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# Trial Conduct

## 1. PURPOSE

The purpose of this procedure is to establish guidelines for acceptable trial conduct needed to validate hydrodynamic design and/or satisfy contractual requirements.

## 2. SCOPE

This procedure applies to the specific trial conduct required to standardize the process of conducting full-scale Speed/Power trials; documenting the environmental and ship conditions, providing necessary data for the analysis and continuous development of prediction methods for ship speed/power performance, while giving a high level of confidence in the full-scale trial data obtained. Various kinds of Speed/Power trials are listed as follows:

- Design Displacement Speed/Power Trials
- Heavy Displacement Speed/Power Trials
- Light Displacement Speed/Power Trial
- Trailed Shaft Trials
- Locked Shaft Trials
- Over-Design Pitch Speed/Power Trials
- Under-Design Pitch Speed/Power Trials
- Astern Speed/Power Trials

## 3. RESPONSIBILITIES

- The Trial Director is the duly authorized shipbuilder's representative responsible for the execution of all phases of the Speed/Power trials. The Trial Director (or his designee) will be on the bridge during the testing period and will work closely with ship's master or owner's representative to facilitate the successful completion of all trial objectives. During the trials, shipbuilder personnel report to the Trial Director who will be in charge of all matters relating to the trial and the trial team. When unforeseen problems, such as weather or technical difficulties require that the trial schedule or trial logistics be modified, the Trial Director shall make the final decision, subject to the concurrence of the ship's master and the owner's representative. The Trial Director will maintain the trial log.
- The shipbuilder is responsible for the overall trial coordination between the ship's crew, trial personnel, and the owner representative. A pre-trial meeting between the trial team, owner and the ship's crew will be held to discuss the various trial events and to resolve any outstanding issues.
- The trial team is responsible for the following:
  a. Operate and maintain all required trial instrumentation and temporary cabling.
  b. Maintain an instrumentation log
  c. Collect and record seawater temperature and specific gravity daily during the trial.
  d. If arranged beforehand, provide the ship master and owner's representative with a preliminary data package before debarking. The contents of the data package will be determined by consultation with the owner's representative at the initial pre-trial briefing.
  e. Provide a final report in accordance with any agreement between the shipbuilder and the ship owner.
- The ship's crew is responsible for the following:
  a. Maintain a log book for manual readings of several main propulsion pa-

rameters on an hourly basis during the testing period. This ship's crew data log will be provided to ship personnel prior to the start of the trials.

b. Provide environmental and ship's loading data to Trial Director daily and as needed.

## 4. DEFINITIONS

- Trial Log: The Trial Director will maintain the trials log in chronological order, during the trials. For each run, the log contains the run number, type of maneuver, approach speed by EM log, approach shaft speed, COMEX and FINEX times, and any comments about the run.
- Instrumentation Log: The Trials Engineer will maintain the instrumentation log during the instrumentation installation and conduct of the trials. This log contains calibration information and the run number, time, and any comments about the maneuver or instrumentation for each run. This log is maintained in chronological order.
- Ship's Crew Data Log: The Trial Director will provide the ship's crew with a Ship's Crew Data log, which the Ship's crew will maintain. In addition to run number and time of run, this log may contain main propulsion plant parameters and environmental conditions.
- COMEX: Command given by the Trial Director to "Commence Execution" of a run.
- FINEX: Command given by the Trial Director to "Finish Execution" of a run.

## 5. PROCEDURES FOR CONDUCTING SPEED/POWER TRIALS

### 5.1 General Preparation Prior to Start of Speed/Power Run

1. Speed/Power Trials are conducted in a predetermined operating area. If the trials are to be conducted over a tracking range, the Trial Director will provide navigational charts of the tracking range and the ship master will identify navigational hazards prior to the ship entering the tracking range area. The ship will be positioned so that the approach should be of a duration and distance long enough to guarantee a steady state ship condition prior to the commencement of the portion of the run where actual test data is taken. With inadequate attention to the approach requirements, the speed data obtained would in fact underestimate the actual ship speed. The data acquisition system should be utilized to monitor steady conditions in real time. Positional data will be supplied by the tracking range to assist in the proper positioning of the ship for optimal tracking purposes. When using a portable radar tracking system or differential GPS, the ship will utilize the tracking display provided by the trials team to position the ship. This display, which shows the trials operational area and the real time position of the ship, is located in the Wheel House. Though a tracking range is no longer required due to the advent of DGPS, once a group of runs begin, all runs in that group should be completed over the same ground whenever possible. Specific procedures for each type of test are discussed below. Tables 1 through Table 8 list the runs to be accomplished during the trial. Additional runs can be added to each

