell weight is 600 g so we were 400 g heavy						
Rho	998.75	kg/m^3							
Volume of Displacement	0.9168	m^3							
Displacement	915.70	kg FW							
Model as launched	126.71	kg	install		removal				
Lifting Bar	0	kg	283.0	lb	291.2	model with slings			
Levelling Mass	0	kg	0.0	lb	6.4	wet slings			
Model Lightship	126.7	kg	283.0	lb	284.8	lb			
Tow Post	13.8	kg	30.4	lb					
Target Ballast	775.2	kg	1709.0						
Actual Ballast	775.1	kg	775.1	217.1661	221.644	225.5845	100	0.2	
Actual Displacement	915.63	kg			5	5	0.21	0.325	
Displacement Error	0.07	kg	0.01%						
Start of Test	Draft		Freeboard						
			target	actual		Average	Variance		
				Port	Stbd		Port	Stbd	
Location	m FS	m MS	mm MS	mm MS	mm MS	mm MS	mm MS	mm MS	
FP	13.5	0.3000	208	207	207	207	-1	-1	
Midship	13.5	0.3000	208	209	208.5	208.75	1	0.5	
AP	13.5	0.3000	208	208	208	208	-2.8E-14	-2.8E-14	
End of Test	Draft		Freeboard						
			target	actual		Average	Variance		
				Port	Stbd		Port	Stbd	
Location	m FS	m MS	mm MS	mm MS	mm MS	mm MS	mm MS	mm MS	
FP	13.5	0.3000	208						
Midship	13.5	0.3000	208						
AP	13.5	0.3000	208						

Table A15: Float QA – OCRE930B – Day 3

Model:	OCRE930		Standard construction						
Date:	April 27, 2015								
Condition:	1								
Description:	Load		added post to vary pull point height						
Trim	0	deg							
Scale	45								
Test Temp	15.6	deg C							
Rho	998.75	kg/m^3							
Volume of Displacement	0.9168	m^3							
Displacement	915.70	kg FW							
			install		removal				
Model as launched	128.41	kg	286.8	lb	model with slings				
Lifting Bar	0	kg	0.0	lb	wet slings				
Levelling Mass	0	kg							
Model Lightship	128.4	kg	286.8	lb	lb				
Tow Post	13.8	kg	30.4	lb					
Target Ballast	773.5	kg	1705.3						
Actual Ballast	773.5	kg	773.5	217.1661	221.644	225.5845	100	0.21	
				1	5	0.6	2	0.325	
Actual Displacement	915.73	kg							
Displacement Error	-0.03	kg	0.00%						
Start of Test	Draft		Freeboard						
			target	actual		Average	Variance		
				Port	Stbd		Port	Stbd	
Location	m FS	m MS	mm MS	mm MS	mm MS	mm MS	mm MS	mm MS	
FP	13.5	0.3000	208	207.5	207.5	207.5	-0.5	-0.5	
Midship	13.5	0.3000	208	209	208.5	208.75	1	0.5	
AP	13.5	0.3000	208	208	207.5	207.75	0	-0.5	
End of Test	Draft		Freeboard						
			target	actual		Average	Variance		
				Port	Stbd		Port	Stbd	
Location	m FS	m MS	mm MS	mm MS	mm MS	mm MS	mm MS	mm MS	
FP	13.5	0.3000	208						
Midship	13.5	0.3000	208						
AP	13.5	0.3000	208						

Table A16: Float QA – OCRE930B – Day 4

Model:	OCRE930		Standard construction						
Date:	May 13, 2015								
Condition:	1								
Description:	Load								
Trim	0	deg							
Scale	45								
Test Temp	15.6	deg C							
Rho	998.75	kg/m^3							
Volume of Displacement	0.9168	m^3							
Displacement	915.70	kg FW							
			install				removal		
Model as launched	126.98	kg	283.6	lb	model with slings				
Lifting Bar	0	kg	0.0	lb	wet slings				
Levelling Mass	0	kg							
Model Lightship	127.0	kg	283.6	lb	lb				
Tow Post	13.8	kg	30.4	lb					
Target Ballast	774.9	kg	1708.4						
Actual Ballast	774.9	kg	774.9	217.1661	221.644	225.5845	100	0.21	
				5	5			0.325	
Actual Displacement	915.70	kg							
Displacement Error	0.00	kg	0.00%						
Start of Test	Draft		Freeboard						
			target	actual		Average	Variance		
				Port	Stbd		Port	Stbd	
Location	m FS	m MS	mm MS	mm MS	mm MS	mm MS	mm MS	mm MS	
FP	13.5	0.3000	208	208	208	208	0	0	
Midship	13.5	0.3000	208	208	208	208	0	0	
AP	13.5	0.3000	208	208	206	207	0	-2	
End of Test	Draft		Freeboard						
			target	actual		Average	Variance		
				Port	Stbd		Port	Stbd	
Location	m FS	m MS	mm MS	mm MS	mm MS	mm MS	mm MS	mm MS	
FP	13.5	0.3000	208						
Midship	13.5	0.3000	208						
AP	13.5	0.3000	208						

Table A17: Float QA – OCRE931 – Day 5

Model:	OCRE931		Polybead model								
Date:	April 20, 2015										
Condition:	1										
Description:	Load										
Trim	0		deg								
Scale	45										
Test Temp	15.6		deg C								
Rho	998.75		kg/m^3								
Volume of Displacement	0.9168		m^3								
Displacement	915.7		kg FW								
			install		removal						
Model as launched	147.94		kg		330.4	lb	199.6	model with slings			
Lifting Bar	62.0		kg		138.4	lb	6.6	wet slings			
Levelling Mass	0		kg								
Model Lightship	86.0		kg		192.0	lb	193.0	lb			
Tow Post	13.8		kg		30.4	lb					
Target Ballast	815.9		kg		1798.8						
Actual Ballast	815.9		kg		815.9	217.16609	221.64399	225.58454	140	0.889	
						5	5	0.328	0.325		
Actual Displacement	915.7		kg								
Displacement Error	0.0		kg		0.00%						
Start of Test	Draft		Freeboard								
			target	actual		Average	Variance				
				Port	Stbd		Port	Stbd			
Location	m FS	m MS	mm MS	mm MS	mm MS	mm MS	mm MS	mm MS			
FP	13.5	0.3000	208	205	205	205	-3	-3			
Midship	13.5	0.3000	208	209.5	208	208.75	1.5	0			
AP	13.5	0.3000	208	208	207.5	207.75	0	-0.5			
End of Test	Draft		Freeboard								
			target	actual		Average	Variance				
				Port	Stbd		Port	Stbd			
Location	m FS	m MS	mm MS	mm MS	mm MS	mm MS	mm MS	mm MS			
FP	13.5	0.3000	208								
Midship	13.5	0.3000	208								
AP	13.5	0.3000	208								

Table A18: Float QA – OCRE931 – Day 6

Model:	OCRE931		Polybead model						
Date:	April 21, 2015								
Condition:	1								
Description:	Load								
Trim	0	deg							
Scale	45								
Test Temp	15.6	deg C							
Rho	998.75	kg/m^3							
Volume of Displacement	0.9168	m^3							
Displacement	915.7	kg FW							
			install		removal				
Model as launched	86.05	kg	192.2	lb	199.6	model with slings			
Lifting Bar	0.0	kg	0.0	lb	6.6	wet slings			
Levelling Mass	0	kg							
Model Lightship	86.1	kg	192.2	lb	193.0	lb			
Tow Post	13.8	kg	30.4	lb					
Target Ballast	815.9	kg	1798.6						
Actual Ballast	815.9	kg	815.9	217.16609	221.64399	225.58454	140	0.889	
					5	5	0.328	0.325	
Actual Displacement	915.8	kg							
Displacement Error	-0.1	kg	-0.01%						
Start of Test	Draft		Freeboard						
			target	actual		Average	Variance		
				Port	Stbd		Port	Stbd	
Location	m FS	m MS	mm MS	mm MS	mm MS	mm MS	mm MS	mm MS	
FP	13.5	0.3000	208	205	205	205	-3	-3	
Midship	13.5	0.3000	208	209.5	208	208.75	1.5	0	
AP	13.5	0.3000	208	208	207.5	207.75	0	-0.5	
End of Test	Draft		Freeboard						
			target	actual		Average	Variance		
				Port	Stbd		Port	Stbd	
Location	m FS	m MS	mm MS	mm MS	mm MS	mm MS	mm MS	mm MS	
FP	13.5	0.3000	208						
Midship	13.5	0.3000	208						
AP	13.5	0.3000	208						

Table A19: Float QA – OCRE933 – Day 1

Model:	OCRE933		Wooden Model						
Date:	May 5, 2015								
Condition:	1								
Description:	Load								
Trim	0	deg							
Scale	45								
Test Temp	15.6	deg C							
Rho	998.75	kg/m^3							
Volume of Displacement	0.9168	m^3							
Displacement	915.70	kg FW							
			install			removal			
Model as launched	216.81	kg	484.2	lb	model with slings				
Lifting Bar	0	kg	0.0	lb	wet slings				
Levelling Mass	0	kg							
Model Lightship	216.8	kg	484.2	lb	lb				
Tow Post	13.8	kg	30.4	lb					
Target Ballast	685.1	kg	1510.4						
Actual Ballast	685.1	kg	685.1		221.64399	225.58454	220		
				5	5	5	2	0.889	
Actual Displacement	915.71	kg							
Displacement Error	-0.01	kg	0.00%						
Start of Test	Draft		Freeboard						
			target	actual		Average	Variance		
				Port	Stbd		Port	Stbd	
Location	m FS	m MS	mm MS	mm MS	mm MS	mm MS	mm MS	mm MS	
FP	13.5	0.3000	150.9	151	151	151	0.15	0.15	
Midship	13.5	0.3000	150.9	151	151.5	151.25	0.15	0.65	
AP	13.5	0.3000	150.9	151	151	151	0.15	0.15	
End of Test	Draft		Freeboard						
			target	actual		Average	Variance		
				Port	Stbd		Port	Stbd	
Location	m FS	m MS	mm MS	mm MS	mm MS	mm MS	mm MS	mm MS	
FP	13.5	0.3000	150.9						
Midship	13.5	0.3000	150.9						
AP	13.5	0.3000	150.9						

Table A20: Float QA – OCRE933 – Day 2

Model:	OCRE933			Wooden Model
Date:	May 6, 2015			left in overnight
Condition:	1			re-weighed model on removal
Description:	Load			
Trim	0	deg		
Scale	45			
Test Temp	15.6	deg C		
Rho	998.75	kg/m^3		
Volume of Displacement	0.9168	m^3		
Displacement	915.70	kg FW		
			install	removal
Model as launched	216.81	kg	484.2	lb
Lifting Bar	0	kg	0.0	lb
Levelling Mass	0	kg		
Model Lightship	216.8	kg	484.2	lb
Tow Post	13.8	kg	30.4	lb
Target Ballast	685.1	kg	1510.4	
Actual Ballast	685.1	kg	685.1	
Actual Displacement	915.71	kg		
Displacement Error	-0.01	kg	0.00%	
Start of Test	Draft			Freeboard
			target	actual
				Average
				Variance
			Port	Stbd
Location	m FS	m MS	mm MS	mm MS
FP	13.5	0.3000	150.9	151 151 151 0.15 0.15
Midship	13.5	0.3000	150.9	151 151.5 151.25 0.15 0.65
AP	13.5	0.3000	150.9	151 151 151 0.15 0.15
End of Test	Draft			Freeboard
			target	actual
				Average
				Variance
			Port	Stbd
Location	m FS	m MS	mm MS	mm MS
FP	13.5	0.3000	150.9	
Midship	13.5	0.3000	150.9	
AP	13.5	0.3000	150.9	

Table A21: Float QA – OCRE933 – Day 3

Model:	OCRE933		Wooden Model							
Date:	May 7, 2015									
Condition:	1									
Description:	Load									
Trim	0	deg								
Scale	45									
Test Temp	15.6	deg C								
Rho	998.75	kg/m^3								
Volume of Displacement	0.9168	m^3								
Displacement	915.70	kg FW								
			install			removal				
Model as launched	216.90	kg	484.4	lb	model with slings					
Lifting Bar	0	kg	0.0	lb	wet slings					
Levelling Mass	0	kg								
Model Lightship	216.9	kg	484.4	lb	lb					
Tow Post	13.8	kg	30.4	lb						
Target Ballast	685.0	kg	1510.2							
Actual Ballast	685.1	kg	685.1		221.64399	225.58454	220			
				5	5	5	2	0.889		
Actual Displacement	915.80	kg								
Displacement Error	-0.10	kg	-0.01%							
Start of Test	Draft		Freeboard							
			target	actual		Average	Variance			
				Port	Stbd		Port	Stbd		
Location	m FS	m MS	mm MS	mm MS	mm MS	mm MS	mm MS	mm MS		
FP	13.5	0.3000	150.9	151	151	151	0.15	0.15		
Midship	13.5	0.3000	150.9	151	151.5	151.25	0.15	0.65		
AP	13.5	0.3000	150.9	151	151	151	0.15	0.15		
End of Test	Draft		Freeboard							
			target	actual		Average	Variance			
				Port	Stbd		Port	Stbd		
Location	m FS	m MS	mm MS	mm MS	mm MS	mm MS	mm MS	mm MS		
FP	13.5	0.3000	150.9							
Midship	13.5	0.3000	150.9							
AP	13.5	0.3000	150.9							

Table A22: Float QA – OCRE933 – Day 4

Model:	OCRE933		Wooden Model					
Date:	May 12, 2015							
Condition:	1							
Description:	Load		Encoder was 0.09 deg when gages read rezero after xpull					
Trim	0	deg						
Scale	45							
Test Temp	15.6	deg C						
Rho	998.75	kg/m^3						
Volume of								
Displacement	0.9168	m^3						
Displacement	915.70	kg FW						
			install		removal			
Model as launched	217.17	kg	485.0	lb	491.6	model with slings		
Lifting Bar	0	kg	0.0	lb	6.6	wet slings		
Levelling Mass	0	kg						
Model Lightship	217.2	kg	485.0	lb	485.0	lb		
Tow Post	13.8	kg	30.4	lb				
Target Ballast	684.7	kg	1509.6					
Actual Ballast	684.8	kg	684.8		221.64399	225.58454	220	-0.325
Actual Displacement	915.75	kg						
Displacement Error	-0.05	kg	0.00%					
Start of Test	Draft		Freeboard					
			target	actual		Average	Variance	
				Port	Stbd		Port	Stbd
				mm MS	mm MS	mm MS	mm MS	mm MS
Location	m FS	m MS	mm MS	mm MS	mm MS	mm MS	mm MS	mm MS
FP	13.5	0.3000	150.9	151	151	151	0.15	0.15
Midship	13.5	0.3000	150.9	151	152	151.5	0.15	1.15
AP	13.5	0.3000	150.9	151	151	151	0.15	0.15
End of Test	Draft		Freeboard					
			target	actual		Average	Variance	
				Port	Stbd		Port	Stbd
				mm MS	mm MS	mm MS	mm MS	mm MS
Location	m FS	m MS	mm MS	mm MS	mm MS	mm MS	mm MS	mm MS
FP	13.5	0.3000	150.9					
Midship	13.5	0.3000	150.9					
AP	13.5	0.3000	150.9					

Table A23: Float QA – OCRE916 – Day 1

Model:	OCRE916	Standard construction									
Date:	May 14, 2015										
Condition:	1										
Description:	Load	Encoder before rezero about -.045 degrees									
Trim	0	deg									
Scale	31.45										
Test Temp	15.6	deg C									
Rho	998.75	kg/m^3									
Volume of Displacement	2.6858	m^3									
Displacement	2682.44	kg FW									
Model as launched	375.94	kg	install		removal	model with slings wet slings					
Lifting Bar	0	kg	376.0	lb							
Levelling Mass	0	kg	0.0	lb							
Model Lightship	375.9	kg	376.0	lb		lb					
Tow Post	13.8	kg	30.4	lb							
Target Ballast	2292.7	kg	5054.5								
Actual Ballast	2292.6	kg	2292.6	217.17	221.64	225.58	20	20			
				200.24	200.69	201.05	200.87	200.42			
				201.05	108.44	117.67	113.82	20			
				20	2	2					
Actual Displacement	2682.36	kg									
Displacement Error	0.08	kg	0.003%								
Start of Test	Draft	Freeboard									
		target	actual		Average	Variance					
			Port	Stbd		Port	Stbd				
Location	m FS	m MS	mm MS	mm MS	mm MS	mm MS	mm MS	mm MS			
FP	13.5	0.4293	262.9	262	262	262	-0.9	-0.9			
Midship	13.5	0.4293	262.9	263	263	263	0.1	0.1			
AP	13.5	0.4293	262.9	263	263	263	0.1	0.1			
End of Test	Draft	Freeboard									
		target	actual		Average	Variance					
			Port	Stbd		Port	Stbd				
Location	m FS	m MS	mm MS	mm MS	mm MS	mm MS	mm MS	mm MS			
FP	13.5	0.4293	262.9								
Midship	13.5	0.4293	262.9								
AP	13.5	0.4293	262.9								

Appendix B – Calibrations

MCTE Calibration of Heidenhain Pitch 1 Calibrated 2015-04-22 09:28

Test Facility: CWT	Serial #:	Filter Frequency:
Data Source: SJS-DAS33:50001 Channel11	Programmable Gain:	Excitation:
Sensor Model:	Plug-In Gain:	

Data Point #	Physical Value (deg)	Measured Value (deg)	Fitted Curve Value (deg)	Error (deg)	Definition of Calibration Curve
					Polynomial Degree = 1 (Linear Fit) $Y = C_0 + C_1 \cdot V$ where $Y(t)$ = Angle (deg), $V(t)$ = measured value (deg), C_0 = 0 deg, C_1 = 1 deg/de,



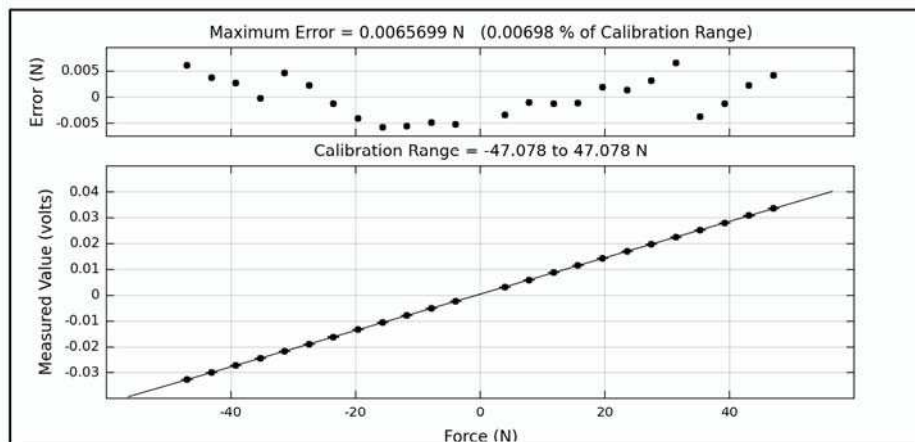
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MCTE
Calibration of Resistance new
Calibrated 2015-04-16 10:37

Test Facility: CWT	Serial #: 1	Filter Frequency:
Data Source: SJS-DAS49-50001 Channel9	Programmable Gain:	Excitation:
Sensor Model: OCRE Resis1	Plug-In Gain:	

Data Point #	Physical Value (N)	Measured Value (volts)	Fitted Curve Value (N)	Error (N)	Definition of Calibration Curve
1	-47.078	-0.032675	-47.072	0.0060354	Polynomial Degree = 1 (Linear Fit) $Y = C_0 + C_1 \cdot V$ where $Y(t)$ = Force (N), $V(t)$ = measured value (volts), $C_0 = -0.59129$ N, $C_1 = 1422.5$ N/volt,
2	-43.155	-0.029919	-43.151	0.0036875	
3	-39.232	-0.027162	-39.229	0.0026947	
4	-35.309	-0.024406	-35.309	-0.00023463	
5	-31.386	-0.021645	-31.381	0.0045898	
6	-27.462	-0.018888	-27.460	0.0022205	
7	-23.539	-0.016133	-23.540	-0.0012950	
8	-19.616	-0.013377	-19.620	-0.0040507	
9	-15.693	-0.010620	-15.699	-0.0057123	
10	-11.770	-0.0078620	-11.775	-0.0054854	
11	-7.8464	-0.0051037	-7.8513	-0.0048982	
12	-3.9232	-0.0023459	-3.9284	-0.0052010	
13	3.9232	0.0031712	3.9198	-0.0034015	
14	7.8464	0.0059308	7.8454	-0.0010039	
15	11.770	0.0086886	11.768	-0.0012459	

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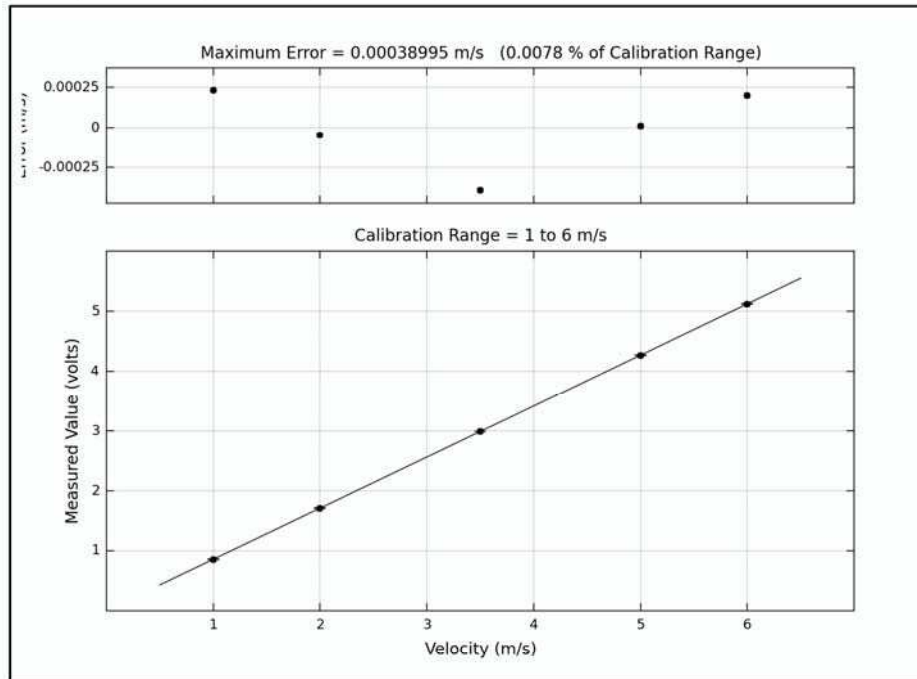


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MCTE
Calibration of Tachogenerator
Calibrated 2014-03-26 16:45Z

Test Facility: CWT	Serial #:	Filter Frequency:
Data Source: SIS-TOWDAS:50001 Channel 1	Programmable Gain:	Excitation:
Sensor Model:	Plug-In Gain:	

Data Point #	Physical Value (m/s)	Measured Value (volts)	Fitted Curve Value (m/s)	Error (m/s)	Definition of Calibration Curve
1	1.0000	0.85312	1.0002	0.00023277	Polynomial Degree = 1 (Linear Fit) $Y = C_0 + C_1 \cdot V$ where $Y(t)$ = Velocity (m/s), $V(t)$ = measured value (volts), $C_0 = 0.00035194$ m/s, $C_1 = 1.172$ m/s/volt,
2	2.0000	1.7061	2.0000	-4.9513e-05	
3	3.5000	2.9856	3.4996	-0.00038995	
4	5.0000	4.2658	5.0000	9.3281e-06	
5	6.0000	5.1192	6.0002	0.00019737	

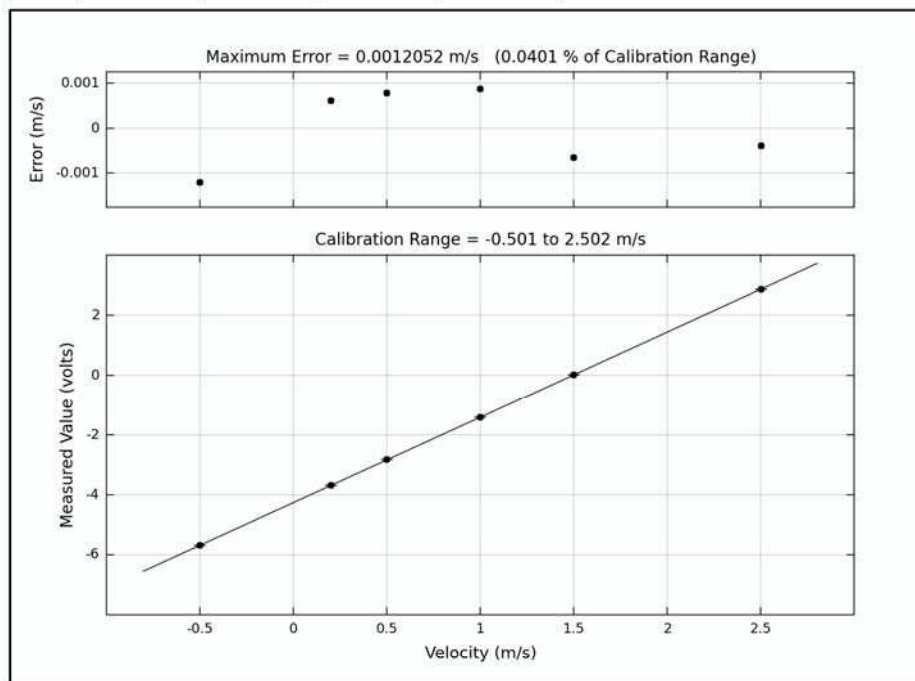


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MCTE Calibration of Carriage Speed Calibrated 2015-01-07 17:37Z

Test Facility: CWT	Serial #:	Filter Frequency:
Data Source: SJS-TOWDAS:50001 Channel 2	Programmable Gain:	Excitation:
Sensor Model: span set to -2 & 5 m/s	Plug-In Gain:	

Data Point #	Physical Value (m/s)	Measured Value (volts)	Fitted Curve Value (m/s)	Error (m/s)	Definition of Calibration Curve
1	-0.50100	-5.7008	-0.50221	-0.0012052	Polynomial Degree = 1 (Linear Fit) $Y = C_0 + C_1 \cdot V$ where $Y(t)$ = Velocity (m/s), $V(t)$ = measured value (volts), $C_0 = 1.4976$ m/s, $C_1 = 0.35079$ m/s/volt,
2	0.20000	-3.6973	0.20061	0.00060901	
3	0.50100	-2.8388	0.50178	0.00078180	
4	1.0000	-1.4160	1.0009	0.00087269	
5	1.5010	0.0078630	1.5003	-0.00065358	
6	2.5020	2.8621	2.5016	-0.00040477	

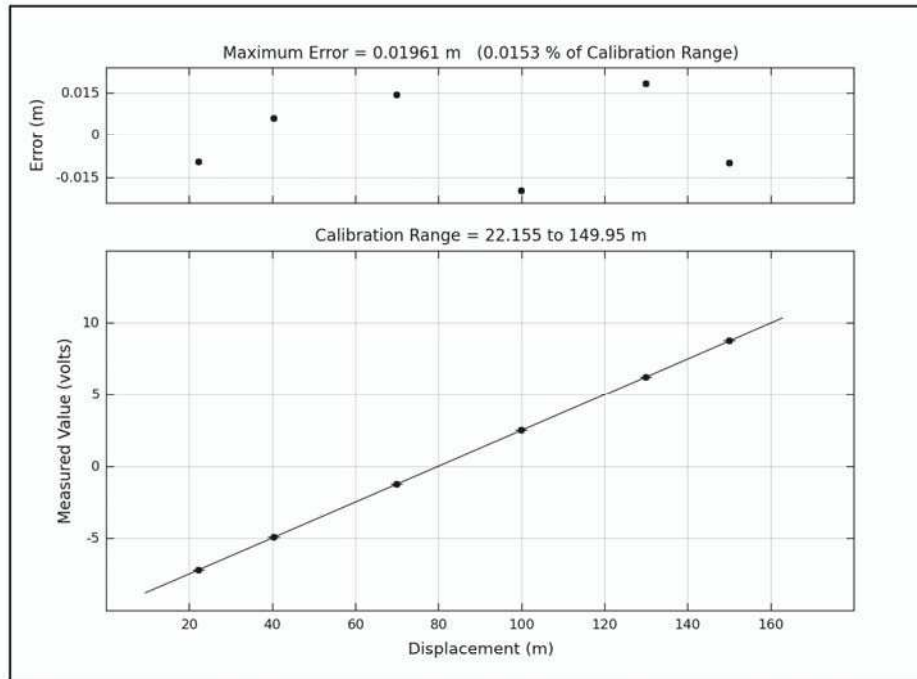


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MCTE
Calibration of Carriage Position
Calibrated 2014-12-09 14:20Z

Test Facility: CWT	Serial #:	Filter Frequency:
Data Source: SJS-TOWDAS:50001 Channel 3	Programmable Gain:	Excitation:
Sensor Model:	Plug-In Gain:	

Data Point #	Physical Value (m)	Measured Value (volts)	Fitted Curve Value (m)	Error (m)	Definition of Calibration Curve
1	22.155	-7.1810	22.146	-0.0094353	Polynomial Degree = 1 (Linear Fit) $Y = C_0 + C_1 \cdot V$ where $Y(t)$ = Displacement (m), $V(t)$ = measured value (volts), $C_0 = 79.717 \text{ m}$, $C_1 = 8.0173 \text{ m/volt}$,
2	40.308	-4.9148	40.314	0.0061175	
3	69.920	-1.2202	69.934	0.014359	
4	99.918	2.5172	99.898	-0.019610	
5	129.92	6.2641	129.94	0.018381	
6	149.95	8.7589	149.94	-0.0098127	



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MCTE
Calibration of Inline load
Calibrated 2015-04-24 09:12

Test Facility: CWT

Data Source: SJS-TOWDAS-50001 Channel 13

Sensor Model: Interface SM10

Serial #: 734938

Programmable Gain:

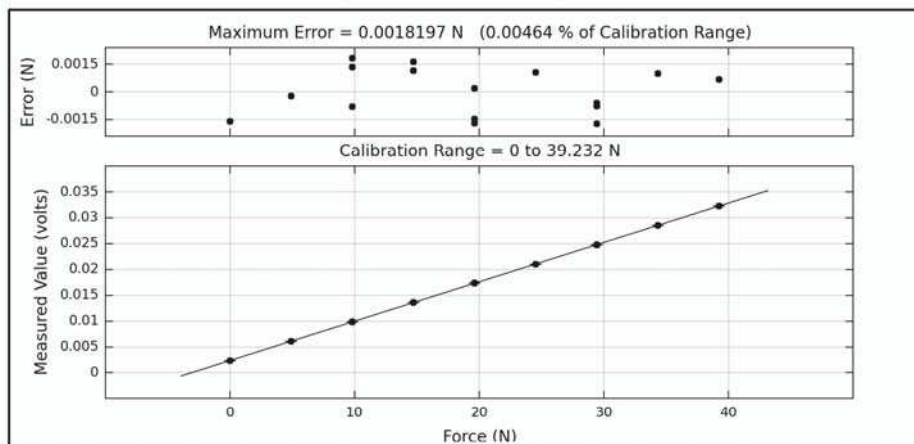
Plug-In Gain:

Filter Frequency:

Excitation:

Data Point #	Physical Value (N)	Measured Value (volts)	Fitted Curve Value (N)	Error (N)	Definition of Calibration Curve
1	0.0000	0.0023565	-0.0015920	-0.0015920	Polynomial Degree = 1 (Linear Fit) $Y = C_0 + C_1 \cdot V$ where $Y(t)$ = Force (N), $V(t)$ = measured value (volts), $C_0 = -3.0953$ N, $C_1 = 1312.9$ N/volt,
2	4.9040	0.0060929	4.9038	-0.00022141	
3	9.8080	0.0098279	9.8072	-0.00081144	
4	9.8080	0.0098299	9.8098	0.0018197	
5	9.8080	0.0098295	9.8094	0.0013629	
6	14.712	0.013565	14.714	0.0016410	
7	14.712	0.013565	14.713	0.0011762	
8	19.616	0.017298	19.614	-0.0017110	
9	19.616	0.017299	19.616	0.00018016	
10	19.616	0.017298	19.615	-0.0014653	
11	24.520	0.021035	24.521	0.0010700	
12	29.424	0.024769	29.422	-0.0017425	
13	29.424	0.024770	29.423	-0.00061258	
14	29.424	0.024769	29.423	-0.00076751	
15	34.328	0.028506	34.329	0.00099843	

Table truncated (1 points not displayed).



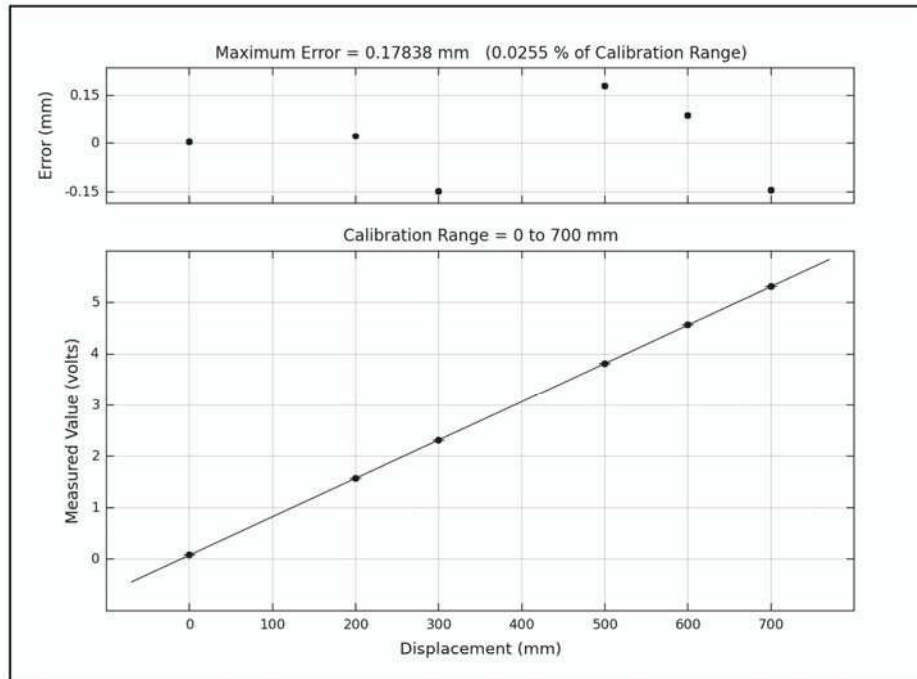
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MCTE
Calibration of Sinkage AP
Calibrated 2015-04-20 13:55

Test Facility: CWT	Serial #: A30122	Filter Frequency:
Data Source: SJS-TOWDAS:50001 Channel 15	Programmable Gain:	Excitation:
Sensor Model: PT-101-0050-111-1110	Plug-In Gain:	

Data Point #	Physical Value (mm)	Measured Value (volts)	Fitted Curve Value (mm)	Error (mm)	Definition of Calibration Curve
1	0.0000	0.077368	0.0049442	0.0049442	Polynomial Degree = 1 (Linear Fit) $Y = C_0 + C_1 \cdot V$ where $Y(t)$ = Displacement (mm), $V(t)$ = measured value (volts), $C_0 = -10.348$ mm, $C_1 = 133.82$ mm/volt,
2	200.00	1.5721	200.02	0.023000	
3	300.00	2.3181	299.85	-0.14811	
4	500.00	3.8151	500.18	0.17838	
5	600.00	4.5617	600.09	0.086884	
6	700.00	5.3072	699.85	-0.14510	



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MCTE
Calibration of Sinkage FP
Calibrated 2015-04-20 14:04

Test Facility: CWT

Data Source: SIS-TOWDAS:50001 Channel 16

Sensor Model: PT101-0025-111-1110

Serial #: A10329

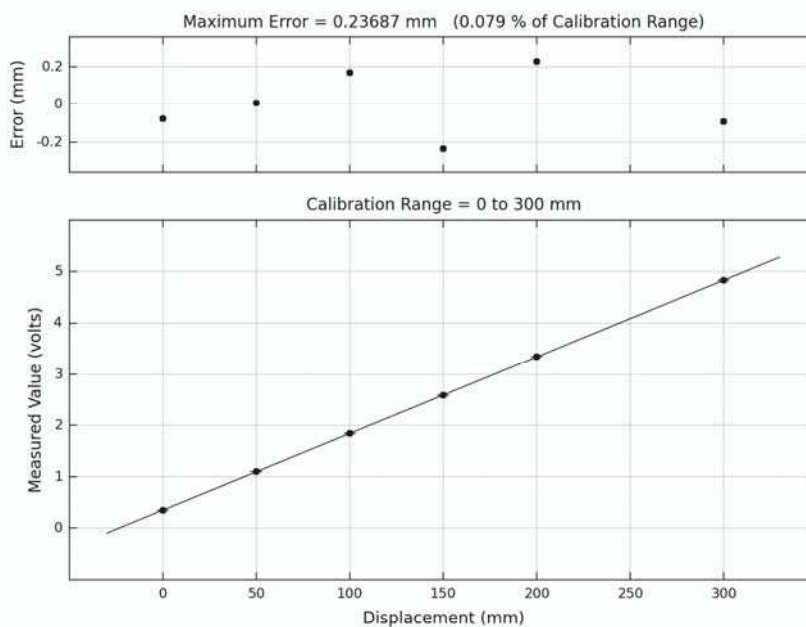
Programmable Gain:

Plug-In Gain:

Filter Frequency:

Excitation:

Data Point #	Physical Value (mm)	Measured Value (volts)	Fitted Curve Value (mm)	Error (mm)	Definition of Calibration Curve
1	0.0000	0.34806	-0.075757	-0.075757	Polynomial Degree = 1 (Linear Fit) $Y = C_0 + C_1 \cdot V$ where $Y(t)$ = Displacement (mm), $V(t)$ = measured value (volts), $C_0 = -23.374$ mm, $C_1 = 66.938$ mm/volt,
2	50.000	1.0962	50.006	0.0063497	
3	100.00	1.8456	100.17	0.16919	
4	150.00	2.5865	149.76	-0.23687	
5	200.00	3.3405	200.23	0.22984	
6	300.00	4.8296	299.91	-0.092754	

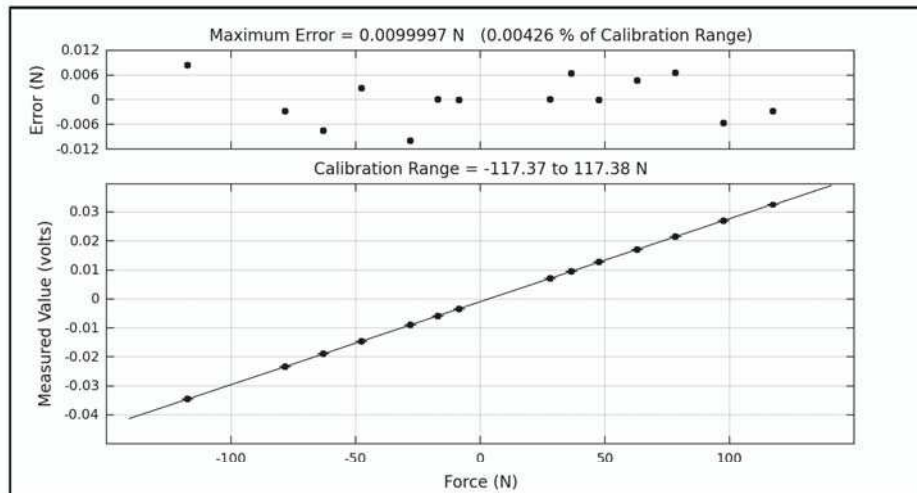


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MCTE
Calibration of Resistance 25
Calibrated 2015-05-14 10:59

Test Facility: CWT	Serial #:	Filter Frequency:
Data Source: SJS-DAS49-50001 Channel 11	Programmable Gain:	Excitation:
Sensor Model: SM-25	Plug-In Gain:	

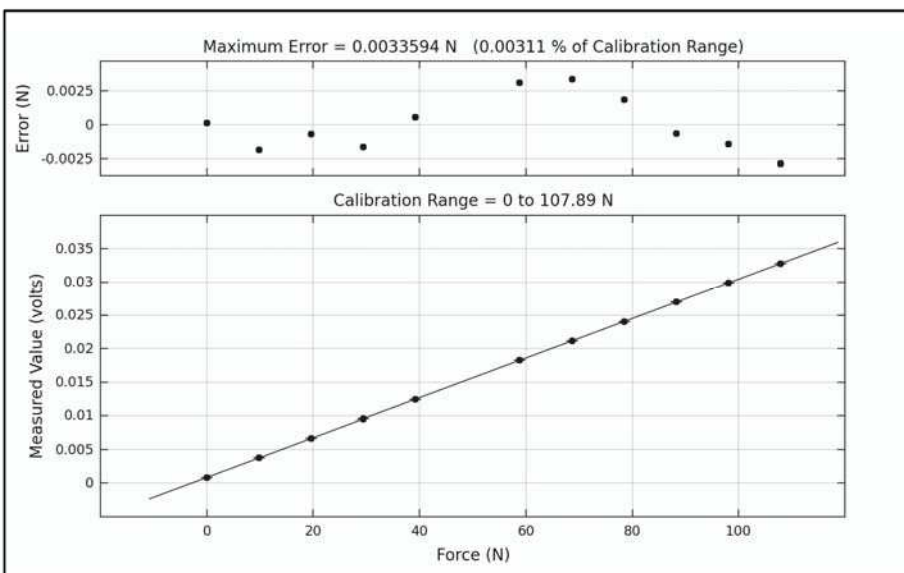
Data Point #	Physical Value (N)	Measured Value (volts)	Fitted Curve Value (N)	Error (N)	Definition of Calibration Curve
1	-117.37	-0.034540	-117.36	0.0084020	Polynomial Degree = 1 (Linear Fit) $Y = C_0 + C_1 \cdot V$ where $Y(t)$ = Force (N), $V(t)$ = measured value (volts), $C_0 = 3.2953 \text{ N}$, $C_1 = 3493.1 \text{ N/volt}$,
2	-78.254	-0.023346	-78.257	-0.0027337	
3	-62.977	-0.018974	-62.984	-0.0074650	
4	-47.714	-0.014602	-47.711	0.0027988	
5	-28.108	-0.0089928	-28.118	-0.0099997	
6	-17.099	-0.0058384	-17.099	2.5824e-05	
7	-8.5700	-0.0033968	-8.5701	-9.2703e-05	
8	28.108	0.0071033	28.108	4.2873e-05	
9	36.637	0.0095467	36.643	0.0063209	
10	47.714	0.012716	47.714	-2.6459e-05	
11	62.977	0.017087	62.982	0.0047292	
12	78.254	0.021461	78.260	0.0064584	
13	97.700	0.027024	97.694	-0.0056992	
14	117.38	0.032659	117.38	-0.0027613	



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MCTE**Calibration of Inline load 25****Calibrated 2015-05-14 11:16****Test Facility:** CWT**Data Source:** SJS-TOWDAS:50001 Channel 14**Sensor Model:** SM-25**Serial #:****Programmable Gain:****Plug-In Gain:****Filter Frequency:****Excitation:**

Data Point #	Physical Value (N)	Measured Value (volts)	Fitted Curve Value (N)	Error (N)	Definition of Calibration Curve
1	0.0000	0.00084417	0.00014649	0.00014649	Polynomial Degree = 1 (Linear Fit) $Y = C_0 + C_1 \cdot V$ where $Y(t)$ = Force (N), $V(t)$ = measured value (volts), $C_0 = -2.8524$ N, $C_1 = 3379.1$ N/volt,
2	9.8080	0.0037461	9.8062	-0.0018293	
3	19.616	0.0066490	19.615	-0.00067006	
4	29.424	0.0095512	29.422	-0.0016421	
5	39.232	0.012454	39.233	0.00055534	
6	58.848	0.018260	58.851	0.0031283	
7	68.656	0.021163	68.659	0.0033594	
8	78.464	0.024065	78.466	0.0018511	
9	88.272	0.026967	88.271	-0.00062663	
10	98.080	0.029869	98.079	-0.0014130	
11	107.89	0.032771	107.89	-0.0028595	



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Appendix C – Run Log

 National Research Council Canada Conseil national de recherches Canada TEST LOG Clearwater Towing Tank(CWT)						
 OCEAN, COASTAL & RIVER ENGINEERING (OCRE) Model Construction Technique Evaluation						
DATE	TIME	WAIT TIME ACTUAL	Speed (m/s)	FILENAME (.DAC)	RUN DESCRIPTION	COMMENTS
21-Apr-15						Assume temp for start test 15.6C
"	9:26			PULL_001	X pull	0.5kg increments
"						Rezo sinkage, tow force, pitch encoder
"	10:35	0:12		M2A5_001	Rough up	0.9970 m/s
"	10:47	0:15		M2A5_002	Rough up	Rezo sinkage
"	11:02	0:10		M2A5_003	Resistance run	0.6902, 0.9203, 1.1887 m/s
"	11:12	0:10		M2A5_004	Resistance run	0.7669, 0.9970, 1.1120 m/s
"	11:22	0:10		M2A5_005	Resistance run	0.9586, 1.3037 m/s
"	11:32	0:10		M2A5_006	Resistance run	1.0736, 1.2654 m/s
"	11:42	0:11		M2A5_007	Resistance run	0.8436, 1.2270 m/s
"	11:53	0:10		M2A5_008	Resistance run	1.0353, 1.1503 m/s
"	12:03	0:10		M2A5_009	Resistance run	1.0736, 1.2654 m/s
"	12:13	0:10		M2A5_010	Resistance run	0.8436, 1.2270 m/s
"	12:23	0:11		M2A5_011	Resistance run	0.6902, 0.9203, 1.1887 m/s
"						
"	12:34	0:10		M2A5_012	Repeatability test 1	0.6902, 0.9203, 1.1887 m/s
"	12:44	0:10		M2A5_013	Repeatability test 2	
"	12:54	0:10		M2A5_014	Repeatability test 3	
"	13:04	0:10		M2A5_015	Repeatability test 4	
"	13:14	0:10		M2A5_016	Repeatability test 5	
"	13:24	0:11		M2A5_017	Repeatability test 6	
"	13:35	0:10		M2A5_018	Repeatability test 7	
"	13:45	0:10		M2A5_019	Repeatability test 8	

DATE	TIME	WAIT TIME ACTUAL	Speed (m/s)	FILENAME (.DAC)	RUN DESCRIPTION	COMMENTS
"	13:55	0:11		M2A5_020	Repeatability test 9	
"	14:06	#####		M2A5_021	Repeatability test 10	Changed last speed to 1.2654m/s
"				PULL_002	X pull	0.5kg increments
"						Remove model
"						

22-Apr-15						Rezo sinkage, tow force, pitch encoder
"	9:30			PULL_003	X pull	0.5kg increments
"						Replace 10lb cooper inline load with 50lb larger / potted S type
	10:45			PULL_004	X pull	Pulls not working out due to I/L weight of load cell.
"	11:08	0:10		M2A6_001	Rough up	0.9970 m/s
"	11:18	0:10		M2A6_002	Rough up	
"	11:28	0:11		M2A6_003	Resistance run	0.6902, 0.9203, 1.1887 m/s
"	11:39	0:11		M2A6_004	Resistance run	0.7669, 0.9970, 1.1120 m/s
"	11:50	0:11		M2A6_005	Resistance run	0.9586, 1.3037 m/s
"	12:01	0:11		M2A6_006	Resistance run	1.0736, 1.2654 m/s
"	12:12	0:11		M2A6_007	Resistance run	0.8436, 1.2270 m/s
"	12:23	0:12		M2A6_008	Resistance run	1.0353, 1.1503 m/s
"	12:35	0:10		M2A6_009	Resistance run	1.0736, 1.2654 m/s
"	12:45	0:10		M2A6_010	Resistance run	0.8436, 1.2270 m/s
"	12:55	0:11		M2A6_011	Resistance run	0.6902, 0.9203, 1.1887 m/s
"						Water temp.: 15.57deg
"	13:06	0:10		M2A6_012	Repeatability test 1	0.6902, 0.9203, 1.1887 m/s
"	13:16	0:11		M2A6_013	Repeatability test 2	"
"	13:27	0:10		M2A6_014	Repeatability test 3	"
"	13:37	0:10		M2A6_015	Repeatability test 4	"
"	13:47	0:10		M2A6_016	Repeatability test 5	"
"	13:57	0:10		M2A6_017	Repeatability test 6	"
"	14:07	0:10		M2A6_018	Repeatability test 7	"
"	14:17	0:10		M2A6_019	Repeatability test 8	"
"	14:27	0:29		M2A6_020	Repeatability test 9	"
"	14:56			PULL_005	X pull	0.5kg increments
"						Remove model

DATE	TIME	WAIT TIME ACTUAL	Speed (m/s)	FILENAME (.DAC)	RUN DESCRIPTION	COMMENTS
"						
23-Apr-15						
"						Perform dyno pull to confirm functioning properly
"	10:10			Bench_check_001	X pull in balance calibration frame	
"						Install model
"	12:21			PULL_006	X pull	0.5kg increments
"						
"	13:04			M1B1_001	Rough up	0.9970 m/s
"	13:14	0:13		M1B1_002	Rough up	
"	13:27	0:10		M1B1_003	Resistance run	0.6902, 0.9203, 1.1887 m/s
"	13:37	0:10		M1B1_004	Resistance run	0.7669, 0.9970, 1.1120 m/s
"	13:47	0:10		M1B1_005	Resistance run	0.9586, 1.3037 m/s
"	13:57	0:10		M1B1_006	Resistance run	1.0736, 1.2654 m/s
"	14:07	0:10		M1B1_007	Resistance run	0.8436, 1.2270 m/s
"	14:17	0:10		M1B1_008	Resistance run	1.0353, 1.1503 m/s
"	14:27	0:11		M1B1_009	Resistance run	1.0736, 1.2654 m/s
"	14:38	0:10		M1B1_010	Resistance run	0.8436, 1.2270 m/s
"	14:48	0:10		M1B1_011	Resistance run	0.6902, 0.9203, 1.1887 m/s
"	14:58	0:10		M1B1_012	Repeatability test 1	0.6902, 0.9203, 1.1887 m/s
"	15:08	0:10		M1B1_013	Repeatability test 2	"
"	15:18	0:10		M1B1_014	Repeatability test 3	"
"	15:28	0:10		M1B1_015	Repeatability test 4	"
"	15:38	0:10		M1B1_016	Repeatability test 5	"
"	15:48	0:10		M1B1_017	Repeatability test 6	"
"	15:58	0:10		M1B1_018	Repeatability test 7	"
"	16:08	0:10		M1B1_019	Repeatability test 8	"
"	16:18	#####		M1B1_020	Repeatability test 9	"
"				PULL_007	X pull	0.5kg increments
"						
24-Apr-15						
"	8:15			PULL_008	X pull	0.5kg increments

DATE	TIME	WAIT TIME ACTUAL	Speed (m/s)	FILENAME (.DAC)	RUN DESCRIPTION	COMMENTS
	8:30					Recalibrate new 10lb interface loadcell, installed a 90° bracket on aft of model for pull, with load cell attached rigidly
				PULL_009	X pull	0.5kg increments
"						
"	10:30			M1B2_001	Rough up	0.9970 m/s
"	10:40	0:11		M1B2_002	Rough up	
"	10:51	0:10		M1B2_003	Resistance run	0.6902, 0.9203, 1.1887 m/s
"	11:01	0:10		M1B2_004	Resistance run	0.7669, 0.9970, 1.1120 m/s
"	11:11	0:10		M1B2_005	Resistance run	0.9586, 1.3037 m/s
"	11:21	0:12		M1B2_006	Resistance run	1.0736, 1.2654 m/s
"	11:33	0:10		M1B2_007	Resistance run	0.8436, 1.2270 m/s
"	11:43	0:10		M1B2_008	Resistance run	1.0353, 1.1503 m/s
"	11:53	0:10		M1B2_009	Resistance run	1.0736, 1.2654 m/s
"	12:03	0:10		M1B2_010	Resistance run	0.8436, 1.2270 m/s
"	12:13	0:10		M1B2_011	Resistance run	0.6902, 0.9203, 1.1887 m/s
"	12:23	0:10		M1B2_012	Repeatability test 1	0.6902, 0.9203, 1.1887 m/s
"	12:33	0:13		M1B2_013	Repeatability test 2	"
"	12:46	0:10		M1B2_014	Repeatability test 3	"
"	12:56	0:10		M1B2_015	Repeatability test 4	"
"	13:06	0:12		M1B2_016	Repeatability test 5	"
"	13:18	0:11		M1B2_017	Repeatability test 6	"
"	13:29	0:10		M1B2_018	Repeatability test 7	"
"	13:39	0:10		M1B2_019	Repeatability test 8	"
"	13:49	0:18		M1B2_020	Repeatability test 9	"
"	14:07	#####		PULL_010	X pull	0.5kg increments
"						Remove model