table if weather or other contingencies require repeat runs.

2. Six powering conditions are recommended for high speed ships or naval vessels in order to define any speed humps that may occur about the speed/length ration of 1.00. Speed range is defined as from 0 m/s or very low speeds to full power.
   a. In the case of ULCCs or VLCCs, three speed conditions and preferably four should be conducted on first-of-class Speed/Power trials. Very low speed conditions are not really of practical interest and hence the SC recommends that the speed range examined be between 50% MCR and MCR. Typical conditions of 50% MCR, 75% MCR, NCR and MCR are suggested.
   b. When testing sister ships of a class, it can be assumed that the speed/power characteristics of earlier ships of the class are fairly well known. From a scientific point of view, it is recommended that three speed/power conditions be examined. However, the number of speed/conditions may be negotiated between the shipbuilder and the owner/owner's representative.
   c. Each speed spot may consist of 2 to 4 individual runs conducted at a steady state rpm or engine loading on reciprocal headings. To ensure that tests are performed in comparable conditions, data between reciprocal runs should be reviewed for consistency and/or anomalies and if there are none, the runs are considered to be conducted over the "same body of water". Individual speed runs conducted in the same conditions should be averaged with their reciprocal runs. In order to monitor the consistency of the data between the reciprocal runs, the Trial Director has to ensure that the speed difference between the two reciprocal runs are consistent with environmental effects. If the difference is not consistent with the effect of environmental conditions, additional reciprocal speed runs must be performed. If two runs are conducted, the speeds are averaged and the speed obtained is utilized as the particular condition's spot speed. If three runs are conducted, the speeds from the two runs conducted in the same directions are compared. A weighted average is utilized to determine the speed for the spot. If four runs are conducted, an average of the speeds from the four runs is the spot speed.

3. Speed/Power Trials in the ahead and astern condition are to be accomplished to determine the steady-state speed and powering capabilities of a ship. The ship will operate in Automatic control mode during the astern tests with the ship being as close to the agreed upon specified trim and displacement as practicable.

4. It is recommended that Universal Coordinated Time (UTC) be used throughout the trials for the purpose of data recording and scheduling. UTC was formerly known as Greenwich Mean Time (GMT). The ship shall conduct a time check at least once a day to ensure that all clocks and timing devices used by data collectors are synchronized. These time checks, with appropriate reset data, if required, will be noted in the ship's master/mates log. The Trial Director will verify and indicate in the Trial log that these time checks have been made.

5. The following information, if available, will be recorded using the trial data acqui-

sition computer in order to develop a time history of each channel and enable a comprehensive uncertainty analysis of the data collected:

a. Date
b. Run Number
c. Time (s)
d. EM log speed (m/s)
e. Propeller shaft torque (N-m)
f. Propeller shaft rpm
g. Ship positional data (determined by radar tracking system or DGPS) (m)
h. Rudder angle (deg)
i. Ship heading (deg)
j. Relative wind direction (deg)
k. Relative wind speed (m/s)
l. Pitch angle (deg)
m. Roll angle (deg)
n. Propeller pitch (m, %)
o. Wave height (m)
p. Relative wave direction (deg)
q. Propeller shaft thrust (N)
r. Water depth (m)

6. Data output from the tracking range or the GPS is smoothed positional data. It will be collected in ASCII tab delimited format and stored on removable mass storage media. Hard copies of the data may also be generated. Tracking data will be recorded at the fastest rate practicable, but should not be less than one sample every second. The Trial Director and the Trial Engineer will determine the format of the data. The data includes the following:
   a. X, Y, Z position.
   b. Speed (dependent upon the analysis method utilized)
   c. Time.
   d. A hard copy of the positional track corrected to the ship's CG.
   e. A hard copy of the chronological listing of the runs recorded including COMEX and FINEX times.

7. At the end of each run, all recorded time histories will be used to evaluate the quality and consistency of the acquired trial data and be stored for "on-line" graphical presentation. The trial date and start time should be documented. The following statistical values should be displayed for each physical quantity:
   a. Number of samples taken
   b. Maximum value
   c. Minimum value
   d. Average value
   e. Standard deviation

   These statistical values will provide the basis for defining objective test criteria. These criteria will then be used to assess the level of confidence in the test data.

8. A plant line-up consistent with normal ship operations will be used to determine ship speed. The ship shall be at the designated trim corresponding to the design displacement with the machinery plant set-up as close as practical to operating conditions (displacement and trim) designated in each of the appropriate tables. Trials may be conducted at the displacement and trim corresponding to the model test conditions. This would provide data useful for correlation between full-scale and model-scale data. However, use of the model data tests to definitively determine the effects of significant displacement/trim changes on full-scale speed/power performance may be somewhat premature. Hence it is recommended that a second full-scale Speed/Power trial be conducted at a displacement that is at least 10% different

than the first trial to more definitively define this effect.

9. Ideally the heading for the initial trial run shall be with and against global drift in accordance with Speed/Power Trial Conditions Procedure 7.5-04-01-01.5. This is especially important for small ships whose performance may be greatly affected by environmental conditions. For large ships, such as ULCCs, performance is not impacted as greatly by environmental conditions. If time is a critical factor, then the initial trial run should be conducted into the waves (head seas), with the second run being conducted on a reciprocal heading. These headings should be maintained throughout the trial. It is imperative that extremely tight control be exercised during the conduct of the trials to minimize as many variables as possible, which could unduly influence the test results. Conducting trials into head and following seas is possible when utilizing DGPS but may not be possible when using a measured mile course or radio-location system. The following requirements are deemed necessary:

   a. The trial runs will be conducted over the same body of water.
   b. For each base course, each trial run will be COMEXed at the same place (within reason).
   c. Modified Williamson turns will be executed between each run to return the ship to the reciprocal baseline and to the same body of water (within reason) that the previous run was conducted. This procedure is used to avoid the possibility of coming across different magnitudes of water current or wind due to large changes in the geographic position of the ship. Engine throttles should not be moved during this evolution so that the ship's machinery plant will steady out sooner. The rudder angle used in this maneuver should be such that ship speed and time loss will be minimized.
   d. The Trial Director will ensure that appropriate time and distance is available after the execution of each modified Williamson turn such that the machinery parameters are steady when the run is COMEXed.
   e. An experienced helmsman will be required to maintain ship heading during each trial run. He should use rudder angles commensurate with maintaining a steady heading. If possible, rudder angles should not exceed ±3 degrees.

10. It is essential that the ship's machinery plant be steadied during each run. The machinery plant will be considered "steady" when the ordered r/min(s), shaft torque(s) and the ship speed are steady. A display of shaft r/min and shaft torque in the Wheel House would be extremely useful in determining steady conditions.

### 5.2 Drag Shaft Run Procedure

Drag Shaft or torsionmeter zeroing runs are conducted while the ship is underway to ensure that the torque zeroes determined via the pierside jack shaft procedure has not changed. These runs must be conducted before and after the Speed/Power Trials. Additional zeroing will be required if torsionmeter ring slippage is suspected. The zeroing will consist of an ahead and an astern drag to determine the torsionmeter zero. The drag shaft procedure can be conducted in free route and on any heading. Description of the pierside jack shaft procedure can be found in Speed/Power Trial Instrumentation Installation and Calibration Procedure 7.5-04-01-01.4.