27-Apr-15						Set up for multiple pull points and install model
"	10:14			PULL_011	X pull	0.5kg increments
"						Rezero sinkage pots
"						Water temp 15.6°
"	10:39			M1B3_001	Rough up	0.9970 m/s

DATE	TIME	WAIT TIME ACTUAL	Speed (m/s)	FILENAME (.DAC)	RUN DESCRIPTION	COMMENTS
"	10:49	0:10		M1B3_002	Rough up	0.9970 m/s
"	10:59	0:10		M1B3_003	Repeatability test 1	0.6902, 0.9203, 1.1887 m/s
"	11:09	0:12		M1B3_004	Repeatability test 2	"
"	11:21	0:11		M1B3_005	Repeatability test 3	"
"	11:32	0:10		M1B3_006	Repeatability test 4	"
"	11:42	0:11		M1B3_007	Repeatability test 5	"
"	11:53	0:10		M1B3_008	Repeatability test 6	"
"	12:03	0:10		M1B3_009	Repeatability test 7	"
"	12:13	0:10		M1B3_010	Repeatability test 8	"
"	12:23	0:10		M1B3_011	Repeatability test 9	"
"	12:33	0:14		M1B3_012	Repeatability test 10	"
"	12:47	0:23		PULL_012	X pull	0.5kg increments original point 18.5cm to water
"	13:10	0:27		PULL_013	X pull	0.5kg increments low point 7.5cm to water
"	13:37	0:15		PULL_014	X pull	0.5kg increments high point, 34cm to water
"	13:52	0:10		M1B3_013	Rough up	0.9970 m/s
"	14:02	0:10		M1B3_014	Rough up	0.9970 m/s
"	14:12	0:10		M1B3_015	Repeatability test 11	0.6902, 0.9203, 1.1887 m/s
"	14:22	0:10		M1B3_016	Repeatability test 12	"
"	14:32	0:10		M1B3_017	Repeatability test 13	"
"	14:42	0:10		M1B3_018	Repeatability test 14	"
"	14:52	0:10		M1B3_019	Repeatability test 15	"
"	15:02	0:10		M1B3_020	Repeatability test 16	"
"	15:12	0:10		M1B3_021	Repeatability test 17	"
"	15:22	0:10		M1B3_022	Repeatability test 18	"
"	15:32	0:10		M1B3_023	Repeatability test 19	"
"	15:42	0:13		M1B3_024	Repeatability test 20	"
"	15:55			PULL_015	X pull	0.5kg increments
"						

5-May-15						Install model
"	9:31			PULL_016	X pull	0.5kg increments
"						Rezero sinkage pots, never rezeroed pitch or tow force
"						Water temp 15.6°
"	9:59			M3B1_001	Rough up	0.9970 m/s

DATE	TIME	WAIT TIME ACTUAL	Speed (m/s)	FILENAME (.DAC)	RUN DESCRIPTION	COMMENTS
"	10:09	0:10		M3B1_002	Rough up	
"	10:19	0:10		M3B1_003	Resistance run	0.6902, 0.9203, 1.1887 m/s
"	10:29	0:10		M3B1_004	Resistance run	0.7669, 0.9970, 1.1120 m/s
"	10:39	0:10		M3B1_005	Resistance run	0.9586, 1.3037 m/s
"	10:49	0:10		M3B1_006	Resistance run	1.0736, 1.2654 m/s
"	10:59	0:10		M3B1_007	Resistance run	0.8436, 1.2270 m/s
"	11:09	0:10		M3B1_008	Resistance run	1.0353, 1.1503 m/s
"	11:19	0:10		M3B1_009	Resistance run	1.0736, 1.2654 m/s
"	11:29	0:11		M3B1_010	Resistance run	0.8436, 1.2270 m/s
"	11:40	0:10		M3B1_011	Resistance run	0.6902, 0.9203, 1.1887 m/s
"	11:50	0:10		M3B1_012	Repeatability test 1	0.6902, 0.9203, 1.1887 m/s
"	12:00	0:11		M3B1_013	Repeatability test 2	"
"	12:11	0:09		M3B1_014	Repeatability test 3	"
"	12:20	0:10		M3B1_015	Repeatability test 4	"
"	12:30	0:14		M3B1_016	Repeatability test 5	"
"	12:44	0:10		M3B1_017	Repeatability test 6	"
"	12:54	0:10		M3B1_018	Repeatability test 7	"
"	13:04	0:10		M3B1_019	Repeatability test 8	"
"	13:14	0:26		M3B1_020	Repeatability test 9	"
"	13:40	#####		PULL_017	X pull	0.5kg increments

6-May-15						
"				PULL_018	X pull	0.5kg increments
"						Rezero sinkage pots and pitch, never rezeroed tow force
"						Water temp @ 15.65°
"	9:12			M3B2_001	Rough up	0.9970 m/s
"	9:22	0:10		M3B2_002	Rough up	
"	9:32	0:10		M3B2_003	Resistance run	0.6902, 0.9203, 1.1887 m/s
"	9:42	0:10		M3B2_004	Resistance run	0.7669, 0.9970, 1.1120 m/s
"	9:52	0:10		M3B2_005	Resistance run	0.9586, 1.3037 m/s
"	10:02	0:10		M3B2_006	Resistance run	1.0736, 1.2654 m/s
"	10:12	0:10		M3B2_007	Resistance run	0.8436, 1.2270 m/s
"	10:22	0:10		M3B2_008	Resistance run	1.0353, 1.1503 m/s

DATE	TIME	WAIT TIME ACTUAL	Speed (m/s)	FILENAME (.DAC)	RUN DESCRIPTION	COMMENTS
"	10:32	0:10		M3B2_009	Resistance run	1.0736, 1.2654 m/s
"	10:42	0:13		M3B2_010	Resistance run	0.8436, 1.2270 m/s
"	10:55	0:10		M3B2_011	Resistance run	0.6902, 0.9203, 1.1887 m/s
"	11:05	0:10		M3B2_012	Repeatability test 1	0.6902, 0.9203, 1.1887 m/s
"	11:15	0:10		M3B2_013	Repeatability test 2	"
"	11:25	0:10		M3B2_014	Repeatability test 3	"
"	11:35	0:10		M3B2_015	Repeatability test 4	"
"	11:45	0:10		M3B2_016	Repeatability test 5	"
"	11:55	0:10		M3B2_017	Repeatability test 6	"
"	12:05	0:10		M3B2_018	Repeatability test 7	"
"	12:15	0:10		M3B2_019	Repeatability test 8	"
"	12:25	0:18		M3B2_020	Repeatability test 9	"
"	12:43	#####		PULL_019	X pull	0.5kg increments
"						Remove model

7-May-15						
"	9:11			PULL_020	X pull	0.5kg increments
"	9:42			PULL_021	X pull	0.5kg increments
	10:10			M3B4_001	Rough up	0.9970 m/s
	10:20	3:33		M3B3_002	Rough up	
						Remove model, pulls and rough ups not looking as good as previous days
	11:31			Bench_check_002	X pull in balance calibration frame	
						Install model
	13:27			PULL_022		
"						Rezero sinkage pots and pitch, never rezeroed towforce
"						Water temp @ 15.65°
"	13:53			M3B3_003	Rough up	0.9970 m/s
"	14:03	0:13		M3B3_004	Rough up	
"	14:16	0:10		M3B3_005	Resistance run	0.6902, 0.9203, 1.1887 m/s
"	14:26	0:10		M3B3_006	Resistance run	0.8436, 1.2270 m/s
"	14:36	0:10		M3B3_007	Repeatability test 1	0.6902, 0.9203, 1.1887 m/s
"	14:46	0:10		M3B3_008	Repeatability test 2	"

DATE	TIME	WAIT TIME ACTUAL	Speed (m/s)	FILENAME (.DAC)	RUN DESCRIPTION	COMMENTS
"	14:56	0:10		M3B3_009	Repeatability test 3	"
"	15:06	0:10		M3B3_010	Repeatability test 4	"
"	15:16	0:10		M3B3_011	Repeatability test 5	"
"	15:26	0:10		M3B3_012	Repeatability test 6	"
"	15:36	0:10		M3B3_013	Repeatability test 7	"
"	15:46	0:10		M3B3_014	Repeatability test 8	"
"	15:56	0:10		M3B3_015	Repeatability test 9	"
"	16:06	#####		M3B3_016	Repeatability test 10	"
"		0:00		PULL_023	X pull	0.5kg increments
"						
12-May-15						
"	9:18			PULL_025	X pull	0.5kg increments
"						Tank stratification: 15.3° bottom, 15.5° top 2 meters, 15.6° on surface
"						Rezero sinkage pots and pitch, never rezeroed towforce
"	9:43	0:10		M3B4_001	Rough up	0.9970 m/s
"	9:53	0:10		M3B4_002	Rough up	
"	10:03	0:10		M3B4_003	Resistance run	0.6902, 0.9203, 1.1887 m/s
"	10:13	0:16		M3B4_004	Resistance run	0.7669, 0.9970, 1.1120 m/s
"	10:29	0:10		M3B4_005	Resistance run	0.9586, 1.3037 m/s
"	10:39	0:10		M3B4_006	Resistance run	1.0736, 1.2654 m/s
"	10:49	0:10		M3B4_007	Resistance run	0.8436, 1.2270 m/s Step visible in tare section.
"	10:59	0:10		M3B4_008	Resistance run	1.0353, 1.1503 m/s
"	11:09	0:11		M3B4_009	Resistance run	1.0736, 1.2654 m/s
"	11:20	0:10		M3B4_010	Resistance run	0.8436, 1.2270 m/s
"	11:30	0:10		M3B4_011	Resistance run	0.6902, 0.9203, 1.1887 m/s
"	11:40	0:10		M3B4_012	Repeatability test 1	0.6902, 0.9203, 1.1887 m/s
"	11:50	0:10		M3B4_013	Repeatability test 2	"
"	12:00	0:10		M3B4_014	Repeatability test 3	"
"	12:10	0:10		M3B4_015	Repeatability test 4	"
"	12:20	0:11		M3B4_016	Repeatability test 5	"
"	12:31	0:10		M3B4_017	Repeatability test 6	"
"	12:41	0:13		M3B4_018	Repeatability test 7	"
"	12:54	0:10		M3B4_019	Repeatability test 8	"

DATE	TIME	WAIT TIME ACTUAL	Speed (m/s)	FILENAME (.DAC)	RUN DESCRIPTION	COMMENTS
"	13:04	0:19		M3B4_020	Repeatability test 9	"
"	13:23	#####		PULL_026	X pull	0.5kg increments
"						Remove model

13-May-15						Computer windows upgrade issues
"	9:58			PULL_027	X pull	0.5kg increments
"						Water temp @ 15.5°
"						Rezero sinkage pots and pitch, never rezeroed towforce
"	10:25	0:10		M1B4_001	Rough up	0.9970 m/s
"	10:35	0:10		M1B4_002	Rough up	
"	10:45	0:10		M1B4_003	Resistance run	0.6902, 0.9203, 1.1887 m/s
"	10:55	0:10		M1B4_004	Resistance run	0.7669, 0.9970, 1.1120 m/s
"	11:05	0:11		M1B4_005	Resistance run	0.9586, 1.3037 m/s
"	11:16	0:10		M1B4_006	Resistance run	1.0736, 1.2654 m/s
"	11:26	0:09		M1B4_007	Resistance run	0.8436, 1.2270 m/s
"	11:35	0:10		M1B4_008	Resistance run	1.0353, 1.1503 m/s
"	11:45	0:12		M1B4_009	Resistance run	1.0736, 1.2654 m/s
"	11:57	0:10		M1B4_010	Resistance run	0.8436, 1.2270 m/s
"	12:07	0:10		M1B4_011	Resistance run	0.6902, 0.9203, 1.1887 m/s
"	12:17	0:10		M1B4_012	Repeatability test 1	0.6902, 0.9203, 1.1887 m/s
"	12:27	0:10		M1B4_013	Repeatability test 2	"
"	12:37	0:10		M1B4_014	Repeatability test 3	"
"	12:47	0:10		M1B4_015	Repeatability test 4	"
"	12:57	0:10		M1B4_016	Repeatability test 5	"
"	13:07	0:10		M1B4_017	Repeatability test 6	"
"	13:17	0:10		M1B4_018	Repeatability test 7	"
"	13:27	0:10		M1B4_019	Repeatability test 8	"
"	13:37	0:13		M1B4_020	Repeatability test 9	"
"	13:50	#####		PULL_028	X pull	0.5kg increments
"						Remove model water temp not updated in acq custom params.

DATE	TIME	WAIT TIME ACTUAL	Speed (m/s)	FILENAME (.DAC)	RUN DESCRIPTION	COMMENTS
13-May-15						Computer windows upgrade issues
"				PULL_029	X pull	1kg increments
"						Water temp @ 15.5°
"						Rezero sinkage pots and pitch, rezero towforce
"	10:41	0:12		M916_001	Rough up	1.193 m/s
"	10:53	0:10		M916_002	Rough up	1.193 m/s
"	11:03	0:10		M916_003	Resistance run	0.826, 1.238 m/s
"	11:13	0:12		M916_004	Resistance run	0.917, 1.468 m/s
"	11:25	0:10		M916_005	Resistance run	1.009, 1.422 m/s
"	11:35	0:10		M916_006	Resistance run	1.101, 1.376 m/s
"	11:45	0:12		M916_007	Resistance run	1.193, 1.284 m/s
"	11:57	0:10		M916_008	Resistance run	1.101, 1.376 m/s
"	12:07	0:10		M916_009	Repeatability test 1	"
"	12:17	0:10		M916_010	Repeatability test 2	"
"	12:27	0:10		M916_011	Repeatability test 3	"
"	12:37	0:10		M916_012	Repeatability test 4	"
"	12:47	0:10		M916_013	Repeatability test 5	"
"	12:57	0:11		M916_014	Repeatability test 6	"
"	13:08	0:09		M916_015	Repeatability test 7	"
"	13:17	0:10		M916_016	Repeatability test 8	"
"	13:27	0:16		M916_017	Repeatability test 9	"
"	13:43	#####		PULL_030	X pull	1kg increments
"						Remove model

Appendix D – Results of Resistance Experiment

Table D24: Resistance Results - TRUFOAM – April 21**Results of Resistance Experiments**

Model:	OCRE931	Test Date:	21-Apr-2015
Description:	TRUFOAM Model	Project:	A1-006518
Condition:	Normal Finish		
Tank:	Towing Tank		
Avg Test Temperature:	15.6 °C		

Run Designation	Time of Day	T1 (s)	T2 (s)	Carriage Speed (m/s)	Resistance (N)	Sinkage (mm)	Trim (deg)
M2A5_001_S1	10:35:14	58.26	164.40	0.9995	12.124	5.74	-0.0945
M2A5_002_S1	10:46:32	59.79	163.72	0.9994	12.201	5.78	-0.0946
M2A5_003_S1	11:01:37	57.24	84.67	0.6917	6.201	2.28	-0.0423
M2A5_003_S2	11:01:37	96.93	129.47	0.9215	10.521	4.12	-0.0722
M2A5_003_S3	11:01:37	149.24	174.62	1.1905	17.732	6.43	-0.1280
M2A5_004_S1	11:11:49	52.30	84.33	0.7684	7.555	2.36	-0.0519
M2A5_004_S2	11:11:49	98.98	127.60	0.9993	12.158	4.39	-0.0885
M2A5_004_S3	11:11:49	139.01	171.04	1.1136	15.052	5.53	-0.1121
M2A5_005_S1	11:21:48	55.19	96.25	0.9596	11.325	3.90	-0.0831
M2A5_005_S2	11:21:48	112.44	150.77	1.3045	23.780	7.58	-0.1571
M2A5_006_S1	11:31:46	58.18	96.30	1.0748	14.036	5.26	-0.1056
M2A5_006_S2	11:31:46	110.56	148.26	1.2673	21.650	7.16	-0.1460
M2A5_007_S1	11:41:43	54.51	98.98	0.8441	8.925	2.95	-0.0644
M2A5_007_S2	11:41:43	113.29	157.58	1.2275	19.288	6.92	-0.1372
M2A5_008_S1	11:52:45	56.69	99.70	1.0366	13.065	4.58	-0.0970
M2A5_008_S2	11:52:45	112.27	154.65	1.1523	16.229	5.83	-0.1205
M2A5_009_S1	12:03:44	56.90	95.66	1.0749	14.054	5.01	-0.1054
M2A5_009_S2	12:03:44	106.31	146.77	1.2673	21.655	7.40	-0.1452
M2A5_010_S1	12:13:19	54.85	98.47	0.8440	8.958	3.05	-0.0644
M2A5_010_S2	12:13:19	116.53	158.10	1.2274	19.303	6.58	-0.1395
M2A5_011_S1	12:23:04	56.81	85.18	0.6916	6.238	2.20	-0.0444
M2A5_011_S2	12:23:04	96.42	129.39	0.9216	10.550	3.96	-0.0768
M2A5_011_S3	12:23:04	150.09	173.86	1.1906	17.690	6.26	-0.1317
M2A5_012_S1	12:34:09	52.21	84.92	0.6916	6.164	2.04	-0.0444
M2A5_012_S2	12:34:09	96.42	129.64	0.9215	10.453	4.04	-0.0753
M2A5_012_S3	12:34:09	150.09	173.34	1.1906	17.598	6.44	-0.1295
M2A5_013_S1	12:44:09	53.32	85.35	0.6916	6.212	1.81	-0.0411
M2A5_013_S2	12:44:09	95.57	130.16	0.9215	10.492	3.60	-0.0756
M2A5_013_S3	12:44:09	148.73	174.96	1.1906	17.610	6.18	-0.1297
M2A5_014_S1	12:53:48	53.49	83.81	0.6916	6.275	1.82	-0.0414
M2A5_014_S2	12:53:48	95.74	129.99	0.9216	10.506	3.62	-0.0759

M2A5_014_S3	12:53:48	146.17	174.11	1.1906	17.570	6.27	-0.1317
Run Designation	Time of Day	T1 (s)	T2 (s)	Carriage Speed (m/s)	Resistance (N)	Sinkage (mm)	Trim (deg)
M2A5_015_S1	13:04:19	54.00	84.67	0.6916	6.157	1.85	-0.0421
M2A5_015_S2	13:04:19	95.57	129.47	0.9215	10.424	3.60	-0.0756
M2A5_015_S3	13:04:19	148.04	175.30	1.1905	17.540	6.17	-0.1306
M2A5_016_S1	13:14:21	51.62	84.84	0.6916	6.227	2.11	-0.0452
M2A5_016_S2	13:14:21	97.44	129.30	0.9215	10.508	3.66	-0.0770
M2A5_016_S3	13:14:21	148.56	174.62	1.1905	17.634	6.03	-0.1298
M2A5_017_S1	13:25:19	53.66	84.50	0.6916	6.148	2.07	-0.0456
M2A5_017_S2	13:25:19	96.76	129.47	0.9215	10.426	3.80	-0.0777
M2A5_017_S3	13:25:19	149.07	174.96	1.1905	17.485	6.18	-0.1321
M2A5_018_S1	13:34:42	54.17	85.35	0.6916	6.179	1.85	-0.0422
M2A5_018_S2	13:34:42	95.91	128.79	0.9216	10.462	3.67	-0.0763
M2A5_018_S3	13:34:42	149.24	175.13	1.1906	17.603	6.08	-0.1313
M2A5_019_S1	13:44:47	53.23	84.67	0.6917	6.263	2.24	-0.0450
M2A5_019_S2	13:44:47	97.96	128.88	0.9216	10.526	3.88	-0.0784
M2A5_019_S3	13:44:47	149.58	174.88	1.1906	17.607	6.20	-0.1319
M2A5_020_S1	13:54:49	56.73	85.69	0.6917	6.088	1.89	-0.0427
M2A5_020_S2	13:54:49	100.00	128.96	0.9215	10.426	3.64	-0.0761
M2A5_020_S3	13:54:49	149.92	174.45	1.1906	17.586	6.28	-0.1318
M2A5_021_S1	14:06:06	51.96	83.13	0.6916	6.263	1.96	-0.0432
M2A5_021_S2	14:06:06	93.19	126.24	0.9216	10.523	3.73	-0.0757
M2A5_021_S3	14:06:06	139.53	170.02	1.2672	21.697	7.08	-0.1483

Table D25: Resistance Results - TRUFOAM – April 22**Results of Resistance Experiments**

Model:	OCRE931	Test Date:	22-Apr-2015
Description:	TRUFOAM Model	Project:	A1-006518
Condition:	Normal Finish		
Tank:	Towing Tank		
Avg Test Temperature:	15.6 °C		

Run Designation	Time of Day	T1 (s)	T2 (s)	Carriage Speed (m/s)	Resistance (N)	Sinkage (mm)	Trim (deg)
M2A6_001_S1	11:07:56	59.79	164.40	0.9995	12.077	4.27	-0.0855
M2A6_002_S1	11:17:56	59.45	164.06	0.9994	12.186	4.56	-0.0854
M2A6_003_S1	11:27:52	53.32	85.52	0.6916	6.242	1.77	-0.0395
M2A6_003_S2	11:27:52	97.27	129.13	0.9215	10.428	3.58	-0.0726
M2A6_003_S3	11:27:52	151.45	174.62	1.1906	17.616	6.15	-0.1286
M2A6_004_S1	11:39:32	52.47	85.18	0.7684	7.520	2.23	-0.0495
M2A6_004_S2	11:39:32	97.19	127.34	0.9994	12.100	4.31	-0.0849
M2A6_004_S3	11:39:32	138.59	170.02	1.1136	15.006	5.26	-0.1098
M2A6_005_S1	11:50:13	56.69	96.51	0.9595	11.340	3.78	-0.0810
M2A6_005_S2	11:50:13	109.93	150.60	1.3045	23.791	7.95	-0.1562
M2A6_006_S1	12:00:21	56.05	96.94	1.0749	13.992	4.98	-0.1028
M2A6_006_S2	12:00:21	107.37	148.90	1.2671	21.573	7.21	-0.1437
M2A6_007_S1	12:11:36	54.73	99.05	0.8441	8.906	2.94	-0.0607
M2A6_007_S2	12:11:36	119.90	159.15	1.2275	19.238	6.65	-0.1365
M2A6_008_S1	12:22:45	58.39	97.57	1.0366	13.078	4.65	-0.0954
M2A6_008_S2	12:22:45	112.48	153.80	1.1523	16.197	6.07	-0.1166
M2A6_009_S1	12:34:39	59.15	95.67	1.0749	14.013	4.90	-0.1034
M2A6_009_S2	12:34:39	106.58	147.19	1.2672	21.515	7.07	-0.1451
M2A6_010_S1	12:44:29	54.77	99.70	0.8440	8.787	2.71	-0.0605
M2A6_010_S2	12:44:29	116.10	159.12	1.2275	19.049	6.49	-0.1363
M2A6_011_S1	12:54:22	52.81	84.67	0.6916	6.245	2.05	-0.0413
M2A6_011_S2	12:54:22	97.79	129.99	0.9215	10.461	3.78	-0.0741
M2A6_011_S3	12:54:22	153.67	175.13	1.1905	17.548	6.17	-0.1304
M2A6_012_S1	13:05:38	52.81	84.84	0.6917	6.138	1.91	-0.0408
M2A6_012_S2	13:05:38	97.79	129.47	0.9216	10.386	3.94	-0.0720
M2A6_012_S3	13:05:38	153.84	175.81	1.1907	17.494	6.44	-0.1274
M2A6_013_S1	13:15:27	51.44	85.01	0.6916	6.143	1.63	-0.0400
M2A6_013_S2	13:15:27	96.76	129.81	0.9215	10.404	3.50	-0.0725
M2A6_013_S3	13:15:27	149.92	175.64	1.1906	17.448	6.26	-0.1278
M2A6_014_S1	13:26:18	55.02	85.43	0.6917	6.069	1.57	-0.0403
M2A6_014_S2	13:26:18	95.91	129.39	0.9216	10.342	3.41	-0.0733
M2A6_014_S3	13:26:18	146.04	175.84	1.1906	17.408	6.12	-0.1289

Run Designation	Time of Day	T1 (s)	T2 (s)	Carriage Speed (m/s)	Resistance (N)	Sinkage (mm)	Trim (deg)
M2A6_015_S1	13:36:49	52.81	85.35	0.6916	6.215	1.74	-0.0394
M2A6_015_S2	13:36:49	96.08	129.47	0.9215	10.489	3.49	-0.0731
M2A6_015_S3	13:36:49	154.96	175.90	1.1906	17.491	6.03	-0.1296
M2A6_016_S1	13:46:39	54.00	85.52	0.6917	6.126	2.00	-0.0398
M2A6_016_S2	13:46:39	95.74	129.81	0.9215	10.410	3.82	-0.0734
M2A6_016_S3	13:46:39	151.43	175.95	1.1906	17.416	6.19	-0.1308
M2A6_017_S1	13:56:41	52.81	84.84	0.6917	6.204	1.65	-0.0404
M2A6_017_S2	13:56:41	96.08	128.96	0.9215	10.416	3.41	-0.0731
M2A6_017_S3	13:56:41	154.47	175.65	1.1905	17.460	6.30	-0.1298
M2A6_018_S1	14:06:58	52.30	85.69	0.6916	6.163	1.75	-0.0404
M2A6_018_S2	14:06:58	96.76	129.99	0.9215	10.450	3.61	-0.0729
M2A6_018_S3	14:06:58	154.53	175.79	1.1906	17.499	6.14	-0.1297
M2A6_019_S1	14:16:47	53.32	85.35	0.6917	6.198	1.53	-0.0403
M2A6_019_S2	14:16:47	94.89	130.16	0.9216	10.381	3.38	-0.0741
M2A6_019_S3	14:16:47	150.47	175.70	1.1906	17.458	6.02	-0.1289
M2A6_020_S1	14:26:41	53.32	85.35	0.6917	6.170	1.89	-0.0428
M2A6_020_S2	14:26:41	97.44	129.30	0.9215	10.411	3.73	-0.0732
M2A6_020_S3	14:26:41	150.09	175.47	1.1906	17.408	6.16	-0.1293

Table D26: Resistance Results - Standard – April 23**Results of Resistance Experiments**

Model: OCRE930 Test Date: 23-Apr-2015
 Description: Standard Model Project: A1-006518
 Condition: Normal Finish