1. Ahead Drag Shaft Procedure
   a. Order Ahead 1/3 and establish steady approach conditions.
   b. Announce COMEX
   c. After 30 seconds, announce EXECUTE. Order All Stop (do not apply astern steam) and let the shaft windmill down.
   d. Maintain heading using minimum rudder angles.
2. Astern Drag Shaft Procedure
   a. Order Astern 2/3 Engine and establish steady approach conditions.
   b. Announce COMEX.
   c. After 30 seconds, announce EXECUTE. Order All Stop (do not apply ahead steam) and let the shaft windmill down.
   d. Maintain heading using minimum rudder angles.
   e. FINEX the run when shaft comes to a stop.

### 5.3 Speed/Power Trial Run Procedure

The procedures will be followed as closely as possible for ahead and astern speed/power runs, but in the case of astern speed/power runs, some adjustments are expected due to the unsteady nature of astern operation of the ship. This procedure is graphically presented in Figure 1.

1. Establish communications among all shipboard data recording stations.
2. Pass word to all shipboard data takers stating the run number, direction and any other pertinent information.
3. Trial Director requests and ship's master orders desired speed (if necessary). The appropriate approach course is ordered which will bring the ship into the optimum tracking area of the trial site. The trial team prepares the computer for data collection. During the approach of each run, the ship will be steadied on course and throttle controls adjusted to give the desired rpm or engine order specified in the appropriate table of the trial agenda. If there are multiple shafts, it is important that the rpms of all shafts be set according to the appropriate rpm schedule detailed in the trial agenda. Note that for locked shaft trials, it is recommended that the ship be dead in the water before the shaft is locked. For twin screw ships, common practice is to lock the longer of the two propeller shafts with the locking gear. For trailed shaft trials, declutch the longer of the propeller shafts so that the shaft will windmill as the ship is driven by the other shaft(s). For propeller pitch trials, adjust the throttle controls to give the desired propeller pitch and rpm. For Over- and Under-Design Pitch Trials, the propeller pitch should be set so that it is at least 10% greater or lesser than the design pitch.
4. The Mate on Deck will inform the Trial Director when the ship has attained the trial conditions required. Note that the requested shaft rpm will be attained before the ship's speed stabilizes, so matching shaft torque and shaft rpm for all shafts and a steady ship's EM log provide the best indications of steady approach.
5. For approximately one minute before the start of the run, the Trial Director and instrumentation operators will monitor the approach data to ensure that all data parameters are steady. After ensuring that steady conditions have been established, the Trial Director orders COMEX. The COMEX command is passed to all instrumentation operators signifying the start of the run. The computer operator will

COMEX the run. Steady state data is acquired using the trial computer and the manually kept log books for the duration of the run.

6. The helmsman will use the minimum rudder necessary to maintain heading., typically ±3°. Autopilot use within these guidelines or within defined acceptability criteria is acceptable.
7. The Trial Director will monitor indicators. Once data recording has begun, do not adjust the throttles. Propeller shaft speed and other engine parameters should be held constant for each of the runs.
8. Computer operator will monitor measured parameters for anomalies.
9. Helmsman will continue to use the minimum rudder necessary to maintain heading.
10. Trial Director will continue to monitor measured parameters. The steady power portion of the run may be extended to obtain the necessary amount of data, especially if weather conditions affect the data.
11. FINEX is announced when the required amount of steady state data have been recorded. The actual time/length of a run is dependent upon the discretion of the Trial Director. His decision should be based upon the needs identified in the meeting with the ship owners and ship builders, the amount of scatter in the data, and whether enough data has been collected in order to conduct a satisfactory uncertainty analysis. For astern speed/power runs and their expected attendant difficulties in maintaining course astern, FINEX will be announced when and if the ship experiences an inability to maintain a straight astern course.
12. The FINEX command is passed to all instrumentation operators ending the data collection and the run. The computer operator will FINEX the run and prepare for the next run.
13. Preparations now begin for the next run with the helmsman bringing the ship to a reciprocal course using a modified Williamson turn. After FINEX, the ship should maintain speed and heading for at least one minute more before conducting a modified Williamson turn. This allows room to establish steady powering conditions prior to passing over the same area as the previous run.
14. The Trial Director will compare the run summary to other available data, check for anomalies, estimate effects of wind and current, and determine the next required run in accordance with the trial agenda.