Tank: Towing Tank
 Avg Test Temperature: 15.6 °C

Run Designation	Time of Day	T1 (s)	T2 (s)	Carriage Speed (m/s)	Resistance (N)	Sinkage (mm)	Trim (deg)
M1B1_001_S1	13:03:26	62.86	163.89	0.9994	12.111	3.89	-0.0809
M1B1_002_S1	13:14:11	58.94	164.40	0.9994	12.122	3.90	-0.0810
M1B1_003_S1	13:26:56	52.64	84.50	0.6916	6.115	1.50	-0.0356
M1B1_003_S2	13:26:56	95.57	130.33	0.9215	10.410	3.48	-0.0680
M1B1_003_S3	13:26:56	141.74	174.45	1.1906	17.316	6.14	-0.1231
M1B1_004_S1	13:36:53	53.49	84.67	0.7684	7.421	2.01	-0.0451
M1B1_004_S2	13:36:53	95.40	128.62	0.9994	12.096	3.89	-0.0816
M1B1_004_S3	13:36:53	138.33	170.70	1.1136	14.922	4.76	-0.1031
M1B1_005_S1	13:46:40	54.77	97.36	0.9595	11.237	3.60	-0.0747
M1B1_005_S2	13:46:40	109.07	149.96	1.3045	23.385	7.52	-0.1506
M1B1_006_S1	13:56:49	56.11	96.90	1.0749	13.944	4.39	-0.0956
M1B1_006_S2	13:56:49	106.41	149.19	1.2672	21.350	6.84	-0.1394
M1B1_007_S1	14:06:40	54.12	99.97	0.8441	8.827	2.27	-0.0551
M1B1_007_S2	14:06:40	113.31	159.00	1.2275	18.887	5.94	-0.1311
M1B1_008_S1	14:16:50	54.73	100.43	1.0366	12.988	4.16	-0.0876
M1B1_008_S2	14:16:50	109.63	155.47	1.1522	16.103	5.10	-0.1099
M1B1_009_S1	14:26:48	56.05	94.59	1.0749	13.975	4.20	-0.0948
M1B1_009_S2	14:26:48	106.31	146.77	1.2672	21.238	6.46	-0.1380
M1B1_010_S1	14:37:46	54.13	99.28	0.8441	8.798	2.13	-0.0535
M1B1_010_S2	14:37:46	113.76	158.06	1.2275	18.874	5.85	-0.1291
M1B1_011_S1	14:47:41	51.44	84.84	0.6916	6.077	1.20	-0.0338
M1B1_011_S2	14:47:41	95.74	128.62	0.9216	10.343	3.16	-0.0657
M1B1_011_S3	14:47:41	140.38	174.11	1.1906	17.195	5.59	-0.1199
M1B1_012_S1	14:58:08	52.64	85.69	0.6916	6.071	1.18	-0.0338
M1B1_012_S2	14:58:08	97.27	129.99	0.9215	10.400	3.14	-0.0648
M1B1_012_S3	14:58:08	141.40	174.62	1.1906	17.201	5.61	-0.1202
M1B1_013_S1	15:08:11	50.08	84.67	0.6916	6.109	1.01	-0.0336
M1B1_013_S2	15:08:11	94.72	129.64	0.9215	10.386	2.65	-0.0647
M1B1_013_S3	15:08:11	140.89	174.45	1.1906	17.229	5.15	-0.1185
M1B1_014_S1	15:17:54	51.53	84.11	0.6916	6.113	1.33	-0.0324
M1B1_014_S2	15:17:54	95.82	129.26	0.9215	10.388	2.89	-0.0644
M1B1_014_S3	15:17:54	141.82	173.77	1.1906	17.242	5.25	-0.1189

Run Designation	Time of Day	T1 (s)	T2 (s)	Carriage Speed (m/s)	Resistance (N)	Sinkage (mm)	Trim (deg)
M1B1_015_S1	15:27:26	72.82	105.41	0.6917	6.126	0.91	-0.0317
M1B1_015_S2	15:27:26	114.99	149.92	0.9215	10.366	2.68	-0.0637
M1B1_015_S3	15:27:26	160.14	194.00	1.1906	17.194	5.15	-0.1179
M1B1_016_S1	15:37:35	68.99	105.41	0.6917	6.103	1.07	-0.0325
M1B1_016_S2	15:37:35	114.99	148.85	0.9215	10.378	2.68	-0.0638
M1B1_016_S3	15:37:35	159.71	194.00	1.1906	17.211	5.16	-0.1180
M1B1_017_S1	15:47:42	70.27	105.83	0.6916	6.133	1.03	-0.0327
M1B1_017_S2	15:47:42	113.71	150.13	0.9215	10.339	2.72	-0.0633
M1B1_017_S3	15:47:42	159.71	194.64	1.1906	17.198	5.23	-0.1177
M1B1_018_S1	15:57:31	70.27	105.62	0.6916	6.077	1.09	-0.0315
M1B1_018_S2	15:57:31	113.93	149.49	0.9216	10.370	2.97	-0.0632
M1B1_018_S3	15:57:31	159.50	195.06	1.1906	17.202	5.50	-0.1164
M1B1_019_S1	16:07:28	71.12	104.98	0.6916	6.128	0.93	-0.0317
M1B1_019_S2	16:07:28	114.99	150.13	0.9215	10.380	2.80	-0.0630
M1B1_019_S3	16:07:28	158.65	193.57	1.1906	17.219	5.48	-0.1169
M1B1_020_S1	16:17:49	70.06	102.85	0.6916	6.096	0.83	-0.0312
M1B1_020_S2	16:17:49	114.35	149.28	0.9215	10.365	2.54	-0.0621
M1B1_020_S3	16:17:49	158.01	194.21	1.1906	17.185	5.05	-0.1161

Table D27: Resistance Results - Standard – April 24**Results of Resistance Experiments**

Model:	OCRE930	Test Date:	24-Apr-2015
Description:	Standard Model	Project:	A1-006518
Condition:	Normal Finish		

Tank:	Towing Tank
Avg Test Temperature:	15.6 °C

Run Designation	Time of Day	T1 (s)	T2 (s)	Carriage Speed (m/s)	Resistance (N)	Sinkage (mm)	Trim (deg)
M1B2_001_S1	10:29:00	82.96	184.16	0.9994	12.094	4.31	-0.0806
M1B2_002_S1	10:40:09	81.77	185.27	0.9994	12.047	4.26	-0.0823
M1B2_003_S1	10:50:13	73.46	103.06	0.6917	6.118	1.65	-0.0366
M1B2_003_S2	10:50:13	114.99	149.28	0.9216	10.349	3.45	-0.0702
M1B2_003_S3	10:50:13	159.71	194.64	1.1907	17.428	6.20	-0.1229
M1B2_003_S4	10:50:13	181.01	194.64	1.1907	17.472	6.26	-0.1241
M1B2_004_S1	11:00:31	73.25	104.98	0.7684	7.443	2.13	-0.0481
M1B2_004_S2	11:00:31	117.33	148.64	0.9993	12.076	3.99	-0.0821
M1B2_004_S3	11:00:31	157.80	190.81	1.1136	14.875	4.92	-0.1053
M1B2_005_S1	11:10:46	75.38	116.06	0.9596	11.253	3.70	-0.0757
M1B2_005_S2	11:10:46	129.69	170.57	1.3046	23.592	7.37	-0.1542
M1B2_006_S1	11:20:59	74.61	116.70	1.0749	13.881	5.05	-0.0990
M1B2_006_S2	11:20:59	128.11	168.49	1.2672	21.411	7.19	-0.1436
M1B2_007_S1	11:32:39	74.74	117.12	0.8441	8.774	2.68	-0.0601
M1B2_007_S2	11:32:39	137.14	178.45	1.2275	19.088	6.69	-0.1336
M1B2_008_S1	11:42:26	77.06	121.03	1.0366	12.994	4.30	-0.0907
M1B2_008_S2	11:42:26	133.65	176.34	1.1522	16.038	5.37	-0.1137
M1B2_009_S1	11:52:43	75.47	116.01	1.0749	13.880	4.85	-0.0994
M1B2_009_S2	11:52:43	127.60	166.44	1.2672	21.373	6.97	-0.1429
M1B2_010_S1	12:02:53	76.02	118.40	0.8440	8.806	2.92	-0.0593
M1B2_010_S2	12:02:53	137.14	177.81	1.2275	19.019	6.54	-0.1337
M1B2_011_S1	12:12:25	73.04	102.21	0.6917	6.153	1.43	-0.0410
M1B2_011_S2	12:12:25	113.93	145.44	0.9216	10.348	3.18	-0.0717
M1B2_011_S3	12:12:25	158.01	188.04	1.2673	21.239	6.99	-0.1434
M1B2_012_S1	12:22:29	74.10	103.49	0.6916	6.089	1.46	-0.0398
M1B2_012_S2	12:22:29	114.35	145.23	0.9215	10.359	3.20	-0.0716
M1B2_012_S3	12:22:29	158.86	189.53	1.2672	21.286	6.69	-0.1427
M1B2_013_S1	12:32:33	73.46	102.64	0.6917	6.129	1.63	-0.0412
M1B2_013_S2	12:32:33	115.42	145.44	0.9216	10.346	3.54	-0.0715
M1B2_013_S3	12:32:33	158.22	189.10	1.2673	21.239	7.07	-0.1427

Run Designation	Time of Day	T1 (s)	T2 (s)	Carriage Speed (m/s)	Resistance (N)	Sinkage (mm)	Trim (deg)
M1B2_014_S1	12:45:19	70.91	102.64	0.6917	6.041	1.60	-0.0411
M1B2_014_S2	12:45:19	113.93	146.08	0.9215	10.330	3.59	-0.0721
M1B2_014_S3	12:45:19	157.80	188.68	1.2673	21.237	7.07	-0.1427
M1B2_015_S1	12:56:07	71.12	102.85	0.6916	6.119	1.61	-0.0406
M1B2_015_S2	12:56:07	113.71	144.81	0.9216	10.393	3.45	-0.0719
M1B2_015_S3	12:56:07	157.58	189.31	1.2673	21.205	7.06	-0.1419
M1B2_016_S1	13:05:56	70.91	102.64	0.6916	6.115	1.69	-0.0399
M1B2_016_S2	13:05:56	115.42	145.23	0.9216	10.395	3.45	-0.0707
M1B2_016_S3	13:05:56	158.01	189.31	1.2672	21.262	6.76	-0.1431
M1B2_017_S1	13:17:37	72.40	102.43	0.6916	6.111	1.73	-0.0408
M1B2_017_S2	13:17:37	113.07	145.87	0.9215	10.365	3.39	-0.0711
M1B2_017_S3	13:17:37	158.43	187.82	1.2672	21.269	6.79	-0.1431
M1B2_018_S1	13:28:29	73.46	103.49	0.6917	6.140	1.75	-0.0386
M1B2_018_S2	13:28:29	114.56	146.08	0.9215	10.382	3.42	-0.0711
M1B2_018_S3	13:28:29	157.58	189.10	1.2672	21.302	6.83	-0.1435
M1B2_019_S1	13:38:31	72.40	102.43	0.6916	6.115	1.85	-0.0401
M1B2_019_S2	13:38:31	114.56	145.23	0.9215	10.422	3.54	-0.0713
M1B2_019_S3	13:38:31	156.09	188.89	1.2673	21.314	6.96	-0.1429
M1B2_020_S1	13:48:30	71.97	102.64	0.6916	6.102	1.39	-0.0404
M1B2_020_S2	13:48:30	113.29	145.23	0.9216	10.371	3.15	-0.0718
M1B2_020_S3	13:48:30	159.29	188.04	1.2673	21.219	6.92	-0.1429

Table D28: Resistance Results - Standard – April 27 (set 1)**Results of Resistance Experiments**

Model: OCRE930 Test Date: 27-Apr-2015
 Description: Standard Model Project: A1-006518
 Condition: Normal Finish

Tank: Towing Tank
 Avg Test Temperature: 15.6 °C

Run Designation	Time of Day	T1 (s)	T2 (s)	Carriage Speed (m/s)	Resistance (N)	Sinkage (mm)	Trim (deg)
M1B3_001_S1	10:38:34	81.98	183.56	0.9995	12.189	3.86	-0.0832
M1B3_002_S1	10:48:33	78.79	185.27	0.9995	12.231	4.12	-0.0830
M1B3_003_S1	10:58:47	77.72	102.43	0.6916	6.288	1.82	-0.0393
M1B3_003_S2	10:58:47	118.19	149.70	0.9216	10.573	3.55	-0.0711
M1B3_003_S3	10:58:47	160.99	193.79	1.1906	17.457	6.03	-0.1247
M1B3_004_S1	11:08:25	73.99	104.87	0.6917	6.353	1.49	-0.0395
M1B3_004_S2	11:08:25	119.05	149.47	0.9216	10.559	3.17	-0.0719
M1B3_004_S3	11:08:25	160.91	192.48	1.1907	17.484	5.66	-0.1275
M1B3_005_S1	11:20:21	73.82	106.12	0.6917	6.361	1.55	-0.0394
M1B3_005_S2	11:20:21	120.68	150.78	0.9215	10.671	3.20	-0.0726
M1B3_005_S3	11:20:21	163.19	195.38	1.1906	17.519	5.60	-0.1264
M1B3_006_S1	11:31:29	75.08	106.30	0.6917	6.322	1.84	-0.0417
M1B3_006_S2	11:31:29	120.56	150.61	0.9215	10.559	3.40	-0.0731
M1B3_006_S3	11:31:29	165.10	195.01	1.1906	17.439	5.68	-0.1274
M1B3_007_S1	11:41:55	74.73	106.20	0.6917	6.361	1.76	-0.0404
M1B3_007_S2	11:41:55	118.60	150.52	0.9215	10.582	3.53	-0.0719
M1B3_007_S3	11:41:55	166.28	195.38	1.1906	17.453	5.73	-0.1268
M1B3_008_S1	11:52:10	76.21	106.00	0.6917	6.402	1.42	-0.0407
M1B3_008_S2	11:52:10	120.49	150.79	0.9215	10.623	3.09	-0.0728
M1B3_008_S3	11:52:10	164.94	195.24	1.1906	17.491	5.89	-0.1256
M1B3_009_S1	12:02:19	75.35	106.01	0.6917	6.384	1.38	-0.0385
M1B3_009_S2	12:02:19	120.77	150.64	0.9216	10.624	3.22	-0.0729
M1B3_009_S3	12:02:19	164.90	195.35	1.1907	17.495	5.96	-0.1261
M1B3_010_S1	12:12:22	74.94	106.08	0.6917	6.501	1.41	-0.0404
M1B3_010_S2	12:12:22	120.11	150.75	0.9216	10.790	3.05	-0.0714
M1B3_010_S3	12:12:22	163.31	195.24	1.1907	17.572	5.49	-0.1249
M1B3_011_S1	12:22:17	74.98	105.95	0.6917	6.574	1.40	-0.0395
M1B3_011_S2	12:22:17	120.22	150.56	0.9216	10.832	3.19	-0.0723
M1B3_011_S3	12:22:17	162.73	195.44	1.1907	17.636	5.70	-0.1267
M1B3_012_S1	12:32:18	75.96	106.06	0.6917	6.510	1.32	-0.0386
M1B3_012_S2	12:32:18	120.13	150.66	0.9216	10.775	2.98	-0.0716
M1B3_012_S3	12:32:18	162.81	195.41	1.1906	17.608	5.52	-0.1256

Table D29: Resistance Results - Standard – April 27 (set 2)

Results of Resistance Experiments

Model:	OCRE930	Test Date:	27-Apr-2015
Description:	Standard Model	Project:	A1-006518
Condition:	Normal Finish		
Tank:	Towing Tank		
Avg Test Temperature:	15.6 °C		

Run Designation	Time of Day	T1 (s)	T2 (s)	Carriage Speed (m/s)	Resistance (N)	Sinkage (mm)	Trim (deg)
M1B3_013_S1	13:51:38	77.08	184.84	0.9995	12.188	3.68	-0.0849
M1B3_014_S1	14:01:14	79.64	184.20	0.9995	12.353	3.55	-0.0868
M1B3_015_S1	14:11:32	73.46	104.98	0.6917	6.340	1.28	-0.0384
M1B3_015_S2	14:11:32	115.84	149.49	0.9216	10.601	2.85	-0.0731
M1B3_015_S3	14:11:32	160.99	194.00	1.1906	17.473	5.44	-0.1265
M1B3_016_S1	14:22:25	71.12	105.83	0.6917	6.346	1.61	-0.0416
M1B3_016_S2	14:22:25	115.84	149.70	0.9216	10.647	3.14	-0.0736
M1B3_016_S3	14:22:25	160.99	194.21	1.1906	17.502	5.47	-0.1271
M1B3_017_S1	14:31:23	71.33	104.98	0.6916	6.370	1.41	-0.0401
M1B3_017_S2	14:31:23	116.27	149.28	0.9215	10.636	2.94	-0.0747
M1B3_017_S3	14:31:23	160.35	194.43	1.1906	17.469	5.35	-0.1272
M1B3_018_S1	14:41:38	71.33	105.19	0.6917	6.386	1.61	-0.0425
M1B3_018_S2	14:41:38	116.48	149.70	0.9216	10.673	3.19	-0.0732
M1B3_018_S3	14:41:38	159.93	194.43	1.1906	17.496	5.52	-0.1260
M1B3_019_S1	14:51:43	73.46	103.28	0.6917	6.449	1.27	-0.0384
M1B3_019_S2	14:51:43	116.91	148.64	0.9216	10.674	3.11	-0.0732
M1B3_019_S3	14:51:43	159.50	193.15	1.1906	17.487	5.72	-0.1292
M1B3_020_S1	15:01:24	71.38	105.62	0.6916	6.340	1.26	-0.0379
M1B3_020_S2	15:01:24	116.61	150.09	0.9216	10.619	2.83	-0.0728
M1B3_020_S3	15:01:24	159.80	193.79	1.1906	17.450	5.28	-0.1272
M1B3_021_S1	15:11:18	73.04	103.92	0.6917	6.313	1.47	-0.0423
M1B3_021_S2	15:11:18	116.06	148.64	0.9216	10.559	3.02	-0.0735
M1B3_021_S3	15:11:18	160.56	194.43	1.1907	17.330	5.33	-0.1268
M1B3_022_S1	15:21:21	72.82	105.62	0.6916	6.455	1.32	-0.0387
M1B3_022_S2	15:21:21	115.20	149.92	0.9216	10.731	2.86	-0.0730
M1B3_022_S3	15:21:21	159.50	193.79	1.1906	17.459	5.26	-0.1267
M1B3_023_S1	15:31:47	72.82	104.98	0.6916	6.235	1.40	-0.0402
M1B3_023_S2	15:31:47	116.27	149.28	0.9216	10.499	2.96	-0.0737
M1B3_023_S3	15:31:47	160.99	194.43	1.1906	17.317	5.32	-0.1266
M1B3_024_S1	15:42:09	71.12	104.98	0.6917	6.351	1.47	-0.0419
M1B3_024_S2	15:42:09	116.91	149.06	0.9216	10.608	3.23	-0.0740
M1B3_024_S3	15:42:09	160.99	193.57	1.1906	17.423	5.50	-0.1266

Table D30: Resistance Results – Wood Model – May 5**Results of Resistance Experiments**

Model:	OCRE933	Test Date:	5-May-2015
Description:	Wooden Model	Project:	A1-006518
Condition:	Normal Finish		
Tank:	Towing Tank		
Avg Test Temperature:	15.6 °C		

Run Designation	Time of Day	T1 (s)	T2 (s)	Carriage Speed (m/s)	Resistance (N)	Sinkage (mm)	Trim (deg)
M3B1_001_S1	9:58:21	77.51	183.56	0.9995	12.228	4.64	-0.0784
M3B1_002_S1	10:08:36	79.43	183.14	0.9995	12.272	4.20	-0.0795
M3B1_003_S1	10:18:47	76.87	104.98	0.6917	6.242	1.64	-0.0417
M3B1_003_S2	10:18:47	118.61	149.06	0.9216	10.535	3.40	-0.0718
M3B1_003_S3	10:18:47	159.93	194.00	1.1907	17.429	6.26	-0.1190
M3B1_004_S1	10:28:49	72.61	103.70	0.7685	7.679	2.08	-0.0517
M3B1_004_S2	10:28:49	117.33	147.36	0.9993	12.290	4.14	-0.0815
M3B1_004_S3	10:28:49	156.94	190.17	1.1136	15.084	4.89	-0.1052
M3B1_005_S1	10:38:34	75.38	116.91	0.9596	11.476	4.13	-0.0724
M3B1_005_S2	10:38:34	129.47	169.93	1.3045	23.596	7.70	-0.1476
M3B1_006_S1	10:48:56	74.79	116.87	1.0750	14.173	5.04	-0.0931
M3B1_006_S2	10:48:56	128.62	167.81	1.2673	21.405	7.00	-0.1369
M3B1_007_S1	10:58:51	74.10	117.12	0.8441	9.062	2.62	-0.0601
M3B1_007_S2	10:58:51	133.94	178.67	1.2275	19.025	6.72	-0.1273
M3B1_008_S1	11:08:33	78.15	120.31	1.0367	13.232	4.18	-0.0901
M3B1_008_S2	11:08:33	130.96	174.83	1.1523	16.262	5.09	-0.1138
M3B1_009_S1	11:18:28	77.72	116.48	1.0749	14.101	4.96	-0.0955
M3B1_009_S2	11:18:28	125.43	166.31	1.2673	21.316	7.12	-0.1361
M3B1_010_S1	11:28:32	75.59	117.55	0.8441	9.094	2.88	-0.0571
M3B1_010_S2	11:28:32	133.52	177.60	1.2275	19.095	6.55	-0.1268
M3B1_011_S1	11:39:57	73.25	103.70	0.6917	6.377	1.36	-0.0363
M3B1_011_S2	11:39:57	116.91	148.21	0.9216	10.654	3.34	-0.0696
M3B1_011_S3	11:39:57	161.84	194.21	1.1906	17.432	6.10	-0.1181
M3B1_012_S1	11:49:31	71.55	105.19	0.6916	6.310	1.44	-0.0374
M3B1_012_S2	11:49:31	114.56	149.49	0.9215	10.574	3.03	-0.0727
M3B1_012_S3	11:49:31	159.93	194.43	1.1906	17.443	5.43	-0.1232
M3B1_013_S1	11:59:29	71.12	105.19	0.6916	6.441	1.45	-0.0383
M3B1_013_S2	11:59:29	114.35	149.28	0.9216	10.639	3.05	-0.0718
M3B1_013_S3	11:59:29	159.93	195.06	1.1906	17.523	5.50	-0.1237
M3B1_014_S1	12:10:08	70.48	105.19	0.6917	6.400	1.38	-0.0372
M3B1_014_S2	12:10:08	114.99	149.28	0.9215	10.584	2.98	-0.0715
M3B1_014_S3	12:10:08	160.78	194.85	1.1906	17.449	5.70	-0.1208

Run Designation	Time of Day	T1 (s)	T2 (s)	Carriage Speed (m/s)	Resistance (N)	Sinkage (mm)	Trim (deg)
M3B1_015_S1	12:19:55	71.12	104.56	0.6916	6.285	1.43	-0.0377
M3B1_015_S2	12:19:55	117.33	149.49	0.9215	10.599	2.99	-0.0719
M3B1_015_S3	12:19:55	159.50	193.79	1.1906	17.409	5.29	-0.1234
M3B1_016_S1	12:29:40	71.12	104.56	0.6917	6.306	1.37	-0.0369
M3B1_016_S2	12:29:40	115.42	149.70	0.9215	10.529	2.98	-0.0721
M3B1_016_S3	12:29:40	160.35	193.79	1.1906	17.379	5.59	-0.1222
M3B1_017_S1	12:43:35	70.69	104.77	0.6917	6.300	1.41	-0.0373
M3B1_017_S2	12:43:35	116.91	149.06	0.9216	10.606	3.42	-0.0676
M3B1_017_S3	12:43:35	160.14	194.64	1.1906	17.498	5.95	-0.1185
M3B1_018_S1	12:53:35	71.76	105.19	0.6917	6.518	1.26	-0.0353
M3B1_018_S2	12:53:35	114.99	149.28	0.9215	10.770	2.86	-0.0702
M3B1_018_S3	12:53:35	160.35	194.00	1.1906	17.654	5.26	-0.1239
M3B1_019_S1	13:03:48	72.40	105.62	0.6916	6.347	1.39	-0.0371
M3B1_019_S2	13:03:48	115.42	149.92	0.9215	10.629	2.99	-0.0717
M3B1_019_S3	13:03:48	159.50	193.79	1.1906	17.491	5.26	-0.1238
M3B1_020_S1	13:13:39	72.40	104.77	0.6917	6.366	1.41	-0.0375
M3B1_020_S2	13:13:39	115.63	149.49	0.9215	10.624	3.01	-0.0708
M3B1_020_S3	13:13:39	159.71	194.64	1.1906	17.516	5.33	-0.1240

Table D31: Resistance Results – Wood Model – May 6**Results of Resistance Experiments**

Model:	OCRE933	Test Date:	6-May-2015
Description:	Wooden Model	Project:	A1-006518
Condition:	Normal Finish		
Tank:	Towing Tank		
Avg Test Temperature:	15.6 °C		

Run Designation	Time of Day	T1 (s)	T2 (s)	Carriage Speed (m/s)	Resistance (N)	Sinkage (mm)	Trim (deg)
M3B2_001_S1	9:11:16	78.53	185.61	0.9994	12.208	4.58	-0.0851
M3B2_002_S1	9:21:49	79.64	183.78	0.9994	12.239	4.59	-0.0859
M3B2_003_S1	9:31:29	71.76	105.62	0.6916	6.381	1.94	-0.0425
M3B2_003_S2	9:31:29	117.33	148.64	0.9215	10.697	3.54	-0.0773
M3B2_003_S3	9:31:29	163.55	194.85	1.1906	17.692	5.90	-0.1306
M3B2_004_S1	9:41:34	70.91	104.98	0.7685	7.633	2.59	-0.0562
M3B2_004_S2	9:41:34	115.63	148.43	0.9994	12.300	4.69	-0.0868
M3B2_004_S3	9:41:34	156.31	190.59	1.1136	15.157	5.27	-0.1131
M3B2_005_S1	9:51:27	75.13	116.70	0.9596	11.498	3.84	-0.0844
M3B2_005_S2	9:51:27	130.16	170.87	1.3045	23.710	7.60	-0.1583
M3B2_006_S1	10:01:08	75.17	117.12	1.0749	14.069	5.07	-0.1066
M3B2_006_S2	10:01:08	129.05	169.08	1.2673	21.410	7.58	-0.1430
M3B2_007_S1	10:11:40	73.04	119.68	0.8440	8.939	2.91	-0.0648
M3B2_007_S2	10:11:40	131.60	178.88	1.2276	19.032	6.86	-0.1375
M3B2_008_S1	10:21:21	75.81	120.53	1.0367	13.234	4.75	-0.0995
M3B2_008_S2	10:21:21	132.24	175.26	1.1523	16.356	5.59	-0.1214
M3B2_009_S1	10:31:32	74.10	115.50	1.0750	14.136	4.81	-0.1066
M3B2_009_S2	10:31:32	127.60	167.64	1.2673	21.465	6.88	-0.1485
M3B2_010_S1	10:41:26	75.47	119.42	0.8440	9.272	2.94	-0.0651
M3B2_010_S2	10:41:26	133.90	179.05	1.2275	19.329	6.34	-0.1399
M3B2_011_S1	10:53:09	70.69	104.77	0.6917	6.269	2.09	-0.0460
M3B2_011_S2	10:53:09	116.69	149.70	0.9215	10.599	3.70	-0.0797
M3B2_011_S3	10:53:09	161.84	194.43	1.1906	17.491	5.97	-0.1316
M3B2_012_S1	11:04:25	70.27	105.41	0.6917	6.299	1.88	-0.0424
M3B2_012_S2	11:04:25	116.27	149.06	0.9215	10.573	3.49	-0.0771
M3B2_012_S3	11:04:25	160.35	194.64	1.1906	17.402	6.06	-0.1312
M3B2_013_S1	11:14:28	72.82	105.41	0.6916	6.258	2.03	-0.0448
M3B2_013_S2	11:14:28	115.63	149.49	0.9215	10.535	3.63	-0.0794
M3B2_013_S3	11:14:28	160.35	194.21	1.1905	17.381	5.96	-0.1313
M3B2_014_S1	11:24:55	70.27	104.77	0.6917	6.310	1.83	-0.0415
M3B2_014_S2	11:24:55	115.20	148.85	0.9216	10.586	3.47	-0.0770
M3B2_014_S3	11:24:55	160.99	194.64	1.1906	17.458	5.91	-0.1309