## 6. REFERENCES

1. 21st ITTC Powering Performance Committee Final Report
2. 22nd ITTC Trials & Monitoring Specialist Committee Final Report
3. Ships and marine technology – Guidelines for the assessment of speed and power performance analysis of speed trial data, Final Draft International Standard ISO/FDIS 15016:(E), ISO/TC 8/SC 9/WG 2 of 2001
4. Speed/Power Trial Instrumentation Installation and Calibration Procedure 7.5-04-01-01.5
5. Speed/Power Trial Conditions Procedure 7.5-04-01-01.4

## 7. RECORDS

1. Computer files of trials data taken
2. Trial Log
3. Instrumentation Log
4. Ship’s Crew Data Log

## 8. ATTACHMENTS

1. Figure 1. Path of ship during typical speed/power maneuver.
2. Table 1. Torsion meter Calibration Run Schedule
3. Table 2. Design Displacement Speed /Power Trial Run Schedule
4. Table 3. Heavy Displacement Speed/ Power Trial Run Schedule
5. Table 4. Light Displacement Speed/ Power Trial Run Schedule
6. Table 5. Trailed Shaft Trial Run Schedule
7. Table 6. Locked Shaft Trial Run Schedule
8. Table 7. Over-Design Pitch Speed/ Power Trial Run Schedule
9. Table 8. Under-Design Pitch Speed/ Power Trial Run Schedule

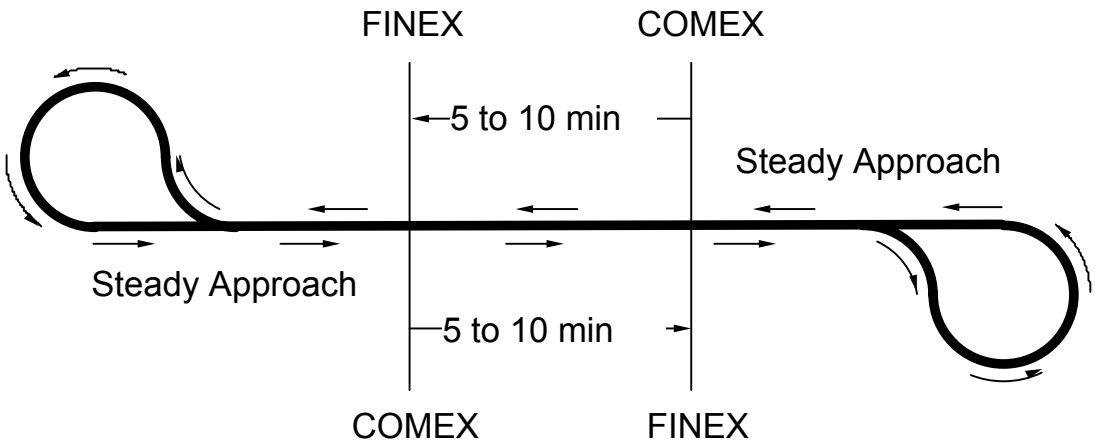


Figure 1. Path of ship during typical speed/power maneuver.

It should be noted that the 5 to 10 minutes shown in the figure representing the portion of the run where steady state data should be taken is only a suggestion. This time frame was determined based upon past history of full-scale trials conduct and corresponds to ships of different lengths and speed capabilities. The actual time/length of run is dependent upon the Trial Director's discretion, ship's speed, type and dimensions. The Trial Director should be aware of or involved in the trial data analysis and hence be cognizant of the minimum trial data requirements. His decision should be based upon the needs identified in the trials agenda, the amount of scatter in the data, and whether enough data has been collected to conduct a satisfactory uncertainty analysis.

NOTE:

1. Minimum approach and run time may be adjusted for astern standardization.
2. Longer times between runs will be required for ships with relatively lower power/size relationships such as VLCCs.

Table 1. Torsion meter Calibration Run Schedule

| Run Number | Run Type | Approach Condition |
|---|---|---|
| | **At Beginning of Underway Phase** | |
| 0100 | Ahead drag shaft run | Ahead 1/3 |
| 0110 | Astern drag shaft run | Astern 2/3 |
| | **At End of Underway Phase** | |
| 0120 | Ahead drag shaft run | Ahead 1/3 |
| 0130 | Astern drag shaft run | Astern 2/3 |

NOTES:

1. Additional runs will be conducted as required and enumeration will continue from Run 0130 in increments of 10.
2. The zeroing will consist of an ahead and an astern drag shaft to determine the torsionmeter zero. The drag shaft procedure can be conducted in free route and on any heading.
3. Torsionmeter zeroing must be conducted before and after the Speed/Power Trials. Additional zeroing will be required if torsionmeter ring slippage is suspected.

In many cases, Speed/Power trials are conducted in order to fulfill contractual requirements. Other trials are conducted to define the speed/power characteristics of the ship at a given displacement, propeller pitch condition, or operating condition, e.g., locked shaft and trailed shaft tests. Their complexity and extent is dictated by the purpose; contractual or scientific.

The purpose of the Design Displacement Trial (Table 2) is to satisfy contractual requirements and/or to determine a baseline for the speed/power characteristics of a class of ship.

Follow-up tests (Tables 3 and 4) are conducted using the same rpm/engine load settings used at the design displacement but at displacements at least 10% different than design. This is to determine the effect of displacement on the ship's speed/power characteristics.

The purpose of trailed shaft tests is to predict the ship's speed/power capabilities in the event of a casualty, which requires the trailing of a propeller shaft. Trailed shaft tests are also useful in obtaining fuel rate data (if the ship is equipped with fuel meters) when different combinations of propeller shafts are driving the ship. These trials are mainly conducted on naval ships.

The purpose of locked shaft tests is to predict the ship's speed/power capabilities in the event of a casualty, which requires the locking of a propeller shaft. These trials are mainly conducted on naval ships.

The purpose of these tests is to determine the effect of changing propeller pitch on the ship's speed/power characteristics. Tests are normally conducted at design pitch. Follow-up tests are conducted using the same engine load settings used during the design pitch tests but at pitches at least 10% higher and lower than design. Unless the ship is equipped with an in-hub propeller pitch sensor, the pitch measurement is extremely difficult to obtain due to temperature contraction and expansion of the control rod(s).

Table 2. Design Displacement Speed/Power Trial Run Schedule

| Run Number | Shaft Speed (rpm) | Shaft Power (kW) | Nominal Speed (m/s) |
|---|---|---|---|
| 10D<br>20D<br>30D | 1 | 1 | 1 |
| 40D<br>50D<br>60D | 2 | 2 | 2 |
| 70D<br>80D<br>90D | 3 | 3 | 3 |
| 100D<br>110D<br>120D | 4 | 4 | 4 |
| 130D<br>140D<br>150D | 5 | 5 | 5 |
| 160D<br>170D<br>180D | Full Power | Full Power | TBD |

Note: Additional runs may be necessary to more fully define the speed/power relationship. If necessary, the Trial Director will add these runs after consultation with the ship's Master and/or the ship owner's representative.

Table 3. Heavy Displacement Speed/Power Trial Run Schedule

| Run Number | Shaft Speed (rpm) | Shaft Power (kW) | Nominal Speed (m/s) |
|---|---|---|---|
| 10H<br>20H<br>30H | 1 | 1 | 1 |
| 40H<br>50H<br>60H | 2 | 2 | 2 |
| 70H<br>80H<br>90H | 3 | 3 | 3 |
| 100H<br>110H<br>120H | 4 | 4 | 4 |
| 130H<br>140H<br>150H | 5 | 5 | 5 |
| 160H<br>170H<br>180H | Full Power | Full Power | TBD |

Note: Additional runs may be necessary to more fully define the speed/power relationship. If necessary, the Trial Director will add these runs after consultation with the ship's Master and/or the ship owner's representative.