Run Designation	Time of Day	T1 (s)	T2 (s)	Carriage Speed (m/s)	Resistance (N)	Sinkage (mm)	Trim (deg)
M3B2_015_S1	11:34:31	69.42	104.98	0.6917	6.315	2.02	-0.0442
M3B2_015_S2	11:34:31	114.56	149.70	0.9215	10.544	3.51	-0.0776
M3B2_015_S3	11:34:31	158.65	194.21	1.1906	17.436	5.82	-0.1295
M3B2_016_S1	11:45:21	70.91	104.77	0.6916	6.304	1.87	-0.0423
M3B2_016_S2	11:45:21	114.99	149.92	0.9215	10.563	3.64	-0.0784
M3B2_016_S3	11:45:21	160.99	194.43	1.1906	17.449	6.30	-0.1301
M3B2_017_S1	11:55:01	70.48	104.98	0.6917	6.375	2.03	-0.0444
M3B2_017_S2	11:55:01	116.06	149.28	0.9215	10.645	3.58	-0.0785
M3B2_017_S3	11:55:01	159.93	195.06	1.1906	17.541	5.91	-0.1308
M3B2_018_S1	12:04:28	71.12	104.77	0.6917	6.350	1.82	-0.0411
M3B2_018_S2	12:04:28	116.91	149.49	0.9215	10.637	3.54	-0.0778
M3B2_018_S3	12:04:28	160.99	194.85	1.1906	17.532	6.08	-0.1314
M3B2_019_S1	12:14:29	74.95	105.41	0.6916	6.277	1.80	-0.0408
M3B2_019_S2	12:14:29	117.33	149.28	0.9215	10.518	3.43	-0.0764
M3B2_019_S3	12:14:29	160.99	194.21	1.1906	17.472	5.82	-0.1298
M3B2_020_S1	12:24:31	69.84	104.77	0.6916	6.295	2.00	-0.0442
M3B2_020_S2	12:24:31	115.84	149.70	0.9215	10.586	3.74	-0.0780
M3B2_020_S3	12:24:31	161.63	194.43	1.1906	17.514	5.98	-0.1313

Table D32: Resistance Results – Wood Model – May 7**Results of Resistance Experiments**

Model: OCRE933 Test Date: 7-May-2015
 Description: Wooden Model Project: A1-006518
 Condition: Normal Finish

Tank: Towing Tank
 Avg Test Temperature: 15.6 °C

Run Designation	Time of Day	T1 (s)	T2 (s)	Carriage Speed (m/s)	Resistance (N)	Sinkage (mm)	Trim (deg)
M3B3_003_S1	13:52:56	83.47	182.50	0.9995	12.308	4.32	-0.0863
M3B3_004_S1	14:02:00	81.56	184.42	0.9994	12.438	4.22	-0.0846
M3B3_005_S1	14:15:44	71.12	103.92	0.6917	6.243	1.68	-0.0383
M3B3_005_S2	14:15:44	115.20	149.70	0.9215	10.566	3.58	-0.0709
M3B3_005_S3	14:15:44	158.65	194.85	1.1906	17.517	6.11	-0.1266
M3B3_006_S1	14:25:17	74.79	119.59	0.8441	8.999	3.04	-0.0593
M3B3_006_S2	14:25:17	135.95	179.39	1.2275	19.086	6.74	-0.1384
M3B3_007_S1	14:34:54	71.12	105.19	0.6917	6.258	2.09	-0.0374
M3B3_007_S2	14:34:54	114.99	149.70	0.9215	10.544	3.81	-0.0727
M3B3_007_S3	14:34:54	160.78	194.43	1.1906	17.446	6.22	-0.1273
M3B3_008_S1	14:45:33	71.97	104.98	0.6917	6.305	1.44	-0.0399
M3B3_008_S2	14:45:33	115.84	148.85	0.9215	10.604	3.42	-0.0714
M3B3_008_S3	14:45:33	160.56	194.43	1.1906	17.501	5.95	-0.1257
M3B3_009_S1	14:55:26	72.40	105.19	0.6917	6.263	1.67	-0.0393
M3B3_009_S2	14:55:26	116.06	149.49	0.9215	10.587	3.49	-0.0715
M3B3_009_S3	14:55:26	160.78	193.79	1.1906	17.357	5.94	-0.1255
M3B3_010_S1	15:05:30	72.82	104.98	0.6916	6.254	1.36	-0.0409
M3B3_010_S2	15:05:30	115.20	149.70	0.9215	10.530	3.28	-0.0718
M3B3_010_S3	15:05:30	162.27	193.36	1.1906	17.377	5.82	-0.1265
M3B3_011_S1	15:15:43	71.55	104.13	0.6917	6.299	1.87	-0.0375
M3B3_011_S2	15:15:43	116.69	149.06	0.9215	10.626	3.57	-0.0705
M3B3_011_S3	15:15:43	159.93	194.21	1.1906	17.425	5.92	-0.1252
M3B3_012_S1	15:25:29	72.19	105.19	0.6917	6.262	1.58	-0.0394
M3B3_012_S2	15:25:29	115.20	148.64	0.9215	10.568	3.74	-0.0718
M3B3_012_S3	15:25:29	161.20	195.49	1.1906	17.327	6.16	-0.1266
M3B3_013_S1	15:35:26	73.04	105.19	0.6917	6.274	1.33	-0.0400
M3B3_013_S2	15:35:26	114.99	148.43	0.9216	10.550	3.18	-0.0729
M3B3_013_S3	15:35:26	159.07	194.43	1.1906	17.343	5.78	-0.1255
M3B3_014_S1	15:45:41	73.04	105.62	0.6917	6.325	1.21	-0.0407
M3B3_014_S2	15:45:41	116.69	149.28	0.9215	10.624	3.41	-0.0713
M3B3_014_S3	15:45:41	162.06	194.00	1.1906	17.460	6.12	-0.1265

Run Designation	Time of Day	T1 (s)	T2 (s)	Carriage Speed (m/s)	Resistance (N)	Sinkage (mm)	Trim (deg)
M3B3_015_S1	15:56:16	72.19	105.19	0.6917	6.327	1.47	-0.0407
M3B3_015_S2	15:56:16	116.48	149.70	0.9215	10.652	3.36	-0.0711
M3B3_015_S3	15:56:16	160.14	194.43	1.1906	17.502	5.85	-0.1262
M3B3_016_S1	16:05:33	72.40	104.34	0.6917	6.370	1.51	-0.0404
M3B3_016_S2	16:05:33	116.91	149.49	0.9215	10.624	3.58	-0.0717
M3B3_016_S3	16:05:33	161.63	194.85	1.1906	17.449	6.04	-0.1256

Table D33: Resistance Results – Wood Model – May 12**Results of Resistance Experiments**

Model:	OCRE933	Test Date:	12-May-2015
Description:	Wooden Model	Project:	A1-006518
Condition:	Normal Finish		
Tank:	Towing Tank		
Avg Test Temperature:	15.6 °C		

Run Designation	Time of Day	T1 (s)	T2 (s)	Carriage Speed (m/s)	Resistance (N)	Sinkage (mm)	Trim (deg)
M3B4_001_S1	9:42:31	84.32	185.48	0.9995	12.242	4.34	-0.0873
M3B4_002_S1	9:53:08	77.30	185.27	0.9994	12.463	5.30	-0.0850
M3B4_003_S1	10:02:32	71.97	105.83	0.6915	6.335	2.78	-0.0384
M3B4_003_S2	10:02:32	115.63	148.64	0.9217	10.672	4.57	-0.0727
M3B4_003_S3	10:02:32	160.35	194.64	1.1906	17.565	7.19	-0.1282
M3B4_004_S1	10:12:26	70.69	104.77	0.7681	7.735	3.58	-0.0476
M3B4_004_S2	10:12:26	116.48	148.64	0.9994	12.449	5.33	-0.0864
M3B4_004_S3	10:12:26	158.86	190.81	1.1136	15.286	6.24	-0.1088
M3B4_005_S1	10:28:29	76.44	116.48	0.9595	11.488	5.12	-0.0807
M3B4_005_S2	10:28:29	133.73	170.57	1.3046	23.850	8.69	-0.1596
M3B4_006_S1	10:38:33	76.15	117.21	1.0750	14.241	6.14	-0.1036
M3B4_006_S2	10:38:33	131.35	169.51	1.2673	21.610	8.15	-0.1487
M3B4_007_S1	10:48:56	78.53	119.59	0.8441	9.083	4.15	-0.0596
M3B4_007_S2	10:48:56	134.41	178.71	1.2275	19.157	7.68	-0.1384
M3B4_008_S1	10:58:41	76.15	120.79	1.0367	13.188	5.56	-0.0932
M3B4_008_S2	10:58:41	132.37	176.67	1.1524	16.305	6.78	-0.1183
M3B4_009_S1	11:08:23	76.32	116.53	1.0751	14.171	5.86	-0.1009
M3B4_009_S2	11:08:23	126.75	167.47	1.2672	21.459	7.96	-0.1455
M3B4_010_S1	11:19:07	75.30	120.10	0.8442	9.093	3.88	-0.0598
M3B4_010_S2	11:19:07	134.07	178.71	1.2276	19.143	7.48	-0.1352
M3B4_011_S1	11:29:26	70.69	104.98	0.6915	6.334	2.67	-0.0398
M3B4_011_S2	11:29:26	116.69	149.49	0.9216	10.568	4.68	-0.0719
M3B4_011_S3	11:29:26	161.63	194.00	1.1906	17.499	7.27	-0.1290
M3B4_012_S1	11:39:26	71.76	105.41	0.6915	6.385	2.54	-0.0397
M3B4_012_S2	11:39:26	116.48	149.49	0.9216	10.643	4.36	-0.0727
M3B4_012_S3	11:39:26	162.06	194.64	1.1906	17.535	7.12	-0.1268
M3B4_013_S1	11:49:27	72.61	105.41	0.6915	6.345	2.67	-0.0394
M3B4_013_S2	11:49:27	116.69	148.00	0.9216	10.571	4.38	-0.0721
M3B4_013_S3	11:49:27	161.20	194.21	1.1906	17.409	6.92	-0.1252
M3B4_014_S1	11:59:32	72.40	103.49	0.6915	6.395	2.59	-0.0378
M3B4_014_S2	11:59:32	116.27	149.28	0.9216	10.628	4.57	-0.0720
M3B4_014_S3	11:59:32	161.42	194.64	1.1906	17.527	7.22	-0.1282

Run Designation	Time of Day	T1 (s)	T2 (s)	Carriage Speed (m/s)	Resistance (N)	Sinkage (mm)	Trim (deg)
M3B4_015_S1	12:09:24	72.61	104.77	0.6915	6.330	2.89	-0.0375
M3B4_015_S2	12:09:24	116.06	148.21	0.9216	10.609	4.66	-0.0710
M3B4_015_S3	12:09:24	161.84	193.79	1.1905	17.471	7.10	-0.1264
M3B4_016_S1	12:19:46	70.91	104.56	0.6915	6.296	2.67	-0.0370
M3B4_016_S2	12:19:46	116.48	150.13	0.9216	10.566	4.66	-0.0714
M3B4_016_S3	12:19:46	160.99	194.64	1.1906	17.382	7.26	-0.1290
M3B4_017_S1	12:30:20	70.48	105.19	0.6916	6.219	2.62	-0.0368
M3B4_017_S2	12:30:20	116.27	149.70	0.9216	10.503	4.53	-0.0725
M3B4_017_S3	12:30:20	160.78	193.79	1.1906	17.333	7.18	-0.1274
M3B4_018_S1	12:40:21	71.55	104.56	0.6915	6.331	2.39	-0.0427
M3B4_018_S2	12:40:21	116.06	150.13	0.9216	10.603	4.33	-0.0717
M3B4_018_S3	12:40:21	161.20	195.06	1.1906	17.476	6.92	-0.1256
M3B4_019_S1	12:53:22	71.76	102.43	0.6915	6.327	2.67	-0.0365
M3B4_019_S2	12:53:22	117.12	149.49	0.9216	10.600	4.35	-0.0724
M3B4_019_S3	12:53:22	160.99	194.21	1.1906	17.501	6.95	-0.1255
M3B4_020_S1	13:03:26	73.46	104.56	0.6916	6.442	2.70	-0.0365
M3B4_020_S2	13:03:26	116.91	148.85	0.9216	10.670	4.46	-0.0703
M3B4_020_S3	13:03:26	161.20	194.43	1.1906	17.560	6.92	-0.1264

Table D34: Standard Model – Large – May 15**Results of Resistance Experiments**

Model: OCRE916 Test Date: 15-May-2015
 Description: Standard Model Project: A1-006518
 Condition: Normal Finish

 Tank: Towing Tank
 Avg Test Temperature: 15.5 °C

Run Designation	Time of Day	T1 (s)	T2 (s)	Carriage Speed (m/s)	Resistance (N)	Sinkage (mm)	Trim (deg)
M916_001_S1	10:41:58	89.78	161.16	1.1952	33.087	6.11	0.0033
M916_002_S1	10:52:39	89.10	161.50	1.1952	33.341	6.29	0.0680
M916_003_S1	11:02:22	79.00	118.82	0.8271	16.406	2.76	0.0026
M916_003_S2	11:02:22	133.73	174.83	1.2398	35.551	6.86	0.0020
M916_003_S1	11:02:22	79.00	118.82	0.8271	16.406	2.76	0.0026
M916_003_S2	11:02:22	133.73	174.83	1.2398	35.551	6.86	0.0020
M916_004_S1	11:12:31	75.30	113.46	0.9186	20.420	3.22	0.0148
M916_004_S2	11:12:31	129.99	164.91	1.4707	52.658	9.56	-0.0392
M916_005_S1	11:24:01	75.81	114.14	1.0106	24.024	4.42	0.0157
M916_005_S2	11:24:01	128.11	164.06	1.4235	47.706	8.99	-0.0276
M916_006_S1	11:34:42	77.85	115.33	1.1033	28.393	5.48	0.0153
M916_006_S2	11:34:42	127.43	163.72	1.3779	44.493	8.40	-0.0189
M916_007_S1	11:44:40	79.27	116.53	1.1954	32.993	6.34	-0.0037
M916_007_S2	11:44:40	126.19	162.22	1.2867	38.039	7.28	-0.0089
M916_008_S1	11:56:02	76.66	113.97	1.1034	28.299	4.90	0.0125
M916_008_S2	11:56:02	125.04	163.55	1.3779	44.323	8.14	-0.0208
M916_009_S1	12:06:55	76.44	114.99	1.1033	28.538	5.41	0.0101
M916_009_S2	12:06:55	125.85	163.55	1.3779	44.357	8.36	-0.0222
M916_010_S1	12:16:42	76.15	115.16	1.1033	28.352	4.82	0.0100
M916_010_S2	12:16:42	125.73	163.89	1.3779	44.463	8.19	-0.0226
M916_011_S1	12:26:25	78.59	114.64	1.1033	28.478	4.85	0.0118
M916_011_S2	12:26:25	124.52	163.50	1.3779	44.370	8.02	-0.0221
M916_012_S1	12:36:55	78.53	115.16	1.1032	28.658	5.39	0.0481
M916_012_S2	12:36:55	127.43	163.72	1.3779	44.771	8.35	0.0142
M916_013_S1	12:46:08	76.15	113.63	1.1033	28.523	5.06	0.0400
M916_013_S2	12:46:08	126.24	163.89	1.3779	44.660	8.12	0.0057
M916_014_S1	12:56:32	76.49	115.50	1.1033	28.422	4.83	0.0403
M916_014_S2	12:56:32	126.24	163.21	1.3779	44.691	8.09	0.0052
M916_015_S1	13:07:22	75.64	115.16	1.1034	28.327	5.29	0.0142
M916_015_S2	13:07:22	126.58	163.38	1.3779	44.539	8.34	-0.0191

Run Designation	Time of Day	T1 (s)	T2 (s)	Carriage Speed (m/s)	Resistance (N)	Sinkage (mm)	Trim (deg)
M916_016_S1	13:16:44	78.19	115.16	1.1032	28.616	4.72	0.0392
M916_016_S2	13:16:44	127.26	163.55	1.3779	44.511	8.05	0.0057
M916_017_S1	13:26:33	77.85	114.48	1.1033	28.478	5.26	0.0133
M916_017_S2	13:26:33	126.41	163.38	1.3779	44.600	8.34	-0.0205

Appendix E – Model Resistance Coefficients

Table E35: Model Resistance Coefficients - TRUFOAM – April 21

Model:	OCRE931	Test Date:	21-Apr-2015
Description:	TRUFOAM Model	Project:	A1-006518
Condition:	Normal Finish		

Tank:	Towing Tank
Avg Test Temperature:	15.6 °C

using Scott's delta V Blockage Corrector

Fr	$10^{-6} Re_M$	$10^3 C_{TM15}$	$10^3 C_{FM15}$	Res15 (N)	$10^3 C_{R15}$
0.144	4.349	4.210	3.486	12.145	0.724
0.144	4.349	4.237	3.486	12.221	0.751
0.099	3.010	4.497	3.739	6.211	0.757
0.132	4.010	4.297	3.540	10.538	0.758
0.171	5.181	4.340	3.375	17.759	0.965
0.110	3.344	4.438	3.664	7.568	0.774
0.144	4.349	4.223	3.486	12.178	0.737
0.160	4.846	4.211	3.416	15.076	0.794
0.138	4.176	4.267	3.513	11.344	0.754
0.188	5.676	4.847	3.318	23.813	1.529
0.155	4.678	4.214	3.439	14.059	0.775
0.182	5.514	4.676	3.336	21.680	1.340
0.121	3.673	4.346	3.599	8.940	0.747
0.176	5.341	4.441	3.356	19.317	1.085
0.149	4.511	4.218	3.462	13.086	0.756
0.166	5.014	4.240	3.395	16.255	0.845
0.155	4.678	4.219	3.439	14.077	0.780
0.182	5.514	4.677	3.336	21.686	1.341
0.121	3.673	4.362	3.599	8.974	0.763
0.176	5.341	4.445	3.356	19.332	1.089
0.099	3.010	4.524	3.739	6.249	0.785
0.132	4.011	4.309	3.539	10.567	0.769
0.171	5.181	4.329	3.374	17.718	0.955
0.099	3.010	4.471	3.739	6.174	0.731
0.132	4.010	4.270	3.540	10.471	0.731
0.171	5.181	4.307	3.375	17.625	0.932
0.099	3.010	4.505	3.739	6.223	0.766
0.132	4.010	4.286	3.540	10.510	0.747
0.171	5.181	4.310	3.375	17.637	0.935
0.099	3.010	4.551	3.739	6.286	0.812
0.132	4.011	4.291	3.539	10.523	0.751
0.171	5.181	4.300	3.375	17.597	0.926

Fr	10^{-6} Re_M	$10^3 \text{ C}_{\text{TM}15}$	$10^3 \text{ C}_{\text{FM}15}$	Res15 (N)	$10^3 \text{ C}_{\text{R}15}$
0.099	3.010	4.466	3.739	6.168	0.727
0.132	4.010	4.258	3.540	10.442	0.719
0.171	5.180	4.293	3.375	17.568	0.919
0.099	3.010	4.516	3.739	6.237	0.777
0.132	4.010	4.293	3.540	10.526	0.753
0.171	5.181	4.316	3.375	17.661	0.941
0.099	3.010	4.459	3.739	6.159	0.719
0.132	4.010	4.260	3.540	10.443	0.720
0.171	5.181	4.280	3.375	17.513	0.905
0.099	3.010	4.481	3.739	6.189	0.742
0.132	4.011	4.273	3.539	10.480	0.734
0.171	5.181	4.308	3.374	17.630	0.933
0.099	3.010	4.542	3.739	6.274	0.802
0.132	4.011	4.299	3.539	10.543	0.760
0.171	5.181	4.309	3.374	17.634	0.934
0.099	3.010	4.415	3.739	6.099	0.676
0.132	4.010	4.259	3.540	10.444	0.720
0.171	5.181	4.304	3.374	17.614	0.929
0.099	3.010	4.543	3.739	6.274	0.804
0.132	4.010	4.298	3.540	10.541	0.759
0.182	5.514	4.687	3.336	21.728	1.351
Statistics for Repeat Runs					
0.099	Mean	4.4974		6.212	0.758
	StDev	0.0408		0.056	0.041
	Min	4.4150		6.099	0.676
	Max	4.5513		6.286	0.812
	Precision (2sd/mean)	1.82%		1.81%	10.77%
0.132	Mean	4.2828		10.502	0.743
	StDev	0.0179		0.044	0.018
	Min	4.2581		10.442	0.719
	Max	4.3089		10.567	0.769
	Precision (2sd/mean)	0.84%		0.85%	4.82%
0.171	Mean	4.3087		17.632	0.934
	StDev	0.0162		0.067	0.016
	Min	4.2795		17.513	0.905
	Max	4.3400		17.759	0.965
	Precision (2sd/mean)	0.75%		0.76%	3.48%

Table E36: Model Resistance Coefficients – TRUFOAM – April 22**Model Resistance Coefficients**

Model:	OCRE931	Test Date:	22-Apr-2015
Description:	TRUFOAM Model	Project:	A1-006518
	Normal		
Condition:	Finish		
Tank:	Towing Tank		
Avg Test Temperature:	15.6 °C		

using Scott's delta V Blockage Corrector

Fr	$10^{-6} Re_M$	$10^3 C_{TM15}$	$10^3 C_{FM15}$	Res15 (N)	$10^3 C_{R15}$
0.144	4.350	4.193	3.486	12.097	0.708
0.144	4.349	4.232	3.486	12.206	0.746
0.099	3.010	4.527	3.739	6.253	0.788
0.132	4.010	4.260	3.540	10.445	0.720
0.171	5.181	4.311	3.374	17.644	0.937
0.110	3.344	4.418	3.664	7.533	0.754
0.144	4.349	4.203	3.486	12.120	0.717
0.160	4.846	4.198	3.416	15.030	0.781
0.138	4.176	4.273	3.513	11.359	0.760
0.188	5.676	4.849	3.318	23.823	1.531
0.155	4.678	4.201	3.439	14.015	0.762
0.182	5.514	4.661	3.336	21.604	1.325
0.121	3.673	4.337	3.599	8.921	0.738
0.176	5.341	4.429	3.356	19.267	1.073
0.149	4.511	4.222	3.462	13.100	0.760
0.166	5.014	4.232	3.395	16.223	0.837
0.155	4.678	4.207	3.439	14.036	0.768
0.182	5.514	4.648	3.336	21.545	1.312
0.121	3.673	4.279	3.599	8.802	0.680
0.176	5.341	4.386	3.356	19.078	1.030
0.099	3.010	4.529	3.739	6.256	0.790
0.132	4.010	4.273	3.540	10.479	0.734
0.171	5.181	4.295	3.375	17.575	0.920
0.099	3.010	4.451	3.739	6.148	0.712
0.132	4.011	4.242	3.539	10.404	0.702
0.171	5.181	4.281	3.374	17.522	0.907
0.099	3.010	4.456	3.739	6.154	0.716
0.132	4.010	4.250	3.540	10.421	0.711
0.171	5.181	4.270	3.375	17.475	0.896

Fr	10^{-6} Re_M	10^3 C_{TM15}	10^3 C_{FM15}	Res15 (N)	10^3 C_{R15}
0.099	3.010	4.401	3.739	6.080	0.662
0.132	4.011	4.224	3.539	10.360	0.685
0.171	5.181	4.260	3.374	17.435	0.886
0.099	3.010	4.508	3.739	6.226	0.768
0.132	4.010	4.285	3.540	10.506	0.745
0.171	5.181	4.281	3.375	17.518	0.906
0.099	3.010	4.442	3.739	6.137	0.703
0.132	4.010	4.252	3.540	10.428	0.713
0.171	5.181	4.262	3.374	17.443	0.888
0.099	3.010	4.499	3.739	6.215	0.760
0.132	4.010	4.256	3.540	10.434	0.716
0.171	5.181	4.273	3.375	17.488	0.899
0.099	3.010	4.470	3.739	6.174	0.731
0.132	4.010	4.269	3.540	10.467	0.729
0.171	5.181	4.283	3.375	17.527	0.908
0.099	3.010	4.494	3.739	6.208	0.755
0.132	4.010	4.241	3.540	10.399	0.701
0.171	5.181	4.272	3.374	17.485	0.898
0.099	3.010	4.474	3.739	6.181	0.735
0.132	4.010	4.253	3.540	10.429	0.713
0.171	5.181	4.260	3.374	17.436	0.886
Statistics for Repeat Runs					
0.099	Mean	4.4725		6.178	0.733
	StDev	0.0370		0.051	0.037
	Min	4.4015		6.080	0.662
	Max	4.5293		6.256	0.790
	Precision (2sd/mean)	1.66%		1.65%	10.09%
0.132	Mean	4.2544		10.433	0.715
	StDev	0.0176		0.042	0.018
	Min	4.2241		10.360	0.685
	Max	4.2849		10.506	0.745
	Precision (2sd/mean)	0.83%		0.81%	4.91%
0.171	Mean	4.2738		17.490	0.899
	StDev	0.0113		0.046	0.011
	Min	4.2602		17.435	0.886
	Max	4.2949		17.575	0.920
	Precision (2sd/mean)	0.53%		0.52%	2.51%