Table 4. Light Displacement Speed/Power Trial Run Schedule

| Run Number | Shaft Speed (rpm) | Shaft Power (kW) | Nominal Speed (m/s) |
|---|---|---|---|
| 10L<br>20L<br>30L | 1 | 1 | 1 |
| 40L<br>50L<br>60L | 2 | 2 | 2 |
| 70L<br>80L<br>90L | 3 | 3 | 3 |
| 100L<br>110L<br>120L | 4 | 4 | 4 |
| 130L<br>140L<br>150L | 5 | 5 | 5 |
| 160L<br>170L<br>180L | Full Power | Full Power | TBD |

Note: Additional runs may be necessary to more fully define the speed/power relationship. If necessary, the Trial Director will add these runs after consultation with the ship's Master and/or the ship owner's representative.

Table 5. Trailed Shaft Trial Run Schedule

| Run Number | Shaft Speed (rpm) | Shaft Power (kW) | Nominal Speed (m/s) |
|---|---|---|---|
| 10TS<br>20TS<br>30TS | 1 | 1 | 1 |
| 40TS<br>50TS<br>60TS | 2 | 2 | 2 |
| 70LTS<br>80TS<br>90TS | 3 | 3 | 3 |
| 100TS<br>110TS<br>120TS | 4 | 4 | 4 |
| 130TS<br>140TS<br>150TS | 5 | 5 | 5 |
| 160TS<br>170TS<br>180TS | Full Power | Full Power | TBD |

Note: Additional runs may be necessary to more fully define the speed/power relationship. If necessary, the Trial Director will add these runs after consultation with the ship's Master and/or the ship owner's representative.

Table 6. Locked Shaft Trial Run Schedule

| Run Number | Shaft Speed (rpm) | Shaft Power (kW) | Nominal Speed (m/s) |
|---|---|---|---|
| 10LS<br>20LS<br>30LS | 1 | 1 | 1 |
| 40LS<br>50LS<br>60LS | 2 | 2 | 2 |
| 70LS<br>80LS<br>90LS | 3 | 3 | 3 |
| 100LS<br>110LS<br>120LS | 4 | 4 | 4 |
| 130LS<br>140LS<br>150LS | 5 | 5 | 5 |
| 160LS<br>170LS<br>180LS | Full Power | Full Power | TBD |

Note: Additional runs may be necessary to more fully define the speed/power relationship. If necessary, the Trial Director will add these runs after consultation with the ship's Master and/or the ship owner's representative.

Table 7. Over-Design Pitch Speed/Power Trial Run Schedule

| Run Number | Shaft Speed (rpm) | Shaft Power (kW) | Nominal Speed (m/s) |
|---|---|---|---|
| 10OP<br>20OP<br>30OP | 1 | 1 | 1 |
| 40OP<br>50OP<br>60OP | 2 | 2 | 2 |
| 70OP<br>80OP<br>90OP | 3 | 3 | 3 |
| 100OP<br>110OP<br>120OP | 4 | 4 | 4 |
| 130OP<br>140OP<br>150OP | 5 | 5 | 5 |
| 160OP<br>170OP<br>180OP | Full Power | Full Power | TBD |

Note: Additional runs may be necessary to more fully define the speed/power relationship. If necessary, the Trial Director will add these runs after consultation with the ship's Master and/or the ship owner's representative.

Table 8. Under-Design Pitch Speed/Power Trial Run Schedule

| Run Number | Shaft Speed (rpm) | Shaft Power (kW) | Nominal Speed (m/s) |
|---|---|---|---|
| 10UP<br>20UP<br>30UP | 1 | 1 | 1 |
| 40UP<br>50UP<br>60UP | 2 | 2 | 2 |
| 70UP<br>80UP<br>90UP | 3 | 3 | 3 |
| 100UP<br>110UP<br>120UP | 4 | 4 | 4 |
| 130UP<br>140UP<br>150UP | 5 | 5 | 5 |
| 160UP<br>170UP<br>180UP | Full Power | Full Power | TBD |

Note: Additional runs may be necessary to more fully define the speed/power relationship. If necessary, the Trial Director will add these runs after consultation with the ship's Master and/or the ship owner's representative.