Table E37: Model Resistance Coefficients - Standard – April 23

Model Resistance Coefficients

Model: OCRE930 Test Date: 23-Apr-2015
 Description: Standard Model Project: A1-006518
 Condition: Normal Finish

Tank: Towing Tank
 Avg Test Temperature: 15.6 °C

using Scott's delta V Blockage Corrector

Fr	$10^{-6} Re_M$	$10^3 C_{TM15}$	$10^3 C_{FM15}$	Res15 (N)	$10^3 C_{R15}$
0.144	4.349	4.206	3.486	12.131	0.720
0.144	4.349	4.210	3.486	12.142	0.724
0.099	3.010	4.435	3.739	6.126	0.696
0.132	4.010	4.253	3.540	10.428	0.713
0.171	5.181	4.238	3.374	17.343	0.863
0.110	3.344	4.360	3.664	7.434	0.696
0.144	4.349	4.201	3.486	12.116	0.715
0.160	4.846	4.174	3.416	14.946	0.758
0.138	4.176	4.234	3.513	11.256	0.721
0.188	5.676	4.767	3.318	23.417	1.449
0.155	4.678	4.186	3.439	13.967	0.748
0.182	5.514	4.612	3.336	21.380	1.276
0.121	3.673	4.298	3.599	8.842	0.699
0.176	5.341	4.348	3.356	18.916	0.993
0.149	4.511	4.193	3.462	13.009	0.730
0.166	5.014	4.207	3.395	16.128	0.812
0.155	4.678	4.196	3.439	13.998	0.757
0.182	5.514	4.588	3.336	21.269	1.252
0.121	3.673	4.284	3.599	8.814	0.685
0.176	5.341	4.346	3.356	18.903	0.990
0.099	3.010	4.408	3.739	6.088	0.668
0.132	4.010	4.225	3.540	10.361	0.685
0.171	5.181	4.208	3.374	17.223	0.834
0.099	3.010	4.403	3.739	6.081	0.664
0.132	4.010	4.249	3.540	10.418	0.709
0.171	5.181	4.210	3.374	17.228	0.835
0.099	3.010	4.430	3.739	6.119	0.691
0.132	4.010	4.243	3.540	10.404	0.703
0.171	5.181	4.217	3.374	17.257	0.842

Fr	$10^{-6} Re_M$	$10^3 C_{TM15}$	$10^3 C_{FM15}$	Res15	$10^3 C_{R15}$
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				(N)	
0.099	3.010	4.434	3.739	6.124	0.694
0.132	4.010	4.244	3.540	10.405	0.704
0.171	5.181	4.220	3.374	17.269	0.845
0.099	3.010	4.442	3.739	6.137	0.703
0.132	4.010	4.235	3.540	10.383	0.695
0.171	5.181	4.208	3.374	17.221	0.833
0.099	3.010	4.426	3.739	6.114	0.687
0.132	4.010	4.240	3.540	10.395	0.700
0.171	5.181	4.212	3.374	17.238	0.838
0.099	3.010	4.449	3.739	6.144	0.709
0.132	4.010	4.224	3.540	10.356	0.684
0.171	5.181	4.209	3.375	17.226	0.835
0.099	3.010	4.408	3.739	6.088	0.668
0.132	4.010	4.236	3.540	10.387	0.696
0.171	5.181	4.210	3.375	17.229	0.836
0.099	3.010	4.444	3.739	6.138	0.705
0.132	4.010	4.241	3.540	10.398	0.701
0.171	5.181	4.214	3.374	17.247	0.840
0.099	3.010	4.422	3.739	6.107	0.682
0.132	4.010	4.234	3.540	10.382	0.695
0.171	5.181	4.206	3.374	17.212	0.831

Statistics for Repeat Runs

0.099	Mean	4.4273	6.115	0.688
	StDev	0.0157	0.022	0.016
	Min	4.4030	6.081	0.664
	Max	4.4485	6.144	0.709
	Precision (2sd/mean)	0.71%	0.72%	4.57%
0.132	Mean	4.2384	10.393	0.699
	StDev	0.0090	0.022	0.009
	Min	4.2238	10.356	0.684
	Max	4.2530	10.428	0.713
	Precision (2sd/mean)	0.43%	0.42%	2.58%
0.171	Mean	4.2138	17.245	0.839
	StDev	0.0090	0.037	0.009
	Min	4.2056	17.212	0.831
	Max	4.2378	17.343	0.863
	Precision (2sd/mean)	0.43%	0.43%	2.14%

Table E38: Model Resistance Coefficients – Standard – April 24**Model Resistance Coefficients**

Model:	OCRE930	Test Date:	24-Apr-2015
Description:	Standard Model	Project:	A1-006518
Condition:	Normal Finish		

Tank:	Towing Tank
Avg Test Temperature:	15.6 °C

using Scott's delta V Blockage Corrector

Fr	$10^{-6} Re_M$	$10^3 C_{TM15}$	$10^3 C_{FM15}$	Res15 (N)	$10^3 C_{R15}$
0.144	4.349	4.201	3.486	12.115	0.715
0.144	4.349	4.184	3.486	12.067	0.698
0.099	3.010	4.437	3.739	6.129	0.697
0.132	4.011	4.227	3.539	10.367	0.688
0.171	5.181	4.265	3.374	17.455	0.890
0.171	5.181	4.275	3.374	17.499	0.901
0.110	3.344	4.374	3.664	7.456	0.710
0.144	4.349	4.195	3.486	12.097	0.709
0.160	4.846	4.161	3.416	14.899	0.745
0.138	4.176	4.239	3.513	11.272	0.727
0.188	5.677	4.808	3.318	23.624	1.490
0.155	4.678	4.167	3.439	13.904	0.729
0.182	5.514	4.626	3.336	21.442	1.290
0.121	3.673	4.273	3.599	8.790	0.674
0.176	5.341	4.395	3.356	19.117	1.039
0.149	4.511	4.195	3.462	13.016	0.733
0.166	5.014	4.191	3.395	16.064	0.796
0.155	4.678	4.168	3.439	13.903	0.729
0.182	5.514	4.617	3.336	21.403	1.281
0.121	3.673	4.288	3.599	8.821	0.689
0.176	5.341	4.379	3.356	19.047	1.023
0.099	3.010	4.462	3.739	6.164	0.723
0.132	4.011	4.226	3.539	10.366	0.687
0.182	5.514	4.588	3.336	21.269	1.251
0.099	3.010	4.416	3.739	6.099	0.677
0.132	4.010	4.232	3.540	10.377	0.693
0.182	5.514	4.598	3.336	21.316	1.262
0.099	3.010	4.445	3.739	6.140	0.705
0.132	4.010	4.226	3.540	10.363	0.687
0.182	5.514	4.588	3.336	21.269	1.252

Fr	10^{-6} Re_M	10^3 C_{TM15}	10^3 C_{FM15}	Res15 (N)	10^3 C_{R15}
0.099	3.010	4.381	3.739	6.052	0.641
0.132	4.010	4.220	3.540	10.347	0.680
0.182	5.514	4.587	3.336	21.268	1.251
0.099	3.010	4.438	3.739	6.129	0.698
0.132	4.011	4.245	3.539	10.411	0.706
0.182	5.514	4.580	3.336	21.235	1.244
0.099	3.010	4.435	3.739	6.126	0.696
0.132	4.010	4.246	3.540	10.413	0.707
0.182	5.514	4.593	3.336	21.293	1.257
0.099	3.010	4.433	3.739	6.122	0.693
0.132	4.010	4.235	3.540	10.383	0.695
0.182	5.514	4.594	3.336	21.299	1.258
0.099	3.010	4.452	3.739	6.150	0.713
0.132	4.010	4.241	3.540	10.400	0.702
0.182	5.514	4.602	3.336	21.333	1.266
0.099	3.010	4.435	3.739	6.126	0.696
0.132	4.010	4.257	3.540	10.440	0.718
0.182	5.514	4.604	3.336	21.345	1.268
0.099	3.010	4.426	3.739	6.112	0.686
0.132	4.010	4.236	3.540	10.388	0.697
0.182	5.514	4.583	3.336	21.249	1.247
Statistics for Repeat Runs					
0.099	Mean	4.432		6.122	0.693
	StDev	0.0223		0.031	0.022
	Min	4.3806		6.052	0.641
	Max	4.4620		6.164	0.723
	Precision (2sd/mean)	1.00%		1.00%	6.42%
0.132	Mean	4.2365		10.389	0.697
	StDev	0.0113		0.028	0.011
	Min	4.2196		10.347	0.680
	Max	4.2575		10.440	0.718
	Precision (2sd/mean)	0.53%		0.53%	3.24%
0.182	Mean	4.5918		21.288	1.256
	StDev	0.0079		0.036	0.008
	Min	4.5804		21.235	1.244
	Max	4.6040		21.345	1.268
	Precision (2sd/mean)	0.34%		0.34%	1.26%

Table E39: Model Resistance Coefficients – Standard – April 27 (set 1)**Model Resistance Coefficients**

Model:	OCRE930	Test Date:	27-Apr-2015
Description:	Standard Model	Project:	A1-006518
Condition:	Normal Finish		
Tank:	Towing Tank		
Avg Test Temperature:	15.6 °C		

using Scott's delta V Blockage Corrector

Fr	$10^{-6} Re_M$	$10^3 C_{TM15}$	$10^3 C_{FM15}$	Res15 (N)	$10^3 C_{R15}$
0.144	4.350	4.232	3.486	12.209	0.746
0.144	4.350	4.247	3.486	12.251	0.761
0.099	3.010	4.560	3.739	6.299	0.821
0.132	4.011	4.318	3.539	10.590	0.779
0.171	5.181	4.272	3.374	17.485	0.898
0.099	3.010	4.607	3.739	6.364	0.868
0.132	4.011	4.312	3.539	10.576	0.773
0.171	5.181	4.278	3.374	17.511	0.904
0.099	3.010	4.613	3.739	6.372	0.874
0.132	4.010	4.359	3.540	10.688	0.819
0.171	5.181	4.288	3.374	17.547	0.913
0.099	3.010	4.584	3.739	6.332	0.845
0.132	4.010	4.313	3.540	10.577	0.774
0.171	5.181	4.268	3.374	17.466	0.893
0.099	3.010	4.612	3.739	6.372	0.873
0.132	4.010	4.323	3.540	10.600	0.783
0.171	5.181	4.271	3.374	17.481	0.897
0.099	3.010	4.642	3.739	6.413	0.903
0.132	4.010	4.339	3.540	10.640	0.800
0.171	5.181	4.281	3.374	17.519	0.906
0.099	3.010	4.629	3.739	6.395	0.890
0.132	4.011	4.339	3.539	10.642	0.799
0.171	5.181	4.281	3.374	17.522	0.907
0.099	3.010	4.713	3.739	6.511	0.974
0.132	4.010	4.407	3.540	10.807	0.867
0.171	5.181	4.300	3.374	17.599	0.925
0.099	3.010	4.766	3.739	6.584	1.027
0.132	4.011	4.424	3.539	10.849	0.884
0.171	5.181	4.316	3.374	17.664	0.941

Fr	10^{-6} Re_M	$10^3 \text{ C}_{\text{TM}15}$	$10^3 \text{ C}_{\text{FM}15}$	Res15 (N)	$10^3 \text{ C}_{\text{R}15}$
0.099	3.010	4.720	3.739	6.521	0.981
0.132	4.011	4.401	3.539	10.793	0.861
0.171	5.181	4.309	3.374	17.635	0.935

Statistics for Repeat Runs

0.099	Mean	4.6447	6.4163	0.9054
	StDev	0.0663	0.0920	0.0664
	Min	4.5604	6.2988	0.8212
	Max	4.7658	6.5844	1.0266
	Precision (2sd/mean)	2.86%	2.87%	14.66%
0.132	Mean	4.3535	10.6762	0.8140
	StDev	0.0421	0.1035	0.0421
	Min	4.3125	10.5763	0.7730
	Max	4.4238	10.8492	0.8843
	Precision (2sd/mean)	1.94%	1.94%	10.35%
0.171	Mean	4.2863	17.5429	0.9119
	StDev	0.0165	0.0679	0.0165
	Min	4.2677	17.4662	0.8933
	Max	4.3156	17.6636	0.9412
	Precision (2sd/mean)	0.77%	0.77%	3.62%

Table E40: Model Resistance Coefficients - Standard – April 27 (set 2)**Model Resistance Coefficients**

Model:	OCRE930	Test Date:	27-Apr-2015
Description:	Standard Model	Project:	A1-006518
Condition:	Normal Finish		

Tank:	Towing Tank
Avg Test Temperature:	15.6 °C

using Scott's delta V Blockage Corrector

Fr	$10^{-6} Re_M$	$10^3 C_{TM15}$	$10^3 C_{FM15}$	Res15 (N)	$10^3 C_{R15}$
0.144	4.350	4.232	3.486	12.208	0.746
0.144	4.350	4.290	3.486	12.373	0.804
0.099	3.010	4.597	3.739	6.351	0.858
0.132	4.011	4.329	3.539	10.618	0.790
0.171	5.181	4.276	3.374	17.500	0.901
0.099	3.010	4.602	3.739	6.357	0.863
0.132	4.011	4.349	3.539	10.665	0.809
0.171	5.181	4.283	3.374	17.530	0.909
0.099	3.010	4.620	3.739	6.380	0.880
0.132	4.010	4.344	3.540	10.653	0.805
0.171	5.181	4.275	3.374	17.497	0.901
0.099	3.010	4.631	3.739	6.397	0.891
0.132	4.010	4.360	3.540	10.691	0.820
0.171	5.181	4.282	3.374	17.523	0.907
0.099	3.010	4.677	3.739	6.460	0.937
0.132	4.011	4.360	3.539	10.692	0.820
0.171	5.181	4.279	3.374	17.515	0.905
0.099	3.010	4.598	3.739	6.351	0.858
0.132	4.011	4.337	3.539	10.637	0.797
0.171	5.181	4.271	3.374	17.478	0.896
0.099	3.010	4.578	3.739	6.324	0.839
0.132	4.011	4.312	3.539	10.576	0.773
0.171	5.181	4.241	3.374	17.358	0.866
0.099	3.010	4.681	3.739	6.466	0.942
0.132	4.011	4.383	3.539	10.749	0.843
0.171	5.181	4.272	3.374	17.486	0.898
0.099	3.010	4.522	3.739	6.246	0.782
0.132	4.011	4.288	3.539	10.516	0.748
0.171	5.181	4.238	3.374	17.344	0.863

Fr	10^{-6} Re_M	10^3 C_{TM15}	10^3 C_{FM15}	Res15 (N)	10^3 C_{R15}
0.099	3.010	4.605	3.739	6.361	0.866
0.132	4.011	4.333	3.539	10.625	0.793
0.171	5.181	4.264	3.374	17.451	0.889

Statistics for Repeat Runs

0.099	Mean	4.6110	6.369	0.872
	StDev	0.0462	0.064	0.046
	Min	4.5218	6.246	0.782
	Max	4.6813	6.466	0.942
	Precision (2sd/mean)	2.01%	2.00%	10.60%
0.132	Mean	4.3395	10.642	0.800
	StDev	0.0266	0.065	0.027
	Min	4.2879	10.516	0.748
	Max	4.3829	10.749	0.843
	Precision (2sd/mean)	1.23%	1.22%	6.65%
0.171	Mean	4.2680	17.468	0.894
	StDev	0.0162	0.066	0.016
	Min	4.2376	17.344	0.863
	Max	4.2833	17.530	0.909
	Precision (2sd/mean)	0.76%	0.76%	3.62%

Table E41: Model Resistance Coefficients – Wooden Model – May 5**Model Resistance Coefficients**

Model:	OCRE933	Test Date:	5-May-2015
Description:	Wooden Model	Project:	A1-006518
Condition:	Normal Finish		

Tank:	Towing Tank
Avg Test Temperature:	15.6 °C

using Scott's delta V Blockage Corrector

Fr	$10^{-6} Re_M$	$10^3 C_{TM15}$	$10^3 C_{FM15}$	Res15 (N)	$10^3 C_{R15}$
0.144	4.349	4.246	3.486	12.248	0.760
0.144	4.349	4.262	3.486	12.292	0.776
0.099	3.010	4.527	3.739	6.253	0.788
0.132	4.010	4.303	3.540	10.553	0.764
0.171	5.181	4.265	3.374	17.456	0.890
0.110	3.344	4.511	3.664	7.692	0.847
0.144	4.349	4.269	3.486	12.310	0.783
0.160	4.846	4.220	3.416	15.108	0.803
0.138	4.176	4.323	3.513	11.495	0.810
0.188	5.676	4.810	3.318	23.628	1.491
0.155	4.678	4.254	3.439	14.196	0.816
0.182	5.514	4.623	3.336	21.436	1.287
0.121	3.673	4.412	3.599	9.077	0.813
0.176	5.341	4.380	3.356	19.053	1.024
0.149	4.511	4.271	3.462	13.253	0.809
0.166	5.015	4.248	3.395	16.288	0.854
0.155	4.678	4.234	3.439	14.124	0.795
0.182	5.514	4.604	3.336	21.347	1.268
0.121	3.673	4.428	3.599	9.109	0.829
0.176	5.342	4.396	3.356	19.124	1.041
0.099	3.010	4.624	3.739	6.388	0.884
0.132	4.011	4.351	3.539	10.672	0.812
0.171	5.181	4.266	3.374	17.459	0.891
0.099	3.010	4.577	3.739	6.321	0.837
0.132	4.010	4.319	3.540	10.592	0.780
0.171	5.181	4.269	3.374	17.470	0.894
0.099	3.010	4.671	3.739	6.452	0.932
0.132	4.010	4.345	3.540	10.656	0.806
0.171	5.181	4.289	3.374	17.551	0.914

Fr	$10^{-6} Re_M$	$10^3 C_{TM15}$	$10^3 C_{FM15}$	Res15	$10^3 C_{R15}$
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				(N)	
0.099	3.010	4.640	3.739	6.411	0.901
0.132	4.010	4.323	3.540	10.601	0.784
0.171	5.181	4.270	3.374	17.476	0.896
0.099	3.010	4.558	3.739	6.296	0.819
0.132	4.010	4.330	3.540	10.617	0.790
0.171	5.181	4.261	3.374	17.436	0.886
0.099	3.010	4.573	3.739	6.317	0.834
0.132	4.010	4.301	3.540	10.547	0.762
0.171	5.181	4.253	3.374	17.406	0.879
0.099	3.010	4.568	3.739	6.310	0.829
0.132	4.010	4.332	3.540	10.624	0.793
0.171	5.181	4.282	3.374	17.525	0.908
0.099	3.010	4.726	3.739	6.529	0.987
0.132	4.010	4.399	3.540	10.788	0.860
0.171	5.181	4.320	3.374	17.681	0.946
0.099	3.010	4.603	3.739	6.358	0.864
0.132	4.010	4.342	3.540	10.647	0.803
0.171	5.181	4.280	3.374	17.519	0.906
0.099	3.010	4.616	3.739	6.377	0.877
0.132	4.010	4.340	3.540	10.641	0.800
0.171	5.181	4.287	3.374	17.543	0.912

Statistics for Repeat Runs

0.099	Mean	4.6075	6.365	0.868
	StDev	0.0567	0.079	0.057
	Min	4.5268	6.253	0.788
	Max	4.7262	6.529	0.987
	Precision (2sd/mean)	2.46%	2.47%	13.07%
0.132	Mean	4.3352	10.631	0.796
	StDev	0.0267	0.066	0.027
	Min	4.3012	10.547	0.762
	Max	4.3992	10.788	0.860
	Precision (2sd/mean)	1.23%	1.23%	6.72%
0.171	Mean	4.2765	17.502	0.902
	StDev	0.0183	0.075	0.018
	Min	4.2530	17.406	0.879
	Max	4.3200	17.681	0.946
	Precision (2sd/mean)	0.85%	0.85%	4.05%

Table E42: Model Resistance Coefficients – Wooden Model – May 6**Model Resistance Coefficients**

Model:	OCRE933	Test Date:	6-May-2015
Description:	Wooden Model	Project:	A1-006518
Condition:	Normal Finish		

Tank:	Towing Tank
Avg Test Temperature:	15.6 °C

using Scott's delta V Blockage Corrector

Fr	$10^{-6} Re_M$	$10^3 C_{TM15}$	$10^3 C_{FM15}$	Res15 (N)	$10^3 C_{R15}$
0.144	4.349	4.240	3.486	12.228	0.754
0.144	4.349	4.250	3.486	12.259	0.764
0.099	3.010	4.627	3.739	6.391	0.888
0.132	4.010	4.369	3.540	10.715	0.830
0.171	5.181	4.330	3.374	17.719	0.955
0.110	3.344	4.484	3.664	7.646	0.820
0.144	4.349	4.272	3.486	12.321	0.786
0.160	4.846	4.239	3.416	15.181	0.823
0.138	4.176	4.331	3.513	11.516	0.819
0.188	5.676	4.833	3.318	23.742	1.515
0.155	4.678	4.224	3.439	14.092	0.785
0.182	5.514	4.625	3.336	21.441	1.289
0.121	3.673	4.353	3.599	8.954	0.754
0.176	5.342	4.381	3.356	19.061	1.026
0.149	4.511	4.272	3.462	13.256	0.810
0.166	5.014	4.273	3.395	16.382	0.878
0.155	4.678	4.243	3.439	14.158	0.804
0.182	5.514	4.637	3.336	21.495	1.300
0.121	3.673	4.515	3.599	9.287	0.916
0.176	5.341	4.450	3.356	19.358	1.095
0.099	3.010	4.545	3.739	6.279	0.806
0.132	4.010	4.330	3.540	10.616	0.790
0.171	5.181	4.280	3.374	17.518	0.906
0.099	3.010	4.568	3.739	6.309	0.828
0.132	4.010	4.319	3.540	10.590	0.780
0.171	5.181	4.259	3.375	17.430	0.885
0.099	3.010	4.539	3.739	6.269	0.799
0.132	4.010	4.304	3.540	10.553	0.764
0.171	5.181	4.254	3.375	17.409	0.880
Fr	$10^{-6} Re_M$	$10^3 C_{TM15}$	$10^3 C_{FM15}$	Res15	$10^3 C_{R15}$

				(N)	
0.099	3.010	4.575	3.739	6.320	0.836
0.132	4.011	4.324	3.539	10.604	0.784
0.171	5.181	4.273	3.374	17.486	0.898
0.099	3.010	4.579	3.739	6.325	0.840
0.132	4.010	4.307	3.540	10.561	0.768
0.171	5.181	4.267	3.374	17.463	0.892
0.099	3.010	4.572	3.739	6.315	0.833
0.132	4.010	4.315	3.540	10.581	0.776
0.171	5.181	4.270	3.374	17.477	0.896
0.099	3.010	4.623	3.739	6.385	0.883
0.132	4.010	4.348	3.540	10.662	0.809
0.171	5.181	4.292	3.374	17.568	0.918
0.099	3.010	4.605	3.739	6.361	0.865
0.132	4.010	4.345	3.540	10.655	0.806
0.171	5.181	4.290	3.374	17.559	0.916
0.099	3.010	4.552	3.739	6.288	0.813
0.132	4.010	4.297	3.540	10.535	0.757
0.171	5.181	4.276	3.374	17.500	0.901
0.099	3.010	4.565	3.739	6.306	0.826
0.132	4.010	4.325	3.540	10.603	0.785
0.171	5.181	4.286	3.374	17.541	0.912

Statistics for Repeat Runs

0.099	Mean	4.5723	6.316	0.833
	StDev	0.0258	0.036	0.026
	Min	4.5387	6.269	0.799
	Max	4.6226	6.385	0.883
	Precision (2sd/mean)	1.13%	1.13%	6.19%
0.132	Mean	4.3214	10.596	0.782
	StDev	0.0168	0.041	0.017
	Min	4.2967	10.535	0.757
	Max	4.3485	10.662	0.809
	Precision (2sd/mean)	0.78%	0.78%	4.30%
0.171	Mean	4.2749	17.495	0.900
	StDev	0.0128	0.053	0.013
	Min	4.2542	17.409	0.880
	Max	4.2925	17.568	0.918
	Precision (2sd/mean)	0.60%	0.61%	2.84%

Table E43: Model Resistance Coefficients – Wooden Model – May 7**Model Resistance Coefficients**

Model:	OCRE933	Test Date:	7-May-2015
Description:	Wooden Model	Project:	A1-006518
Condition:	Normal Finish		
Tank:	Towing Tank		
Avg Test Temperature:	15.6 °C		

Fr	$10^{-6} Re_M$	$10^3 C_{TM15}$	$10^3 C_{FM15}$	Res15 (N)	$10^3 C_{R15}$
0.144	4.350	4.274	3.486	12.328	0.788
0.144	4.349	4.320	3.486	12.459	0.834
0.099	3.010	4.526	3.739	6.253	0.787
0.132	4.010	4.316	3.540	10.584	0.777
0.171	5.181	4.287	3.374	17.544	0.912
0.121	3.673	4.382	3.599	9.014	0.783
0.176	5.341	4.394	3.356	19.115	1.039
0.099	3.010	4.537	3.739	6.269	0.798
0.132	4.010	4.307	3.540	10.562	0.767
0.171	5.181	4.270	3.374	17.473	0.895
0.099	3.010	4.571	3.739	6.315	0.832
0.132	4.010	4.332	3.540	10.621	0.792
0.171	5.181	4.283	3.374	17.529	0.908
0.099	3.010	4.541	3.739	6.273	0.802
0.132	4.010	4.325	3.540	10.605	0.786
0.171	5.181	4.248	3.374	17.385	0.873
0.099	3.010	4.536	3.739	6.265	0.796
0.132	4.010	4.301	3.540	10.547	0.762
0.171	5.181	4.253	3.374	17.404	0.878
0.099	3.010	4.567	3.739	6.310	0.828
0.132	4.010	4.341	3.540	10.643	0.801
0.171	5.181	4.264	3.374	17.453	0.890
0.099	3.010	4.541	3.739	6.273	0.801
0.132	4.010	4.317	3.540	10.586	0.778
0.171	5.181	4.240	3.374	17.354	0.866
0.099	3.010	4.549	3.739	6.285	0.810
0.132	4.010	4.309	3.540	10.567	0.770
0.171	5.181	4.244	3.374	17.370	0.870
0.099	3.010	4.586	3.739	6.335	0.846
0.132	4.010	4.340	3.540	10.641	0.800
0.171	5.181	4.273	3.374	17.488	0.898

Fr	10^{-6} Re_M	10^3 C_{TM15}	10^3 C_{FM15}	Res15 (N)	10^3 C_{R15}
0.099	3.010	4.587	3.739	6.337	0.848
0.132	4.010	4.352	3.540	10.670	0.812
0.171	5.181	4.283	3.374	17.529	0.909
0.099	3.010	4.619	3.739	6.381	0.880
0.132	4.010	4.340	3.540	10.641	0.801
0.171	5.181	4.270	3.374	17.477	0.896

Statistics for Repeat Runs					
0.099	Mean	4.5601	6.230	0.8209	
	StDev	0.0286	0.039	0.0286	
	Min	4.5263	6.253	0.7871	
	Max	4.6192	6.381	0.8799	
	Precision (2sd/mean)	1.25%	1.25%	6.96%	
0.132	Mean	4.3255	10.606	0.7860	
	StDev	0.0165	0.040	0.0164	
	Min	4.3015	10.547	0.7619	
	Max	4.3515	10.670	0.8120	
	Precision (2sd/mean)	0.76%	0.75%	4.18%	
0.171	Mean	4.265	17.455	0.890	
	StDev	0.0165	0.068	0.0165	
	Min	4.2403	17.354	0.8658	
	Max	4.2865	17.544	0.9121	
	Precision (2sd/mean)	0.77%	0.77%	3.70%	

Table E44: Model Resistance Coefficients – Wooden Model – May 12**Model Resistance Coefficients**

Model:	OCRE933	Test Date:	12-May-2015
Description:	Wooden Model	Project:	A1-006518
Condition:	Normal Finish		

Tank:	Towing Tank
Avg Test Temperature:	15.6 °C

using Scott's delta V Blockage Corrector

Fr	$10^{-6} Re_M$	$10^3 C_{TM15}$	$10^3 C_{FM15}$	Res15 (N)	$10^3 C_{R15}$
0.144	4.350	4.251	3.486	12.262	0.765
0.144	4.349	4.328	3.486	12.483	0.842
0.099	3.009	4.596	3.739	6.346	0.857
0.132	4.011	4.358	3.539	10.689	0.818
0.171	5.181	4.298	3.374	17.592	0.924
0.110	3.343	4.547	3.664	7.747	0.883
0.144	4.349	4.323	3.486	12.469	0.837
0.160	4.846	4.276	3.416	15.310	0.859
0.138	4.176	4.329	3.513	11.507	0.816
0.188	5.676	4.861	3.318	23.882	1.543
0.155	4.678	4.275	3.439	14.264	0.836
0.182	5.514	4.668	3.336	21.640	1.332
0.121	3.673	4.422	3.599	9.098	0.823
0.176	5.342	4.410	3.356	19.185	1.055
0.149	4.511	4.257	3.462	13.210	0.795
0.166	5.015	4.259	3.395	16.331	0.865
0.155	4.678	4.253	3.439	14.194	0.814
0.182	5.514	4.636	3.336	21.490	1.300
0.121	3.674	4.426	3.599	9.108	0.827
0.176	5.342	4.407	3.356	19.172	1.051
0.099	3.009	4.594	3.739	6.344	0.855
0.132	4.011	4.317	3.539	10.586	0.777
0.171	5.181	4.282	3.374	17.526	0.908
0.099	3.009	4.632	3.739	6.396	0.893
0.132	4.011	4.347	3.539	10.660	0.807
0.171	5.181	4.291	3.374	17.563	0.917
0.099	3.009	4.603	3.739	6.356	0.864
0.132	4.010	4.318	3.540	10.589	0.778
0.171	5.181	4.260	3.374	17.436	0.886

Fr	$10^{-6} Re_M$	$10^3 C_{TM15}$	$10^3 C_{FM15}$	Res15	$10^3 C_{R15}$
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(N)					
0.099	3.009	4.639	3.739	6.406	0.900
0.132	4.010	4.341	3.540	10.645	0.801
0.171	5.181	4.289	3.374	17.554	0.915
0.099	3.009	4.592	3.739	6.341	0.853
0.132	4.011	4.333	3.539	10.626	0.794
0.171	5.181	4.276	3.375	17.498	0.901
0.099	3.009	4.567	3.739	6.307	0.828
0.132	4.011	4.316	3.539	10.584	0.776
0.171	5.181	4.254	3.374	17.410	0.879
0.099	3.010	4.511	3.739	6.229	0.772
0.132	4.011	4.289	3.539	10.520	0.750
0.171	5.181	4.242	3.374	17.360	0.867
0.099	3.009	4.593	3.739	6.342	0.853
0.132	4.011	4.330	3.539	10.620	0.791
0.171	5.181	4.276	3.374	17.503	0.902
0.099	3.009	4.590	3.739	6.338	0.850
0.132	4.010	4.330	3.540	10.618	0.790
0.171	5.181	4.283	3.374	17.528	0.908
0.099	3.010	4.673	3.739	6.453	0.933
0.132	4.011	4.358	3.539	10.688	0.819
0.171	5.181	4.297	3.374	17.587	0.923

Statistics for Repeat Runs				
0.099	Mean	4.5991	6.351	0.860
	StDev	0.0414	0.057	0.041
	Min	4.5109	6.229	0.772
	Max	4.6725	6.453	0.933
	Precision (2sd/mean)	1.80%	1.80%	9.63%
0.132	Mean	4.3305	10.621	0.791
	StDev	0.0203	0.050	0.020
	Min	4.2894	10.520	0.750
	Max	4.3580	10.689	0.819
	Precision (2sd/mean)	0.94%	0.94%	5.14%
0.171	Mean	4.2772	17.505	0.903
	StDev	0.0183	0.075	0.018
	Min	4.2415	17.360	0.867
	Max	4.2983	17.592	0.924
	Precision (2sd/mean)	0.86%	0.86%	4.06%

Table E45: Model Resistance Coefficients – Large Standard – May 15**Model Resistance Coefficients**

Model:	OCRE916	Test Date:	15-May-2015
Description:	Standard Model	Project:	A1-006518
Condition:	Normal Finish		
Tank:	Towing Tank		
Avg Test Temperature:	15.5 °C		

using Scott's delta V Blockage Corrector

Fr	$10^6 Re_M$	$10^3 C_{TM15}$	$10^3 C_{FM15}$	Res15 (N)	$10^3 C_{R15}$
0.145	7.502	3.863	3.156	33.152	0.708
0.145	7.502	3.893	3.156	33.406	0.737
0.100	5.164	4.043	3.376	16.440	0.666
0.149	7.733	3.907	3.139	35.620	0.768
0.100	5.164	4.043	3.376	16.440	0.666
0.149	7.733	3.907	3.139	35.620	0.768
0.111	5.734	4.081	3.312	20.461	0.769
0.166	8.591	4.686	3.081	52.741	1.606
0.122	6.307	3.969	3.255	24.072	0.713
0.166	8.591	4.246	3.081	47.788	1.166
0.133	6.884	3.938	3.205	28.449	0.733
0.160	8.308	4.236	3.099	44.571	1.137
0.145	7.503	3.851	3.155	33.058	0.696
0.152	7.878	4.027	3.128	38.109	0.899
0.133	6.884	3.924	3.204	28.354	0.720
0.160	8.308	4.219	3.099	44.400	1.120
0.133	6.884	3.957	3.204	28.594	0.753
0.160	8.308	4.223	3.099	44.435	1.124
0.133	6.884	3.932	3.204	28.408	0.727
0.160	8.307	4.233	3.099	44.540	1.134
0.133	6.884	3.949	3.205	28.534	0.745
0.160	8.308	4.224	3.099	44.447	1.125
0.133	6.883	3.975	3.205	28.714	0.770
0.160	8.308	4.262	3.099	44.848	1.163
0.133	6.884	3.956	3.204	28.579	0.751
0.160	8.308	4.252	3.099	44.737	1.153
0.133	6.884	3.941	3.204	28.477	0.737
0.160	8.308	4.254	3.099	44.769	1.155
0.133	6.884	3.928	3.204	28.383	0.723
0.160	8.308	4.240	3.099	44.616	1.141

Fr	10^{-6} Re_M	$10^3 \text{ C}_{\text{TM}15}$	$10^3 \text{ C}_{\text{FM}15}$	Res15 (N)	$10^3 \text{ C}_{\text{R}15}$
0.133	6.883	3.969	3.205	28.672	0.764
0.160	8.307	4.237	3.099	44.588	1.138
0.133	6.884	3.949	3.205	28.534	0.745
0.160	8.308	4.246	3.099	44.678	1.147

Statistics for Repeat Runs				
0.133	Mean	3.947	28.52	0.74
	StDev	0.0164	0.12	0.02
	Min	3.9241	28.35	0.72
	Max	3.9747	28.71	0.77
	Precision (2sd/mean)	0.83%	0.82%	4.41%
0.160	Mean	4.241	44.62	1.14
	StDev	0.0141	0.15	0.01
	Min	4.2194	44.40	1.12
	Max	4.2619	44.85	1.16
	Precision (2sd/mean)	0.66%	0.67%	2.47%

Appendix F – Sinkage and Trim

Table F46: Sinkage and Trim – TRUFOAM – April 21**Sinkage and Trim**

Model:	OCRE931	Test Date:	21-Apr-2015
Description:	TRUFOAM Model	Project:	A1-006518
Condition:	Normal Finish	Length WL:	4.949 m
		Model Scale:	45
Tank:	Towing Tank		
Avg Test Temperature:	15.6 °C		

Fr	$10^2 Z_v/L_M$	Heidenhain θ_v (Degrees)	TrimPots θ_v (Degrees)
0.144	0.116	-0.0726	-0.0945
0.144	0.117	-0.0485	-0.0946
0.099	0.046	0.0017	-0.0423
0.132	0.083	-0.0266	-0.0722
0.171	0.130	-0.0197	-0.1280
0.110	0.048	-0.0096	-0.0519
0.144	0.089	-0.0396	-0.0885
0.160	0.112	-0.0595	-0.1121
0.138	0.079	-0.0456	-0.0831
0.188	0.153	-0.0506	-0.1571
0.155	0.106	-0.0665	-0.1056
0.182	0.145	-0.0450	-0.1460
0.121	0.060	-0.0189	-0.0644
0.176	0.140	-0.0274	-0.1372
0.149	0.092	-0.0650	-0.0970
0.166	0.118	-0.0770	-0.1205
0.155	0.101	-0.0438	-0.1054
0.182	0.150	-0.0253	-0.1452
0.121	0.062	-0.0069	-0.0644
0.176	0.133	-0.0176	-0.1395
0.099	0.044	0.0144	-0.0444
0.132	0.080	-0.0127	-0.0768
0.171	0.127	-0.0096	-0.1317
0.099	0.041	-0.0034	-0.0444
0.132	0.082	-0.0310	-0.0753
0.171	0.130	-0.0264	-0.1295
0.099	0.037	0.0009	-0.0411
0.132	0.073	-0.0256	-0.0756
0.171	0.125	-0.0231	-0.1297
Fr	$10^2 Z_v/L_M$	Heidenhain	TrimPots

			θ_v (Degrees)	θ_v (Degrees)
	0.099	0.037	0.0138	-0.0414
	0.132	0.073	-0.0126	-0.0759
	0.171	0.127	-0.0103	-0.1317
	0.099	0.037	-0.0139	-0.0421
	0.132	0.073	-0.0400	-0.0756
	0.171	0.125	-0.0392	-0.1306
	0.099	0.043	0.0046	-0.0452
	0.132	0.074	-0.0218	-0.0770
	0.171	0.122	-0.0198	-0.1298
	0.099	0.042	-0.0263	-0.0456
	0.132	0.077	-0.0537	-0.0777
	0.171	0.125	-0.0535	-0.1321
	0.099	0.037	-0.0081	-0.0422
	0.132	0.074	-0.0356	-0.0763
	0.171	0.123	-0.0363	-0.1313
	0.099	0.045	-0.0013	-0.0450
	0.132	0.078	-0.0283	-0.0784
	0.171	0.125	-0.0292	-0.1319
	0.099	0.038	-0.0128	-0.0427
	0.132	0.074	-0.0394	-0.0761
	0.171	0.127	-0.0400	-0.1318
	0.099	0.040	0.0115	-0.0432
	0.132	0.075	-0.0147	-0.0757
	0.182	0.143	-0.0267	-0.1483
Statistics for Repeat Runs				
0.099	Mean	0.0406	-0.0016	-0.0433
	StDev	0.0034	0.0123	0.0016
	Min	0.0365	-0.0263	-0.0456
	Max	0.0460	0.0144	-0.0411
	Precision (2sd/mean)	16.95%	-1547.17%	-7.27%
0.132	Mean	0.0763	-0.0285	-0.0760
	StDev	0.0037	0.0124	0.0015
	Min	0.0727	-0.0537	-0.0784
	Max	0.0832	-0.0126	-0.0722
	Precision (2sd/mean)	9.61%	-87.02%	-4.02%
0.171	Mean	0.1259	-0.0279	-0.1307
	StDev	0.0026	0.0134	0.0013
	Min	0.1218	-0.0535	-0.1321
	Max	0.1301	-0.0096	-0.1280
	Precision (2sd/mean)	4.09%	-96.29%	-2.04%

Table F47: Sinkage and Trim – TRUFOAM – April 22**Sinkage and Trim**

Model:	OCRE931	Test Date:	22-Apr-2015
Description:	TRUFOAM Model	Project:	A1-006518
Condition:	Normal Finish	Length WL:	4.949 m
		Model Scale:	45
Tank:	Towing Tank		
Avg Test Temperature:	15.6 °C		

Fr	$10^2 Z_v/L_M$	Heidenhain θ_v (Degrees)	TrimPots θ_v (Degrees)
0.144	0.086	-0.0648	-0.0855
0.144	0.092	-0.0445	-0.0854
0.099	0.036	0.0030	-0.0395
0.132	0.072	-0.0242	-0.0726
0.171	0.124	-0.0192	-0.1286
0.110	0.045	-0.0130	-0.0495
0.144	0.087	-0.0429	-0.0849
0.160	0.106	-0.0627	-0.1098
0.138	0.076	-0.0286	-0.0810
0.188	0.161	-0.0364	-0.1562
0.155	0.101	-0.0615	-0.1028
0.182	0.146	-0.0437	-0.1437
0.121	0.059	-0.0181	-0.0607
0.176	0.134	-0.0289	-0.1365
0.149	0.094	-0.0394	-0.0954
0.166	0.123	-0.0537	-0.1166
0.155	0.099	-0.0547	-0.1034
0.182	0.143	-0.0379	-0.1451
0.121	0.055	-0.0432	-0.0605
0.176	0.131	-0.0543	-0.1363
0.099	0.041	0.0036	-0.0413
0.132	0.076	-0.0235	-0.0741
0.171	0.125	-0.0234	-0.1304
0.099	0.039	-0.0135	-0.0408
0.132	0.080	-0.0397	-0.0720
0.171	0.130	-0.0397	-0.1274
0.099	0.033	-0.0141	-0.0400
0.132	0.071	-0.0405	-0.0725
0.171	0.127	-0.0418	-0.1278

	Fr	$10^2 Z_v/L_M$	Heidenhain θ_v (Degrees)	TrimPots θ_v (Degrees)
	0.099	0.032	-0.0161	-0.0403
	0.132	0.069	-0.0430	-0.0733
	0.171	0.124	-0.0433	-0.1289
	0.099	0.035	0.0044	-0.0394
	0.132	0.070	-0.0220	-0.0731
	0.171	0.122	-0.0247	-0.1296
	0.099	0.040	-0.0103	-0.0398
	0.132	0.077	-0.0384	-0.0734
	0.171	0.125	-0.0451	-0.1308
	0.099	0.033	-0.0045	-0.0404
	0.132	0.069	-0.0312	-0.0731
	0.171	0.127	-0.0371	-0.1298
	0.099	0.035	0.0068	-0.0404
	0.132	0.073	-0.0198	-0.0729
	0.171	0.124	-0.0231	-0.1297
	0.099	0.031	-0.0029	-0.0403
	0.132	0.068	-0.0293	-0.0741
	0.171	0.122	-0.0351	-0.1289
	0.099	0.038	-0.0106	-0.0428
	0.132	0.075	-0.0379	-0.0732
	0.171	0.125	-0.0450	-0.1293
Statistics for Repeat Runs				
0.099	Mean	0.0358	-0.0057	-0.0406
	StDev	0.0036	0.0084	0.0009
	Min	0.0308	-0.0161	-0.0428
	Max	0.0413	0.0068	-0.0394
	Precision (2sd/mean)	20.39%	-294.36%	-4.57%
0.132	Mean	0.0729	-0.0325	-0.0732
	StDev	0.0040	0.0085	0.0006
	Min	0.0683	-0.0430	-0.0741
	Max	0.0796	-0.0198	-0.0720
	Precision (2sd/mean)	11.00%	-52.32%	-1.77%
0.171	Mean	0.1249	-0.0358	-0.1293
	StDev	0.0026	0.0089	0.0011
	Min	0.1215	-0.0451	-0.1308
	Max	0.1302	-0.0231	-0.1274
	Precision (2sd/mean)	4.11%	-49.92%	-1.67%

Table F48: Sinkage and Trim - Standard – April 23

Sinkage and Trim			
Model:	OCRE930	Test Date:	23-Apr-2015
Description:	Standard Model	Project:	A1-006518
Condition:	Normal Finish	Length WL:	4.949 m
		Model Scale:	45
Tank:	Towing Tank		
Avg Test Temperature:	15.6 °C		

Fr	$10^2 Z_v/L_M$	Heidenhain θ_v (Degrees)	TrimPots θ_v (Degrees)
0.144	0.079	-0.0693	-0.0809
0.144	0.079	-0.0683	-0.0810
0.099	0.030	-0.0307	-0.0356
0.132	0.070	-0.0591	-0.0680
0.171	0.124	-0.1057	-0.1231
0.110	0.041	-0.0375	-0.0451
0.144	0.079	-0.0682	-0.0816
0.160	0.096	-0.0881	-0.1031
0.138	0.073	-0.0620	-0.0747
0.188	0.152	-0.1152	-0.1506
0.155	0.089	-0.0805	-0.0956
0.182	0.138	-0.1057	-0.1394
0.121	0.046	-0.0474	-0.0551
0.176	0.120	-0.1015	-0.1311
0.149	0.084	-0.0760	-0.0876
0.166	0.103	-0.0959	-0.1099
0.155	0.085	-0.0807	-0.0948
0.182	0.130	-0.1017	-0.1380
0.121	0.043	-0.0473	-0.0535
0.176	0.118	-0.0991	-0.1291
0.099	0.024	-0.0284	-0.0338
0.132	0.064	-0.0568	-0.0657
0.171	0.113	-0.1030	-0.1199
0.099	0.024	-0.0277	-0.0338
0.132	0.063	-0.0559	-0.0648
0.171	0.113	-0.1031	-0.1202
0.099	0.020	-0.0287	-0.0336
0.132	0.054	-0.0561	-0.0647
0.171	0.104	-0.1018	-0.1185

	Fr	$10^2 Z_V/L_M$	Heidenhain θ_V (Degrees)	TrimPots θ_V (Degrees)
	0.099	0.027	-0.0294	-0.0324
	0.132	0.058	-0.0570	-0.0644
	0.171	0.106	-0.1033	-0.1189
	0.099	0.018	-0.0288	-0.0317
	0.132	0.054	-0.0569	-0.0637
	0.171	0.104	-0.1030	-0.1179
	0.099	0.022	-0.0287	-0.0325
	0.132	0.054	-0.0569	-0.0638
	0.171	0.104	-0.1032	-0.1180
	0.099	0.021	-0.0282	-0.0327
	0.132	0.055	-0.0559	-0.0633
	0.171	0.106	-0.1035	-0.1177
	0.099	0.022	-0.0289	-0.0315
	0.132	0.060	-0.0560	-0.0632
	0.171	0.111	-0.1019	-0.1164
	0.099	0.019	-0.0283	-0.0317
	0.132	0.057	-0.0556	-0.0630
	0.171	0.111	-0.1019	-0.1169
	0.099	0.017	-0.0293	-0.0312
	0.132	0.051	-0.0565	-0.0621
	0.171	0.102	-0.1028	-0.1161
Statistics for Repeat Runs				
0.099	Mean	0.0222	-0.0288	-0.0328
	StDev	0.0040	0.0008	0.0013
	Min	0.0168	-0.0307	-0.0356
	Max	0.0303	-0.0277	-0.0312
	Precision (2sd/mean)	35.68%	-5.43%	-8.06%
0.132	Mean	0.0582	-0.0566	-0.0642
	StDev	0.0057	0.0010	0.0016
	Min	0.0513	-0.0591	-0.0680
	Max	0.0702	-0.0556	-0.0621
	Precision (2sd/mean)	19.50%	-3.38%	-5.04%
0.171	Mean	0.1089	-0.1030	-0.1185
	StDev	0.0064	0.0011	0.0020
	Min	0.1020	-0.1057	-0.1231
	Max	0.1241	-0.1018	-0.1161
	Precision (2sd/mean)	11.77%	-2.07%	-3.36%

Table F49: Sinkage and Trim – Standard – April 24

Model:	OCRE930	Test Date:	24-Apr-2015
Description:	Standard Model	Project:	A1-006518
Condition:	Normal Finish	Length WL:	4.949 m
		Model Scale:	45
Tank:	Towing Tank		
Avg Test Temperature:	15.6 °C		

Fr	$10^2 Z_v/L_M$	Heidenhain θ_v (Degrees)	TrimPots θ_v (Degrees)
0.144	0.087	-0.0672	-0.0806
0.144	0.086	-0.0688	-0.0823
0.099	0.033	-0.0268	-0.0366
0.132	0.070	-0.0554	-0.0702
0.171	0.125	-0.0430	-0.1229
0.171	0.127	-0.0108	-0.1241
0.110	0.043	-0.0374	-0.0481
0.144	0.081	-0.0679	-0.0821
0.160	0.099	-0.0864	-0.1053
0.138	0.075	-0.0639	-0.0757
0.188	0.149	-0.0265	-0.1542
0.155	0.102	-0.0792	-0.0990
0.182	0.145	-0.0206	-0.1436
0.121	0.054	-0.0450	-0.0601
0.176	0.135	-0.0144	-0.1336
0.149	0.087	-0.0720	-0.0907
0.166	0.108	-0.0852	-0.1137
0.155	0.098	-0.0785	-0.0994
0.182	0.141	-0.0224	-0.1429
0.121	0.059	-0.0440	-0.0593
0.176	0.132	-0.0191	-0.1337
0.099	0.029	-0.0279	-0.0410
0.132	0.064	-0.0540	-0.0717
0.182	0.141	-0.0292	-0.1434
0.099	0.029	-0.0260	-0.0398
0.132	0.065	-0.0515	-0.0716
0.182	0.135	-0.0330	-0.1427
0.099	0.033	-0.0258	-0.0412
0.132	0.072	-0.0517	-0.0715
0.182	0.143	-0.0342	-0.1427

	Fr	$10^2 Z_V/L_M$	Heidenhain θ_V (Degrees)	TrimPots θ_V (Degrees)
	0.099	0.032	-0.0256	-0.0411
	0.132	0.073	-0.0536	-0.0721
	0.182	0.143	-0.0350	-0.1427
	0.099	0.032	-0.0262	-0.0406
	0.132	0.070	-0.0517	-0.0719
	0.182	0.143	-0.0371	-0.1419
	0.099	0.034	-0.0262	-0.0399
	0.132	0.070	-0.0523	-0.0707
	0.182	0.137	-0.0372	-0.1431
	0.099	0.035	-0.0276	-0.0408
	0.132	0.069	-0.0556	-0.0711
	0.182	0.137	-0.0405	-0.1431
	0.099	0.035	-0.0248	-0.0386
	0.132	0.069	-0.0519	-0.0711
	0.182	0.138	-0.0394	-0.1435
	0.099	0.037	-0.0251	-0.0401
	0.132	0.072	-0.0517	-0.0713
	0.182	0.141	-0.0407	-0.1429
	0.099	0.028	-0.0260	-0.0404
	0.132	0.064	-0.0521	-0.0718
	0.182	0.140	-0.0430	-0.1429
Statistics for Repeat Runs				
0.099	Mean	0.033	-0.026	-0.040
	StDev	0.0030	0.0010	0.0008
	Min	0.0282	-0.0279	-0.0412
	Max	0.0374	-0.0248	-0.0386
	Precision (2sd/mean)	18.49%	-7.31%	-3.85%
0.132	Mean	0.0685	-0.0526	-0.0715
	StDev	0.0032	0.0013	0.0004
	Min	0.0637	-0.0556	-0.0721
	Max	0.0725	-0.0515	-0.0707
	Precision (2sd/mean)	9.42%	-5.12%	-1.13%
0.182	Mean	0.1397	-0.0369	-0.1429
	StDev	0.0028	0.0042	0.0005
	Min	0.1352	-0.0430	-0.1435
	Max	0.1429	-0.0292	-0.1419
	Precision (2sd/mean)	4.01%	-22.54%	-0.64%

Table F50: Sinkage and Trim – Standard – April 27 (set1)**Sinkage and Trim**

Model:	OCRE930	Test Date:	27-Apr-2015
Description:	Standard Model	Project:	A1-006518
Condition:	Normal Finish	Length WL:	4.949 m
		Model Scale:	45
Tank:	Towing Tank		
Avg Test Temperature:	15.6 °C		

Fr	$10^2 Z_v/L_M$	Heidenhain θ_v (Degrees)	TrimPots θ_v (Degrees)
0.144	0.078	-0.0336	-0.0832
0.144	0.083	-0.0186	-0.0830
0.099	0.037	0.0324	-0.0393
0.132	0.072	0.0050	-0.0711
0.171	0.122	-0.0402	-0.1247
0.099	0.030	0.0400	-0.0395
0.132	0.064	0.0128	-0.0719
0.171	0.114	-0.0319	-0.1275
0.099	0.031	0.0560	-0.0394
0.132	0.065	0.0287	-0.0726
0.171	0.113	-0.0174	-0.1264
0.099	0.037	0.0352	-0.0417
0.132	0.069	0.0089	-0.0731
0.171	0.115	-0.0356	-0.1274
0.099	0.036	0.0445	-0.0404
0.132	0.071	0.0171	-0.0719
0.171	0.116	-0.0279	-0.1268
0.099	0.029	0.0585	-0.0407
0.132	0.063	0.0312	-0.0728
0.171	0.119	-0.0132	-0.1256
0.099	0.028	0.0618	-0.0385
0.132	0.065	0.0341	-0.0729
0.171	0.120	-0.0100	-0.1261
0.099	0.029	0.0923	-0.0404
0.132	0.062	0.0654	-0.0714
0.171	0.111	0.0207	-0.1249
0.099	0.028	0.1087	-0.0395
0.132	0.064	0.0820	-0.0723
0.171	0.115	0.0379	-0.1267

Fr	$10^2 Z_V/L_M$	Heidenhain θ_V (Degrees)	TrimPots θ_V (Degrees)
0.099	0.027	0.0998	-0.0386
0.132	0.060	0.0729	-0.0716
0.171	0.112	0.0285	-0.1256

Statistics for Repeat Runs

0.099	Mean	0.0311	0.0629	-0.0398
	StDev	0.0039	0.0278	0.0010
	Min	0.0268	0.0324	-0.0417
	Max	0.0371	0.1087	-0.0385
	Precision (2sd/mean)	25.05%	88.35%	-5.03%
0.132	Mean	0.0654	0.0358	-0.0722
	StDev	0.0039	0.0279	0.0007
	Min	0.0603	0.0050	-0.0731
	Max	0.0718	0.0820	-0.0711
	Precision (2sd/mean)	12.05%	155.89%	-1.96%
0.171	Mean	0.1157	-0.0089	-0.1262
	StDev	0.0037	0.0282	0.0010
	Min	0.1109	-0.0402	-0.1275
	Max	0.1218	0.0379	-0.1247
	Precision (2sd/mean)	6.32%	-631.68%	-1.54%

Table F51: Sinkage and Trim – Standard – April 27 (set 2)**Sinkage and Trim**

Model:	OCRE930	Test Date:	27-Apr-2015
Description:	Standard Model	Project:	A1-006518
Condition:	Normal Finish	Length WL:	4.949 m
		Model Scale:	45
Tank:	Towing Tank		
Avg Test Temperature:	15.6 °C		

Fr	$10^2 Z_v/L_M$	Heidenhain θ_v (Degrees)	TrimPots θ_v (Degrees)
0.144	0.074	-0.0257	-0.0849
0.144	0.072	0.0179	-0.0868
0.099	0.026	0.0399	-0.0384
0.132	0.058	0.0117	-0.0731
0.171	0.110	-0.0330	-0.1265
0.099	0.032	0.0475	-0.0416
0.132	0.063	0.0187	-0.0736
0.171	0.111	-0.0261	-0.1271
0.099	0.029	0.0502	-0.0401
0.132	0.059	0.0231	-0.0747
0.171	0.108	-0.0213	-0.1272
0.099	0.032	0.0507	-0.0425
0.132	0.064	0.0232	-0.0732
0.171	0.111	-0.0214	-0.1260
0.099	0.026	0.0606	-0.0384
0.132	0.063	0.0334	-0.0732
0.171	0.116	-0.0111	-0.1292
0.099	0.026	0.0449	-0.0379
0.132	0.057	0.0158	-0.0728
0.171	0.107	-0.0281	-0.1272
0.099	0.030	0.0187	-0.0423
0.132	0.061	-0.0093	-0.0735
0.171	0.108	-0.0547	-0.1268
0.099	0.027	0.0717	-0.0387
0.132	0.058	0.0445	-0.0730
0.171	0.106	0.0007	-0.1267
0.099	0.028	0.0091	-0.0402
0.132	0.060	-0.0188	-0.0737
0.171	0.108	-0.0632	-0.1266

Fr	$10^2 Z_v/L_M$	Heidenhain θ_v (Degrees)	TrimPots θ_v (Degrees)
0.099	0.030	0.0444	-0.0419
0.132	0.065	0.0171	-0.0740
0.171	0.111	-0.0272	-0.1266

Statistics for Repeat Runs

0.099	Mean	0.0285	0.0438	-0.0402
	StDev	0.0026	0.0183	0.0018
	Min	0.0255	0.0091	-0.0425
	Max	0.0325	0.0717	-0.0379
	Precision (2sd/mean)	18.18%	83.65%	-8.88%
0.132	Mean	0.0609	0.0159	-0.0735
	StDev	0.0030	0.0185	0.0006
	Min	0.0571	-0.0188	-0.0747
	Max	0.0652	0.0445	-0.0728
	Precision (2sd/mean)	9.70%	232.86%	-1.52%
0.171	Mean	0.1095	-0.0285	-0.1270
	StDev	0.0029	0.0188	0.0009
	Min	0.1062	-0.0632	-0.1292
	Max	0.1156	0.0007	-0.1260
	Precision (2sd/mean)	5.21%	-131.48%	-1.35%

Table F52: Sinkage and Trim – Wooden Model – May 5

Sinkage and Trim			
Model:	OCRE933	Test Date:	5-May-2015
Description:	Wooden Model	Project:	A1-006518
Condition:	Normal Finish	Length WL:	4.949 m
		Model Scale:	45
Tank:	Towing Tank		
Avg Test Temperature:	15.6 °C		

Fr	$10^2 Z_v/L_M$	Heidenhain θ_v (Degrees)	TrimPots θ_v (Degrees)
0.144	0.094	-0.0360	-0.0784
0.144	0.085	-0.0077	-0.0795
0.099	0.033	0.0285	-0.0417
0.132	0.069	0.0016	-0.0718
0.171	0.126	-0.0439	-0.1190
0.110	0.042	0.0309	-0.0517
0.144	0.084	0.0012	-0.0815
0.160	0.099	-0.0184	-0.1052
0.138	0.084	0.0011	-0.0724
0.188	0.156	-0.0626	-0.1476
0.155	0.102	-0.0023	-0.0931
0.182	0.141	-0.0388	-0.1369
0.121	0.053	0.0328	-0.0601
0.176	0.136	-0.0324	-0.1273
0.149	0.085	0.0059	-0.0901
0.166	0.103	-0.0124	-0.1138
0.155	0.100	-0.0315	-0.0955
0.182	0.144	-0.0688	-0.1361
0.121	0.058	0.0494	-0.0571
0.176	0.132	-0.0157	-0.1268
0.099	0.027	0.0572	-0.0363
0.132	0.067	0.0305	-0.0696
0.171	0.123	-0.0172	-0.1181
0.099	0.029	0.0386	-0.0374
0.132	0.061	0.0127	-0.0727
0.171	0.110	-0.0343	-0.1232
0.099	0.029	0.0735	-0.0383
0.132	0.062	0.0473	-0.0718
0.171	0.111	0.0002	-0.1237

Fr	$10^2 Z_V/L_M$	Heidenhain θ_V (Degrees)	TrimPots θ_V (Degrees)
0.099	0.028	0.0538	-0.0372
0.132	0.060	0.0278	-0.0715
0.171	0.115	-0.0196	-0.1208
0.099	0.029	0.0355	-0.0377
0.132	0.060	0.0098	-0.0719
0.171	0.107	-0.0371	-0.1234
0.099	0.028	0.0283	-0.0369
0.132	0.060	0.0009	-0.0721
0.171	0.113	-0.0472	-0.1222
0.099	0.028	0.0430	-0.0373
0.132	0.069	0.0161	-0.0676
0.171	0.120	-0.0313	-0.1185
0.099	0.025	0.1012	-0.0353
0.132	0.058	0.0748	-0.0702
0.171	0.106	0.0281	-0.1239
0.099	0.028	0.0419	-0.0371
0.132	0.060	0.0157	-0.0717
0.171	0.106	-0.0306	-0.1238
0.099	0.029	0.0398	-0.0375
0.132	0.061	0.0139	-0.0708
0.171	0.108	-0.0345	-0.1240

Statistics for Repeat Runs

0.099	Mean	0.0285	0.0492	-0.0375
	StDev	0.0018	0.0217	0.0016
	Min	0.0255	0.0283	-0.0417
	Max	0.0331	0.1012	-0.0353
	Precision (2sd/mean)	12.95%	88.41%	-8.45%
0.132	Mean	0.0625	0.0228	-0.0711
	StDev	0.0039	0.0218	0.0015
	Min	0.0577	0.0009	-0.0727
	Max	0.0692	0.0748	-0.0676
	Precision (2sd/mean)	12.63%	191.19%	-4.12%
0.171	Mean	0.1133	-0.0243	-0.1219
	StDev	0.0072	0.0219	0.0023
	Min	0.1063	-0.0472	-0.1240
	Max	0.1265	0.0281	-0.1181
	Precision (2sd/mean)	12.68%	-179.87%	-3.84%

Table F53: Sinkage and Trim – Wooden Model – May 6**Sinkage and Trim**

Model:	OCRE933	Test Date:	6-May-2015
Description:	Wooden Model	Project:	A1-006518
Condition:	Normal Finish	Length WL:	4.949 m
		Model Scale:	45
Tank:	Towing Tank		
Avg Test Temperature:	15.6 °C		

Fr	$10^2 Z_v/L_M$	Heidenhain θ_v (Degrees)	TrimPots θ_v (Degrees)
0.144	0.093	-0.0335	-0.0851
0.144	0.093	-0.0181	-0.0859
0.099	0.039	0.0681	-0.0425
0.132	0.072	0.0428	-0.0773
0.171	0.119	-0.0038	-0.1306
0.110	0.052	0.0434	-0.0562
0.144	0.095	0.0130	-0.0868
0.160	0.107	-0.0068	-0.1131
0.138	0.078	0.0209	-0.0844
0.188	0.154	-0.0431	-0.1583
0.155	0.103	-0.0177	-0.1066
0.182	0.153	-0.0522	-0.1430
0.121	0.059	0.0014	-0.0648
0.176	0.139	-0.0609	-0.1375
0.149	0.096	-0.0047	-0.0995
0.166	0.113	-0.0234	-0.1214
0.155	0.097	-0.0125	-0.1066
0.182	0.139	-0.0479	-0.1485
0.121	0.059	0.0842	-0.0651
0.176	0.128	0.0222	-0.1399
0.099	0.042	0.0363	-0.0460
0.132	0.075	0.0101	-0.0797
0.171	0.121	-0.0356	-0.1316
0.099	0.038	0.0324	-0.0424
0.132	0.070	0.0067	-0.0771
0.171	0.122	-0.0403	-0.1312
0.099	0.041	0.0172	-0.0448
0.132	0.073	-0.0079	-0.0794
0.171	0.120	-0.0535	-0.1313

	Fr	$10^2 Z_V/L_M$	Heidenhain θ_V (Degrees)	TrimPots θ_V (Degrees)
	0.099	0.037	0.0360	-0.0415
	0.132	0.070	0.0105	-0.0770
	0.171	0.119	-0.0349	-0.1309
	0.099	0.041	0.0313	-0.0442
	0.132	0.071	0.0047	-0.0776
	0.171	0.118	-0.0404	-0.1295
	0.099	0.038	0.0257	-0.0423
	0.132	0.074	-0.0013	-0.0784
	0.171	0.127	-0.0468	-0.1301
	0.099	0.041	0.0450	-0.0444
	0.132	0.072	0.0191	-0.0785
	0.171	0.119	-0.0271	-0.1308
	0.099	0.037	0.0414	-0.0411
	0.132	0.072	0.0149	-0.0778
	0.171	0.123	-0.0306	-0.1314
	0.099	0.036	0.0162	-0.0408
	0.132	0.069	-0.0096	-0.0764
	0.171	0.118	-0.0552	-0.1298
	0.099	0.040	0.0268	-0.0442
	0.132	0.076	0.0001	-0.0780
	0.171	0.121	-0.0467	-0.1313
Statistics for Repeat Runs				
0.099	Mean	0.0391	0.0308	-0.0432
	StDev	0.0022	0.0095	0.0018
	Min	0.0364	0.0162	-0.0460
	Max	0.0423	0.0450	-0.0408
	Precision (2sd/mean)	11.14%	61.64%	-8.20%
0.132	Mean	0.0722	0.0047	-0.0780
	StDev	0.0021	0.0094	0.0011
	Min	0.0693	-0.0096	-0.0797
	Max	0.0756	0.0191	-0.0764
	Precision (2sd/mean)	5.80%	398.21%	-2.69%
0.171	Mean	0.1208	-0.0411	-0.1308
	StDev	0.0029	0.0094	0.0007
	Min	0.1176	-0.0552	-0.1316
	Max	0.1273	-0.0271	-0.1295
	Precision (2sd/mean)	4.73%	-45.63%	-1.11%

Table F54: Sinkage and Trim – Wooden Model – May 7

Sinkage and Trim			
Model:	OCRE933	Test Date:	7-May-2015
Description:	Wooden Model	Project:	A1-006518
Condition:	Normal Finish	Length WL:	4.949 m
		Model Scale:	45
Tank:	Towing Tank		
Avg Test Temperature:	15.6 °C		

Fr	$10^2 Z_v/L_M$	Heidenhain θ_v (Degrees)	TrimPots θ_v (Degrees)
0.144	0.087	-0.0531	-0.0863
0.144	0.085	0.0076	-0.0846
0.099	0.034	0.0089	-0.0383
0.132	0.072	-0.0160	-0.0709
0.171	0.124	-0.0632	-0.1266
0.121	0.061	-0.0118	-0.0593
0.176	0.136	-0.0747	-0.1384
0.099	0.042	0.0111	-0.0374
0.132	0.077	-0.0157	-0.0727
0.171	0.126	-0.0623	-0.1273
0.099	0.029	0.0237	-0.0399
0.132	0.069	-0.0024	-0.0714
0.171	0.120	-0.0485	-0.1257
0.099	0.034	0.0092	-0.0393
0.132	0.071	-0.0172	-0.0715
0.171	0.120	-0.0630	-0.1255
0.099	0.027	0.0036	-0.0409
0.132	0.066	-0.0226	-0.0718
0.171	0.117	-0.0678	-0.1265
0.099	0.038	0.0170	-0.0375
0.132	0.072	-0.0098	-0.0705
0.171	0.120	-0.0568	-0.1252
0.099	0.032	0.0063	-0.0394
0.132	0.076	-0.0204	-0.0718
0.171	0.125	-0.0658	-0.1266
0.099	0.027	0.0045	-0.0400
0.132	0.064	-0.0209	-0.0729
0.171	0.117	-0.0672	-0.1255
0.099	0.024	0.0245	-0.0407
0.132	0.069	-0.0020	-0.0713
0.171	0.124	-0.0490	-0.1265

Fr	$10^2 Z_V/L_M$	Heidenhain θ_V (Degrees)	TrimPots θ_V (Degrees)
0.099	0.030	0.0239	-0.0407
0.132	0.068	-0.0017	-0.0711
0.171	0.118	-0.0474	-0.1262
0.099	0.031	0.0155	-0.0404
0.132	0.072	-0.0108	-0.0717
0.171	0.122	-0.0563	-0.1256

Statistics for Repeat Runs

0.099	Mean	0.0316	0.0135	-0.0395
	StDev	0.0051	0.0079	0.0013
	Min	0.0244	0.0036	-0.0409
	Max	0.0422	0.0245	-0.0374
	Precision (2sd/mean)	32.45%	117.37%	-6.39%
0.132	Mean	0.0706	-0.0127	-0.0716
	StDev	0.0038	0.0079	0.0007
	Min	0.0642	-0.0226	-0.0729
	Max	0.0770	-0.0017	-0.0705
	Precision (2sd/mean)	10.84%	-123.70%	-1.96%
0.171	Mean	0.121	-0.059	-0.126
	StDev	0.0030	0.0077	0.0007
	Min	0.1168	-0.0678	-0.1273
	Max	0.1256	-0.0474	-0.1252
	Precision (2sd/mean)	4.95%	-26.15%	-1.04%

Table F55: Sinkage and Trim – Wooden Model – May 12**Sinkage and Trim**

Model:	OCRE933	Test Date:	12-May-2015
Description:	Wooden Model	Project:	A1-006518
Condition:	Normal Finish	Length WL:	4.949 m
		Model Scale:	45
Tank:	Towing Tank		
Avg Test Temperature:	15.6 °C		

Fr	$10^2 Z_v/L_M$	Heidenhain θ_v (Degrees)	TrimPots θ_v (Degrees)
0.144	0.088	-0.0467	-0.0873
0.144	0.107	0.0277	-0.0850
0.099	0.056	0.0372	-0.0384
0.132	0.092	0.0102	-0.0727
0.171	0.145	-0.0329	-0.1282
0.110	0.072	0.0466	-0.0476
0.144	0.108	0.0166	-0.0864
0.160	0.126	-0.0032	-0.1088
0.138	0.103	0.0193	-0.0807
0.188	0.176	-0.0448	-0.1596
0.155	0.124	-0.0056	-0.1036
0.182	0.165	-0.0420	-0.1487
0.121	0.084	0.0155	-0.0596
0.176	0.155	-0.0483	-0.1384
0.149	0.112	-0.0282	-0.0932
0.166	0.137	-0.0479	-0.1183
0.155	0.119	-0.0228	-0.1009
0.182	0.161	-0.0604	-0.1455
0.121	0.078	0.0295	-0.0598
0.176	0.151	-0.0340	-0.1352
0.099	0.054	0.0366	-0.0398
0.132	0.095	0.0094	-0.0719
0.171	0.147	-0.0347	-0.1290
0.099	0.051	0.0575	-0.0397
0.132	0.088	0.0310	-0.0727
0.171	0.144	-0.0157	-0.1268
0.099	0.054	0.0274	-0.0394
0.132	0.089	0.0006	-0.0721
0.171	0.140	-0.0438	-0.1252

Fr	$10^2 Z_V/L_M$	Heidenhain θ_V (Degrees)	TrimPots θ_V (Degrees)
0.099	0.052	0.0524	-0.0378
0.132	0.092	0.0251	-0.0720
0.171	0.146	-0.0210	-0.1282
0.099	0.058	0.0289	-0.0375
0.132	0.094	0.0015	-0.0710
0.171	0.144	-0.0427	-0.1264
0.099	0.054	0.0255	-0.0370
0.132	0.094	-0.0021	-0.0714
0.171	0.147	-0.0465	-0.1290
0.099	0.053	0.0132	-0.0368
0.132	0.092	-0.0142	-0.0725
0.171	0.145	-0.0592	-0.1274
0.099	0.048	0.0331	-0.0427
0.132	0.087	0.0052	-0.0717
0.171	0.140	-0.0383	-0.1256
0.099	0.054	0.0445	-0.0365
0.132	0.088	0.0178	-0.0724
0.171	0.140	-0.0269	-0.1255
0.099	0.055	0.0490	-0.0365
0.132	0.090	0.0226	-0.0703
0.171	0.140	-0.0221	-0.1264

Statistics for Repeat Runs

0.099	Mean	0.0536	0.0368	-0.0384
	StDev	0.0026	0.0131	0.0019
	Min	0.0482	0.0132	-0.0427
	Max	0.0585	0.0575	-0.0365
	Precision (2sd/mean)	9.76%	71.30%	-9.96%
0.132	Mean	0.0910	0.0098	-0.0719
	StDev	0.0027	0.0134	0.0007
	Min	0.0874	-0.0142	-0.0727
	Max	0.0946	0.0310	-0.0703
	Precision (2sd/mean)	6.04%	275.00%	-2.07%
0.171	Mean	0.1434	-0.0349	-0.1271
	StDev	0.0029	0.0129	0.0014
	Min	0.1397	-0.0592	-0.1290
	Max	0.1468	-0.0157	-0.1252
	Precision (2sd/mean)	4.02%	-74.09%	-2.18%

Table F56: Sinkage and Trim – Large Standard –May 15**Sinkage and Trim**

Model:	OCRE916	Test Date:	15-May-2015
Description:	Standard Model	Project:	A1-006518
Condition:	Normal Finish	Length WL:	7.081 m
		Model Scale:	31.45
Tank:	Towing Tank		
Avg Test Temperature:	15.5 °C		

Fr	$10^2 Z_v/L_M$	Heidenhain θ_v (Degrees)	TrimPots θ_v (Degrees)
0.145	0.086	0.0033	-0.0814
0.145	0.089	0.0680	-0.0825
0.100	0.039	0.0026	-0.0394
0.149	0.097	0.0020	-0.0903
0.100	0.039	0.0026	-0.0394
0.149	0.097	0.0020	-0.0903
0.111	0.046	0.0148	-0.0503
0.166	0.135	-0.0392	-0.1343
0.122	0.062	0.0157	-0.0588
0.166	0.127	-0.0276	-0.1253
0.133	0.077	0.0153	-0.0702
0.160	0.119	-0.0189	-0.1154
0.145	0.090	-0.0037	-0.0836
0.152	0.103	-0.0089	-0.0982
0.133	0.069	0.0125	-0.0725
0.160	0.115	-0.0208	-0.1137
0.133	0.076	0.0101	-0.0707
0.160	0.118	-0.0222	-0.1150
0.133	0.068	0.0100	-0.0732
0.160	0.116	-0.0226	-0.1139
0.133	0.069	0.0118	-0.0744
0.160	0.113	-0.0221	-0.1152
0.133	0.076	0.0481	-0.0710
0.160	0.118	0.0142	-0.1158
0.133	0.071	0.0400	-0.0724
0.160	0.115	0.0057	-0.1144
0.133	0.068	0.0403	-0.0737
0.160	0.114	0.0052	-0.1138
0.133	0.075	0.0142	-0.0715
0.160	0.118	-0.0191	-0.1153

Fr	$10^2 Z_V/L_M$	Heidenhain θ_V (Degrees)	TrimPots θ_V (Degrees)
0.133	0.067	0.0392	-0.0743
0.160	0.114	0.0057	-0.1143
0.133	0.074	0.0133	-0.0722
0.160	0.118	-0.0205	-0.1153

Statistics for Repeat Runs

0.133	Mean	0.072	0.023	-0.072
	StDev	0.0039	0.0151	0.0014
	Min	0.0667	0.0100	-0.0744
	Max	0.0774	0.0481	-0.0702
	Precision (2sd/mean)	10.95%	130.45%	-3.98%
0.160	Mean	0.116	-0.008	-0.115
	StDev	0.0018	0.0154	0.0008
	Min	0.1132	-0.0226	-0.1158
	Max	0.1179	0.0142	-0.1137
	Precision (2sd/mean)	3.20%	-373.02%	-1.33%

Appendix G – Balance Verification Tests

Table G57: Summary of Balance Verification Tests – Small Model

Test	LC	Date	Slope (N/N)	Intercept (N)	R^2	SEE (N)	n	Chauvenet	
								slope (N/N)	SEE (N)
PULL_001_S1	10 lb Cooper	4/21/2015 11:55	0.99994	-1.303	0.99964	0.1878	7	0.44	2.55
PULL_002_S1	10 lb Cooper	4/21/2015 16:52	0.99879	-2.250	0.99979	0.1718	9	0.24	2.26
PULL_003_S1	10 lb Cooper	4/22/2015 11:59	0.99621	-2.198	0.99968	0.1650	7	0.22	2.14
PULL_004_S1	50 lb S-type	4/22/2015 13:08	0.98287	-3.616	0.99993	0.1148	7	2.59	1.22
PULL_005_S1	50 lb S-type	4/22/2015 17:25	0.98203	15.492	0.99991	0.1450	6	2.74	1.77
PULL_006_S1	50 lb S-type	4/23/2015 15:00	0.99335	15.382	1.00000	0.0263	9	0.73	0.41
PULL_007_S1	50 lb S-type	4/23/2015 19:07	0.98522	15.331	0.99999	0.0426	6	2.17	0.11
PULL_008_S1	50 lb S-type	4/24/2015 10:50	0.99134	15.198	0.99999	0.0337	6	1.08	0.27
PULL_009_S1	SM-10	4/24/2015 12:13	0.99015	-2.673	0.99996	0.0848	9	1.30	0.67
PULL_010_S1	SM-10	4/24/2015 16:36	0.99318	-2.794	0.99997	0.0699	9	0.76	0.39
PULL_011_S1	SM-10	4/27/2015 12:43	1.00121	-3.044	1.00000	0.0099	9	0.67	0.71
PULL_012_S1	SM-10	4/27/2015 15:16	1.00053	-3.073	1.00000	0.0202	9	0.55	0.52
PULL_013_S1	SM-10	4/27/2015 15:39	0.99998	-3.049	1.00000	0.0164	9	0.45	0.59
PULL_014_S1	SM-10	4/27/2015 16:06	1.00022	-3.057	1.00000	0.0192	9	0.49	0.54
PULL_015_S1	SM-10	4/27/2015 18:24	0.99996	-3.064	1.00000	0.0237	9	0.45	0.45
PULL_016_S1	SM-10	5/5/2015 12:00	1.00178	-3.136	1.00000	0.0048	9	0.77	0.80
PULL_017_S1	SM-10	5/5/2015 16:09	1.00018	-3.125	1.00000	0.0155	9	0.49	0.60
PULL_018_S1	SM-10	5/6/2015 10:40	1.00130	-3.122	1.00000	0.0056	9	0.69	0.79
PULL_019_S1	SM-10	5/6/2015 15:12	1.00074	-3.127	1.00000	0.0185	9	0.59	0.55
PULL_020_S1	SM-10	5/7/2015 11:40	0.98614	-3.462	0.99992	0.1159	9	2.01	1.24
PULL_021_S1	SM-10	5/7/2015 12:11	0.98409	-3.352	0.99990	0.1324	9	2.37	1.54
PULL_022_S1	SM-10	5/7/2015 15:56	1.00127	-3.948	1.00000	0.0074	9	0.68	0.75
PULL_023_S1	SM-10	5/7/2015 18:58	1.00133	-3.956	1.00000	0.0085	9	0.69	0.73
PULL_024_S1	SM-10	5/8/2015 10:54	1.00116	-3.965	1.00000	0.0043	9	0.66	0.81
PULL_025_S1	SM-10	5/12/2015 11:47	1.00123	-3.860	1.00000	0.0101	9	0.67	0.70
PULL_026_S1	SM-10	5/12/2015 15:52	1.00137	-3.871	1.00000	0.0104	9	0.70	0.70
PULL_027_S1	SM-10	5/13/2015 12:27	1.00105	-3.937	1.00000	0.0142	9	0.64	0.63
PULL_028_S1	SM-10	5/13/2015 16:21	1.00170	-3.970	1.00000	0.0174	9	0.76	0.57
Average			0.99991	-3.376	1.00000	0.0200			
StDev			0.00309	0.469	0.00001	0.0218			
Min			0.99015	-3.970	0.99996	0.0043			
Max			1.00178	-2.673	1.00000	0.0848			

Table G58: Summary of Balance Verification Tests – Large Model

Test	LC	Date	Slope (N/N)	Intercept (N)	R^2	SEE (N)	n
PULL_029_S1	SM-25	5/15/2015 12:44	0.99638	-3.438	0.99999	0.0675	9
PULL_030_S1	SM-25	5/15/2015 16:12	0.99597	-2.752	0.99999	0.0638	9
Average			0.99618	-3.095	0.99999	0.0657	
StDev			0.00029	0.485	0.00000	0.0026	
Min			0.99597	-3.438	0.99999	0.0638	
Max			0.99638	-2.752	0.99999	0.0675	